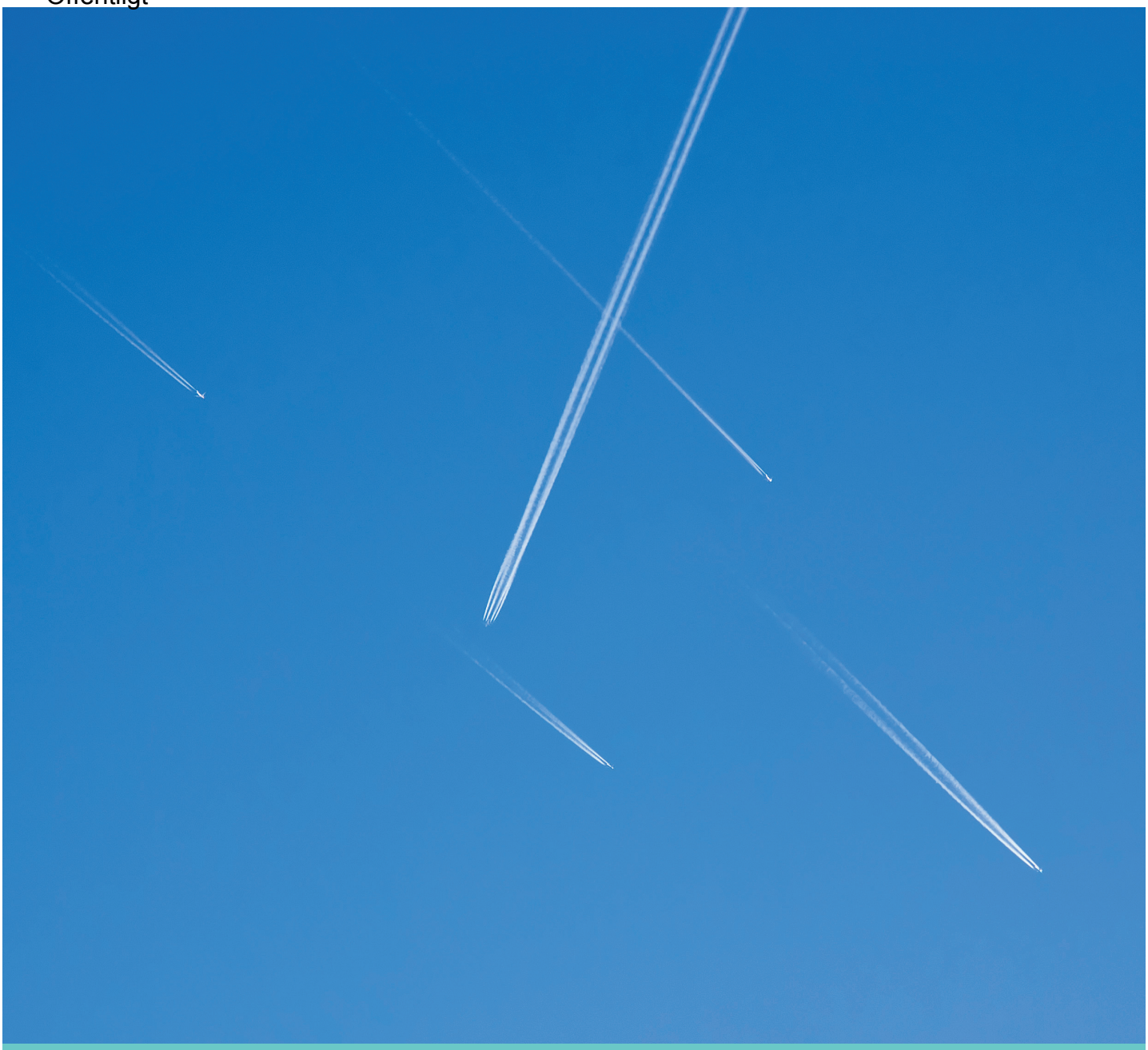

An evaluation of the Danish Innovation Assistant Programme

En effektmåling af Videnpilotordningen

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Danish Agency for Science
Technology and Innovation

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and Higher Education

An evaluation of the Danish Innovation Assistant Programme

En effektmåling af Videnpilotordningen

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Copenhagen, August 2013

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SAMMENFATNING PÅ DANSK >

Videnpilotordningen under *Rådet for Teknologi og Innovation* blev lanceret som en del af *'Viden flytter ud'*-tiltaget under regeringen i 2004. Ordningen har eksisteret siden 2005 og har som formål at øge små og mellemstore virksomheders vækst ved at øge incitamentet til og nedbryde barrierer for ansættelsen af akademikere i disse virksomheder.

På baggrund af den danske vækstudfordring generelt og den økonomiske afmatning i kølvandet på finanskrisen indtager Videnpilotordningen en central rolle blandt de politikinstrumenter, der sigter at skabe vækst og øge virksomheders kompetencer i forhold til innovation og nytænkning. Interessen for ordningen skyldes også, at en række tidligere analyser (f.eks. Junge og Skaksen, 2010, CEBR, 2011[2]) har vist positive sammenhænge mellem virksomheders andel af højtuddannede medarbejdere og deres produktivitet, og at udbygningen af ordningen kan argumenteres for at kunne reducere den for tiden høje arbejdsløshed blandt akademikere i Danmark.

Som led i sin løbende evalueringsstrategi har *Styrelsen for Forskning og Innovation*, der administrerer ordningen, bedt *Centre for Economics and Business Research (CEBR)* om at belyse, hvorvidt det kan vises, at ordningen lever op til sin målsætning. Til dette formål har CEBR fulgt både deltagende personer og virksomheder i et omfattende datamateriale. Denne rapport beskriver tilhørende analyse.

Med hensyn til metodologi, analysevariation samt hvilke indikatorer, der vurderes, er denne effektmåling af Videnpilotordningen i international sammenhæng 'best practice'. Den kan tjene som målestok for evaluering af effekten af en specifik indgriben i erhvervslivet, der kan udføres, hvis behandlingsgruppens etablerede datakvalitet er ganske høj, og der findes højt detaljerede landsdækkende registre med dataserier over tid for virksomheder og individer.

Analysen sammenligner løn- og beskæftigelsesudvikling for en stikprøve af individer, der deltager i ordningen (videnpiloter) med andre, sammenlignelige personer, der ikke deltager. Analysen sammenligner også vækst og produktivitetsudviklingen i en stikprøve af virksomheder, der deltager i ordningen, med andre (meget) sammenlignelige virksomheder, der ikke deltager.

[2] Junge og Skaksen, 2010, Produktivitet og videregående uddannelse, CEBR, 2011, Ansættelse af Ph.D.er og produktivitet.

Analysens resultater kan sammenfattes som følger:

Personer, der deltager i ordningen, øger deres beskæftigelsesrate i forbindelse med deltagelsen i ordningen. Dette er ikke overraskende, da ansættelse er en definerende karakteristik af selve ordningen. Efter mere end et år efter begyndelsen af deltagelsen kan det dog ikke længere vises, at beskæftigelsesraten blandt deltagerne er højere end i en referencegruppe af højt sammenlignelige individer – men det kan nævnes, at analysens observationsperiode delvist ligger i en højkonjunktur med lav arbejdsløshed blandt højtuddannede.

