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Product innovation and decision-making autonomy in subsidiaries of multinational companies

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ABSTRACT

This paper investigates the relationship between subsidiary decision-making autonomy and their development of product innovations. Using survey data from 563 subsidiaries located in six European countries, we show how the degree of decision-making autonomy, as well as the functional area in which the subsidiary has decision-making autonomy, affect the probability of a subsidiary developing product innovations. We find that higher decision-making autonomy increases the probability of a subsidiary developing a product innovation. This effect is particularly pronounced, but not restricted to, decision-making in the area of R&D or the adoption of technologies. The positive effect extends also to functional areas such as investment, finance, supplier selection as well as marketing and sales. In addition, our study suggests that higher degrees of novelty of product innovation still benefit from subsidiaries' autonomy, but may require higher degrees of managerial involvement by headquarters.

1. Introduction

The profitability and competitiveness of multinational enterprises (MNEs) is, to a large extent, driven by its ability to accumulate technological knowledge and innovate (Cantwell, 1989, 1995; Kogut & Zander, 1993). The contemporary network-based theory of the MNE views subsidiaries as strategic actors that augment the technological capabilities of the MNE at foreign locations by developing subsidiary-specific advantages (Birkinshaw, Hood, & Jonsson, 1998; Cantwell & Piscitello, 2014). Firms' external linkages or networks play an important role for product innovation (Powell, Koput, & Smith-Doerr, 1996; von Hippel, 1988), and subsidiaries' embeddedness in the local external network serves as a key mechanism of the MNE to source knowledge (Cano-Kollmann, Cantwell, Hannigan, Mudambi, & Song, 2016). Subsidiaries' local network ties are perceived as a resource and a valuable input for product innovation (Andersson et al., 2001, 2002; Andersson, Forsgren, & Holm, 2007; Ciabuschi, Dellestrand, & Martín, 2011; Frost, 2001; Luo, 2003; Mu, Gnyawali, & Hatfield, 2007).

Product innovation in MNE subsidiaries and the ability of subsidiaries to access local external networks are fundamentally related to the managerial question on the degree and nature of decision-making autonomy within the MNE (Hoenen & Kostova, 2014). This paper argues that MNE subsidiaries are not able to develop product innovations when they lack the required decision-making autonomy. When

subsidiary decision-making autonomy has been previously studied, it has been related to financial performance, but not to subsidiary innovativeness (see Kawai and Strange (2013) for an overview). It is unknown if and how subsidiary decision-making autonomy translates in the development of new products in a subsidiary (Michailova & Zhan, 2015; Mudambi, Pedersen, & Andersson, 2014). Embedded in the integration-responsiveness framework (Bartlett & Ghoshal, 1989) and starting from the premise that the MNE can be seen as a network of subsidiaries each with their own capabilities (Birkinshaw et al., 1998; Strutzenberger & Ambos, 2014), this paper relates the degree and the nature of decision-making autonomy to product innovation in subsidiaries.

We explore decision-making autonomy along two dimensions; a) the degree of autonomy, and b) the functional area in which a subsidiary has a certain degree of decision-making autonomy. We test our hypotheses using unique survey data from a representative sample of 563 multinational subsidiaries located in six Central and Eastern European countries (Poland, the Czech Republic, the Slovak Republic, Hungary, Romania and (East) Germany). MNEs entered these emerging economies in the 1990s mainly to exploit market opportunities and labour cost advantages. Yet more recently, they co-located R&D and innovation in the region (Manea & Pearce, 2006; Pavlinek, 2012; UNCTAD, 2005). Central and Eastern European countries share many economic and institutional characteristics. For example, they have all adopted the

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EU legal framework with respect to intellectual property rights protection. Yet, the effectiveness of intellectual property rights protection varies (European Union, 2013) affecting the inflow of foreign direct investment (Javorcik, 2004) as well as the knowledge-sourcing strategies by MNEs (Santangelo, Meyer, & Jindra, 2016). Against this background, we explore how decision-making autonomy affects product innovation at subsidiary level.

Our results indicate that higher levels of decision-making autonomy are associated with a higher probability of a subsidiary generating product innovations. This conclusion applies specifically to decision-making autonomy in the area of research and development, but extends to investment and financial decisions as well. All else equal, a subsidiary that takes all R&D decisions itself has a 0.35 higher probability of generating a new product than a subsidiary that has no decision-making autonomy. The positive effect of autonomy on product innovation is highest for innovations that are new to the subsidiary and lowest for product innovations new to the world. We conclude that the network-based theory of the MNE emphasizing subsidiaries' external embeddedness requires a simultaneous recognition of the relevance of the internal distribution of decision-making autonomy. In the face of the current emphasis in the literature on the need of MNEs to be externally embedded, we think this is an important conclusion with clear managerial implications.

2. Theory and hypotheses

2.1. Product innovation in MNEs and subsidiaries' competence-creation

Product innovation is a key strategy for firms to generate a sustained competitive advantage (Cantwell, 1989; Danneels, 2002). New product development is a cumulative and gradual process of continuous adjustment and refinement based on the development of new technology and its use in production (Pavitt, 1987). Innovation strategies constitute of not only the development of new technology (as in the case of R&D and inventions) but especially its use in production and commercial applications. A product innovation is thus generally defined as the implementation of a new or significantly improved good or service (OECD, 2005). In the case of MNEs, product innovation is associated with the accumulation of knowledge and technology in international networks and considered central to MNEs' overall competitiveness (Cantwell, 1989, 1995).

The contemporary view relates MNEs' ability to generate product innovations to internal economies of scale due to the transfer of knowledge within the internal network, as well as external economies associated with the absorption of knowledge available at foreign locations (Cantwell, 1989, 1995; Castellani & Zanfei, 2006; Tippmann, Sharkey, & Mangematin, 2014). MNEs not only exploit, but also augment their technological capabilities at foreign locations (Piscitello, 2005, 2014; Kuemmerle, 1999). This view of the MNE emphasizes the ability of subsidiaries to source knowledge from its external environment (Cano-Kollmann et al., 2016). This approach fundamentally challenges earlier views on the MNE (Kindleberger, 1969; Stopford & Wells, 1972; Vernon, 1966) that assumed a "quasi-colonial relationship between the parent company and foreign subsidiaries, wherein the latter are in charge of replicating the former's activities abroad, with strategic decisions—including R&D and innovation strategies—being rigidly centralised" (Zanfei, 2000: 515).

