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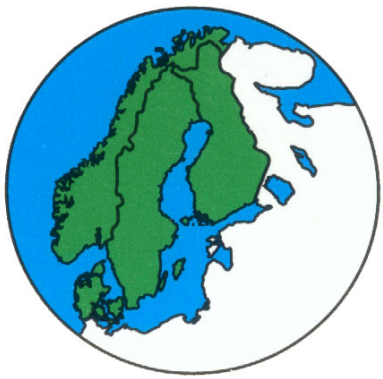

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The Role of National Culture and Environmental Awareness in Recovery and Utilization of Recycled Paper

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Abstract
This paper explores how national culture and environmental awareness affect the recovery and utilization of recovered paper on country level. We extent models of previous studies by including a wide array of "softer" country level factors, e.g. Hofstede's cultural dimensions and diffusion of ISO 14001 certificates. Our models are tested on panel data from 22 leading paper-producing countries in 1995-2008. Our empirical results further confirm the roles of geographical, demographic and essentially economic determinants but we are also able to empirically demonstrate that cultural characteristics and concern for the environment play a significant role.

1. Introduction

The global demand for recycled paper in paper and board production has been in continuous growth during the past decades. Regionally, growth in the demand for paper and paperboard is shifting from Europe and North America to Asia, causing changes in national level utilization of recovered paper. Global production increase of wood pulp has during the 2000s not matched that of paper and paperboard (over 15% change between 1999 and 2006), reflecting gains in rates of paper recycling and the continuing rise in the use of recovered fiber and decreasing use of fresh wood fiber in paper production (Suomalainen, 2008).

According to the FAO ForeSTAT database, the use of recycled paper nowadays globally exceeds the use of wood pulp as a raw material. This development has been boosted by technological progress and especially by

good price competitiveness of recycled fiber. Recovered paper is cheaper than wood pulp even in periods of high prices. Also the environmental awareness – at both the producer and consumer ends – and regulation has influenced the demand for recycled paper (see e.g. Lundmark, 2001; Huhtala and Samakovlis, 2003; Samakovlis 2003; Berglund and Söderholm, 2003b).

In using recycled materials, natural resources are saved, emissions reduced and the burden on solid waste reduced (van Beukering and Bouman, 2001), so there are many positive aspects involved in the growth of recovered paper utilization. However, allocation of recycling benefits between virgin and recovered fibres is a difficult question, as also recently indicated by Laurijssen et al. (2010) in analysing CO2 and energy impacts of paper recycling in the Netherlands.

In this paper we explore whether national culture and indicators of environmental awareness at country level, such as the diffusion of environmental management systems, play a significant role in country's recycled paper recovery and utilization rates. We extend two econometric models introduced by Berglund et al. (2002) and Berglund and Söderholm (2003b) by including an array of new variables and test them on panel data of 22 leading paper-producing countries.

The rest of the paper is organized as follows. A short review of previous studies is given in the next section. In Section 3, we present some key definitions related to the subject. Current global trends in recovered paper use are given in Section 4. Our empirical models, data collection, and estimation methods are reported in Section 5. Regression analysis results are shown and discussed in Section 6, and Section 7 concludes the paper with recommendations for future research.

2. Previous studies

There exists limited literature about econometric analyses for inter-country differences in waste paper recovery and use. Van Beukering and Bouman (2001) developed and tested an empirical model for the recovery and utilization of waste paper and lead. Based on panel data from 50 countries during 1970 – 1997 they concluded that waste materials recovered in developed countries are increasingly exported for utilization in developing countries. Apart from geographic and economic conditions, like forest resources, population density, and manufacturing wages, general dependency on foreign trade and net import ratio of paper products were found consistently positively related to utilization rate in both the developed and developing countries.

Later, Berglund et al. (2002) as well as Berglund and Söderholm (2003a, 2003b) provided a critical analysis and complementary empirical evidence on the global recycling and trade of recovered paper. They questioned the earlier finding of Van Beukering and Bouman (2001) that international trade patterns of recovered paper are a major determinant of utilization rates, and focused instead on the availability of recovered fiber. In addition, they included the shares of various paper grades of the total paper and board production as an explanatory variable. Based on cross-sectional data from over 80 countries in 1996 (Berglund et al., 2002) and panel data from 49 countries during 1990-1996 (Berglund and Söderholm, 2003a, 2003b), they concluded that relative recovered paper collection and use largely depend on long-standing economic factors such as population density and competitiveness in the world market for paper and board products. Recovered paper availability was found to be the main determinant of the inter-country differences in utilization rates.