Personer, der deltager i ordningen, øger deres lønindkomst i forbindelse med deltagelsen i ordningen. Lønindkomsten forbliver højere end i referencegruppen i årene efter begyndelsen af deltagelsen, men konvergerer herefter.

Virksomheder, der deltager i ordningen, øger deres årlige vækst i antallet af højtuddannede medarbejdere i forbindelse med deltagelsen. Det kan dog ikke vises, at virksomheder, der deltager i ordningen, bliver ved med at ansætte flere højtuddannede i årene efter deltagelsen i ordningen.

Virksomheder, der deltager i ordningen, er også kendetegnet ved et midlertidigt forhøjet antal medarbejdere i årene efter deltagelsen, men det viser sig at være svært at finde robuste sammenhænge for finansielle succesparametre som værditilvækst, profit eller arbejdsproduktivitet. Dette skyldes ret stor variation i nogle virksomheders udvikling i disse variable, som ikke er relateret til, hvorvidt de deltager i ordningen.

For delstikprøver af mindre virksomheder, som ikke er kendetegnet ved større ændringer i deres succesvariable, findes, at deltagelsen i ordningen korrelerer positivt med stigende værditilvækst og profit. Således forøger deltagende virksomheder deres værditilvækst i gennemsnit med op til ca. 800.000 kr. og profitten med op til ca. 400.000 kr. i årene efter deltagelsen.

Disse resultater peger i retning af eventuelle positive effekter af ordningen og er i tråd med en tidligere analyses[3] resultater, men er behæftede med en betydelig statistisk usikkerhed. Så selvom datamaterialet er blevet betydelig udvidet i forhold til den tidligere analyse, er det på baggrund af de nye resultater stadig ikke muligt at træffe sikre udsagn om, i hvilket omfang deltagelsen i videnpilotordningen forøger værdiskabelsen eller profitten i virksomheden.

Det er ikke muligt at påvise positive sammenhænge mellem deltagelsen i programmet og arbejdsproduktivitet, lønniveau og afkastningsgraden (return-on-assets).

[3] DASTI, 2010, "Effektmåling af videnpilotordningens betydning for små og mellemstore virksomheder Innovation: Analyse og evaluering 4/2010"

Som sammenfatning kan det siges, at eventuelle positive effekter af ordningen kommer til udtryk i, at videnpiloter kommer hurtigere i arbejde, hvilket er forbundet med, at de kommer på et højere lønniveau i de første år efter deltagelsen end andre, sammenlignelige personer, der ikke deltager. Disse potentielle effekter kan forventes at være højere i de nuværende år, som i modsætning til en stor del af analyseperioden er kendetegnet ved en lavkonjunktur.

Resultater for virksomhedsdelen peger i retningen af, at virksomheder, som deltager i ordningen, oplever højere vækst i værditilvækst og profit, men en betydelig statistisk usikkerhed medfører, at disse resultater skal fortolkes med forsigtighed.

EXECUTIVE SUMMARY >

The Innovation Assistant Programme under the Danish Council for Technology and Innovation was launched as part of the *"Knowledge is moving out"*-initiative by the Danish government in 2004. The programme has existed since 2005 and has the purpose of increasing the growth of small and medium-sized enterprises by increasing incentives and breaking down barriers to employment of highly educated individuals in these enterprises.

Because of Denmark's growth problems in general and the economic downturn in the wake of the financial crisis, the Innovation Assistant Programme plays a central part among the policy instruments aiming at creating growth and increasing the competences of enterprises on innovation and creative thinking. The interest in the programme is also due to a number of previous analyses (ie. Junge og Skaksen, 2010, CEBR, 2011[4]) that have shown positive correlations between the share of highly educated employees in enterprises and their productivity, and that the expansion of the programme can be argued to reduce the presently high unemployment rate among the highly educated in Denmark.

As part of its ongoing evaluation strategy, the Danish Agency for Science, Technology and Innovation (DASTI), which administers the programme, has asked the Centre for Economics and Business Research (CEBR) to cast light on whether it can be shown that the programme fulfils its objectives. For this purpose, CEBR has followed both participating individuals and enterprises in an extensive set of data. This report describes the corresponding analysis.

With regard to methodology, variation of the analysis and the indicators taken into consideration, this impact analysis of the Innovation Assistant Programme is international best practice. It may serve as a standard for intervention evaluations that can be carried out if the established data quality of the treatment group is quite high, and highly detailed national registers with data time series for enterprises and individuals are available.

The analysis compares salary and employment developments for a sample of participating individuals (innovation assistants) with other comparable individuals not participating. The analysis also compares growth and productivity developments for a sample of participating companies with other (highly) comparable companies not participating.

The results of the analysis can be summarised as follows:

Individuals who participate in the programme increase their employment rate in association with participating in the programme. This is not surprising, since employment is a defining characteristic of the programme itself. It cannot be shown that the employment rate among participants is higher than for a reference group of highly comparable individuals more than a year after starting to participate.

[4] Junge og Skaksen, 2010, Produktivitet og videregående uddannelse, CEBR, 2011, Ansættelse af Ph.D.er og produktivitet.

However, it should be noted that the observation period of the analysis falls partly within an economic boom period with low unemployment among the highly educated.

Individuals who participate in the programme increase their salary income in association with participation. Salary income remains higher than for the reference group in the years after starting to participate, but then converges.

Companies that participate in the programme increase their yearly growth of the number of highly educated employees in association with participation. However, it cannot be shown that companies that participate in the programme continue to employ more highly educated individuals in the years after participation.

Companies that participate in the programme are also characterised by a temporary increase in the number of employees in the years after participation, but it turns out to be difficult to find robust associations for financial success parameters such as value added, profits or labour productivity. This is due to a quite large variation in certain companies' developments for these variables, which is unrelated to their participation in the programme.

For subsamples of smaller companies that are not characterised by large changes in their success variables, it is found that participation in the programme is positively correlated to increasing value added and profits. Thus, participating companies on average increase their value added by up to approx. DKK 800,000 (EUR 106,000) and their profits by up to approx. DKK 400,000 (EUR 53,000) in the years after participation.

These results point to possible positive effects of the programme and correspond with the results of a previous analysis,[5] but are subject to a significant statistical uncertainty. So even though the data material has been expanded significantly compared to the previous analysis, it is still not possible to make any certain claims about the extent that companies' value added and profits are increased by participating in the programme on the background of the new results.

It is not possible to show positive correlations between programme participation and labour productivity, salary levels and return on assets.

In conclusion, it can be said that any positive programme effects are expressed by innovation assistants finding employment quicker, which is associated with a higher salary level in the first years after participating than other comparable individuals who do not participate. These potential effects can be expected to be higher in the present years, which unlike a large part of the analysis period are characterised by an economic downturn.

[5] DASTI, 2010, "Effektmåling af videnpilotordningens betydning for små og mellemstore virksomheder Innovation: Analyse og evaluering 4/2010"

For the company part of the analysis, results indicate that participating companies experience higher growth in value added and profits, but a significant statistical uncertainty means that these results must be interpreted with care.