The shift toward integrated innovation strategies within MNEs coincides with the emergence of an international network of specialized subsidiaries (Cantwell & Mudambi, 2005). While some of the subsidiaries within such a network may have a competence-exploiting role, others take on a more technologically creative function and the level and complexity of their R&D differ accordingly (Cantwell, 1989). The distinction between competence-exploiting and competence-creating activities is analogous to the distinction between exploitation and exploration in organizational learning theory (March, 1991; Danneels,

2002). The emphasis on innovation has led to an increased scholarly interest in the role of subsidiaries. In their overview of fifty years of headquarters-subsidiary research, Kostova, Marano, and Tallman (2016) document this increased interest in the subsidiary and the simultaneous interest in knowledge creation and transfer.

The literature on competence-creation in subsidiaries stresses the embeddedness of foreign subsidiaries in the business networks of the host country and emphasizes the reliance on local knowledge sources (Almeida, 1996; Frost, 2001). Subsidiaries' external embeddedness is seen as a critical factor for subsidiary performance, including the development of new knowledge (Andersson et al., 2002, 2007; Ciabuschi et al., 2011; Ciabuschi, Holm, & Martín, 2014; Rugman & Verbeke, 2001). The access to localised knowledge in a host country is a crucial factor in explaining the capacity of MNEs for exploratory activity (Andersson et al., 2002; Forsgren, Holm, & Johanson, 2005).

The notion of competence-creation is broad and refers to different business functions and/or activities of subsidiaries (see Cantwell and Mudambi (2005) for an overview). Whereas some subsidiaries implement product innovations they developed themselves, other subsidiaries merely implement product innovations developed elsewhere in the MNE, for example, by the parent or other units of the MNE network. In addition, we need to distinguish between product innovations on the one hand, and R&D or inventions (patents) on the other. R&D is an input into the innovation process (rather than an output), and only one source of innovation (Archibugi & Pianta, 1995). Patents constitute a direct outcome of the inventive process but not all inventions become innovations (OECD, 2009), and a high share of patented inventions are not turned into a commercial applications (Giuri et al., 2007).

A number of studies have focused on subsidiaries' participation in R & D (Asakawa, 2001; Ambos 2005; Ambos & Reitsperger, 2004; Chiesa, 2000; Kuemmerle, 1999; Nobel & Birkinshaw, 1998) or have used patents as an indicator of subsidiaries' innovation (Almeida & Phene, 2004; Frost, 2001; Mudambi et al., 2007; Phene & Almeida, 2008). Here, we contribute to this line of work by focusing on product innovations developed in focal subsidiaries. In what follows, we relate the subsidiaries' ability to develop product innovations to the degree and nature of their decision-making autonomy.

2.2. Subsidiary product innovation requires decision-making autonomy

As argued earlier, prior research on subsidiaries' competence-creation explicitly recognizes the relevance of subsidiaries' external embeddedness to the development of new knowledge (Andersson et al., 2002, 2007; Ciabuschi et al., 2011; Ciabuschi et al., 2014; Rugman & Verbeke, 2001). We contend that the shift towards external embeddedness to generate new knowledge needs to be facilitated by a simultaneous shift in the allocation of decision-making autonomy to optimize the conditions under which subsidiaries generate such product innovations. "The greater the variety of challenges and opportunities offered by local contexts ... the greater will be the need for autonomy within the MNC's organisation" (Zanfei, 2000: 524–525). The extent to which a subsidiary is embedded in the local context is fundamentally related to the extent to which strategic decision-making resides with the subsidiary relative to the headquarters (Ambos, 2005; Doz & Prahalad, 1984; Mudambi & Navarra, 2004; Meyer et al., 2011).

Although subsidiary autonomy has been studied before (see, for overviews, Kawai and Strange (2013) and Reilly and Scott (2014)), evidence regarding the relation between subsidiary autonomy and subsidiary innovative performance is mostly conceptual (e.g. Michailova and Zhan (2015)). Empirical evidence is partial (e.g. Lazarova, Peretz, and Fried (2017) only looks at autonomy in the human resource domain) or indirect (e.g. Mudambi et al. (2007) use patents as an indicator of product innovation) and still limited (Gammelgaard, McDonald, Stephan, Tüselmann, & Dörrenbacher, 2012: 1162). Early research by Bartlett and Ghoshal (1989) hinted at a positive relationship between autonomy and innovation in MNEs.

Bartlett and Ghoshal (1989) cited the cases of Unilever, ITT and Philips as MNEs whose subsidiaries are endowed with considerable strategic and operational autonomy. By comparing the innovative behaviour of these firms with that of multinationals with highly centralised resources they observed that relatively autonomous subsidiaries created and diffused more innovations.

To incorporate autonomy in the network based theory of the MNE, we build on the classic integration-responsiveness framework. Balancing the need for decentralization and the need for central coordination (Bartlett & Ghoshal, 1989) relates to the managerial question of how headquarters should control its subsidiaries, and more specifically how much decision-making autonomy subsidiaries have relative to headquarters (Hoenen & Kostova, 2014). In our view, the argument regarding the importance of subsidiaries' external embeddedness as an innovation input cannot be disconnected from the discussion of subsidiary autonomy, defined as the degree to which a subsidiary possesses decision-making power vis-à-vis its parent company in terms of strategic, functional, and operational areas (O'Donnell, 2000; Taggart & Hood, 1999).

