



# Evaluating the Russian Forest Sector: Market Orientation and Its Characteristics

Wignall, J.B.

IIASA Interim Report  
October 2001



Wignall, J.B. (2001) Evaluating the Russian Forest Sector: Market Orientation and Its Characteristics. IIASA Interim Report. Copyright © 2001 by the author(s). <http://pure.iiasa.ac.at/6475/>

**Interim Report** on work of the International Institute for Applied Systems Analysis receive only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute, its National Member Organizations, or other organizations supporting the work. All rights reserved. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage. All copies must bear this notice and the full citation on the first page. For other purposes, to republish, to post on servers or to redistribute to lists, permission must be sought by contacting [repository@iiasa.ac.at](mailto:repository@iiasa.ac.at)



International Institute for  
Applied Systems Analysis  
Schlossplatz 1  
A-2361 Laxenburg, Austria

Tel: +43 2236 807 342  
Fax: +43 2236 71313  
E-mail: [publications@iiasa.ac.at](mailto:publications@iiasa.ac.at)  
Web: [www.iiasa.ac.at](http://www.iiasa.ac.at)

---

**Interim Report**

**IR-01-047**

**Evaluating the Russian Forest Sector:  
Market Orientation and Its Characteristics**

Jim Wignall ([jim.wignall@sympatico.ca](mailto:jim.wignall@sympatico.ca))

---

**Approved by**

Sten Nilsson  
Leader, Forestry Project

9 October 2001

---

*Interim Reports* on work of the International Institute for Applied Systems Analysis receive only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute, its National Member Organizations, or other organizations supporting the work.

## **Contents**

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>2</b>	<b>LITERATURE REVIEW</b>	<b>2</b>
<b>3</b>	<b>THE RUSCOMP DATABASE</b>	<b>4</b>
<b>4</b>	<b>METHODOLOGY: ROUGH SETS AND DISCRIMINANT ANALYSIS</b>	<b>5</b>
	4.1 Discriminant Analysis (DA)	7
	4.2 Rough Set Analysis (RS)	8
<b>5</b>	<b>RESULTS</b>	<b>11</b>
<b>6</b>	<b>SUMMARY OF THE ANALYSIS</b>	<b>13</b>
	6.1 Market Oriented Firms	13
	6.2 Planned Economy Firms	13
<b>7</b>	<b>CONCLUSIONS</b>	<b>13</b>
	<b>REFERENCES</b>	<b>14</b>

## **Abstract**

This paper deals with the analysis of data coming from the RUSCOMP database. The purpose of this analysis is to identify those characteristics of Russian forestry firms that are perceived to be important for a firm's market orientation. The two orientations of particular interest are market-focused orientation, where the firm is responsive to its market's needs, and planned economy orientation, where the firm relies on non-market relationships.

Analysis was conducted using two methods, discriminant analysis and rough sets methodology. Both methods attempt to discover relationships in data that includes observations divided into homogeneous classes described by a set of attributes. Discriminant analysis proved less successful in describing the data, with only 41% of the cases being correctly classified. Rough set analysis provided better results and when applied to a dataset described by a reduced set of the attributes, it correctly evaluated 52% of the cases. The paper describes how a reduced set of the attributes was derived and also evaluates different possible options of such a reduction. In the last stage of the evaluation, decision rules with appropriate characteristics were generated and subsequently analyzed in order to extract knowledge statements allowing for the identification of the factors that contribute to a forestry firm market orientation.

In summary, the analysis indicated that market-oriented firms rely on cash-based transactions to acquire their raw materials and do not experience significant supply problems. They also export a large portion of their finished goods. They are being paid for their services, as opposed to receiving barter credits, and engage in formal arrangements. In their business dealings these firms are avoiding a reliance on relationships in favor of the market-based mechanisms.

In contrast, planned economy firms often rely on barter. They experience problems with timber supply that are most likely related to cash flow problems. Their primary market is a domestic one, where it is easier to engage in informal arrangements based on relationships.

## **Acknowledgments**

The author gratefully acknowledges the support of the Forestry Project at IIASA for providing the data used for analysis. Lars Carlsson, Nils-Gustav Lundgren, and Mats-Olov Olsson encoded the data and performed calculations of the Gadicke indices, as well as provided support in understanding the underlying research and the attributes used. Szymon Wilk, of the Poznan Institute of Technology in Poznan, Poland, conducted the computations for the rough set portion of the analysis. Wojtek Michalowski, of the University of Ottawa in Ottawa, Canada, provided invaluable supervision and guidance. This research was partially supported by the Natural Sciences and Engineering Research Council of Canada (NSERC).