Along with the infrastructure, the amount of virgin fiber available and other "hard" factors, e.g. legislation, environmental awareness and political issues, are presumably some other country-level characteristics that may have a significant impact on the utilization and recovery of recovered paper.

In the studies mentioned above, these "softer factors" are measured implicitly or not at all. For example, Berglund et al. (2002) hypothesize that national environmental policies are more prevalent in richer countries. Thus, they expect recovered paper recovery rates to positively correlate with GDP per capita. However, country's wealth, i.e. GDP per capita, has an influence on many other factors that may affect recovery rate as well. For example, the quality of infrastructure, or, as Berglund et al. (2002) themselves pointed out, the labor costs. If a variable reflects various determinants of recovery or utilization rates it is somewhat difficult to interpret the results, or to draw vary precise conclusions about the role of an individual determinant. Our paper differs from these earlier studies in that we use more explicit indicators for the "softer" country level characteristics, e.g. the Hofstede cultural dimensions (Hofstede, 1980) and diffusion of ISO 14001 certificates, to gain more precise information on factors affecting recovered paper utilization and collection rates.

3. Definitions

Main raw materials for the paper production are wood pulp (mechanical pulp, semi chemical pulp and chemical pulp) and recovered paper. A limited substitution between wood pulp and recovered paper is possible. Fine papers, such as copy papers and high quality magazine papers, are typically solely produced from various wood pulp mixtures whereas waste based newsprint

includes 50-100% recovered paper, cartonboards 50-75% and corrugated boards up to 100% (Diesen, 2007). Recovered paper is used as raw material in the paper industry when its availability is secured and when its usage is economically rational (Berglund and Söderholm, 2003a; Berglund and Söderholm, 2003b; Haarla, 2007). Thus, recovered paper utilization is both supply- and demand driven, and it is shaped by both economics and politics (Berglund et al., 2002). Production technologies are fairly standardized and available worldwide (e.g. Berglund and Söderholm, 2003a). The infrastructure and a well-organized collection system, therefore, play an important role in the collection and utilization of recovered paper.

Utilization rate, *UR*, measures to what extent recovered paper is being used in paper and board production. *UR* is generally calculated by dividing country's recovered paper consumption, RP_{cons}, by the total paper and board production, PB_{prod} (see, e.g. Van Beukering and Bouman, 2001; Berglund et al., 2002; Berglund and Söderholm, 2003a, 2003b):

$$UR = \frac{RP_{cons}}{PB_{prod}} \qquad (1)$$

The share of country's paper consumption entering the recovered paper market is called recovery rate, *RR*, (e.g. Baumgärtner and Winkler, 2003; Berglund et al., 2002; Berglund and Söderholm, 2003a, 2003b). Recovery rate is calculated by dividing recovered paper production, i.e. collection, $RP_{collect}$, by total paper and board consumption, PB_{cons}:

$$RR = \frac{RP_{collect}}{PB_{cons}} \qquad (2)$$

According to Baumgärtner and Winkler (2003), the recovery rate is bounded from above at about 80% since part of the paper produced is used as a raw material for durable goods, or cannot be recovered (e.g. sanitary papers).

4. Current trends in waste paper recovery and usage

Recovered paper collection and consumption during the period 1992 - 2008 by region are shown in Figures 1 and 2. In turn, Table 1 shows the percentages of collection, trade and consumption by region.

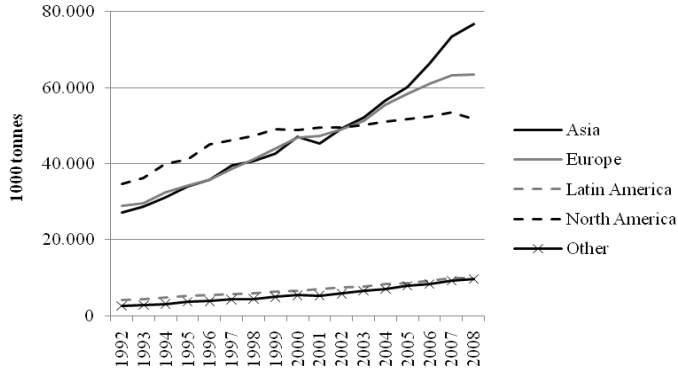

Figure 1. Recovered paper collection (1000 tonnes) by region.

