Paper

Management quality and productivity

university of groningen

Eda Aral (University of Groningen)
Marcel van den Berg
Ahmed Boutorat
Harry Garretsen (University of Groningen)
Angie Mounir
Janka Stoker (University of Groningen)

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CBS Heerlen
CBS-weg 11
6412 EX Heerlen
P.O. Box 4481
6401 CZ Heerlen
+31 45 570 60 00

www.cbs.nl

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Nederlandstalige managementsamenvatting

- Het *World Management Survey* (WMS) is een internationaal geharmoniseerd onderzoek, dat op vergelijkbare wijze de kwaliteit van het management meet in organisaties.
- In 2018 is voor het eerst van in Nederland gevestigde industriële bedrijven de managementkwaliteit volgens de WMS-methodiek gemeten.
- De gegevens over de managementkwaliteit zijn vervolgens gekoppeld aan CBS-data over bedrijfskenmerken en kenmerken van de CEO. Deze koppeling levert een voor de Nederlandse industriële sector representatieve steekproef op van 433 bedrijven.
- Een eerste verkenning van de gecombineerde data in opdracht en met steun van het ministerie van EZK liet zien dat er een duidelijke en significant positieve samenhang is tussen de overall managementkwaliteit enerzijds en productiviteit, internationale ontplooiing en innovatief vermogen anderzijds (Van den Berg et al. 2019).
- In het onderhavige vervolgonderzoek is de samenhang tussen productiviteit, managementkwaliteit, internationale ontplooiing en innovativiteit verder uitgediept en econometrisch bestendigd.
- Rekening houdend met een uitgebreide set van bedrijfskenmerken die medebepalend zijn voor productiviteitsniveaus, zoals omvang, locatie, multinationaliteit, bedrijfstak en zaken als inzet van fysiek kapitaal en samenstelling van het menselijk kapitaal, houdt het positieve verband tussen productiviteit en managementkwaliteit empirisch overtuigend stand.
- Internationale ontplooiing en innovativiteit hebben naast managementkwaliteit eveneens een directe positieve en significante samenhang met productiviteit.
- Deze bevindingen laat zich goed vergelijken met de resultaten in andere WMS-landen.
- We vinden echter geen empirisch bewijs voor het bestaan van interactie-effecten tussen managementkwaliteit en internationale ontplooiing of innovativiteit. Met andere woorden, we vinden geen bewijs dat er een extra sterk verband is tussen innovativiteit of internationale ontplooiing enerzijds en productiviteit anderzijds voor bedrijven met een hogere managementkwaliteit.
- Deze resultaten wijken af van eerdere bevindingen in andere WMS-landen. Dit hangt mogelijk samen met het feit dat de steekproef van bedrijven met name bestaat uit grote en volwassen industriële bedrijven, terwijl een dergelijk interactie-effect van managementkwaliteit op de relatie tussen innovativiteit of internationale ontplooiing en productiviteit mogelijkerwijs met name aangrijpt bij kleinere, jongere of snelgroeiende bedrijven.
- Van belang is te benadrukken dat de in dit rapport gepresenteerde analyses laten zien dat productiviteit, managementkwaliteit, internationale ontplooiing en innovativiteit onderling samenhangen, maar wat de richting van mogelijke causaliteit tussen de gevonden verbanden is, kan op basis van deze analyses niet worden vastgesteld. Daar is aanvullend onderzoek met tijdreeksgegevens en deels ook andere methodieken voor nodig.
- Het kernresultaat van dit onderzoek is derhalve dat managementkwaliteit een relevante en belangrijke determinant is van de productiviteit van bedrijven. Verder onderzoek naar enerzijds causale verbanden tussen managementkwaliteit en bedrijfsprestaties en anderzijds de determinanten van managementkwaliteit is derhalve nodig om de mechanismen onderliggend aan productiviteitsgroei beter te leren begrijpen.

1. Introduction

In this research report, we present the findings of an empirical investigation into the relationship between the management quality of Dutch manufacturing firms and their productivity, innovativeness and portfolio of international activities. This report is the result of a research project commissioned by the Dutch Ministry of Economic Affairs and Climate Policy and a collaboration between researchers from the University of Groningen and Statistics Netherlands.

In 2018, the University of Groningen, cooperating with researchers from Rabobank, conducted a large scale study among medium and large (> 50 personnel) industrial firms in the Netherlands. The aim of this study was to measure the quality of the management of participating firms and the leadership practices of the top-tier management (Dieteren et al., 2018). This 'survey' consists of structured interviews with a top-manager of each firm, and constitutes an element of an internationally harmonized survey called the World Management Survey (WMS). The key feature of the WMS is to consistently measure the quality of the management of firms across countries and industries. Over the years, this survey has been conducted in 36 countries by now, including the Netherlands. The main aim of the research derived from the survey is to show how and to what extent management practices are associated with firm performance. Empirical research, starting with the seminal paper by Bloom and van Reenen (2007), has consistently shown that the quality of these management practices is positively associated with firm performance. In particular, there is convincing evidence that (labor) productivity is higher in firms characterized by high quality management practices, even when controlling for firm characteristics associated with productivity levels such as the quality of the labor force and capital intensity of the firm (Bloom and van Reenen, 2010a,b). Conceptually, management is considered a dimension of the production technology and is in that capacity incorporated in the traditional production function alongside common input factors such as labor and capital (Bloom, Sadun and van Reenen, 2016). The concept of management or managerial capital could in that sense shed a new light on the considerable dispersion in total factor productivity (TFP) levels among firms when only labor and capital are taken into account as input factors (Sadun, 2019).

In 2019, commissioned by the Dutch Ministry of Economic Affairs and Climate Policy, the University of Groningen collaborated with Statistics Netherlands in a research project aimed at confronting the WMS-survey response with productivity data of individual firms, and exploring the possibilities these combined data offer. The key finding of this descriptive exercise was that labor productivity showed to be positively associated with the quality of management practices in the Netherlands as well, a corroboration of the results obtained in several other countries. In addition, the quality of management practices also turned out to be positively associated with innovativeness and venturing into foreign markets. The results of this descriptive exercise are captured in the report "Management quality and micro-data: an exploration of the data" (Van den Berg et al., 2019).1

The current report constitutes a follow-up on our joint 2019 study. Due to the exploratory nature of the first stage of this research track, further research was deemed necessary in order to econometrically cement and extent our findings. This study aims to provide just that. The main focus of this report is on the interplay between productivity, management quality, innovativeness and venturing abroad. More specifically, the research questions of this study are twofold:

[1] Report in Dutch: "Managementkwaliteit en microdata: een dataverkenning".

1. What is the relationship between the quality of management practices and productivity both measured at the level of the firm, controlling for a wide range of firm characteristics?
2. To what extent does the addition of innovativeness and venturing abroad and of the interaction between innovativeness or venturing abroad and the quality of management practices provide an explanation for observed productivity differences between firms?

In answering these two questions, our contribution is threefold. First, since the WMS is an internationally harmonized survey, the results from the survey enable us to replicate existing research conducted in other countries, drawing heavily on the seminal work of Bloom, van Reenen and Sadun and colleagues, for yet another country: the Netherlands. Our findings thus contribute to the still growing body of knowledge in this research domain, and this extension is especially relevant for (Dutch) economic policymakers, believing that a better understanding of the drivers of firm productivity is of a great help in shaping the policy agenda for future prosperity.

Second, the depth of the firm-level micro-data available in the business registers of Statistics Netherlands enables us not only to build on existing work but crucially to take it a step further by taking (for example) the capital intensity and the quality of the human capital deployed by the firm into account. Estimating a multivariate regression model that is as complete as possible in terms of control variables, enables us to get a clear(er) picture of the relationship between productivity and the quality of management practices. Third, the interaction between the quality of management practices and innovativeness or international venturing is an under-researched topic thus far (Bloom, Sadun and van Reenen, 2012; Bloom et al., 2018). The breadth of our firm-level data enables us to add to this topic and to further unravel the relationship between productivity and management quality, thereby informing economic policy makers about the relevance of management practices.

Finally, a cautionary note is due before moving on to an introduction of the various data sources employed in this study and a discussion of our empirical approach in chapter 2. The research findings discussed in this report should not be interpreted in causal terms. That is, our econometric approach does not warrant conclusions of the sort “increasing the quality of management practices leads to higher productivity levels”. In order to be able to draw conclusions of causal nature a different kind of research set-up is required, such as an intervention study. We leave this as a possible avenue for further research.

The remainder of this report is structured as follows. Chapter 2 introduces the WMS-survey more elaborately, in addition to the data sources from Statistics Netherlands drawn upon to enrich the survey response, the variables taken from these sources and the procedure followed to merge these various data sources. Chapter 2 also lays out our empirical approach to econometrically estimate the relationship between management quality and productivity. We discuss the main empirical results from this exercise in Chapter 3. Chapter 4 summarizes and wraps up.

2. Data and empirical approach

This chapter consists of three parts. In section 2.1 we introduce the various data sources that serve as the input for the rich dataset employed in the analysis. Section 2.2 provides a brief description of the data preparations and merging procedure that ultimately result in an integrated data set. Our empirical approach to tackling the research questions introduced in chapter 1 is laid out in section 2.3.

2.1 Data

A broad range of firm-level micro-data are employed in the analyses presented in chapter 3. In this section we briefly introduce each underlying data source and the variables drawn from it.

World Management Survey (WMS)

The WMS is conducted spring 2018 by the University of Groningen jointly with researchers from Rabobank. The study is based on an internationally harmonized and peer-reviewed survey procedure developed by Bloom & Van Reenen (2007). The aim of the survey is to assess the quality of the management of the firm through structured interviews and a follow-up questionnaire. The WMS assesses firms' management quality across 18 key management practices in three key areas of management (Bloom et al., 2014). First, *monitoring*: Are modern manufacturing techniques introduced and used for cost efficiency and quality improvement objectives? How well do organizations monitor the operations inside the firm? Second, *targets*: Do organizations set the right targets, track the outcomes continuously, communicate the targets effectively, and take appropriate action if the targets and the performance outcomes are inconsistent? Third, *incentives* or *'people management'*: Are organizations promoting and rewarding employees based on performance, prioritizing selective hiring, developing skills, making room for talent, and trying to keep their best employees? Averaging firms' scores for the 18 management practices, WMS offers a single, overall management score which is found to be positively associated with firm performance; first and foremost with productivity, profitability, growth, and survival, besides higher returns to information technologies (Bloom, Sadun, & Van Reenen, 2012).

The research project of the University of Groningen concerns a random sample of 1500 medium and large (at least 50 employees) industrial firms in the Netherlands. Rabobank conducted the same survey on a comparable sample of 1200 firms. Both samples were drawn from the Orbis firm register and the survey response from both samples was appended after the fieldwork was finalized. This appended dataset, consisting of a joint total of 459 observations, forms the foundation of our analysis, corresponding to a response rate on the joint survey of 17 percent. Together these 459 firms represent approximately a considerable one quarter of overall Dutch manufacturing activity.

Registry of Business Demographics (RBD)

The Registry of Business Demographics is derived from the General Business Register (GBR) and maintained by Statistics Netherlands. It is the backbone of panel data research into Dutch firms and contains a number of basic firm characteristics of every firm located in the Netherlands, such as the sector of activity in accordance with internationally harmonized classifications such as NACE and ISIC, firm size in terms of employment, location information, multinational status, etc. A satellite database is maintained in which the location of ultimate controlling institution of the firm is registered.

Structural Business Statistics (SBS), Baseline and Statistics of Finances of Enterprises (SFE)
These three separate data sources each provide a host of financial information of Dutch firms, either obtained through a survey (SBS) or derived from corporate and income tax declarations. We employ the SBS as the main source for our turnover and value added information. As this data source covers smaller firms less comprehensively, we supplement the SBS with equivalent information from Baseline to minimize the number of missing values. Some more detailed variables are not available from the SBS. For these variables we supplement Baseline with the SFE. This is not our preferred source, since the unit of measurement in the SFE is the enterprise group instead of the firm, which is the unit of measurement of most sources (e.g. RGD, SBS, Baseline). Using information from the SFE thus implies making the necessary assumption that the information at the enterprise group level is valid for each firm that is part of the group. This also implies that only variables expressed in terms of ratios can be taken from the SFE.