## **About the Author**

Jim Wignall graduated from Carleton University in Ottawa, Canada with a Bachelor of Commerce Degree. He is currently employed by ALSTOM Canada Inc. as a Principal Technologist, and is enrolled in the Master of Management Studies program at Carleton University.

# Evaluating the Russian Forest Sector: Market Orientation and Its Characteristics

Jim Wignall

## 1 Introduction

In the past decade there have been dramatic changes in the Russian political structure. These changes were accompanied by a movement, on the part of some firms, toward a market-based operation from the former centrally planned economy. To encourage and sustain that movement it is necessary to know what distinguishes firms that are making that adaptation to new conditions from firms that are not. The ultimate expectation is that by identifying the characteristics that distinguish the two types of firms, an institutional framework can be established to encourage the transition of Russian firms towards a market-oriented operation. The establishment of such institutional framework is beyond the scope of this study.

The scope of this paper is to describe the analysis of data that attempts to identify those characteristics of the firms that are perceived to be important for market orientation. Moreover, this study is focused on one sector of the Russian economy — namely the forestry sector. The analysis presented in this paper relies on the data gathered from 245 interviews with forestry managers from across Russia, and in a variety of forestry related businesses, that were conducted under the auspices of IIASA's Forestry Project. The information from the interviews was encoded in the RUSCOMP database. This information included descriptions of the firm, its products, suppliers, and customers.

Social scientists at IIASA (Carlsson *et al.*, 2000) utilized several of the attributes from the database to create a measure of the firm's operation in relation to market oriented or centrally planned focus. This measure, the GADICKE attribute (Gaddy and Ickes, 1998), assigns the firm into one of four classes, based on the firm's distance to the market and its level of relational capital. Distance to the market is described as the combination of a firm's geographic distance to its potential markets, and the degree to which its practices are consistent with a market oriented operation. Relational capital is a measure of the goodwill the firm has created with suppliers, customers, employees, and government officials expressed as a relaxation of the usual business requirements, such as cash payment for wages, taxes, and supplies. The combination of High and Low values for each of these two measures defines the four classes mentioned above.

A firm is considered to be market oriented if it has a "low" distance to the market, i.e., is responsive to its market's needs, and is not reliant on non-market relationships with business associates or officials to be successful.



A firm is considered to be oriented toward a planned economy if it relies on non-market relationships rather than tending toward market driven principles. The distance to the market will be “high” for these firms, making it difficult for them to operate in a market economy.

## 2 Literature Review

As a part of the literature review, a number of agencies were approached in order to learn about their expertise in motivating a change in a firm’s market orientation. These included the European Union’s European Commission, the World Bank (WB), the International Monetary Fund (IMF), and the Canadian Government and its agencies; in particular, the Department of External Affairs, and the Canadian Industrial Development Agency (CIDA). These organizations have an interest in the changes taking place in Russia, either as institutional stakeholders or loan guarantors. Despite such involvement in a transformation of the Russian economy and a financial exposure, these organizations did not conduct specific studies on the transition of Russian firms towards a market economy. There has been research conducted to examine the changes in other countries, but not in Russia. These studies point toward some of the factors identified as significant to the success of change management in those regions.

One of the studies, by Gaddy and Ickes (1998), deals specifically with restructuring in Russia. It examines why all firms have not changed from an operation more appropriate in a planned economy to an operation more consistent with a market economy. Their paper describes how some firms are restructuring to reduce the “distance to the market,” while others are exploiting “relational capital” to survive without restructuring. The paper examines the implications of this behavior with reference to monetary policy and intergovernmental relations.

Another paper that deals with the changes in Russia was researched at IIASA (Carlsson, *et al.*, 2000). This paper looks at why, after ten years of transition, forestry production in Russia is at lower levels than before the transition began. The conclusion presented is that the lack of a tradition of privately owned commodity producing firms and the lack of a powerful middle class contributes to such a situation.

The economists from the WB also studied economic transitions of several countries around the world. Some of their research focused on shifting responsibilities for social services (Sewell, 1997). This provision of services is a factor in the behavior of firms that utilize relational capital. In the past, this provision of social services was considered a domain of firms in a planned, centralized economy. In the current free market economy this feature of a firm may be a less reliable indicator. With inflation driving up prices in the face of frozen or declining wages, social benefits may become a reasonable incentive, for any firm, to attract and keep workers.

