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Human resource management and organisational productivity: A systems approach based empirical analysis

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Abstract

Purpose – The purpose of this paper is to present robust evidence about the effects of human resource management (HRM) systems on organizational productivity, by mixing both distal objective and proximal subjective measures, and by proposing an estimation method that employs hard HRM data.
Design/methodology/approach – The purpose of the study is achieved via a simultaneous equations system that has been estimated and simulated, based on an augmented Cobb-Douglas production function, which innovatively has been transformed from static to dynamic, using both economics-based literature and literature from the HRM discipline.
Findings – The study supports the view that HRM has a positive impact on productivity, through employee skills, attitudes, and behaviour. Additionally, the study finds that a 10 per cent increase in the extent of the systematic use of HR practices will lead to a 3.27 per cent increase in the total production, and that employee compensation and incentives play the most important role in improving production efficiency. Further, the study finds that for each additional year of systematic use of HR practices, total production will be increasing by 0.07 per cent per annum.
Practical implications – The findings of the study suggest practitioners that competitiveness (expressed by increased productivity) will be increased not by reducing costs, as a result of dismissing employees or decreasing wages, but instead by improving productivity as a result of increased compensation and incentives, and improved training and development.
Originality/value – The key output of the paper is the development of a sophisticated model that links an HRM system to a production system, through intermediate HRM outcomes, and the extension of the "generalised method of moments" as a systems estimation method that should be used for curing possible misspecification and common method bias problems in the HRM discipline.

Keywords High-performance work systems, HR strategy, Organization effectiveness
Paper type Research paper

Introduction

A growing body of theory and empirical research demonstrating the causal links between human resource management (HRM) and business performance has now dominated both academic and practitioner debate over the last 20 years or so (Gerhart, 2007). However, while the field of the HRM – performance relationship has evolved rapidly (Paauwe, 2009), core questions about the relationship between HRM and performance still lack robust explanation (Camps and Luna-Arocas, 2012; Guest, 2011; Jiang and Liu, 2015). These core questions are extended along two dimensions. The first refers to the contingency question asking "under what conditions an HRM system may have an impact on performance?" The second refers to the process question asking "what is the process under which an HRM system may have an impact on performance?" Additionally, various problems have bedevilled research in this area making our knowledge uncertain (Purcell and Kinnie, 2007; Guest, 2011). Although the

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general message conveyed by a large part of the literature is that HR practices do promote organizational performance (Wall and Wood, 2005), a combinations factors related to the methodology and frameworks followed, the performance measures used, the configuration of the HRM system(s) used for analysis, and the theory that explains the causal link between HR practices and performance have produced mixed research results in the field (Purcell and Kinnie, 2007).

Considering that the use of financial performance measures are far removed from HRM influence, i.e., too distal (Rucci *et al.*, 1998), and that there is no convincing methodology measuring the influence of HR practices on profitability (Purcell and Kinnie, 2007), in this study we have used a mixture of measures (i.e. operational and financial performance) to develop a robust model of HRM – performance relationship. This is because, despite the presence of well-established models linking HRM to proximal operational performance, through employee attitudinal and behavioural HRM outcomes, very few studies have explored this chain with respect to distal measures such as sales and profit (Wei and Lau, 2010). Specifically, we tested whether HRM outcomes such as employee skills, attitudes, and behaviour mediate the relationship between HRM and total production, utilizing a production function and a related HRM system (Guest, 2011; Voorde *et al.*, 2012). In addition, we examined whether employee behaviour, being an input variable in the production function, along with capital assets and labour, improves organizational productivity. Thus, this paper by combining HRM perspectives with those from production sciences, decision sciences, and operations management tries to meet researchers who argue for a broadening of analysis beyond HRM into related areas (see Sparrow and Cooper, 2014).

The present study contributes to the literature in four ways. First, previous research has examined organizational productivity in terms of capital assets and labour, adopting from the economists' toolbox a Cobb-Douglas production function as a baseline function (Grimshaw and Rubery, 2007). The Cobb-Douglas specification for the production function expresses physical output as a multiplicative and exponential function of all the inputs involved such as labour and capital assets. This function is attractive, compared to other production functions such as the constant elasticity of substitution function, because it generates coefficients and tests hypotheses that are easy to interpret (MacDuffie, 1995). Moreover, its underlying assumptions of the substitutability between labour and capital assets and the multiplicative relationship among interrelated inputs is a good fit to the manufacturing context (MacDuffie, 1995). The usual methodology followed in previous studies has been to directly augment the baseline Cobb-Douglas production function with various HR practices inputs in order to capture their effects on productivity. For example, Birdi *et al.* (2008) and Jones *et al.* (2010) extended the baseline function by incorporating an HRM vector to capture the effects of the HR practices. The present study brings together two inputs that have not been integrated in previous research within the baseline production function: employee behavioural responses and the time lag since HR practices were systematically introduced in the organization. In particular, we followed calls from Richardson and Thompson (1999, p. 32) arguing that the "time lag in terms of the design and introduction of new HR strategies as well as their impact on organizational performance is important for future research", Guest (2011, p. 9) highlighting that "one of the problems arising from the limited data from longitudinal studies is that we do not know when good HRM was introduced", and Wright and Nishii (2012) arguing that it takes some time before an investment in HR practices has a positive impact on performance. Thus, the production function in the present study, which has properly controlled for capital assets and labour, contributes to the literature in three

ways. First, by introducing the time lag of HR practices in the production function, it transforms a properly specified production function from a static to quasi-dynamic one, enabling the whole methodology framework to incorporate and predict elements (Wright *et al.*, 2005). Considering, that this new input in the production function is introduced in a multiplicative form, it is pointing towards non-linear effects between HRM and productivity (Kaufman, 2015; White and Bryson, 2013). Second, this is taken to recognize that HR practices mature over time and only matured HR practices tend to yield significant productivity gains (Kato and Morishima, 2002). Third, it properly mixes both the distal objective (e.g. sales) and proximal perceived subjective (e.g. employee behaviour) measures with respect to HRM (Rucci *et al.*, 1998; Sparrow and Cooper, 2014).