System of Social Statistical Datasets (SSD)
The SSD is an interconnected system of registers and surveys at the level of the individual who is identified through an encrypted social security number. It contains a host of social statistics concerning individuals, households, jobs, wages and much more. This information can be linked to firms inasmuch as the individual concerns an employee of the firm. We tap into the SSD for two reasons. First, through information provided to CBS by the Dutch Chamber of Commerce we are able to identify the CEO of the firms participating in the WMS (see section 2.2). From the SSD we merge a number of variables to our list of CEOs, such as gender, age, marital status, offspring, nationality, income (fixed and variable), duration of tenure with the firm, number of years of working experience in the industry. Second, we construct a number of variables that serve as a proxy for the quality and composition of the human capital deployed by the firm, such as the duration of tenure with the firm, gender and age distribution of the workforce, the mean of contract hours worked, the mean wage per hour, share of workers with a temporary contract and share of part-time workers.

International Trade in Goods Statistics
The Trade in Goods Statistics database provides information on all goods exports and imports by individual firms registered in the Netherlands. Extra-EU trade is recorded by the Customs Authority and always includes origin/destination and product information aligning with various internationally harmonized classification systems. Trade within the EU is recorded by the Dutch Tax Authority. Only firms with intra-EU import and/or export values larger than a total of 1.2 million euro (threshold in 2016) are required to specify their trade transactions in terms of type of product (and origin/destination country) through an additional questionnaire from Statistics Netherlands. Below this threshold firms only report the total import and export value of intra-EU trade.

International Trade in Services Statistics
The Trade in Services Statistics database is less comprehensive than the data concerning goods trade. From this source we merge the total value of imports and exports of services to our sample. Please note that the Trade in Services Statistics database excludes trade in travel services, insurance services, activities of special purpose vehicles and passenger air transport services.

WBSO tax credit

The WBSO is a tax credit aimed at stimulating firms to engage in R&D.[2] The firm-level data regarding the use of this tax instrument are merged to the GBR on an annual basis. This instrument provides as such the most comprehensive picture of R&D-efforts by Dutch firms. Firms have to supply information on the number of hours of labor invested in R&D and the associated wage costs to be eligible for the WBSO.

Innovation box

The innovation box is a tax credit for firms also aimed at stimulating innovation. Income derived from innovation is subjected to lower effective tax rates under the innovation box regime. The innovation box is as such an element of the corporate tax regime and available at the level of tax units which can be matched to the enterprise groups of the GBR. To be eligible for a tax credit, the profits reported by the firm need to be directly derived from a patent for at least 30 percent. This instrument provides as such a picture of R&D-output by Dutch firms.

2.2 Data preparations

In this section we provide a brief discussion of the procedure developed to merge the various data sources into a single data set serving as the input for our analysis. For an elaborate discussion of the process we refer to Chapter 2 in Van den Berg et al. (2019).

Matching WMS-survey to the business register

The first step that needs to be taken is the merging of the survey data from the WMS to the business register at CBS. This is necessary to be able to further enrich the survey response with additional information from the data sources introduced in Section 2.1. The WMS-survey was registered on identification keys of both firm and branches from the Chamber of Commerce. These keys can be merged to the General Business Register (GBR). In case of missing identification keys firms can be merged based on their name and address information.

The GBR distinguishes between two levels of aggregation: the firm and the enterprise group, where the enterprise group consists of one or more firms located in the Netherlands. After first inspection matching the survey response shows to be most plausible at the level of the firm. This is convenient, since this enables us to subsequently merge the survey response with the RBD and additional firm-level data sources. Matching at the level of the enterprise group would result in matching more than one survey to the same enterprise group in 15 percent of the cases. This would seriously complicate the analysis, since varying survey responses would be pitted against the same set of enterprise characteristics and performance measurements.

Matching identification keys from the Chamber of Commerce to firms in the GBR is done via two intermediate identification systems, one of which is the enterprise group. In some cases the match is evident, when one key ultimately pairs with one unique firm in the GBR. In case this match is not evident we need to determine which firm within the enterprise group participated in the WMS. We proceed sequentially as follows:

1. Allow a match if the name of the firm in WMS-records exactly matches the name of the firm in the GBR;
2. Allow match if the address matches exactly and uniquely;
3. Manually screen firms within the enterprise group and investigate if a plausible match can be made

[2] In Dutch: Wet Bevordering Speur-en Ontwikkelingswerk.

Only 2 of the 459 observations in the WMS-data could ultimately not be matched with the GBR. This may be due to events such as acquisitions that result in firms being temporarily untraceable in the GBR. In addition, 5 firms emerge from both samples (Rabobank and University of Groningen). In this case we favor matches on identification keys of firms over branches. This results in 452 unique surveys available for matching to the GBR. The procedure laid out above ultimately enables us to match 94 percent of the survey response to the GBR (Table 2.1).

Table 2.1 Matching procedure WMS-response to GBR

Survey response (WMS)	459	
- Unavailable for matching		2
- Duplicate responses		5
Available for matching	452 (98%)	
- Enterprise group = firm		288
- Matched by name		127
- Matched by address		9
- Manually matched		9
Matched to firm in the GBR	433 (94%)	

Once the match between the survey response and the GBR is made, it is straightforward to augment the data set by merging information from various data sources available within Statistics Netherlands. This merge is preferably made on the unique firm identifier in the GBR. In some cases we are interested in dimensions that are only available at the enterprise group. In that case the merge is made at that level under the assumption that the information at the level of the enterprise group applies to all firms within the group. Which variable is set at which level of aggregation is presented in Table 2.3a and 2.3b. In addition, the grand total of 433 observations available for the analysis does not mean that the analyses are by default derived from the same number of observations. Missing values for specific firms in specific variables (e.g. productivity) reduce the number of observations available for the regressions.

Identifying the CEO of surveyed firms

Another important step in the data preparations is the identification of the CEO of the surveyed firms in the registers of Statistics Netherlands. This is not a straightforward step, since the survey does not provide any identifying information of the CEO. It is worth the effort however, since making this match enables us to control for the characteristics and wage level of the CEO. Luckily, there is a workaround. Firms are required to inform the Chamber of Commerce about the composition of the board of directors of the firm, including personal identification numbers (PIN), period of tenure and job titles of all board members. Nonetheless, it is not always straightforward which board member is the CEO of the firm. After encryption of the PIN we are able to merge the wage plus variable remuneration of all board members to the data set and proceed as follows:

We flag all board members with one of the following four job titles: (i) general director, (ii) CEO, (iii) managing director or (iv) statutory director. Should only one board member have this job title in the 6-month period prior to the survey we consider this member to be the CEO. Should there be more than one board member with this title we additionally weigh the wage plus bonuses received in the past 12 months by each board member and consider the most earning board member to be the CEO. In doing so we also take into account the case where we do not know the PIN of all board members. In cases with missing PINs for board members and employees earning

more than the known board members, we assume the higher earning employee is the board member with unknown PIN and is considered to be the CEO.

Identifying the CEO is less straightforward in the remaining cases. The data reveal that in a considerable number of cases the obvious CEO left the firm within 6 months before the firm was surveyed. In those cases we still consider this individual to be the CEO, since it is seems plausible to assume that management quality and firm performance can still be attributed to a CEO that has left the firm this recently.

Finally, in some cases no information about board members is available at all. In those cases we resort to public sources, such as social media, searching for the CEO and his or her date of birth. This information can be traced back to the SSD in order to identify the CEO in the micro-data.

This procedure enables us to identify the CEO of the surveyed firm in 82 percent of the cases. The composition of the matches made is depicted in Table 2.2.

Table 2.2 Identifying CEOs using the SSD

Survey response (matched with business register)	433	
- Matched by job title		193
- Matched by wage incl. bonuses		149
- Match by date of birth		14
Identification of the CEO	356 (82%)	

After identifying the CEO of a firm, a selection of variables is drawn from the SSD and mapped to the firm through the firm identifier available in the wage data.

2.3 Empirical approach

The data preparations and merging of a multitude of data sources to the survey response as discussed in the previous sections, results in an integrated data set at the firm-level that serves as the input for our analysis. In this section we discuss the set-up of our regression models. The empirical analysis consists of two main parts, divided along the lines of the two research questions.

The relationship between the quality of management practices and productivity

We explore the relationship between productivity and the quality of management practices by building on the basic regression model that was estimated in the data exploration in Van den Berg et al. (2019). The empirical regularity emerging from the analysis in Van den Berg et al. (2019) revealed a positive and significant correlation between productivity (defined as value added per employee) and the quality of management, controlling for a few basic firm characteristics. This confirmed related regressions using the same Dutch WMS data set but a different productivity measure in Dieteren et al. (2018). We proceed with a qualitatively comparable set-up as in Van den Berg et al (2019) which directly builds on for instance the approach in Bloom, Sadun and Van Reenen (2010). However, since we updated the data following our 2019-report for the current analysis, we slightly modify the baseline ordinary least squares regression model that serves as the starting point of the analysis. The cross-section regression model is of the following form:

$$\log(\frac{VA_i}{empl_i}) = \alpha + \delta WMS_i + \gamma_1 \log(empl_i) + \gamma_2 MNE_i + \gamma_3 industry_i + e_i$$

Where i denotes the surveyed firm. The variable WMS is either the Z-score for overall quality of the management, or one of the three Z-scores of sub-dimensions of management quality (targets, monitoring and people). The basic control variables include the (log of) firm size in terms of employment, a dummy variable set expressing the status of the firm as a multinational (domestic firm, Dutch multinational or foreign multinational) and a dummy variable set controlling for the industry of operation of the firm. Firm size is used as a control variable because it is a stylized fact that larger firms display, ceteris paribus, a higher level of productivity. It is also common practice in models that try to explain the variation in firm productivity, to include industry dummies to take unobservable industry specific factors into account that may have a bearing on firm productivity. Bloom et al (2012) show that MNEs have a larger productivity in general, which is why we also include this as a control in our basic model. The definition of the variables and their source are presented in Table 2.3a and b below. All regressions are estimated using robust standard errors.

Table 2.3a List of variables and definitions

variable	Definition	source	level of aggregation	year
VA / empl	labor productivity measured as value added per employee	SBS, Baseline	firm	2017
WMS_overall	Z-score overall management quality	WMS	firm	2018
- WMS_monitoring		WMS	firm	2018
- WMS_targets		WMS	firm	2018
- WMS_people		WMS	firm	2018
empl	firm size in terms of employment	RBD	firm	2018
MNE	domestic firm, Dutch MNE, foreign MNE	RBD, UCI, SFO	enterprise group	2017
industry	sector of operation according to 2-digit NACE classification	RBD	firm	2018

This basic OLS regression model provides a first indication of the correlation between management quality and productivity. In order to obtain a clearer picture of the degree to which these dimensions are correlated we need to estimate a more elaborate model. We proceed in a stepwise fashion and extend the model sequentially with coherent bundles of explanatory variables.

The first step in extending our baseline model is to add an additional set of firm characteristics. We include the age of the firm separating between four age groups, to allow for the fact that firm productivity may vary across the life cycle of a firm. We also add a set of dummy variables controlling for the province of location of the firm within the Netherlands. Region-specific factors like the existence of business networks, localized human capital that fosters productivity or competition intensity that may be region-specific justify the inclusion of these regional dummies.

The next extensions entail the inclusion of a set of variables expressing the composition and quality of the capital stock of the firm, both in terms of human capital and in terms of physical capital. In terms of physical capital intensity we include the (log of) the sum of tangible (real estate, machinery, IT-equipment, transport equipment, etc.) and intangible (goodwill, patents, concessions, etc.) assets per employee. The quality of human capital deployed by the firm is

accounted for by including the average wage per hour.[3] Since we do not have available direct measures of human capital that are not related to the firm, such as years of schooling or highest level of education attained per worker, we have to rely on a measure set at the level of the firm, average wage per hour. This is, however, not only a proxy for human capital but also correlated with firm productivity itself. Since the focus of our analysis is not on causality but on associations between productivity and our various explanatory variables, this is considered reasonable. Still, it is far from a perfect measure of a firm's human capital, a notion that should be kept in mind with the interpretation of our empirical results.

