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Management of Technology*

**Effects of Organization on Financial  
Innovation**

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## **Abstract**

We explore whether there are differences in the organizational structures for innovators and non-innovators in financial services. We hypothesize a u-shaped relationship between innovation and structure: financial service firms which are either highly rigid or highly flexible will exhibit the highest degree of innovation. We find, however, that firms with a product development orientation and with more formal procedures are apparently the ones which appear to have larger product arrays aimed at different markets. This product development orientation measure reveals itself more strongly through the interaction with measured organizational formality. Although no normative conclusions can be derived with the data available, such results, which are in line with other studies about innovation in financial services, seem to suggest that formalized and differentiated product development processes tend to be associated with successful innovative behavior in financial services firms.

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This essay explores the interaction between organizational structure and innovation in financial services. The essay addresses one research question: Are there differences in the characteristics of the organizational structures for innovators and non-innovators? The paper is organized into three sections. First, we review pertinent literature and develop a conceptual framework. Then, hypotheses and the research design are introduced. This is followed by a discussion of results. The essay is based on the presumption that certain aspects of a firm's structure affect the manner and extent to which financial service firms innovate. The organizational structure of the firm -its flexibility and its research capabilities- are hypothesized to determine the organization's ability to recognize and exploit opportunities for innovation. Our findings indicate that firms with formalized procedures and product development orientation appear to have larger product arrays aimed at different markets. We cannot, however, make any normative assertion based on the data available because error in our model is high. This notwithstanding, our results are useful in associating certain measures of organizational structure to product development in financial services.

## **Research Background**

### **Organizational structure**

Sustained competitiveness, long-term profitability, and long-term growth require organizations to adjust to their environments (Lawrence and Dyer, 1983). The very notion of strategic management implies the possibility of adaptation (Chakravarty, 1982). Contingency theorists suggest that there is not one best way to organize, and that organizations change their structures to adapt to their environments, resulting in

formalized responses to uncertainty and complexity (Lawrence and Lorsch, 1967a and 1967b; Galbraith, 1973). Lawrence and Lorsch (1967b: 4) suggest that organizations develop specialized functional appendages to deal with environmental vicissitudes. This ends in a "... state of segmentation of the organizational system into subsystems, each of which tends to develop particular attributes in relation to the requirements posed by its relevant external environment." For these authors, firms adapt to the environment by matching sub-unit differentiation and inter-unit coordination.

Other authors place a stronger emphasis on transmutations into more informal or "organic" systems as the environment becomes turbulent. Burns and Stalker (1961) showed that organic firms were more successful in industries with rapidly changing markets and technology. In stable markets, success was associated with "mechanistic" organizations. These "organic" structures are decentralized, informal, loosely controlled, and imprinted with flexibility. Individual tasks are constantly adjusted and re-defined, and, as a result, organizations with such structures adapt more easily. This type of institution is characterized by "...a network structure of control, authority, and communication" (Burns and Stalker, 1961:121). Communications are lateral and open, and they contain information rather than instructions. In contrast, in "mechanistic" structures tasks are specialized, and "...functionaries tend to pursue the technical improvement of means, rather than the accomplishment of the ends" (Burns and Stalker, 1961: 120). Communications, control, and authority are hierarchically structured. Information flows vertically and contains precise unambiguous instructions rather than equivocal ideas and unclear chatter. As a result, this type of mechanistic organization is formal, tightly controlled, and rigid.

Decision-making in the organic type is non-programmed: "...problems cannot be broken down and distributed among specialist roles within a clearly defined hierarchy"

(Burns and Stalker, 1961:121). In mechanistic organizations, choices are "...to some extent a foregone conclusion... because of the existence of an institutional framework around the individual" (Burns and Stalker, 1961: 115).

Mechanistic structures function better under stable conditions because procedures and communications can be abridged, and roles and duties are easier to define (Galbraith, 1973; Starbuck and Dutton, 1973). Organic structures deal better with innovation and changing conditions. Open communications, flat hierarchical structures, and close interaction between people are traits of archetypal innovative organizations (Bentley, 1990; Hull and Hage, 1982; Kanter, 1985). As environmental uncertainty increases (for example in markets characterized by rapid new product introduction), product development processes should become more organic and decentralized (Shrivastava and Souder, 1987). In summary, different structural forms are necessary for long-term success, as the environment impinges upon existing arrangements, and "...firms purposefully adopt structures to encourage learning" (Dodgson, 1993:387). Thus, innovation, according to this literature, seems to be fostered by flexibility (more open forms of communication and less formality): what Burns and Stalker (1961) called organic forms.

**Innovation = Invention + Exploitation (Roberts, 1988).**

Along with these structural adjustments, organizations teeter between the pursuit of the unknown and the development of the known. They have to allocate wisely limited resources to exploration and exploitation, because "...an organization that engages exclusively in exploration will ordinarily suffer from the fact that it never gains the

returns of its knowledge, (and) ...an organization that engages exclusively in exploitation will ordinarily suffer from obsolescence" (Levinthal and March, 1993: 105).

Engaging in new businesses too aggressively can result in failure. Rumelt (1974) found that firms prone to diversify into uncharted territories failed more often; their current capabilities ill-equipped them to withstand alien environments. Similarly, Meyer and Roberts (1986) found that new businesses had a higher likelihood of failure when entering unfamiliar markets through new market applications.

Yet firms that concentrate on improving their existing capabilities and neglect searching for new opportunities can also fail. The institutionalization of routinized capabilities leads to inertia, and firms become unable to react when confronting environmental changes (Haveman, 1992). Tushman and Anderson (1986) show that technological discontinuities herald the demise of many organizations, as their core competencies are obliterated. This paradoxical predicament places firms between a rock and a hard place: to innovate and not to innovate both increase the likelihood of failure:

The farther a company seeks to innovate, the greater the likelihood its innovation effort will fail. But the less it seeks to innovate, the greater the likelihood the corporation will fail (Roberts, 1994).

Such dilemma is conspicuously present in new product development. Technological change causes environmental upheaval, and firms try to ride the furious waves of the circumstances on top of new products and services. Technological discontinuities are ephemeral bridges that close the gap between the known and the unknown. However, firms often lock onto established routines that carry them away from the bridges, along "...trajectories that can ultimately prove fatal" (Christensen and Rosenbloom, 1993:17).

There is, then, an apparently inevitable trade-off between aggressive exploration and exploitation. Too much innovation allows little benefiting from the old, and firms that become entrenched in established routines fail to recognize and take advantage of the new. The work of Meyer and Roberts (1986, 1988) is particularly illustrative. They found that small high-technology firms performed best when they had a well-focused strategy. Firms that went too far away from their core technologies and markets in successive innovations were the worst performers. Hence, a balance between exploration and exploitation seemed to be necessary.

Thus, certain structural characteristics of organizations are apparently more conducive to innovation than others, but innovation is in itself a delicate balance between exploring the new and exploiting the old. Organizations can be structured so that "...exploration is strengthened while exploitation is undermined" (Levinthal and March, 1993) or vice versa. Some structures can restrain process routinization while others can force behavior into habit.

Given that organizations can vary in their structural arrangements and in their innovation habits, the interaction of these two variables will render different routine modes. In highly organic firms exploration will be continuous. Structural arrangements are organic, communications are lateral, decision-making is not "...broken down and distributed among specialist roles within a clearly defined hierarchy" (Burns and Stalker, 1961:5), and knowledge is distributed. There is a network structure of power and control, but it is constantly changing. Communications are lateral and unpredictable. "Decision-making is a garbage can process, where solutions, participants, loosely coupled problems and choice opportunities with different half-lives flow into the organization at different rates and connect whenever they meet in time and space" (Cohen, et al., 1972). The structure has no checks for continuous exploration and no incentives for exploitation. At

the other extreme, highly mechanistic firms will routinize what's seemingly unroutinizable, and they will create hierarchies that methodically explore. These firms will devote much attention to developing differentiated capabilities to create products: problems, broken down into sub-tasks, will be assigned to different people in the hierarchy; communications will be vertical and will carry instructions and outcomes rather than raw information or suggestions; power and control will be localized; and knowledge is going to be at the top. Products, then, will emerge through such differentiated capabilities and through tight controls.

## **Hypothesis**

In the aforementioned literature, we see that different patterns of innovation occur as a function of the structural characteristics the organization and, also, the extent to which they have developed an orientation toward product development (in, among other things, the degree of organizational differentiation that exists for creating new products). We propose that this observation also applies to financial service firms:

H0: Controlling for product development orientation, financial service firms which are either highly rigid or highly flexible (i.e., highly organic or highly mechanistic) will exhibit the highest degree of innovation.