In multinational firms, autonomy-control tensions reflect the power-dependence structure between headquarters and subsidiaries (Pfeffer & Salancik, 1978). If power is the antipode of dependency in exchange relations (Emerson, 1962), the headquarters unit's power is high when it controls critical resources required by others but does not depend on the subsidiaries' resources, and vice-versa (Aldrich, 1979; Pfeffer & Salancik, 1978). With subsidiaries' need to be externally embedded, the balance of power within the MNE has shifted towards the subsidiary (Ambos, Asakawa, & Ambos, 2011; Birkinshaw et al., 1998; Birkinshaw & Hood, 1998). The extent to which a subsidiary is externally embedded in the local context is thus logically connected to the degree to which strategic decision-making resides with the subsidiary relative to the headquarters (Doz & Prahalad, 1984; Meyer et al., 2011). As a result of the more strategic role for subsidiaries and their need to be externally embedded, the internal control structure comes to the fore as well. Hence, the emphasis on *external* embeddedness – perhaps paradoxically so – coincides with a need to better understand the nature of decision-making autonomy *within* the MNE.

In general, higher levels of autonomy at the subsidiary correlate positively with the subsidiary performing more advanced roles (Birkinshaw & Morrison, 1995). The micro-foundations and mechanisms through which autonomy affects subsidiary product innovation originate from motivation and creativity research (Beugelsdijk, 2008; Mudambi et al., 2007). Psychological needs for autonomy and self-determination underlie the intrinsic motivation of individuals (Deci & Ryan, 1985) and formal organizational architecture can stimulate the motivation of organizational members (Keupp, Palmié, & Gassmann, 2011; Thompson, 1965). Organizational conditions that satisfy the needs for autonomy and self-determination tend to increase intrinsic motivation (Sherman & Smith, 1984). In contrast, greater surveillance and evaluation have been shown to undermine intrinsic motivation (Dasí, Pedersen, Gooderham, Elter, & Hildrum, 2017; Deci & Ryan, 1985). This explains why subsidiary autonomy regarding sourcing and hiring, marketing and product development, positively affects patenting (Mudambi et al., 2007), and why the more headquarters exercises legal rights to monitor and control the subsidiary, the lower the level of subsidiary initiative (Bouquet & Birkinshaw, 2008), and the lower the expected level of subsidiary product innovation (Bartlett & Ghoshal, 1989; Florida, 1997).

Autonomy allows the subsidiary to act independently and pursue strategically valuable opportunities, including the fostering of linkages with external partners. This, however, creates the risk that these subsidiaries become stand-alone units disconnected from the MNE network, a challenge referred to as dual embeddedness (Figueiredo, 2011; Meyer et al., 2011) or the innovation-integration dilemma (Mudambi, 2011). This challenge is rooted in the organizational tensions unique to the MNE, arising out of the subsidiaries' need to be responsive to local

conditions but be integrated in the MNE internal network at the same time (Bartlett & Ghoshal, 1989). Too high levels of autonomy can lead to a peripheral position of the subsidiary (Noorderhaven & Harzing, 2009) resulting in rent-seeking behaviour by subsidiary managers (Mudambi & Navarra, 2004), a lack of information exchange and shared identity (Asakawa, 2001; Clark & Geppert, 2011), and the liability of internal isolation (Monteiro et al., 2008). The risks associated with autonomy without integration have been summarised by Ghoshal and Bartlett (1995: 148): “In the absence of an integration process, decentralised entrepreneurship may lead to some temporary performance improvement as existing slack is harnessed, but long term development of new capabilities or businesses is seriously impeded”. Lack of decision-making autonomy may be suboptimal for subsidiary product innovation, yet very high levels of autonomy may be harmful as well (Aghion & Tirole, 1997). This suggests that the relation between subsidiary decision-making autonomy and the ability of subsidiaries to generate product innovation is positive, yet declining (i.e. declining marginal returns) for very high levels of autonomy. This is our first hypothesis.

Hypothesis 1. A non-linear relationship exists between subsidiary decision-making autonomy and subsidiary product innovation, with increasing levels of decision-making autonomy first leading to increases in subsidiary product innovation and after a certain level leading to lower levels of subsidiary product innovation.

The above discussion relates to the degree of subsidiary decision-making autonomy. In addition to level, we consider the nature of autonomy to be relevant too. We predict that it is not only subsidiary autonomy in areas related to R&D and innovation that affect subsidiaries' innovativeness. Product innovation is based on the continuous interaction between the creation of technology and its use in production (Pavitt, 1987). Subsidiaries need to relate technology from the realm of R&D to feedback information received from the production unit. Firms innovate by drawing upon knowledge and expertise from a wide range of external sources (Chesbrough, 2003; Laursen & Salter, 2006), including collaboration with final customers and the users of product innovations (von Hippel, 1988, 2006). User involvement reduces the risks inherent to product development (Ogawa & Piller, 2006). This means that decision-making autonomy in R&D and innovation cannot be disconnected from decision-making autonomy in marketing and sales. Likewise, supplier involvement improves product design, reduces cycle time, and lowers costs while improving product quality (Ragatz, Handfield, & Petersen, 2002; Song & Thieme, 2009). Interactions with suppliers cannot be disconnected from subsidiary new product development. The same holds for financial decision-making autonomy (Monteiro, Mol, & Birkinshaw, 2017).

What the above suggests is that the positive but declining effect of autonomy on the ability of subsidiaries to generate product innovations does not only hold for autonomy in functional areas related to R&D, but extends to areas such as operations, supplier selection, marketing and sales, and finance. Hence, subsidiaries with decision-making autonomy in functional areas such as marketing, sales, operations, supplier, and finance (all but R&D) will innovate more than subsidiaries with lower levels of autonomy in these functional areas.

Hypothesis 2. Conditional on the non-linearity as predicted under H1, subsidiaries with decision-making autonomy in a variety of functional areas (production, sales, marketing, finance, R&D) have higher levels of product innovation than subsidiaries with autonomy in a limited number of functional areas (e.g. R&D only).

3. Empirical analysis

3.1. Survey and sample

We test our hypotheses on the degree and nature of subsidiary

decision-making autonomy with the 2013 survey of the IWH-FDI-Micro-Database (see IWH (2012)). The data is based on a survey of foreign subsidiaries located in six countries in Central and Eastern Europe (CEE), namely the Czech Republic, Hungary, Romania, Poland, the Slovak Republic and (East) Germany (Poland: 18%, Romania: 15%, Slovak Republic: 6%, the Czech Republic: 22%, Hungary: 9% and East Germany 30%).

