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The Distinct Features of Hidden Champions in Germany: A Dynamic Capabilities View

The Distinct Features of Hidden Champions in Germany: A Dynamic Capabilities View

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Abstract

Hidden Champions (HCs) are firms unknown to the wider public, but global leaders in the niche markets they serve. This paper looks at distinctive features of these firms, focusing on their dynamic capabilities. Employing a unique data base on German firms, we identify a representative sample of German HCs. Based on a matching technique, we examine differences to other firms in terms of the firms' processes, position, and path. We find that HCs' competitive strategy rests on technology leadership and customisation. HCs are more open in their knowledge management, but without compromising control over the new product development process. HCs do not invest more into innovation, but achieve higher innovation success. The higher efficiency can be linked to their superior technological capabilities and to higher investment in human capital and HR management practices that mobilise the creative potential of their employees.

Key Words: Hidden Champions, Germany, Competitive Strategy, Knowledge Management, Innovation, Dynamic Firm Capabilities

JEL: L21, L25, M10, M21, O31, O32

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1. Introduction

Innovation and globalisation are two major challenges of many small and medium-sized enterprises (SMEs) for developing a successful competitive strategy. In most markets in highly developed open economies, innovation is a key driver of competition. SMEs need to develop capabilities and management practices not only to keep pace with technological change, but also to gain competitive advantages from innovation, allowing them to compete over large firms. However, SMEs face a number of obstacles to innovation, including high fixed costs of conducting R&D, a high risk exposure if an innovation project fails, limited access to external financing, and lack of market reputation (see Acs and Audretsch 1988, Rammer et al. 2009). At the same time, globalisation challenges many SMEs through increased competition while they face difficulties in exploiting the opportunities of global markets (see Paul et al. 2017, Fliess and Busquets 2006).

But there are some groups of SMEs that manage to leverage the advantages of globalisation through innovation-based globally oriented business models. One group are so-called 'born globals'. These are start-ups and young firms that from the beginning pursue a vision to develop and commercialise products for users across the globe (see Fryges 2006). They access global markets by using innovative sales channels such as the Internet and foreign distribution partners. Another group are established SMEs that aim at being a world-market leader in niche markets. Hermann Simon (1990, 1996) was the first to denote these firms as 'Hidden Champions' (HCs).¹ Generally HCs operate in product niches and can become market leader by following a strategy of specialisation. They seek opportunities in markets that are often not economically attractive for large companies. Due to the fact that the national markets for these applications are often too small, HCs have to be present globally. In recent years, attention towards HCs has increased as they provide an attractive model for small firms to gain from globalisation (see Audretsch et al. 2018, Garaus et al. 2015, Huh 2015, Lee et al. 2014, Petraite and Dlugoborskyte 2017, Purg et al. 2016, Voudoris et al. 2000, Witt and Carr 2014).

¹ HCs are not restricted to the group of SMEs, though the majority of them are below the SME threshold of 250 employees (see section 3). Sometimes, particularly in the German context, the debate on HCs goes beyond SMEs, referring to the concepts of '*Mittelstand*', family enterprises and owner-managed enterprises, and including large firms of up to several billions of annual sales. In this paper, we also include HCs beyond the SME size threshold. These larger firms often share communalities with SMEs in ownership, governance structure and enterprise culture (see Welter et al. 2014, for a discussion of *Mittelstand* and SMEs in Germany)

This paper aims to contribute to the growing literature on Hidden Champions (HCs) in two ways. First, we want to shed more light on the specific strategies pursued by HCs to maintain global market leadership. In particular we look at the way HCs position themselves in markets, the knowledge management practices they use, and the innovation paths they follow. Secondly, we broaden the empirical methodology of HC analyses by employing a new approach which uses a unique data base on German firms, enabling a representative analysis of HCs. Thereby, we overcome the shortcomings of most of the existing studies, which are usually based on case studies or a deliberate selection of identified HCs.

2. Hidden Champions and Innovation Management

The phenomenon of Hidden Champions has been explored by Simon since the beginning of the 1990s (see Simon 1990, 1996, 2012). The term 'Hidden Champions' is used to describe SMEs and mid-sized companies with high world market shares. They are often among the technology and innovation leaders in their sector and they significantly influence the development of their market. The firms are called 'Hidden', because they operate in niche markets or as suppliers in business-to-business settings, and are mostly not publicly known. They are 'Champions' because they are exceptionally successful firms due to their global leadership, and strong international competitiveness in their respective fields.

According to the assumptions of Simon's concept (see Simon 2012), Hidden Champions share the following characteristics:

- A HC takes a Top-3 position on the global market, or the first position in Europe or on its continent – its market position is primarily dependent on its market share (or on its relative share).
- Its revenue does not exceed five billion Euros.
- It has got little popularity and leads a more or less hidden existence away from the public eye.

Although innovation is not part of Simon's definition of HCs, Simon considers innovation as a crucial factor which constitutes one of the pillars for HCs' competitive advantages.

The concept of the firm's innovative potential is defined in a variety of ways by different authors. Some scholars describe the innovative potential very narrowly, others define it as part

of an extensive model of managing innovation (see e.g. Nelson and Winter 1982, Kline and Rosenberg 1986, Cohen and Levinthal 1990). In the tradition of the resource-based theory of the firm (Penrose 1959, Barney 2001, Prahalad and Hamel 1990), the firm's scope of innovation is understood as the resources that the firm should have at its disposal in order to create and commercialise innovations effectively.