We propose that there will be a curvilinear concave relationship between innovation and structure. Institutions that are highly organic will have flexible structures and ad-hoc methodologies for developing new services. In the extreme, product development activities may resemble garbage-can processes of organizational choice



(Cohen et al., 1972), and they will generate a large number of ideas very frequently. Ideas will generate in disparate places and take shape informally, casually, and randomly. Ideas for new products may often, for instance, be brought into firms by executives who see them working elsewhere and think they might be adapted locally. After some informal evaluation projects may be carried on by provisional committees or other emergent quasi-structures. Thus, decision-making may even become an "organized anarchy" (Cohen, et al., 1972). Ideas can start flashing spontaneously throughout the organization "...as collections of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be an answer, and decision-makers looking for work." (Cohen et al., 1972: 1) As a result there may be a high degree of new idea generation and innovation.

On the other extreme, highly mechanistic institutions will create specific hierarchical sub-units to generate new products and will tend to have formalized procedures to create them. Processes for carefully documenting ideas may exist, and each product will have to be approved through established channels. By incorporating these structures, exploration becomes routinized, and the respective sub-units develop and generate streams of new products. As a result, these organizations may create and launch products methodically, thus resulting in a high degree of product proliferation.

Therefore, these different interactions between organizational structural characteristics and innovation will render a curvilinear, concave, relationship between organizational characteristics and degree of innovation, as shown in Figure 1.

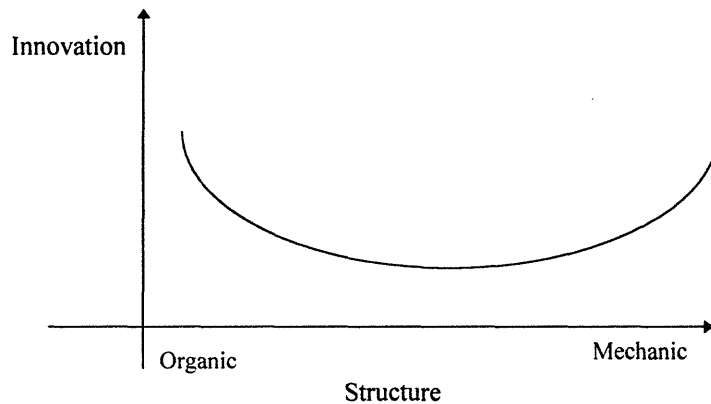


Figure 1: Hypothesized relationship of organizational structure versus innovation

As suggested in Figure 1, we will focus on two organizational design choices. First, we will determine the effects of organizational flexibility upon innovative activity. Second, we will determine whether “product development orientation”, i. e., the degree to which the organizations have developed norms, routines, procedures, or functions for the creation of new products mediates the effect of structure upon innovation.

The model to be tested is:

$$I_n = k + C_n + F_n + \varepsilon$$

Where  $I_n$  = Degree of innovation as measured through the number of products the institution has aimed at various markets (as explained later).

$C_n$  = The degree to which the firm has developed an orientation for identifying opportunities for innovation and for new product creation.

$F_n$  = The firm's flexibility, i.e., the degree to which an organization has structural schemes at the firm level for dealing with innovation opportunities.

$k$  = constant.

Specifics of these measures are explained in what follows:

## **Methods**

### **Measures**

#### **Predictor variables**

We used measures of organizational formality as surrogates for the degree to which organizations are either mechanic or organic. According to this, we presume that rigid organizations have also a high degree of formalization, defined as the degree to which norms, rules and procedures are explicitly formulated. The rationale for this approximation stems directly from extant organization theory. Social structure is one of the basic elements of organizations (Leavitt, 1965). Social structure is defined as “the patterned or regularized aspects of the relationships existing among participants in an organization” (Scott, 1992: 16), and it “...varies in the extent to which it is formalized.” (Scott, 1992: 18). Thus,

A formal social structure is one in which the social positions and the relationships among them have been explicitly specified and are defined independently of the personal characteristics of the participants occupying these positions. By contrast, in an informal social structure, it is impossible to distinguish between the characteristics of the positions and the characteristics of the participants. In an informal structure, when specific participants leave or enter the system, their roles and relationships develop and change as a function of their personal characteristics and the interactions that occur among them.

Thus, through formalization behavior becomes predictable. The attributes of formal social structures are similar to the attributes of “mechanistic” organizations as defined by Burns and Stalker. As these authors indicate (Burns and Stalker, 1961: 5):

In mechanistic organizations the technical methods, duties, and powers attached to each functional role are precisely defined. Each individual pursues his task as something distinct from the real tasks of the concern as a whole, as if it were the subject of a sub-contract.

In contrast, organic firms do not have an unambiguously defined structure, both in terms of the relationships among the participants and the characteristics of the tasks they perform. In that type of organization (Burns and Stalker, 1961: 6):

Individuals have to perform their special tasks in the light of their knowledge of the tasks of the firm as a whole. Jobs lose much of their formal definition in terms of methods, duties, and powers, which have to be redefined continually by interaction with others participating in a task.

Thus, the extent to which social structures are formalized are also an indication of the extend to which they are more mechanistic. A useful approximation can be obtained with scales that have traditionally used for measuring formalization. These scales measure the construct by determining the amount or norms and rules which are present in

the organization in written form. Oldham and Hackman (1981: 71), for instance, define formalization as “the extent to which rules, procedures, instructions, and communications are written.” Thus, using commonly accepted measures of formality, it is possible to obtain good approximations of the extent to which organizations are either mechanic or organic. As shown in Table 1, two scales were used to measure the degree of formalization. One was adapted from Inkson, et al. (1970), and it measures the degree of formalization by determining the extent to which rules and procedures are written. The second one is based on a seven-point Likert scale adapted from Oldham and Hackman (1981), and it also measures formalization in terms of the extent to which rules, procedures and instructions are written. Both measures were expected to be positively intercorrelated. They were designated with the acronyms FORM1 and FORM2. The explanation of these items is included in Appendix 1.

Product Development Orientation indicates the degree to which firms have created specialized abilities through the development of norms, routines, procedures, or functions for the creation of new products. We were interested in several facets that comprise Product Development Orientation. Part of such orientation is related to the extent to which an organization has created differentiated organizational functions to confront particular external demands (Lawrence and Lorsch, 1967). Hence, we assessed the existence of a specialized appendage to perform research and to develop new products in a manner equivalent to that of the traditional R&D function found in many goods-producing industries. In addition, we evaluated whether companies formally developed

business plans to launch products and had performance indicators to monitor product performance. The existence of such procedures would be indicative of a product development orientation (Cooper et al., 1994; Thwaites, 1992; Iwamura et al., 1991). A 5-item scale, adapted from Thwaites (1991, 1992) and Iwamura et al. (1991), was used to measure this (as presented in Appendix 1). The variable was designated PDO.

Table 1: Measures

<b>Variable (NAME)</b>	<b>Measure</b>	<b>References</b>
Formalization ( FORM)	Degree to which norms, rules and procedures are explicitly formulated. Two redundant measures.	Inkson, Pugh, and Hickson (1970), Oldham and Hackman (1981)
Product Development Orientation (PDO)	Extent to which an organization has created specialized abilities through the development of norms, routines, procedures, or functions for the creation of new products.	Thwaites (1991, 1992), Iwamura et al. (1991)

### **Outcome variable**

To assess the degree of innovation it was necessary to account for the tension between invention and exploitation (Roberts, 1988, 1991), or March's (1991: 71) "...exploration of new possibilities and exploitation of old certainties." Exploration produces a variety of experiences. It is associated with "...experimentation, variation, diversity, search, risk taking, play, flexibility, discovery and innovation...Exploitation, on the other hand, produces reliability in experiences and it is associated with refinement, choice, production, efficiency, selection, implementation, execution, consistency, unity, and convergence" (March, 1991: 71). Levinthal and March (1993: 105) suggest that firm survival requires striking a fine balance between the two processes "...by engaging in

enough exploitation to insure the organization's current viability, and to engage in enough exploration to ensure its future viability." The challenge of measuring this tension is indeed not trivial because the construct has multiple determinants, and it may not necessarily translate into discernible behavioral outcomes at the firm level.

March (1991) has proposed a theoretical model in which learning, understood as (exploration + exploitation), is operationalized into a turnover variable which, arguably, introduces the exploration ingredient into organizations, while exploitation is operationalized as the speed at which people learn an organizational extant code or way of doing things (March, 1991). Measuring this may be difficult. It is very complicated to determine what "the code" is for a particular organization and also to establish a useful base line for comparison purposes. Moreover, the introduction of new people or practices might be a result and not a cause of exploration and doesn't necessarily mean that exploration will be encouraged.

