

Labor Flexibility and Innovation

The Moderator Effect of Environmental Dynamism

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Abstract

The paper analyzes the moderator effect of environmental dynamism in the relationship between human resource flexibility dimensions and innovativeness. The results of our survey to a sample of first-tier automotive suppliers indicate that the firm's level of environmental dynamism moderates the relationship between some flexibility dimensions and innovativeness: firms in high-dynamic environments can benefit more from both internal and external flexibility than firms in low-dynamic environments. Internal flexibility dimensions, specifically functional and numerical, are positively related to innovativeness whereas the association of external flexibility depends on the type of contingent employees: negative association for 'short-term hires' and positive association for 'consulting/contracting firms'. The paper discusses the implications of these results for research and managerial practice.

Introduction

Innovation contributes to the firm's competitive advantage by giving the firm a first-mover advantage and enabling it to differentiate itself in the market [1]. Among the factors influencing the innovation process of the firm, the relationship between human resource (HR) flexibility and innovation has received little attention. HR flexibility focuses on adapting employee attributes (such as knowledge, skills, behaviors or volume of work) to changing environmental conditions. This flexibility is important because influences innovation in several ways. For instance, skill polyvalence enables employees to respond better to stimuli which have appeared previously by thinking of new ideas and accelerating the process of new product development to introduce more products, more quickly than competitors.

However, prior research has not established consistent relationships between HR flexibility and innovation. Whereas some theoretical perspectives and empirical research suggest the need to build and sustain committed human resources with full-time and permanent contracts [2,3], others argue that different types of looser employment relationships are beneficial to innovation [4]. The failure to take into account some moderators like environmental dynamism could be one reason to explain the non-conclusive relationships between HR flexibility and innovation. Environmental dynamism describes the rate of change and the unpredictability of change in a firm's external environment. Firms in highly dynamic environments may need to enhance the in-house dispersion of knowledge and the deployment of employees' skills through flexible practices that contribute to innovation. Similarly, firms in highly dynamic environments may need more access to relevant external knowledge with less risk than firms in more stable environments.

Then, the purpose of this research is to study the role of dynamism as a moderator of the HR flexibility-innovation relationship. Based on previous work, we develop a conceptual

model and propose how each dimension of HR flexibility may contribute to the firm's innovation, and how environmental dynamism may moderate these relationships. Several hypotheses are formulated and tested with data collected from Human Resource and Technology managers working for Spanish first-tier automotive suppliers. Our research develops the theoretical perspective on HR flexibility and innovation by analyzing more flexibility dimensions than other studies. The 'breadth' of our flexibility constructs and the moderator effect of environmental dynamism allow analyzing different causal mechanisms between HR flexibility and innovation.

Discussion and hypotheses

Innovation is studied in many disciplines and has been defined from different perspectives. This study focuses on innovativeness that we define as the newness of the product and process innovation developed by the firm, and the improvement in the innovation process of the firm (such as time, cost and quality). This definition is consistent to the approach to innovativeness in the literature; for instance, Rogers [5] defines innovativeness as the newness or earlier adoption of innovations by the firm in comparison to competitors.

Innovativeness depends not only on the firm's ability to exploit its resources but on exploring new not yet existing or at least fully realized dynamic capabilities [6]. Capability theory [7] predicts that the firm's ability to build and reconfigure internal and external competencies to respond to rapid changes in their environment lies at the center of innovativeness. Flexibility options have the potential to broaden the range of capabilities necessary for innovativeness. Some scholars [8,9] argue that human resource (HR) flexibility dimensions constitute a platform to build other levels of flexibility and explain the variations of innovativeness. Milliman et al. [10] define human resource flexibility as "the capacity of HR management to facilitate the organization's ability to adapt effectively and in a timely manner to changing or diverse demands from either its environment or from within the firm itself" [10, p. 325].