Following these considerations, Teece and Pisano (1994) developed a more comprehensive and dynamic approach by introducing the concept of the 'Dynamic Capabilities of Firms' (Teece and Pisano 1994, Teece et al. 1997, Teece 2007). They pointed out that winners in the global marketplace have been firms demonstrating timely responsiveness and rapid and flexible product innovation, along with the management capability to effectively coordinate and redeploy internal and external competences. The main sources of firms' competitive advantages include the ability to adjust to the shifting character of the environment, and (strategic) management which is excellent in adapting, integrating, and re-configuring internal and external organisational skills, resources, and functional competences towards changing environments (see Teece and Pisano 1994).

As a model for strategic management with a focus on efficiency, three dimensions are of uppermost interest in the framework of dynamic firm capabilities: processes, position, and path (see Teece et al. 1997).

- '*Managerial and organisational processes*' stress the importance of the way things are done in the firm. That implies both the intra-organisational interactions amongst different functions and departments, and the inter-organisational relations to partners outside the firm, especially customers and suppliers. There has to be a balance of routines and well known practices in combination with the agility in dealing with challenges and new trends in the environment of the firm. In particular, three capabilities are vital. First, management coordinates and integrates internal and external actors and activities and forms e.g. strategic alliances, technological collaborations and relations to different stakeholders. All these linkages provide specific knowledge that is supposed to be integrated into business processes. Secondly, learning is crucial. A learning organisation distinguishes itself by being able of communicating and sharing knowledge and connecting new ideas to its current knowledge basis. Learning needs both organisational and individual skills what makes human resource management fundamental to firm success. Thirdly, there is the capacity of reconfiguration. In volatile environments there is permanent need to rearrange

firm's asset structure, and to master essential internal and external transformations. This requires ongoing monitoring of market trends and technological changes and implies readiness to absorb new ideas and impulses.

- '*Position*' expresses a variety of assets an enterprise can exploit, e.g. financial, technological, intellectual, organisational, and market assets. Excellence in this area builds the basis for strategic and operational management and defines the competitive advantages of the firm. The scope of action depends of the firm's cash position and the available means to finance trendsetting projects. Nevertheless, the pillars for the development of innovative processes, products and services are the endowment of technology and intellectual property. The formal setting of an organisation, e.g. the hierarchy and the degree of vertical integration, in combination with informal relations are key pillars of corporate culture. Critical organisational assets include a firm's networks and external sources of knowledge. They can have a significant impact on the outcomes of innovation processes. Furthermore, in-depth knowledge about market mechanism and awareness of the specific needs and preferences of customers strongly influence a firm's market position and profitability prospects. Achieving an excellent reputation with clients is an important management objective just as well as having a large number of regular customers and reliable relations to suppliers. Recapitulating the above mentioned remarks on assets, position refers to the difficult-to-trade-factors and uniqueness of the firm.
- The notion of '*path*' recognises that the history of a firm matters. What happened in the past, especially the accumulation of technological and intellectual knowledge, is crucial for the assimilation of new ideas and impulses. The learning capacity of an enterprise is path dependent. Firms can choose among an almost infinite range of technologies which they can apply to compete in existing markets or to get access to new business fields. It is a dynamic process in the sense that the know-how earned in the past and present will be more efficiently exploited in the future. In-house research and development (R&D) is an essential precondition for the firms' 'absorptive capacity' – the ability to recognise, assimilate and apply new knowledge (see Cohen and Levinthal 1990). Cooperative arrangements and openness to external sources of knowledge are further relevant means of accumulating capacities. In this regard, path is also about human capital. Knowledge is not only embedded in equipment and products but it is embodied in people. Some firms have the individual capacity to engage in basic and applied research or they are linked to these areas by empowering competent and committed employees.

Linking the concept of the dynamic capabilities of firms with the phenomenon of Hidden Champions, it seems to be obvious that the success of a firm does not happen accidentally but is the result of leadership and strategic orientation, an appropriate organisational structure, especially with respect to resources and people, and how processes are designed.

Recent studies on HCs have shown that processes, position, and path are important factors when looking for success drivers in HCs and lessons other firms can learn (see Simon, 2012, 2014a, 2014b as well as Audretsch et al. 2018, Kaudela-Baum et al. 2014, Kirner and Zenker 2011, Rasche 2003, Posch and Wiedenegger 2013, Venohr and Meyer 2007). A short summary of the empirical findings shows the following:

- HCs show managerial and organisational process qualities by striving for operational effectiveness, continuously assimilating, attaining, and extending best practices. In addition, they create distinctive organisational cultures that are built on owner-entrepreneurs and long-term relationships within the firm and with key external partners. HCs have very strong corporate cultures associated with excellent employee identification and motivation. The customer base and upstream relations to suppliers are essential. HCs rely on their own strengths and outsource less than other firms. For the customers they provide a wide choice of solutions and services, an advantage that can only be achieved by independently operating along the value chain. Profound production capacity and service orientation are amongst other critical factors for their competitive superiority. HCs' business idea can be quoted as 'deep rather than wide' and refers to the deep knowledge along the value chain, and the firms' conviction to stick to their own proficiency.
- HCs' position and path can be illustrated on various observations. The understanding of market as a strategic orientation is usually leading to narrowly-defined markets, both from a customer and technology perspective. HCs concentrate their limited resources on niche market segments with the aim to exploit market opportunities worldwide. Specialisation in product and know-how is combined with global marketing activities. HCs are very close to their top customers. In order to fulfil unique requirements of their clients, HCs use a well-approved range of technologies which they can adjust at customer's options. The accumulation of technological and intellectual knowledge is a necessary capacity that is difficult to copy by others. One usually finds in HCs a pronounced willingness to invest in R&D. Simultaneously, HCs put sufficient resources in marketing and offer consulting and value added services for their customers. Finally, HCs are aware that the qualification,

training, and motivation of employees are necessary preconditions for the accumulation of technological knowledge and the performance on the market.