In this study we are using what is perhaps a less refined but much simpler and direct approach. If exploration "...is associated with experimentation, variation, diversity, search, risk taking, play, flexibility, discovery and innovation... and.... exploitation, on the other hand, produces reliability in experiences and it is associated with refinement, choice, production, efficiency, selection, implementation, execution, consistency, unity, and convergence..." (March, 1991:71); it is not unreasonable to assume that such tendencies will be reflected in companies' outputs. In particular, if a firm's products have often been produced for very different markets or using different technologies, we observe that exploratory tendencies appear to be important or at least present in that firm. If, on the contrary, a firm exhibits little variability in its product offerings, exploratory tendencies seem slight and exploitation appears to be the dominant innovation mode.

In order to evaluate the firm's position along these dimensions, we use a variation of Roberts' (1991) methodology for evaluating strategic focus. Roberts (1991) and Meyer and Roberts (1986) tracked institutions' new products over time and assessed their newness in terms of technological characteristics and target markets. They obtained various "focus" measures which were then correlated with performance. In their studies, a "highly focused" strategy indicated that the associated company remained adept at a relatively narrow range of products and markets and therefore leaned towards the exploitation side of the innovation equation (and vice versa).

Following these authors, a similar approach is used here. Two dimensions, clients and products, are employed to define the market for financial services. Financial products have a very broad range of possible combinations even when choices are reduced to these two dimensions. Different client-product combinations should yield different strategic and competitive profiles and the degree of variability would render a surrogate for our variable innovation. When confined to these two dimensions, each company's choices can be represented in the form of a matrix composed of several product and client categories. Each cell requires a particular knowledge base, both in the form of knowledge of certain fundamental operations at the level of the firm and also in the form of public-policy and regulatory considerations. Hence, we presume that the dispersion of the cloud of points in this matrix provides a measure of innovation (Meyer and Roberts, 1988; Meyer and Roberts, 1986; Roberts, 1991).

In order to simplify the analysis, the client dimension was divided into major client groups. Traditionally, banks have divided this dimension into corporate and retail banking. We found such categorization adequate, but added a third segment to include: a) the government, which encompasses all products related to the nation's state and other products not particularly aimed at corporate or individual clients; b) corporate customers,



which includes all non financial companies in any industry; and c) individuals, which includes products aimed at individual clients of varied net worth. These three "client" categories can be broken down into smaller segments, but we found this to be rather cumbersome and unnecessary for the purposes of this study.

A wide range of financial services can be supplied to each of the client groups, but, for simplicity, the product dimension was broken down into three possibilities. The first category is composed of traditional financial intermediation, in the second category we included financial processes, and in the third category we included financial strategies. There is an increasing degree of complexity in each successive product category. As Alic (1994) indicates, newer financial products are based upon the intensive application of systems, knowledge, or both. Transactional applications (Alic, 1994) are developed based on the ability to transfer, manage, and manipulate large volumes of data. Additionally, analytical tools provide new services through the use of solutions to previously difficult mathematical problems and with a very thick component of creativity. These products differ substantially from traditional banking intermediation and "...open up strategic opportunities for supplying new service products and for delivering existing services in new ways." (Alic, 1994: 7). As a result, "...in the U. S. retail banking, the half-dozen standard products of two decades ago have given way to more than a hundred" (Alic, 1994: 8).

The classification into these three categories is also in line with extant literature on processes of service innovation. Barras (1986) and Buzzacchi et al. (1995) argue that many service industries have evolved through a series of distinctive stages. Buzzacchi et al. (1995), for instance, posit a transition in the Italian banking industry that moves banks from a technological regime of "mass automation" to one of "smart automation". The

first regime is characterized by a strong drive to attain efficiency and is primarily driven by traditional banking services. The latter regime is based upon bringing new products to an increasingly sophisticated clientele that requires more complex solutions to their needs.

Thwaites (1995) also posits a multi-stage historical evolution of financial services (exemplified with the Building Society Industry in the UK). The first era, termed "the mass production era", is characterized by undifferentiated product development, price competition, and little innovation. This is also associated with traditional financial services. The second phase, named the "mass marketing era", is characterized by the provision of differentiated products which are heavily pushed through marketing campaigns and, finally, the "post industrial era" is distinguished by a more complicated and changing environment that requires a greater degree of innovation and the creation of sophisticated new services. The mass marketing era is roughly equivalent to Alic's (1995) "transactional applications" and the post-industrial era corresponds to his "analytical applications". This literature then suggests that the proposed classification represents a progressively increasing level of complexity and adequately encompasses not only the array of products a financial institution may have, but also its ability to explore and pursue progressively more sophisticated products and markets.

Thus, we determined an index by tabulating the banks' products over time along these dimensions, and this measure of dispersion served as a surrogate for the degree of innovation that characterized the firm. The measure has, evidently, many shortcomings.

To be entirely accurate, one should include all products ever developed by the firm regardless of whether they were ever launched (successfully or not). Because records of such activities are rarely kept, such measures would have to be pursued based entirely on recollections from executives, thus resulting in an extremely complex data-gathering process and, possibly, in poor reliability. Creating histories of products launched is more feasible, and it is likely to capture firms' innovative proclivities. Thus, to develop these indices we followed the work of Roberts (1991) closely.

Because of the characteristics of the products studied, Meyer and Roberts (1986) were able to depict very accurate sequential histories of products developed by several firms. In financial institutions, like the ones under analysis in this work, we found it extremely difficult to replicate exactly the methodology. Banks were typically instituted with a minimum package of products, before they moved to other cells of their client-product matrices, thus making it difficult to establish a consistent and comparable baseline. Therefore, we employed an alternative approach using the chi-square distribution.

Though normally used to test hypothesized relationships among categories of data points, in this case we used chi-square as a measure to establish degree of firm innovation. A comparison was made between the chi-square obtained for each bank's client-product matrix and a client-product matrix for a totally unfocused bank (for practical purposes a bank with a large number of products in each cell of the client-product matrix). The procedure used was as follows:

Let,

$N_{cp}$  = number observed in (c,p)th cell of the client product matrix, and  
 $e_{cp}$  = number expected in the (c,p)th cell under the assumption of a totally unfocused bank with a large and equal number of products in each cell.

for  $c= 1,2,3$ ; and  $p= 1,2,3$ .

$$\text{Let } N_p = \sum_{p=1}^3 N_{cp} \text{ ,and}$$

$$N_c = \sum_{c=1}^3 N_{cp}$$

Then we calculate a chi square statistic as follows:

$$\chi^2 = \sum_{c=1}^3 \sum_{p=1}^3 \frac{(N_{cp} - e_{cp})^2}{e_{cp}}$$

Because we were comparing with a hypothetical highly innovative (or "unfocused") bank, the higher the value obtained the more "focused" (i.e. the more concentrated in certain segments and product categories) the institution was and vice-versa: smaller values meant the institution was closer to the hypothetical bank we were setting up for comparison purposes and, therefore, it was more dispersed and covering a wider array of clients and product categories. We designated this variable as INNOV. Appendix 2 illustrates the dispersion calculation using two matrices of very different banks. Our choice of comparing to a "highly unfocused" bank was one of convenience. Conceptually it is perhaps more adequate and rigorous to define the reference point as the average of all banks. This would render a measure of differentiation with respect to a

prototypical average bank and not a hypothetical bank. Moreover, choosing the average bank does not have the potential problem of confounding the choice of an arbitrary point of comparison with any sort of implicit normative statement about optimal dispersion of client product matrices. However, although conceptually clearer, it is also a bit more cumbersome to evaluate and interpret, particularly because of the existence of negative values and the dynamic nature of the overall average. From a numerical standpoint results are not altered by choosing any other reference point, and, hence, we chose as such, arbitrarily, a hypothetical bank with 30 products per cell.

Redundantly, for validation purposes, we incorporated a scale for executives to self-assess firm innovativeness. This four-item scale evaluated degree of product variability, number of market segments the company was attacking, geographic coverage, and number of customers. An index was developed by linearly combining reported scores. The variable was designated INN\_SLF.

## **Sample**

Our hypothesis was tested in a group of 23 commercial banks in Costa Rica. This sample of firms was chosen for several reasons: a) We wanted to study organizations working in a relatively confined environment. By using institutions within the same country we were seeking to control effectively for regulatory and macroeconomic effects. b) We wanted to choose organizations that were experiencing a discernible environmental change (primarily because of changes in regulations). c) We wanted to analyze not necessarily a large sample but all institutions within a given environment (i.e. the "population"). We were particularly concerned with the possibility of excluding institutions that were influencing a given market in an important manner. d) We wanted

to obtain relevant information from archival sources and first-hand data from industry participants, and therefore wanted to deal with relatively young institutions.

Semi-structured interviews with executives complemented with archival studies were chosen as the most appropriate data-gathering techniques. Archival data were used for corroborating questionnaire and interview data. A questionnaire was prepared and pre-tested twice. Length, confusing wording, and other errors were corrected during the pre-testing phase of our research. The final product was used fundamentally as an instrument to guide semi-structured interviews. A database of top management teams of all institutions included in the sample was prepared, and this served as the basis for arranging appointments and conducting interviews.