Data have been collected from 1121 subsidiaries drawn from the Bureau van Dijk Amadeus database (edition 2012). This sample is drawn from a total population of 15,508 firms by applying several criteria across all six countries. We include firms with a minimum of 10 employees, and at least one foreign investor holding either a minimum of 10% direct shares (or voting rights) or a minimum of 25% indirect shares (or voting rights). This ownership criterion is in line with the statistical provisions used by the IMF and World Bank to define foreign direct investment. The population was further stratified for each host country by sector (manufacturing and services). Each sector was further stratified according to firm size in terms of number of employees (i.e., small, medium and large firms). The survey was implemented by means of computer assisted telephone interviews between September and December 2013. Our questionnaire was pre-tested in each country and interviews were conducted by native speakers who received intensive training. The respondents were local subsidiary managers or alternatively staff that had sufficient overview over issues related to production, finance and innovation.

As a result of this stratified sampling procedure, our final sample of 563 foreign subsidiaries is representative in terms of sub-national regional distribution, sector and firm size. Half of the foreign subsidiaries are in manufacturing (61%) and half are in service industries (39%). On average subsidiaries are 16 years old, and employ 162 employees. About 48% are small (less than 49 employees), 37% medium-sized (between 50 and 249 employees) and 15% large firms (250 employees and more).

3.2. Dependent variable

We follow prior research (Bertrand & Mol, 2013; Garriga, von Krogh, & Spaeth, 2013; Laursen & Salter, 2006; Piening, Salge, & Schäfer, 2016), and use a standardised survey based measurement of product innovation. Our dependent variable refers to *product innovation* measured as “Did your enterprise introduce product innovations, i.e. new or significantly improved products during 2011–2013?” This definition is proposed by the Oslo Manual, which codifies guidelines for collecting and interpreting innovation data (OECD, 2005), as an international harmonised standard used by national statistical offices in innovation surveys (including the European Community Innovation Survey). To make sure product innovation is measured consistently the survey clearly defined, in line with the Oslo Manual, product innovation as significant improvements in technical specifications, components and materials, incorporated software, user friendliness, or other functional characteristics. Product innovations by firms in the service sector can include significant improvements in how services are provided (for example, in terms of their efficiency or speed), the addition of new functions or characteristics to existing services, or the introduction of entirely new services. Purely aesthetic modifications of products (such as colour, style, and packaging) are not considered as product innovation. Similarly, the resale of new products bought from other enterprises does not constitute a product innovation. This explanation was included in the survey to assist respondents answer the question on product innovation.

Our dependent variable is dichotomous and equals 1 if the foreign subsidiary introduced product innovations (Bertrand & Mol, 2013; Monteiro et al., 2017). It is important to note that an innovation does not need to be developed by the firm itself but can be acquired from other firms or units within the MNE (OECD, 2005). We include only those innovations that have been mainly developed by the subsidiary

itself. We assign a zero if the foreign subsidiary did not introduce any product innovations during the reference period or when these product innovations were developed by headquarters or other units of the MNE.

3.3. Key independent variable

Subsidiary decision-making autonomy. We measure the level of autonomy with regard to decision-making in particular business functions (Ghoshal, Korine, & Szulanski, 1994; O'Donnell, 2000; Rabbiosi, 2011; Simões, Biscaya, & Nevado, 2002). Subsidiary managers answered the question “Who takes the following decisions?” We distinguish between several business functions (Gammelgaard et al., 2012; Young & Tavares, 2004) including decisions related to (1) the focus of research and development, (2) the adoption of major advanced technologies, (3) sales and marketing, (4) which suppliers will be used, (5) investment, (6) financing. Responses are on a five-point Likert-type scale ranging from “only by your foreign investor” (1) to “mainly by foreign investor” (2), “equally your enterprise and your foreign investor” (3), “mainly by your enterprise” (4) and “only by your enterprise” (5). We measure decision-making autonomy by taking the average of all six functional areas (Jarvis, MacKenzie, & Podsakoff, 2003); we obtain one factor with an eigenvalue larger than 1, and a Cronbach's alpha of .9, suggesting autonomy can be measured by one factor. Decision-making autonomy ranges between 1 (low autonomy) and 5 (high autonomy), and is generally lower for business functions such as finance and investment (2.8 on a 1–5 scale) compared to operational management, like the choice of supplier (3.8 on 1–5 scale). By taking a summative scale, we test whether autonomy in multiple functional areas is a better predictor of product innovation than autonomy in fewer functional areas (as predicted by H2).

3.4. Control variables

We use three different sets of control variables to account for subsidiary, MNE, and industry- and country-specific effects. The first set of control variables accounts for subsidiary characteristics. We include a dummy that equals 1 if the subsidiary has R&D expenditures between 2011 and 2013 (Simões et al., 2002; Taggart & Hood, 1999). Second, we include subsidiary size, measured as the log of the number of employees (Camisón-Zornoza, Lapedra-Alcamí, Segarra-Ciprés, & Boronat-Navarro, 2004). We also include the age of the subsidiary – measured in years since incorporation (Cohen & Levinthal, 1990; Taggart & Hood, 1999). Fourth, we include the degree of external embeddedness. We follow Rowley, Behrens, and Krackhardt (2000) who use the degree of local density as a proxy for local embeddedness. We measure external embeddedness as the percentage of supplies sourced from either internally or from local external partners. It ranges from –100 (100% is sourced internally from the MNE) to 100 (100% is sourced locally and externally). Fifth, we control for the quality of human capital by including the share of employees that hold a degree of tertiary education. Sixth, following OECD guidelines for measuring innovation cooperation (OECD, 2005: 20), we measure external knowledge sourcing by the extent of local knowledge sourcing by asking subsidiary managers to indicate “the importance of potential co-operation partners as source for knowledge relevant for R&D and innovation by the foreign subsidiary”. We focus specifically on the importance of (a) external suppliers, (b) external customers, (c) external firms of the same sector (competitors) located in the host country, and (d) universities and other public sector research in the host country. Responses range from “not important” (1), to “important” (2) and “very important” (3). Following extant literature (Nell, Ambos, & Schlegelmilch, 2011; Yamin & Andersson, 2011), we use the average of these four items as our index of external knowledge sourcing (Jarvis et al., 2003).

