In this article, the Knott and Wildavsky stages of knowledge utilization are considered separately and compared with the previous stage to find factors explaining why researchers are able to climb up the ladder of knowledge utilization from the echelon of no transmission to transmission, then to cognition, reference, effort, influence, and application. The results suggest that there are barriers to climbing and that these barriers are primarily located between the stage of no transmission and the stage of transmission. These results carry theoretical and policy implications that are explored in the last part of the article.

Climbing the Ladder of Research Utilization

Evidence from Social Science Research

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Knowledge utilization is a field of research concerned with factors explaining the utilization of scientific and technical knowledge by decisionmakers and those in professional practices. This research field is expanding rapidly as universities and researchers are under pressure to increase the utilization of research results by decisionmakers and society at large. The perception that taxpayers are not getting an adequate return from their investments in university research is accompanied by a growing demand for more measurable results regarding the utilization of university research. Although there is an

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enormous reservoir of research results, the study of knowledge utilization is still in its infancy (Lester 1993; Oh and Rich 1996; Rich 1997), with a large pool of normative studies and case studies cohabiting with a rather small pool of quantitative studies. Furthermore, the field of knowledge utilization is still in its infancy regarding the development of a general theoretical framework that explains the conditions under which research is utilized. This article tackles these issues in adopting the view that the utilization of research is more adequately described as a process comprising many stages rather than as a product arriving at the final stage of decision making. More specifically, the objectives of this article are: (1) to find factors explaining why social science scholars succeed in climbing up from the lowest echelon of transmission to that of cognition, reference, effort, and influence up to the highest echelon of application of their research results in the ladder (or process) of knowledge utilization and (2) to derive implications for future research and future public policy from the factors explaining success in climbing the echelons of the ladder of knowledge utilization. To our knowledge, there are as yet no studies that have explored the factors explaining why researchers succeed in climbing up through the various stages of knowledge utilization.

The article is organized as follows. First, it deals with the main approaches to the measurement of the utilization of knowledge. Second, it briefly reviews the major explanatory models of knowledge utilization to apply these explanations to data about 1,129 Canadian scholars in six social science disciplines (anthropology, economics, political science, social work, sociology, and industrial relations). The last part of the article discusses the implications of the findings for future research and policies.

Prior Studies and Theoretical Predictions

The measurement of the utilization of knowledge has centered almost exclusively around the product and process views of knowledge. The *product* perspective associates utilization to cases of instrumental use where the knowledge of a single study induces users to make particular decisions that would not have been made otherwise. Seeking to bring in some of the noninstrumental aspects of utilization, some studies have incorporated conceptual and symbolic uses of knowledge (Beyer and Trice 1982; Pelz 1978). The conceptual use refers to cases where knowledge of a single study provides new ideas, new theories, and new hypotheses leading to new interpretations about the issues and the facts surrounding the decision-making contexts without inducing changes in decisions. Finally, symbolic use of knowledge occurs when practitioners and decisionmakers use knowledge to legitimate

their views. Though examining utilization with such primitive measures (Rich 1997) may provide insights into knowledge utilization, such an operationalization falls short of the conceptual complexity inherent to the idea of knowledge utilization. Furthermore, as pointed out by Rich (1991), conceptual and symbolic uses can be considered as catchall categories that limit their validity.

The *process* view of knowledge utilization associates use to scales of utilization related to various aspects of decision-making processes. The most frequently cited scales of utilization are the Hall levels of use scale (Hall, George, and Rutherford 1979), the Hall stages of concern scale (Hall, George, and Rutherford 1979), the Johnson evaluation utilization scale (Johnson 1980), the Pelz and Horsley research utilization index (Pelz and Horsley 1981), the Larsen information utilization scale (Larsen 1982), and the van de Vall and Bolas overall policy impact scale (van de Vall and Bolas 1982). However, these scales place too much emphasis on instrumental use, are too focused on particular uses (i.e., evaluation), or place too much emphasis on perceptions at the expense of observable behavior. The Knott and Wildavsky scale (1980) does not carry these shortcomings, and it is a scale that is frequently cited in the literature. Moreover, Lester and Wilds (1990) and Lester (1993) have used this scale to derive an index based on cumulative stages of utilization by state agency officials. More recently, Landry, Amara, and Lamari (2001) have used a slightly modified Knott and Wildavsky scale to derive an index of utilization of the knowledge produced by Canadian scholars. The Landry, Amara, and Lamari index of utilization has been tested for its reliability. The scale used in the present study is a modified Knott and Wildavsky, including the following six stages of utilization: transmission, cognition, reference, effort, influence, and application. The scale is cumulative in the sense that cognition builds on transmission, reference on cognition, effort on reference, influence on effort, and application on influence. Table 1 presents the descriptive stages of knowledge use as they were presented in the questionnaire sent to the respondents of the survey.

Previous studies that have used knowledge utilization scales as their dependent variable have aggregated the stages to construct overall indices of knowledge utilization, and they have attempted to identify factors explaining the extent of utilization. In this article, each stage of the knowledge utilization scale is considered separately, and it is compared with the previous stage to find factors explaining how researchers are able to climb up the ladder of knowledge utilization from the echelon of no transmission to the echelon of transmission, then from the stage of transmission to that of cognition, from cognition to reference, from reference to effort, from effort to influence, and finally, from influence to application. To our knowledge, no prior empirical

TABLE 1
Stages of the Ladder of Knowledge Utilization

Stage 1	Transmission: I transmitted my research results to the practitioners and professionals concerned.
Stage 2	Cognition: My research reports were read and understood by the practitioners and professionals concerned.
Stage 3	Reference: My work has been cited as a reference in the reports, studies, and strategies of action elaborated by practitioners and professionals.
Stage 4	Effort: Efforts were made to adopt the results of my research by practitioners and professionals.
Stage 5	Influence: My research results influenced the choice and decision of practitioners and professionals.
Stage 6	Application: My research results gave rise to applications and extension by the practitioners and professionals concerned.

studies have examined the factors explaining why researchers succeed in climbing up the echelons of the ladder of knowledge utilization.