After designing and pre-testing our questionnaire, we reviewed secondary sources. We checked local available trade journals (in finance, economics and business) and the country's main newspapers. The search narrowed down to four sources which were checked one by one between 1975 and 1995. Preliminary product histories by institution were developed based on these references. Once these preliminary product histories were developed, products were classified into client-product matrices by institution. We sought help from industry experts to code products into these matrices.

We then carried on detailed interviews with bank executives. During the interviews we jointly determined with the interviewee the accuracy of the client-process matrices that had been developed from secondary sources, and assessed the accuracy of the classification made in the different categories of these matrices. Questionnaires were administered during these interviews, and, in most cases, were filled out in the presence of the researcher. This was intended to provide immediate clarification and assistance and also to allow for additional questioning and expansion on some topics. Usually, questions were read aloud, and the respondent would offer explanations aside from

simply filling out the form. Notes were taken throughout by the researcher and many interviews were recorded. Clarification was sought afterwards, when necessary, via telephone. Care was taken to interview top level managers with several years of experience in the same institution. We gathered additional data through conversations with bank employees and industry experts.

### **Data Analysis**

Before conducting any statistical analyses, we carried on a psychometric evaluation of our measuring instruments. As mentioned before, we performed two pre-tests. In the first instance we administered a preliminary questionnaire to a group of MBA students who had experience in the financial arena. A second pre-test, which was performed with a much improved questionnaire, was conducted with high-level bank managers from several countries. Cronbach's alpha was used to measure the reliability of the research instrument. Nunnally (1967) advocates a Cronbach's alpha greater than 0.5 for exploratory research. Using this as a guide we improved the quality of our indicators until acceptable results were obtained. Our final instrument rendered a Cronbach's alpha coefficient of 0.93 for FORM and 0.85 for PDO. In both cases the value of alpha did not undergo any important variation when any single item was omitted. Individual items presented in both cases high and significant correlations with the other items that comprised the scale. These analyses showed that the scales used to measure these variables were internally consistent. To assess construct validity we included some redundant measures in our instrument. A second scale was introduced to measure formality. Figure 2 is a bivariate scatterplot of the two variables that measured formality.

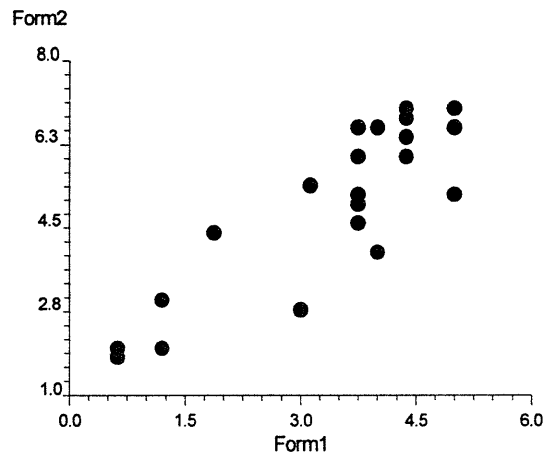


Figure 2. Scatter plot of two redundant measures of formality, FORM1 and FORM2.

The Pearson correlation coefficient for the bivariate relationship shown in Figure 2 was 0.86 at the 1% significance level (Spearman rank correlation coefficient of 0.76,  $p < 0.001$ ). The correlation of the redundant measure with our variable FORM is strong and positive, hence both scales were apparently measuring the same underlying construct. Similarly, for our variable INNOV, we introduced a self assessment of the degree of innovativeness exhibited by each institution. A bivariate plot (Figure 3) for these two measures of innovation (i.e., the index calculated through the Roberts-Meyer methodology and the self evaluation of the executives) also exhibits a strong and positive relationship. The Pearson correlation coefficient for this bi-variate relationship is equal to 0.84 ( $p < 0.001$ ) and the Spearman-rank correlation coefficient is equal to 0.82 ( $p < 0.001$ ). Both measures are measuring the same underlying construct.



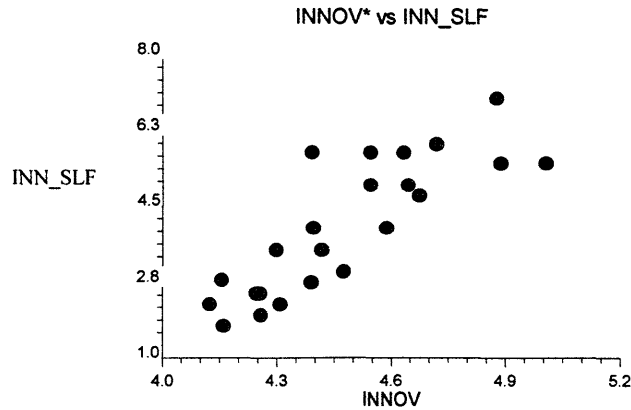


Figure 3. Scatterplot of two redundant measures of innovation.

Once comfortable with our measures, univariate statistics were determined to gain a preliminary understanding of the different dimensions of information at our disposal. Table 2 shows a summary of descriptive statistics for all variables of interest. In this table we have included measures of organizational size (number of employees, total assets, # of branches) to obtain better insights into emergent relationships and organizational patterns.

Table 2. Descriptive statistics for all variables in the dataset of organizational factors and innovation in financial services.

Variable	Mean	s.d.	min.	max.	Normality*
N_EMPLOY	536.4	975.1	35	3200	No
TOT_ASSET	39.7	77.9	0.64	306.8	No
#BRANCH	14.98	34.1	0	125	No
FORM	4.94	1.73	1.80	7	Yes
PDO	4.81	1.39	1.71	6.6	Yes
INNOV	224.7	12.4	199.8	242.5	Yes

\*Normality is assessed through Kolmogorov-Smirnov tests, p-value<0.05

Numbers for TOTASSET are in millions of monetary units.

Table 2 presents a large range of values for all variables related to size (NEMPLOY, TOTASSET, #BRANCH), with a few institutions which are notably larger than the rest. The wide variability in the #BRANCH variable suggests that some institutions have wider geographical coverage than others. Presuming that size implies more systems and formal procedures, the presence of large institutions suggests a few institutions that notably depart from the rest in the variable FORM. This is, however, not the case. Inspection of frequency plots for this variable reveals the presence of a slightly bimodal distribution with a larger count of observations in the protuberance associated with larger values of FORM (see Figure 4). This suggests that some small institutions have developed and have systems and procedures in place that are similar to those of larger institutions.

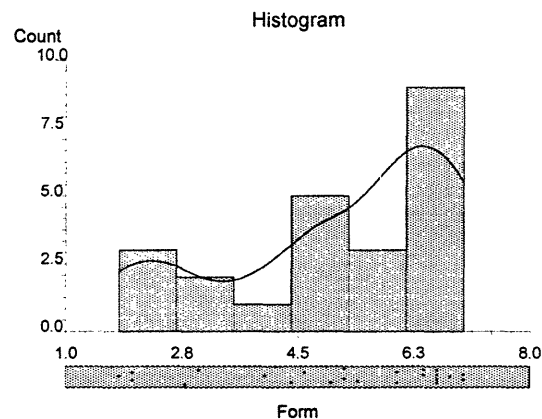


Figure 4. Histogram of FORM.

The distribution observed in Figure 4 also suggests the presence of a fairly large number of institutions that either score high or low on FORM. This could signal that firms are clustered into distinct categories. Moreover, this distribution signals the

possible presence of non-linearity, hence requiring carefulness when applying any statistical tests that assume linearity.

The measure of innovation in Table 2, INNOV, reveals a fairly large variance. This suggests that firms in the sample apparently have different arrays of products, that is, some firms are very focused and dedicated to particular market segments with a reduced set of products, and others attack several market segments with a more extended assortment of products.

Before conducting any further analysis, all variables were plotted against each other to detect any emergent relationship and to check for linearity. Inspection of the scatterplots revealed the presence of non-linearity in several bi-variate relationships. This was particularly true for all variables involving size, denoting the presence of some scale effects. The bi-variate relationships between INNOV and all measures of organizational characteristics do exhibit curvilinearities (see for example Figure 5).

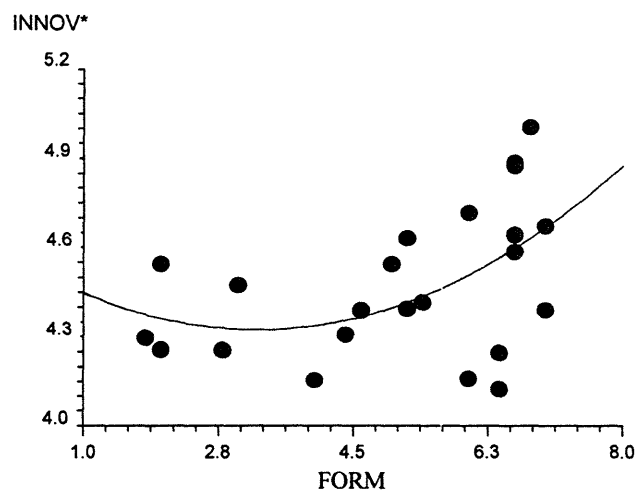


Figure 5. Scatter plot of INNOV\* versus FORM.