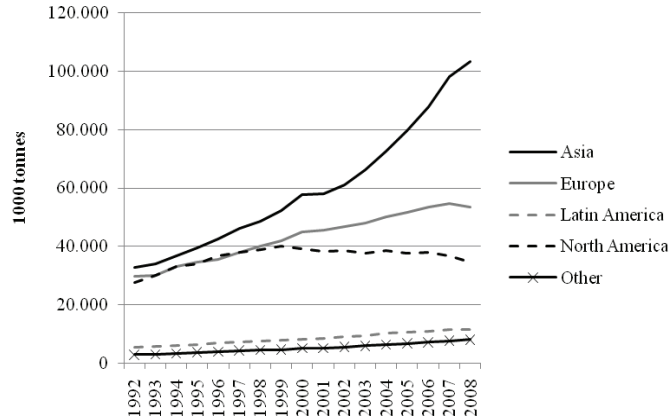

Figure 2. Recovered paper consumption (1000 tonnes) by region.

As shown in Figures 1 and 2, in Asia, the collection of recovered paper has more than doubled and the consumption has almost tripled during the period. Consumption exceeds collection which makes Asia a net importer of recovered paper. In 2008, Asia consumed approximately half of all recovered paper (see Table 1). Imports into Asia have grown to account more than 60% of the world's total.

Recovered paper collection and consumption are increasing in Europe and Latin America as well (see Figures 1 and 2). Instead, in North America the consumption has slightly decreased since 1999 and the collection seems to be stagnating. In Europe, recovered paper collection (% of world's total) is stable but an increasing share of it is exported, Asia being the largest export destination (see Table 1), whereas North America's share of collection and trade has declined.

Table 1. Recovered paper collection, imports, exports and consumption by region.

	1992	1995	2000	2005	2008
Collection (% of world's total)					
Asia	28	29	30	32	36
Europe	30	29	30	31	30
Latin America	4	4	4	5	5
North America	36	35	32	28	24
Other	3	3	3	4	5
Imports (% of world's total)					
Asia	42	35	44	60	64
Europe	41	42	35	28	26
Latin America	9	8	7	5	4
North America	7	13	12	7	5
Other	1	1	1	1	1
Exports (% of world's total)					
Asia	6	6	6	12	11
Europe	38	40	43	43	45
Latin America	0	2	1	1	1
North America	55	52	48	40	38
Other	0	2	3	3	4
Consumption (% of world's total)					
Asia	33	33	37	43	49
Europe	30	29	29	28	25
Latin America	6	5	5	6	5
North America	28	29	25	20	16
Other	3	3	3	4	4

The development of the recovery and utilization rates of 22 countries investigated in this study is reported in Table 2. As shown, there is an overall increase of *RR* and *UR* in most of the countries between 1995 and 2008. The highest recovery rates can be found in Norway (85 % in 2008) and Western Europe countries, and the lowest in India (29%). With *UR*, the inter-country differences are tremendous, varying from 5% in Finland to 84% in Philippines. The lowest utilization rates are found in Northern countries (i.e. Finland, Sweden, Norway, Russia, Canada) whereas the highest rates can be found in Western Europe and Southeast Asian countries.

Table 2. The recovery and utilization rates by country.

	RR (%)			UR (%)		
	1995	2000	2008	1995	2000	2008
Argentina	26	31	40	38	51	57
Austria	66	62	70	40	44	46
Belgium	38	49	55	24	35	59
Brazil	33	38	41	32	36	40
Canada	43	38	59	23	25	30
Chile	33	32	43	39	39	47
China	30	38	40	37	55	70
Finland	31	41	45	5	5	5
France	39	46	64	48	58	61
Germany	68	73	77	58	61	68
India	26	28	29	40	47	54
Italy	35	41	57	56	56	56
Japan	50	56	73	53	56	62
Norway	45	55	85	11	14	25
Philippines	18	27	48	75	84	83
Poland	37	35	39	40	41	37
Romania	31	29	44	32	40	83
Russia	24	30	35	14	18	27
Spain	41	48	69	73	81	84
Sweden	43	57	72	16	17	17
United Kingdom	35	42	78	66	74	80
USA	45	49	58	37	40	38