Taking into account that employee behaviour is an explanatory variable in the production function, a second contribution of this study is to connect the production function with the HRM system that determines employee behaviour. Previous research has examined individually either the augmented production function (Birdi *et al.*, 2008; MacDuffie, 1995) or the HRM system with respect to firm performance as the ultimate output and not with respect to the production function as the intervening process (see Prieto and Santana, 2012). The present study brings together the augmented production function and the HRM system. Specifically, it utilizes the AMO theory, where the HRM policy domains (Lepak *et al.*, 2006) of employee's "ability" to perform, "motivation" to perform, and "opportunity" to perform, first generate the HRM outcomes of employee skills, employee attitudes, and employee behaviour, which in turn affect firm performance (Appelbaum *et al.*, 2000; Ichniowski *et al.*, 2000; Kooij *et al.*, 2013). Thus, the connection of the production function with the HRM system in the present study, contributes to the literature in at least three ways. First, it provides a convincing methodology for measuring the influence of HR practices on objective measures of output (Purcell and Kinnie, 2007) by shifting the analysis of the impact of HR practices on performance away from statistical significance to concern for the effect size (Combs *et al.*, 2006). Second, although it is accepted that HRM is positively related to performance (e.g. Combs *et al.*, 2006; Wall and Wood, 2005), relatively few studies have explored the impact of HRM systems, through employees' skills, attitudes, and behaviour, on objective measures such as sales and profits (Guest, 2011). Third, by connecting the HRM system with the production function, the specification of the relationship between HRM and firm performance is properly determined, resulting in unbiased and consistent estimates (Gerhart, 2007; Greene, 2008).

Ordinary least squares and maximum likelihood are two common methods of estimation used in the HRM literature. Both methods depend on assumptions such as specifying particular distributions of errors. The generalized method of moments (GMM) is an estimation procedure that allows operational models to be specified while avoiding restrictive assumptions (Greene, 2008). Another contribution of this study is the introduction of GMM as an estimation method for systems investigating the HRM-performance relationship. This method contributes to the literature in two ways. First, it extends the estimation method of the instrumental-variable regressions, proposed by Antonakis *et al.* (2012) for curing possible common method bias problem. Second, it contributes to the relatively new literature of systems approach of the impact of HR practices on organizational productivity (Kato and Morishima, 2002) by providing rigorous evidence through econometric methodology. The systems approach stresses the interdependence of external and internal factors in an organization. This has the advantage to objectively separate the impact of each HRM system on organizational productivity, with a significant statistical confidence (Wang *et al.*, 2002).

Finally, there have been calls for more research in different national settings, especially in non-US/UK contexts (Boselie *et al.*, 2005). Responding to such a call, this study has been conducted in the Greek context. Greece is a peripheral country in the European Union that has been heavily affected by the 2008 economic and financial crisis. Therefore, it would be interesting to extend the debate on the role of HRM systems in improving organizational performance to countries such as Greece (Katou *et al.*, 2014). This is because countries such as Greece that cannot attract new domestic or foreign investment in order to get out of the recession may rely on their own people, i.e., on its own human capital. We consider this as the fourth contribution of the study, because it presents additional evidence, which supports the HRM-performance relationship from different contexts.

HRM-productivity framework

Figure 1 presents an operational model linking HRM to production. This model, by integrating frameworks that have previously run independently in the HRM and performance literatures (Albrecht *et al.*, 2015) has three distinctive components – the HRM systems, the HRM outcomes, and the production process. Specifically.

The HRM systems

According to the AMO theoretical framework there are three HRM systems that shape individual and aggregate employee characteristics that influence organizational productivity (Lepak *et al.*, 2006): first, the HRM system that influences employees' ability to perform; second, the HRM system that influences employees' motivation to perform; and finally, the HRM system that influences employees' opportunity to perform. The HR practices that constitute these systems are not considered to be bundles of HR practices that the best practice approach advocates, but they are just HR

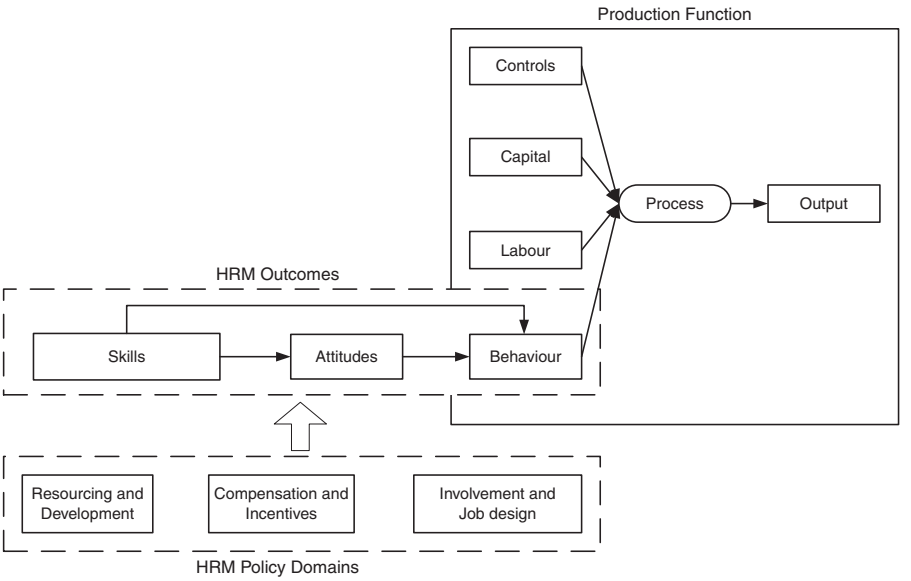

Figure 1.
The HRM-productivity framework

practices domains that put up the conditions of the mediating mechanism in the HRM – performance relationship (Boxall and Macky, 2009; Combs *et al.*, 2006).