The composition of the workforce is expressed in terms of the share of part-time workers, the share of workers on a temporary contract and the share of employees with less than 5 years of tenure with the firm as a measure of employees' experience. An alternative measure of the latter, namely the average number of years of tenure in the firm, is also considered. The motivation for this extension is that from a standard production perspective we can think of productivity being determined by the (stock of) factor inputs, next to the labor force (both in terms of size and composition). We therefore include various measures of both human and physical capital. Also, Bloom et al (2016) model management practices as the firm's stock of "managerial capital" next to more conventional measures of capital.

Finally, in a final extension of our model we include two variables related to the CEO of the firm that we expect to correlate with firm productivity. We include the CEO's total wage, including any variable components such as bonuses, summed over the most recent 12 months before participation of the firm in the WMS, and the CEO's experience working in the same industry. Both in the finance and the strategic management literature is has been well established that there is a "CEO-effect", ceteris paribus, on firm performance, see for example Bertrand and Schoar (2003) or Quigley and Hambrick (2015).

Table 2.3b List of variables and definitions

Variable	Definition	source	level of aggregation	year
firm_age	0-2, 3-4, 5-9, 10+ years	RBD	firm	2018
Region	province of location	GBR	firm	2018
assets / empl	total fixed assets per worker	Baseline, SFO	firm or enterprise group	2017
wage / hour	average wage per hour excl. top 6 earning individuals in the firm	SSD	firm	2018
part_time	share of part-time workers in total workforce	SSD	firm	2018
Temporary	share of workers with temporary contract in total workforce	SSD	firm	2018
Tenure	share of workers with 5 years or less tenure with the firm	SSD	firm	2018
CEO_wage	wage including variable components of the CEO summed over 12 months	SSD	firm	2017/ 2018
CEO_tenure	years of tenure of the CEO in this position	WMS	firm	2018

[3] In constructing this variable, the wages of the 6 highest earning individuals within the firm are ignored.

The interaction between management quality, innovativeness and venturing abroad

The preferred specification resulting from the analysis concerning the first question serves as the starting point for the analysis concerning the second research question. In this part of the analysis the focus is on the interaction between firm productivity and management quality, as measured by our WMS-scores, on the one hand and innovation and internationalization on the other. Bloom et al. (2012) suggest that innovation (proxied by investment in ICT-capital by firms) does not only have a direct association with firm productivity, but also via management practices. Firms with better management practices see that an additional unit of ICT-capital has a larger positive association with firm productivity as compared to firms with lower management scores. While interesting, a drawback of their analysis is that ICT-capital, the stock of ICT-assets per firm, is at best imperfectly related to innovation, the flow of new ideas and products so to say. It is also for this reason that we prefer to use a more direct measure of innovation in our estimations. Similarly, Bloom et al (2018) argue that a firm's trade intensity (measures along both extensive and intensive trade margin) can not only have a direct positive relationship with firm productivity but also in tandem with management practices. For a sample of US and Chinese firms, they show that an additional unit of firm exports is associated with even higher positive firm productivity if a firm has better management practices.

The data allow for including several measures of innovativeness and internationalization. Our preferred measure of innovativeness is the use of the innovation box. This has two reasons. First, the use of the innovation box is a measure of innovation output. A link with firm-level productivity is of course more straightforward for R&D-efforts that have resulted in an actual (patented) innovation than for R&D-input per se. Second, the innovation box data is virtually complete in the sense that firms eligible for this tax reduction are highly likely to make use of this facility and are thus included in our data. Our preferred measure of internationalization is the share of exports, goods and services combined, in total turnover: the export intensity. The data exploration presented in Van den Berg et al. (2019) revealed a positive correlation between management quality and export intensity. This notion, combined with the well-known fact that exporters are on average more productive than non-exporters (see for example Wagner, 2012), illustrates the relevance of this measure digging in to the relationship between productivity and management quality. We do not use trade status in terms of a dummy variable as a measure of internationalization, since virtually all firms in our sample are trading across borders.

We proceed in three steps as follows:

1) Descriptive analysis. We first investigate, descriptively and graphically, the correlation between our preferred measures of innovativeness and internationalization on the one hand, and management quality and productivity on the other. This provides an intuitive picture of the correlation between these dimensions.
2) Regression analysis. We add our measures of internationalization and innovativeness to our preferred specification resulting from section 3.1. First as exogenous explanatory variables in order to investigate to what extent they correlate with firm-level productivity once controlling for other firm characteristics. Then we turn to answering our research question by introducing interaction terms between internationalization and innovativeness and management quality along the lines of the regression models presented below. This enables us to investigate to what extent there is an additional effect of innovation or internationalization on firm-level productivity for firms characterized by high levels of management quality following the reasoning laid out above. The vector $\mathbf{X_i}$ in this model comprises of the set of firm characteristics included in our preferred specification.

$$\log\left(\frac{VA_i}{wp_i}\right) = \alpha + \delta WMS_i + \rho INN_i + \tau(WMS_i \times INN_i) + \gamma \boldsymbol{X}_i + e_i$$

$$\log\left(\frac{VA_i}{wp_i}\right) = \alpha + \delta WMS_i + \rho EXP_i + \tau(WMS_i \times EXP_i) + \gamma \boldsymbol{X}_i + e_i$$

3) Robustness checks. Besides our preferred measures, innovation box use and export intensity, we look into an alternative measure of both internationalization and innovativeness. In a few robustness checks we will investigate to what extent our findings are robust to the use of these alternative measures.

3. Results

In this chapter we present the findings of the empirical analysis as it has been laid out in Section 2.3. The chapter consists of two sections separated along the lines of our two research questions. Each section kicks off with a brief descriptive and mainly graphical exploration of the data before we turn to presenting our regression results.

3.1 The relationship between the quality of management practices and productivity

We start by painting a brief and very broad picture of the firms in our sample, before turning to the first research question econometrically. The firms in our sample belong exclusively to industrial sectors, with manufacturers of food products, manufacturers of machinery and equipment and manufacturers of metal products being the three most prominent subsectors in our sample. Furthermore, the sample consists for almost 30 percent of domestic firms. About one quarter is a Dutch multinational firm and the remaining 45 percent is part of a foreign multinational. About one third of the firms in our sample has between 50 and 99 employees and an additional one third between 100 and 199. Only 25 firms have more than 500 employees. Even though our data set covers approximately 25 percent of industrial activity in The Netherlands, the share of multinational firms (70 percent) is larger than for the whole population of firms in the Dutch manufacturing sector. For an elaborate discussion of the representability of the sample we refer to section 2.2 in Van den Berg et al. (2019).

Virtually all the firms in the sample engage in exporting (rendering export status a pointless measure of internationalization, see Chapter 2). Therefore, the export share in turnover will be the focus of our analysis in section 3.2. Indeed, the degree to which firms depend on exports for their revenues varies considerably. Both the average and median export intensity, goods and services combined, are 42 percent with a standard deviation of 30 percent.

As we have already discussed in Chapter 2, we operationalize innovativeness in two ways: patent box use and hours spent on R&D according to WBSO-use. The data reveal that a considerable 35 percent of the firms in our sample makes use of the patent box and about twice as many firms in our study (68 percent) makes use of the WBSO-facility.

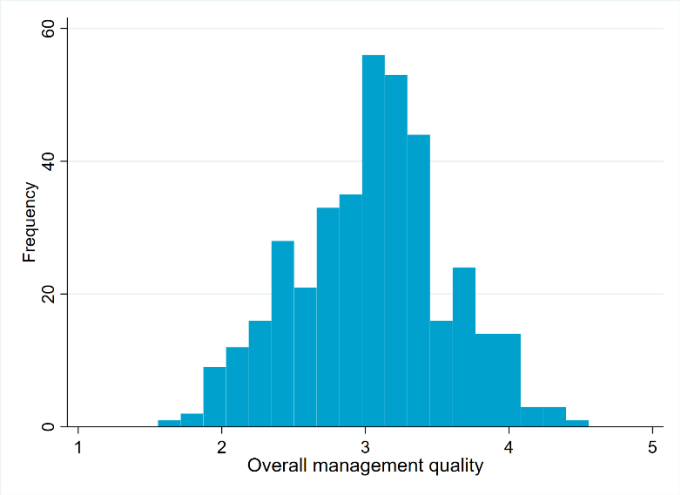
The firms available for the analysis in our sample return an average overall management score of 3.05 on a scale of 1 to 5, with a standard deviation of 0.53.[4] As reported in Dieteren et al. (2018), the Netherlands ranks sixth internationally in terms of management quality. Zooming in on sub-dimensions of management quality, Dutch firms, on average, score higher in monitoring practices (3.34) and lower in people management practices (2.88), compared to the average scores in other countries (Bloom and van Reenen, 2010b). The distribution of the overall management score across our sample of firms is depicted in Figure 3.1.[5] A negative skew is observable, indicating a

[4] The WMS-survey data also includes a set of noise controls, such as a variable indicating which interviewer surveyed a particular firm and a variable indicating at which point during the week the interview took place. A regression of management scores on the various noise controls shows that these controls jointly have no explanatory power with regard to management quality, indicating that management quality has been measured unbiasedly in our sample of firms.

[5] The number of observations available for the analysis is lower than the 433 surveyed firms that have been matched to the GBR. This is because we ignore firms operating in non-industrial sectors according to the GBR, firms with missing or negative productivity figures and firms with missing management-scores.

higher frequency of firms with above average management quality. Nonetheless, a statistical test for normality of the distribution of the overall management scores reveals that we cannot reject the hypothesis that management scores are distributed normally (p-value=0.400).

Figure 3.1 Management scores across firms (N=385)



The key performance indicator in our analysis is firm-level labor productivity (value-added per employee). The average firm in the sample has a labor productivity of 95.000 euro value added per employee. The productivity distribution of the firms in the sample is depicted in Figure 3.2. Productivity levels are far from normally distributed. The distribution is characterized by a short left tail and a long right tail driving up the average level of productivity. The largest number of firms is located in the bracket with a productivity level between 50 and 75.000 euro.

Figure 3.2 Labor productivity levels across firms (in euro, N=385)

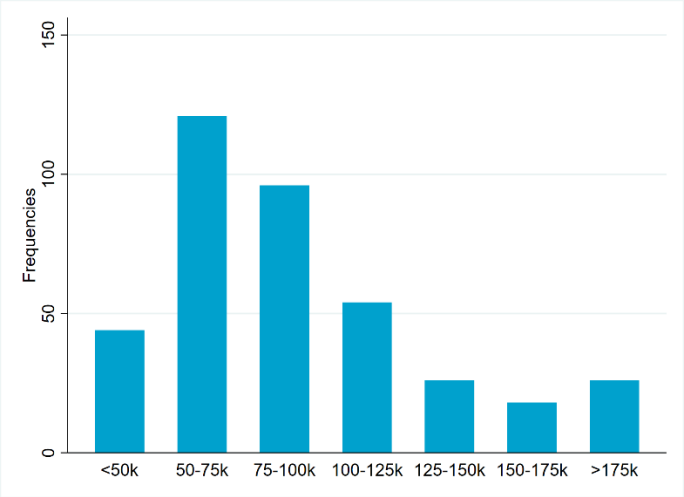
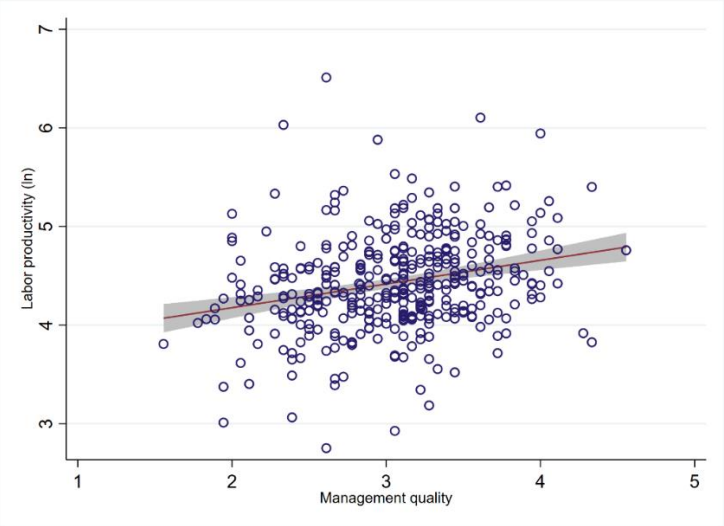


Figure 3.3 plots firm-level labor productivity against management quality including a line of best fit, much in line with Figure 3.2 in Van den Berg et al. (2019). Just as we have seen earlier, there is a positive correlation between the overall management quality of the firm and its level of productivity. This correlation coefficient is statistically significant at a level of 95 percent.