DEUTSCHSPRACHIGE ZUSAMMENFASSUNG >

Die vorliegende Studie wurde vom *Centre for Economics and Business Research (CEBR)* an der Handelshochschule Kopenhagen (CBS) für die *Styrelsen for Forskning og Innovation (DASTI)* des Ministeriums für Forschung, Innovation und weiterführende Bildung erstellt.

Sie betrachtet das Wissenspilotprogramm (*„Videnpilotordning", VP-Programm*), ein vom *DASTI* geführtes Innovationsprogramm. Dieses Programm existiert seit 2005 und subventioniert die Neuanstellung von Akademikern in kleinen und mittelständischen Unternehmen mit geringem Anteil hochqualifizierter Fachkräfte durch Gehaltszuschüsse. Ziel des Programms ist es, die Kompetenzen teilnehmender Unternehmen zu erhöhen und deren Wettbewerbsfähigkeit zu steigern.

Die Studie folgt ca. 360 teilnehmenden Personen und ca. 320 teilnehmenden Firmen in dänischen Registerdaten. Diese erlauben es, Aussagen über den Berufserfolg der am Programm teilnehmenden Personen zu machen, sowie das Wachstum teilnehmender Unternehmen zu analysieren.

Der Berufserfolg wird dabei anhand der Entwicklung des Beschäftigungsgrades und Jahresgehaltes gemessen. Auf Unternehmensniveau betrachtet die Studie Entwicklungen in der Anzahl hochausgebildeter Mitarbeiter, der Beschäftigung, der Lohnkosten, sowie der finanziellen Variablen Wertschöpfung, Gewinn und Arbeitsproduktivität.

Um den Berufserfolg der teilnehmenden Personen und das Wachstum der Unternehmen beurteilen zu können, werden aus den umfangreichen vorliegenden Registerdaten Kontrollgruppen von Personen oder Unternehmen ausgewählt, die die gleichen oder sehr ähnliche äussere Merkmale aufweisen wie die Teilnehmer im Jahr vor deren Teilnahme im VP-Programm. Die statistischen Methoden der Studie bestehen aus Vergleichen der verschiedenen Erfolgsvariablen zwischen den Teilnehmer- und den Kontrollgruppen. Zusätzlich dazu erlauben die Daten, für teilnehmende Unternehmen die Entwicklungen von Erfolgsvariablen nach Teilnahme im Programm mit den entsprechenden Entwicklungen vor der Teilnahme zu vergleichen. Ein ähnlicher Vergleich für Unternehmen in der Kontrollgruppe erlaubt es, auch unbeobachtbare Faktoren aus dem statistischen Modell herauszufiltern.

Die Ergebnisse der Studie lassen sich wie folgt zusammenfassen:

Personen, die am VP-Programm teilnehmen, weisen im ersten Jahr nach Beginn der Teilnahme am Programm eine höhere Beschäftigungsquote als Personen der Vergleichsgruppe auf. Nach zwei und mehr Jahren haben sich die Beschäftigungsquoten beider Gruppen jedoch weitgehend angeglichen, womit es nicht möglich ist, einen langfristigen Beschäftigungseffekt des VP-Programms auf individueller Ebene nachzuweisen. An dieser Stelle sei jedoch darauf hingewiesen, dass ein grosser Teil der Beobachtungsperiode der Analyse in eine Zeit guter Konjunktur mit allgemein geringer Akademikerarbeitslosigkeit fällt.

Personen, die am Programm teilnehmen, weisen eine bessere Gehaltsentwicklung als Personen, die nicht teilnehmen, auf. Dieser Unterschied ist statistisch signifikant für die ersten Jahre nach Beginn der Teilnahme.

Unternehmen, die am Programm teilnehmen, erhöhen die Beschäftigung hochqualifizierter Mitarbeiter im Vergleich zu Unternehmen in der Kontrollgruppe, sowie die Beschäftigung generell mit, im Durchschnitt, ca. einem zusätzlichen Mitarbeiter in Verbindung mit der Teilnahme am Programm.

In Bezug auf die finanziellen Erfolgsvariablen lässt sich feststellen, dass es grundsätzlich schwierig ist, potentielle Teilnahmeeffekte in den Daten zu isolieren: erhebliche Heterogenität der Firmen in Bezug auf die Entwicklung der Erfolgsvariablen relativ zu der Grösse der Stichprobe und der Grösse der potentiellen Effekte führt dazu, dass die Ergebnisse der jeweiligen Analyse von der Wahl des ökonometrischen Modells sowie der Stichprobenauswahl abhängen.

In Stichproben kleinerer teilnehmender Unternehmen mit geringer Heterogenität in den Erfolgsvariablen und der Entwicklung dieser Variablen, sind teilnehmende Unternehmen durch, im Durchschnitt, höheres Wachstum in der Wertschöpfung sowie des Unternehmensgewinns gekennzeichnet. Hier liegen für teilnehmende Unternehmen die potentiellen geschätzten Teilnehmereffekte bei bis zu ca. 800,000 Dänischer Kronen (ca. 106.000€) in Bezug auf die die jährliche Wertschöpfung und 400,000 Kronen (53.000€) für Unternehmensgewinn in den Jahren nach Programmteilnahme.

Diese Ergebnisse ähneln den Ergebnissen einer früheren Studie, die auf weniger umfangreichem Datenmaterial beruht[6], lassen sich jedoch aufgrund eines Mangels an statistischer Signifikanz und fehlender Robustheit in Bezug auf die Stichprobenauswahl nicht verallgemeinern.

Für die Erfolgsvariablen Rendite (return on assets), Lohnkosten (als Mass für das Lohnniveau des Unternehmens) sowie Arbeitsproduktivität lassen sich keine positiven potentiellen Teilnehmereffekte ermitteln. Auch in Bezug auf diese Variablen lassen die Ergebnisse den Schluss zu, dass die Bedeutung der Anstellung von Wissenspiloten in vielen Unternehmen von anderen Entwicklungen überlagert wird, und dass auch das im Vergleich zu einer früheren Studie ausgeweitete Datenmaterial noch nicht ausreicht, um gesicherte Aussagen über den Erfolg des Programms treffen zu können.

[6] DASTI, 2010, "Effektmåling af videnpilotordningens betydning for små og mellemstore virksomheder Innovation: Analyse og evaluering 4/2010"

1. INTRODUCTION >

This report presents the data, methodology, and results of an evaluation of the Danish Innovation Assistant Programme (*'Videnpilotordningen' - VP programme* in the following). The analysis was completed by CEBR for DASTI in 2012. It contributes to DASTI's strategy to continuously monitor and evaluate its innovation support programmes, to develop and improve the designs of its initiatives, and to improve programme evaluation techniques.

The VP programme was launched in 2005 and aims at increasing the growth and productivity of small and medium-sized enterprises (*SMEs*) by increasing the share of their employees with a higher education.[7] It is supposed to overcome any mutual reservations between SME managers and university graduates and increase academic knowledge in SMEs. To achieve this goal, the VP programme subsidizes the employment of university graduates in small and medium-sized companies.

