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IDENTIFYING TEMPORAL RELATIONSHIPS WITHIN MULTIDIMENSIONAL PERFORMANCE MEASUREMENT

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Abstract. The paper investigates temporal relationships between leading drivers of success, non-financial outputs, and financial outcomes as suggested by the Balanced Scorecard. Based on a sample of 42 companies with a four-year survey data, we find partial confirmation of temporal causality between selected actions and performance. The effects of the leading variables on the non-financial outputs are the strongest in the same year. Also, the influence of innovation and HR policies via the number of patented innovations and new products (services) on profit growth is the strongest within one year. These findings have important implications for the design of cause-and-effect relationships schemes (strategy maps) and the development of contemporary performance measurement systems.

Keywords: performance measurement, multidimensional models, leading and lagging variables, temporal causality, strategy maps, structural equation modelling.

JEL Classification: M00.

Introduction

After about two decades of their presentation in the literature, the effectiveness of contemporary multidimensional models of performance measurement such as the Balanced Scorecard still hasn't been conclusively established. One of the most compelling research questions is related to the identification of temporal relationships between actions and performance implicitly suggested by these models. To what extent can organizations be confident that investments in learning and growth, for example, will actually impact innovations in internal processes and product development which will, in turn, attract new customers or lead to customer loyalty and, further, to financial performance? The multidimensionality of PMS suggests that there is a sequence of drivers that lead to results in a certain period of time. The cause-and-effect relationships between leading and lagging performance measures are hence dependent upon time. In practice, there has been little research that would incorporate time dimension into the investigation of the effectiveness of multidimensional performance measurement. Most survey papers in management accounting are cross-sectional, despite of the fact that they aim to test theories that specify causal relationships among variables (Van der Stede *et al.* 2005).

The objective of this study is to investigate the temporal interdependencies between various drivers and their outcomes implicitly suggested by the BSC (and similar other models). Using longitudinal survey design covering the period 2007–2010, we compare the temporal fit of the leading drivers of success, the intermediate (non-financial) outputs, and the financial outcomes of a sample of 42 firms. The paper thus delivers tentative implications for understanding and further development of the strategy maps and the related performance measurement systems.

1. Theoretical background

Temporal relationships between the strategic drivers of success and financial performance implicitly implied by multidimensional performance measurement models have not received much attention to date (De Geuser *et al.* 2009). Most prior studies investigate the relation between *specific* non-financial performance measures and *current* performance. In claiming that companies that use a combination of non-financial and financial performance measures perform better than firms relying on financial indicators of performance alone, however, it is crucial to consider the time frame related to performance evaluation. Some empirical studies investigated temporal relationships between *specific* non-financial performance measures (such as customer satisfaction, total quality management, or human resource management) and *future* financial performance (see Banker *et al.* 2000; Lipe, Salterio 2000; Banker *et al.* 2004; Foster, Gupta 1997; Ittner, Larcker 1998a; Behn, Riley 1999; Said *et al.* 2003).

Strategy maps (Kaplan, Norton 2000; Kaplan, Norton 2004), on the other hand, visually depict the whole chain of cause-and-effect relationships between organizational resources and tangible outcomes. Numerous studies confirm that the multidimensional performance measurement systems (such as the BSC) may be an effective way to improve organizational performance (Lipe, Salterio 2000; Kaplan, Norton 2001; Braam, Nijssen 2004; Davis, Albright 2004; Papalexandris *et al*. 2004; De Geuser *et al.* 2009). There are also some critical voices (Nørreklit 2000, 2003) claiming that the relationships in the Balanced Scorecard are logical rather than causal. Schneiderman (1999) identifies that breaking the cause-and-effect relationships, i.e. non-existence of links between non-financial and expected results, may be one of the contributors of the BSC failure in practice. Empirical studies that would actually investigate temporal relationships between various drivers from the four perspectives of the BSC are rare. Liang and Hou (2006) provide only a partial confirmation of the BSC cause-and-effect relationships. In their analysis of monthly data from a hotel chain throughout a 10-year period, they find that customer satisfaction drives financial outcomes (but no support of other hypotheses, such as that employee development is associated with increased sales per customer or occupancy).