To further examine the nature of these emergent relationships, a correlation matrix was computed. Because of the detected curvilinearities, and the non-normalities (in the case of the size measures) we noted in the descriptive statistics section, Spearman-rank correlation coefficients were used to construct the correlation matrix. Table 3 presents the Spearman-rank correlations for the variables under study. Our measure INNOV exhibits a negative correlation because the chi-square value computed becomes smaller for firms with larger arrays of products. To avoid confusion we included the accessory variable INNOV\* (= 1/INNOV).

Inspection of the correlation matrix suggests that all variables that are being used to measure size are intercorrelated. This is not true for the measure of total assets and number of branches, suggesting that there are institutions which are large but operate in a limited geographic area or vice versa. This, in turn, suggests different strategic approaches to conducting the business. Notice that measures of formality do not present very high correlations with measures of size. This indicates that some small institutions may have a high degree of formality.

Table 3. Spearman-rank correlations for all variables in the dataset of organizational factors and innovation in financial services. Pair-wise deletion.

Variable	1	2	3	4	5	6
1	1.00					
2	0.79***	1.00				
3	0.79**	0.32	1.00			
4	0.56*	0.26	0.58*	1.00		
5	0.12	0.15	-0.03	0.18	1.00	
6	-0.74***	-0.80***	-0.67*	-0.48*	-0.21	1.00
7	0.74***	0.80***	0.67*	0.48*	0.21	-1.00

\*\*\* =  $p < 0.001$ , \*\* =  $p < 0.01$ , \* =  $p < 0.05$ , ~ =  $p < 0.1$

1=NEMPLOY, 2=TASSET, 3=#BRANCH, 4=FORM, 5=PDO, 6=INNOV, 7=INNOV\*

Inspection of the scatterplot of INNOV\* against FORM, as depicted in Figure 5, reveals a curvilinear relationship between the variables. The polynomial line fitted to the data shows the presence of a non-linear, non-monotonic relationship between INNOV\* and FORM. To confirm this apparent non-linearity, we performed recursive linear fits. Starting with the first quartile and performing one-step increments in the number of observations, we calculated least-squares trend lines for all partial data-sets. In Figure 6 we have plotted the results for three of these fits and included a least-squares trend line to observe the evolution of the slope of the resulting curve.

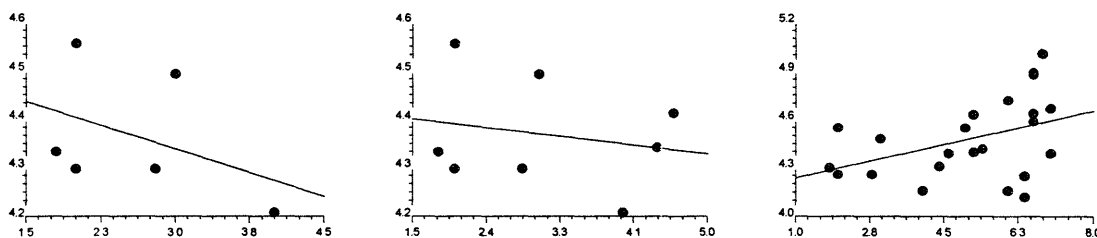


Figure 6. Linear fits for first 6 observations, first 8 observations, and complete data set.

It can be seen that the slope of the curve appears to be negative for the first 6 observations. It remains negative through part of the range of the independent variable and then it becomes positive as more observations are added. In Figure 7 we have overlaid all one-step incremental fits and plotted least-squares trend lines. This figure clearly shows that the slope of the linear fits change sign, going from negative to positive, thus indicating the presence of a concave non-linearity.

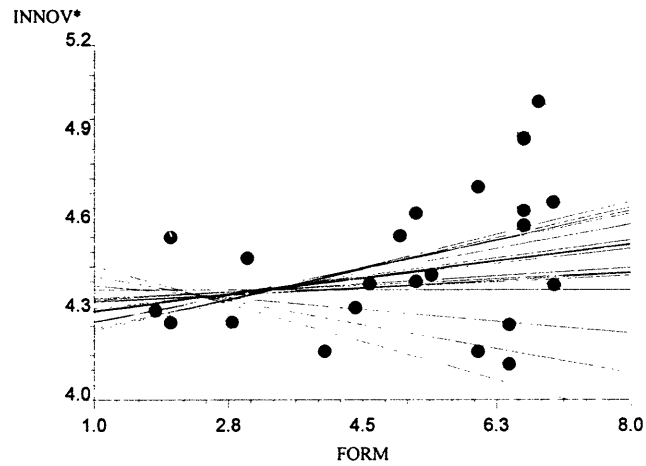


Figure 7. Recursive linear fits for sub data sets with one-step increments.

A Durbin-Watson Value of 1.39, calculated through a bivariate linear regression of INNOV\* against FORM did not permit us to reject the possibility of residuals being autocorrelated (at the 5% level, lower limit for rejecting the possibility of autocorrelation is 1.257 and the upper limit for accepting such occurrence is 1.437). Though the DW test is used only to detect autocorrelation, such occurrence could also indicate non-linearity. Therefore, to further look into this apparent curvilinearity, we performed a non-linear regression in an attempt to develop a model to describe the observed relationship, and thus check whether such non-linearity had an important impact. We fitted a polynomial of the second degree with the form:

$$Y = A + BX + CX^2 + \varepsilon$$

Table 4 presents summary results of parameter estimates and pseudo-R-squared statistics for the non-linear model. The polynomial model seems to perform a better job in describing the relationship at hand than a simpler linear model. The small values of the parameter associated with the quadratic portion of the model suggest that by introducing this term a correction is made with the linear portion of the model thus

improving the R-square statistic (from 0.16 to 0.22). Hence, we thought it necessary to transform the independent variable FORM in order to restore linearity to this relationship.

Table 4. Parameter estimates of non-linear models. Model 1 (second degree polynomial)

Model	Dep. var.	Parameter						R <sup>2</sup> (%) <sup>♦</sup>
		A		B		C		
		Estimate	S. E. <sup>^</sup>	Estimate	S. E. <sup>^</sup>	Estimate	S. E. <sup>^</sup>	
1	INNOV*	4.81	2.54	-1.08	1.27	0.16	0.14	22.6

♦ PSEUDO-R-SQ. <sup>^</sup>Asymptotic standard error

Using Tukey's ladder of transformations we presumed that power functions of the independent variable FORM would be adequate for this case. We, nevertheless, tried several possibilities, but it was apparent that power functions of the independent variable were the most adequate transformations to induce linearity in the relationship. By fitting nonlinear regression models we observed that the quadratic term of the fitted second degree polynomial would tend to zero (thus leaving a linear form) when FORM was raised to approximately the 3.75 power. This was confirmed through visual inspection. In Figure 8 we have re-plotted INNOV\* against the transformed version of FORM (hereupon named FORM\*). A least-squares trend line and a polynomial fit of the second degree are superimposed on the model. It can be seen that both lines are practically indistinguishable, thus indicating that, for our purposes, a satisfactory transformation had been attained.

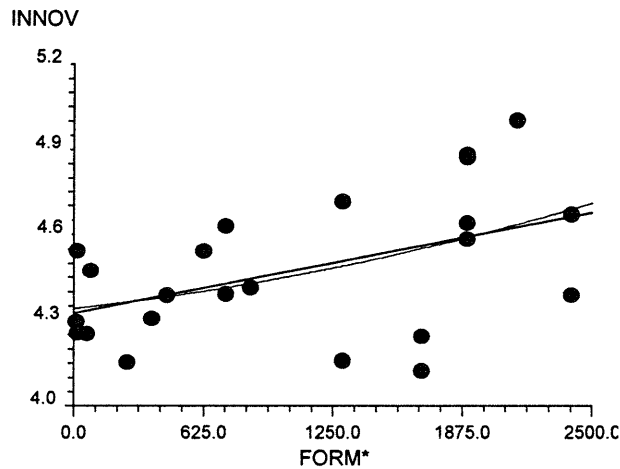


Figure 8. Scatter plot of transformed version of FORM (FORM\*) versus the dependent variable INNOV.