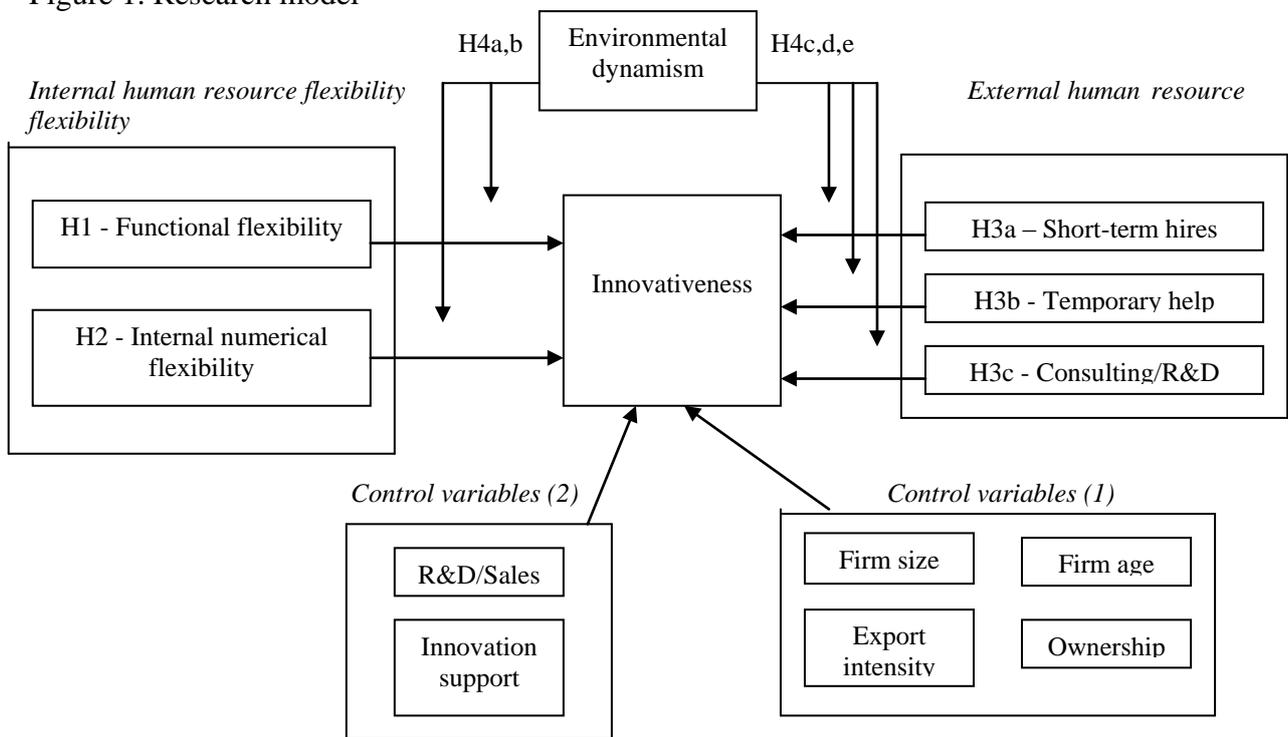
HR flexibility can be classified in internal and external. Internal HR flexibility involves efforts to increase the firm's ability to adjust to changing circumstances through modifications of the internal labor market or work organization (functional flexibility and internal numerical flexibility). External HR flexibility uses changes in the external labor market through several mechanisms such as short-term hires, temporary help agencies, or consulting/contracting firms and R&D centers. Each type of HR flexibility may contribute differently to deploy employees' embedded knowledge and to broaden the access to knowledge-based resources that support innovativeness.

The literature review reveals disagreements about the nature of the association between HR flexibility and innovativeness. Whereas some theoretical perspectives and empirical research suggest the need to build and sustain committed human resources with full-time and permanent contracts, others argue that different types of looser employment relationships may contribute to innovativeness. The non-conclusive findings can be explained because the absence of moderators in these studies and because prior research is mostly focused on the influence of single flexible practices on limited measures of innovation output [3,11,12,13].

Environmental dynamism may be relevant to this topic of research. Figure 1 depicts our research model. We propose that both internal and external dimensions of HR flexibility are

related to innovativeness, and that environmental dynamism moderates these relationships. The next paragraphs develop the research hypotheses.

Figure 1. Research model



Internal HR flexibility includes two dimensions: functional flexibility and internal numerical flexibility. First, functional flexibility means a process through which firms adjust to changes in the demand for their output by an internal reorganization of workplaces based on multiskilling, multitasking, teamwork and the involvement of employees in job design and the organization of work. Two causal mechanisms are proposed to relate functional flexibility and innovativeness.

On the one hand, functional flexibility practices like multiskilled teams may contribute to a wider dispersion of skills and knowledge that make the deployment of individual workers to particular tasks more adaptable and, as a consequence, may positively influence innovativeness. Firms with larger percentages of employees involved in functional flexibility practices are more able to develop innovation activities because: (a) functional flexible practices require employees to be trained in order to increase their individual skills; and (b) the process of innovation in the firm needs the cooperation between different departments. Both inputs create opportunities for the adoption of multifunctional teams that need employees with skill polyvalence and a wider dispersion of knowledge which leads to greater innovation at the firm level of analysis.