The BSC strategy maps underlie a number of interrelated hypotheses. Starting from the top is the hypothesis that improved financial outcomes (increased sales) can be achieved only if customers are satisfied. Extant empirical studies provide ambiguous evidence on temporal relationships between customer satisfaction and financial performance. Studies find positive association between customer satisfaction and *future* financial performance (Foster, Gupta 1997; Behn, Riley 1999; Banker *et al.* 2000), or no association at all (e.g. Ittner, Larcker 1998b). Further down the chain is the hypothesis that customer satisfaction is driven by new (or improved) products or services. While some studies have confirmed simultaneous improvements in customer and employee satisfaction (Siguaw, Enz 1999; Bernhardt *et al*. 2000), indicating that employee satisfaction could also act as a driver, these findings typically apply to service industries. There, employees can directly provide customers with better interactions, thereby increasing customer satisfaction (Heskett *et al*. 1994; Johnson *et al.* 2009). More generally, the hypothesis assumes new products and services are delivered by (renewed or innovative) internal processes. New products and services derive from R&D activities. The relationship between R&D intensity and innovation performance has been empirically demonstrated in several studies (e.g. Deeds 2001; Parthasarthy, Hammond 2002; Greve 2003). Innovation is considered as a critical enabler and competitive success has been found as highly dependent upon an organization's management of the innovation process (Di Benedetto 1996; Balachandra, Friar 1997; Griffin 1997; Adams *et al*. 2006). Studies also confirm that creation of new knowledge is most beneficial for (operating) process innovation and new product development (Armbrecht *et al*. 2001). Moreover, firms maintaining external linkages with other firms or sources of information, e.g. through participation in research projects, university links, etc. (Atuahene-Gima 1995; Tipping, Zeffren 1995), ensure continuous sparking of ideas and the development of innovative concepts. Finally, continuous improvements and innovations in internal processes (both operating and innovative processes) are conditioned by intangible assets (human capital, organizational capital, and information capital). Human capital and organisational capital have been identified as key assets of the firm and catalysts of innovations (Roos 1998; Hall 1992). Firms with high commitment HRM systems that have interrelated HR practices are considered critical drivers of employee motivation, commitment, and productivity (Ichniowsky *et al.* 1997; Bridges, Harrison 2003).

Multidimensional performance measurement models following these cause-and-effect relationships would typically include performance indicators of the various leading drivers, outputs, and financial outcomes and try to monitor their execution through time.

The research question is related to the identification of temporal relationships between actions and performance implicitly suggested by the above described cause-and-effect relationships. How quickly does a specific variable affect the next variable in the cause-and-effect relationships chain?

2. Research methodology

We use longitudinal design to investigate this question. While empirical testing of temporal relationship imposes significant data requirements to measure different variables at different times, they provide greater confidence for causal inferences than cross-sectional designs because they more easily establish temporal priority (Pinsonneault, Kraemer 1993).

2.1. Sample

The sample consists of 42 companies that participated in the contest for the best employer in Slovenia, which has started in 2007 and has been organized every year. Although more than 100 companies participate in this nation-wide contest every year, we selected those that participated in years 2007 and 2009 to capture a two-year time span in leading indicators. Through the contest, significant data on human resource management, processes, and innovation management are collected. The overall responsibility for a comprehensive and truthful completion of the survey lay with the executive managers. However, the actual respondents for respective parts of the questionnaire were various department managers in the participating companies in line with their area of responsibility. The financial data was collected from the Slovenian Agency for Public Records (AJPES) that gathers accounting information of all firms registered in Slovenia. The key characteristics for the entire sample of companies are summarized in Table 1.