Once comfortable with the independent variable FORM\*, we performed a similar analysis with the independent variable PDO. Figure 9 is a scatterplot of this variable against the dependent variable INNOV\* with a least-squares trend line and a polynomial line of the second degree overlaid on it. We performed a partial regression of INNOV\* against PDO and obtained a Durbin-Watson statistic of 1.63, indicating that the residuals were not autocorrelated (critical value at the 5% significance level = 1.437). To check this result we fitted a non-linear quadratic function to this relationship. Although the Beta coefficient of the quadratic term was small, we noticed an important relative increment in the fit through the addition of the quadratic term. The pseudo R-square statistic for the non-linear fit was equal to 4.00% while its value for a simple linear function was 3.34%. The addition of the quadratic term improves the R-square by 0.66%, which is not negligible if compared to the original value (i.e., improves the R-squared value by 19.7%).



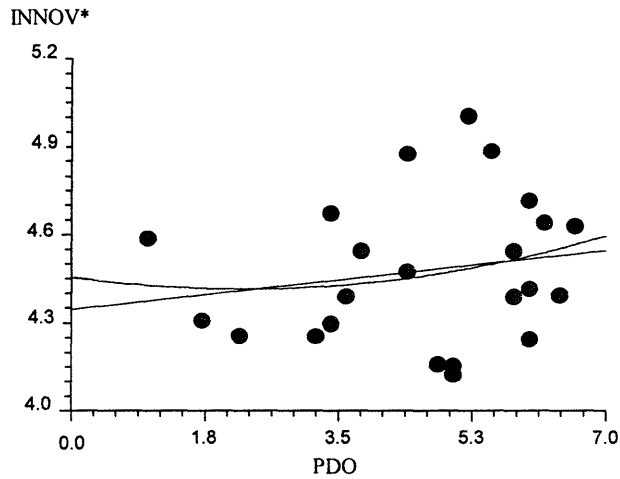


Figure 9. Scatterplot of PDO versus INNOV\*.

We again found, using Tukey's ladder of transformations that power functions adequately restored linearity to this relationship. To find the optimum point we graphically estimated the point at which the value of the Beta coefficient of the quadratic term became zero (thus leaving a linear functional form). Such estimation can be observed in Figure 10. This figure shows that at around 1.87 the coefficient of the quadratic goes to zero and then changes sign (i.e. becomes convex), rendering a good approximation of the power transformation that was required.

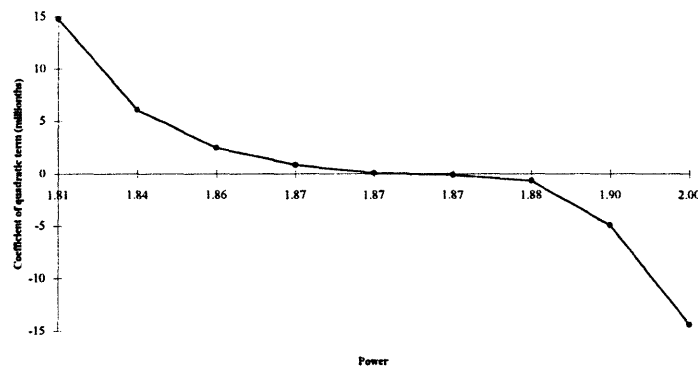


Figure 10. Plot for calculating power of transformation for PDO.

As a result of these analyses we decided to utilize a transformed version of our original independent variable PDO. The transformed version of this variable was termed PDO\*. Figure 11 is a plot of PDO\* versus the independent variable INNOV. We can see, through the overlaid trend and polynomial lines (which are indistinguishable from each other), that linearity has been attained through this transformation.

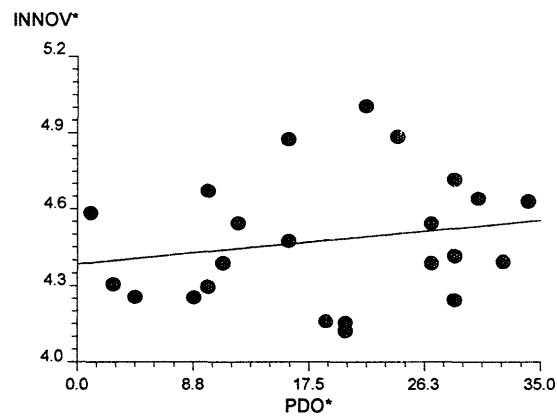


Figure 11. Scatterplot of PDO\* (the transformed version of PDO) and INNOV\*.

Finally, we noticed an interaction between our two independent variables, manifested through a convex curvilinear relationship. As Figure 12 shows, firms with differentiated capabilities for developing new products tend to attain intermediate scores on the variable FORM. The observed relationship urged us to include this interaction into our model, given that the main effects may not be manifesting themselves entirely through their additive terms.

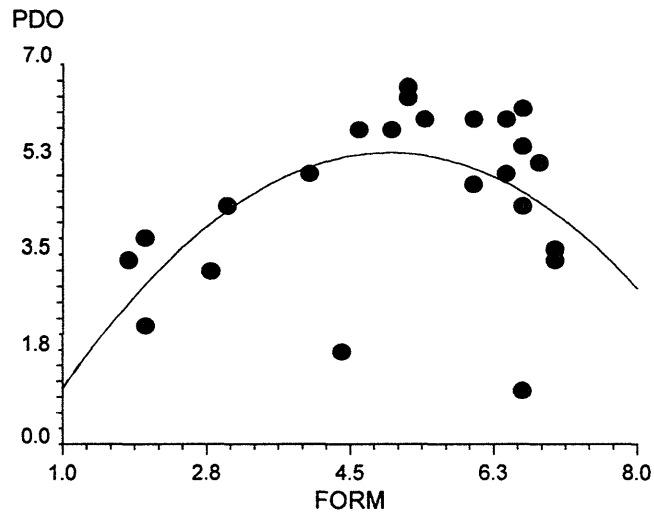


Figure 12. Scatterplot of FORM vs. PDO.

We therefore created an interaction term PDO\_FORM by multiplying the variables FORM\* and PDO\*. In multiplying these two variables very large numbers are obtained, and, therefore, very small Beta coefficients are likely to happen. We quickly checked for linearity (using a similar methodology to the one we used for the independent variables PDO and FORM). Figure 13 is a scatterplot of the interaction term against the independent variable INNOV\*. We can see that both the polynomial fit and the linear fit are straight lines. The coefficient of the quadratic term in the polynomial line is negative and very small (hence the curve is slightly convex), but we found, using a variety of tests, that no functional transformation appeared to be necessary.

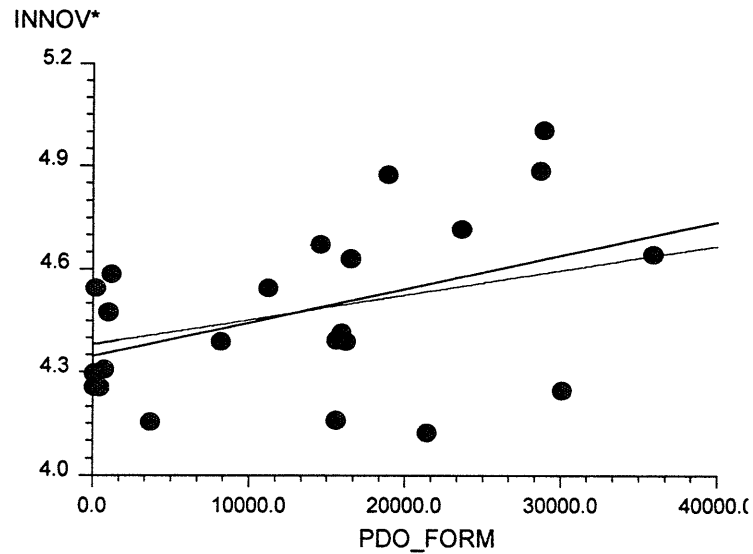


Figure 13. Scatterplot of PDO\_FORM vs. INNOV\*.

Once we were comfortable with the variables to analyze, we estimated Pearson correlation coefficients to examine emergent bi-variate relationships. Table 5 shows that FORM\* is positively correlated to INNOV\*, possibly indicating that larger arrays of product offerings aimed at different markets are found among institutions which are highly formal. As expected from studying the bivariate scatterplots, PDO\* presents positive correlation coefficients with respect to INNOV\*, though not significant. This could indicate that the existence of differentiated intrafirm functions to develop new products is not correlated with innovation. The interaction term, however, is positively correlated to both independent variables and to the dependent variable INNOV\*, thus indicating that the main effect of PDO\* is not specified through its additive term but through an interaction with the other independent variable.

Table 5. Pearson correlation coefficients for variables of interest.

	INNOV*	FORM*	PDO*
INNOV*	1.00		
FORM*	0.48*	1.00	
PDO*	0.19	0.13	1.00
PDO FORM	0.45*	0.73***	0.66***

\*\*\*p<0.001, \*p<0.05

Following these analyses we decided to use PDO\* as our question predictor and FORM\* as a control. We built a sequence of nested models, starting with our baseline (INNOV\* regressed against PDO\*) and subsequently adding the control and interaction variables (FORM\* and PDO\_FORM). Table 6 summarizes these results. Notice that the Beta coefficients are small. We had anticipated such small numbers would occur as a result of the large magnitudes of the independent variables after transformation.