The second set of control variables concerns headquarters strategy. First, we include a dummy for entry mode strategy measured by a dummy for full acquisitions (versus greenfields). Mergers and

Table 1
Descriptive statistics (n = 563).

Variable	Mean	St. dev	1	2	3	4	5	6	7	8	9	10
1 Product innovation	0.44	0.50	1									
2 Subsidiary decision-making autonomy	3.1	1.1	0.28	1								
3 External embeddedness	24.1	58.9	0.24	0.36	1							
4 R&D dummy	0.55	0.50	0.34	0.20	0.12	1						
5 Subsidiary size (log)	4.11	1.35	0.04	−0.21	0.01	0.13	1					
6 Subsidiary age	16	12	0.01	0.02	0.04	0.08	0.13	1				
7 Entry mode full acquisition	0.36	0.48	0.15	−0.07	0.10	0.03	0.20	0.19	1			
8 Share of highly educated employees	31.8	29.3	0.06	0.14	−0.05	0.05	−0.35	−0.10	−0.11	1		
9 One foreign shareholder	0.72	0.45	0.09	0.03	−0.05	0.04	−0.01	0.00	0.08	0.06	1	
10 Knowledge sourcing	0.67	0.76	0.16	0.06	0.10	0.32	0.09	0.03	0.06	0.08	0.01	1
11 Manufacturing sector	0.61	0.48	0.11	−0.11	0.02	0.12	0.34	0.05	0.15	−0.54	−0.04	0.05

acquisitions have been associated with technology driven investment motives, for example, when foreign firms substitute ‘bought’ technology with ‘internally-produced’ technology (Cassiman, Colombo, Garrone, & Veugelers, 2005; Kogut & Chang, 1991). Third, we control for the type of ownership – one foreign owner versus multiple owners – by including a dummy taking the value 1 if the subsidiary has one main shareholder (Filatotchev, Stephan, & Jindra, 2008; Hoskisson et al., 2000).

Finally, we control for host country and industry characteristics. We introduce a dummy that equals 1 if the foreign subsidiary is in manufacturing (based on NACE Rev. 2, 2 digit codes 10 to 32) and 0 in case of services (including NACE codes 35–39, 45–47, 49–53, 58–82). We control for host-country effects by including host country dummies.

3.5. Common method variance

As the data for our dependent and explanatory variables are collected from the same respondents, there is the potential risk of common measurement variance causing a common method bias (Chang, van Witteloostuijn, & Eden, 2010; Siemen, Roth, & Oliveira, 2010). In such a case, self-report data can create false correlations if the respondents have a propensity to provide consistent answers to survey questions that are otherwise unrelated leading to inflated correlations. Podsakoff, MacKenzie, Lee, and Podsakoff (2003: 888) argue that a “way to diminish method biases is to use different scale endpoints and formats for the predictor and criterion measures”. Following this argument, our dependent variable is measured on a 0–1 scale, and our key independent variable is constructed based on a 1–5 scale. In addition, we conduct a Harman single factor test, a post-hoc statistical procedure to check for common measurement variance (Podsakoff et al., 2003). Harman’s one factor analysis yields five factors explaining 70% of variance, with the first factor explaining only 20% of variance. In addition, as mentioned before, our 2013 survey was the final wave in a research project covering multiple waves. Matching the 2013 data with the data from the previous wave in 2011 yields 49 firms that indicate they had been surveyed in 2011.¹ If a common method bias would be present, we could expect that these subsidiaries would know what to expect in the 2013 survey and could anticipate the answers, possibly resulting in a common method variance. If that were the case, the scores for product innovation and subsidiary autonomy would be systematically different for those firms participating in the 2011 survey compared to those that did not participate in the previous wave. A *t*-test shows this is not the case ($p = .19$ for product innovation; $p = .60$ for autonomy). Hence, although we cannot completely rule out common method bias, we have no strong reasons to suspect it is affecting our

results.

4. Method

We estimate a probit model explaining the probability that a subsidiary develops a product innovation. We account for the endogeneity of the probability of a subsidiary developing a product innovation with the two-stage treatment effect model using the Inverse Mills ratio (Heckman, 1979). In the first stage, a selection equation examined factors driving the probability that a firm reports the introduction of a product innovation. In the first stage we include all control variables, and we follow Patel, Kohtamaki, Parida, and Wincent (2015) and use fixed effects derived from two digit NACE (industry) code as an instrument in this first stage. In the second stage, the outcome equation tests whether the subsidiary *itself* has developed these product innovations. The dependent variable in the first stage and the second stage differ because subsidiaries can report a product innovation, but may not have developed the product innovation themselves (but, for example, the product innovation was mainly developed elsewhere inside the MNE). Our variable of interest in the second equation is subsidiary autonomy. The second stage models account for the possible selection bias by including the inverse Mills ratio as an additional control variable. A total of 535 of the 785 subsidiaries included in the first stage report the introduction of a product innovation, and 334 subsidiaries of these 535 subsidiaries have developed the product innovation themselves. After including all control variables, our dependent variable in the final outcome model takes the value 1 when the subsidiary has developed a product innovation (249 cases) and takes the value 0 when they do not develop an innovation themselves (314 cases). The number of observations in the final model is 563.

5. Results

Means, standard deviations and correlations for our key variables are shown in Table 1. We calculate the variance inflation factor (VIF) for each of the regression coefficients in our full model to test for the presence of multicollinearity. VIF values for all variables in the model as well as the average VIF are all below 2.0 and well below the critical cut-off value suggested by Hair, Black, Babin, Anderson, and Tatham (2006), suggesting absence of multicollinearity. A test of the normality of the standard errors shows this assumption holds as well (Murphy, 2007).

5.1. Key findings

We run a series of regression models. The main results are shown in Table 2. Model 1 only includes the control variables. We find that subsidiaries that perform R&D are more likely to develop product innovations. Similarly, subsidiaries that are externally embedded are more likely to introduce a product innovation, a result in line with extant literature. Full acquisitions are more innovative than greenfield

¹ The 2011 wave included questions regarding subsidiary autonomy. There are too few observations to run a regression including the 2011 measure of subsidiary autonomy to explain 2013 scores on product innovation. Depending on specification, this number drops to 30 when including all control variables, making the results statistically unreliable. Moreover, subsidiary autonomy in 2011 was measured in a slightly different way, making it difficult to compare results.