Table 1. Descriptive statistics

	Mean	Std. deviation
Gross salary 2006	1,459.1	488.7
Gross salary_2010	1,800.1	561.9
Assets_2006	50,525,005.8	137,358,177.2
Assets_2010	68,420,451.6	227,098,096.9
Sales_2006	42,318,369.4	94,534,027.0
Sales_2010	48,387,841.2	144,269,949.1
Net profit_2006	3,429,715.7	18,202,595.1
Net profit_2010	3,690,077.2	26,927,168.2
N. of employees_2006	311.7	702.0
N. of employees_2010	273.9	696.0
ROE 2006 (in %)	23.6	34.5
ROE 2010 (in %)	–13.5	99.9
Value added per employee_2006	48,600.0	41,117.1
Value added per employee_2010	47,230.4	29,606.1
Growth in value added per employee from 2006 to 2010 (in %)	0.2	0.7
Growth of sales from 2006 to 2010 (in %)	0.3	0.8
Growth of assets from 2006 to 2010 (in %)	0.7	1.4
Growth of profit from 2006 to 2010 (in %)	–26.3	162.7
Growth of profit from 2006 to 2008 (in %)	–19.1	125.2
Growth in value added per employee from 2006 to 2008 (in %)	0.3	0.6
Growth of assets from 2006 to 2008 (in %)	1.0	2.1
Growth of sales from 2006 to 2008 (in %)	0.5	0.6

2.2. Variable measurement

Leading variables – inputs

The first three variables, *human resources management, process renewal, and innovation policy*, are measured with multiple items in years 2007 and 2009. Using a five-point, verbally anchored response scale, ranging from "it is not true" (1) to "it is perfectly true" (5), the survey questionnaire asked the respondents to indicate to what extent the selected statements on human resources management, process renewal, and innovation policy, respectively, are true.

1. *Human resources management.* The central variable is *human resources management (HRM)* that influences all other variables in the BSC model. It is measured with five items. A sample item is "Mentors and trainers play an important role in the development of human resources".
2. *Process renewal.* Renewed processes typically importantly contribute to the product and service innovations and to better financial results. Three items measured the transformation of processes over the last three years. An example item is "The firm has renewed the processes of production and/or service delivery in the last three year".
3. *Innovation policy.* An efficient policy of innovation systematically influences the development of new patents and other intellectual property rights and via those new products and services. We measured it with four items, i.e. "The firm actively cooperates with research institutes and universities". We measure all three variables in year 2007.

Intermediate lagging variables – non-financial outputs

4. *Innovation.* The degree of innovation was measured with one item only "How many patented innovations have you got in your firm?" in absolute terms.
5. *New products or services.* The number of *new products or services* was measured with only one item, as well, "How many innovative products or services have you introduced in the last three years?" in absolute terms. We measure those variables in 2007 and 2009 and include them interchangeably to the estimated model.

Final lagging variables – financial results

Financial results were measured with various financial performance measures. Since our sample is very heterogeneous, yet too small to control for average industry performance, we express financial results in terms of growth. We calculated growth of net income, sales, and value added per employee from 2006 to 2010. Alternatively we calculated growth also from the beginning of 2007 to the end of 2008.

Control variables

The control variables are *industry* (where we distinguish between manufacturing and services, denoted as 0 and 1, respectively) and *employee education* (measured as average