Table 6. Results of regression analyses.

Model	Intercept	Question Predictor	Control Predictor	Interaction		R-sq (%)
		PDO*	FORM*	PDO* FORM*		
1	4.39***	4.84E-3				3.8
2	4.26***	3.34E-3	2.21E-4*			24.8
3	4.29***	1.57E-3	1.82E-4	2.71E-6		25.0

\*\*\*p<0.001, \*p<0.05

We then inspected influence statistics to uncover possible perturbations caused by atypical data points. Figure 14 is a scatter plot of influence statistics Hat diagonal and Cook's D. We notice that observation number 23 appears to have an unduly large effect on our final fit.

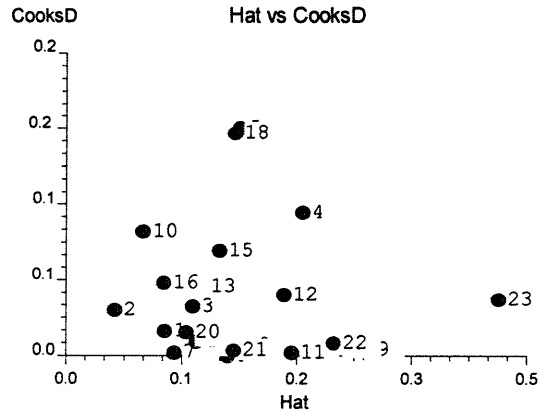


Figure 14. Plot of influence statistics, Hat Diagonal vs. Cook's D.

We reran the model without this observation and did observe an important change in the magnitudes of the Beta coefficients. We therefore decided to leave this observation out and chose the model shown in Table 7.

Table 7. Final fitted model

Model	Intercept	Question predictor.	Control Predictor.	Interaction.	R-sq (%)
		PDO*	FORM*	PDO*_FORM*	
Final	4.29***	9.07E-4	1.26E-4	5.58E-6	25.1

\*\*\*p<0.001, \*p<0.05

The model was "untransformed" to facilitate interpretation. The model, after substitution of the corresponding untransformed variables, is as follows:

$$\text{INNOV} = I + \beta_1 \text{PDO}^{1.87} + \beta_2 \text{FORM}^{3.75} + \beta_3 \text{PDO}^{1.87} \text{FORM}^{3.75} + \varepsilon$$

where I denotes the intercept and the  $\beta$ s are the beta coefficients indicated in Table 7. This model was chosen as the basis for our discussion. Assumptions about normality of

the residuals were revised through the normal probability plot. We found some evidence of heteroscedasticity when inspecting diverse plots of residuals versus our independent variables. The plot of residuals versus the predicted values shows that variance is not homogeneous throughout. The normal probability plot confirms this by showing a departure from normality at the lower end of the residual distribution (see Figure 15). Although slight departures from the normality assumption may not appreciably alter our inferences, we were concerned with such departures because of the small size of our data set, and thus we prefer to treat our results cautiously. We tested for the presence of autocorrelated disturbances using the Durbin-Watson statistic and found no evidence of such occurrence. Multicollinearity (determined using tolerance statistics) did not appear to be a problem. In all we found that more robust estimations were difficult to achieve because of the small size of our data set. However, we must note that the observations included in the set represented 82% of all banks operating in this economy.

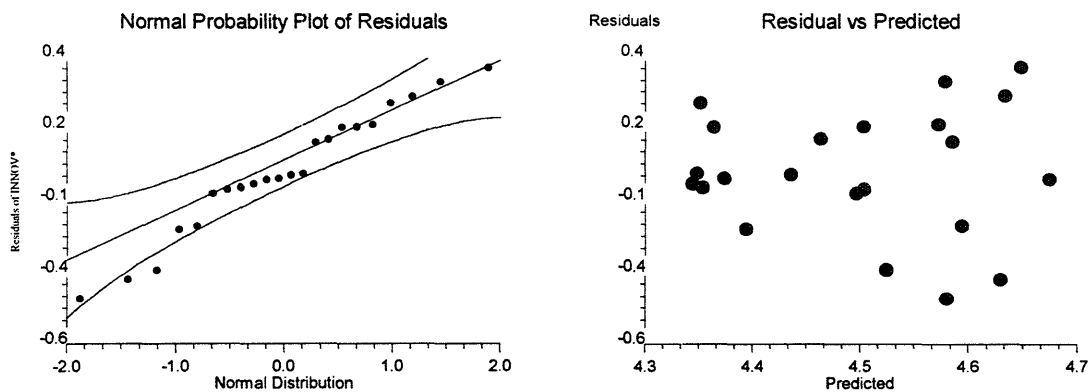


Figure 15. Normal Probability Plot and plot of residuals versus predicted for final model.

## Summary and Discussion

We wanted to assess the effect of some organizational factors on innovation in financial services. Hence, we established a baseline model in which INNOV, the degree to which firms in the sample innovated, was regressed on PDO (the degree to which these firms had developed an orientation for developing new products) and firm flexibility, using as a proxy a formality measure (FORM). The goal was to establish whether different organizational arrangements were more or less conducive to innovative activities. We found that the baseline model explained little of the variability observed in our dependent variable INNOV. However, when the variable FORM was introduced into the model and, particularly, when the interaction between FORM and PDO was introduced, we obtained a model which explained approximately 25% of the observed variability in the dependent variable.

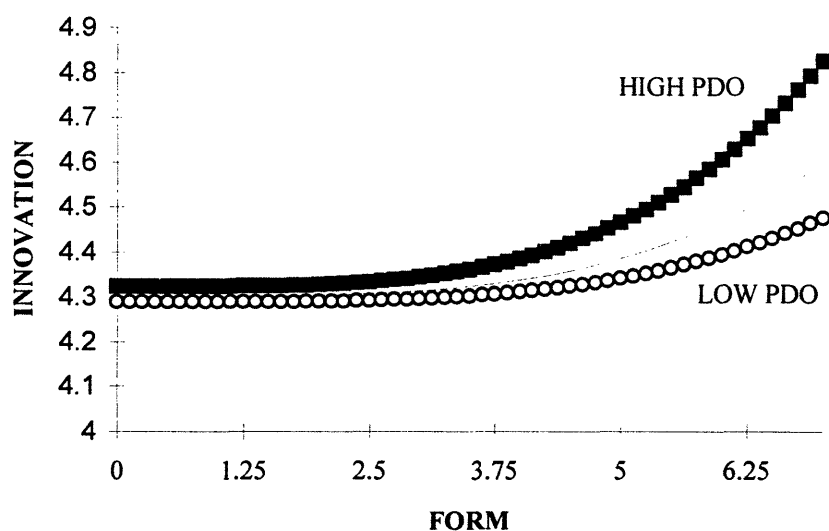


Figure 16. INNOV vs. FORM for various levels of PDO.



Figure 16 is a visual display of the final model in which our dependent variable INNOV is plotted against FORM for different levels of PDO. Although our findings appear to indicate that formal firms with a product development orientation seem to have larger product arrays aimed at different markets, we cannot make any normative assertion to this respect. We had expected that very flexible firms would also exhibit a high degree of innovativeness, perhaps in spite of not having well-defined product development orientation. Such was not the case. We also thought that having an orientation toward product development would, per se, result in higher degrees of innovativeness. This was not the case either. Such effects appear to reveal themselves more strongly through the interaction with our formality measure. We can only claim, with the data at hand, that there appears to be some variability, which makes us believe that in fact some organizational characteristics do have an effect upon innovation. Results, however, are not entirely compelling for the following reasons:

1) The theoretical frameworks do not seem to provide an adequate backdrop to understand what goes on in these banks. Although these frameworks have been widely used in describing organizational characteristics associated with innovation and management in many areas<sup>1</sup>, the predictive power of the framework appears to be weak in our setting. The framework is adequate in perhaps explaining arrangements at the organizational level associated with products that require few variations and

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<sup>1</sup> For instance the management of information resources (Nosek, 1989); the understanding of strategic management of small firms in different environments (Covin and Slevin, 1989); public accounting firms (Zanzi, 1987); R&D efficiency (Link and Zmud, 1986); the management of end-user computing (Brown and Bostrom, 1994); the effects of downsizing (Finne, 1991); the relationship between strategy formation patterns and sales growth rates (Slevin and Covin, 1997); etc.

customization, but probably fails when explaining tailor-made products. Our simplistic measures at the organizational level might be suitable for explaining differences observed in, for instance, retail products; but they may not be so useful when applied to, for instance, corporate products, simply because the latter case could require a more direct customer connection. Our data do not permit to draw such distinctions.