Several factors analyzed in the WB studies are also used as characteristics of the firms considered in this study. One of these factors is the existence of obstacles to doing business (Brunetti *et al.*, 1997a). The perception of obstacles is considered to be a characteristic of forestry firms. Another factor is associated with the conditions necessary for reform to succeed (World Bank, 1998a). The WB study attempted to

identify attributes that can indicate if a country's political conditions are favorable for reform to take place. The study was intended to help the bank tailor programs to individual countries, based on their readiness for reform, and it parallels the Forestry Project in its attempt to identify the characteristics of a market oriented firm.

Expanding on this theme, the WB surveyed 3,600 firms in 69 countries worldwide to develop cross-country indicators of "institutional uncertainty" (World Bank, 1998b). The study highlighted the need for a reliable institutional framework for doing business and provided a way to measure the reliability of institutions on a cross-country basis. The motivation for this current research is a need for the studies leading towards the establishment of a reliable institutional framework. The knowledge of characteristics that differentiate market oriented firms from planned economy firms will provide important information for the creation of a Russian institutional framework that encourages market oriented behavior by firms.

The WB has also conducted a study of 20 economies in transition (Brunetti *et al.*, 1997b). This publication provided an alternate framework for investigating the performance of an economy. The study looked at five factors that indicate the stability of the institutional framework of the economy. These factors are the predictability of rules, political stability, the security of property rights, the reliability of the judiciary, and the lack of corruption. It investigated whether these factors can explain differences in economic performance.

On the national level, the WB has conducted studies of countries that were under Soviet influence or control. Among others, the reform of the Polish economy was analyzed (Montes-Negret and Papi, 1997). The Polish program involved the restructuring of enterprises at the same time that the banks were restructured. The banking sector has been successfully revitalized, and enterprises seem to be as well. This study highlighted the importance of reforming the banking sector to enable it to support reforms in the business and industrial sectors.

Another study compared medium-sized firms in the Czech Republic, Hungary, and Poland. According to the findings, private ownership dramatically improved corporate performance (Frydman *et al.*, 1997). Outside ownership, by owners not previously involved in the business operation, was more successful, when measuring performance, than any form of inside ownership, whether by former managers or workers. With inside ownership, the firm's performance under management ownership was dramatically better than under worker ownership. Worker ownership offered no performance improvement over state ownership. Foreign ownership was not significantly better than domestic "outsiders'" ownership. Increased revenue generation, rather than success at cost cutting, was found to be the reason the reformed firms were able to sustain or increase employment. This WB study indicated that, in Eastern European countries, the type of ownership might affect a firm's long-term success and viability. The analysis described in this paper may indicate whether this has an effect on the market orientation of forestry firms in Russia. Moreover, our study is one of the few that deals with individual firms.

Finally, the WB looked at aspects of the transition by Russia itself, in contrast to other European countries. One study pointed out that Russia is different from other Eastern

European countries (Denizer, 1997) because the other countries implemented political reform before economic reform. They also achieved a faster economic reform, in part, because they had the goal of applying for membership to the European Union. The Former Soviet Union (FSU) republics stayed connected to Russia, and they remain enmeshed in socialist politics.

In summary, most existing research focuses on economies as a whole rather than individual firms within those economies. In addition, that research has examined countries other than Russia. What little existing research that has been done on Russia examines the behavior of Russian firms in general. What is currently missing are studies of the transition of Russian firm's from a centrally planned economy to a market oriented economy. This current study will help fill that void by looking at the characteristics of individual firms in the Russian forestry sector.

### **3 The RUSCOMP Database**

The original RUSCOMP database was created as a result of the interviews with managers of Russian forestry enterprises. It was comprised of 245 records (corresponding to the individual enterprises), each described by 109 attributes.

As IIASA's Forestry Project is focused, among others, on the sustainable use of Russian forest resources, the analysis described here deals only with firms directly engaged in forestry operations. Thus, firms that provided consulting services as well as forestry research institutes were eliminated. Firms that were highly specialized, such as the firm producing reproduction wooden ships, were also removed. The resulting RUSCOMP database used in the analysis reported here contained information on 214 firms.

Prior to the analysis described in this paper, values for the attributes were developed from the interview information. The individual attributes were examined to determine suitability for inclusion in the analysis. Some attributes did not relate to the actual firm or were of highly subjective character. Other attributes contained similar or duplicate information. Still others contained too few cases to contribute significantly to the analysis. Moreover, the attributes of a hierarchical structure were decomposed to the simplest elements. And finally, some attributes were used to create the index values for distance to the market and relational capital and were therefore correlated with the indices. A more detailed description of the evaluation of the original attributes is as follows:

- The attributes that are not related to the description of the firm were eliminated as well as the attributes that described geographical location. Examples include the attributes that represent the respondent's position and the region where the firm operates.
- Production was described by a variety of attributes. Collectively, the attributes provided the needed information to calculate the distance to the market and relational capital indices. These attributes were eliminated from the analysis.