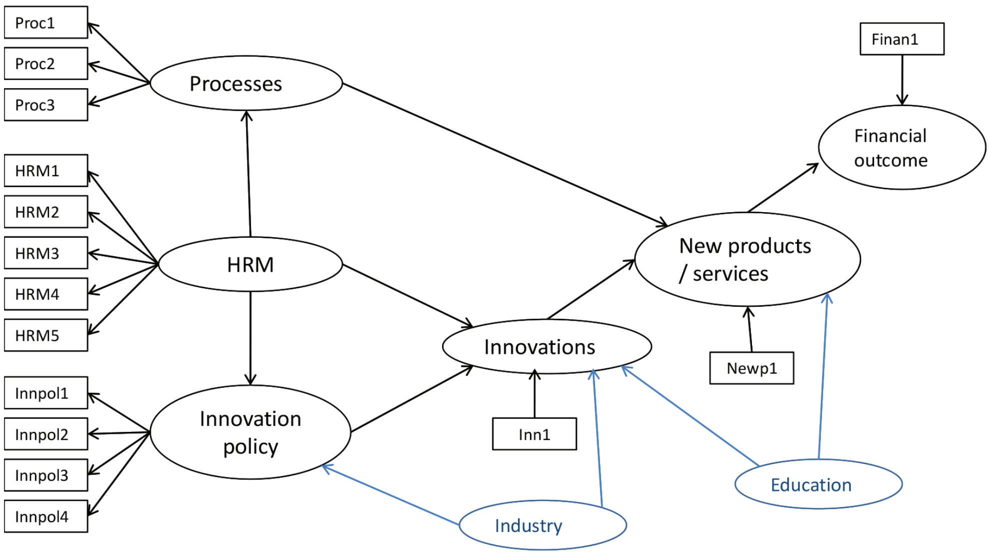

Fig. 1. The conceptual model

education level of employees in the company whereby the companies were asked to indicate percentages of employees with completed primary school, secondary school, bachelor degree, and graduate degree such as master or doctorate). We assume that the number of patented innovations and institutionalized innovation policies are prevalent in the manufacturing industry (including mining, energy sector, and agriculture) rather than the service industry, and also that the relationships between innovation policies and actual innovations are stronger because of more explicated innovation policies in manufacturing industry. We also assume that the number of new products and services is positively associated with employee education, while training on the job and human resources management may play a rather indirect role.

The conceptual model is presented in Figure 1.

2.3. Method

Temporal relationships in the model were analysed by comparing the strength of the relationships among the variables in different time frames. We estimated three models: in the first model, we test whether the reactive time of lagging (non-financial output) variables to the leading variables is in the same year (in 2007). The financial results in the model are measured in 2008 when all leading variables can show their full effect. In the second model, we lag the number of new products and services and financial results for two years. In the third model, we also lag the number of patented innovation for two years along with the number of new products and services and financial results.

We estimated the models by using the partial least squares (PLS) approach to structural equation model (SEM) (Wold 1985; Lohmöller 1989). We used SmartPLS 2.00 software (Ringle *et al.* 2005). PLS structural equation modelling is a prediction oriented variance-based approach that focuses on endogenous target constructs in the model and aims at maximizing their explained variance. As stressed in a recent review of the use of PLS method in management studies, the method is particularly useful when the research objective focuses on prediction of key target constructs (e.g., strategic success of firms) by different explanatory constructs (e.g., sources of competitive advantage) (Hair *et al.* 2012). In comparison to standard moderated regression analysis, the PLS algorithm estimates how much each indicator contributes to the composite score of the latent variable, rather than assumes equal weights for all indicators of a scale. This assures that indicators with weaker relationships to related indicators and the latent construct are given lower weights, which makes PLS preferable to techniques such as regression in which multiple indicators of a construct are typically averaged and hence assumed to have equal importance for the latent construct. Weighting scheme for each block of indicators thus depends on the model being estimated (Chin 1998). In other words, PLS simultaneously estimates the structural and measurement paths (i.e., relationships between latent variables and their indicators). The method may be thought of as an intermediate procedure between OLS, principal component analysis and a bootstrap approach.

Its advantage over the variance-covariance based structural equation modelling technique is in at least three aspects: since its iterative least squares regression-like estimation proceeds block by block, it allows for estimation of smaller sample sizes; it imposes less severe requirements about the distribution assumptions; and it allows for the use of both formative and reflective variables in the models (Vandenbosch 1996). These advantages also dictated our choice of the method.

3. Results

3.1. Measurement model

The model presented in Figure 1 is composed of eight variables. The multiple item variables need to adhere to the norms that prove individual item reliability, construct reliability, convergent validity, and discriminant validity of the composite variables in the model (Bagozzi 1994). It is considered adequate when an item has a factor loading on the latent variable that is greater than 0.7072, which implies that more than 50% of the variance in the observed variable is shared with the construct. As shown in Table 2, all but two item loadings exceed the 0.7072 threshold providing evidence of satisfactory individual item reliability. The exceptions are one indicator for Innovation Policy and one indicator for Processes. They have nevertheless been preserved in the analysis because they satisfy the minimum standard for acceptable construct reliability (Dillon-Goldstein's composite reliability $\rho > 0.7$, see Table 3).

To assess the internal consistency of the two composite scales in the study, the Cronbach's (1951) α coefficient is calculated. The unidimensionality of the two composite scales in the study is also assessed through Dillon-Goldstein ρ (Tenenhaus *et al.* 2005). A level of 0.70 is suggested as an acceptable level of reliability (Vandenbosch 1996). Corroborating the Cronbach's α analysis, Dillon-Goldstein's ρ values are also above 0.70 for each construct, providing strong evidence of unidimensionality (see Table 3).