In the empirical part of the paper, we aim at analysing the significance of these competitive approaches in HCs. In contrast to the existing literature, we apply a representative and comprehensive data set on HCs and compare them to a group of firms of similar size, operating in the same sectors and commanding similar resources, but following a different competitive strategy. Through this approach, we try to identify distinct features of processes, position and path that constitute the uniqueness of HCs.

3. Methodology and Data

Identification of Hidden Champions

Most existing studies on HCs follow a bottom-up (or list-based) approach to identify this specific group of firms. Researchers establish a list of firms that meet the criteria of being a HC, such as high market share, global activity, niche-market focus, relatively small size, and significant growth. Through examining case by case, it can be ensured that all firms entering the list actually meet the criteria. A drawback of this approach is a likely bias towards markets in which researchers expect to find HCs. It is also extremely difficult to establish a complete list of HCs as information on the relevant criteria is usually not public, and not all 'real' HCs disclose such information. List-based approaches frequently miss HCs that are very small, young or operating in markets outside the radar of researchers.

In our study, we follow a top-down approach. We employ a representative database of firms in Germany covering all firms with 5 or more employees in all manufacturing and business-oriented service sectors. For the key characteristics of a HC, being among the top-3 suppliers in its market, we do not have a direct measure (i.e. asking firms if they are among the top 3 firms in their main market). We are also sceptical that such a direct measure would be reliable since it is rather subjective as firms may delineate markets in terms of geography, customer groups or product characteristics in a way that they rank among the top 3. Instead, we combine information on a firm's global market orientation, the firm's market share in its main product market, and the firm's sale growth (relative to market growth) to identify HCs:

- 1) Global market orientation is measured by an export share higher than 50% and by sales to customers located outside Europe. The rationale behind this definition is that HCs need to serve the global and not just a regional market, and that they need to be a relevant market player.
- 2) Firms that are among the top-3 sellers in a market will show a high market share. The actual value of the market share of top-3 sellers is likely to depend on the market size. The larger the total market volume is, the more likely it is that the number of competitors increase, pushing the market share of the third largest supplier downwards. We apply the following thresholds for the market share to qualify as HC:
 - global market volume up to €0.2 billion: market share of >10%
 - global market volume €0.2 to €0.5 billion: market share of >7%
 - global market volume €0.5 to €1.0 billion: market share of >3%
 - global market volume €1.0 billion or more: market share of >1%
- 3) Above average market growth is defined as an increase in firm sales in the past 5 years by at least 10% above the industry average. Industry is defined at the 3-digit level of the international standard industry classification. The growth criteria ensures that HCs are firms that have gained in market share recently. Combining a relatively high market share and an increase in market share makes a firm a visible and relevant market player that will be considered by other competitors as a leading firm.

In addition, we restrict HCs to have less than 10,000 employees to meet the criteria of excluding very large firms.

Our database is the German Innovation Survey, which is the German part of the Community Innovation Survey (CIS) coordinated by the Statistical Office of the European Commission (ESTAT). The German Innovation Survey is designed as a panel survey ('Mannheim Innovation Panel') and conducted annually (see Peters and Rammer 2013 and Behrens et al. 2017 for more details). The survey rests on a 13% stratified random sample of the firm population in Germany and allows to extrapolate survey results to the total number of firms in the sectors and size classes covered by the survey. This feature provides the opportunity to calculate an estimate on the total number of HCs in Germany, including a breakdown by sector and size class. The gross sample size of the German Innovation Survey is about 35,000 firms. Owing to a response rate of 25 to 30%, the average weight per firm in the sample is about 25 but varies greatly among sectors and size class owing to disproportionate sampling quotas.

We use data from six survey waves (reference years 2006, 2008, 2010, 2012, 2014, 2016) as only these waves contained all the information required for identifying HCs. The export criteria is measured by two indicators, the ratio of export sales over total sales, and whether firms have sold products outside Europe. The German Innovation Survey obtains information on a firm's market share (ms) for its main product line j ,² along with the sales share of the main product line in a firm's total sales (s_j). This data can be used to estimate the total market volume (MV) for a firm's main product line:

$$MV_j = (S \cdot s_j) / ms_j \text{ (} S \text{ representing the volume of sales)}$$

Above market growth is calculated using panel data on the firms' sales development in the past five years compared to the development of sales in a firm's NACE 3-digit industry.

Sector and Size Distribution of Hidden Champions

In 2016, the extrapolated total number of HCs in Germany was close to 1,800, which is broadly in line with findings by Simon (2012) and Langenscheidt and Venohr (2015). These firms employed more than 490,000 persons and had total sales in 2016 of €285 billion. The number of HCs steadily grew over the past 8 years, from less than 1,500 firms in 2008, though the number has been higher in 2006 (~1,700). Variations in the number of HCs over time can partly be attributed to imprecision in the extrapolated data and partly to changes in assigning firms to the group of HCs if they are close to the threshold values. The lower number in 2008 may reflect a less favourable business cycle environment, resulting in a lower number of firms meeting the growth criteria and in fewer firms with an export share beyond 50%.

The distribution of HCs across sectors and size classes is heavily disproportionate. For the average of the years 2006 to 2016, 0.6% of all firms in the total population of the Innovation Survey have been classified as HCs. This share is between 3 and 5% in sectors such as the electronics, chemical & pharmaceutical, machinery, and vehicles industries (see Table 1). In the service sectors, HCs are very rare, except for IT services and engineering/R&D services

² The market share is a self-reported figure and hence risks some overstatement by firms, e.g. by delineating markets in terms of geography, customer groups or product characteristics in a way that their market share raises. We do not think that this is a serious problem in our data because there is no incentive for firms to overstate their market share. The market share question is one of many on a firm's market environment and performance. The survey is not used for benchmarking purposes. It is also not obvious to respondents for what purpose this information will be used.