5. Research methodology

5. 1. Our extended models for the recovery and utilization rates

Our econometric models extend the models introduced by Berglund et al. (2002) and Berglund and Söderholm (2003b) by including an array of new variables to examine the role of national culture and environmental awareness in recovery and utilization of recovered paper. Equation for the recovery rate, *RR*, is expressed as:

$$RR_{it} = \alpha_i + \beta_1 \ln(GDP_{it}) + \beta_2 URBPOP + \beta_3 POPDEN + \beta_4 \ln(ISO_{it}) + \beta_5 PDI_i + \beta_6 IDV_i + \beta_7 MAS_i + \beta_8 UAI_i + \beta_9 SCHOOL_{it} + \beta_{10} \ln(INT_{it}) + \varepsilon_{it} \quad (3)$$

where i is country, t is year, α_i are country-specific effects and ε_{it} is an idiosyncratic error. Regression coefficients, β_n, are assumed to be common to all countries and years.

Model for the utilization rate, *UR*, is:

$$UR_{it} = \alpha_i + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(FOREST_{it}) + \beta_3 NTB_{it} + \beta_4 SE + \beta_5 RR + \beta_6 \ln(ISO_{it}) + \beta_7 PDI_i + \beta_8 IDV_i + \beta_9 MAS_i + \beta_{10} UAI_i + \beta_{11} SCHOOL_{it} + \beta_{12} \ln(INT_{it}) + \varepsilon_{it} \quad (4)$$

GDP, URBPOP, POPDEN, FOREST, *NTB* and *SE* measure the infrastructure and other "hard" factors affecting country's recovered paper recovery and/or utilization rates, whereas *ISO*, *PDI*, *IDV*, *MAS*, *UAI*, *SCHOOL* and *INT* measure "softer" country level characteristics that also may have a significant impact on *UR* and *RR*. The addition of these softer variables differentiates our models from those of previous studies (Berglund et al., 2002; Berglund and Söderholm, 2003b).

Gross domestic product per capita (*GDP*) is intended to measure the impact of economic factors on the recovery and utilization rates. We expect the impact on *RR* to be positive because wealthier countries presumably have better infrastructure and, therefore, a better organized recovered paper collection system. People in richer countries are also probably more willing to pay extra for end products made of recycled paper so that increase in GDP per capita should lead to an increase in *UR* as well.

Urban population (*URBPOP*) and population density (*POPDEN*) measure the recovered paper collection costs, especially transportation costs. They are

supposed to have a positive influence on *RR* because the collection system is more cost-effective in densely populated urban areas.

FOREST is country's forest area (in km^2). It measures the long-run availability of virgin fibers. A decrease in forest area should lead to an increase in utilization rate, for recovered paper is a substitute for virgin fibers.

NTB denotes the proportion of newsprint, tissue, and packaging paper and board in a country's paper and board production. Recycled fibers are primarily used to make packaging and board materials and newsprint. Recovered paper is also an important raw material in tissues of which about 50% is made of recovered paper (Diesen, 2007). Thus, we expect an increase in *NTB* to increase *UR*.

Structural effect *SE* is the share of production to consumption of paper and board. In leading paper producing-countries with small domestic markets the supply of recovered paper is relatively small in contrast to the total demand for raw material in paper industry. Thus, an increase in *SE* should lead to a decrease in *UR*. Recovery rate, *RR,* measures the supply of recovered paper as well. Naturally, higher availability of recovered paper should lead to a higher utilization rate.

ISO denotes the cumulative number of ISO 14001 certificates per million people. ISO 14001 is a standard for environmental management systems. It is part of the larger family of ISO 14000 standards, but ISO 14001 is the only one that can be audited for certification. In our models, the diffusion of certificates is meant to measure managers' environmental awareness. An increasing number of certificates should lead to higher recovery and utilization rates of recovered paper.