Table 2. The measurement model

	Original sample	Sample mean	Standard error	T statistics
Industry	1	1		
Education	1	1		
Profit growth -> Financial outcome	1	1		
N. of new products	1	1		
N. of new patents	1	1		
Proc1<- Processes	0.853	0.840	0.080	10.611
Proc2 <- Processes	0.701	0.694	0.165	4.260
Proc3 <- Processes	0.828	0.811	0.103	8.047
Innpol1<- Inn Policy	0.770	0.751	0.150	5.137
Innpol2 <- Inn Policy	0.813	0.787	0.123	6.601
Innpol3 <- Inn Policy	0.758	0.739	0.147	5.169
Innpol4 <- Inn Policy	0.685	0.674	0.120	5.694
HRM1 <- HRM	0.781	0.785	0.063	12.399
HRM2 <- HRM	0.716	0.696	0.130	5.496
HRM3 <- HRM	0.850	0.843	0.057	15.019
HRM4 <- HRM	0.787	0.768	0.097	8.072
HRM5 <- HRM	0.856	0.846	0.057	15.020

Table 3. Model quality criteria

	AVE	Composite reliability	Cronbachs alpha	Redundancy	R square 1 model	R square 2 model	R square 3 model
Inn Policy	0.574	0.843	0.758	0.051	0.291	0.293	0.308
HRM	0.639	0.898	0.858				
Processes	0.635	0.838	0.711	0.147	0.234	0.229	0.229
N. of innovations				0.167	0.294	0.292	0.265
N. of new products				0.003	0.123	0.153	0.258
Financial outcome				0.133	0.133	0.095	0.095

Convergent and discriminant validity of the two composite constructs is assessed by the average variance extracted (AVE). AVE greater than 0.50 indicates satisfactory convergent validity, whereas discriminant validity is assessed by cross-loadings and comparisons of AVE to the variance shared between any two constructs. As shown in Table 3, the AVE values for all latent variables are greater than the 0.5 cut-off point, indicating acceptable level of convergent validity.

3.2. Structural model

Table 4 summarizes the PLS structural analysis and Figures 2, 3 and 4 provide a diagrammatic representation of the differences in structural paths in the originally proposed model.

Model 1, Model 2, and Model 3 differ in the time span in which the relationships between the leading and lagging variables are observed: in Model 1 we observe the impact of HRM, processes renewal, and innovation policy (leading variables) on the number of new patented innovations in the same year, i.e. 2007. Also, the impact of new patented innovations on the number of new products and services is observed within year 2007. Growth in profit, sales and value added per employee are observed in the period from the beginning of 2007 to the end of 2008. In Model 2 we measure the impact of the three leading variables on patented innovations in the same year (2007) with the assumption that new products and services are introduced after two years (2009). Financial results are observed now from the initial effort that goes to the leading forces in the model (i.e., the beginning of 2007) till one year after the products are introduced to the market (2010). In Model 3, we measure the strength of the impact of the three leading variables on patented innovations after two years (2009); in the same year we also measure the impact of preceding variables on the number of new products (services). The growth in financial performance is lagged for one year and is observed from the beginning of 2007 till the end of 2010. The relationships of interest that vary in time in the three models are hence only those that are presented in Table 4 within the border.

Our results indicate that HRM is strongly and positively associated with innovation policy and process renewal (the path coefficients are above 0.45, $p < 0.001$). Innovation policy has a relatively quick effect on the number of patented innovations. As we see from the coefficients in all three models, the effect is positive and relatively strong in the same year (in Models 1 and 2 the effect is above 0.34, $p < 0.05$), but is no longer significant after two years (Model 3, path coefficient 0.191, not significant). New patented innovations are also relatively quickly translated to new products and services as the effects are significant only in Model 1 and 3 in which these two variables are observed in the same year (path coefficients of 0.324, $p < 0.05$ and 0.438, $p < 0.001$, respectively). In Model 2, where the number of new products or services is lagged for two years, the effect is considerably weaker and no longer significant. The effect of new products and services introduced to the market has the strongest effect on financial results in Model 1, but is strong and positive also in Models 2 and 3 (path coefficients of 0.364, 0.308 and 0.308, $p < 0.001$, respectively). In all three models the financial outcome is observed a year later than the preceding variable. HRM *per se* has no direct impact on the introduction of new products (services) or the number of patented innovations. The impact of