Table 2
Regression results (dependent variable is subsidiary product innovation).

Variables	Model (1)	Model (2)	Model (3)
External Embeddedness	0.00474*** (0.00108)	0.00325** (0.00114)	0.00323** (0.00115)
R&D	0.463** (0.166)	0.362** (0.170)	0.363** (0.170)
Knowledge Sourcing	−0.0241 (0.0824)	−0.00560 (0.0835)	−0.00625 (0.0835)
Age	−0.00585 (0.00508)	−0.00672 (0.00532)	−0.00677 (0.00532)
Size	0.0145 (0.0524)	0.0453 (0.0534)	0.0458 (0.0535)
Industry	0.268 (0.157)	0.285 (0.158)	0.283 (0.157)
Full acquisition	0.332* (0.126)	0.403** (0.129)	0.396** (0.130)
Human capital	0.00430 (0.00269)	0.00352 (0.00272)	0.00351 (0.00272)
Single foreign shareholder	0.160 (0.139)	0.126 (0.142)	0.124 (0.142)
Czech Republic	−0.393** (0.189)	−0.359* (0.192)	−0.359* (0.192)
Hungary	−0.559** (0.234)	−0.438* (0.238)	−0.440* (0.239)
Poland	−0.366** (0.181)	−0.346* (0.183)	−0.349* (0.184)
Romania	−0.166 (0.186)	−0.0575 (0.190)	−0.0565 (0.191)
Slovak Republic	−0.313 (0.326)	−0.0901 (0.330)	−0.0866 (0.331)
Autonomy	–	0.278*** (0.0638)	0.372 (0.305)
Autonomy squared	–	–	−0.0149 (0.0472)
Mills Ratio	−1.039** (0.368)	−1.129** (0.374)	−1.130** (0.374)
Constant	−0.295 (0.460)	−1.191** (0.508)	−1.318** (0.648)
Observations	563	563	563
Pseudo R2	0.18	0.21	0.21
Loglikelihood	−315.7	−306	−305.9
LR Chi-square	141.5	161.1	161.1
P-value Chi	0.0000	0.0000	0.00000
Increase in LR compared to model 1		19.4	19.4

Standard errors in parentheses.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

investments, and the probability that a manufacturing firm will generate a product innovation is higher than a service firm. The inverse Mills ratio is significant suggesting that selection is indeed an issue (see also Patel et al. (2015)) and it is important to correct for it in our models.

In model 2 we add subsidiaries' decision-making autonomy and we find that the effect is positive and significant. By adding subsidiary autonomy the log likelihood improves significantly ($\Delta LR \chi^2 = 16$; $p < .0001$). In model 3, we test for a non-linear effect of decision-making autonomy, as predicted by our first hypothesis. We find no evidence of a non-linear effect of decision-making autonomy. The model fit does not increase when adding the squared term of subsidiary autonomy ($\Delta LR \chi^2 = 0.2$; $p = .66$). We find an overall classification rate of 73%, meaning that our model is able to correctly classify 73 percent of the cases (i.e. attribute a 0 to non-innovators and a 1 to innovators based on the model), which can be considered good.

5.2. Do all dimensions of autonomy matter equally to product innovation?

So far we have used a composite measure of autonomy. As predicted in our second hypothesis, different aspects of autonomy may impact product innovation differently. We explore the individual dimensions of decision-making autonomy on the likelihood to observe product innovations. We re-estimate model 2 (the linear effect of decision-making autonomy). Instead of the composite autonomy index, we now include the level of autonomy for each of the six business functions. To compare the effects of these different aspects of autonomy, we calculate marginal effects. As the marginal effects for each aspect of autonomy cannot be directly inferred from the estimated coefficients in a Probit model, we calculate the marginal effects using the margins command in STATA (Meyer, van Witteloostuijn, & Beugelsdijk, 2017).

We provide more intuition for the relation between nature of autonomy and product innovation in two ways. First, we calculate the marginal effect of a one unit increase in each specific type of autonomy on the probability of a subsidiary developing a new product. In addition, we exploit our fine-grained measure of autonomy. This is a five point Likert scale, meaning we can calculate in a detailed manner how much the probability of generating a product innovation changes depending on the exact category of autonomy (a 1 reflecting no autonomy – a 3 joint decision-making – and a 5 full autonomy by the subsidiary). We calculate how the probability of innovation changes for each category. We use the first category as the base category (that is answer category “1”, implying no autonomy with all decisions made by headquarters). Table 3 summarizes these marginal effects.

We find that all aspects of subsidiary autonomy exert a positive and significant effect on the probability of a subsidiary developing product innovations. We continue to find that this relation is linear, providing partial support for our first hypothesis. Although the relations are significant, the effect of subsidiaries' decision-making autonomy differs substantially depending upon the business function in question.

Our marginal effects analysis shows that the effect size of autonomy is substantial, and largest for autonomy on research and development. All else equal, a one unit increase in autonomy in research and development is associated with a 0.084 increase in the probability that the subsidiary innovates. This probability increase is only 0.024 for decision-making autonomy related to sales and marketing.

In line with our finding that more decision-making autonomy for subsidiaries will be positively related to the probability of generating product innovations, we find that the effect size increases as the level of autonomy increases. As shown in Table 3, compared to having no autonomy and the parent taking all decisions in research and development (a 1 on a 1–5 scale), the probability to innovate is 0.23 higher when the subsidiary is involved in decision-making (a 3 on the 1–5 scale), and 0.35 when the subsidiary takes all decisions (a 5 on the 1–5 scale). The absolute effect sizes are smaller for the other aspects of autonomy, but we observe a similar increase in effect size when autonomy levels increase.