- Some attributes such as OPERATE, which indicates that the firm is still in operation had the same value for most cases. COUNTRY, which indicates the country in which the firm operates, had the same value for all cases. Both attributes were eliminated.
- Attributes MAINP, MAINP1, MAINP5, MAINP10 describe the main product of the firm at the time of the interview, as well as the prior 1, 5 and 10 years. Less than 10% of the firms reported a change during this period, so only the attribute describing the current firm's production was used.
- Some attributes such as OTHOBSTA and FORMLEG1 describe opinions of the interviewee that were unrelated to the firm's characteristics and were omitted from further analysis.
- INVESTM is an attribute indicating whether or not a firm invests in its operation. INVTYPE indicates the type of investment, with one choice being "No investment". INVESTM and other attributes with a similar pairing were eliminated.
- Any attributes that were directly used in calculating the values of the GADICKE index and those that were collinear with some other attributes were not considered.
- Finally, the attributes that had more than 71 missing values were also eliminated.

As a result, 88 attributes were eliminated from the analysis and the modified RUSCOMP database contained information on 214 firms described by 21 attributes. Table 1 includes information on all the attributes used and their description.

#### **4 Methodology: Rough Sets and Discriminant Analysis**

As mentioned, the purpose of the study is to identify the characteristics (attributes) of a forestry firm that are associated with its market orientation, as measured by the GADICKE index. There are several possible approaches to address this problem. We decided to focus on two — the Rough Sets (RS) and the Discriminant Analysis (DA). Both methods deal with the classification problems where homogenous classes are described by a set of the attributes. DA was selected because it is one of the traditional methods used for multi-variate analysis. RS was selected because it allows analysis where the data contains imperfectly balanced cases between the classes and does not require rigorous assumptions regarding variables' distribution. The results of the application of these two analytical methods have been compared by Krusinska *et al*, (1992) and Browne *et al*, (1998). These both studies report that in ideal situation the two methods produced approximately the same results, supporting our choice of a methodology.

Table 1: Attribute names and descriptions.

Attribute Code	Description	Values for the Attribute
LEGSTAT	The form of incorporation or type of organization.	There are 14 values of this attribute describing types of firms and forms of incorporation.
TIMBSUP	Major source of timber supply.	State, private, company, mixed [a combination of state and private sources].
TETIMAQU	Terms of timber acquisition.	Stumpage, long-term contract, short-term contract.
ALTSUPP	Alternative supply of timber. Is there a backup supply of timber not currently utilized?	Yes, no.
EXPLSHOR	Explanation of shortage. What is the reason for any shortage in supply?	Financial, legislation, technology, disorder.
PAYTIMB	Payment for timber/raw materials. What is the method of payment for the supply of timber?	Cash on/before/after delivery, barter.
BROKBUY	Violation of buying agreement. A measure of the magnitude of the problem of broken buying agreements.	Large, small, none.
BUYFORM	Buying transaction formalities.	Written, oral.
CUSTOMER	Customers for products.	Private, company, state.
EXPMARK	Most important export market.	Europe, Asia, North America, no export.
HOMEMARK	Most important home market.	Region, rest of Russia, both.
SALEFORM	Form of sales transaction agreement.	Contract, oral.
BROKSELL	Violation of selling agreements. Magnitude of the problem of broken selling agreements.	Large, small, none.
PAYSELL	Terms of Sale. What is the method of payment for sales of the product?	Cash on/before/after delivery, barter.
IMPOBST	Most important obstacle to doing business.	Taxes, legislation, enforcement of business legislation, finding market/dealing with competition, no obstacles.
TOTEMP98	Total employment 1998/99 (current employment at the time of the survey.)	1–25, 26–100, 101–200, 201–500, 500+.
ACTIVITY	Main activity of firm.	Forest management, Harvesting, Sawmill/process, Pulp/paper, Trading/consult, Sawmill/harvesting, etc.
EXPCAT	Export share category.	None, less than 40%, more than 40%.
ESTABLIS	“Era” company established	Before 1947, between 1947 and 1989, after 1989.
BACK1	Background of the firm.	State, old private, new private, joint venture.
GADICKE	Gaddy-Ickes Space [Decision Variable]. 2 x 2 matrix based on “Distance to the Market” and “Relational Capital”.	Values are: 1. Low/Low (market oriented) 2. Low/High (either market environment) 3. High/High (planned economy) 4. High/Low (unlikely to succeed).