Table 4. Structural models

	Model 1			Model 2			Model 3		
	Original sample	Sample mean	Standard error	Original sample	Sample mean	Stand. error	Original sample	Sample mean	Standard error
HRM -> Inn Pol	**0.453*****	0.453	0.180	**0.454*****	0.466	0.185	**0.471*****	0.492	0.168
HRM -> Processes	**0.483*****	0.513	0.089	**0.479*****	0.501	0.094	**0.479*****	0.511	0.090
Inn Pol -> N. of innovations	**0.347***	0.334	0.177	**0.345***	0.326	0.179	**0.191**	0.181	0.172
N. of innovations -> N. of new products	**0.324***	0.308	0.166	**0.289**	0.294	0.156	**0.438*****	0.436	0.123
N. of new products-> Fin. outcome	**0.364*****	0.376	0.097	**0.308*****	0.307	0.109	**0.308*****	0.310	0.114
HRM -> N. of new products	**–0.103**	–0.107	0.200	**0.041**	0.037	0.176	**0.074**	0.071	0.160
HRM -> N. of innovations	**–0.308**	–0.295	0.167	**–0.306**	–0.299	0.163	**–0.249**	–0.248	0.169
Processes -> N. of new products	**0.014**	0.021	0.248	**0.198**	0.188	0.180	**0.182**	0.185	0.151
Industry -> Inn Pol	**–0.292**	–0.296	0.161	**–0.293**	–0.280	0.168	**–0.293**	–0.283	0.164
Industry -> N. of innovations	**–0.308***	–0.297	0.165	**–0.308***	–0.292	0.165	**–0.416*****	–0.416	0.178
Education -> N. of new products	**0.066**	0.056	0.137	**–0.021**	–0.026	0.138	**–0.044**	–0.046	0.133
Education -> N. of innovations	**–0.076**	–0.066	0.143	**–0.075**	–0.071	0.147	**0.048**	0.055	0.135