(0.5% of all firms in these sectors), reflecting the large barriers for small service firms to supply global markets. By size class, firms with 500 to 999 employees report the highest share of HCs in Germany (7.6%). Among firms with less than 50 employees, less than 0.5% are HCs.

Table 1: Hidden Champions in Germany by sector and size class (average 2006-2016)

Sector (NACE) / size class	Absolute number	Share in all HCs (%)	Share in all firms (%)
Manuf. of Food, Beverages, Tobacco (10-12)	23	1.4	0.1
Manuf. of Textiles, Clothes, Leather (13-15)	34	2.1	1.4
Manuf. of Wood Products, Paper (16-17)	71	4.3	1.4
Manuf. of Chemicals, Pharmaceuticals (19-21)	103	6.3	4.2
Manuf. of Rubber and Plastic Products (22)	78	4.8	1.6
Manuf. of Glass, Ceramics, Concrete, Metals (23-24)	142	8.6	2.7
Manuf. of Metal Products (25)	108	6.6	0.5
Manuf. of Electronics, Optical Products (26)	196	12.0	4.8
Manuf. of Electrical Equipment (27)	78	4.7	2.1
Manuf. of Machinery (28)	404	24.7	3.8
Manuf. of Vehicles (29-30)	76	4.7	3.4
Manuf. of Furniture, Medical, Other Products (31-33)	117	7.1	0.8
Mining, Utilities, Waste Management (5-9, 35-39)	8	0.5	0.1
Wholesale Trade, Transportation (46, 49-53)	39	2.4	0.1
Media Services, Telecommunication (18, 58-61)	5	0.3	0.1
IT Services (62-63)	60	3.7	0.5
Financial and Consulting Services (64-66, 69-70, 73-74)	4	0.3	0.0
Engineering and R&D Services (71-72)	87	5.3	0.5
Other Business Services (78-82)	5	0.3	0.0
5 to 9 employees	80	4.9	0.1
10 to 19 employees	169	10.3	0.2
20 to 49 employees	283	17.3	0.5
50 to 99 employees	330	20.2	1.7
100 to 249 employees	347	21.2	2.5
250 to 499 employees	204	12.4	4.6
500 to 999 employees	140	8.6	7.6
1,000 and more employees	83	5.1	6.1
Total	1,637	100.0	0.6

Note: Figures are extrapolated to the total firm population in Germany in the listed sectors and size classes.
Source: German Innovation Survey.

In absolute terms, the largest number of HCs in Germany is found in the machinery industry. With about 400 HCs, one out of four of German HCs operate in this sector. About 200 HCs are found in the electronics industry (incl. semiconductors, computers, communication technologies, instruments and optical products). The size classes with 50 to 999 employees and 100 to 249 employees host the largest absolute number of HCs in Germany (close to 350 each).

Comparing Hidden Champions with Other Firms Using Matching

For comparing HCs with other firms, one has to take into account their specific industry and size structure which limits the informative value of a simple comparison with the average firm since such a comparison may first of all reflect sector and size differences, but less the different strategic orientation of HCs. For establishing a proper 'control group' of other firms, we use the matching technique. For each HC in our sample we match another firm (which has been observed in the same year) that is as similar as possible with respect to the sector (NACE 2-digit), size (number of employees, using eight size classes) and age. We include age because becoming a HC usually takes time so that comparing HCs with much younger firms is not meaningful.

We apply a propensity score matching using the mahalanobis distance measure (see Rosenbaum and Rubin 1983, Smith and Todd 2005). The result of the propensity score model is reported in Table 6 in the Appendix. The probability that a firm is classified as a HC is strongly influenced by size, age and sector. The observation year also affects the HC probability, with a statistically significant positive effect for the years 2006 and 2008 as compared to 2016 when controlling for sector, size and age. As 2016 is the year with the highest number of extrapolated HCs in Germany, the result implies that the structure of the German firm population has shifted towards sectors, size classes and firm ages with a higher propensity to host HCs.

The total number of HC observations in our sample (firm x year) providing complete information on the matching variables is 1,011 for the six observation years (i.e. on average 170 per year). Although the German Innovation Survey is based on a panel sample, only few firms participate every year in the survey. We identified 588 individual HCs participating at least once in the 2006 to 2016 period. At the same time, there are 102,064 potential control observations in the data set (about 17,000 per year), guaranteeing a high quality of matching results. In fact, we were able to match for each HC a control group firm from the same sector and size class with a very similar age and an observation for the same year. Table 7 in the Appendix contains key statistics on the high quality of our matching results.

After matching, the key distinguishing characteristics of HCs as compared to the control group remain (see Table 2). The average market share of HCs is 33.6% and 18.9% for the control group. Note that the market share of the control group firms does not necessarily refer

to the world market, but to a geographically confined (regional) market. The size of the sales market of HCs is significantly smaller (€1.9 billion on average) than the one of control group firms (€5.6 billion), confirming the niche market orientation of HCs. HCs realised a significantly higher medium-term sales growth of more than 10% p.a., compared to 3.4% for the controls.

The export share of HCs (63.7%) clearly exceeds the one of the control group firms (32.0%). While HCs have sales outside Europe in most years, this is the case for 65.8% of the control firms. The average number of employees in HCs is 502, while the control group firms are somewhat smaller (418), though the difference is statistically only weakly significant (note that matching for size was not performed on the absolute number of employees but by belonging to the same size class). The differences between HCs and other firms are larger before matching than after matching, pointing to the importance of the matching approach for a proper comparison of HCs with other comparable firms.