Figure 3.3 Labor productivity and management quality (N=384)



As we explained in section 2.3, we start out with a our basic OLS model where next to the overall quality of management practices, firm productivity is determined by *firm size*, *MNE status*, and an *industry dummy* (not reported), see the first column of Table 3.1. For all estimation results reported in Table 3.1, the corresponding results for the three management quality sub-dimensions (monitoring, targets and people) are given in the Appendix. All management quality variables are included as standardized z-scores.

It turns out that there is a significant and positive relationship (at 95% level of significance) between a firm's overall management quality score and firm productivity. Although, our primary interest is in this relationship, the estimation results also indicate that larger firms are more productive and that national firms have a somewhat lower productivity (against the benchmark group of Dutch MNEs). For the 3 sub-dimensions of management quality, see the Appendix, we do find a positive relationship with firm productivity for monitoring and targets but not for people management. This is a finding that specifically holds for the quality of 'monitoring' management in (almost) all our alternative model specifications. The relationship between the quality of 'targets' management and in particular the quality of 'people' management is weaker or often non-existent in our various models specifications.

In our first model extension, see column (2), we add the *age of the firm* and a *location dummy*. The location dummy (not reported here) captures the effect that the location-specific factors (here, the province) might have a bearing on firm productivity. One could for instance envision that in provinces with a long-industrial history, like Noord-Brabant, knowledge networks and the associated knowledge spillovers are more developed than in say the province of Drenthe where economic activity is much more rooted historically in the agricultural sector. The age of the firm is included because it is well-established that firm productivity may vary over the life-cycle of a firm. We do still find a positive and significant association for our sample of 385 firms between their overall management quality and productivity, though somewhat weaker than in the basic model.

Table 3.1: Quality of management practices and productivity – the overall score

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Overall score(z)	0.0818***	0.0784**	0.0724**	0.0378	0.0638**	0.0661*
	(0.029)	(0.031)	(0.030)	(0.030)	(0.030)	(0.036)
Firm size (fte, log)	0.105***	0.102**	0.0751*	0.0476	0.0769*	0.0613
	(0.039)	(0.042)	(0.039)	(0.039)	(0.039)	(0.050)
MNE status: Dutch MNE as base						
National Firm	-0.144**	-0.132**	-0.0708	0.000870	-0.0689	-0.0373
	(0.063)	(0.062)	(0.077)	(0.077)	(0.077)	(0.096)
Foreign MNE	0.114	0.118	0.104	0.0838	0.110	0.0457
	(0.073)	(0.075)	(0.068)	(0.068)	(0.070)	(0.084)
Firm age: < 3 years as base						
3-5 years		0.00298	-0.0980	0.00219	-0.0196	-0.0543
		(0.207)	(0.237)	(0.246)	(0.252)	(0.373)
5-10 years		-0.141	-0.232	-0.0105	-0.0967	-0.0199
		(0.208)	(0.213)	(0.226)	(0.231)	(0.351)
>10 years		-0.0826	-0.168	0.0906	-0.00402	-0.0840
		(0.196)	(0.186)	(0.219)	(0.223)	(0.340)
Fixed assets (log)			0.115****	0.0900****	0.109****	0.0967****
			(0.024)	(0.024)	(0.024)	(0.027)
Average hourly wage				0.700****		
				(0.170)		
% part-time employees				-0.214	-0.260	-0.186
				(0.220)	(0.225)	(0.263)
% temp contracts				-0.00946	-0.144	-0.0957
				(0.201)	(0.203)	(0.235)
% employees <= 5 years experience				0.194	0.107	0.0913
				(0.157)	(0.159)	(0.199)
CEO wage (log)						0.141***
						(0.053)
CEO experience in firm (# years)						0.00681
						(0.009)
constant	3.867****	4.101****	3.707****	1.487**	3.591****	2.040***
	(0.202)	(0.267)	(0.371)	(0.644)	(0.400)	(0.743)
N	385	385	365	364	364	293
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.18	0.17	0.24	0.28	0.24	0.23

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

In the analytical underpinning of their empirical research regarding the impact of management quality on productivity, Bloom, Sadun and Van Reenen (2016) include management quality or management practices next to other factor inputs like labor and capital in a production function. They consider management to be a (soft) version of technology or capital. In this view, the overall management quality reflects a firm's stock of management capital which, just like human or physical capital, can be seen as having a direct bearing on firm productivity. To investigate the relevance of management quality, and thus so to speak of the 'stock of management capital', our second model extension includes direct measures of *physical and human capital* and also a set of variables that tracks the *composition of the work force*. The workforce variables also indirectly capture aspects of the human capital composition of the firm: firms with on average more temporary employees and/or more employees with a short tenure are thought to be ceteris paribus less productive.

In column (3) of Table 3.1 we first add physical capital (proxied by a firm's *fixed tangible and intangible assets*) to our model. Our main result as to the significant positive relationship between overall management quality and firm productivity continues to hold, and the estimation also shows that firms with more physical capital are more productive.

The model in column (4) adds human capital by including the *average hourly wage* as a direct proxy for human capital (a higher wage indicating higher level of human capital) as well as the variables capturing the composition of the work force. As is clear from column (4), all explanatory variables, with the notable exception of the average hourly wage (and fixed assets), now become insignificant. The reason for this result is that firm wages and firm productivity are highly correlated to begin with, and are analytically more or less two sides of the same coin. This specification thus comes close to regressing productivity on itself. For this reason we drop the average hourly wage from our subsequent specifications. The drawback is that we do not have a direct measure for the quality of human capital. Years of schooling or highest education level attained would be obvious candidates, see Bloom et al (2014), but these data are unfortunately not available for all workers in the Netherlands (yet).

Column (5) contains our preferred model specification for our sample (n=364).[6] By dropping the average hourly wage while maintaining fixed assets and the composition of the workforce as explanatory variables. Again, we see a significant and positive relationship between a firm's overall management quality score and its productivity. Physical capital and firm size are also positively and significantly associated with firm productivity. Note that the composition of the work force does not seem to have any significant correlation with productivity, even after dropping average hourly wage. This remains true when alternative measures of employee experience, such as the average (or median) number of years of experience of employees per firm, are used.[7]

[6] Our preferred model constitutes of a sample of firms that is very similar to the sample subjected to a representability analysis in Van den Berg et al. (2019) in Section 2.2. This sample is highly representable for the relevant firm population in terms of size and industry of activity.

[7] Note that due to data limitations it is not possible to determine the exact number of years of experience for employees with more than 10 years of experience. The median number of years of experience is 10 years for around 45 percent of the firms in our sample. This in fact means that the median employee experience is at least 10 years in 45 percent of our firms. Measures such as the average and median number of years of experience therefore have their limitations.

In the final column of table 3.1, and for a somewhat smaller sample due to limited data availability (n=293), we extend the model underlying column (5) by adding two variables that relate to the potential relevance of the CEO of the firm: the *CEO wage* and the *CEO experience in the firm* (number of years). The estimation results suggest that CEO wage and firm productivity are significantly positively correlated, while CEO experience does not seem to matter. Also in this specification, a higher score on overall management quality goes along with a significantly higher productivity. Note that because of the fact that including the CEO variables we end up with a much smaller sample, we decided to continue our analyses regarding our second research question on the full sample without the CEO-variables.

All in all, the estimation results reported in table 3.1 confirm for our sample of Dutch manufacturing firms the main findings in similar estimations for other countries as summarized in Bloom et al (2014): in a multi-variate model of firm productivity the overall management quality of a firm has a direct and significantly positively relationship with firm productivity.

3.2 The interaction between management quality and innovativeness

In this section we present our findings regarding the question to what extent the interaction between innovativeness and the quality of management practices provides an explanation for observed productivity differences between firms. We start by graphically illustrating to what extent innovativeness is associated with management quality and productivity, not controlling for any additional firm characteristics. Our preferred measure of innovativeness is patent box use, as we argued in Chapter 2, but firm productivity is also related to other measures of innovativeness like the number of hours spent on R&D, see Figure 3.4.

Figure 3.4 Labor productivity and innovativeness (left panel: N=388, right panel: N=267)

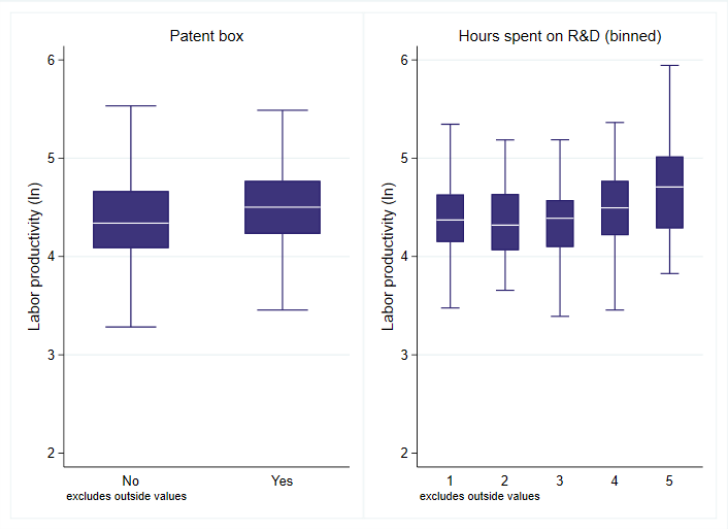
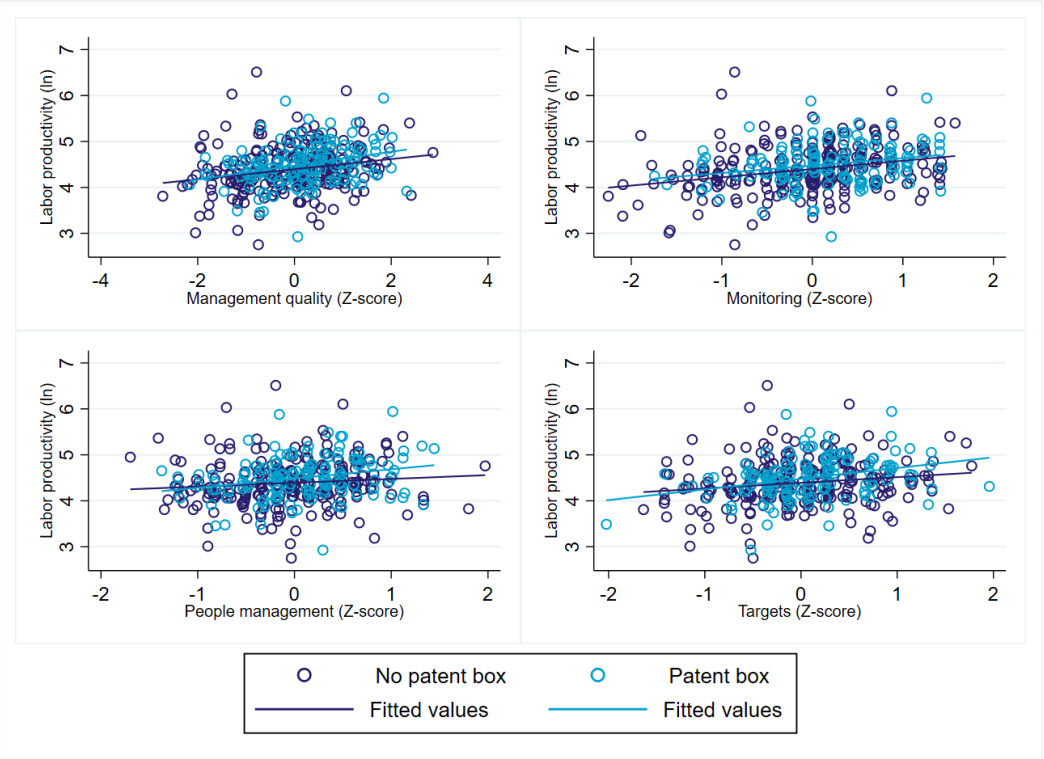


Figure 3.4 shows that productivity is positively associated with both R&D-input and output: firm productivity clearly increases in the number of hours reportedly spent on R&D (right panel) and is higher among firms with patents derived from R&D (left panel). Introducing management quality and its sub-dimensions into the equation yields the picture emerging from Figure 3.5. Overall, we see a positive correlation between management quality and productivity both for firms that make use of the patent box and for firms that do not.[8] However, the linear curve is steeper for innovative firms. That is to say except for monitoring where both curves are upward sloping, but are also equally steep. Using the WBSO as an alternative proxy for innovativeness (see Figure A4 in the Appendix) yields similar correlations. The patterns emerging from these figures thus provide preliminary evidence for a stronger association between productivity and management quality for innovative firms.