The literature on knowledge utilization is concerned with factors explaining why research is utilized. In this article, we must also pay attention to factors explaining why researchers succeed in climbing up the echelons of the ladder of knowledge utilization. This latter literature refers to barriers to entry. The literature on knowledge utilization derives its explanatory variables from four major alternatives (Buxton and Hanney 1996; Devine, Thomas, and Thimothy 1987; Kline and Rosenberg 1986; Landry 1990; Landry, Amara, and Lamari 2001; Rothwell 1994; Weiss 1979; Yin and Moore 1988): a technological model, an economic model, an institutional dissemination model, and a social interaction model. While each model focuses on the importance of research results in decision making, there are differences among them regarding the major determinants of knowledge utilization.

The technological model, also referred to as the science push model in the literature, stresses the supply of research findings as the major determinant of knowledge utilization. Prior studies have considered many dimensions of research results influencing utilization: (1) content attributes (Dearing and Meyer 1994; Edwards 1991) and (2) types of research—basic/applied (Machlup 1980) and research domains and disciplines (Landry, Amara, and Lamari 2001; Oh 1997; Rich 1997).

In the economic model, also referred to as the demand pull model, knowledge utilization is explained only by the needs and the context of the users. Use of knowledge is increased when researchers focus their projects on the needs of users instead of focusing them only on the advancement of scholarly knowledge (Chelimsky 1997; Frenk 1992; Landry, Amara, and Lamari 2001;

Orlandi 1996; Rich 1991; Silverside 1997; Weiss 1979; Yin and Moore 1988). McLaughlin (1998) and Fullan (1998) have pointed out that no theory can anticipate all of the local contingencies surrounding the context of the users of research. Many chapters of a recent Organization for Economic Cooperation and Development (OECD) report on knowledge management develop a similar argument (OECD 2000).

The institutional dissemination model explains knowledge utilization based on two determinants: the adaptation of the research products to meet the needs of the users and the dissemination efforts (Huberman and Thurler 1991).

The social interaction model, also known as the interaction model, has been developed to overcome the criticisms of the previous models (Dunn 1980; Huberman and Thurler 1991; Landry, Amara, and Lamari 2001; Nyden and Wiewel 1992; Oh 1997; Yin and Moore 1988). The social interaction model predicts that the more sustained and intense the interaction between researchers and users, the more likely it is that there will be utilization. Unlike the prior models, this one suggests giving greater attention to the relationships between researchers and users at the different stages of knowledge production, dissemination, and utilization. The social model integrates the explanatory factors of the prior models in a general model by using the following explanatory factors of research utilization: types of research outputs, organizational interests of users, adaptations of the products disseminated, dissemination efforts, and institutional and social linkage mechanisms.

After we have identified the factors explaining knowledge utilization, we need to explain how these factors influence the likelihood that researchers succeed in climbing up the ladder of knowledge utilization. This second task can be achieved by considering the changes in transaction costs that researchers must support while attempting to climb from one echelon to the next on the ladder of knowledge utilization. *Transaction costs* refer to the costs of actions and tasks required to ensure utilization of knowledge. These transaction costs are actually barriers to entry.

In the market of knowledge there are suppliers and demanders, as in any market. This article focuses on the suppliers: researchers who produce knowledge. In a perfect world where no transaction costs exist, there are no barriers to entry and suppliers of knowledge are chosen from those who are competing to become suppliers, based on how closely the knowledge they propose to supply matches the needs of users. On the supply side of the market, there are barriers to entry that may prevent many researchers who want to supply knowledge to users. Entry occurs through the different stages of the ladder of knowledge utilization: transmission, cognition, reference, effort,

influence, and application. How do transaction costs influence the utilization of knowledge and barriers to entry that may keep researchers from supplying knowledge to users at the different echelons of the ladder of knowledge utilization? Economists classify barriers to entry into four categories: barriers created by public policies, absolute cost advantages, economies of scale, and customization of products.

The Canadian research councils that provide funding for university research have developed a set of highly detailed policies and regulations regarding expenses that are admissible for funding and reimbursement. The expenses incurred in tasks and activities to insure utilization of research results in the scholarly community tend to be more credible and more easily reimbursed than the expenses incurred to insure dissemination and use outside the scholarly community. Furthermore, activities to insure utilization of research still play a minor role in the evaluation of the track records of the applicants for research grants. Therefore, the existing public policies create barriers to entry in activities and tasks that must be incurred to insure knowledge utilization outside the scholarly community. These barriers result from the obligation that the researchers have to support by themselves the totality of the costs related to insuring utilization of knowledge outside the scholarly community.

Absolute cost advantages occur when scholars involved in activities and tasks to insure knowledge utilization by users have average cost curves significantly lower over their entire range than those of potential new entrants. Among possible sources of such an advantage are control of knowledge acquired from learning by doing in the matter of knowledge utilization, especially professional expertise and skills acquired through past experiences as well as specialized know-how that is useful in only a narrow range of applications related to linkage and exchanges between researchers and users. Each of these may be considered as only a temporary disadvantage by a new entrant that, over time, can only be counterbalanced by supporting additional costs that scholars who have learned by doing no longer have to support.

Economies of scale represent barriers to entry when the costs of activities and tasks incurred by scholars to insure knowledge utilization are large, relative to total demand of research results by users. Under these circumstances, a small number of scholars are willing to support these costs without inducing other scholars to enter the market of knowledge utilization.

The degree to which the research results are customized to one or a few users (tailored for an individual user) also influences the costs of the activities and tasks incurred by scholars when they attempt to insure utilization of their research results. Generally speaking, the more customized the research results, the greater the costs supported by the scholars.

The logic of the explanatory models of knowledge utilization and barriers to entry suggests the following theoretical predictions.

Prediction 1. Focus of the research projects on advancement of scholarly knowledge is related to the issue of customization. Generally speaking, the less customized the research projects, the lower the use of knowledge, and as a consequence, the lower the likelihood of successful ascent in the ladder of knowledge utilization.

Prediction 2. Sources of funding influence the use of knowledge. More precisely, we predict that research projects based on university internal funds are less likely to lead to knowledge utilization than projects funded by sources external to universities. The assumption underlying this prediction is that the researchers who rely on external sources of funds are more likely than the others to be influenced by the policies and expectations of the funding agencies. Generally speaking, the more important the external funding, the higher the use of knowledge, and as a consequence, the higher the likelihood of successful ascent on the ladder of knowledge utilization.