Table 2: Comparison of HCs and controls with respect to HC criteria

	HCs value	Controls before matching				Controls after matching			
		value	diff.	s.e.	t-stat	value	diff.	s.e.	t-stat
Market share (%)	33.9	16.7	17.2	0.9	18.5 ***	18.9	15.0	1.2	12.6 ***
Market size (billion €)	1.93	2.68	-0.75	1.0	-0.75	5.57	-3.64	1.28	-2.84 ***
Sales growth (%)	10.36	2.11	8.24	0.29	28.78 ***	3.39	6.96	0.44	15.72 ***
Export share (%)	63.7	12.3	51.4	0.7	69.9 ***	32.0	31.7	1.2	26.8 ***
Sales outside Europe (% of firms)	92.1	28.7	63.3	1.6	39.6 ***	65.8	26.3	2.1	12.5 ***
No. of full-time employees (#)	502.5	122.3	380.3	14.7	25.94 ***	417.9	84.6	46.4	1.82 *

Source: German Innovation Survey.

4. Empirical Analysis

In order to characterise the peculiarities of HCs with respect to processes, position and path, we employ a variety of indicators on each of the three dimensions. The choice of indicators is restricted, however, by the availability of relevant measures in the innovation survey. Since the survey has not been designed to analyse strategy and management in HCs, but mainly serves the requirements of European and national innovation statistics, we were not able to cover all aspects of the 'Dynamic Capabilities of Firms'. Nevertheless, we have a number of variables that proxy the main concepts of dynamic firm capabilities. For each variable, we test whether the performance of HCs differs significantly from the performance of the control

group firm, using the propensity score matching method. Most variables are available for all six reference years of our data set. The results presented below represent the average over the entire period covered in this study (2006 to 2016).

For the position of HCs, we consider six group of indicators (Table 3). For financial resources, we find that HCs have a significantly higher productivity and a higher profit margin than control group firms. In terms of labour productivity (net value added per full-time employee), HCs outperform the control group by 29%. The average profit margin of 7.7% is 38% higher than among comparator firms. The better financial position indicated by both variables does not transfer into higher investment, however. The level of expenditure on intangible assets such as innovation (including R&D), software and marketing is not significantly different from the control group, nor is capital expenditure in fixed assets. Part of the HCs' more comfortable financial situation is re-invested into people, reflected by a higher average wage level of 11% compared to the control group (see Table 5 below).

In terms of innovative assets, HCs focus on product innovations while the share of HCs with process, organisational or marketing innovation does not significantly differ from comparator firms. Product innovation is significantly more ambitious in terms of the degree of novelty. The share of HCs with new-to-the-market product innovations (49.6%) exceeds the one of the control group (31.6%) by 57%. For product line novelties (i.e. new products with no predecessor product in the firm), the difference is 25%. Though HCs do not introduce process innovations more frequently, they more often yield unit cost reductions and quality improvements from these innovations.

The superior innovation performance is also revealed by market results of innovations. The sales share of product innovation is 20.3% for HCs, compared to 16.5% of the comparator firms. For the sales share of new-to-the-market innovations, the relative gap is even larger (6.8% for HCs vs. 4.4% for the control group). HCs also gain higher results from process innovation both in terms of cost savings and sales increase from quality improvement.

For protecting their innovative assets, HCs rely significantly stronger on patenting and informal protection methods (secrecy, complex design). Combining patents and secrecy indicates that HCs' innovations rest both on novel technological knowledge (which can be protected through patents) as well as tacit, non-obvious knowledge (see Hall et al. 2014). Interestingly, there is only a slightly higher share of HCs relying on lead time, and other

formal protection methods (industrial designs, trademarks, copyrights) are not used more frequently.

Table 3: Indicators on the position of HCs and controls

	HCs value	Controls after matching			
		value	diff.	s.e.	t-stat
Financial resources					
Productivity (net value added per full-time employee, m€)	0.13	0.10	0.03	0.01	5.54 ***
Profit margin earnings before taxes per sales, (%)	7.68	5.56	2.12	0.34	6.26 ***
Innovation expenditure over sales (%) ^{a)}	5.87	5.42	0.45	0.58	0.77
Share of capital expenditure in total innovation expenditure (%) ^{a)}	30.7	36.5	-5.9	1.9	-3.13 ***
Capital expenditure on fixed assets per sales (%)	4.19	4.18	0.02	0.30	0.06
Software expenditure per sales (%)	1.06	1.02	0.04	0.13	0.26
Marketing expenditure per sales (%)	1.23	1.29	-0.06	0.14	-0.46
Innovative assets (share in all firms, %)					
Product innovations	73.5	65.1	8.5	2.1	4.03 ***
Process innovations	51.8	51.7	0.1	2.3	0.04
Organisational innovation	60.7	62.2	-1.5	2.3	-0.62
Marketing innovation	54.6	53.2	1.4	2.4	0.57
Market novelties ^{a)}	49.6	31.6	18.1	2.3	7.92 ***
Product line novelties ^{a)}	44.7	35.7	9.0	2.3	3.91 ***
Unit cost reduction from process innovation ^{a)}	31.3	23.5	7.8	2.1	3.73 ***
Quality improvement from process innovation ^{a)}	32.7	24.1	8.6	2.1	4.06 ***
Innovation results (%)					
Sales share of product innovations ^{a)}	20.3	16.5	3.8	1.1	3.44 ***
Sales share of market novelties ^{a)}	6.8	4.4	2.4	0.6	3.95 ***
Sales share of product line novelties ^{a)}	4.3	3.5	0.8	0.5	1.61
Share of unit cost reduction owing to process innovation ^{a)}	2.2	1.7	0.5	0.3	1.93 *
Increase in sales due to quality improvement ^{a)}	2.0	1.4	0.6	0.3	2.09 **
IP protection methods used (share in all firms, %)					
Patents	64.1	53.2	10.9	3.0	3.64 ***
Utility patents	45.0	34.6	10.4	2.9	3.54 ***
Industrial designs	24.4	23.3	1.1	2.6	0.44
Trademarks	47.2	42.3	4.9	3.0	1.62
Copyright	28.1	27.3	0.8	2.7	0.30
Secrecy	76.3	69.5	6.9	3.1	2.20 **
Complex design	51.4	44.1	7.3	3.5	2.10 **
Lead time	67.5	61.9	5.6	3.3	1.67 *
Focus of competitive strategy (mean 4 pt Likert scale, 0-3)					
Improving your existing goods or services	2.55	2.45	0.09	0.10	0.93
Introducing entirely new goods or services	1.92	1.62	0.30	0.12	2.43 **
Reaching out to new customer groups	2.05	1.95	0.10	0.12	0.82
Customer specific solutions	2.43	2.22	0.21	0.11	1.96 **
Low-price	1.25	1.36	-0.11	0.11	-0.95
Structure of supplies and sales (%)					
Sales share of 3 main customers	35.4	31.5	4.0	3.1	1.27
Supply share of 3 main suppliers	33.1	36.1	-3.1	3.0	-1.04
Sales share main product	66.9	65.8	1.1	1.3	0.90