By definition, all product innovations contain a degree of novelty. In line with the Oslo Manual (OECD, 2005) the minimum requirement for a change in a firm's products to be considered an innovation is that it is new or significantly improved to the firm. In our survey we can also differentiate between product innovations that are new to the market or new to the world (Laursen & Salter, 2006; Monteiro et al., 2017). Innovations are new to the market when the foreign subsidiary is the first to introduce the innovation on the market in which it competes, including both geographic region and product line. An innovation is new to the world when the foreign subsidiary is the first to introduce the innovation to all markets and industries, domestic and international. We exploit this additional information to explore, if our main finding on the positive relation between autonomy and product innovation holds for differing degrees of novelty of product innovation.

On the one hand, creativity-innovation theory predicts that radical innovations are difficult to manage (Amabile, 1988; Beugelsdijk, 2008)

Table 3
Marginal effects of autonomy on the probability of a subsidiary developing a product innovation.

	Decisions on the focus of research and development	Decisions on adoption of major technologies	Decisions related to sales and marketing	Decisions on which suppliers will be used	Decisions on investment	Decisions on financing
Average increase of the probability of a product innovation new to the firm after a one unit increase in autonomy	.084 (.013)***	.06 (.014)***	.024 (.014)*	.052 (.015)***	.063 (.015)***	.042 (.013)**
Increase of the probability of an product innovation compared to base category (no autonomy)						
1						
2	Only the foreign parent	.08 (.06)	.002 (.069)	–.06 (.09)	.12 (.06)**	.15 (.17)
3	Mainly the foreign parent	.23 (.06)***	.08 (.06)	.02 (.05)**	.15 (.05)**	.21 (.15)
4	Joint decision – making	.20 (.07)**	.017 (.06)	.15 (.08)**	.20 (.07)**	.30 (.19)
5	Mainly the subsidiary	.27 (.07)***	.11 (.06)**	.15 (.08)**	.29 (.07)***	.59 (.19)***
	Only the subsidiary	.35 (.06)***				

* p < 0.1.

** p < 0.05.

*** p < 0.01.

Table 4

Regression results novelty of product innovation.

Variables	New to the Market	New to the World		
	Model 1	Model 2	Model 3	Model 4
External	0.00272**	0.00268*	0.00150	0.00153
Embeddedness	(0.00138)	(0.00138)	(0.00142)	(0.00142)
R&D	0.289	0.291	0.450**	0.452**
	(0.209)	(0.209)	(0.208)	(0.208)
Knowledge Sourcing	0.141	0.141	–0.0329	–0.0329
	(0.0951)	(0.0951)	(0.0943)	(0.0944)
Age	0.00233	0.00230	0.00192	0.00202
	(0.00515)	(0.00514)	(0.00562)	(0.00563)
Size	–0.0223	–0.0215	0.114*	0.114*
	(0.0617)	(0.0618)	(0.0624)	(0.0625)
Industry	0.143	0.141	0.309	0.316
	(0.185)	(0.185)	(0.192)	(0.193)
Full acquisition	0.238*	0.229	–0.0343	–0.0231
	(0.145)	(0.148)	(0.151)	(0.153)
Human capital	0.000837	0.000858	0.00706**	0.00707**
	(0.00315)	(0.00315)	(0.00315)	(0.00315)
Single foreign shareholder	–0.124	–0.124	0.296*	0.298*
	(0.163)	(0.163)	(0.173)	(0.173)
Czech Republic	0.395*	0.393*	–0.432**	–0.433**
	(0.216)	(0.216)	(0.218)	(0.218)
Hungary	0.451*	0.448	–0.611**	–0.605**
	(0.273)	(0.273)	(0.283)	(0.283)
Poland	0.559**	0.555**	–1.049***	–1.047***
	(0.203)	(0.203)	(0.228)	(0.228)
Romania	0.275	0.275	–0.380*	–0.381*
	(0.228)	(0.228)	(0.220)	(0.220)
Slovak Republic	–0.0864	–0.0865	–0.529	–0.536
	(0.535)	(0.536)	(0.436)	(0.436)
Autonomy	0.282***	0.391	0.146**	–0.0116
	(0.0750)	(0.387)	(0.0732)	(0.363)
Autonomy squared	–	–0.0167	–	0.0244
		(0.0577)		(0.0552)
Mills Ratio	–0.754	–0.753	–1.161**	–1.155**
	(0.459)	(0.459)	(0.461)	(0.461)
Constant	–2.247***	–2.409**	–1.944**	–1.731**
	(0.621)	(0.838)	(0.601)	(0.768)
Observations	563	563	563	563
Pseudo R2	0.14	0.14	0.21	0.21
Loglikelihood	–224.5	–224.5	–218.5	–218.4
Chi-square	71.46	71.54	119.2	119.4
P-value Chi	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses.

* p < 0.1.

** p < 0.05.

*** p < 0.01.

suggesting that headquarter involvement is not productive. Radical product innovations would require very high levels of subsidiary decision-making autonomy. On the other hand, radical innovations are generally associated with higher risks of failure, higher upfront investments and potentially also higher degrees of complexity. The risk-return trade-off is different for more radical innovations, suggesting that for more radical innovations the support of top managers is required (Ettlie, Bridges, & O’Keefe, 1986). As headquarters make key decisions regarding current and future resource allocation including new product development (Meyer & Benito, 2016), this would predict lower levels of subsidiary decision-making autonomy.

Our estimation results in Table 4 show that autonomy remains a significant predictor of these different types of product innovation, but that the size of the effect of autonomy declines with increasing novelty of the product innovations. In our main model, as shown in Table 2, we find a marginal effect of autonomy on product innovation new to the subsidiary equal to 0.084 (with a confidence interval of [0.048;.12]; p = .000). Based on the results shown in Table 4, this becomes 0.062 (CI = [0.03;.09]; p = .000) for product innovations that are new to the

market, and 0.032 (CI = [0.00087; 0.06]; $p = .044$) for product innovations that are new to the world. Hence, although autonomy is always significant, it matters most for product innovations that are new to the subsidiary, less so for product innovations that are new to the (geographic/product) market and least for product innovations that are new to the world. In line with our previous results, we do not find support for a non-linear effect of autonomy.