2) Although helpful at the level of the organization, our study seems to point to the need of evaluating product development practices at a functional level. Use of alternative frameworks, like proximity to the customer, the importance of lead users (von Hippel, 1988), the sources of innovations (von Hippel, 1988), and the variations that occur in the functional sources of innovation and associated structural arrangements for each of the cells in the client-product matrix might render better insights and would be an interesting path to follow in further research. Such alternative theoretical schemes could perhaps be more tightly related to performance, controlling for type of product.

3) Our results have a high error. There are many other variables that might be affecting the hypothesized relationship. Many of these intervening variables cannot be controlled for with the data at hand. In particular, we are not measuring resources available. Organizational structure should mediate the relationship between resources deployed and innovation. Firms' resource allocation levels will clearly be correlated with productivity, and such relationship will be mediated by the organizational arrangements chosen by firms to develop new products. Should we be able to determine data on resource allocation, normative conclusions could be drawn with respect to which

organizational arrangements seem to work better, not only in terms of products developed, but in terms of products developed for given levels of resources. Such path is clearly an interesting one to follow in further research.

4) Our results are statistically weak. Excluding from consideration the obvious weakness of having such small number of data points, we can clearly see that constructs, despite being fairly common and relatively simple, did not provide enough granularity for more detailed and enlightening analyses. We need to refine and develop more precise constructs for studying the effects of organization on innovation in financial services. Further research could use an inductive approach. Case studies are the needed vehicle for developing such constructs with a grounded theory approach.

In all, the results are useful in bringing concepts forward to the study of structural arrangements associated with financial innovations. Such results are in line with a few studies that report similar findings. Reidenbach et al. (1986), for instance, explored new product development practices in retail banks and found that the existence of a formalized development process was positively correlated with bank performance. Average and below-average performing banks tended to have less structured new product development processes. Iwamura and Jog (1991), for a sample of 86 investment houses, found that the degrees of centralization and formalization were significantly higher for firms categorized as innovators than for non-innovators. In our study we found some variance that points to similar outcomes, but our results are hard to confirm due to the drawbacks of extant theory, measures chosen, and availability of data.

A more detailed look is needed of product development activities themselves, particularly the activities that precede the development of a product (such as emergence of ideas, roles needed for bringing ideas forward, and the prominence such roles acquire at different points in time). Aside from understanding organizational level effects upon innovation, we should also take a more detailed look into product development processes at the functional level and to identify the most important variables that them within financial service firms. An ample literature on the management of innovation is available to theoretically ground such effort. The studies of Marquis (1969), Roberts and Frohman (1978), Roberts (1988), and others refined and developed exact definitions of many product development mechanisms, which could provide a useful starting point for the understanding of the emergent R&D function within financial services firms.

As corollaries, differential effects of alternative organizational forms can be conceptualized as influencing innovation and performance in terms of their effect upon the strategy of the firm (Burgelman, 1983). Lacking strategic intent may render innovation efforts useless. For instance, a firm's subunit may generate a multitude of new products, but such products may not have any inter relation among themselves in the context of the company's strategic pursuits<sup>2</sup>. Quinn (1986) and Maidique and Hayes (1984) have shown that strategic planning and thinking are important ingredients of the innovative firm in ways which move further into actively managing the alternative

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<sup>2</sup>Easingwood and Storey (1993) for instance, analyzed 78 financial products in the UK and found that Internal Synergy, defined as the degree to which new products extended or complemented the firms product line and fitted with the delivery system of the organization accounted for over 25% of the observed variability in product performance.

periods of chaos versus continuity that innovation implies (Roberts, 1988). If R&D works in isolation, firms may not take full advantage of possible synergy that may emerge from its association with business activities and strategic objectives (Spencer and Triant, 1989). Strategy can serve to integrate several aspects of the organization in order to gain advantage from innovation (Shrivastava and Souder, 1987). Here, further research could add to our overall framework by exploring the interaction of organization and strategy on innovation. Such an investigation should include the effects of managerial profiles and marketing and technological inputs upon innovation activities.

Finally, an interesting ramification would be to look at the possibility of both organic and mechanistic types coexisting within firms and, although processes might be initiated in a typical organic fashion, they are implemented in a mechanistic way (Spender and Kessler, 1995).

Our observed results and the above suggestions need further and more thorough assessment with larger samples of data over longer periods of time.

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## **Appendix 1**

Scale 1 for FORM1.

Seven point scales for the following items: 1) The organization has a large number of rules and written procedures; 2) In my organization there are manuals that specify procedures; 3) There are written job descriptions for most positions in the organization; 4) There are written performance indicators for the people who work in this company; 5) There is a formal orientation program for individuals who are new to the organization.

Scale 2 (redundant measure of formality) for FORM2:

Five-point scales for the following items in answer to: In my organization the following documents exist, are formally written and are well-known by employees: 1) Formal job contracts; 2) Information brochures for employees; 3) Organizational chart; 4) Written operating instructions; 5) Formal job descriptions; 6) Manuals of procedures; 7) Policy manuals; 8) Research reports.

Scale 3 (to measure degree of product development orientation) for PDO.

Seven-point scale for the following items: 1) The organization has assigned somebody the task of investigating, evaluating and developing new products; 2) When a new product is developed, the company develops a formal design and a business plan; 3) New product performance is formally evaluated; 4) We have performance indicators that permit determining how new products are doing; 5) The person assigned to develop new products is a top level manager.

## Appendix 2

Calculation of the indices is as follows:

We compare with a hypothetical, highly unfocused, bank with many products in each cell of the matrix. In this case we set this number, arbitrarily, to 30. In general if we labeled matrices as shown in Figure Ap2-1, we would have:

<table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td style="padding: 5px;">a<sub>13</sub></td><td style="padding: 5px;">a<sub>23</sub></td><td style="padding: 5px;">a<sub>33</sub></td></tr> <tr><td style="padding: 5px;">a<sub>12</sub></td><td style="padding: 5px;">a<sub>22</sub></td><td style="padding: 5px;">a<sub>32</sub></td></tr> <tr><td style="padding: 5px;">a<sub>11</sub></td><td style="padding: 5px;">a<sub>21</sub></td><td style="padding: 5px;">a<sub>31</sub></td></tr> <tr><td colspan="3" style="padding: 5px;">Product</td></tr> </table>	a <sub>13</sub>	a <sub>23</sub>	a <sub>33</sub>	a <sub>12</sub>	a <sub>22</sub>	a <sub>32</sub>	a <sub>11</sub>	a <sub>21</sub>	a <sub>31</sub>	Product			<table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td style="padding: 5px;">e<sub>13</sub></td><td style="padding: 5px;">e<sub>23</sub></td><td style="padding: 5px;">e<sub>33</sub></td></tr> <tr><td style="padding: 5px;">e<sub>12</sub></td><td style="padding: 5px;">e<sub>22</sub></td><td style="padding: 5px;">e<sub>32</sub></td></tr> <tr><td style="padding: 5px;">e<sub>11</sub></td><td style="padding: 5px;">e<sub>21</sub></td><td style="padding: 5px;">e<sub>31</sub></td></tr> <tr><td colspan="3" style="padding: 5px;">Product</td></tr> </table>	e <sub>13</sub>	e <sub>23</sub>	e <sub>33</sub>	e <sub>12</sub>	e <sub>22</sub>	e <sub>32</sub>	e <sub>11</sub>	e <sub>21</sub>	e <sub>31</sub>	Product		
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Product																									

Figure Ap2-1: Client-Product matrices for given bank and for hypothetical comparison base.

We calculate Chi-square as follows

$$\chi^2 = \sum_{c=1}^3 \sum_{p=1}^3 \frac{(N_{cp} - e_{cp})^2}{e_{cp}}$$

Hence,

$$\chi^2 = \frac{(a_{11} - e_{11})^2}{e_{11}} + \frac{(a_{12} - e_{12})^2}{e_{12}} + \dots + \frac{(a_{33} - e_{33})^2}{e_{33}}$$

An example of these matrices is shown in Figures Ap2-2 and Ap2-3. Figure Ap2-2 depicts the client product matrix of a small bank which is apparently concentrated in the corporate segment, and Figure Ap2-2 shows a matrix of a bank which provides more services to all three market segments in the c-p matrix.

Client	0	0	2
	1	2	0
	8	1	1
	Product		

Figure Ap2-2: Client-product matrix.

Client	1	1	2
	2	6	2
	13	4	2
	Product		

Figure Ap2-3: Client-product matrix.

Following the above formulae we obtain a Chi-sq. of 242.5 for the c-p matrix of Figure Ap2-2 and a Chi-sq. equal to 211.97 for the c-p matrix in Figure Ap2-3.

Given that we had longitudinal data (i.e., bank product histories over time), we compared rates of change in the observed chi-squared values at different times. These rates of change were highly correlated to the value of the most recent c-p matrix, hence we used this value as our measure.