Table 3: Continued

	HCs value	Controls after matching			
		value	diff.	s.e.	t-stat
Competitive environment (mean 4 pt. Likert scale, 0-3)					
Rapid aging of product	0.92	0.98	-0.06	0.04	-1.42
High uncertainty about technological change	1.10	1.13	-0.03	0.05	-0.54
Own products easy to substitute by competitor products	1.47	1.60	-0.13	0.05	-2.69 ***
High threat by market entries	1.28	1.37	-0.09	0.05	-1.83 *
Competitors' actions difficult to predict	1.47	1.51	-0.05	0.04	-1.06
Change in demand difficult to predict	1.66	1.72	-0.06	0.05	-1.10
Strong competition by competitors from abroad	1.86	1.63	0.23	0.05	4.27 ***
Product price increases lead to immediate loss of clients	1.50	1.74	-0.24	0.07	-3.39 ***
No of competitors (mean 6 pt. ordinal scale) ^{b)}	2.58	3.13	-0.55	0.08	-6.50 ***

a) Propensity score models also include a dummy variable 'introduction of innovations', implying that HCs with innovations are compared with control group firms also having introduced innovations, and vice versa.

b) 0, 1-5, 6-10, 11-15, 16-50, 51+

Source: German Innovation Survey.

The strong focus of HCs on innovations with a higher degree of novelty is mirrored in the competitive strategy pursued by the firms. HCs more often focus on the introduction of entirely new products. This 'technology leadership' strategy is combined with a customisation strategy which put emphasis on customer-specific solutions. There are no significant differences for other competitive strategies such as reaching out to new customer groups or focusing on low price. HCs also do not differ in terms of customer and supplier concentration. The three main customers account for 35% of HCs total sales, which is a high value, but almost matched by comparator firms (32%). Product diversification is rather low, with a sales share of the main product line of 67%, which is only marginally higher than the control group's value (66%).

HCs business strategy results in a distinct competitive environment for HCs which is characterised by a low substitutability of own products, less threat from market entries and a low price elasticity of demand. The strong international orientation of HCs implies a higher competitive pressure from abroad. The number of competitors is significantly lower than for control group firms.

Turning to managerial and organisational processes of HCs, we first examine the management capabilities, using managers' assessment of the significance of eleven items that represent a firm's ability to manage change and innovation (Table 4). For four items, HCs outperform control group firms. HCs management reports higher capabilities for developing new technical solutions, providing scope for trial and error, leaving a high degree of personal

responsibility to employees, and building upon the creativity of employees. There are no significant differences for items related to intra-firm cooperation, incentives to employees or the speed of taking up and transferring ideas.

Another aspect of processes refers to external relations. We find HCs to engage more frequently in co-operation with external partners. This applies to all type of partners except competitors. The largest difference to the control group is found for co-operation with universities and research institutes. HCs are also more likely to contract out R&D. However, HCs rely more often on their own capacity when developing new products and are less frequently engaged in joint new product development.

A final process-related group of variables refers to the information sources used by firms to inform and guide their innovative activities. HCs report significantly higher importance for five sources (ranked by the difference to control group firms): universities, patent files, the own firm, customers, and journals. For all other information sources, including suppliers and competitors as well as fairs or crowd sourcing, no significant differences emerge. This pattern reveals the strong focus of HCs on scientific knowledge (related to technology leadership) and in-house sources. The higher importance of customers as information source is only significant at a rather low level of statistical confidence which indicates that customisation is less a distinctive feature of HCs as compared to technology leadership.

Finally, we look at differences in the path of HCs. For measuring this dimension, we rely on indicators that represent the accumulation of technological and intellectual knowledge (Table 5). We find that HCs are significantly more often engaged in continuous R&D, meaning that they employ dedicated R&D workers and run an in-house R&D lab. 67% of HCs belong to this group, compared to 53% among comparator firms. In contrast, HCs are less frequently conducting R&D on an ad-hoc base (12%), while 18% of control group firms are occasional R&D performers. The share of R&D expenditure is not significantly higher, however. The stock of patents which counts all patents applied at the German, European or International patent office in the prior 20 years is clearly higher for HCs (91 per HC, 55 for control group firms). Human capital is another distinct difference. 24% of HCs' workforce hold a university degree, compared to 19% among comparators. Training expenditure per employee are also significantly higher, as is the wage level, indicating a large stock of human capital.