Specifically, the HRM system that involves the traditional HRM areas of resourcing and development influences employees' ability to perform by improving their knowledge, skills and, abilities. The HRM system involving the areas of compensation and incentives influences employees' motivation to perform by shaping their attitudes of motivation, commitment, and satisfaction. The HRM system including the areas of involvement and job design influences employees' opportunity to perform by shaping their behaviours such as employee retention (counterpart of turnover) and presence (counterpart of absenteeism). Each of these three HRM systems may directly or indirectly influence all three HRM outcomes of employees' skills, attitudes, and behaviours. Therefore, the HRM systems may be associated with more than one HRM outcome category (Lepak *et al.*, 2006), indicating that the influences of the three HRM systems on productivity may fully or partially be mediated by the three HRM outcomes (Banks and Kepes, 2015; Katou *et al.*, 2014).

The HRM outcomes

The philosophy of the AMO perspective is that it encompasses mediating changes in employees' abilities, motivations, and opportunities to participate, that positively influence organizational productivity (Boselie *et al.*, 2005; Knies and Leisink, 2013). In the present model, the HRM outcomes of employee skills, attitudes, and behaviours are broader than employees' abilities, motivations and opportunities, respectively, because it includes highly interrelated yet logically and empirically distinct constructs than the traditional AMO perspective. The influence of these HRM outcomes on organizational productivity may take place either serially from skills through attitudes and then through behaviours (Wright and Nishii, 2012) or in parallel directly from skills, attitudes, and behaviour on organizational performance (Jiank *et al.*, 2012; Subramony, 2009).

Considering the serially mediating mechanism, which has been advanced over the last decade or so (Purcell and Kinnie, 2007), it is argued that employee characteristics, such as employee skills, do not provide value to the organization unless they are embedded through proper employee attitudes (Wright *et al.*, 1994). Furthermore, it is the employee attitudes that determine the extent to which employees are prepared to use effectively their various capabilities for the benefit of the organization (Schuler and Jackson, 1987). Moreover, it is argued that in order to bring lasting and better results and to significantly contribute to the success of their organization, employees must be motivated, committed, and satisfied (Paul and Anantharaman, 2003; Paauwe, 2004). Additionally, it is accepted that unless the organization is able to retain its employees, it will not be able to capitalize on the human assets developed within the organization. Thus, employee retention and employee presence may have a positive impact on organizational effectiveness (Boselie *et al.*, 2001; Wood *et al.*, 2012).

From the discussion thus far we see that the present model integrates both the AMO perspective in terms of the three HRM systems included and the causal model of the serially related HRM outcomes (Wright and Nishii, 2012; Purcell and Kinnie, 2007). Accordingly, we hypothesize the following functions.

The employee skills function

The pool of employee resources and capabilities of an organization depends considerably on employee resourcing and development (Appelbaum and Reichart,

1998). Aaker (1989) and Snell (1992) argue that staffing and training lie at the heart of the processes aiming at developing the necessary skills for maintaining competitive advantage and organizational performance. Individual and team training and development may be employed to add new skills to the existing employee resources and capabilities. Increasing employee skills and abilities are expected to create future returns through increased productivity and business performance (Shih *et al.*, 2006). Apart from resourcing and development (*RD*), compensation and incentives (*CI*), and involvement and job design (*IJ*) are considered to positively affect employee skills (*SK*) (Lepak *et al.*, 2006). This is presented in the following function:

$$SK = f\left(\overset{+}{RD}, \overset{+}{CI}, \overset{+}{IJ}\right) \tag{1}$$

where the signs above the variables indicate the sign of the relationship between the dependent and the explanatory variables. Accordingly, we hypothesize that:

H1. Resourcing and development, compensation and incentives and involvement, and job design positively influence employee skills.

The employee attitudes function

The processes of resourcing and development, compensation and incentives, and involvement and job design have an impact on the attitudes of employees, such as motivation, commitment, and satisfaction either directly or indirectly through increased skills (Wright *et al.*, 2003). Specifically, a large body of research considers motivation to be a key determinant of performance (Keller, 1999). Employees' attitudes and behaviours generally depend on the practices and procedures the organization is employing (Montes *et al.*, 2003). In particular, training and development may convey a message to employees that it is in the best interest of the organization to have employees stay longer in the firm (Guest, 2001; Lepak *et al.*, 2006; Wright *et al.*, 2003). Furthermore, incentive schemes basing employee rewards on profits may ensure that employee interests are aligned with owner interests. Similarly, benefits schemes applied to all employees may send a message that all employees are valuable assets (Wright *et al.*, 2003). Accordingly, skills (*SK*), resourcing and development (*RD*), compensation and incentives (*CI*), and involvement and job design (*IJ*) are considered to positively affect employee attitudes (*AT*). Hence:

$$AT = f\left(\overset{+}{SK}, \overset{+}{RD}, \overset{+}{CI}, \overset{+}{IJ}\right) \tag{2}$$

Accordingly, we hypothesize that:

H2. Employee skills, resourcing and development, compensation and incentives, and involvement and job design positively influence employee attitudes.

The employee behaviour function

The above messages to employees, which determine the so-called employment security dimensions (Pfeffer, 1998), may be translated into employee behaviours, such as staying long within the organization and to avoid absenteeism (Datta *et al.*, 2005; Guest, 2001). In fact, according to the job performance theory (Campbell, 1990), it is employee's attitudes that have an impact on the behaviour of employees that subsequently has an impact on organizational performance (Wright *et al.*, 2003; Wright and Nishii, 2012).