Power distance (*PDI)*, individualism (*IDV)*, masculinity (*MAS)* and uncertainty avoidance (*UAI)* indices are the four Hofstede (1980) cultural dimensions. Based on surveys with over 88,000 employees from 72 countries, Hofstede's operationalization of culture is perhaps the most influential of all representations of culture, and it has inspired thousands of empirical studies (Kirkman et al, 2006). In high power distance cultures (with a high *PDI*) people expect and accept that power is distributed unequally, and respect for authority is high (Franke and Nadler, 2008). The *PDI* is expected to have a positive effect on the recovery and utilization rates, as consumers and paper industry decision-makers in such cultures should be more willing to comply with recovery targets set by policy-makers. In individualistic cultures (with a high *IDV* index) people are expected to take care of themselves, whereas collectivistic cultures (with a low *IDV* index) are characterized by cohesive in-groups taking care of their members (Franke and Narled, 2008). As collectivist cultures are more

concerned about others, it is expected that the availability of recovered paper and, thus, the recovery rate and utilization rate are higher. The third cultural dimension or *MAS* (masculinity vs. femininity) refers to whether the dominant value in a society is assertiveness as opposed to caring. Femininity could be characterized by concerns about others' future well-being (Mearns and Yule, 2009), and thus the *RR* and *UR* are expected to be higher in less masculine cultures (with a low *MAS* index). Uncertainty avoidance refers to the tendency to avoid uncertain and ambiguous situations. In cultures with high uncertainty avoidance (a high *UAI*), managers are expected to tolerate less business risks and, therefore, use more raw materials of steady quality, availability and price level, i.e. they use more virgin fiber in paper production.

SCHOOL and *INT* denote average years of schooling and the cumulative number of Internet users per million people. They are used as proxy indicators of a country's citizens' level of awareness on environmental concerns. These are supposed to have positive effects on the recovery and, thus, also the utilization rate of recovered paper.

5.2 Data sources

Our data is annual country level panel data for the period 1995 – 2008. The number of countries included is 22. Data for this study was collected from various databases.

For each year and country the consumption of recovered paper was defined by apparent consumption: collection plus imports minus exports. The utilization rate, *UR*, was calculated by dividing recovered paper consumption by paper and board production. Data on recovered paper and paper and board were obtained from the Industry Statistics Database provided by RISI. Gross domestic products and populations between 1995 and 2008 were gathered from the WDI Online database by the World Bank. GDP was measured at constant US dollars at 2000 prices. Forest area data is from WDI Online database as well. The number of Internet users per 1000 people and average years of schooling was obtained from the Global Market Information Database (GMID) database provided by Euromonitor International. Cumulative numbers of ISO 14001 certificates were gathered from the web site of ISO surveys by ISO and Hofstede's cultural dimensions are from Geert Hofstede's web page.

5.3 Estimation methods

Two basic specifications of panel data models are the fixed effects model and the random effects model. In fixed effects models, unobservable country-specific effects α_i are assumed to be fixed parameters to be estimated, or they

are eliminated by using the so-called within regression estimator. Explanatory variables are assumed to be independent of the error ε_{it} but the country-specific effects α_i are permitted to correlate with regressors. In random effects estimation, α_i are assumed to be random parameters rather than fixed and they act as an error term together with ε_{it}. Explanatory variables are supposed to be independent of both α_i and ε_{it} for all i and t. For further information see e.g. Baltagi (2005).

The random effect specification suffers from inconsistency, if there is correlation between explanatory variables and α_i. The Hausman specification test was, therefore, used to test, which one of the model specifications would be more appropriate in this study. According to the Hausman test, the random effects specification is more efficient with *RR* and *UR*. Models (3) and (4) were, therefore, estimated by using random effects model specification with statistical package Stata 10. The estimation method was generalized least squares (GLS).

6. Results and discussion

Table 3 provides descriptive summary statistics for our variables in levels. The time period is 1995-2008.

Table 3. Descriptive statistics for all countries and years.

	Mean	*SD*	*Min*	*Max*
Utilization rate, % (*UR*)	45	21	5	87
Recovery rate, % (*RR*)	46	15	18	85
GDP per capita, US$ (*GDP*)	16 627	12 559	371	42 683
Urban population, % (*URBPOP*)	71	16	27	97
Population density, people/km^2 (*POPDEN*)	127	119	3	383
Forest area, km^2 (*FOREST*)	1 081 463	1 987 788	6670	8 092 685
Proportion of newsprint, tissue and packaging paper and board in paper and board production , % (*NTB*)	65	15	25	98
Structural effect, % (*SE*)	156	159	43	815
Diffusion of ISO 14001 certificates per million people (*ISO*)	188	396	0	3153
Power distance index (*PDI)*	56	22	11	94
Individualism (*IDV*)	56	20	20	91
Masculinity (*MAS*)	51	21	5	95
Uncertainty avoidance index (*UAI*)	67	23	29	95
Average years of schooling (*SCHOOL*)	9	2	6	13
Diffusion of Internet users per thousand people (*INT*)	277	261	0.1	870

Table 4 presents the results of the estimations. Estimated coefficients are common to all countries included in the analyses.