Although the programme is small-scale, especially when compared to e.g. U.S. or European-level knowledge transfer programmes, schemes similar to the VP programme are currently being discussed or implemented in other countries as well, for example in a couple of local states in Germany and Austria. For this reason, the present study might also have an interest outside Denmark. From an academic point of view, the study furthermore contributes to our understanding of employment subsidies for highly skilled employees and the effects of knowledge transfers to SMEs.

The present analysis was supposed to address two questions: First, how do individuals who participate in the programme perform with regard to their employment and income developments? Second, how do participating companies perform in terms of employment and productivity growth? For this purpose, individuals and companies are followed in large-scale register data, and the success of programme participants is compared to highly similar individuals and companies that do not participate in the programme.

The two different questions imply that the present report is divided into two parts. The first part addresses the question of the extent to which individuals benefit from participating in the programme. This question has recently gained increasing public attention in Denmark, as unemployment among especially young university graduates is soaring in the aftermath of the recent financial crisis and the current Danish economic slowdown. This part looks at employment and salary developments of programme participants in association with programme participation.

[7] The education classifications of this study follow the International Standard Classification of Educations (ISCED). In the following, employees with at least a post-secondary education (ISCED classifications 4,5, and 6) are referred to as 'highly educated employees'.

The second part of the analysis looks at whether companies benefit from participating in the VP programme. This company-level analysis is again based on large-scale register data. It might be considered of primary interest, since the purpose of the VP programme is to increase company performance, whereas any individual employment effects are secondary.

The success parameters of interest in this part of the company-level analysis are employment growth, the number of highly educated employees, and the growth in value added, profits, return on assets, average wages, and labour productivity.

2. THE INNOVATION ASSISTANT PROGRAMME (VIDENPILOTORDNINGEN) >

An Innovation Assistant ('videnpilot', VP) is an academic employee with a post-secondary or tertiary-level education. In Danish educational terminology, this corresponds to respectively a medium-length (bachelor level) and a long higher education (postgraduate level). The employee has to be employed in an SME to solve one or more specific development tasks.

A VP-project is subsidised by DASTI and is supposed to contribute to the company's innovation, growth and productivity. The subsidy pays up to half of the VP's salary, with a maximum of DKK 12,500 (€1,700) a month for 6-12 months.

Privately owned small or medium-sized companies with at least 2 and at most 100 employees can apply for funding if there are at most two highly educated employees in the company, it has existed for at least a year, and its yearly revenues surpass DKK 1 million (€130,000).

The programme was launched in the beginning of 2005. Until 2012, approximately 500 projects have been completed.[8]

For the following analysis, it is relevant to have an idea of just how VP-projects come into life to better understand what kind of individuals and companies participate in the programme. However, it needs to be acknowledged that there is little if any general knowledge about how VP-company collaborations are initiated. Anecdotal evidence suggests that it is often the VP who contacts the company and suggests an employment relationship under the VP programme. And yet, it might also be presumed that companies hiring new employees might exploit the opportunity of saving wage costs in the beginning of the employment relationship.

[8] The analysis can only consider projects for which there is information in the data after they have been started, so the most recent projects are not part of the analysis.

3. DATA >

The data for the analysis is from three sources:

1. DASTI supplied information on individual VP-projects. Information includes individual identification numbers of participating individuals, company identifiers, and the start date of the project. These data will henceforth be called the *DASTI data*.

2. Data from companies' financial reports from *Experian A/S*, a credit rating agency. These data will be referred to as the *Experian data* in the following sections.

3. Register information from *Statistics Denmark*. This is matched employer-employee data including information on individuals (demographic information, information on education, wage and occupation) and companies (e.g. size, turnover). These data will be referred to as the *Statistics Denmark data*.

DASTI data

Since the start of the programme in 2005, DASTI has continuously collected information such as individual IDs of VPs, the start-up time of VP-projects, hosting company IDs (VP-companies in the following) and whether or not projects were completed or aborted before schedule. Individual IDs are social security numbers (CPR numbers) while company IDs are the numbers by which companies are registered by the public authorities (CVR numbers).

The Statistics Denmark data

Characteristics for individuals are drawn from Statistics Denmark's register. Data is available up to 2010, implying that there is no information on the most recent projects. Statistics Denmark data is typically available on an annual basis, with census date in mid-November. It allows associating individuals with their companies using the unique company and individual IDs.[9] Over the last decades, the data resources of Statistics Denmark have been continuously extended, as all Danish data with an associated individual or company ID can be merged with the existing data. For example, the present analysis benefits from Statistics Denmark's individual-level information on education (degrees, focus of electives, grades) and company-level information on turnover.

[9] Timmermans B. The Danish Integrated Database for Labor Market Research: Towards Demystification for the English Speaking Audience. Aalborg. 2010

The Experian data

The Experian data consists of approximately 1.7 million financial records in the period from 2000 to 2010. The timing of the records is based on the closing dates of the financial report periods. In case of companies filing multiple reports in a calendar year, only one of these is selected for the analysis. The closing date of the financial reports sets the time structure of the company-level analysis (which is relevant to before-after comparisons). When merging information from Statistics Denmark with the Experian data (such as information on the number of highly skilled employees), it is the latest available information in the Statistics Denmark registers before a given financial report's closing date which is used in association with the financial report in question.[10]

A first look at the data

As a point of departure, there are 416 VPs in the DASTI data. Six of these cannot be found in the registers that form the basis of the analysis, and there is no information on the highest educational degree of 16 individuals. Since education is a control variable of key importance for the analysis, these individuals are not included, leaving us with 394 individuals for the individual-level analysis. For 30 of these individuals, it has proven impossible to find highly similar controls. This implies that the individual-level analysis is based on 364 individuals who participated in the VP programme.

370 companies which have hosted VP projects can be found in the Experian database the year before the start of programme participation. The remaining companies not in the Experian data must be presumed to be unincorporated and thus not obliged to submit financial reports to the authorities. Companies can be followed until 2009 in the Statistics Denmark data and until 2011 in the Experian data. In the sample of companies employed for the subsequent analysis, the companies are observed over an average time span of 6.7 years.

The results of this report are based on DASTI's information on the company-VP matches. This is important to note, because the identification of hosting companies is not always straightforward: Single companies may have several CVR numbers, and there might be an element of randomness or selection regarding which CVR number hosting companies use to register their VP-projects. In approximately 30 percent of the projects, the Statistics Denmark data (described in greater detail below) suggest that the VP is employed at a company with a different CVR number than the one stated in the DASTI data.[11]

[10] Most companies have their closing date at the end of December, which implies a short time lag between the Statistics Denmark information (of end-November) and the financial report information. However, there are also companies that have chosen other dates, e.g. end of March, to close books. For these companies, the information from the Statistics Denmark registers comes with a time lag of up to one year.

[11] This will of course govern robustness checks of later findings. It might be noted that some of the companies that the Statistics Denmark data suggests are the 'real' hosts of the VP-projects do not fulfill the conditions for programme participation.

For one of the extensions of the analysis, DASTI provided data on companies that have participated in the so-called *Innovation Networks*. These networks are collaborations of typically small and medium-sized companies with the purpose of increasing knowledge transfer and innovation. The data on Innovation Networks consist of 1923 observations belonging to 1158 companies, the discrepancy owing to the fact that a number of companies participate in these networks more than once. We only consider the earliest participation in any of these networks for the following analysis.