Prediction 3. As the number of publications increases, researchers have more research results available for use by practitioners and professionals. The transaction costs incurred by the researchers in actions and tasks required to insure the utilization of knowledge decrease as the publication assets increase because the researchers have more by-products to offer to potential users, thus generating situations of increasing returns. Likewise, the publication assets represent economies of scale that decrease the costs of climbing up the echelons of the ladder of knowledge utilization. Therefore, the greater the publication assets, the greater the increasing returns and the more likely researchers are to succeed in climbing up the echelons of the ladder of utilization, especially to climb to the echelon of reference.

Prediction 4. Research results are idiosyncratic products defined by high levels of professional expertise, skills, and know-how in research methods. The professional expertise and skills acquired by researchers regarding how to use qualitative or quantitative research methods are associated with significant human investments. The transaction costs incurred by the researchers in actions and tasks required to insure the utilization of knowledge are not influenced by the types of research products, namely by the fact that research is either based on qualitative or quantitative methodologies. Likewise, we hypothesize that the type of research products considered does not affect the

costs related to climbing up from a lower to a higher echelon in the ladder of knowledge utilization.

Prediction 5. The use of knowledge is increased when the researchers customize their projects primarily on the needs of the users. However, the more customized the research results, the greater the costs incurred by the researchers in actions and tasks required, insuring the utilization of knowledge. Moreover, as the researchers attempt to climb the echelons of the ladder of knowledge utilization, the more customized their research results need to be, and as a consequence, the greater the costs incurred by the researchers in actions and tasks required to insure the utilization of knowledge.

Prediction 6. The influence of the users' context derives from the explanatory variables of the economic model. From this model we derive that use of knowledge increases as users consider research pertinent, as research coincides with their needs, as users' attitudes give credibility to research, and as results reach users at the right time. The transaction costs incurred by the researchers in actions and tasks required to insure the utilization of knowledge increase as researchers invest resources to tailor the research to the context of the users. These investments increase as one progressively climbs up the echelons of the ladder of knowledge utilization.

Prediction 7. Huberman and Thurler (1991) have developed valid and interesting indicators of adaptations of research products for users. Adaptation includes factors such as efforts to make reports more readable and easier to understand, efforts to make conclusions and recommendations more specific and more operational, efforts to focus on variables amenable to interventions by users, and efforts to make reports more appealing. The prediction is that when researchers invest resources to customize their products so as to facilitate their appropriation by users, it increases the use of social science knowledge. This prediction is central in the dissemination model. In terms of transaction cost economics, it means that the higher the costs supported by researchers to customize their products, the higher the use of social science knowledge. The higher the researchers attempt to climb up the ladder of knowledge utilization, the more customized the research products need to be, and as a consequence, the greater the costs that the researchers must incur regarding the customization of their research products for the needs of users.

Prediction 8. Researchers engage resources into dissemination efforts when they hold meetings to discuss the subject and scope of their projects

with users, to discuss results with users, and to disseminate results to users. The more customized the dissemination activities, the greater the costs of dissemination efforts incurred by the researchers. The higher the researchers attempt to climb up the ladder of knowledge utilization, the more customized the dissemination efforts need to be, and as a consequence, the greater the costs that the researchers must incur regarding the customization of their dissemination efforts for the needs of users.

Prediction 9. In addition to integrating all the variables of the previous model, the social interaction model explains utilization with recourse to a new variable: the linkage mechanisms. Huberman and Thurler (1991) have devised one of the most interesting sets of indicators of mechanisms linking researchers and users. The mechanisms considered include informal personal contacts, participation in committees, and transmission of reports to nonacademic organizations. The more resources the researchers invest in these types of linkage mechanisms, the higher the use of social science research. As they climb up the echelons of the ladder of knowledge utilization, the researchers must invest increasing levels of resources in the creation and consolidation of linkages with users. The higher the researchers attempt to climb in the ladder of knowledge utilization, the more customized the linkage mechanisms need to be, and as a consequence, the greater the costs that the researchers must incur regarding the customization of the linkage mechanisms for the needs of the users.

Data

The data used in this study were collected using a mail survey during the winter of 1998. The respondents were faculty members of fifty-five Canadian universities in departments of anthropology, economics, industrial relations, political science, social work, and sociology. We identified the respondents with Web sites. We contacted by telephone the few departments that did not have Web sites. This procedure generated a population of 3,252 persons. A questionnaire of seventeen questions was sent to this population on 12 January 1998. A follow-up letter was sent a week later. A total of 1,388 questionnaires were returned to us, thus resulting in a gross return rate of 42 percent. However, 159 of these questionnaires were not usable for the following reasons: potential respondents had retired (17), potential respondents were not faculty members but administrative personnel (42), questionnaires went to wrong addresses (46), respondents were in a sabbatical year outside Canada

(36), respondent had health problems (1), and respondents refused to participate in the survey (17). Therefore, 1,229 of the questionnaires obtained were usable, indicating a net return rate of 38 percent. A review of the prior studies based on sample surveys employed to study various aspects of knowledge utilization suggests that the present survey has one of the largest number of respondents and one of the highest return rates (Oh 1996). Such a large data set composed of faculty members of diverse social science disciplines is especially appropriate to study the factors explaining the utilization of social science knowledge produced in Canadian universities where pressure to increase the utilization of university research has increased gradually over the past twenty years.

The Model

Dependent Variable

Knowledge utilization was measured using a validated modified Knott and Wildavsky scale with the following process of cumulative stages of use: transmission, cognition, reference, effort, influence, and application (Knott and Wildavsky 1980; Landry, Amara, and Lamari 2001; Lester 1993; Lester and Wilds 1990). Each stage is presumed to be more important than the previous one, and the entire scale is cumulative in the sense that all these stages of knowledge use are important indicators and build on each other. Cognition builds on transmission, reference on cognition, effort on reference, influence on effort, and application on influence. In this study, each stage of the knowledge utilization scale is considered separately and is compared with the previous stage to find factors explaining how researchers are able to climb up the ladder of knowledge utilization from the echelon of no transmission to the echelon of transmission, then from the stage of transmission to that of cognition, from cognition to reference, from reference to effort, from effort to influence, and finally, from influence to application.