On the other hand, functional flexibility practices can improve the quality of working life by reducing monotonous, repetitive work [14] and these practices are supported by some human resource policies like on-the-job training that contribute to develop core employees [15].

Hypothesis H1. The greater the firm's functional flexibility, the greater the firm's innovativeness.

The second dimension of internal HR flexibility is internal numerical flexibility which is related to adjusting the employment volume to changes in demand through part-time contracts and the annual, monthly or weekly redistribution of employees' working-time (flexible working hours). The concepts of psychological contract, organizational commitment and psychological safety may offer causal explanations to link internal numerical flexibility and innovativeness. First, psychological contract and organizational commitment are two related concepts: psychological contract consist of employees' beliefs regarding what employers owe them and what they owe their employers in turn, whereas organizational commitment is a stabilizing force that bind individuals to organizations [16]. Employees who perceive that they are valued by their organizations are likely to reciprocate with greater dedication to ensure organizational goals are met [17]. For instance, employees able to balance work and family, because they are covered by flexible practices like flexitime, and are supported by their supervisors, may feel increased psychological contract and commitment towards their organization [18] which in turn may allow to make increased efforts in innovation activities.

Second, the concept of psychological safety –the degree of support for interpersonal risk taking- reinforces the link between flexibility and innovation. The implementation of internal numerical flexible practices requires the support of employees' supervisors and top management [18]. Without this support, employees may feel reluctant to adopt such practices like flexitime because they are afraid managers perceive them as little compromised to their jobs. However, the use of internal numerical flexible practices in a supportive environment enhances the employee's psychological safety. Then psychological safety leads to greater innovation at the firm level of analysis. Edmonson [19] explains how employees with greater psychological safety can feel more comfortable asking questions and speaking up about concerns which in turn are likely to help them through learning processes of innovativeness. This learning process contributes to the deployment of knowledge and the performance of multi-functional teams in innovation activities like new product development or new technology adoption. As a consequence, we propose that the availability of flexible practices like flexitime may eventually enhance innovativeness.

Hypothesis H2. The greater the firm's internal numerical flexibility, the greater the firm's innovativeness.

External HR numerical flexibility adjusts the level of the firm's production output by contracting and firing temporary employees: short-term hires, temporary help agencies and consulting/contracting firms. Firms use non-standard work arrangements in their innovation activities for different reasons. On the one hand, firms may emphasize numerical flexibility: the ability to change the number of employees working on certain tasks according to changes in workload. The use of 'more or less input of similar knowledge' from short-term hires and temporary help agencies may reduce costs; training, recruitment, and hiring costs are lower for temporary than for permanent employees, and firms are able to manage capacity more efficiently [20]. On the other hand, firms may also develop flexibility capabilities by assessing, creating, and implementing 'new knowledge'. These two needs of knowledge should have different implications to use each type of external work arrangement.

First, short-term hired employees may contribute to reduce labor costs but they may also have negative outcomes. Innovativeness requires organizational commitment that it is less frequently found among short-term hired employees [3,21]. Other scholars [22,23] find

that the percentage of short-term hires is negatively related to employee trust, internal workers' attitudes and to the quality of employee-supervisor relationship which may negatively influence innovativeness in the workplace. Therefore, we propose a negative relationship between short-term hires and innovativeness because of a lower psychological contract and commitment towards their firms.

Hypothesis H3a. The greater the firm's level of short-term hires, the lower the firm's innovativeness.

Second, firms can lease employees from temporary help agencies for the same reasons that short-term hired employees, i.e., cost reduction or innovation support. Besides, the aforementioned negative influence that employees with lower psychological contract and organizational commitment may have on innovativeness, temporary workers placed in client organizations via temporary help agencies may also represent a threat to job security, indicating the firm can easily get someone else to do the same job which can affect the stigmatization of temporary employees and negatively influence job satisfaction, commitment and innovative behaviors in the workplace [24]. External workers are more difficult to organize and often have different objectives from those of the permanent workers, making collective bargaining difficult which may negatively influence labor relations in the workplace.

Hypothesis H3b. The greater the firm's level of employees from temporary help agencies, the lower the firm's innovativeness.

Third, firms may use consulting/contracting firms or universities/R&D centers instead of temporary help agencies in innovation activities to provide numerical flexibility and, at the same time, to access new knowledge. Thus, firms are able to hire individuals with a narrow set of skills to complete a specified project, and then, when the project is over or the product replaced, those individuals are released and a new set of contingent workers, whose narrow set of skills meet the needs of a new project, is brought in. Then, rather than hiring temporary employees either directly or via temporary help agencies, firms concerned with developing new knowledge may acquire the services of consulting/contracting firms or universities/R&D centers. These external employees bring knowledge of occupational and industry best practices into the firm, and may stimulate exploration of ideas outside the firm's knowledge stock [4].