Of the 1158 firms that participated in any of the networks, 1121 are found in the Experian data. The discrepancy must again be assumed to be a result of non-incorporated firms.

4. INDIVIDUAL-LEVEL ANALYSIS >

General methodological issues

The empirical analysis addresses the basic evaluation problem: What is the causal effect of participation in the programme on given outcome variables?

In accordance with the relevant econometrical literature, which again borrows from the biometrics and epidemiological literature, programme participants will subsequently also be referred to as treatments. Also, starting to participate in the programme will also be referred to as receiving a treatment. Non-participants who act as a control group for the statistical comparisons will be referred to as controls.[12]

There are different ways of addressing the evaluation problem. One way is using a linear regression model. This model is estimated on a sample of both participating and non-participating individuals. The linear regression model includes a set of conditioning variables which hold constant a set of observable characteristics and identifies causal effects under a *conditional independence assumption*, by which participants do – on average – not differ from non-participants in characteristics that (a) have an impact on the outcome variables and (b) are not controlled for in the regression model.

These characteristics, sometimes called 'omitted variables', prohibit interpreting treatment-control differences in outcome variables as causal programme effects. Instead, they offer alternative interpretations of latter results. And the above 'identifying' conditional independence assumption is equivalent to assuming that there exists no other explanation for treatment-control differences in the outcome variables than the fact that treatments have participated in the programme.

Obviously, any empirical model supposed to isolate programme effects needs to maximise the validity of this assumption. A first step in this direction is to carefully select a control group for the analysis by a *matching procedure*. These procedures are explained in greater detail in the following sections. The procedures select one (or more than one) 'twin' or 'match' for each treatment. They imply that controls are highly similar to treatments in their observable characteristics, which also increases the likelihood that treatments and controls are highly similar in their unobservable characteristics.

Also, the way the dependent 'outcome' variable enters the model has implications for the validity of the conditional independence assumption. For example, statistical comparisons of individual-specific before-after developments over time or fixed effects models will typically be preferred to cross-sectional comparisons.

And as noted earlier, a set of conditioning variables can control for any systematic differences between the treatment and control group which might remain even if the controls were selected in a way to make them as similar as possible to the treatments in their observable characteristics.

[12] The term 'controls' is also sometimes used for the conditioning variables in statistical models. In this report, 'controls' refers to subjects in a reference group and not conditioning variables.

Selection of controls

Obviously, the validity of any statistical comparison can be questioned if treatments (individuals or companies) systematically differ from the controls in characteristics that the subsequent regression model is unable to take fully into account. We want to select individuals into the control groups that are as similar as possible to the treatments in the most dimensions possible. The problem of finding 'good' matches is that there are no two absolutely identical individuals, so it should be acknowledged that any analysis that identifies controls on the basis of a matching procedure is nothing but a sophisticated comparison that requires additional all-else-equal assumptions for causal interpretation.

The controls can be selected by a host of different matching procedures developed over the last decades. Overviews of these procedures are found in *Caliendo and Kopeinig, 2008*, and *Blundell and Costa Dias, 2009*.[13] The basic idea is to find for each participant one or more 'twins' that are as similar to the given participant as possible, and to use these matches as the analysis' control group.

The specific matching procedure depends on the nature of the data. The modeller typically chooses between *matching on observables* and *propensity score matching*, or some combination of the two.

Matching on observables simply means that for each treatment, one or more 'twins' (referred to as matches in the following) are selected from the group of potential controls that have the same observable characteristics in a number of dimensions. For example, one could choose for each participating VP one control individual with the same education, gender, and stays in the same geographic region. For companies, one could select controls on the basis of industry, size, financial performance measures, and other characteristics.

When treatments are not particularly unique and there are a lot of potential candidates in the pool of potential controls, matching on observables might be the preferred choice. But, matching on observables runs into a *multidimensionality problem* when one uses too many observable characteristics as conditions in the procedure: It becomes impossible to find controls for all participants when they are required to be equal in too many dimensions.

Of course, one way of "solving" this problem would be to disregard a lot of information in the data and only require equality in a few observable characteristics. In this case one could, for each treatment, select one or more controls from the pool of potential controls that are equal in a few dimensions (or use the entire population of potential controls as controls and weigh them in the subsequent regressions).

[13] Blundell, R., Costa Dias, M., 2009. Alternative Approaches to Evaluation in Empirical Microeconomics. Journal of Human Resources 44(3., 565-640.

Caliendo, M., S. Kopeinig, 2008. Some Practical Guidance for the Implementation of Propensity Score Matching, Journal of Economic Surveys (2008) Vol. 22, No. 1, pp. 31–72.

Yet another option is to combine the benefits of the matching-on-observables-procedure with the benefits of the *propensity-score-matching-procedure*. The latter method has the benefit of allowing the use of vastly more information than the matching-on-observables method: It condensates all variables which might be considered relevant for the choice of programme participation into one single metric. This is simply the estimated predicted probability of programme participation, called the *propensity score*.[14] This way, it is possible to find matches that are most similar in terms of the propensity score instead of a set of observable characteristics.

The number of matches selected for each participant is set by the modeller, who faces a trade-off between bias and efficiency: By including many matches for each participant into the control group, the sample size is increased and the variance of the subsequent estimators is reduced. However, increasing the number of matches for each participant might lead to selecting subjects into the control group that are not very similar to the treatment. This decreases the validity of the conditional independence assumption. So there is a trade-off between the precision of the statistical estimates and minimizing the risk of matching participants with controls that differ in observed and unobserved characteristics.

Empirical specification

The empirical implementation is done in the following steps: (i) select a group of controls, (ii) specify the regression model.

For the individual-level analysis, the selection of controls is from the registers of Statistics Denmark, which contain information on the entire Danish population, and is carried out in three steps:

First, we adjust the sample of potential controls. This is achieved by deleting individuals with characteristics not found for any VP. For example, we drop individuals with educations that no single VP has taken, and younger than the youngest VP in our sample. The resulting data is referred to as the *adjusted individual-level sample*.

Second, we calculate a probability model for the likelihood of VP programme participation for any given individual. This model provides evidence of which individual characteristics are associated with programme participation, which might be interesting in its own right. It is also used to calculate the propensity score for each individual in the data and for each year, which is simply the predicted participation probability for the given individual in the given year.

[14] Rosenbaum, P.R., and D. Rubin (1983). The central role of the propensity score in observational studies for causal effects. Biometrika (1983) 70(1): 41-55.

The conditioning variables of the propensity score matching procedure are selected in cooperation with DASTI and include all variables potentially important for programme participation and available in the data. The list consists of factors such as demographic information (age, gender, marital status), information on education, including 15 education categories, whether the individual is currently in any education programme, the average grade of the final secondary education examination, and focus of secondary education electives (math, language). There are also occupational codes (17 categories including unemployment and leave), wage income (9 categories), labour market experience (5 categories), and geographical location of residence (9 categories).

For programme participants, these characteristics are collected for the year before treatment, called '*year 0*' or *t=0* in the following. This ensures that no information affected by treatment enters the propensity score model.