Table 4. Estimated regression coefficients and model fitting statistics.

	Recovery rate (*RR*)	Utilization rate (*UR*)
Constant	38.37	-16.38
	(24.14)	(25.56)
Ln *GDP* per capita	0.5558	**8.725****
	(2.5061)	(2.254)
ln *ISO14001*	**2.027****	0.2811
	(0.3684)	(0.2676)
PDI	**-0.3336****	**0.4202***
	(0.1181)	(0.1764)
IDV	-0.1504	**-0.3652***
	(0.1212)	(0.1531)
MAS	-0.0405	**0.4358****
	(0.1035)	(0.0992)
UAI	0.0190	**-0.4003****
	(0.0974)	(0.1126)
SCHOOL	**1.531****	0.0438
	(0.4742)	(0.3246)
INT	-0.4043	0.7864
	(0.6593)	(0.5637)
URBPOP	0.1339	
	(0.1477)	
POPDEN	**0.0312**$^{+}$	
	(0.0177)	
SE		**-0.0495****
		(0.0102)
RR		**0.1637****
		(0.0384)
ln *FOREST*		**-4.220***
		(1.770)
NTB		**0.4743****
		(0.0827)
Wald-test (chi^2)	252.4**	546.5**
R^2 overall	0.6791	0.7092
Observations	288	288
Number of countries	22	22

$+ p < 0.10$, $* p < 0.05$, $** p < 0.01$

Starting with the recovery rate *RR*, the estimated coefficient of GDP per capita is positive but not significant. It thus seems that the building and maintenance of the paper recycling infrastructure is relatively inexpensive. However, the collection costs do play some role in recovered paper collection since population density has the expected positive sign and it is also statistically significant at a 10% significance level.

Positive and statistically significant coefficients of the number of ISO 14001 certificates and average years of schooling indicate that increasing environmental awareness increases the recovery rate. Instead, variables of the national culture are not significant except for the power distance index which is negative and significant at a 1% level.

With the utilization rate, the estimated coefficients of the "hard" determinants were as expected. The effect of the country's wealth (GDP per capita) was statistically significant and positive. Thus, it seems that in wealthier countries demand for end products made of recycled paper is higher. The measures of supply had statistically significant impacts on the *UR* as well. The estimated coefficient of the structural effect was negative and that of recovery rate was positive. The indicator for the availability of virgin fiber (*FOREST*) was negative and significant, and the allocation of the total paper production between various paper grades showed the expected effect as well, as the proportion of newsprint, tissue, and packaging paper and board in a country's paper and board production (*NTB*) had a positive influence on the recovered paper utilization rate.

All of the cultural variables had statistically significant effects on the utilization rate. The effects of power distance (*PDI*), individualism (*IDV*) and uncertainty avoidance (*UAI*) were as expected but the masculinity-femininity (*MAS*) dimension showed a significant effect in the direction opposite from what we expected. It appears that more masculine cultures are more efficient users of recovered fiber. This may be at least partly explained by the cost-effectiveness of recovered fiber, as managers in masculine countries would emphasize internal efficiency and advantage over competitors relatively more than those in more feminine countries (Wacker and Sprague, 1998; Vecchi and Brennan, 2009).

The level of education and the diffusion of the internet did not have, unexpectedly, significant impact on the utilization rate. It thus seems that the environmental awareness affects the recovery rate, but not directly on the utilization rate.

7. Conclusions

Even though our results support earlier studies, further confirming the roles of geographical, demographic and essentially economical determinants of the collection and utilization of recovered paper in paper and board production, we were also able to empirically demonstrate that the environmental awareness and the cultural factors play a significant role.

The diffusion of environmental management (ISO 14001), as well as average years of schooling, were discovered as important factors in explaining the recovery of recovered paper. These effects indicate the environmental awareness and concern of both consumers and managers at the country level. This finding, along with the established effects of the cultural dimensions on the utilization rate, could be used in planning the national and international policies and incentives for collection and use of recovered paper.

In further research, it would be beneficial to take into account the imports and exports of the recovered paper and end products in the models. Also, forecasting the future recovery and utilization rates would be very interesting and useful, yet challenging, task.

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