Hypothesis H3c. The greater the firm's use of consulting/contracting firms, the greater the firm's innovativeness.

Firms in high-dynamic environments may need more access to relevant external knowledge with less risk than low-dynamic firms. External knowledge may leverage the internal stock of knowledge to develop and adopt innovations in order to face greater technological uncertainty in the environment. At the same time, firms in highly dynamic environments may also need to enhance the in-house dispersion of knowledge and the deployment of employees' skills through core innovation activities.

First, given that functional flexibility involves the deployment of employees' skills and abilities, and the dispersion of knowledge, firms in highly dynamic environments should be more in need of deploying a wider dispersion of knowledge through functional flexibility that contributes to innovativeness. Thus, environmental dynamism may positively moderate the

relationship between functional flexibility and innovativeness. Regarding internal numerical flexibility, although it is possible to argue that there is not so much knowledge deployed as in the implication of functional flexible practices, environmental dynamism may still positively moderate the relationship between this flexibility dimension and innovativeness. Flexitime and other similar flexible practices are mostly used by core employees who are the most closely associated to innovativeness. Firms in highly dynamic environments need to accommodate more changes in the organization of work, and to mitigate the increased work-family conflict of core employees in these environments. Then, the proposed positive link between internal numerical flexibility and innovativeness, may be further enhanced under high- than low-dynamic environments. Therefore, we propose the two following moderator effects of environmental dynamism on internal flexibility dimensions:

Hypothesis H4a. The greater the level of the firm's environmental dynamism, the more positive the relationship between functional flexibility and innovativeness.

Hypothesis H4b. The greater the level of the firm's environmental dynamism, the more positive the relationship between internal numerical flexibility and innovativeness.

Second, regarding external HR flexibility, employing contingent workers in combination with internal employees in highly dynamic environments might be advantageous to upgrade the firm's knowledge stock. There are three external HR flexibility dimensions: (1) short-term hires, (2) temporary help agencies, and (3) consulting/contracting firms and R&D centers. The first two dimensions are primarily related to the adjustment of employment volume to accommodate changes in production output. Firms in highly dynamic environments may be more in need of these adjustments than firms in low-dynamic environments. If environmental dynamism raises the rotation of temporary employees, then the negative influence of both types of temporary employment –short-term hires and temporary help agencies- would be further enhanced in terms of lower organizational commitment which in turn would negatively affect innovativeness. Then, we propose the following moderator effects:

Hypothesis H4c. The greater the level of the firm's environmental dynamism, the more negative the relationship between the use of short-term hires and innovativeness.

Hypothesis H4d. The greater the level of the firm's environmental dynamism, the more negative the relationship between the use of temporary help agencies and innovativeness.

The third dimension –consulting/contracting firms and R&D centers- involves the access to relevant knowledge. External knowledge employees may reduce the risk of value erosion associated with firm's existing alternatives available to manage potential environmental changes. Firms engaging in continuous exploration of knowledge are likely to have technical groups with varied perspectives and are thus better able to reframe problems and overcome familiar through patterns and competitive traps when the environment demands organizational change [25]. Thus, we propose a positive moderator effect of environmental dynamism because firms in highly dynamic environments may benefit more from the access to external knowledge.

Hypothesis H4e. The greater the level of the firm's environmental dynamism, the more positive the relationship between the use of consulting/contracting firms and innovativeness.

Procedures for collecting data

In order to test the hypotheses, we surveyed a sample of Spanish first-tier suppliers of automotive systems/components to automobile assemblers. The automotive industry was chosen as a framework for the empirical study because of several reasons. First, the automotive industry is of economic significance to many countries and is one of the largest manufacturing activities in the world. Second, the history of this industry is fairly well disseminated, which facilitates a general understanding and knowledge of the industry. Third, the automotive industry has been a leader in the adaptation of many innovations in process management and technologies along the supply chain, and offers the potential to simultaneously examine different dimensions of flexibility.

Our final sample includes 123 first-tier suppliers of automotive systems/components to automobile assemblers. The target population of automotive suppliers was taken from the 362 firms listed in the Spanish Association of Automobile Suppliers. The response rate to the survey was 33.9 per cent, which is similar to other empirical studies of HR flexibility [26]. The unit of analysis is the firm. The plant was not used as unit of analysis because firms may often obtain flexibility by dividing work differently among various establishments. The distribution of surveyed firms by size indicates that 12.2% are small firms (less than 50 employees), 31.7% are medium-sized firms (between 50 and 250 employees) and 56.1% are large firms (more than 250 employees).