Table 4: Indicators on managerial and organisational processes of HCs and controls

	HCs	Controls after matching			
	value	value	diff.	s.e.	t-stat
Management capabilities (mean 5 pt. Likert scale, 1 to 5)					
Detecting new client's needs	3.89	3.74	0.15	0.10	1.44
Development of new technical solutions	3.96	3.72	0.24	0.11	2.33 **
Scope for development via 'trial and error'	2.95	2.75	0.20	0.11	1.78 *
Strong individual responsibility of employees	3.77	3.53	0.24	0.10	2.46 **
Creativity of employees	3.77	3.59	0.18	0.10	1.89 *
Incentive schemes for employees to innovate	3.04	2.87	0.17	0.11	1.54
Stimulation of internal competition between projects	2.19	2.17	0.02	0.10	0.17
Internal co-operation between departments / firm units	3.56	3.46	0.10	0.11	0.94
Inclusion of external partners	2.85	2.76	0.09	0.11	0.82
Rapid transfer of new ideas to market launch	3.28	3.26	0.03	0.11	0.27
Rapid imitation of competitor's innovations	3.02	2.96	0.06	0.11	0.58
Co-operation and co-development (share in all firms, %) ^{a)}					
Co-operation agreement	50.4	38.4	12.0	2.6	4.68 ***
Co-operation within own enterprise group	20.0	15.8	4.2	2.0	2.13 **
Co-operation with customers	24.0	18.3	5.7	2.1	2.71 ***
Co-operation with suppliers	20.6	15.7	4.9	2.0	2.49 **
Co-operation with competitors	8.0	8.2	-0.1	1.4	-0.09
Co-operation with consultants, private laboratories	18.0	14.2	3.8	1.9	2.03 **
Co-operation with universities	38.9	29.5	9.4	2.4	3.84 ***
Co-operation with research centres	22.4	15.6	6.8	2.0	3.38 ***
Contracted-out R&D	46.0	31.2	14.8	2.5	5.87 ***
Mainly own development of product innovations	58.6	51.2	7.4	2.4	3.07 ***
Mainly joint development of product innovations	26.8	31.9	-5.1	2.2	-2.30 **
Mainly development of product innovations by others	2.1	3.2	-1.1	0.8	-1.34
Mainly own development of process innovations	33.2	29.7	3.4	2.2	1.54
Mainly joint development of process innovations	22.1	23.6	-1.5	2.0	-0.72
Mainly development of process innovations by others	3.1	3.3	-0.2	0.9	-0.24
Information sources used (mean of 4-point Likert scale, 0 to 3) ^{a)}					
Own firm	2.31	2.13	0.17	0.08	2.24 **
Customers	2.06	1.92	0.14	0.08	1.67 *
Suppliers	1.26	1.25	0.01	0.07	0.10
Competitors	1.44	1.43	0.02	0.07	0.21
Consultants, private R&D service firms	0.81	0.82	-0.01	0.06	-0.17
Universities	1.26	1.05	0.21	0.07	3.00 ***
Public research centres	0.78	0.70	0.08	0.06	1.23
Fairs	1.48	1.37	0.11	0.07	1.53
Journals	1.19	1.07	0.13	0.06	1.98 **
Chambers of commerce	0.78	0.77	0.01	0.06	0.15
Patent files	0.96	0.77	0.19	0.06	2.97 ***
Standardisation documents	0.85	0.79	0.07	0.06	1.10
Crowdsourcing	0.35	0.35	0.00	0.08	0.00

a) Propensity score models include a dummy variable 'introduction of innovations', implying that HCs with innovations are compared with control group firms also having introduced innovations, and vice versa.

Source: German Innovation Survey.

Table 5: Indicators on path of HCs and controls

	HCs	Controls after matching			
	value	value	diff.	s.e.	t-stat
R&D expenditure over sales ^{a)}	3.80	3.18	0.63	0.47	1.33
Continuous in-house R&D (share in all firms, %)	66.7	52.9	13.8	2.2	6.22 ***
Occasional in-house R&D (share in all firms, %)	12.4	17.9	-5.5	1.6	-3.36 ***
Stock of patents (#)	91.0	55.0	36.0	15.6	2.30 **
Share of graduates (%)	23.8	18.6	5.2	1.1	4.97 ***
Training expenditure per employee (1,000 €)	0.61	0.47	0.14	0.05	2.93 ***
Wage level (salaries and wages per full-time employee, 1,000 €)	54.5	49.1	5.4	1.1	5.01 ***

a) Propensity score models include a dummy variable 'introduction of innovations', implying that HCs with innovations are compared with control group firms also having introduced innovations, and vice versa.

Source: German Innovation Survey.

5. Conclusions

In this paper we analysed the distinct features of Hidden Champions from Germany in terms of their business strategy and innovation management. Using a matching technique, we compared a representative sample of HCs across all sectors and size classes with other firms from the same sector, size class and age. Investigating three dimensions of the dynamic capabilities of firms (strategic position, managerial and organisational processes, and paths for sustaining competitiveness), we find that HCs pursue an innovation-based business strategy that focuses on technological excellence combined with strong emphasis on customer-specific solutions (customisation) to gain global leadership in niche markets.

The active strategic approach to innovation of HCs is certainly a demanding one which requires high managerial and organisational capabilities. For those firms that are able to pursue this route, the strategy pays off. HCs achieve a substantially higher profit margin (a premium of two percentage points on average) and a higher productivity (+29% on average). HCs operate in a more comfortable competitive environment, being less exposed to price competition and threat by new entries.