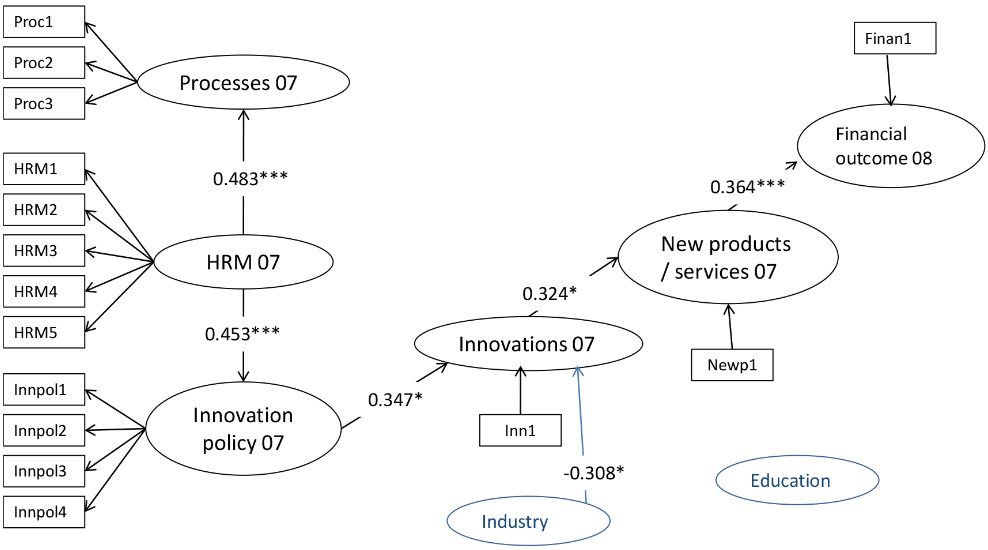

Fig. 2. Results of the estimated model 1

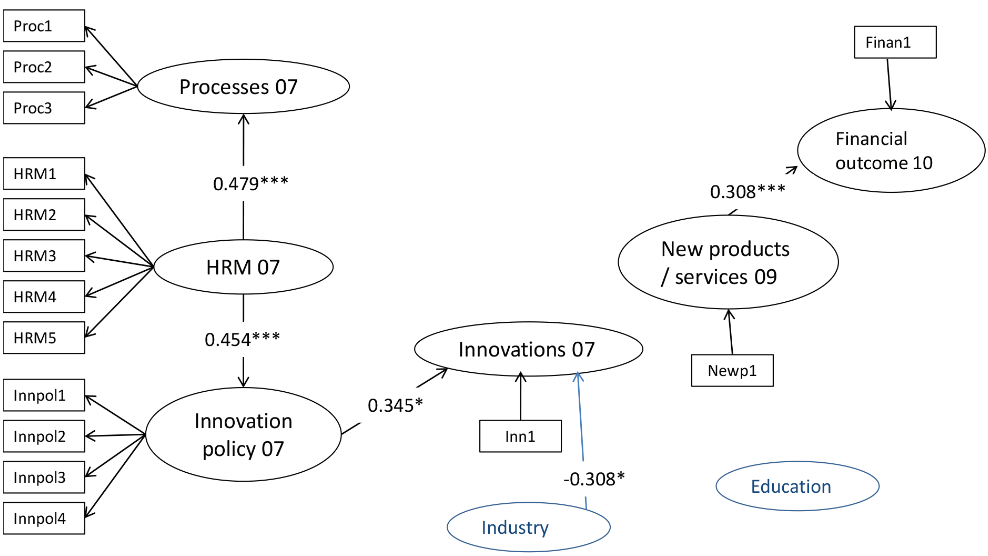

Fig. 3. Results of the estimated model 2

HRM is hence only indirect via the innovation policy. Surprisingly, the process renewal is not significant in any time for the introduction of new products and services. Control variable *industry* is significant in all models. Its inclusion in the models significantly improves the explanatory power of the variables in the model. Since the majority of firms stem from service industry, the speed of effect between innovation policy and the number of new products or services is not surprising. In contrast to our expectation, *employee education* does not significantly affect any of the variables.