For each stage of the ladder of utilization, the dependent variable is a binary variable. It takes a value of 1 when the researchers succeed in passing a stage and 0 when they fail to pass it. This variable was constructed from the responses to the following question: "Please indicate what has become of your research of the last five years, in relation to the following aspects." The respondents were asked to qualify, for each of the six echelons of the ladder of knowledge utilization, what becomes of their research, using a 5-point scale ranging from 1 (*never*), 2 (*rarely*), 3 (*sometimes*), 4 (*usually*), to 5 (*always*).

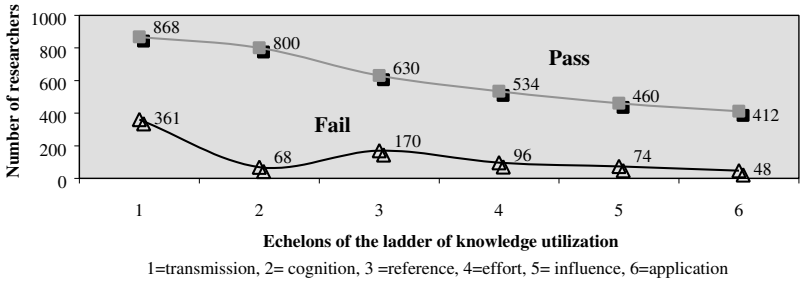

Figure 1: Number of Researchers Climbing and Falling Down the Echelons of the Ladder of Knowledge Utilization

The binary variable takes the value of 1 when the respondents replied *always*, *usually*, or *sometimes*, and it takes the value of 0 otherwise. Figure 1 shows the number of researchers climbing and falling at the different echelons of the ladder of knowledge utilization. The highest echelon of the ladder, that is, application of knowledge, is successfully reached by 412 (33 percent) of the 1,229 scholars surveyed. The same figure also indicates that 361 (29 percent) of the researchers do not even reach the first echelon of the ladder, that is, the mere transmission of their research results to users. The other echelon where the researchers fall in great proportion is the stage of reference. Indeed, 170 (21 percent) of the 800 researchers who have successfully passed the first two echelons of transmission and cognition do not succeed in climbing to the upper echelons of the ladder of knowledge utilization.

To identify the determinants explaining how researchers succeed in passing these different stages of the ladder of knowledge utilization, the form of the model that has been estimated for each of the six stages of the ladder of knowledge utilization is:

$$\begin{aligned}\text{Log}\,(P_i/1-P_i) = {} & \beta_0 + \beta_1\text{QUANP} + \beta_2\text{QUALP} + \beta_3\text{PUBA} + \beta_4\text{KNOWF} \\ & + \beta_5\text{USERF} + \beta_6\text{FUNDI} + \beta_7\text{FUNDE} + \beta_8\text{USERC} \\ & + \beta_9\text{ADAPP} + \beta_{10}\text{DISSE} + \beta_{11}\text{LINKA},\end{aligned}$$

where $\beta_i (i = 0 \ldots 11)$ are the coefficients and Log $(P_i/1 - P_i)$ is the logarithm of the ratio of the probability that the research results of scholar *i* succeed in passing a stage of the ladder of knowledge utilization relative to the probability that the same research results fail to pass the same stage of the ladder of knowledge utilization.

TABLE 2
Overview of Operationalizations and Predictions of Impact of the Independent Variables on the Ascent of the Ladder of Knowledge Utilization

Variables Derived from Models	*Measures of Variables*	*Predictions Regarding Influence on Utilization*	*Predictions Regarding the Ascent of the Ladder of Utilization*
Technological model			
Focus on advancement of knowledge	Index of extent to which research is focused on advancement of knowledge	Negative	Indeterminate
Types of products	Dichotomic variable: quantitative, qualitative research	Indeterminate	Indeterminate
Sources of funding	Dichotomic variable: internal, external funding	Indeterminate	Indeterminate
Publication assets	Index of number and categories of publications	Positive	Positive
Economic model			
Focus on users' needs	Index of extent to which research is focused on users' needs	Positive	Positive
Researchers'/ users' context	Index indicating perceptions of researchers regarding pertinence, credibility, timing, and so forth of research	Positive	Positive
Institutional model			
Adaptation of products	Index of adaptation of research products for users	Positive	Positive
Dissemination efforts	Index of efforts in dissemination activities	Positive	Positive
Social interaction model			
Institutional and social linkages (this model also includes the variables of the other models)	Index of involvement in institutional and social (informal) linkages	Positive	Positive

Independent Variables

Table 2 provides an overview of the operationalizations and predictions of impact of the independent variables on the utilization and the climb up the ladder of knowledge utilization. The detailed operationalizations of the

independent variables are presented in Appendix 1. The Cronbach's alpha coefficient is reported in Appendix 2 for indices comprising multiple items.

Results

Results of the estimations of the logit models for each of the six stages of the ladder of knowledge utilization are presented in Table 3. The computed value of the chi-square statistics for each of the six stages of knowledge utilization is greater than its critical value (i.e., 24.72) with 11 degrees of freedom at the 1 percent level. The models are thus significant at the 1 percent level. The explanatory power of the models indicated by the percentages of correct predictions is also very good. Indeed, the estimated models predict correctly more than 80 percent of the cases of the researchers who pass or fail to pass the different stages of the ladder of knowledge utilization. Finally, the Cox and Snell R^2 varies between .076 and .418, which is quite acceptable for models with qualitative dependent variables.