Finally, we apply a single nearest-matching procedure (by employing STATA Corp.'s psmatch2-command) on the basis of the probability model's predicted propensity scores (participation probabilities). In this procedure we also impose the condition that twins are exactly equal in terms of education (approximately 2,200 different categories in total and approximately 175 different categories for VPs), gender, occupation (11 categories) and highly similar in age. Again, all information entering the matching procedure is from the year prior to programme participation. We strive for minimum bias of the later estimators and choose only one control (instead of several controls) for each treatment.

For the following treatment-control analysis, it is necessary to define a year 0 (t=0) for controls just as has been done for treatments. This allows modelling the dynamics of potential treatment effects in association with programme participation. For controls, year 0 or t=0 is simply the year in which a given control is selected into the control group. This is the year in which the given individual is most similar to its twin in terms of observable characteristics and propensity score.

The following comparisons over time will be relative to year 0 instead of calendar time. E.g. for treatments, t=2 is two years after the year before treatment (i.e., one year after the start of programme treatment). For controls, t=2 is two years after being selected into the control group.

Individual-level analysis: the regression model

The individual-level analysis is carried out using separate multivariate regressions. We consider the following success parameters:

(a) Whether or not the individual is employed in *t=1, t=2, ..., t=5*, implemented by indicator (dummy) variables.

(b) The increase in wage income (salary) between year 0 and year *t=1, t=2, ..., t=5*.

The success parameters are regressed on a treatment dummy (taking the value 1 for treatments and 0 for controls) and the following conditioning variables: age, gender, experience, average grade of final secondary education (high school) examination, occupation in year 0, the sum of the Statistics Denmarks unemployment index (measuring the aggregated time an individual has been registered as being unemployed).

Individual-level analysis: descriptive statistics

394 individuals who have participated in the VP programme can be found in the Statistics Denmark registers. Of these, 364 can be associated with controls equal or similar in the dimensions described in the previous section. These 364 individuals form the basis for the subsequent analysis. TABLE 4.1 describes the adjusted individual-level sample (the total pool of available controls), the sample of VPs, and the samples of VPs and controls used for the subsequent analysis.[15]

[15] The variable on whether or not a person is in education at a given point in time is from Statistics Denmark's education registers, while the variable of having education as one's occupation is from Statistics Denmark's education occupation classifications (pstill). Individuals who work while studying are classified as under education in the education registers and as working in the occupation information.

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TABLE 4.1: Individual-level characteristics

	Adjusted sample excluding VPs (N = 1.018.245)		Treatment group (N=394)		Analysis sample, Treatments (N=364)		Analysis sample, Controls (N=364)	
Variable	Mean	Std. dev	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
General information								
Age (years)	37.176	11.358	34.226	9.380	34.162	9.426	34.110	9.627
Female	0.401	0.490	0.419	0.494	0.409	0.492	0.409	0.492
Experience (years, since 1980)	10.483	8.169	6.104	6.669	6.203	6.811	6.332	6.685
Average grade, secondary education (high school)	84.304	9.173	84.265	8.304	84.354	8.279	84.511	8.833
Average wage (DKK)	300574	199968	171721	207544	178437	212787	183930	197212
Years of registered unemployment	1.149	2.005	1.241	1.979	1.170	1.898	1.163	2.076
Married	0.487	0.500	0.411	0.493	0.429	0.496	0.412	0.493
In education	0.137	0.344	0.398	0.490	0.401	0.491	0.393	0.489
Post-secondary or tertiary education	0.588	0.492	0.807	0.395	0.805	0.397	0.805	0.397
Education: arts and humanities	0.142	0.349	0.183	0.387	0.181	0.386	0.181	0.386
Education: social sciences	0.273	0.445	0.274	0.447	0.288	0.454	0.288	0.454
Education: technical sciences	0.253	0.434	0.355	0.479	0.346	0.476	0.346	0.476
Secondary education, elective direction: no information	0.606	0.489	0.330	0.471	0.332	0.472	0.363	0.481
Secondary education, elective direction: general	0.193	0.395	0.231	0.422	0.231	0.422	0.187	0.390
Secondary education, elective direction: math	0.125	0.331	0.226	0.419	0.223	0.417	0.245	0.430
Secondary education, elective direction: languages	0.041	0.198	0.157	0.365	0.157	0.364	0.151	0.359

Region of residence								
Copenhagen	0.312	0.463	0.223	0.417	0.217	0.413	0.247	0.432
Zealand N	0.112	0.315	0.056	0.230	0.049	0.217	0.055	0.228
Zealand S	0.076	0.264	0.079	0.270	0.082	0.275	0.077	0.267
Funen, Bornholm	0.079	0.269	0.157	0.365	0.162	0.369	0.135	0.342
Jutland S	0.065	0.247	0.046	0.209	0.049	0.217	0.052	0.223
Jutland W	0.095	0.294	0.063	0.244	0.063	0.244	0.058	0.233
Jutland E	0.177	0.381	0.231	0.422	0.234	0.424	0.277	0.448
Jutland N	0.080	0.271	0.142	0.350	0.140	0.348	0.099	0.299
Region not specified	0.005	0.071	0.003	0.050	0.003	0.052		
Occupation (from Statistics Denmark's variable 'pstill')								
Self-employed	0.000	0.015	0.003	0.050				
Manager	0.031	0.173	0.025	0.157	0.025	0.156	0.025	0.156
Employee, high level	0.324	0.468	0.259	0.439	0.277	0.448	0.277	0.448
Employee, medium level	0.123	0.328	0.074	0.261	0.077	0.267	0.077	0.267
Employee, basis level	0.227	0.419	0.099	0.299	0.102	0.303	0.102	0.303
Employee, other	0.055	0.228	0.030	0.172	0.022	0.147	0.022	0.147
Employee, no further information	0.103	0.305	0.063	0.244	0.069	0.253	0.069	0.253

Unemployed	0.036	0.187	0.241	0.428	0.228	0.420	0.228	0.420
On parental leave	0.003	0.051	0.013	0.112	0.008	0.091	0.014	0.117
On sickness pay	0.001	0.036	0.005	0.071	0.005	0.074	0.003	0.052
Non-salaried worker	0.003	0.056	0.018	0.132	0.019	0.138	0.005	0.074
Education measure	0.007	0.082	0.030	0.172	0.027	0.164	0.038	0.193
In job market training	0.003	0.055	0.005	0.071	0.003	0.052	0.003	0.052
On social benefits ("revalidering")	0.001	0.035	0.003	0.050	0.003	0.052	0.005	0.074
Unknown	0.000	0.020	0.008	0.087	0.008	0.091	0.003	0.052
Outside labour force, other	0.015	0.122	0.033	0.179	0.036	0.186	0.038	0.193
In education	0.031	0.173	0.058	0.235	0.060	0.239	0.060	0.239
Year								
2005	0.436	0.496	0.234	0.424	0.225	0.418	0.225	0.418
2006	0.080	0.272	0.142	0.350	0.137	0.345	0.137	0.345
2007	0.082	0.274	0.152	0.360	0.148	0.356	0.148	0.356
2008	0.077	0.266	0.140	0.347	0.143	0.350	0.143	0.350
2009	0.122	0.327	0.152	0.360	0.162	0.369	0.162	0.369

We find that individuals who participate in the scheme are represented among all occupations, age groups and income levels. There is no gender bias in programme participation. However, many VPs are relatively young, are unemployed or recent higher education graduates, have sparse labour market experience and low income.