Data were collected through questionnaires mailed in three consecutive rounds at one-month intervals to the company's headquarters during the second quarter of the year 2007. No incentives were provided to participate in filling out the survey. The replies received were checked for non-response bias by using the time trend extrapolation method which assumes that firms responding late are more similar to non-respondents. Under this technique, we compared the first one-third of the responses with those in the last one-third. There were no significant differences (based on t-tests) in terms of firm characteristics (size, age or innovation metrics) which confirms that the survey results are not based solely on a minority subsample and that the results can be generalized to the population of interest. In order to minimize common method bias, we use separate sources of data for measuring the independent and dependent variables. Human Resource Managers to respond to items related to HR management and policies, and Technology Managers responded to questions related to innovation.

Innovativeness is the key dependent variable. Because innovativeness is a multidimensional concept, a construct of five items ($\alpha=0.845$) was developed. Based on a confirmatory factor analysis, the five items loaded significantly onto one factor ($p<0.001$), and there was a good fit for our proposed solution ($\chi^2/df=2.13$; RMSEA=0.74; CFI=0.931; GFI=0.927). The five items of the scale assess comparisons of innovation performance relative to similar firms in the same industry with a seven-point Likert scale with endpoints 'at the bottom of similar firms in the industry' (=1) and 'at the top of similar firms in the industry' (=7) in the year 2006. Nevertheless, and in order to test the robustness of our results, we also obtained two quantitative measures of innovation: the number of product and process innovations developed by the firm in the year 2006; and the number of new ideas that had

been adopted by the firm and recognized by a formal suggestion award program in the year 2006. Each quantitative measure of innovation is positively correlated with the managerial perception of innovativeness (number of innovations $r=0.666$ $p=0.000$; number of new ideas $r=0.413$ $p=0.000$; number of ideas adopted by employee $r=0.515$ $p=0.000$). This warrants that our subjective measure of innovativeness is consistent with objective measures of innovation performance.

The independent variables are related to dimensions of HR flexibility. They were calculated as the number of employees covered or affected by HR flexible practices divided by the total number of employees in the firm. We used lagged values (one year) of flexibility dimensions (the year 2005 for flexibility and the year 2006 for innovativeness) because some flexibility dimensions may require time to affect the innovative behavior of employees. The dimension of functional flexibility includes the practices: job rotation, employee development, multiskilled teams, and employee involvement in job design and planning. The dimension of internal numerical flexibility includes the practices: flexitime, and workload reduction. Regarding the dimensions of external flexibility, we calculated three measures: short-term hires (temporary and fixed-term employees), temporary employees hired via temporary help agencies, and professionals/employees from contracting/consulting firms or University/R&D centers. In each measure, the number of contracted employees was divided by the total number of employees in the firm.

The moderator variable included in the research model is *Environmental dynamism* which measures the level of dynamism in the firm's environment. This variable is a construct of eight items adapted from Klaas et al. [27] that assesses the level of change in the firm's environment. These items are measured on seven-point Likert scales with end points 'totally disagree' (=1) and 'totally agree' (=7).

We include two groups of control variables in the regression of innovativeness. The first group are firm characteristics that influence innovation: firm size (number of employees), firm age (number of years), export intensity (percentage of sales exported), and ownership control (1=foreign ownership; 0=non-foreign ownership). Both firm size and firm age were skewed, and thus log transformations are used in the analyses. The second group are variables related to the firm's R&D inputs and management support to innovation: the percentage of sales invested in R&D, and a construct (*Innovation support*) of four items adapted from Verdú-Jover et al. [13] and measured on seven-point Likert scales with end points 'totally disagree' (=1) and 'totally agree' (=7).

Prior to data collection, the content validity of the items and scales included in the survey was established by grounding them in existing literature. Pre-testing the survey with academics and practitioners before the collection of data further validated it. Before testing the hypotheses, the dimensionality, discriminant validity and reliability were evaluated for each scale.

The research hypotheses were tested through hierarchical regression analysis. The control variables were introduced in the two first steps of the regression, then the main effect variables in the third step, followed by the interaction terms (cross-products) in the final step. To reduce the potential negative effect of multicollinearity after introducing interaction terms, we used Lance's [28] residual centering technique to control this problem. In this two-stage procedure, we first regressed the interaction term and then used the resulting residual instead of the interaction term in the regression equation. This approach reduces multicollinearity

between the interaction terms and main effects variables, yielding a regression coefficient for the cross-product term that can be directly interpreted as the effect of the interaction term in the dependent variable. The test for the effects of multicollinearity indicates that all the variance inflation factors (VIF) are less than the threshold value of 10 indicating that “multicollinearity may be unduly influencing the least squares estimates” [29, p. 387].