[8] Figure A2 and A3 in the Appendix present the direct relationship between management quality and innovativeness.

Figure 3.5 Productivity, management quality and patent box use (N=384)



Figures 3.4 and 3.5 thus illustrate that firm productivity, innovativeness, and overall management quality are positively correlated. The next question is then what these relationships look like, when we add innovativeness to the main model from section 3.1, the specification underlying column (5) in Table 3.1. We are interested in the direct effect of innovativeness and overall management quality as well as the interaction effect. As to the latter, Bloom, Sadun and Van Reenen (2012) show for a sample of subsidiaries of US MNEs in Europe that an additional unit of ICT investment yields a significantly larger increase in firm productivity when the overall management quality is also higher. In other words, Bloom et al. (2012) find a significant positive interaction effect for ICT investment and management quality. As we explained before ICT-investment is, however, a rather imperfect proxy for innovation, this is why we opt for a more direct measure of firm innovation in our estimations below.

In Table 3.2 below, we present our estimation results for the relevance of overall management quality and innovativeness for firm productivity for two proxies of innovativeness: the patent box and the WSBO measure. Estimation results for the 3 sub-dimensions of management quality are again relegated to the Appendix. Column (1) of Table 3.2 shows the estimation results for the patent box proxy, which is our preferred measure of innovativeness (see Chapter 2). Both innovativeness and overall management quality have a direct, significant and positive association with firm productivity (for the management sub-dimensions this is always the case for monitoring too). The interaction effect is, however, not significant (neither for overall management quality nor for the 3 sub-dimensions). Firm size turns insignificant once we add patent box use to our model. This is probably due to the fact that larger firms make use of the patent box more often than smaller firms in our sample. In column (2) the WSBO proxy is used. Here we see innovativeness losing its significance whereas overall management quality continues to be significantly positively correlated with firm productivity. Column (3) adds an interaction effect to

the model of column (2). Here too, the interaction effect is not significant. However, adding an interaction term between the overall quality of management and the use of WBSO, renders the management score insignificant.

All in all, there is some evidence, for the patent box variable at least, that innovativeness has direct positive bearing on firm productivity, but there is no evidence in our estimations to support an interaction effect with overall management quality. Management quality itself continues to be significant. One reason for the lack of an interaction effect might be that the firms in our sample are the larger firms (>50 employees). A question for future research would be if for smaller/start-up firms the overall management quality might possibly matter more in terms of increasing the impact innovation has on firm productivity.

Table 3.2 Productivity, management quality and innovation – overall score

	Model (1)	Model (2)	Model (3)
Overall score(z)	0.0671*	0.0644**	0.0533
	(0.036)	(0.030)	(0.048)
Patent box	0.122**		
	(0.060)		
Patent box X Overall score	-0.0245		
	(0.060)		
WBSO		-0.0229	-0.0230
		(0.064)	(0.065)
WBSO X Overall score			0.0175
			(0.057)
Firm size (fte, log)	0.0611	0.0796**	0.0791**
	(0.040)	(0.040)	(0.040)
MNE status: Dutch MNE as base			
National Firm	-0.0454	-0.0709	-0.0726
	(0.078)	(0.077)	(0.078)
Foreign MNE	0.131*	0.107	0.106
	(0.070)	(0.070)	(0.070)
Firm age: < 3 years as base			
3-5 years	-0.0350	-0.0153	-0.0101
	(0.251)	(0.252)	(0.253)
5-10 years	-0.114	-0.0958	-0.0921
	(0.231)	(0.231)	(0.232)
>10 years	-0.0227	-0.00320	0.0000648
	(0.223)	(0.223)	(0.224)
Fixed assets (log)	0.110****	0.109****	0.109****
	(0.024)	(0.024)	(0.024)
% part time employees	-0.295	-0.267	-0.268
	(0.225)	(0.226)	(0.226)
% temp contracts	-0.106	-0.147	-0.153
	(0.204)	(0.204)	(0.205)
%employees <= 5 years experience	0.104	0.105	0.107
	(0.159)	(0.159)	(0.160)
_cons	3.635****	3.610****	3.608****
	(0.400)	(0.404)	(0.405)
N	364	364	364
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
adj. R^2	0.25	0.24	0.24

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

3.3 The interaction between management quality and venturing abroad

This section deals with the question to what extent the interaction between internationalization and the quality of management practices correlates with observed productivity differences between firms. Again, we first look for patterns in the data by presenting them graphically in various ways. As motivated in Chapter 2, our preferred measure of internationalization is the share of exports (goods and services jointly) in total turnover: the export intensity.

Figure 3.6 plots firm-level productivity against export intensity. A seemingly non-linear inverted U-shaped relationship emerges. Some simple univariate regressions confirm that a quadratic relationship between productivity and export share indeed yields a better fit than a linear relationship. At first productivity shows to increase in the export intensity, up to a share of exports in turnover of about 60 percent. Beyond that point the curves flattens out and ultimately decreases slightly for export shares approaching 100 percent.

Figure 3.6 Productivity and export intensity (N=352)

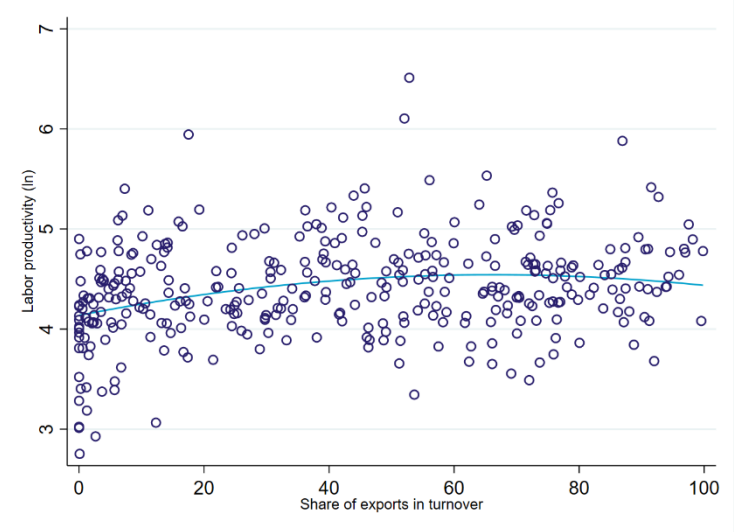


Figure 3.7 adds the overall score on management quality. The picture that emerges as a result is a darkening of the squares, meaning higher productivity, from the lower left to the upper right corner. Or, in other words, labor productivity seems to increase both in management quality and export intensity simultaneously.

Figure 3.7 Productivity, management quality and export intensity (N=348)

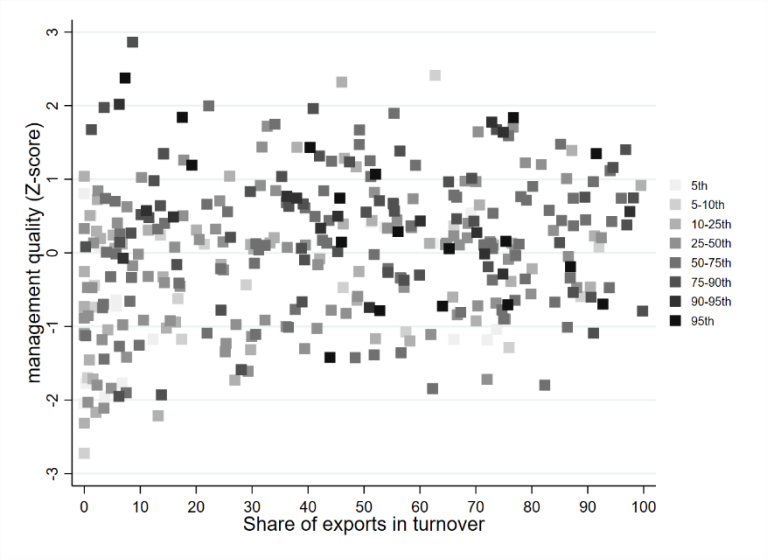
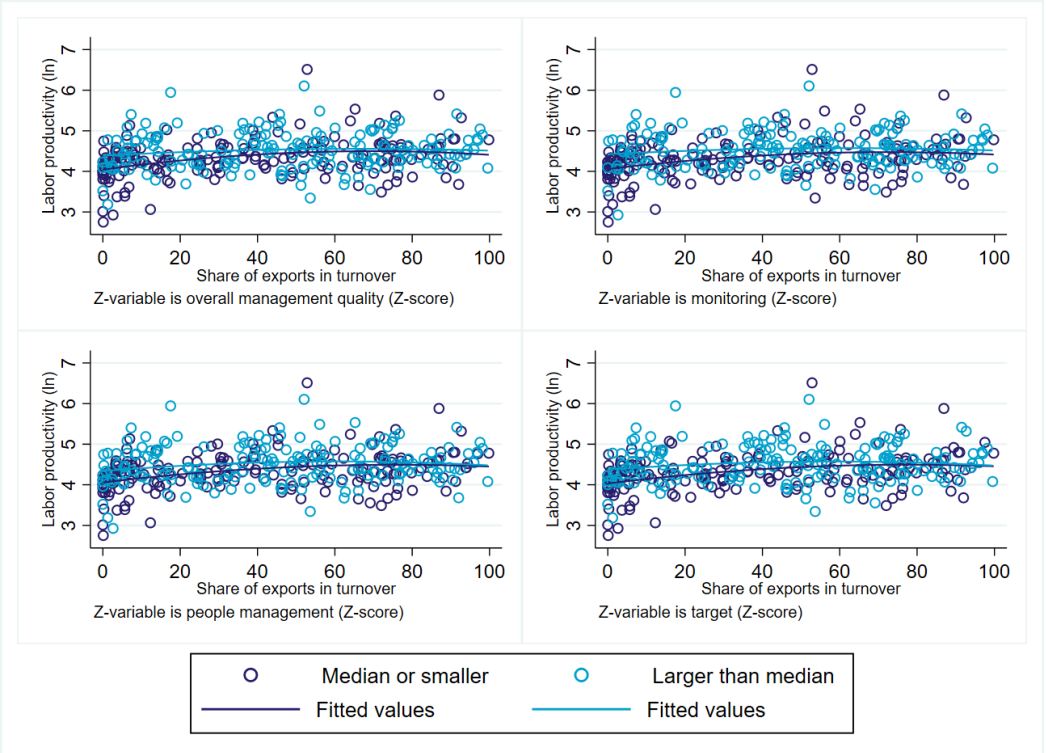


Figure 3.8 adds the 3 sub-dimensions of management quality when we also split the sample between firms with above and below median management quality scores. The patterns emerging are quite subtle and not immediately obvious. It seems that for less well managed firms, the relationship between productivity and export intensity is more pronounced, and particularly for firms with smaller export shares the relationship between productivity and management quality seems to be stronger. Nonetheless, relative to the patterns observed regarding the interaction between innovativeness and management we see less convincing evidence in favor of our proposition that the positive correlation between productivity and management quality is stronger for firms engaging more intensely in exporting.