As for the explanatory variables included in the models, the results reported in Table 4 show that eight of them are significant at levels between 1 percent and 10 percent for the case where the probability of climbing the echelon of transmission is compared with that of failing to climb it. Estimations made for the other stages of the ladder of knowledge utilization indicate that between two and four variables significantly explain at levels between 1 percent and 10 percent the probability of climbing the echelons of the ladder of utilization. Two explanatory variables stand out: users' context and external funding. The variable users' context, which is a measure of the receptivity of users to research, significantly explains the climb for the first five echelons of the ladder of knowledge utilization (Prediction 6). Its positive coefficients indicate that a positive variation in the index measuring the receptivity of users to research increases the likelihood that researchers succeed in climbing the echelon indicated by the numerator. The variable external funding measures the importance of funding that researchers have from sources external to their universities (Prediction 2). This latter variable significantly explains the ascent up to the echelons of transmission, cognition, reference, and effort. Its positive coefficients signify that an increase in the importance of external funding also increases the likelihood of climbing these four echelons of the ladder of knowledge utilization.

The variables related to research methods on which knowledge is based, such as measured by quantitative products and qualitative products, significantly explain the climb up to the echelon of transmission but fail to explain the ascent in the other echelons of the ladder of knowledge utilization (Pre-

TABLE 3

Estimated Logit Models of Factors Affecting the Climb up the Echelons of the Ladder of Knowledge Utilization

Independent Variable	*Transmission/ No Transmission*	*Cognition/ Transmission*	*Reference/ Cognition*	*Effort/ Reference*	*Influence/ Effort*	*Application/ Influence*
Intercept	–4.26 (.000)***	–.933 (.459)	–4.98 (.000)***	–5.88 (.000)***	–4.81 (.002)***	.512 (.809)
Quantitative products (QUANP)	.466 (.095)*	.474 (.256)	.163 (.574)	–.134 (.695)	.085 (.812)	.089 (.835)
Qualitative products (QUALP)	.443 (.084)*	.337 (.375)	–.350 (.198)	.224 (.464)	–.041 (.905)	.033 (.935)
Publication assets (PUBA)	–.006 (.465)	.007 (.569)	.047 (.000)***	–.004 (.611)	.020 (.087)*	.024 (.112)
Focus on advancement of scholarly knowledge (KNOWF)	–.831 (.142)*	–1.073 (.171)	.045 (.897)	.401 (.336)	.136 (.749)	.445 (.372)
Focus on users' needs (USERF)	.280 (.505)	.489 (.358)	.072 (.809)	–.195 (.593)	–.229 (.549)	.548 (.219)
University funding (FUNDI)	–.005 (.934)	–.022 (.795)	–.011 (.842)	.022 (.765)	.008 (.910)	–.190 (.064)*
External funding (FUNDE)	.097 (.058)*	.116 (.127)*	.088 (.075)*	.1544 (.021)**	.089 (.207)	.079 (.368)
Users' context (USERC)	.174 (.000)***	.112 (.002)***	.147 (.000)***	.203 (.000)***	.188 (.000)***	–.003 (.967)
Adaptation of products (ADAPP)	.050 (.153)*	.010 (.843)	.049 (.191)	.124 (.010)***	.053 (.310)	.133 (.034)**
Dissemination efforts (DISSE)	.225 (.000)***	.049 (.369)	.105 (.004)***	–.034 (.494)	.028 (.592)	.044 (.455)
Linkage mechanisms (LINKA)	.048 (.050)**	.051 (.132)*	.022 (.323)	.025 (.391)	.005 (.868)	.0003 (.994)
n	903	682	636	506	436	378
Chi-square ($df = 11$)	488.16	57.90	140.47	66.24	34.61	25.83
Cox and Snell R^2	.418	.081	.198	.123	.076	.133
Percentage of correct predictions	88.48	93.40	81.92	86.17	87.39	89.15

NOTE: Numbers in parentheses indicate *p* value.
*Variable is significant at the 10 percent level. **Variable is significant at the 5 percent level. ***Variable is significant at the 1 percent level.

TABLE 4
Impacts of the Significant Explanatory Variables on the Probability of Transmission of Research Results to Users

Partial Elasticities of the Probability of Transmission for the Significant Continuous Variables

Elasticity/ Dissemination Efforts	*Elasticity/ Linkage Mechanisms*	*Elasticity/ Adaptation of Products*	*Elasticity/ Users' Context*	*Elasticity/ External Funding*
.13	.14	.13	.55	.06

Percentage of Change of the Probability of Transmission Resulting from Change in the State of the Significant Binary Variables

Change in the State of Variable (initial/modified)	*Percentage of Variation in the Probability of Transmission*
Research projects not based on the advancement of scholarly knowledge/Projects based on the advancement of scholarly knowledge	–3.0
Nonqualitative research/Qualitative research	5.4
Nonquantitative research/Quantitative research	5.9

diction 4). The positive coefficients indicate that the higher the number of researchers using either quantitative or qualitative research methods, the higher the likelihood that their research results succeed in climbing to the stage of transmission of knowledge. Although it may at first sight appear contradictory, this result may simply indicate that the researchers surveyed did not classify themselves in a mutually exclusive manner into one of these two research methods. Likewise, this result may indicate that the researchers who adopt a methodology that can clearly be classified as either quantitative or qualitative have a higher likelihood of reaching the echelon of transmission in the ladder of utilization.

The two indicators of dissemination significantly explain the climb in two echelons. Both dissemination efforts and adaptations of products increase the likelihood of transmission. Furthermore, an increase in dissemination efforts (Prediction 8) increases the likelihood of climbing from the echelon of cognition to that of reference, while additional adaptations of products for the users (Prediction 7) increase the probability of climbing from the echelon of influence to the echelon of application.

As for the investments made by the researchers in the creation and consolidation of linkage mechanisms between them and the users, their increase enhances the likelihood of successfully climbing to the echelon of trans-

mission and from transmission to cognition (Prediction 9). However, investments in linkage mechanisms do not affect the likelihood of a climb in the higher echelons of the ladder of knowledge utilization.

The other variables do not influence as much as predicted the climb through the echelons of the ladder of knowledge utilization. The focus of research projects on users' needs never significantly explains the likelihood of a climb from lower to upper echelons in the ladder of utilization (Prediction 5). As for its counterpart, the focus of research projects on the advancement of scholarly knowledge, it influences significantly and negatively the likelihood of a climb from the echelon of no transmission to that of transmission but does not explain a climb to the higher echelons (Prediction 1). The impact of the variable funding from internal university sources (FUNDI) is significant and negative only on the likelihood of climbing from influence to application, and it otherwise never explains a climb in the ladder of knowledge utilization (Prediction 2).