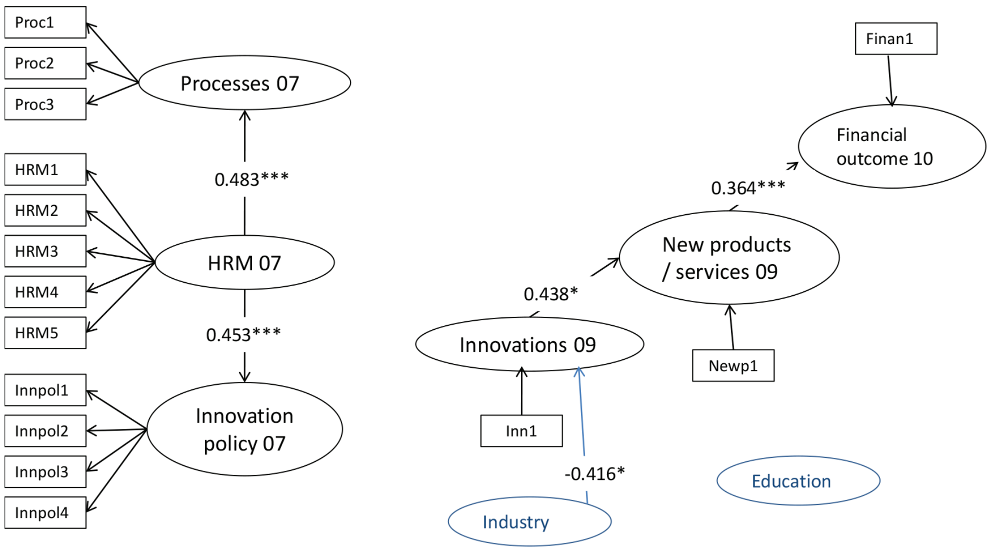

Fig. 4. Results of the estimated model 3

To evaluate the model, R^2 values are calculated for endogenous constructs. In addition, the predictive validity of the parameter estimates is assessed via a cross-validated redundancy index or so called Stone-Geisser Q^2 test (Geisser 1974; Stone 1974). Since PLS approach lacks an index that can provide the goodness of fit statistics like in variance-covariance based SEM-ML, a set of statistics is needed to estimate the quality of the model: next to the reliability and validity of constructs, the significance of the variance explained (R^2 values) and the sign of the redundancy indexes (Q^2 values) for all constructs provide an assessment of model fit (Tenenhaus *et al.* 2005; Vandenbosch 1996). Model 1 explains 13.3% of profit growth after one year, and the explanatory power of preceding BSC variables on profit growth slightly evaporates after two years. In Models 2 and 3, R^2 for the financial outcome expressed as profit growth is rather smaller, only 9.5%. Moreover, HRM explains a considerable variation in innovation policy (R^2 ranges from 29.1 to 30.8% in the three models) and also in process renewal (R^2 is 23%). Number of patented innovations is significantly explained by the innovation policy (R^2 is 29%), and the variation of the number of new products (services) that stem from innovation is explained from 12 to 25.8% in different models. Overall, the results indicate that a BSC model can explain a rather high degree of variation in financial and non-financial outcomes. As shown in Table 3, the redundancy for all latent variables is satisfactory, with all Q^2 values being greater than 0, providing additional support for the model's predictive relevance.

Discussions and conclusions

This paper opened with the general observation that the temporal relationships between actions and performance implicitly suggested by multidimensional performance measurement frameworks have not been decisively confirmed. The research method and design of this study allow for a causal statement concerning the association between the leading drivers and lagging outputs and outcomes.

Overall, our study finds that the effects of the leading variables on the intermediate lagging variables are the strongest in the same year. HRM is strongly and positively associated with contemporaneous innovation policy and operating process renewal. Further, innovation policy positively impacts the number of new patented innovations within the same year. These, in turn, are also quickly translated into new products and services. Also, the influence of innovation and HR policies via the number of patented innovations and new products (services) on profit growth is the strongest within one year. The effect of new products and services introduced to the market, however, has a delayed effect on financial results. Surprisingly, HRM has no direct impact on the introduction of new products (services) or the number of new patented innovations. The impact of HRM is only indirect via the innovation policy. Also, the operating process renewal is not significant in any time for the introduction of new products and services.

This study makes two contributions to the existing performance measurement and management control literature. Firstly, it provides empirical evidence of temporal relationships between BSC variables, an aspect that has gained little attention in the BSC literature so far. As Davis and Albright (2004) observe, developing and understanding causal assumptions between selected measures is an integral component of a properly designed BSC. A better understanding of value creation through time can be used as the basis strategic decision-making. While results may suggest the relative importance of different leading variables, the study's focus was on the temporal causality of associated drivers, outputs and outcomes. Secondly, longitudinal designs are generally not frequently used in this field because repeated surveys are difficult and costly to conduct, are subject to increasing non-response over time, and result in incomplete longitudinal data (Van der Stede *et al.* 2005). This study builds on data from a longitudinal survey design.

While considerable care has been taken to collect reliable and valid data, a couple of limitations are associated with empirical execution of the analysis. First of all, we are aware of the positive bias that could be inherent to the firms that compete at the best employer contest. Nevertheless, in the times when financial crisis considerably hit the economy, those firms still continued pursuing HR and innovation policies as their primary driver in the BSC model. Second, as is often the case with the estimation of models, the possibility of endogeneity always exists (Chenhall, Moers 2007). We considered this issue on substantive grounds rather than statistically. Given the broad theoretical agreement about causes and effects in the BSC model, we believe that simultaneity (reciprocal relationship between endogenous and exogenous variables) as one of potential causes for endogeneity in the model is not a concern. By lagging endogenous variables in time, we minimize the issue of simultaneity. The second potential for endogeneity in the model are omitted variables. In selecting which variables to include in the model, we followed the theory (and empirical evidence) predicting the causal relationship among the variables in the BSC. We have controlled for industry effects and the effect of educational background of the employees on innovations. Overall, we believe that the direction of causality flows most logically from the leading indicators (exogenous variables) in the model to the lagging indicators as endogenous variables.

We suggest that future research focuses on studying temporal relationships between leading and lagging perspectives in the BSC for different level of competition (and type of strategy) and in different industries.

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