Figure 3.8 Productivity, export intensity and dimensions of management quality (N=348)



Like with innovation, we use our preferred model from section 3.1 (as shown in column (5) of Table 3.1) to assess the internationalization dimension. More specifically, we add the export intensity variable to our model. Again, we are interested in two questions. First, is there a separate direct effect of overall management quality and export intensity on firm productivity? Second, is there an interaction effect between overall management quality and export intensity? As to the second question, Bloom et al (2018) use trade data for the USA and China to show that firms that export (more) have an even higher productivity when their overall management quality is higher.

Table 3.3 presents the estimation results. Overall management quality is again significant and with the expected positive sign. Likewise, a higher export intensity goes along with a significantly higher firm productivity. The interaction effect is not significant. In accordance with our previous estimation, firm size and physical capital matter and so does now the foreign MNE status. The fact that we do not find an interaction effect runs counter to the findings of Bloom et al. (2018) for US and Chinese firms. However, in their sample there are many firms that do not export or only started to do so in the sample period. In our sample we have very few non-exporters. Or, in the parlor of modern international trade theory, in our sample we only cover the intensive margin of trade via our export intensity variable and the extensive margin (whether or not a firm exports at all) is less relevant to begin with. It might therefore be more relevant to investigate the interaction effect for a sample of firms where the extensive margin is more prevalent and where management quality might be more of a decisive factor in determining whether firms do export at all. Notwithstanding the lack of an interaction effect, our main finding that overall management quality matters for firm productivity continues to hold.

Furthermore, figure 3.6 suggests a nonlinear relationship between export intensity and productivity. Adding a quadratic term to the model in column (3) of table 3.2 returns an insignificant result. However, if the sample is split into four parts by the percentiles of export intensity, we see that the productivity of firms with an export intensity in the lowest 25 percentiles is significantly lower than that of firms with higher export intensity. Holding everything else constant, no significant difference in productivity is seen amongst firms with export intensities in the 26^{th} percentile or higher. Therefore, the positive correlation between export intensity and productivity seems to be particularly present at relatively lower values of export intensity.

Table 3.3 Productivity, management quality and export intensity

	Model (1)	Model (2)	Model (3)	Model (4)
Overall score(z)	0.0464**	0.0745**	0.0442*	0.0448**
	(0.023)	(0.034)	(0.023)	(0.023)
Export intensity(%)	0.189**	0.195**	0.472*	
	(0.084)	(0.084)	(0.268)	
Export intensity X Overall score		-0.0777		
		(0.072)		
Export intensity squared			-0.309	
			(0.279)	
Export intensity category: intensity in 25th – 50th percentile as base				
1st – 25th percentile				-0.137**
				(0.062)
50th – 75th percentile				0.0120
				(0.061)
50th – 75th percentile				0.0544
				(0.060)
Firm size (fte, log)	0.0593**	0.0601**	0.0572*	0.0557*
	(0.030)	(0.030)	(0.030)	(0.030)
MNE status: Dutch MNE as base				
National Firm	-0.0108	-0.00492	-0.00495	-0.000701
	(0.059)	(0.060)	(0.060)	(0.060)
Foreign MNE	0.158***	0.156***	0.161***	0.158***
	(0.053)	(0.053)	(0.053)	(0.053)
Firm age: < 3 years as base				
3-5 years	-0.0133	-0.0152	-0.0195	-0.0104
	(0.185)	(0.185)	(0.185)	(0.185)
5-10 years	-0.0547	-0.0585	-0.0626	-0.0691
	(0.170)	(0.170)	(0.170)	(0.169)
>10 years	0.0531	0.0492	0.0457	0.0403
	(0.163)	(0.163)	(0.163)	(0.162)
Fixed assets (log)	0.128****	0.128****	0.126****	0.130****
	(0.018)	(0.018)	(0.018)	(0.018)
% part time employees	-0.215	-0.216	-0.183	-0.178
	(0.171)	(0.171)	(0.174)	(0.174)
% temp contracts	-0.260*	-0.257*	-0.265*	-0.250
	(0.152)	(0.152)	(0.152)	(0.153)
%employees <= 5 years experience	0.120	0.118	0.112	0.0902
	(0.122)	(0.122)	(0.122)	(0.123)
_cons	3.397****	3.411****	3.387****	3.532****
	(0.299)	(0.299)	(0.299)	(0.295)
N	331	331	331	331
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
adj. R^2	0.45	0.45	0.45	0.45

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

4. Summary

The two main research questions underlying this study, as commissioned by the Dutch Ministry of Economic Affairs and Climate Policy, are:

(1) to establish whether management quality, as measured by the WMS methodology of Bloom et al. (2014), is positively and significantly related to firm productivity in our sample of Dutch manufacturing firms when controlling for other possible additional determinants of firm productivity;
(2) to analyze the relationship between firm productivity and management quality when we allow for the inclusion of innovativeness and internationalization, and when we allow these two variables to interact with management quality in our sample of Dutch manufacturing firms.

The answer to the first question is that there is a robust positive association between firm productivity and management quality. In virtually all of our estimations this relationship is established, thereby confirming what Bloom et al. (2014) have found for manufacturing firms in other countries as well. It also confirms the preliminary WMS-findings in Dieteren et al. (2018) and Van den Berg et al. (2019) for the case of The Netherlands.

The answer to the second question is more mixed. Innovation and internationalization on the one hand, and management quality on the other hand, separately have their own direct positive relationship with firm productivity; but we do not find evidence (yet) of significant interaction effects. The latter might be due to the fact that larger and more mature firms constitute the bulk of our sample. It may be the case that management quality has a more pronounced impact on the relationship between innovation or internationalization and productivity among younger and/or smaller firms. This is certainly a topic that deserves further research in our view.

Overall, the general picture that emerges from our analysis, and again in line with previous work by Van den Berg et al. (2019) and Dieteren et al. (2018) using the same WMS-data for Dutch manufacturing firms, is consistent with the notion that management quality is a relevant determinant of firm productivity. Since firm productivity growth is the ultimate driver of future economic growth and prosperity and since our 'degree of ignorance' as to the determinants of (Dutch) firm productivity is still very large (Roelandt et al., 2019), the evidence that management quality may be part of solving the productivity puzzle is mounting and now corroborated for the case of the Netherlands. Further research into the exact ways by which management quality matters, in a causal sense(!), for firm performance is needed. The same goes for the possible determinants of the observed substantial heterogeneity in management quality across Dutch manufacturing firms.

References

Bertrand, M., & Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *The Quarterly Journal of Economics*, 118(4), 1169–1208.

Bloom, N., & Van Reenen, J. (2007). Measuring and explaining management practices across firms and countries. *The Quarterly Journal of Economics*, 122(4), 1351-1408.

Bloom, N., & Van Reenen, J. (2010a). New approaches to surveying organizations. *The American Economic Review*, 100(2), 105-09.

Bloom, N., & Van Reenen, J. (2010b). Why do management practices differ across firms and countries?. *Journal of Economic Perspectives*, 24(1), 203-24.

Bloom, N,, R. Sadun & J. Van Reenen (2012), Americans do IT Better: US Multinationals and the Productivity Miracle, *American Economic Review,* 102(1), 167-201.

Bloom, N., Sadun, R., & Van Reenen, J. (2016). Management as a Technology? *National Bureau of Economic Research*, No. w22327.

Bloom, N., K. Manova, J. Van Reenen, S. Teng Sun, Z. Yu (2018), Managing trade: evidence from China and the US, *NBER Working Paper,* 24718.

Dieteren, J., J. Groenewegen, S. Hardeman, H. Garretsen, L. de Haan, & J.I. Stoker (2018), Managementkwaliteit in Nederland gemeten, *Economisch-Statistische Berichten, https://esb.nu/esb/20043804/managementkwaliteit-in-nederland-gemeten*

Quigley T. J., & Hambrick D. C., (2015). Has the "CEO effect" increased in recent decades? A new explanation for the great rise in America's attention to corporate leaders. *Strategic Management Journal*. 36(6), 821–830.

Roelandt, Th., M. Akkermans, M. Polder & H. Van der Wiel (2019),De Mondiale Productiviteitspuzzel *Economisch-Statistische Berichten, https://esb.nu/esb/20054795/de-mondiale-productiviteitspuzzel-voor-nederland*

Sadun, R. (2019), New Empirical Evidence Shows: When It Comes to Productivity, Management Matters, Pro-Market Blog, Chicago Booth Business School.

Van den Berg, M., Boutorat, A., Garretsen, H., Mounir, A. & Stoker, J. (2019), *Managementkwaliteit en microdata: een dataverkenning*. Centraal Bureau voor de Statistiek, Heerlen, the Netherlands, *https://www.cbs.nl/nl-nl/achtergrond/2019/19/managementkwaliteit-en-microdata-een-dataverkenning*

Wagner, J. (2012). International trade and firm performance: a survey of empirical studies since 2006. *Review of World Economics*, 148(2), 235-267.

Appendix

Table A1 Quality of management practices and productivity – monitoring

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Monitoring(z)	0.116***	0.109**	0.112***	0.0752*	0.100**	0.108**
	(0.042)	(0.043)	(0.039)	(0.040)	(0.040)	(0.049)
Firm size (fte, log)	0.106***	0.102**	0.0731*	0.0442	0.0749*	0.0596
	(0.039)	(0.042)	(0.039)	(0.039)	(0.039)	(0.050)
MNE status: Dutch MNE as base						
National Firm	-0.133**	-0.124**	-0.0587	0.0106	-0.0583	-0.0209
	(0.063)	(0.063)	(0.077)	(0.077)	(0.077)	(0.097)
Foreign MNE	0.101	0.108	0.0934	0.0754	0.102	0.0387
	(0.075)	(0.078)	(0.068)	(0.068)	(0.070)	(0.084)
Firm age: < 3 years as base						
3-5 years		0.0181	-0.0810	0.0185	-0.00184	-0.0342
		(0.206)	(0.237)	(0.245)	(0.251)	(0.372)
5-10 years		-0.123	-0.211	0.00296	-0.0761	-0.00367
		(0.207)	(0.212)	(0.226)	(0.230)	(0.351)
>10 years		-0.0726	-0.155	0.102	0.0133	-0.0789
		(0.196)	(0.185)	(0.218)	(0.222)	(0.339)
Fixed assets (log)			0.115****	0.0901****	0.109****	0.0956****
			(0.024)	(0.024)	(0.024)	(0.027)
Average hourly wage				0.695****		
				(0.168)		
% part-time employees				-0.203	-0.256	-0.168
				(0.219)	(0.224)	(0.262)
% temp contracts				0.0168	-0.119	-0.0677
				(0.201)	(0.204)	(0.235)
%employees <= 5 years experience				0.194	0.115	0.0790
				(0.156)	(0.158)	(0.198)
CEO wage (log)						0.140***
						(0.053)
CEO experience in firm (# years)						0.00627
						(0.009)
Constant	3.865****	4.046****	3.657****	1.469**	3.534****	2.021***
	(0.202)	(0.276)	(0.368)	(0.632)	(0.398)	(0.739)
N	385	385	365	364	364	293
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.18	0.17	0.25	0.28	0.25	0.24

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A2 Quality of management practices and productivity – targets