The presentation of the results of Table 3 was based on the signs of the coefficients of the explanatory variables. It did not take into account the scope of these coefficients because, in the logistic functional form on which logit regressions are based, the estimated values of coefficients, such as those presented in Table 3, cannot be interpreted as elasticity coefficients or as coefficients reflecting the marginal impacts of the explanatory variables. To assess the scope of the impact of the explanatory variables on the likelihood of climbing up the ladder of knowledge utilization, we have ascertained the partial elasticities of the continuous variables and have measured the variation of the likelihood of climbing the echelons of the ladder of knowledge utilization with or without the presence of the binary variables. Given the results of Figure 1, which indicate that failure to climb is most frequent when researchers attempt to climb from echelon 0 of no transmission to the echelon 1 of transmission of knowledge to users, we have evaluated these elasticity coefficients only for this case. Furthermore, the results of the estimations of the logit models indicated that most of the explanatory variables considered significantly explained the likelihood of climbing from echelon 0 to 1 but that they generally do not explain very successfully the climb to the higher echelons of the ladder. These results have led us to attempt to measure the scope of the impact of these explanatory variables on the likelihood of transmission of research results to users.

The partial elasticities for the continuous variables that have been found to significantly explain transmission were calculated with Equation 3 presented in Appendix 3. These partial elasticities reflect the average of the elasticity coefficients calculated for each of the 903 observations. As can be seen in the upper section of Table 4, the elasticity coefficient of the variable users'

context is the highest. This coefficient takes a value of .55, thus indicating that a positive relative change of 10 percent in the index of the users' context increases the likelihood of transmission by 5.5 percent. Likewise, a positive relative change of 10 percent in the index of dissemination efforts, linkage mechanisms, and adaptation of products increases the likelihood of the transmission of research results by 1.3 percent, 1.4 percent, and 1.3 percent, respectively.

The lower section of Table 4 presents the percentage of change in transmission generated by changes in the state of the significant explanatory variables that are binary. These results are calculated using Equation 5 presented in Appendix 3. The coefficients show that the likelihood of transmission would be increased by 5.4 percent if the scholars who do not base their research on qualitative methods decided to adopt qualitative methods. Similarly, the likelihood of the transmission of research knowledge to users would be increased by 5.9 percent if the scholars who do not use quantitative methods decided to base their research on such methods. Furthermore, the results of Table 4 also indicate that the likelihood of the transmission of knowledge to users would decrease by 3 percent if all the researchers who do not focus their research projects on the advancement of scholarly knowledge decided to do so.

Discussions and Implications

After researchers have decided to incur costs in actions and tasks to insure the utilization of their research results, they must choose a level of entry, that is, how many (if any) echelons of the ladder of knowledge utilization to climb. The choice of the number of echelons to climb in the ladder is one of the most critical decisions in knowledge utilization. The chosen level of echelons in the ladder of knowledge utilization determines the extent to which researchers incur costs in actions and tasks to insure the utilization of their research results by users outside the scholarly community, and the degree to which they succeed in insuring knowledge utilization.

The theoretical part of the article argues that as scholars attempt to climb the echelons of the ladder of knowledge utilization, the greater the costs they incur in actions and tasks required to insure utilization of knowledge. As for the empirical part of the article, it shows that, of the nine predictions tested, only Prediction 5 regarding the focus of research projects on users' needs does not find any support. All the other predictions (except those related to publication assets and funding of research from sources internal to universities) appear to be supported as researchers attempt to climb the echelon of

transmission. Predictions 2 and 6 were more fully supported. The receptivity of users to research (users' context) explained the ascent in the ladder of knowledge utilization from the no transmission echelon to the influence echelon. As for the importance of funding from sources external to universities, it explained the climb from the echelon of no transmission to the echelon of adoption. In short, the explanatory power of the theoretical predictions is very satisfactory when one attempts to explain the climb to the echelon of transmission, but much less satisfactory when one attempts to explain the climb to the higher echelons of the ladder of knowledge utilization.

Four explanatory variables (focus on advancement of knowledge, types of products, sources of funding, and publication assets) were derived from the technological model and they have performed poorly in explaining a climb up the ladder of knowledge utilization. If one accepts the internal funding variable, the other variables successfully explain the climb to the echelon of transmission but generally fail to explain a climb to the higher levels of the ladder of knowledge utilization. The variable related to external funding is the only one derived from the technological model that significantly explains a climb to higher echelons of knowledge utilization. As for publication assets, their increase augments the likelihood of climbing from the stage of cognition to that of reference and from the stage of effort to that of influence. In short, external funding and the number of publications are better predictors of a climb up the ladder of knowledge utilization than variables related to intrinsic attributes of science: types of methods used and focus on advancement of scholarly knowledge.

Two explanatory variables were derived from the economic model. The variable *focus on users' needs* totally failed to explain a climb up the ladder of knowledge utilization, whereas the variable *users' context* was a much better predictor by explaining a climb to the echelon of transmission, then from transmission to cognition, from cognition to reference, from reference to effort, and finally, from effort to influence. These results indicate that the context within which the users of research operate is a better predictor of climbing than the attributes of research such as measured by the indicator of focus of research projects on users' needs.

Contrary to theoretical predictions, the two explanatory variables derived from the institutional dissemination model, adaptation of products and dissemination efforts, were able to predict correctly the climb to the first echelon of the ladder but did not succeed well in explaining the climb to the higher echelons of knowledge utilization. Increased adaptation of products augments the likelihood of climbing from the stage of influence to that of application, whereas increased dissemination efforts augments the likelihood of climbing from the stage of cognition to that of reference. These mixed results

lead us to suggest that dissemination is a good predictor of transmission but not a good predictor of a climb to the higher echelons of knowledge utilization. These results have very important practical and theoretical implications.

Finally, the variable *linkage mechanisms* was derived from the social interaction model. The results indicate that it predicts correctly a climb to the stage of transmission and a climb from transmission to cognition, but that it fails to explain a climb to the higher echelons of the ladder of utilization of knowledge.