In particular, it has been argued that turnover is heavily influenced by job satisfaction, motivation, and organizational commitment (Reeve, 1996). No employee would like to stay with an organization if they are not satisfied with their work, if they lose their motivation and commitment to the organization (Liao *et al.*, 2009; Allen *et al.*, 2003), and if they are not developing their skills and knowledge (Thomson and Harley, 2007). Thus, skills (SK), attitudes (AT), resourcing and development (RD), compensation and incentives (CI), and involvement and job design (IJ) are considered to positively affect employee behaviour (BE). Therefore:

$$BE = f\left(\overset{+}{SK}, \overset{+}{AT}, \overset{+}{RD}, \overset{+}{CI}, \overset{+}{IJ}\right) \tag{3}$$

Accordingly, we hypothesize that:

H3. Employee skills, employee attitudes, resourcing and development, compensation and incentives, involvement and job design positively influence employee behaviour.

The production process

The usual production-function framework is described by the following equation:

$$Q = f(K, L, T) \tag{4}$$

where Q measures output, K and L measure total capital assets and total employment, respectively, and T is a variable, such as long implementation of strategies, indicating the entrepreneurial factor in the production function (Jones and Kato, 1995; Kato and Morishima, 2002; Wang *et al.*, 2002; Jones *et al.*, 2006; Birdi *et al.*, 2008). In our case, variable T refers to the time lag since HR practices started systematically being used by the organization. This is important for the proper specification of the production function because it is argued that it takes some time before the implementation of HR practices start to influence performance (Wright and Nishii, 2012).

Although the input of L in the production function refers to the total number of people employed, this number may be misleading in a production function due to the fact that some employees are not present (absenteeism) in the production process, lowering thus the absolute number of total employees, and due to the fact that some employees do not stay within the organization (employee turnover), disturbing thus the synergistic efficiency structure of employees (Lopez and Sune, 2011). Thus, considering that retention (d' Arcimoles, 1997; Boselie *et al.*, 2001) and presence (Arthur, 1994; d' Arcimoles, 1997; Boselie *et al.*, 2001) constitute two major behavioural characteristics of employees, a variable BE which denotes a measure of behaviour and includes these two characteristics should be included in the production function. Therefore, the production function in (4) should be augmented with variable BE, which is assumed to positively influence the effect on production of the total number of people employed. Thus, capital (K), labour (L), time (T), and behaviour (BE) are considered to positively affect output (Q), determining the new augmented production function used in the study, which is:

$$Q = f\left(\overset{+}{K}, \overset{+}{L}, \overset{+}{T}, \overset{+}{BE}\right) \tag{5}$$

Accordingly, we hypothesize that:

H4. Capital, labour, the time lag since HR practices started to be systematically used by the organization, and employee behaviour positively influence organizational productivity.

Methodology

Sample

A large questionnaire survey in the Greek manufacturing sector was carried out between March and September 2012. A sample of 600 organizations was used from the main Greek directory – ICAP. The sample was obtained by employing the stratified methodology, including organizations with more than 20 employees. 20 per cent of the approximately 3,000 organizations were randomly chosen from each stratum of the directory. Using personal connections-samplers, the questionnaires were taken personally to the organizations. In all, 169 usable questionnaires were received, a response rate of approximately 28.2 per cent. The distribution of the sample organizations with respect to the type of industry was similar with the distribution of the population organizations. Specifically, 46.2 per cent of the sample organizations were involved in the production of food products, beverages, textiles and textile products, linen, wearing apparel, footwear and leather products. We classified these organizations as being traditional because the primary inputs for their production come mainly from the agricultural sector, which still is the traditional sector in Greece. The rest of the sample organizations (i.e. 53.8 per cent) were involved in the production of wood and cork, pulp and paper, petroleum products, chemicals, pharmaceuticals, rubber and plastic products, non-metallic mineral products, basic metal industries, metal products except machinery, machinery and equipment, office machinery and computers, electrical equipment, electrical machinery, motor and other transport equipment, furniture, and other. We classified these as modern organizations, because the primary inputs for their production do not come from the agricultural sector. The breakdown of company size with regard to number in the labour force is as follows: from 20 to 100 (41.5 per cent), from 101 to 200 (25.5 per cent), and more than 200 (33.0 per cent).

Most of the questions for the survey were drawn from existing international HRM surveys such as the Cranet survey (e.g. Brewster and Hegewisch, 1994). The questionnaire was originally developed in English, then, it was translated into Greek, and finally translated back from Greek to English. The translated questionnaire was piloted in ten organizations, and it was handed to the CEO, or Personnel Officers, or Financial Officers of the sample organizations. One person responsible in each firm from the HRM function completed the survey questionnaire. We acknowledge this as a limitation, although it is argued that it is not how many people from each organization respond to a survey that is critical but who responds to the survey that is most important (Lepak *et al.*, 2006).

Measures

All variables used in the study are presented in column one of Table I. Specifically.

Basic production function variables. Total sales (Q) of the organization were used as the output in the production function, total fixed assets (K) were used as total capital stock, and total number of employees (L) was used as labour (Jones *et al.*, 2006).

Variable/construct	Items and dimensions	Cronbach α	Per cent of variance explained
Capital stock	In million €		
Sales	In million €		
Labour	In numbers of employees		
Skills	Competences	0.919	86.140
	Managerial cooperation skills		
	Employee cooperation skills		
Attitudes	Motivation	0.923	86.943
	Commitment		
	Satisfaction		
Behaviour	Retention (counterpart of turnover)	0.855	87.317
	Presence (counterpart of absenteeism)		
Resourcing and development	Recruitment	0.852	67.373
	Selection		
	Separation		
	Flexible work arrangements		
	Training and development		
	Monitoring training and development		
	Careers		
	Performance appraisal		
Compensation and incentives	Job evaluation	0.871	66.220
	Compensation		
	Promotion		
	Incentives		
	Benefits		
Involvement and job design	Work design	0.830	66.312
	Participation		
	Involvement		
	Communication		
	Health and safety		
Controls	Time (since HRM started been used)	0.971	73.673
	Industry (1 = traditional, 2 = modern)		

Table I.
Characteristics of all the variables used in the study

Although the survey respondents reported these measures, the data are factual and separate from any perceptual HRM systems or HR outcomes measures.