Results

Table 1 shows the distribution percentages of the employees who are involved in innovation activities in the surveyed firms in the period 2004-2006. These data suggest that employees directly involved in innovation activities are far less subject to external flexibility. Although the use of flexible practices has increased over the period 2004-2006, staff in general is approximately twice as likely to be the target of flexible contracts as the staff specifically involved in innovation. Thus, whereas the percentage of temporary employees in the workforce increased from 13.72% to 17.57%, the percentage of temporary employees directly engaged in innovation activities in relation to all innovation employees decreased from 12.6% to 7.83%.

Table 2 indicates three managerial perceptions about how contingent employees are used in the firm’s innovation activities: consulting/contracting firms are more used to innovate, whereas short-term hires and temporary help agencies contribute less to innovation. Nevertheless, these are single items of managerial perceptions and do not try to capture abstract notions such as ‘enhancing innovativeness’ which may require several other items to provide a meaningful measurement. The objective of this descriptive information is to complement the results of the multivariate analysis that show the statistical significant associations between flexibility and innovativeness.

Table 1. Variation in the composition of the workforce in the surveyed automotive suppliers

| | Year 2004 | Year 2006 |
|---|-----------|-----------|
| Percentage of temporary employees in the workforce | 13.72 | 17.57 |
| Percentage of permanent employees in the workforce | 86.28 | 82.43 |
| Percentage of permanent employees directly engaged in innovative activities | 16.88 | 15.80 |
| Percentage of full-time permanent employees directly engaged in innovative activities | 16.45 | 15.28 |
| Percentage of permanent employees directly engaged in innovation activities in relation to all employees directly engaged in innovation | 87.40 | 92.17 |
| Percentage of full-time permanent employees directly engaged in innovation activities in relation to all employees directly engaged in innovation | 85.17 | 89.15 |

Table 2. Perceived managerial assessment of items indicating the reason to use contingent employees

| | Short-term hires | Temporary help agencies | Consulting/contracting firms or R&D centres |
|--|------------------|-------------------------|---|
| We use contingent employees as a direct contributor to innovation | 1.47 | 1.85 | 5.72 |
| We use contingent employees as supportive of freeing-up core employees | 2.74 | 3.26 | 1.83 |
| We use contingent employees for other reasons that to contribute to innovation | 5.92 | 5.71 | 2.69 |

Items assessed on 7-point Likert scales with endpoints ‘totally disagree’ (=1) and ‘totally agree’ (=7) n = 123

These descriptive results suggest that except consulting/contracting firms, flexible working is used more as to reduce labor costs or compensate demand fluctuations than to introduce new knowledge into the firm. Thus, only 5.2% of short-term hires and temporary help agencies’ employees are used to free up permanent staff to initiate new projects. Some

firms use consulting/contracting firms or R&D centers to support the outsourcing of exploratory work to universities and/or to access external sources of knowledge; as a result of their links with the universities/R&D centers, these firms now have most of the knowledge they need and can supplement this with input from in-house R&D employees. Additionally, correlation analyses indicate that innovativeness is positively related to the percentage of full-time employees devoted to R&D activities ($r=0.491$; $p=0.000$) and the percentage of supportive part-time employees devoted to R&D activities ($r=0.354$; $p=0.002$).

Table 3 shows the results of the hierarchical regression. There are 4 models, each one for a consecutive step in the regression. We only report the results of the full model to test the research hypotheses. In the first group of control variables, firm size ($\beta=-0.152$; $p<0.001$), firm age ($\beta=-0.249$; $p<0.001$) and ownership control ($\beta=-0.117$; $p<0.05$) are negatively related to innovativeness; and export intensity ($\beta=0.225$; $p<0.001$) is positively related to innovativeness. In the second group of control variables, both ‘innovation support’ ($\beta=0.325$; $p<0.001$) and ‘R&D intensity’ ($\beta=0.193$; $p<0.01$) are positively related to innovativeness. The next two steps in the regression include the independent and moderator variables. First, ‘functional flexibility’ is positively related to innovativeness ($\beta=0.251$; $p<0.001$) which supports hypothesis H1. Second, ‘internal numerical flexibility’ is positively related to innovativeness ($\beta=0.182$; $p<0.001$) which supports hypothesis H2. Regarding the three dimensions of external flexibility: ‘short-term hires’ is negatively related to innovativeness ($\beta=-0.744$; $p<0.001$), ‘temporary help agencies’ employees’ is marginally related to innovativeness ($\beta=-0.180$; $p<0.1$), and ‘consulting/contracting firms’ is positively related to innovativeness ($\beta=0.192$; $p<0.01$); these results support hypothesis H3a & H3c, and do not support hypothesis H3b. Finally, environmental dynamism positively moderates the relationship between ‘functional flexibility’ and innovativeness ($\beta=0.405$; $p<0.05$), and between ‘consulting/contracting firms’ and innovativeness ($\beta=0.453$; $p<0.01$) which support hypotheses H4a and H4e; the other three moderator effects are not statistically significant and therefore hypotheses H4b, H4c and H4d are not supported.