Overall, these results suggest that the crucial stage of knowledge utilization is the stage of transmission. We have found that nearly 30 percent of the scholars fail to climb the echelon of transmission and that seven variables—namely, types of research methods, focus on advancement of scholarly knowledge, external funding, users' context, adaptation of products, dissemination efforts, and linkage mechanisms—significantly explain the climb to the echelon of transmission. Likewise, we have found that only two variables significantly explain the climb to more than two higher echelons of the ladder of knowledge utilization: external funding and users' context. These results suggest that there are barriers to entry and that these barriers are primarily located between the stage of no transmission and the stage of transmission. These results carry theoretical and policy implications that need to be explored carefully.

Theoretical Implications

From a theory building standpoint, the results of this study suggest that a scholar who attempts to provide research results to users will have to make significant investments in acquiring skills, expertise, and know-how, and to support significant costs of customization that are tailored to one or a few users and not easily transferable to other situations of knowledge utilization. Therefore, as the activities and tasks organized by researchers to insure the utilization of their research results become more idiosyncratic, that is, require high levels of professional skills, specialized know-how, and customization, the specificity of the knowledge transferred increases and the number of potential users decreases. Consequently, the circumstances under which the utilization of knowledge is enhanced and the likelihood of climbing successfully up the echelons of the ladder of knowledge utilization is increased deteriorate into a situation of dependence of the scholars vis-à-vis the users that is yet to be understood. Indeed, the likelihood of utilization and the likelihood of climbing up the ladder of utilization theoretically take their maximum values when the scholars invest resources in the supply of idiosyncratic knowledge for one or a few users. The problem is that high investments in

idiosyncratic knowledge cannot be redeployed at low costs to insure utilization of research by other users. The extreme case would be one where a scholar would supply knowledge to a single user. What is needed is to build a theory that would explain knowledge utilization simultaneously by the largest possible number of users. Therefore, the modified barrier to entry approach appears to have some merit but deserves additional scrutiny. Furthermore, although the theoretical approach successfully explains a climb to the echelon of transmission, it does not explain very successfully the ascent to the higher echelons of the ladder. Therefore, further theoretical research is also needed to dig into the factors explaining why scholars are likely to climb or fail to climb the echelons of the ladder of knowledge utilization.

Public Policy Implications

The findings of this study bring some water to the mill of the public policymakers by pointing to factors that significantly explain the climb or the failure to climb through the different echelons of the ladder of knowledge utilization. Some of these factors are more easily amenable to interventions than others. Positive relative changes in attributes of research, users' needs, and dissemination and linkage mechanisms increase the likelihood of transmission of research results to users but do not generally increase the likelihood of climbing to the higher echelons of the ladder of knowledge utilization. The policy lesson that can be derived from this overall result is that policy makers should prioritize the creation of incentives fostering transmission. Furthermore, another policy lesson that can be drawn from the calculation of the partial elasticities is that policy makers should prioritize the development of measures targeting the receptive capacity of the users because they would have a greater impact on the likelihood of transmission than measures that would target dissemination, linkage, and funding factors. The fact that relative positive changes in the receptive capacity of users to research also increase the likelihood of climbing successfully five out of the six echelons of the ladder of knowledge utilization provides additional evidence supporting prioritization of the receptive capacity of users as a target for policy interventions. The fact that relative positive changes in importance of external funding contribute to increase the likelihood of an ascent through the first four echelons of the ladder of utilization of knowledge also suggests that policy makers should use the regulations of the funding agencies to send clear messages regarding activities and tasks that scholars should accomplish to insure the utilization of research. The fact that focusing of the research projects primarily on the needs of the users never explains an ascent in the echelons of the ladder of knowledge utilization suggests that policy makers should not

attempt to use this factor as a tool to increase climbing up the ladder of knowledge utilization. Overall, policy makers should invest more in the activities and tasks that scholars accomplish to customize their products to the needs of users, as well as receptive capacity of users, dissemination efforts, and linkage mechanisms if one seeks to increase the likelihood of climbing successfully the different echelons of the ladder of knowledge utilization. However, investments in this direction also imply that extremely customized research might decrease the number of its potential users.

Limitations and Suggestions for Future Research

This study suffers from some limitations worth pointing out. First, although the sample is rather large (1,229 scholars), it was not large enough to subdivide the researchers by discipline. Since the discipline is an important explanatory factor of utilization, future research on the ascent up the ladder of knowledge utilization should attempt to take this factor into account. Second, this study followed prior studies by employing a scale of knowledge utilization. However, rather than using the echelons of the ladder of knowledge utilization to construct an overall index of use of knowledge, we have tried to find factors explaining why researchers are able to climb the different echelons of the ladder of knowledge utilization. There is an increasing recognition that the idea of knowledge utilization must be desegregated into stages or other units. Such a desegregation has shown that factors such as dissemination and linkage mechanisms that are generally considered to be powerful explanatory factors and to be the most efficient targets for policy interventions are less important than factors such as the receptive capacity of users when one climbs from the stage of transmission to the higher stages in the ladder of knowledge utilization. Future research must recognize that the same factors do not explain success at all the stages of knowledge utilization. Third, the predictive power of the barriers to entry approach was quite satisfactory to explain the ascent to the echelon of transmission but much less so regarding the likelihood of climbing up to the higher echelons of the ladder of knowledge utilization. Future research should give some thought to improving the predictive power of this approach by including other types of costs.

Appendix 1
The Independent Variables Measures

The independent variables included in the explanatory model are measured as follows.

Types of Research Products

QUANP: Research products based on data analyzed using correlation or multivariate techniques (1 = correlation or multivariate techniques are usually or always used in research projects and 0 = otherwise).

QUALP: Research products based on case studies using qualitative data (1 = case studies using qualitative data are usually or always used in research projects and 0 = otherwise).

Researchers' Context

PUBA: Publication assets measured as the total number of articles, chapters of books, and books published during the past five years. The books were multiplied by 5.

KNOWF: Opinion of the researcher regarding the extent to which his or her projects are focused on the advancement of scholarly knowledge. Frequency of focus is measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*never focused on advancement of scholarly knowledge*), to 5 (*always*).