6. Conclusion

In this paper we explored how subsidiary decision-making autonomy affects the probability that MNE subsidiaries generate product innovations. We do so against the background of a critical shift in our theorizing on the organizational architecture of the multinational firm in which subsidiaries take a more strategic role than in the past, including the role of innovators. Our study of 563 subsidiaries located in Central and Eastern Europe indicates that autonomy has a positive and linear effect on the likelihood that subsidiaries generate product innovations. This supports the argument that dispersed power arrangements contribute to the implementation of innovation (Aiken & Hage, 1971; Burns & Stalker, 1961; Clark, 1968; Thompson, 1965) and that external constraints can negatively affect intrinsic motivation in organizations (Beugelsdijk, 2008; Deci & Ryan, 1985; Mudambi et al., 2007; Sherman & Smith, 1984). We do not find support for a non-linear relationship between subsidiary decision-making autonomy and subsidiary product innovation.

The managerial implications of our study are clear: subsidiaries endowed with decision-making autonomy – specifically in the areas of R&D, investment and finance – will have a higher probability to develop product innovations. All else being equal, the probability of a fully autonomous subsidiary generating a product innovation is approximately 0.35 higher than an otherwise similar subsidiary with no autonomy. Our finding that autonomy in R&D has the largest effect on the ability of subsidiaries to develop new products extends the study by Mudambi, Pedersen, and Andersson (2014) who show that subsidiary power is obtained through functional power. In our post hoc test, we found that higher degrees of novelty of product innovation still benefit from subsidiaries' autonomy, but may require higher degrees of headquarters managerial involvement. This finding is in line with Ettlie et al. (1986) who showed that the organisation strategy for radical and incremental innovations differs, and that centralization of decision-making may be beneficial for radical innovations. This finding also extends the study by Raab, Ambos, and Tallman (2014) who show that managerial involvement can be critical for knowledge sharing. We consider a further exploration of the relation between centralization-decentralization and decision-making autonomy in the MNE, and the differential effect on radical and incremental product innovations an exciting and relevant topic for future research.

More generally, our study highlights the importance of organizational design within the MNE. The shift in theorizing from the MNE as a hierarchical nested organizational system to the view of the MNE as a network of interdependent subsidiaries orchestrated by headquarters emphasizes the need to understand the nature of interdependencies between headquarters and subsidiaries (Benito, Lunnan, & Tomassen, 2014). As we argued throughout this paper, subsidiaries require autonomy in all functional areas (and especially R&D) to develop product innovations. Decision-making autonomy is a key aspect of organizational design and goes back to the original work by Bartlett and Ghoshal (1989) on the organizational balancing act between local responsiveness and global integration. In the case of product innovation, this study presents empirical evidence in support of autonomous subsidiaries stressing local responsiveness. The ability to generate product innovation is, however, just one – admittedly important – part of the product development process in the MNE and its long term competitiveness. The transfer of knowledge between MNE units as well as the ability to benefit from input from other subsidiaries in the MNE is also important.

The implicit assumption in our analysis is that subsidiaries are interdependent, but in such a way that they can perform their activities independently. In this view, each subsidiary is rather autonomous, and the sum of these interdependent subsidiaries constitutes the MNE. This so-called pooled interdependency is, however, only one type of interdependency and subsidiaries can be interrelated in sequential or reciprocal ways too (Benito et al., 2014). Empirically, we selected subsidiaries that do product development themselves, which gives us reason to believe our implicit assumption of pooled interdependency is correct. Changing the assumed nature of interdependency may, however, have implications for the role of decision-making autonomy. In the case of sequential or reciprocal interdependencies, the interaction between subsidiaries within the MNE and between subsidiaries and headquarters becomes more important, and as a result the role of decision-making autonomy may change. It could be that the negative effects of very high levels of subsidiary decision-making autonomy (rent seeking, liability of internal isolation, lack of knowledge exchange) are particularly relevant for subsidiaries that are sequentially or reciprocally interdependent. This may in turn explain why we did not find support for a negative effect of very high levels of decision-making autonomy in our sample of (relatively independent) subsidiaries. Hence, we should be careful in generalizing our positive and linear relation between subsidiary decision-making autonomy and product innovation to all types of competence creating subsidiaries. Studies attempting to theorize on the nature of interdependencies within the MNE and its implications for new product development would be a useful extension to the present study. In doing so, we feel this question of organizational design should not be limited to subsidiaries and headquarters only. One particular interesting aspect of organizational design of MNEs concerns the use of regional (Alfoldi, McGaughey, & Clegg, 2017) and divisional (Benito, Lunnan, & Tomassen, 2011) headquarters. In balancing the interests of the subsidiary and corporate headquarters, regional or divisional headquarters or subsidiaries with a regional mandate can influence knowledge flows within the MNE (Lunnan & Zhao, 2014). Integrating these different levels of analysis allows one to study MNEs as an organizational system instead of a network of stand-alone entities, an approach which is gaining ground rapidly (Nell, Kappen, & Laamanen, 2017).

To conclude, the purpose of this study was to understand how the degree and the nature of decision-making autonomy in MNE subsidiaries are related to the ability to develop new products in the subsidiary. By relating both the degree and the nature of autonomy to actual product innovations (not R&D, not patents, but a concrete outcome of knowledge development), this paper contributes to the literature that has emphasized the need of MNEs to use their foreign subsidiaries to tap into local external knowledge pools by embedding itself in the external host country environment. This coincides with a simultaneous recognition that subsidiary specific advantages are critical to the competitiveness of the MNE, and is reflected in what has become known as the network-based theory of the MNE. MNEs leverage competence from local subsidiaries by designing organizational architectures that allow for creativity ultimately leading to subsidiary-specific advantages including the ability to develop product innovations. We argued that the need to tap into local external knowledge pools requires subsidiaries to have decision-making autonomy. This paper suggests that the prominence of external embeddedness in the contemporary network-based theory of the multinational firm requires a simultaneous recognition of the importance of the allocation of decision-making autonomy within the multinational firm. In the context of product innovation, our paper suggests that higher decision-making autonomy increases the probability of a subsidiary developing a product innovation. This effect is particularly strong, but not restricted to, decision-making in technology related areas and extends to other functional areas too.

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