A more systematic way of describing the propensity of programme participation is to estimate a binary choice model. The results of this model (specified as a logit model) are shown in Table 4.2 which displays a selection of coefficient estimates. Note that this model is also the backbone of the matching procedure used to identify one matched control for each programme participant.

A look at the estimates of the individual-level logit model reveals that they by and large corroborate the findings of the mean comparisons of Table 4.2: Individuals participating in the programme are often relatively young, there are regional differences, they are not characterised by high or low secondary education grades, and they have high unemployment rates and low salary incomes. When controlling for these characteristics, labour market experience (as long as it is positive) does not come out as an important explanatory factor with regard to programme participation.

The matching procedure finds controls for 364 of the total 394 participants in the adjusted individual sample. The remaining 30 participants remain unmatched because no other individual in the adjusted individual sample (the total pool of available controls) could be found who was equal to these individuals in the dimensions of education, gender, occupation and age.

The matched sample of treatments and controls can be compared by referring to the right hand side columns of TABLE 4.1 and 4.2. We conclude that the matching procedure succeeded in finding a group of controls highly similar to the group of participants. This allows us to analyse treatment-control differences in the success factors associated with programme participation in the following section.

Tabel 4.2: Individual-level analysis. Logit estimation results. Dependent variable: Individual participates in the VP-programme in the following year. Selected coefficients.

	Adjusted sample		Sample of treatments and controls	
	N=1,018,245, LR chi2(78) =1129.19, Pseudo R2 = 0.1618		N=728, LR chi2(76)= 25,57, R2=0.026	
	Coeff.	Ste.	Coeff.	Ste.
General information				
Female	-0.122	0.114	-0.065	0.192
Married	-0.004	0.111	0.078	0.173
In education	-0.050	0.181	0.009	0.310
Age (in years, omitted: <25 years)				
(25-29)	0.750***	0.216	0.187	0.351
(30-34)	0.717***	0.256	0.304	0.427
(35-39)	0.611**	0.301	0.316	0.503
(40-44)	0.441	0.339	0.456	0.609
(45-49)	0.758**	0.352	0.548	0.617
(50+)	0.024	0.359	0.688	0.610
Region of residence (omitted: Copenhagen)				
Zealand N	0.325	0.243	0.142	0.406
Zealand S	1.446***	0.216	0.242	0.344
Funen, Bornholm	1.436***	0.171	0.372	0.273
Jutland S	1.018***	0.265	0.176	0.402
Jutland W	0.784***	0.233	0.298	0.386
Jutland E	0.775***	0.151	-0.063	0.237
Jutland N	1.269***	0.176	0.516	0.302
Region not specified	-0.079	1.007		

Secondary education final grade average (omitted group: unknown)				
(0-75)	0.064	0.205	0.281	0.324
(76-85)	0.242	0.163	0.308	0.257
(86-90)	-0.227	0.210	0.502	0.350
(90+)	0.011	0.190	0.332	0.301
Occupation (from Statistics Denmark's 'pstill' variable, omitted: pstill-category 12 ('VAT-payer'))				
Self-employed (pstill=14)	1.976*	1.051		
Manager	0.774	0.475	-0.047	0.794
Employee, high level	0.270	0.348	-0.090	0.557
Employee, medium level	0.159	0.384	-0.063	0.602
Employee, basis level	0.192	0.366	-0.040	0.597
Employee, other	0.702	0.438	-0.058	0.771
Employee, no further information	0.372	0.379	-0.016	0.621
Unemployed	1.998***	0.321	-0.160	0.541
On parental leave	1.219**	0.543	-0.604	0.923
On sickness pay	1.681**	0.773	0.474	1.367
Non-salaried worker	2.551***	0.487	0.804	0.981
Undergoing education measure	1.909***	0.418	-0.540	0.678
In job market training	2.808***	0.785	-0.265	1.582
On social benefits ("revalidering")	1.292	1.063	-0.949	1.410
Unknown (pstill=57)	2.645***	0.663	0.842	1.298
Outside labour force, other	0.876**	0.398	-0.311	0.633
In education	0.415	0.378	-0.095	0.606

Salary (omitted: no information)				
0-0.15% of sample mean	0.249	0.183	0.087	0.298
15-25% of sample mean	0.472**	0.219	0.265	0.352
25-50% of sample mean	0.275	0.201	-0.260	0.317
50-75% of sample mean	-0.828***	0.287	-0.033	0.450
75-100% of sample mean	-0.784***	0.275	0.105	0.446
100-125% of sample mean	-1.193***	0.287	-0.244	0.430
125-150% of sample mean	-1.379***	0.302	-0.115	0.444
150-200% of sample mean	-1.527***	0.313	0.027	0.480
200%+ of sample mean	-1.741***	0.408	-0.398	0.604

Notes: *, **, *** denote statistical significance at the 10, 5, and 1% level. Additional variables included in the regressions, but not presented in this table are: education (15 categories), experience (five categories), high school average grade (five categories), unemployment experience index (variable 'sumgrad', six categories).

Individual-level analysis: Results

This section presents treatment-control differences in the outcome variables wage income (Statistics Denmark variable *slon*) and employment (Statistics Denmark variable *pstill* with a value of less than *40*). Results are based on descriptive graphs and estimations with conditioning variables taking any remaining treatment-control differences into account. All conditioning variables are from t=0, i.e. they are collected in the year before treatment or, in the case of controls, the year of selection into the control group.

When interpreting results, it might be kept in mind that the available data suggest that long-term employment relationships for VPs in their hosting companies are not very common. For example, 69 VPs were hired in 2005 with the VP-company match confirmed by the Statistics Denmark data. Of these employment relationships, 53 (77 percent) were terminated within three years. For the employment relationships started in 2005 and 2006, 71 percent were terminated within two years.[16]

Potential employment effects

In the following, employment rates of VPs are compared with the employment rates of individuals in the control group. Employment is measured by the Statistics Denmark variable 'pstill' assuming a value of less than 40.[17] Note that this variable is conditioned on when controls were selected into the control group. As a consequence, employment rates are exactly equal for the two groups of individuals in year 0 (t=0).

[16] In this project's vintage of the Statistics Denmark data, the individual-company-match can only be followed until the year 2008, preventing us from following individual-company relationships over longer time periods or in more recent VP-projects.

[17] Individuals on leave are not counted as employed.