#### 4.1 Discriminant Analysis (DA)

DA is used to build a predictive model that will assign a case (forestry firm) into specific class (identified through the GADICKE index) considering the attributes of the firm. In this analysis we are looking for those attributes of the firms that will predict whether or not the firm has specific market orientation. Rather than building a classification model, we are using DA to identify those attributes that are the most “discriminant.”

The DA generates a number of sets of values, each representing coefficients in a discriminant function for all the attributes. The number of these sets is limited by the degrees of freedom of the dependent variable, in this case the GADICKE index. Because there are 4 classes according to the GADICKE index, there are (n-1) or 3 sets of attributes that are used to create discriminant functions. For each set, the following steps are taken. The Standardized Canonical Discriminant Coefficients and Structure Coefficients for each attribute are multiplied together to produce Discriminant Ratio Coefficients (DRCs) (Thomas, 1992). A subset containing the largest positive DRCs is selected. These DRCs are a measure of the relative importance of each corresponding attribute. When added together, they indicate the amount of correlation between this sub-set of attributes and the GADICKE index. That is a measure of their ability to distinguish between the firms in each of the classes. The discriminant function consists of this set of DRCs and their associated attributes.

With this data, the correlation between the subsets of attributes and the GADICKE index value is between 60% and 76%. The subsets of attributes used to build the discriminant functions in this study are given in Table 2.

Table 2: Reduced sets of the attributes for the discriminant functions.

<b>Set 1 Attributes</b>	<b>Attribute Coefficient</b>
BROKBUY	0.237
PAYTIMB	0.186
EXPCAT	0.175
ALTSUPP	0.135
Explanation = 73.3%	
<b>Set 2 Attributes</b>	
BROKBUY	0.265
EXPMARK	0.247
EXPCAT	0.091
Explanation = 60.3%	
<b>Set 3 Attributes</b>	
ESTABLISH	0.406
TIMBSUP	0.139
TOTEMP98	0.127
BUYFORM	0.095
Explanation = 76.7%	

As a further test, validation testing was performed to determine how well the functions were able to classify the forestry firms (cases) into the 4 index classes. When classification testing was performed using the non-missing pooled classification, only 51% of the original grouped cases were correctly classified using this subset of attributes. Further, when cross-validation testing was performed, only 41% of the grouped cases were correctly classified. This result is not satisfactory, so the alternate analytical method, RS, was tested.

## 4.2 Rough Set Analysis (RS)

The RS theory, its mathematical foundations, basic concepts, and the applications are described, amongst others, in Lin (1997), Pawlak (1991), and Slowinski (1992) and was used to analyze the data described in this paper.

The RS theory is based on the observation that it is very difficult to properly describe the characteristics of a problem while relying on imprecise information about the values of the problem's attributes (here, they are descriptions of business transactions and the business environment). In other words, imprecise information causes indiscernability of the firms' groupings into market oriented and planned economy classes in terms of information available from the interview data. The RS theory provides a powerful tool to identify a minimal subset of attributes — a reduct, which gives a satisfactory description of a decision problem. In this paper we describe an application of the RS theory to identify a reduct enabling the classification of a firm as either market oriented or planned economy.

Application of the RS to the RUSCOMP database, resulted in 2,045 reducts, with a core (set of the attributes common for all reducts) that is empty. Since there was no core, we were required to use an alternative approach to find the most significant attributes. This resulted in the identification of a so-called pseudo-reduct. The pseudo-reduct will allow us to identify those attributes of a firm that most contribute to its evaluation in terms of market orientation.

We applied a multi-step approach consisting of:

- Generating decision rules;
- Selecting the best rules for each class; and
- Extraction of the decision attributes.

In the first step, all available attributes were used to generate the decision rules by the LEM2 algorithm following Grzymala-Busse (1992). A set containing 74 rules was generated.

In the next step, the rules were ranked and the best rules for each class were chosen. The rule was considered as the best if it was the strongest one for a given class, where strength is measured by the number of cases in that class to which the rule applies divided by the total number of cases in that class. If there was more than one rule with maximum strength, all of them were selected. The “best” selected rules for each of the classes are presented in Table 3.

Table 3: The best decision rules.