Table 3. Linear regression of innovativeness (year 2006) with individual measures of HR flexibility (year 2005)

| | Model 1 | Model 2 | Model 3 | Model 4 |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|
| Firm size (log) | -0.254*** (3.807) | -0.040 (1.096) | -0.131*** (3.054) | -0.152*** (4.039) |
| Firm age (log) | -0.043 (0.652) | -0.163*** (4.311) | -0.237*** (6.597) | -0.249*** (7.405) |
| Export intensity | 0.803*** (11.575) | 0.209*** (4.172) | 0.288*** (6.126) | 0.225*** (4.350) |
| Ownership control | -0.082 (1.259) | -0.116** (3.013) | -0.088** (2.615) | -0.117** (3.155) |
| Innovation support | - | 0.702*** (13.264) | 0.370*** (4.924) | 0.325*** (3.452) |
| R&D intensity | | 0.191*** (3.562) | 0.297*** (5.139) | 0.193** (2.915) |
| Functional flexibility (H1) | - | - | 0.166*** (3.150) | 0.251*** (4.425) |
| Internal numerical flexibility (H2) | | | 0.180*** (3.720) | 0.182*** (3.825) |
| Short-term hires (H3a) | | | -0.300*** | -0.744*** |

| | | | | |
|---|----------|----------|--------------------|--------------------------------|
| | | | (5.657) | (5.419) |
| Temporary help agencies (H3b) | | | -0.023 (0.695) | -0.180 ⁺ (1.899) |
| Consulting/contracting firms (H3c) | | | 0.148** (2.824) | 0.192** (3.215) |
| Environmental dynamism (ED) | - | - | - | 0.418** (2.955) |
| Functional flexibility x ED (H4a) | | | | 0.405* (2.166) |
| Internal numerical flexibility x ED (H4b) | | | | 0.093 (1.544) |
| Short-term hires x Ed (H4c) | | | | -0.075 (1.124) |
| Temporary help agencies x ED (H4d) | | | | -0.037 (0.563) |
| Consulting x ED (H4e) | | | | 0.453** (2.932) |
| F (full model) | 34.85*** | 77.57*** | 108.34*** | 141.26*** |
| Adjusted R ² | 0.210 | 0.478 | 0.623 | 0.715 |
| Change in R ² | | 0.268 | 0.145 | 0.092 |

Standardized beta coefficients; t-values between parentheses.

Level of significance: ⁺p<0.1 *p<0.05 **p<0.01 ***p<0.001

| Hypothesis | H1 | H2 | H3a | H3b | H3c | H4a | H4b | H4c | H4d | H4e |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Support | Yes | Yes | Yes | No | Yes | Yes | No | No | No | Yes |

Conclusion

The results of this empirical study to a sample of Spanish automotive suppliers indicate that internal (functional and numerical) flexibility and the external flexibility of R&D consulting/contracting firms are positively related to innovativeness. Regarding the other two dimensions of external flexibility, the percentage of short-term hires is negatively related to innovativeness whereas the percentage of employees from temporary help agencies is not significantly related to innovativeness. Environmental dynamism positively moderates the relationship between two dimensions of HR flexibility and innovativeness: functional flexibility and R&D consulting/contracting firms. The remaining dimensions of HR flexibility are not significantly moderated by environmental dynamism.

Despite the limitations of the research design (small sample size, cross-sectional data), we believe that the results of this study offer important insights for the field of HR flexibility and innovation management. They confirm the positive contribution of internal HR flexibility to innovativeness, and that the impact of external flexibility depends on the type of contingent employee. The importance of environmental dynamism is also highlighted and firms in highly dynamic environments could benefit more from some flexibility dimensions.