HR systems. For the classification of the HRM systems we followed Lepak *et al.* (2006), who indicated three sets of HR practices according to the AMO perspective. Respondents were asked to report their perceptions about the extent of systematic use (measured on a five-point scale, where 1 = very low to 5 = very high) of HR practices (Huselid *et al.*, 1997). Example items include "How would you rate the extent of systematic use of the training and development practice in your organization?" and "How would you rate the extent of systematic use of work design practice in your organization?"

HRM outcomes. Following Guest (1997) and Batt (2002), three types of HRM outcomes have been indicated (measured on a five-point scale, where 1 = very bad to 5 = very good): employee skills (competence, managerial cooperation skills, employee cooperation skills), employee attitudes (motivation, commitment, satisfaction), and employee behaviours (retention, presence). Example items include "How would you rate motivation of employees in your organization?" and "How would you rate retention of employees in your organization?"

Controls. With respect to variable *T* of the long implementation of successful strategies, we asked respondents about "the number of years (from 0 to 6 = more than 5 years) since when the organization started using systematically each one of the individual HR practices". Although we acknowledge that this construct is skewed to the left due to level "6 = more than 5 years", we still believe that this construct gives an indication of the mean value of the years since organizations started systematically using the HR practices. Comparing performance across organizations in different industries might be problematic due to industry effects (Batt, 2002). Therefore, we used the traditional and modern classification of the organizations to produce an industry control (*IN*) to capture all other organizational and environmental forces that are related to productivity (Prieto and Santana, 2012).

Consistency of the survey instrument

Content validity of the questionnaire is established by using accepted and validated items developed in the literature. All Cronbach α's presented in Table I are much higher than 0.70, indicating construct internal consistency (Nunnally, 1978). Construct validity is verified considering that the values of the percentage of total variance explained (see Table I) and the average variable extracted (AVE) (see Table II) per dimension obtained by applying confirmatory factor analysis with Varimax rotation and the eigenvalue greater than one criterion, are higher than 50.0 (Hair *et al.*, 2008). Construct composite reliability is assessed by examining the calculated composite reliability scores (Pavlou and Gefen, 2005). The figures in Table II indicate that the degree of construct reliability is acceptable, since all reliability scores exceed 0.90. Construct discriminant validity is assessed by examining whether the square root of each factor's AVE is larger than its correlations with other factors (Gefen and Straub, 2000). Table II presents the correlation coefficients of all constructs used in the study. It is seen that all correlation coefficients are smaller than the square root of each factor's AVE, thus providing evidence for separate constructs.

Statistical analysis

Equations (1), (2), (3), and (5) constitute an over-identified simultaneous equations system. Production, employee skills, attitudes, and behaviour, i.e., the final outcome and intermediate outcomes, constitute the endogenous variables, whilst, the three HRM systems, the capital and labour inputs in the production function, the time indicator and the industry control constitute the exogenous variables. To test the proposed framework and considering that the data are cross-sectional, the estimation method used in the study is the GMM, treating all exogenous variables of the system as instruments (Greene, 2008), in order to get estimates that will be robust to heteroskedasticity of unknown form (Eviews, 2000). This method is advantageous relative to the standard regression analysis because it considers the problem of the simultaneous equation bias, due to the possible relationships between explanatory variables and errors (Gerhart, 2007; Greene, 2008; Lebedinski and Vandenberghe, 2014). In estimating the system we employed both linear and exponential specification of its equations. However, in the next section we only report the results for the exponential specification (i.e. the linear in logs specification) due to the fact that these results are much better than the results referring to the linear specification, thus supporting Chadwick's (2007) caution about the existence of non-linear relationships between human resource practices and manufacturing

Table II.
Means, standard errors of means, and correlations between all the variables used

	Mean (standard error)	Construct reliability[a]	Capital	Sales	Labour	Skills	Attitudes	Behaviour	Resourcing and development	Compensation and incentives	Involvement and job design	Time
Capital (million €)	46.477 (21.623)		1									
Sales (million €)	59.500 (19.995)		0.467**	1								
Labour	289.195 (33.447)		0.472**	0.360**	1							
Skills	3.3931 (0.0689)	0.998	−0.034	0.063	−0.036	[0.907]						
Attitudes	3.2862 (0.0729)	0.998	−0.034	0.045	0.064	0.842**	[0.912]					
Behaviour	3.4882 (0.0723)	0.997	−0.051	0.030	0.005	0.712**	0.762**	[0.902]				
Resourcing and development	3.2351 (0.0624)	0.987	−0.085	−0.024	0.043	0.424**	0.449**	0.362**	[0.647]			
Compensation and incentives	3.1886 (0.0608)	0.989	−0.077	0.076	−0.073	0.495**	0.527**	0.356**	0.587**	[0.702]		
Involvement and job design	3.3827 (0.0619)	0.986	−0.063	0.054	−0.042	0.479**	0.507**	0.360**	0.517**	0.463**	[0.678]	
Time	3.9624 (0.1369)	0.997	0.123	0.176*	0.152*	0.154*	0.156*	0.037	0.221*	0.212**	0.256**	[0.761]

Notes: [a]Construct reliability $= \left(\sum_i \lambda_i\right)^2 \Big/ \left[\left(\sum_i \lambda_i\right)^2 + \sum_i \left(1-\lambda_i^2\right)\right]$ where λ_i is standardized loading; [b]Diagonal figures in brackets represent average variance extracted (AVE).
*,**Correlation is significant at the 0.05 and 0.01 level (two-tailed)

performance. Under the exponential specification, the production function takes the form of a Cobb-Douglas type production function (Kato and Morishima, 2002; Wang *et al.*, 2002; Bartel, 2004; Goergen *et al.*, 2014; Jones *et al.*, 2006; Birdi *et al.*, 2008). Furthermore, we must note here that apart from the system of Equations (1), (2), (3), and (5), which proposes serial influence of HRM outputs, we estimated an alternative system, which assumes parallel influence of HRM outcomes. In the serial influence approach, employee behaviour is the ultimate HRM output that is included as an explanatory variable in the production function. This variable depends on employee skills either directly or indirectly through employee attitudes. In the parallel influence approach, all three HRM outputs, and not only employee behaviour, are included as explanatory variables in the production function. However, the results of the second system were not promising, and thus we do not report them.