#	Rule	% Strength
1	if (PAYTIMB = 1) and (BUYFORM = 1) and (CUSTOMER = 2) and (PAYSELL = 1) then (GADICKE = 1)	16.4
2	if (ALTSUPP = 2) and (BROKBUY = 3) and (EXPCAT = 3) and (ESTABLIS = 1) then (GADICKE = 2)	16.1
3	if (BROKBUY = 1) and (PAYSELL = 5) then (GADICKE = 3)	17.2
4	if (PAYTIMB = 20) and (EXPMARK = 19) and (ACTIVITY = 1) and (ESTABLIS = 1) then (GADICKE = 4)	15.6
5	if (EXPLSHOR = 20) and (CUSTOMER = 2) and (EXPMARK = 19) and (HOMEMARK = 1) and (ESTABLIS = 1) then (GADICKE = 4)	15.6

In a last step, the attributes from the condition part of the best rules were extracted to form a pseudo-reduct (so-called best pseudo-reduct). This provides a starting point to search for the reduct containing the most significant attributes. The attributes in the pseudo-reduct generated from the best rules are presented in Table 4.

Table 4: The best pseudo-reduct.

#	Attribute	# of occurrences in the best rules
1	ACTIVITY	1
2	ALTSUPP	1
3	BROKBUY	2
4	BUYFORM	1
5	CUSTOMER	2
6	ESTABLIS	3
7	EXPCAT	1
8	EXPLSHOR	1
9	EXPMARK	2
10	HOMEMARK	1
11	PAYSELL	2
12	PAYTIMB	2

All 2,045 reducts generated by the RS were evaluated in order to find those reducts that included all the attributes from the best pseudo-reducts. Unfortunately, there were no such reducts. Thus, the set of reducts was searched once more to find reducts that had the largest number of attributes common with the best pseudo-reduct (or in other words, that had the largest intersection with the best pseudo-reduct). There were three such reducts — two containing 10 attributes, and one containing 11 attributes. The longer reduct was not considered further. This led to the identification of two reducts (denoted as the best reduct #1-1 and the best reduct #1-2, respectively). Both reducts contain 9 out of 12 attributes from the best pseudo-reducts.



The set of all reducts was then searched in order to find reducts that included all the attributes from the best pseudo-reducts except CUSTOMER and ESTABLISH, because these two attributes have the same value in the rules pointing towards more than one class. Since these attributes provide no discrimination between these classes, they can be eliminated without reducing the quality of the classification. Unfortunately, there were no such reducts. The whole set of reducts was searched once more to find reducts that had the largest number of attributes common with the best pseudo-reduct, again excluding the CUSTOMER and ESTABLISH attributes. There were 7 such reducts — two containing 9 attributes, three containing 10 attributes, and two containing 11 attributes. Only the shortest reducts were retained (denoted as the best reduct #2-1 and the best reduct #2-2, respectively). Both reducts contain 8 out of 12 attributes from the best pseudo-reducts.

The analysis of the RUSCOMP database was continued in order to distinguish a shortlist of the attributes, considering their different properties. Thus, the set of all reducts was searched to find the reduct that minimized the number of attributes. There was one such reduct (denoted as atom reduct) containing 8 attributes. Also we tried to identify which of the attributes appear most frequently among the 2,045 reducts.

First, the frequencies of attributes in all reducts were calculated. Then, the set of reducts was examined to find the reduct that contained the largest number of the most frequent attributes. There was one such reduct (denoted as beta reduct) containing 8 attributes. Next, we proceeded to evaluate relationships between a set of the attributes identified with the help of DA and the information provided by the RS. We started by combining the condition attributes used by the discriminant functions and formed a DA pseudo-reduct. The DA pseudo-reduct contains 9 attributes. Then, the set of all reducts was searched to find the reduct that included all the attributes from the DA pseudo-reduct. There was no such reduct. The set was searched again to find the reducts with the largest intersection with the DA pseudo-reduct. There was one such reduct (denoted as DA reduct). It contains 10 attributes, from which 8 come from the DA pseudo-reduct. The results of all the analysis described above are summarized in Table 5.

## 5 Results

Table 5: Selected reducts and pseudo-reducts.