USERF: Opinion of the researcher regarding the extent to which his or her projects are focused on users' needs. Frequency of focus is measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*never focused on users' needs*), to 5 (*always focused on users' needs*).

FUNDI: Degree of importance of university funding for the realization of research projects during the past five years. The degree of importance is measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*negligible importance*), to 5 (*decisive importance*).

FUNDE: Degree of importance of external funding for the realization of the research projects during the past five years. The degree of importance is measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*negligible importance*), to 5 (*decisive importance*). Four sources of external funding were considered: (1) research councils (i.e., Social Sciences and Humanities Research Council of Canada), (2) not-for-profit organizations, (3) industry, and (4) ministries and government agencies. The index of degree of importance of external funding ranges from 0 to 20.

Users' Context

USERC: Perception of users' context measured as an index indicating the opinions of the researcher regarding six statements. The opinions are measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*disagree completely with the statement*), to 5 (*completely agree with the statement*). The six statements considered are as follows: (1) my research is considered pertinent by

practitioners and professionals, (2) my research coincides with the needs and expectations of practitioners and professionals, (3) there is a target public of practitioners comprising a receptive audience for the dissemination and use of my research results, (4) practitioners and professionals attribute credibility to my research results, (5) my research is oriented to take into account the needs of users, and (6) my research findings have reached users at just the right moment to be used. Therefore, this index ranges from 0 to 30.

Dissemination

ADAPP: Adaptation of products measured as an index of importance accorded by the researcher in adapting his research products for users. This index is composed of five cumulative dimensions that range on a 5-point scale of adaptation. Therefore, the index ranges from 0 to 25. The 6-point scale of adaptation ranges from 0 (*does not apply*), 1 (*negligible adaptation*), to 5 (*decisive adaptation*). The five dimensions are: (1) readability and use of comprehension of my reports and research articles; (2) specific, operational nature of conclusion or recommendation; (3) focus on variables that can be manipulated by users; (4) sensitivity to users' sensibilities; and (5) appeal of reports (graphics, color, humor, packaging).

DISSE: Dissemination effort measured by an index of importance accorded by the research to three types of activities of dissemination during the past five years. The importance of these activities is measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*negligible importance*), to 5 (*decisive importance*). The three categories of activities included are: (1) preparing and conducting meetings to plan the subject and scope of projects with users, (2) formal meetings to report on a study's progress or to discuss preliminary results with users, and (3) preparation and effectuation of research results dissemination activities among users. This index ranges from 0 to 15.

Interactions

LINKA: Intensity of linkages with users is measured as an index indicating the importance accorded by the researchers to different linkage mechanisms. The importance of the mechanisms is measured on a 6-point scale ranging from 0 (*does not apply*), 1 (*negligible importance*), to 5 (*decisive importance*). The eight linkage mechanisms considered are the following: (1) informal contacts with personnel and experts of government agencies; (2) informal contacts with personnel and experts of private organizations; (3) participation in committees, seminars, and workshops organized by government agencies; (4) participation in committees, seminars, and workshops organized by private organizations; (5) sending reports to ministries and government agencies; (6) sending reports to private organizations; (7) publication of articles in newspapers; and (8) participation in radio or television programs. Therefore, this index ranges from 0 to 40.

Appendix 2
Internal Reliability Coefficients (Cronbach's alpha) for Variables Including Multiple Item Scales

Name of Variable	*Number of Cases*	*Number of Items in Scales*	
Knowledge utilization (KU)	1,229	6	.89
Adaptation of products (ADAPP)	1,158	5	.74
Dissemination efforts (DISSE)	1,229	3	.85
Linkage mechanisms (LINKA)	1,084	8	.81
Users' context (USERC)	1,072	6	.91
Publication assets (PUBA)	1,229	3	.56
External funding (FUNDE)	1,041	3	.55

Appendix 3
Determination of the Impacts of Explanatory Variables in Logit Model of Climbing the Ladder of Research Utilization

The logistic function has the following form:

$$Z(X) = \frac{1}{\left(1+\exp\left(-\gamma_1 - \gamma_2 X\right)\right)}, \tag{1}$$

where X is the explanatory variable and γ_1 and γ_2 are parameters.

The first derivative of the function $Z(X)$ with respect to X permits to assess the marginal impact of the variable X:

$$\frac{\partial Z}{\partial X} = \frac{\gamma_2 \exp\left(-\gamma_1 - \gamma_2 X\right)}{\left(1+\exp\left(-\gamma_1 - \gamma_2 X\right)\right)^2}. \tag{2}$$

If $\gamma_2 > 0$, then $Z(X) > 0$. It means that the variable X has a positive impact on the $Z(X)$ and that a positive variation of X will increase $Z(X)$. However, if $\gamma_2 < 0$, then $Z(X) < 0$, which means that a variation of X results in a variation of $Z(X)$ in the opposite direction.

The partial elasticity for the variable X is given by the expression

$$\frac{\partial Z}{\partial X} \bullet \frac{X}{Z} = \frac{\left(\gamma_2 \exp\left(-\gamma_1 - \gamma_2 X\right)\right)}{\left(1+\exp\left(-\gamma_1 - \gamma_2 X\right)\right)} \bullet X. \tag{3}$$

The elasticity is also given by the expression

$$\frac{\partial Z}{\partial X} \bullet \frac{X}{\hat{Z}}, \tag{4}$$

where $\hat{Z}$ is the predicted value of Z.

The partial elasticities of binary variables cannot be obtained because the variables are not continuous. However, the impact of these variables can be assessed by considering to what extent the probability of success of the scholars to pass a given stage of knowledge utilization changes with or without the presence of these variables. In this case, one must compute for each of these variables the predicted value of Z for the group of cases where the variable takes the value 0 ($\hat{Z}_0$). Then the predicted value of Z is computed for the same group in assuming that the binary variable takes the value 1 ($\hat{Z}_1$). The percentage of change is obtained with the expression

$$\text{Percentage of variation} = \frac{\left(\hat{Z}_1 - \hat{Z}_0\right)}{\hat{Z}_0} \bullet 100. \tag{5}$$

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