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Targets(z)	0.0995***	0.0929**	0.0742*	0.0347	0.0685	0.0837
	(0.036)	(0.037)	(0.044)	(0.044)	(0.044)	(0.053)
Firm size (fte, log)	0.112***	0.108**	0.0821**	0.0510	0.0833**	0.0674
	(0.041)	(0.044)	(0.039)	(0.039)	(0.039)	(0.050)
MNE status: Dutch MNE as base						
National Firm	-0.157**	-0.147**	-0.0863	-0.00410	-0.0806	-0.0526
	(0.063)	(0.062)	(0.077)	(0.077)	(0.077)	(0.096)
Foreign MNE	0.116	0.121	0.109	0.0867	0.115	0.0433
	(0.071)	(0.074)	(0.069)	(0.068)	(0.070)	(0.084)
Firm age: < 3 years as base						
3-5 years		0.00569	-0.0957	-0.000229	-0.0226	-0.0775
		(0.209)	(0.238)	(0.246)	(0.252)	(0.373)
5-10 years		-0.141	-0.232	-0.00308	-0.0882	-0.0334
		(0.211)	(0.214)	(0.227)	(0.232)	(0.352)
>10 years		-0.0803	-0.166	0.102	0.0128	-0.0814
		(0.200)	(0.187)	(0.219)	(0.224)	(0.341)
Fixed assets (log)			0.115****	0.0888****	0.108****	0.0957****
			(0.024)	(0.024)	(0.024)	(0.027)
Average hourly wage				0.720****		
				(0.169)		
% part-time employees				-0.237	-0.300	-0.229
				(0.219)	(0.224)	(0.260)
% temp contracts				-0.0213	-0.167	-0.116
				(0.201)	(0.203)	(0.234)
%employees <= 5 years experience				0.211	0.132	0.123
				(0.156)	(0.159)	(0.198)
CEO wage (log)						0.144***
						(0.053)
CEO experience in firm (# years)						0.00793
						(0.009)
Constant	3.833****	4.061****	3.667****	1.399**	3.546****	1.967***
	(0.211)	(0.274)	(0.372)	(0.639)	(0.400)	(0.742)
N	385	385	365	364	364	293
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.18	0.16	0.24	0.28	0.24	0.23

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A3 Quality of management practices and productivity – people

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
People(z)	0.0802*	0.0803	0.0727	0.0184	0.0583	0.0479
	(0.044)	(0.049)	(0.047)	(0.047)	(0.048)	(0.057)
Firm size (fte, log)	0.115***	0.111***	0.0820**	0.0520	0.0838**	0.0691
	(0.040)	(0.042)	(0.039)	(0.039)	(0.039)	(0.050)
MNE status: Dutch MNE as base						
National Firm	-0.158**	-0.146**	-0.0814	-0.00232	-0.0774	-0.0525
	(0.063)	(0.063)	(0.077)	(0.077)	(0.077)	(0.097)
Foreign MNE	0.132*	0.135*	0.121*	0.0914	0.124*	0.0591
	(0.070)	(0.072)	(0.068)	(0.068)	(0.070)	(0.084)
Firm age: < 3 years as base						
3-5 years		-0.0115	-0.113	-0.00905	-0.0416	-0.110
		(0.205)	(0.239)	(0.246)	(0.252)	(0.374)
5-10 years		-0.149	-0.240	-0.00697	-0.105	-0.0483
		(0.206)	(0.214)	(0.227)	(0.232)	(0.353)
>10 years		-0.0961	-0.181	0.0924	-0.0176	-0.116
		(0.195)	(0.187)	(0.220)	(0.225)	(0.341)
Fixed assets (log)			0.118****	0.0899****	0.111****	0.0987****
			(0.024)	(0.024)	(0.024)	(0.027)
Average hourly wage				0.731****		
				(0.170)		
% part-time employees				-0.232	-0.279	-0.235
				(0.221)	(0.226)	(0.264)
% temp contracts				-0.0290	-0.181	-0.131
				(0.201)	(0.203)	(0.235)
%employees <= 5 years experience				0.208	0.113	0.116
				(0.158)	(0.161)	(0.200)
CEO wage (log)						0.145***
						(0.054)
CEO experience in firm (# years)						0.00767
						(0.009)
Constant	3.813****	4.107****	3.704****	1.374**	3.592****	2.000***
	(0.205)	(0.262)	(0.374)	(0.650)	(0.405)	(0.749)
N	385	385	365	364	364	293
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.17	0.16	0.23	0.28	0.24	0.22

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Figure A1 Management quality and patent box use (N=393)

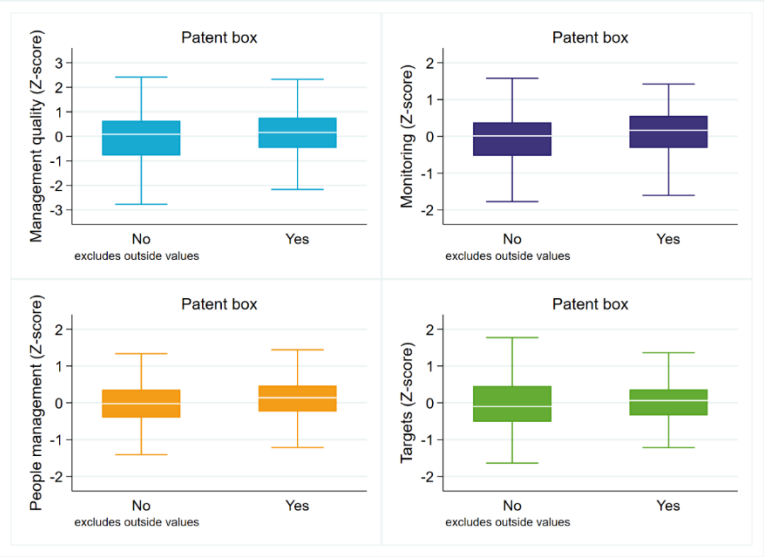


Figure A2 Management quality and hours spent on R&D (N=272)

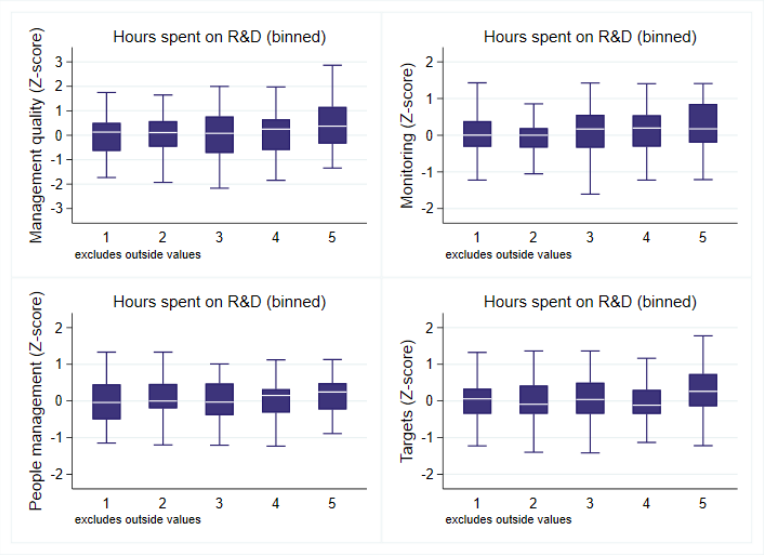


Figure A3 Productivity, management quality and hours spent on R&D (N=268)

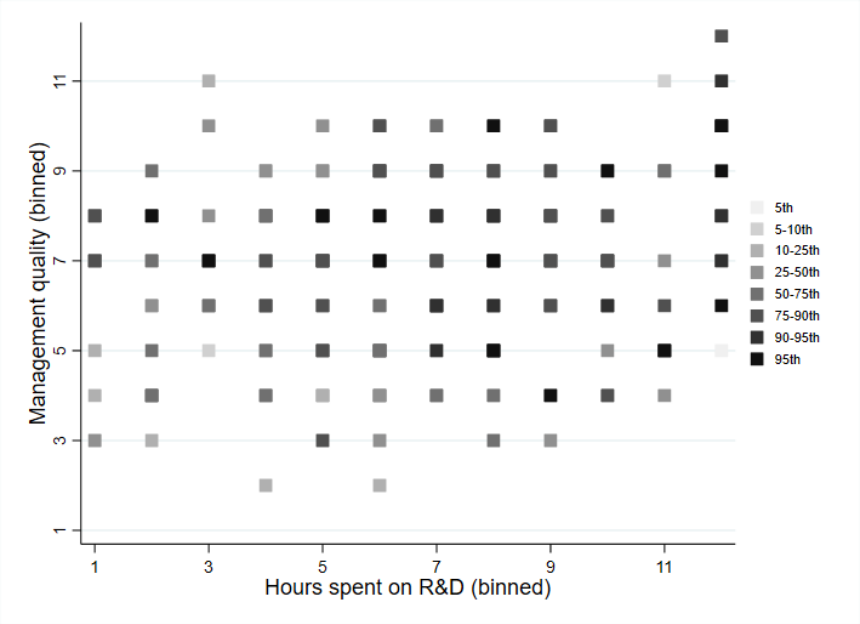


Table A4 Productivity, management quality and innovation – monitoring

	Model (1)	Model (2)	Model (3)
Monitoring(z)	0.122**	0.101**	0.0913
	(0.047)	(0.040)	(0.059)
Innovation box	0.126**		
	(0.061)		
Innovation box X Monitoring	-0.0890		
	(0.079)		
WBSO		-0.0260	-0.0261
		(0.064)	(0.064)
WBSO X Monitoring			0.0173
			(0.074)
Firm size (fte, log)	0.0618	0.0780*	0.0774*
	(0.040)	(0.040)	(0.040)
MNE status: Dutch MNE as base			
National Firm	-0.0300	-0.0605	-0.0616
	(0.078)	(0.078)	(0.078)
Foreign MNE	0.124*	0.0987	0.0982
	(0.070)	(0.070)	(0.070)
Firm age: < 3 years as base			
3-5 years	-0.0209	0.00324	0.00314
	(0.250)	(0.252)	(0.252)
5-10 years	-0.0906	-0.0748	-0.0755
	(0.230)	(0.231)	(0.231)
>10 years	0.00234	0.0144	0.0125
	(0.222)	(0.223)	(0.223)
Fixed assets (log)	0.109****	0.109****	0.109****
	(0.024)	(0.024)	(0.024)
% part time employees	-0.316	-0.263	-0.263
	(0.225)	(0.225)	(0.225)
% temp contracts	-0.0676	-0.122	-0.127
	(0.204)	(0.204)	(0.205)
%employees <= 5 years experience	0.114	0.113	0.112
	(0.158)	(0.159)	(0.159)
_cons	3.557****	3.555****	3.556****
	(0.398)	(0.401)	(0.402)
N	364	364	364
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
adj. R^2	0.25	0.25	0.24

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A5 Productivity, management quality and innovation – targets

	Model (1)	Model (2)	Model (3)
Targets(z)	0.0544	0.0691	0.0743
	(0.053)	(0.044)	(0.075)
Innovation box	0.122**		
	(0.060)		
Innovation box X Targets	0.0285		
	(0.091)		
WBSO		-0.0199	-0.0197
		(0.065)	(0.065)
WBSO X Targets			-0.00764
			(0.089)
Firm size (fte, log)	0.0646	0.0857**	0.0858**
	(0.040)	(0.040)	(0.040)
MNE status: Dutch MNE as base			
National Firm	-0.0559	-0.0824	-0.0822
	(0.078)	(0.077)	(0.078)
Foreign MNE	0.138*	0.112	0.112
	(0.070)	(0.070)	(0.071)
Firm age: < 3 years as base			
3-5 years	-0.0276	-0.0189	-0.0199
	(0.252)	(0.253)	(0.254)
5-10 years	-0.112	-0.0873	-0.0878
	(0.231)	(0.232)	(0.232)
>10 years	-0.0169	0.0137	0.0129
	(0.224)	(0.224)	(0.225)
Fixed assets (log)	0.109****	0.107****	0.107****
	(0.024)	(0.024)	(0.024)
% part time employees	-0.323	-0.306	-0.305
	(0.224)	(0.225)	(0.226)
% temp contracts	-0.131	-0.170	-0.169
	(0.203)	(0.204)	(0.204)
%employees <= 5 years experience	0.120	0.130	0.130
	(0.159)	(0.159)	(0.160)
_cons	3.609****	3.562****	3.564****
	(0.400)	(0.404)	(0.405)
N	364	364	364
adj. R^2	0.24	0.24	0.23