Common method bias

To minimize the possible effect of common method bias we used two sources for collecting data (Podsakoff *et al.*, 2003). The first source is the ICAP database in order to get the objective measures of sales, number of employees, and capital assets of each sample organization. The second source refers to the personnel officers of each sample organization to get perceived subjective measures with respect to HR practices and HRM outputs.

Although the correlation matrix in Table II highlights some high correlations between the perceived subjective measures, the construct composite reliability test and the construct discriminant validity test indicated above that all constructs are reliable and independent. Additionally, multicollinearity among these constructs is not a serious concern since all relevant checks such as condition index (largest CI = 19.809, which is less than 30), tolerance values (smallest TOL = 0.266, which is greater than 0.10), and variance inflation factors (largest VIF = 3.762, which is less than 10) did not suggest evidence of significant multicollinearity (Kleinbaum *et al.*, 1988).

The application of Harman's single factor test (Harman, 1976) to all the perceived subjective constructs in the model, using an un-rotated factor analysis with eigenvalue greater than one criterion, revealed seven factors, and not just one. Specifically, the analysis revealed that the first factor explained 26.86 per cent of the variance in the data, which is not relatively very high, and the first three factors were those that together explained about 50 per cent of the variation (53.03 per cent) in the data and not just the first factor. Because several factors were identified and the first factor did not account for the majority of the variance, common method bias does not appear to be a concern (Podsakoff and Organ, 1986).

Considering all the above we believe that common method bias in the data are relatively limited. However, to avoid the biased and inconsistent estimates of possible common method, estimation procedures such as theGMM utilizing instrumental variables were used. The instrumental variables were developed using the objective variables of the sample organizations presented in Table III, which are grouped as close as possible to the context of the three HRM systems used in the study. Specifically, each construct of the three HRM systems is regressed on all the objective variables included in each relevant group context in Table III. The instrumental variable that corresponds to each HRM system is the prediction of the dependent variable obtained from each regression. The instrumental variables methodology

Variables	Mean	Standard error
Resourcing and development		
Per cent of positions filled using formal processes	84.06	1.79
Average days taken to fill new positions	21.81	1.46
Ratio of offers made to the total number of applicants	0.14	0.01
Per cent of managerial employees completing training programmes per year	45.80	2.27
Per cent of non-managerial employees completing training programmes per year	35.19	1.92
Average number of training days managerial employees follow per year	7.33	0.51
Average number of training days non-managerial employees follow per year	5.86	0.43
Compensation and incentives		
Per cent of managerial employees promoted annually	19.91	1.50
Per cent of non-managerial employees promoted annually	17.53	1.15
Per cent of managerial employees whose salary is determined on the basis of their performance appraisal	56.77	2.35
Per cent of non-managerial employees whose salary is determined on the basis of their performance appraisal	45.44	2.15
Number of years between promotions of managerial employees	3.44	0.15
Number of years between promotions of non-managerial employees	3.71	0.16
Involvement and job design		
Per cent of managerial employees whose jobs have been formally designed	72.87	2.21
Per cent of non-managerial employees whose jobs have been formally designed	69.91	2.00
Percentage of grievances settled in one year	88.10	1.51
Average number of days to settle a grievance	6.07	0.73
Percentage of managerial employees involved in participation schemes	64.89	2.55
Percentage of non-managerial employees involved in participation schemes	26.02	1.65

Table III.
Variables used in developing instruments

"truly is a cure to endogeneity resulting from omitted variables, measurement error, simultaneity, and common method bias" (Cameron and Trivedi, 2005; Greene, 2008; Kennedy, 2003), and "we hope future researchers will reap the benefits of this method" (Antonakis *et al.*, 2012).

Results

Table II presents means, standard errors of means, and bivariate correlation coefficients between all the variables used in the study. Further it shows that all HRM systems are positively and significantly correlated to all HRM outcomes, and that capital assets, labour and time used of HR practices are positively and significantly correlated to sales. All these correlations may support the hypotheses indicated by the relationships specified in the operational model.

However, results based on correlations, although interesting, may be misleading due to the interactions between several variables. Therefore, in order to isolate the possible influences between the variables involved in the operational model presented in Figure 1, Equations (6), (7), (8), and (9) present the results of the estimated equations

with GMM, using Eviews 6.0. Considering the relatively small significant levels of the coefficients (reported in brackets under the estimated coefficients) and the rather high for cross-section data coefficients of determination (R^2), the results are highly acceptable.

Production function

$$\log(Q) = 1.6756 + 0.0670T + 0.3784\log(K) + 0.6432\log(L) + 0.3778\log(BE) - 0.0161IN$$
$$[\text{sig.}] \quad [0.001] \quad [0.043] \quad [0.000] \quad [0.000] \quad [0.088] \quad [0.021] \qquad (6)$$
$$R^2 = 0.8018 \quad \overline{R}^2 = 0.7957$$

Skills function

$$\log(SK) = 0.0421 + 0.4716\log(RD) + 0.2879\log(CI) + 0.2323\log(IJ)$$
$$[\text{sig.}] \quad [0.515] \quad [0.000] \quad [0.026] \quad [0.035] \qquad (7)$$
$$R^2 = 0.6523 \quad \overline{R}^2 = 0.6460$$

Attitudes function

$$\log(AT) = -0.1451 + 0.9032\log(SK) + 0.1949\log(CI)$$
$$[\text{sig.}] \quad [0.061] \quad [0.000] \quad [0.046] \qquad (8)$$
$$R^2 = 0.7878 \quad \overline{R}^2 = 0.7852$$

Behaviour function

$$\log(BE) = 0.2691 + 0.8202\log(AT)$$
$$[\text{sig.}] \quad [0.000] \quad [0.000] \qquad (9)$$
$$R^2 = 0.7010 \quad \overline{R}^2 = 0.6992$$

Evaluation of the model about its ability to explain the underlying relationships is carried out by considering the signs of the estimates. The estimated parameters turned out to have the expected sign in all cases, supporting all hypotheses of the operational model of the study. As far as their magnitude is concerned little can be said with certainty, given the non-existence of similar models concerning Greek manufacturing.