But how do HCs translate the business strategy into practice and how do they build an innovative organisation? Despite their strong innovation focus, HCs do not spend more on innovation and R&D while market results of innovations are significantly higher both for product and process innovation. The finding indicates that HCs allocate their resources very efficiently. The higher efficiency can be linked, among others, to four management practices that could be lessons for other SMEs.

- First, HCs put strong emphasis on own new technology development, especially new technical solutions for clients based on continuous in-house R&D and close links to science.
- Secondly, HCs pursue open innovation strategies and networking without compromising control over the new product development process.
- Thirdly, they apply a rather complex IP management by combining patent protection, secrecy and complex design of their products, the latter complicating or impeding reverse engineering by competitors.
- Finally, and perhaps most importantly, HCs invest significantly more resources into human capital, resulting in a better skilled work force that enjoys creativity, responsibility and freedom for developing new ideas and engaging in innovation.

Overall, we find evidence that HCs build-up, maintain and enlarge distinguishing and difficult-to-replicate competitive advantages.

While our research is based on a unique representative data base of German HCs, the analysis was restricted by a lack of data on actual management practices in HCs. This clearly limits our ability to derive detailed management recommendations. While our findings point to the need for developing a variety of capabilities simultaneously for becoming a HC, more case-study based research would be needed to exemplify how this actually can take place in practice.

As HCs are successful firms, they have attracted attention from policy makers who wish to foster the emergence of HCs and their market performance. But making a case for active public policy support in favour of HCs is difficult. The key competitive advantage of HCs is strategic orientation and superior capabilities. Both tend to be the results of competent and courageous entrepreneurs. Firms that do not manage to become HCs are hardly prevented from doing so by specific barriers or market failures which could be addressed by policy. Nevertheless, as HCs are highly innovative firms, they face the typical barriers to R&D - knowledge spillovers and high uncertainty. Offering effective R&D support programmes is probably the best way for policy to support HCs.

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7. Appendix

Table 6: Estimation results of the propensity score model for the matching analysis

Variable	Coefficient	Std. Err.	z Value	sig. ^{a)}
<i>Size dummies^{b)}</i>				
<20 employees	-2.391	0.138	-17.36	**
20-49 employees	-1.641	0.132	-12.44	**
50-99 employees	-1.081	0.125	-8.67	**
100-249 employees	-0.839	0.118	-7.13	**
250-499 employees	-0.234	0.121	-1.94	
500-999 employees	-0.158	0.132	-1.19	
Age (years)	0.002	0.001	3.50	**
<i>Sector dummies (NACE)^{c)}</i>				
Manuf. of Food, Beverages, Tobacco (10-12)	0.804	0.564	1.43	
Manuf. of Textiles, Clothes, Leather (13-15)	2.380	0.530	4.49	**
Manuf. of Wood Products, Paper (16-17)	2.578	0.522	4.94	**
Manuf. of Chemicals, Pharmaceuticals (19-21)	2.765	0.515	5.37	**
Manuf. of Rubber and Plastic Products (22)	2.522	0.521	4.84	**
Manuf. of Glass, Ceramics, Concrete, Metals (23-24)	2.740	0.513	5.34	**
Manuf. of Metal Products (25)	2.005	0.521	3.85	**
Manuf. of Electronics, Optical Products (26)	3.402	0.508	6.70	**
Manuf. of Electrical Equipment (27)	2.505	0.524	4.78	**
Manuf. of Machinery (28)	3.162	0.506	6.25	**
Manuf. of Vehicles (29-30)	2.770	0.516	5.37	**
Manuf. of Furniture, Medical, Other Products (31-33)	1.851	0.525	3.53	**
Mining, Utilities, Waste Management (5-9, 35-39)	0.038	0.602	0.06	
Wholesale Trade, Transportation (46, 49-53)	1.328	0.522	2.54	*
Media Services, Telecommunication (18, 58-61)	0.453	0.613	0.74	
IT Services (62-63)	1.327	0.557	2.38	*
Financial, Consulting, Business Services (64-66, 69-70, 73-74, 78-82)	-0.566	0.585	-0.97	
Engineering and R&D Services (71-72)	2.045	0.525	3.90	**
<i>Year dummies^{d)}</i>				
2006	0.377	0.115	3.28	**
2008	0.220	0.117	1.88	
2010	0.073	0.116	0.63	
2012	0.043	0.116	0.37	
2014	-0.068	0.120	-0.57	
Constant	-5.642	0.517	-10.91	**
No. of observations	103,075			
No. of treated observations ('Hidden Champions')	1,011			

a) **: p<0.01; *: p<0.05

b) Reference: 1,000 or more employees

c) Reference: other sectors (NACE 1-3, 41-43, 45, 47, 55-56, 68, 75, 77, 84-88, 90-96)

d) Reference: 2016

Source: German Innovation Survey.

Table 7: Quality of matching results

	Unmatched	Matched
Pseudo R ²	0.161	0.000
Likelihood Ratio Chi ²	1,832.18	0.53
p>Chi ²	0.000	1.000
Mean bias	22.0	0.1
Median bias	19.4	0.0
B value	147.8	3.2
R value	0.66	1.21
Observations of concern (variance ratio in [0.5, 0.8) or (1.25, 2]) (%)	27	0
Bad observations (variance ratio in <0.5 or >2) (%)	48	0
Summary of distribution of abs(bias)	Before matching	After matching
Mean	22.039	0.121
Standard deviation	16.673	0.516
Variance	277.987	0.266
Skewness	1.554	5.128
Kurtosis	6.126	28.344
90% percentile	37.944	0.260
95% percentile	54.281	0.521
99% percentile	81.165	2.930

Source: German Innovation Survey.



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