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A6 Productivity, management quality and innovation – people

	(1)	(2)	(3)
People(z)	0.0541	0.0586	0.0179
	(0.057)	(0.048)	(0.081)
Innovation box	0.125**		
	(0.060)		
Innovation box X People	-0.00297		
	(0.096)		
WBSO		-0.0173	-0.0167
		(0.065)	(0.065)
WBSO X People			0.0600
			(0.096)
Firm size (fte, log)	0.0658	0.0859**	0.0851**
	(0.040)	(0.040)	(0.040)
MNE status: Dutch MNE as base			
National Firm	-0.0528	-0.0789	-0.0827
	(0.078)	(0.078)	(0.078)
Foreign MNE	0.146**	0.122*	0.119*
	(0.070)	(0.070)	(0.070)
Firm age: < 3 years as base			
3-5 years	-0.0503	-0.0385	-0.0165
	(0.252)	(0.253)	(0.256)
5-10 years	-0.125	-0.105	-0.0851
	(0.232)	(0.233)	(0.235)
>10 years	-0.0408	-0.0171	0.00171
	(0.224)	(0.225)	(0.227)
Fixed assets (log)	0.111****	0.110****	0.110****
	(0.024)	(0.024)	(0.024)
% part time employees	-0.306	-0.284	-0.287
	(0.226)	(0.227)	(0.228)
% temp contracts	-0.142	-0.184	-0.192
	(0.203)	(0.204)	(0.204)
%employees <= 5 years experience	0.106	0.111	0.119
	(0.161)	(0.161)	(0.162)
_cons	3.645****	3.607****	3.597****
	(0.404)	(0.409)	(0.410)
N	364	364	364
adj. R^2	0.24	0.23	0.23

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Figure A4 Management quality and export intensity (N=350)

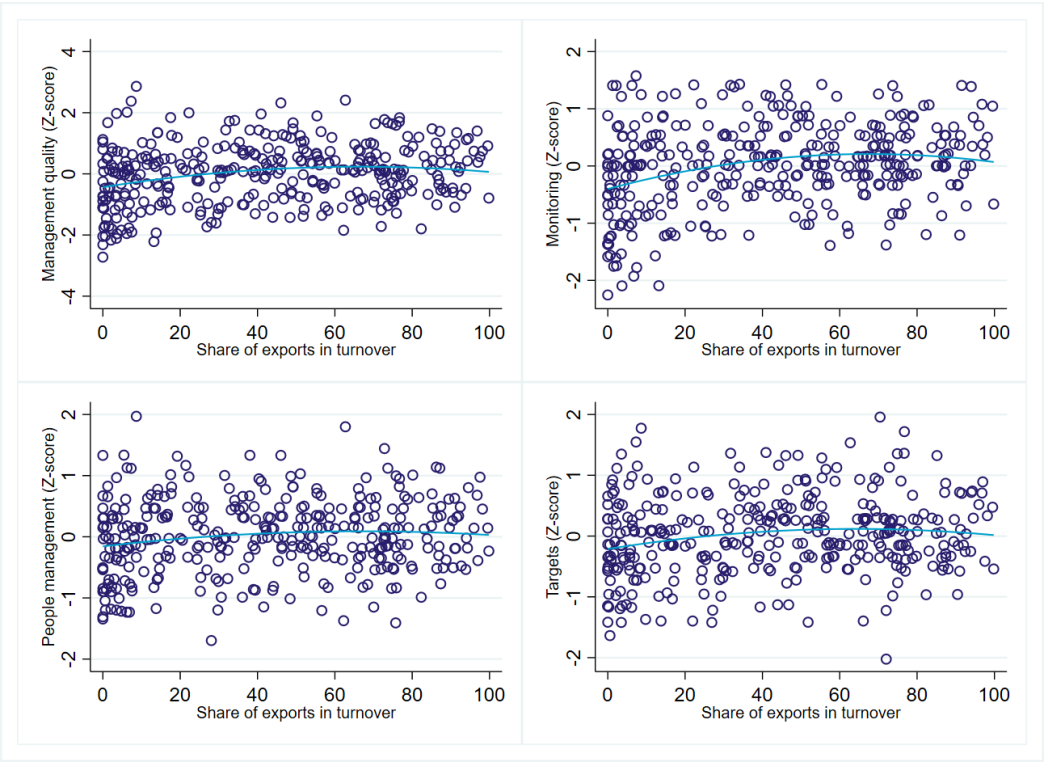


Table A7 Productivity, management quality and internationalization – monitoring

	Model (1)	Model (2)	Model (3)	Model (4)
Monitoring(z)	0.0896***	0.128***	0.0859***	0.0849***
	(0.030)	(0.043)	(0.031)	(0.031)
Export intensity(%)	0.176**	0.180**	0.405	
	(0.084)	(0.084)	(0.269)	
Export intensity X Monitoring		-0.118		
		(0.093)		
Export intensity squared			-0.249	
			(0.278)	
Export intensity category: intensity in 25th – 50th percentile as base				
1st – 25th percentile				-0.122*
				(0.062)
50th – 75th percentile				0.0129
				(0.060)
50th – 75th percentile				0.0542
				(0.060)
Firm size (fte, log)	0.0540*	0.0539*	0.0526*	0.0514*
	(0.030)	(0.030)	(0.030)	(0.030)
MNE status: Dutch MNE as base				
National Firm	-0.00397	0.00185	0.000469	0.00439
	(0.059)	(0.059)	(0.059)	(0.059)
Foreign MNE	0.147***	0.149***	0.150***	0.148***
	(0.052)	(0.052)	(0.053)	(0.053)
Firm age: < 3 years as base				
3-5 years	0.00391	-0.00167	-0.00190	0.00507
	(0.184)	(0.184)	(0.184)	(0.184)
5-10 years	-0.0347	-0.0381	-0.0419	-0.0492
	(0.169)	(0.169)	(0.169)	(0.168)
>10 years	0.0681	0.0618	0.0616	0.0556
	(0.161)	(0.161)	(0.161)	(0.161)
Fixed assets (log)	0.128****	0.128****	0.127****	0.130****
	(0.018)	(0.018)	(0.018)	(0.018)
% part time employees	-0.208	-0.219	-0.182	-0.177
	(0.170)	(0.170)	(0.172)	(0.173)
% temp contracts	-0.226	-0.223	-0.231	-0.220
	(0.152)	(0.152)	(0.152)	(0.153)
%employees <= 5 years experience	0.125	0.119	0.119	0.0990
	(0.120)	(0.120)	(0.120)	(0.121)
_cons	3.368****	3.397****	3.361****	3.491****
	(0.295)	(0.296)	(0.295)	(0.292)
N	331	331	331	331
adj. R^2	0.45	0.45	0.45	0.45

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A8 Productivity, management quality and internationalization – targets

	Model (1)	Model (2)	Model (3)	Model (4)
Targets(z)	0.0539	0.102*	0.0516	0.0549*
	(0.033)	(0.053)	(0.033)	(0.033)
Export intensity(%)	0.194**	0.199**	0.494*	
	(0.084)	(0.085)	(0.268)	
Export intensity X Targets		-0.125		
		(0.107)		
Export intensity squared			-0.329	
			(0.279)	
Export intensity category: intensity in 25th – 50th percentile as base				
1st – 25th percentile				-0.145**
				(0.062)
50th – 75th percentile				0.00620
				(0.061)
50th – 75th percentile				0.0520
				(0.060)
Firm size (fte, log)	0.0641**	0.0649**	0.0616**	0.0600**
	(0.030)	(0.030)	(0.030)	(0.030)
MNE status: Dutch MNE as base				
National Firm	-0.0168	-0.0113	-0.0102	-0.00614
	(0.059)	(0.059)	(0.060)	(0.060)
Foreign MNE	0.161***	0.157***	0.164***	0.160***
	(0.053)	(0.053)	(0.053)	(0.053)
Firm age: < 3 years as base				
3-5 years	-0.0185	-0.0173	-0.0248	-0.0152
	(0.186)	(0.186)	(0.186)	(0.185)
5-10 years	-0.0491	-0.0550	-0.0577	-0.0641
	(0.170)	(0.170)	(0.170)	(0.170)
>10 years	0.0666	0.0594	0.0580	0.0531
	(0.163)	(0.163)	(0.163)	(0.163)
Fixed assets (log)	0.126****	0.127****	0.124****	0.129****
	(0.018)	(0.018)	(0.018)	(0.018)
% part time employees	-0.243	-0.240	-0.206	-0.203
	(0.171)	(0.171)	(0.174)	(0.174)
% temp contracts	-0.277*	-0.273*	-0.281*	-0.263*
	(0.152)	(0.152)	(0.152)	(0.153)
%employees <= 5 years experience	0.137	0.138	0.129	0.105
	(0.121)	(0.121)	(0.121)	(0.122)
_cons	3.360****	3.375****	3.352****	3.505****
	(0.298)	(0.298)	(0.298)	(0.294)
N	331	331	331	331
adj. R^2	0.44	0.44	0.44	0.44

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A9 Productivity, management quality and internationalization – people

	Model (1)	Model (2)	Model (3)	Model (4)
People(z)	0.0214	0.0336	0.0205	0.0212
	(0.035)	(0.057)	(0.035)	(0.035)
Export intensity(%)	0.194**	0.196**	0.515*	
	(0.085)	(0.085)	(0.269)	
Export intensity X People		-0.0311		
		(0.113)		
Export intensity squared			-0.351	
			(0.279)	
Export intensity category: intensity in 25th – 50th percentile as base				
1st – 25th percentile				-0.142**
				(0.063)
50th – 75th percentile				0.0141
				(0.061)
50th – 75th percentile				0.0529
				(0.061)
Firm size (fte, log)	0.0667**	0.0671**	0.0639**	0.0625**
	(0.030)	(0.030)	(0.030)	(0.030)
MNE status: Dutch MNE as base				
National Firm	-0.0167	-0.0154	-0.00961	-0.00560
	(0.060)	(0.060)	(0.060)	(0.060)
Foreign MNE	0.170***	0.169***	0.174***	0.170***
	(0.053)	(0.053)	(0.053)	(0.053)
Firm age: < 3 years as base				
3-5 years	-0.0291	-0.0293	-0.0353	-0.0254
	(0.186)	(0.187)	(0.186)	(0.186)
5-10 years	-0.0547	-0.0556	-0.0637	-0.0695
	(0.172)	(0.172)	(0.172)	(0.171)
>10 years	0.0543	0.0542	0.0457	0.0409
	(0.164)	(0.165)	(0.164)	(0.164)
Fixed assets (log)	0.128****	0.128****	0.126****	0.131****
	(0.018)	(0.018)	(0.018)	(0.018)
% part time employees	-0.234	-0.232	-0.195	-0.192
	(0.173)	(0.174)	(0.176)	(0.176)
% temp contracts	-0.299**	-0.299*	-0.303**	-0.289*
	(0.152)	(0.152)	(0.152)	(0.153)
%employees <= 5 years experience	0.138	0.138	0.129	0.107
	(0.123)	(0.124)	(0.123)	(0.124)
_cons	3.365****	3.365****	3.356****	3.507****
	(0.303)	(0.303)	(0.303)	(0.299)
N	331	331	331	331
adj. R^2	0.44	0.44	0.44	0.44

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Explanation of symbols

Empty cell	Figure not applicable
.	Figure is unknown, insufficiently reliable or confidential
*	Provisional figure
**	Revised provisional figure
2019–2020	2019 to 2020 inclusive
2019/2020	Average for 2019 to 2020 inclusive
2019/2020	Crop year, financial year, school year, etc., beginning in 2019 and ending in 2020
2017/18–2019/20	Crop year, financial year, etc., 2017/18 to 2019/20 inclusive

Due to rounding, some totals may not correspond to the sum of the separate figures.

Colophon

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