#	Attribute Code	best pseudo-reduct	best reduct #1-1	best reduct #1-2	best reduct #2-1	best reduct #2-2	atom reduct	beta reduct	DA pseudo-reduct	DA reduct
1	ACTIVITY	✓	✓	✓	✓	✓				
2	ALTSUPP	✓	✓	✓	✓	✓			✓	
3	BACK1						✓			
4	BROKBUY	✓	✓	✓	✓	✓	✓		✓	✓
5	BROKSELL						✓	✓		✓
6	BUYFORM	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	CUSTOMER	✓	✓	✓				✓		
8	ESTABLIS	✓							✓	✓
9	EXPCAT	✓	✓			✓	✓		✓	✓
10	EXPLSHOR	✓			✓	✓		✓		
11	EXPMARK	✓	✓	✓	✓	✓		✓	✓	✓
12	HOMEMARK	✓		✓	✓					
13	IMPOBST						✓	✓		
14	LEGSTAT									
15	PAYSELL	✓	✓	✓	✓	✓		✓		
16	PAYTIMB	✓	✓	✓			✓		✓	✓
17	SALEFORM									
18	TETIMAQU		✓	✓	✓	✓	✓	✓		✓
19	TIMBSUP								✓	✓
20	TOTEMP98								✓	✓

These reducts were then used to generate classification rules. Once the rules were generated, validation tests for their classification accuracy were conducted. Two types of validation tests were used: 10-fold cross-validation, and leaving-one-out.<sup>1</sup>

In both cases the LEM2 algorithm was used to generate decision rules. The results of the validation tests are presented in Table 6.

<sup>1</sup> Cross-validation involves randomly selecting part of the data set for hold out. The selected part of the data is not used to develop a classifier (either discriminant function or set of rules). The hold out data is then used to test the predictive accuracy of a classifier. It is classified and the results are compared with actual class membership in order to derive a measurement of the quality of classification. 10-fold cross-validation involves repeating this process 10 times. In the leave-one-out classification, each case is first removed from a training data and subsequently classified by the classifier. This is also known as the “U-method.”

Table 6: Rough sets: accuracy of classification: validation tests.

#	Subset of Attributes	% Accuracy	
		10-fold Cross-Validation	Leaving-One-Out Test
1	All condition attributes	42.55 ± 8.30	42.52
2	best pseudo-reduct	52.75 ± 10.50	49.53
3	best reduct #1-1	47.10 ± 6.67	46.73
4	best reduct #1-2	47.53 ± 10.00	48.60
5	best reduct #2-1	45.65 ± 13.16	46.26
6	best reduct #2-2	42.53 ± 6.67	45.33
7	atom reduct	43.48 ± 6.78	45.79
8	beta reduct	43.01 ± 9.86	42.06
9	DA pseudo-reduct	45.32 ± 7.69	43.93
10	DA reduct	46.77 ± 7.69	42.06

For all tests, the highest classification accuracy was achieved for best pseudo-reduct (i.e., a set of attributes containing all the attributes that appeared in the best rules). Also, in both cases, the second best choices were achieved for the reducts containing attributes from the best pseudo-reduct (best reduct 1-1 and best reduct 1-2). This analysis suggests that the best reduced set of the attributes, to be used for evaluating market orientation by a forestry firm, should be derived from the best pseudo-reduct. This set contains the attributes listed in Table 7.

Table 7: Attributes in best pseudo-reduct.

Attribute
ACTIVITY
ALTSUPP
BROKBUY
BUYFORM
CUSTOMER
ESTABLIS
EXPCAT
EXPLSHOR
EXPMARK
HOMEMARK
PAYSELL
PAYTIMB

The DA functions were only able to correctly classify in 41% of the cases during cross-validation testing. Results of the RS cross-validation testing indicate the best pseudo-reduct correctly classified only 52.75% of the cases. This is not much better. However, interview data is very difficult to analyze, and the less stringent data requirements for

RS analysis make it the preferred approach. The results from the RS analysis also seem more robust in light of the data available.

## **6 Summary of the Analysis**

The classification rules that are further used to interpret the features of a firm's market orientation are based on the attributes coming from the best pseudo-reduct. These rules are being interpreted in order to derive the descriptive statement about the factors used to describe market orientation. These descriptions are given below for only two classes of the greatest interest, namely a Market Oriented ( $GADICKE = 1$ ) class and a Planned Economy ( $GADICKE = 3$ ) class.

### **6.1 Market Oriented Firms**

- In general, these are the firms that transact business in cash, instead of barter or other forms of credit. These firms do not have timber supply problems as they have either an adequate supply from their primary source or they have an alternate source that provides the balance of raw material needs. The bulk of production is being exported with a small fraction sold domestically.
- They adhere to formal business practices characterized by written agreements signed by both parties.

### **6.2 Planned Economy Firms**

- These are older, state-owned firms that were typically established before 1947 and may be newly privatized. They focus primarily on local and domestic markets.
- They arrange payments either in cash or in barter. They experience supply problems created by the lack of purchasing agreements or the violation of those that do exist.