Evaluation of the model with respect to the accuracy, with which the system of the equations forecasts the most important endogenous variables, can be made by investigating the forecasting performance of the simulated model (Greene, 2008) and associated with this criterion the HRM policy decision. We performed static simulation (and not dynamic simulation, because our data were cross-section and not time-series) using the estimated Equations (6), (7), (8), and (9). To evaluate the performance of the simulated model we employed the Theil's (1966) inequality coefficient (U) and its decomposition into the inequality proportions of bias proportion (U^B), variance proportion (U^V), and covariance proportion (U^C). We note here that the smaller the U is, the better the forecasting ability of the model. Furthermore, the forecasting ability of the model is better, when U^B and U^V are small, and U^C is large.

Considering the cross-section nature of the data used, the magnitudes of these coefficients, which are reported in Table IV, suggest that the forecasting performance of the model is satisfactory.

Discussion

Although the production function used in the study was not homogeneous, we found that the production process in Greek manufacturing exhibits constant returns of scale (i.e. if all inputs increase proportionally by a constant factor, output increases by the same proportional factor), because the sum of the elasticities of capital (0.38) and labour (0.64) add up to 1 (1.02). Presence and retention of employees increase total productivity, reflected in the elasticity of the behavioural variable, which is positive (0.38). The extensive use of HR practices in terms of time increases total production, considering its positive coefficient (0.07). This finding means that for each additional year of systematic use of HR practices, total production will be increasing by 0.07 per cent per annum. The coefficient of the industry control variable, capturing all other organizational and environmental forces that are related to productivity, being negative (−0.02), differentiates total productivity in favour of the traditional organizations compared to the modern organizations. These findings are important from three aspects. First, due to the constant returns of scale, increase of production depends proportionally on increases of capital and labour. Thus, these two inputs to production do not constitute factors, which the organization could advance for improving productivity. Second, it assumes that it is the behaviour of its workforce that may increase productivity. This finding is meaningful for increasing productivity because organizations could follow policies that may improve employee presence and retention. Third, by supporting the view that there is a time lag before the effects of management practices are translated to changes in organizational performance (Kozlowski and Klein, 2000; Wright *et al.*, 2005), recommending organizations to invest in HRM policies and practices in order to have the opportunity to see improvements in productivity.

Employee attitudes fully mediate the relationship between employee skills and employee behaviour, supporting Guest (2001) and Wright *et al.* (2003). Considering that the experiments referring to the parallel influence approach did not yield promising results, makes us to support the view of Wright *et al.* (2003), arguing that employee behaviour is of central importance to organizational effectiveness and that employee attitudes have a considerable influence of employee behaviour. Thus, we suggest that future researchers should use the research protocol employed in this study, which among others is considering the non-linear feature of the HRM – performance relationship and the serial influence of HRM outputs.

The perceived HRM systems of resourcing and development, compensation and incentives, and involvement and job design directly and positively influence

Table IV. Theil inequality forecasting coefficients

Variables	Theil inequality U	Bias proportion U^B	Variance proportion U^V	Covariance proportion U^C
Sales	0.135002	0.011990	0.144445	0.843565
Behaviour	0.081673	0.005953	0.048060	0.945987
Attitudes	0.084352	0.007225	0.053220	0.939555
Skills	0.102667	0.010369	0.094856	0.894775

perceived employee skills, demonstrating that the ability to perform domain is more important than the other two domains in determining employee skills and cooperation (Lepak *et al.*, 2006). This finding suggests that HRM policies and practices contribute to sustained competitive advantage by enabling the development of skills that are embedded in the organization's workforce. This core finding is consistent with the resource-based view of the firm (Barney, 1991), supporting that the organization can gain a competitive advantage from the effective and efficient use of the resources it possesses.

By examining the multipliers of the endogenous variables with respect to the application of a change to the exogenous variables of the three HRM systems, the sensitiveness of the system may be investigated. The multipliers were calculated as the percentage change between the simulated endogenous variable under the application of a 10 per cent increase in one (or all) of the exogenous variable and the corresponding simulated endogenous variables before the application of this increase of the exogenous variable. From the multiplier figures presented in Table V it is clear that compensation and incentives play the most important role in increasing output productivity, and in improving employee attitudes and behaviour in Greek manufacturing firms. The role of employee resourcing and development in increasing output productivity comes next, which influences the most employee skills, and last comes the role of employee involvement and job design. These findings support the view of Prendergast (1999, p. 7) that incentives are the "essence of economics", and considering that no study of management in the context of a production function has yet internalized incentives in the modelling of the HRM-performance link has added empirical evidence (Ziebert and Zubanov, 2008).

In terms of a combined improvement on the extent of systematic use of all HRM systems by 10 per cent, the impact on production (sales) is equal to 3.27 per cent. This increase is smaller than the increase found by Kato and Morishima (2002) for Japanese manufacturing, where a highly participatory system of human resource management practices (HRMPs) will lead to a significant 8-9 per cent increase in productivity, and closer to the result of Jones and Kato's (1995) finding that the improvement of employee stock ownership plans will lead to a 4-5 per cent increase in productivity. Furthermore, Jones *et al.* (2006) found that a one standard deviation increase in the construct of employee opportunities to participate and to receive appropriate information and pertinent rewards would increase productivity by 1 per cent, a result that may be considered to be similar with the results of the present study. However, there are no previous studies in the Greek context having estimated the effects of HR practices on firm productivity, using both perceived subjective and financial objective data, so it is rather difficult to consider the plausibility of the quantitative results obtained through the multipliers.