International and managerial implications

This research has implications for managerial practice. First, executives need to simultaneously consider how the different components in the organizational structure interface with the external environment, and they also need to understand the implications of different flexibility dimensions for innovation outcomes. The descriptive analysis shown in table 1 indicates that external flexibility on the whole is far less likely associated with the staff engaged in innovation activities. It seems that employers are more likely to protect staff seen as directly contributing to innovation from the downturns in the labor market. Innovation-related staff are more likely to be treated as part of full-time-permanent employment (with functional flexibility), whereas staff less directly involved in innovation are more targeted to flexible employment contracts.

Second, managers' efforts to introduce HR flexible practices into the firm can be rewarded beyond their impact on HR development and cost performance. Our results suggest that the right combination of flexibility dimensions may have a significant impact on the firm's innovation through causal mechanisms like, for example, the deployment of knowledge among multiskilled teams or the access to new knowledge from consulting firms. The results also remark the importance that the firm's innovation strategy may have to obtain the most benefits from HR flexibility. Given the negative association between some external numerical flexibility dimensions and innovativeness, the possible positive contribution of short-term hires (such as to free up core employees to initiate new R&D activities) may totally depend on the firm's innovation strategy.

These results also support and extend the current literature on flexibility and innovation. For instance, our research corroborates the positive impact of internal flexibility on innovation that has already been demonstrated by other scholars. However, the research reported here extends prior research in two ways. First, because the positive association of internal flexibility and innovativeness has been tested within a broader set of functional and internal numerical flexible practices. Second, because this positive association has been tested under the influence of several external HR flexibility dimensions. Although other scholars also find positive effects of functional flexibility, they do not recognize that flexibility capabilities involve internal and external flexibility dimensions that may have competing effects on innovation. Thus, a limitation of many studies is the use of a single measure of flexibility. On the contrary, we have explored the influence of multiple dimensions of HR flexibility that have been measured with the number of employees covered or affected by flexible practices.

Our research also extends the literature by demonstrating that both full-time employees and supportive part-time employees involved in R&D activities are positively related to innovativeness. Prior research has not tested whether the positive association between flexibility and innovation holds separately for both full-time (core) and support employees. The positive expectation about core employees is logical and straightforward, as they are direct contributors to innovation. The prediction with support employees is less clear. While these employees may not be direct contributors to innovation within the firm, support employees may indirectly facilitate innovation because they may perform work that frees up core employees to devote more time to innovation, or complement knowledge of core employees. Our results complement the stream of research that analyse the supportive role of temporary employees to core full-time R&D employees but from other perspective, the perspective of part-time employees who also support innovation activities.

Regarding the association between external flexibility and innovativeness, our research shows that this relationship depends on the type of contingent employee. Whereas the use of short-term hires is negatively associated to innovativeness, the contracting of employees from consulting firms or R&D centers is positively associated to innovativeness; the influence of employees hired via temporary help agencies is not statistically significant. This result contributes to clarify the contradictory results in the literature that have analyzed the link between external flexibility and innovation where some studies find a positive relationship and others find a negative relationship. We have developed our arguments in terms of the contribution of external flexibility dimensions to the process of knowledge access and deployment within the firm. Then, it is possible to reconcile the non-conclusive results of the literature by using a common argument base to analyze the influence of several flexibility dimensions.

The moderator effect of environmental dynamism also makes a contribution to the literature of flexibility and innovation because it confirms the importance of environmental dynamism to innovation. Our paper extends this stream of research by demonstrating that environmental dynamism moderates those internal and external HR flexibility dimensions that are more knowledge-intensive. Thus, three dimensions of HR flexibility –internal numerical flexibility, short-term hires and temporary help agencies- are not moderated by the environmental dynamism. These dimensions are perhaps less knowledge-intensive because they are more related to the adjustment of employment volume and the redistribution of working time. However, functional flexibility and consulting firms/R&D centers focus more on accessing/deploying knowledge than on adjusting employment volume, and their relationships to innovativeness are moderated by environmental dynamism.

Then, firms in highly dynamic environments can benefit more from functional flexibility and consulting firms/R&D centers than firms in low-dynamic environments. The rate of technological change in the firm's environment may enhance the need to access relevant external knowledge with less risk, as well as the internal dispersion and deployment of knowledge through employees' skills and abilities. Both flexibility dimensions may contribute to the firm's innovativeness by enhancing the stock of knowledge and its flow through core employees towards innovative activities.

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Acknowledgement.

The authors greatly appreciate the financial support of the Spanish Ministry of Science and Innovation (Grant SEJ2007-62964/ECON).