## **7 Conclusions**

The aim of this study was to attempt to identify characteristics that distinguish market oriented firms from planned economy firms. This identification is needed to aid in establishing an institutional framework that encourages the transition of firms toward market-oriented operations.

In summary, market oriented firms use business practices that are consistent with a formal business environment while planned economy firms use business practices that are most effective in an informal business environment.

Following our findings it is clear that, if an institutional framework is to foster market oriented behavior, it must create an environment where formal business practices are encouraged and firms benefit from engaging in these practices.

Organizations such as the WB or the IMF may use information from the studies like this one while tailoring their economic programs for specific sectors of the economies in transition. This study has identified some firm's characteristics that contribute to specific market orientation, and encouraging a firm's behavior along the lines described by these characteristics will lead to the establishment of solid foundations for a firm's transition towards operation according to the principles of a free economy.

## References

- Browne, C., I. Duntsch and G. Gediga (1998). IRIS Revisited: A Comparison of Discriminant and Enhanced Rough Set Data Analysis, Rough Sets. In: L. Polkowski and A. Skowron (eds.) *Knowledge Discovery*, Vol. 2, Physica Verlag, 345–368.
- Brunetti, A., G. Kisunko and B. Weder (1997a). Institutional Obstacles for Doing Business: Data Description and Methodology of a Worldwide Private Sector Survey. World Bank Discussion Paper No. 1759, The World Bank, Washington DC, USA.
- Brunetti, A., G. Kisunko and B. Weder (1997b). Institutions in Transition: Reliability of Rules and Economic Performance in Former Socialist Countries. World Bank Discussion Paper No. 1809, The World Bank, Washington DC, USA.
- Carlsson, L., N.-G. Lundgren and M.-O. Olsson (2000). Why is the Russian Bear Still Asleep After Ten Years of Transition? Interim Report IR-00-019. International Institute for Applied Systems Analysis, Laxenburg, Austria.
- Denizer, C. (1997). Stabilization, Adjustment, and Growth Prospects in Transition Economies. World Bank Discussion Paper No. 1855, The World Bank, Washington DC, USA.
- Frydman, R., C.W. Gray, M. Hessel and A. Rapaczynski (1997). Private Ownership and Corporate Performance: Some Lessons from Transition Economies. World Bank Discussion Paper No. 1830, The World Bank, Washington DC, USA.
- Gaddy, C. and B.W. Ickes (1998). To Restructure or Not to Restructure: Informal Activities and Enterprise Behavior in Transition. Unpublished manuscript.
- Grzymala-Busse, J.W. (1992). LERS — A System for Learning from Examples Based on Rough Sets. In: R. Slowinski (ed.) *Intelligent Decision Support*, Kluwer Academic Publishers, 3–18.
- Krusinska, E., R. Slowinski and J. Stefanowski (1992). Discriminant versus Rough Sets Approach to Vague Data Analysis. *Applied Stochastic Models and Data Analysis*, 8, 43–56.
- Lin, T. (1997). Fuzzy Controllers: An Integrated Approach Based on Fuzzy Logic, Rough Sets, and Evolutionary Computing. In: T. Lin and N. Cercone (eds.) *Rough Sets and Data Mining*, Kluwer Academic Publishers, 123–139.
- Montes-Negret, F. and L. Papi (1997). The Polish Experience with Bank and Enterprise Restructuring. World Bank Discussion Paper No. 1705, The World Bank, Washington DC, USA.

- Pawlak, Z. (1991). *Rough Sets: Theoretical Aspects of Reasoning about Data*. Kluwer Academic Publishers.
- Sewell, D. (1997). Shifting Responsibility for Social Services as Enterprises Privatize in Belarus. World Bank Discussion Paper No. 1719, The World Bank, Washington DC, USA.
- Slowinski, R. (ed.). (1992). *Intelligent Decision Support. Handbook of Applications and Advances of the Rough Set Theory*. Kluwer Academic Publishers.
- Thomas, D. (1992). Interpreting Discriminant Functions: A Data Analytic Approach. *Multivariate Behavioral Research*, 27, 335–362.
- World Bank (1998a). Political Credibility and Economic Reform. World Bank Discussion Paper No. 681–85, The World Bank, Washington DC, USA.
- World Bank (1998b). Cross-Country Indicators of Institutional Uncertainty. World Bank Discussion Paper No. 680–51C, The World Bank, Washington DC, USA.