Table V. Multipliers for a 10 per cent increase in the systematic use of HR practices

Variables	Resourcing and development	Compensation and incentives	Involvement and job design	Joint HR practices
Sales	1.265928	1.352861	0.621739	3.274047
Behaviour	3.385425	3.620481	1.653937	8.900311
Attitudes	4.142751	4.431508	2.020149	10.95491
Skills	4.596906	2.782304	2.239110	9.914312

The methodology followed in this study reflects two cross-disciplinary approaches. On the one hand, the personnel economics approach, based on the incentive theory, which usually proposes the estimation of Cobb-Douglas production functions depending on the quantifiable inputs of capital and labour, and on information referring to wage rates and efficiency levels. On the other hand, the HRM performance approach, based on high-commitment work systems, indicate that HRM policies and practices themselves may have an impact on production by promoting effort (Grimshaw and Rubery, 2007). However, although the study joins these two approaches, its findings should be treated with caution because it has three major limitations. First, the simultaneous equation system used was static due to the cross-section nature of the data used. Thus, the simulation model and the calculated multipliers were also static. But, apart from the usual recommendation to future researchers that they should focus on examining the productivity effects of HR practices by estimating a similar dynamic system using either time series or longitudinal data, we remind them about the technique that we used in this study. The use of the time lag indicator since HR practices were systematically introduced in the organization is a much more simple and cost effective technique. Second, perceptual data are collected from single source respondent – with managers making comment about the attitudes they perceive in others. Thus, it is suggested that future researchers should refine the method proposed in the study by individualizing perceived data and by using a multilevel design in order to apply the system's estimation methodology. Third, the findings from the Greek context may not generalize across borders. Future research should consider including other countries such as Portugal, Spain, Cyprus, and Ireland that are experiencing similar economic conditions (Teague and Roche, 2014).

The findings of the study suggest that the impact on production (sales) of a 10 per cent increase in the extent of systematic use of HR practices is equal to 1.35 per cent for compensation and incentives, 1.27 per cent for resourcing and development, and 0.62 per cent for involvement and job design. This finding highlights that the motivation-enhancing HRM practices, such as compensation and incentives are the most important to explain manufacturing outcomes (Bello-Pintado, 2015) and support further the view that compensation and incentives are the essence of economics that improve productivity (Prendergast (1999).

The findings clearly show that an investment approach via human capital is clearly critical to improve productivity. Additionally, a clear message of the study is that "paying higher wages translates into more efficiency" (Guthrie, 2007, p. 344). However, many studies highlight the role of institutions in influencing output levels when certain preferred institutional strategies are not compatible with organizational strategies (e.g. Steedman and Wagner, 1989; Mason, 2000). Considering this, it may be argued that there are both micro and macro implications from the findings of this study. For example, a core policy that has been agreed between Greece, which is currently under economic and financial crisis and the "Three Institutions" (i.e. the European Commission, the International Monetary Fund, and the European Central Bank), is to decrease the general level of wages in the public and private sectors for improving competitiveness of the economy. However, this institutional policy may have negative impact on Greek organizations. This is because the findings of this study suggest that competitiveness (expressed by increased productivity) will be increased not by reducing costs, as a result of decreased compensation, but instead by improving productivity, as a result of increased compensation and incentives. Thus, at a micro level, the findings relate to the thrust of HR strategy, suggesting that organizational

productivity appears to require a specific HRM "formula" which includes positive compensation. But, the macro economic context creates conditions that would make it difficult for firms to fulfil this internal formula. Accordingly, Greek manufacturing firms might find themselves in a double bind. However, some might claim that such ideas are inappropriate in such a difficult economic climate, but these actions may create a more forward-thinking view of HRM (Marchington, 2015).

Conclusions

Having presented robust evidence about the effects of HRM systems on organizational productivity, through a methodologically challenging interdisciplinary system's estimation approach, this study lays out the core of a future human capital management approach as a way of addressing and guiding HR strategy around organizational productivity. It further suggests several important conclusions. First, the study concludes that a 10 per cent increase in the extent of the systematic use of HR practices leads through employee behaviour to a 3.27 per cent increase in the production of Greek manufacturing firms. However, it should be considered whether the costs of extra HRM usage might outweigh the benefits from increased production (Chadwick, 2007). Second, past systematic use of HR practices positively contribute to productivity (Shin and Konrad, 2015). Specifically, for each additional year of systematic use of HR practices, total production will increase by 0.07 per cent per year. This is taken to recognize that "HRMP 'mature' over time and only matured HRMPs tend to yield significant productivity gains" (Kato and Morishima, 2002, p. 517). Third, based on the AMO perspective, the study concludes that the impact of the HR practices on organizational productivity is serially mediated by the HRM outcomes of employee skills, attitudes, and behaviour (e.g. Guest, 1997; Appelbaum *et al.*, 2000; Ichniowski *et al.*, 2000). Fourth, although these conclusions are consistent with theory, the study shifts the analysis of the impact of HR practices on performance away from statistical significance to the estimation of the effect size of HRM systems (Combs *et al.*, 2006; Guest, 2011), by finding that employee compensation and incentives play a much more crucial role in determining organizational productivity, than employee resourcing and development, and involvement and job design. Thus, the study is not just indicating the HRM system that has the highest influence on productivity but it measures its precise contribution (Voorde *et al.*, 2012). Accordingly, this study implies that developers of HR practices in organizations should note that HR practices might somehow determine performance outcomes, but that mediating processes play an important role. Additionally, HR managers should have a very good understanding of how they can shape individuals' skills, attitudes, and behaviour towards the goal of improving organizational performance.

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