FIGURE 4.1: Share of treatments and controls in an employment relationship ('pstill'<40). By year after year 0 (on horizontal axis)

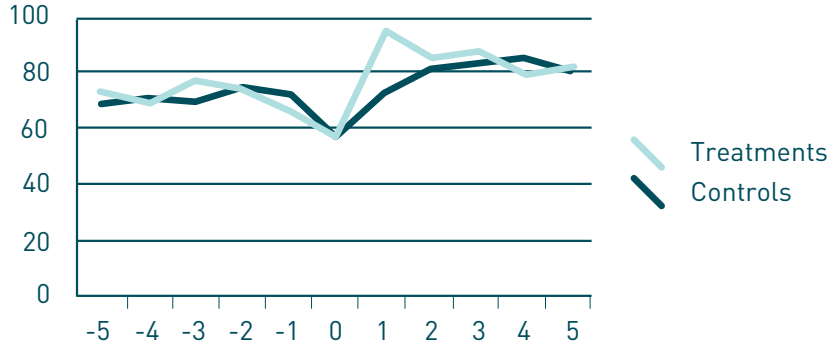
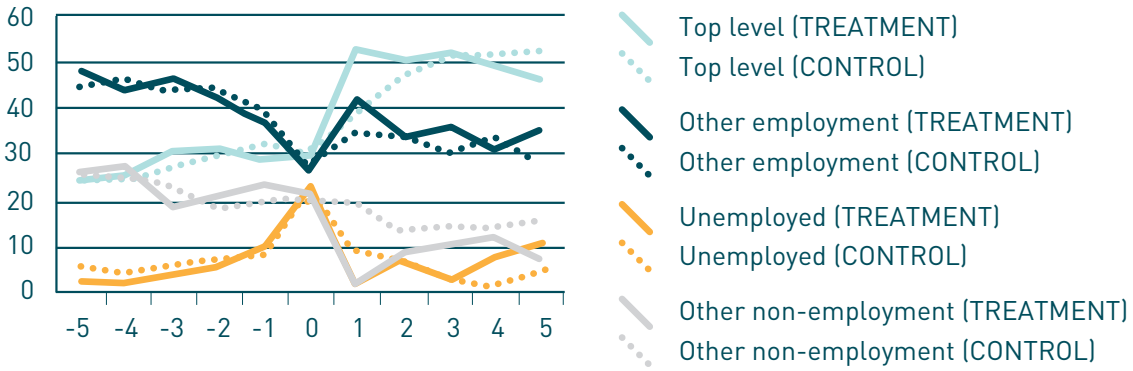


FIGURE 4.2: Share of treatments and controls, by occupation. By year after year 0 (on horizontal axis)



A first look at the data, see FIGURE 4.1, suggests that VPs are characterised by decreasing employment rates in the years before treatment. But in association with treatment, the employment rate increases to almost 100 percent. This is not surprising, since employment is a defining characteristic of the programme. This increase is not matched by the control group's development in year t=1. However, employment rates of the two groups converge over time and are at the same level two years after treatment.

FIGURE 4.2 splits up developments in occupation status by *top level employment (pstill<33), other employment (33<pstill<39), unemployment (pstill=40)*, and other *non-employment (pstill>40)*. Here, it is found that treatments and controls are characterised by highly similar developments in these variables in the years before year 0, suggesting that the matching procedure has been successful. The graph further suggests that in year 0, a number of individuals in the two groups are finishing education or have left employment in the year prior to treatment or being selected into the control group. After treatment, a large share of treatments are categorised as top level employees, while controls pick up and have the same shares of individuals in this category after approximately two to three years.

Employment probabilities are more formally analysed by means of simple binary choice logit models, with 'the individual is employed' at t=x, x=1,2...5 being the dependent variable, where t=0 is the year before treatment, t=1 is the year in which treatment takes place, etc. Estimation is by separate binary choice models for each t=x, x=1,2...5.

Table 4.3 displays the results. The coefficient of interest is the one associated with the treatment dummy 'Treatment=1".

We find a substantial potential programme effect on employment, as a coefficient of 2.361 implies an increase in the odds ratio of being employed by factor (exp(2.18)=) 10.5. This large increase comes as no surprise, given that employment is a defining characteristic of the programme, and given that we already had seen that employment is close to 100 percent for treatments in the year after the start of programme participation.[18]

Potential programme effects for the years following programme participation are a (exp(0.271)=) factor 1.3 increase in employment probability in year t=2, which is not significantly different from zero, and a factor 1.9 increase in year t=3, which just fails to be significant at the ten percent level. After more than three years after the start of participation, the signs of the coefficients switch around zero and become insignificant.

For the most part, the remaining variables come out as insignificant. The exception is low-wage individuals and individuals unemployed in year 0, who have the lowest probability of being employed in subsequent years.

We conclude that overall results indicate a presence of potential short-run employment effects and an absence of potential long-term effects of the programme. However, it should be noted that most of the observation period is from a boom period with high labour demand in the Danish economy. This implies that non-participants cannot be assumed to catch up to the same extent in current years compared to the analysis period.

[18] The numbers of observations of the estimations are reduced by the fact that some of the explanatory variables completely determine the outcome variables. As a robustness check, the models for employment and salary developments were estimated without explanatory variables. This did not change the overall results in any significant way.

TABLE 4.3: Logit binary choice model results. Dependent variable: The individual is employed in t=x.

	Dependent variable: The individual is employed in t=1		Dependent variable: The individual is employed in t=2	
	Coeff.	Ste.	Coeff.	Ste.
Treatment=1	2.365***	0.350	0.271	0.293
Age (years)	-0.0669**	0.030	-0.011	0.029
Female	-0.360	0.300	-0.399	0.308
Annual wage (DKK 1000)	0.004***	0.001	0.006***	0.002
(Years of unemployment up to t=0)*1000	50.480	74.080	-174.5**	78.900
Year of experience since 1980	0.000	0.037	-0.012	0.040
Married	0.300	0.318	0.257	0.349
Secondary education, no information	1.785	2.156	0.145	2.069
Secondary education, elective direction: math	-0.580	0.508	-0.390	0.605
Secondary education, elective direction: languages	-0.461	0.590	-1.380**	0.586
Secondary education: hf ("higher preparation")	0.309	0.706	-1.492**	0.682
Secondary education: average grade	0.028	0.026	0.017	0.025

Dependent variable: The individual is employed in t=3		Dependent variable: The individual is employed in t=4		Dependent variable: The individual is employed in t=5	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
0.577	0.354	-0.423	0.408	0.281	0.716
-0.031	0.036	-0.033	0.035	-0.104	0.120
-0.179	0.392	0.744	0.538	0.961	1.078
0.002	0.002	-0.001	0.002	0.007	0.004
-147.100	101.000	-114.500	96.880	-343.500	317.200
0.017	0.045	0.035	0.047	0.229*	0.135
-0.304	0.418	0.384	0.438	0.696	0.881
3.091	2.413	5.429*	2.910	7.224	6.034
0.837	0.753	0.010	0.782	2.769*	1.507
-0.977	0.667	-1.491*	0.837	1.392	1.025
0.725	1.207	-0.451	1.012	-0.051	1.343
0.042	0.029	0.0759**	0.038	0.043	0.071

Occupation				
Top level (pstill=31, 32, omitted category)				
Employee, medium level (pstill=34)	0.854	1.000	-1.268*	0.753
Employee, basic level (pstill 35)	-0.676	0.627	-0.788	0.578
Employee, other (pstill=36)				
Salaried employee, no further information (pstill=37)	-0.581	0.683	-0.429	0.647
Unemployed	-1.480***	0.531	-0.382	0.559
In education	-1.295*	0.696	-1.040	0.802
Self-employed				
On leave, and other non-employed	-1.137*	0.601	-0.415	0.655
Immigrant status: not an immigrant (omitted category)				
Immigrant status: first generation	-0.702	0.639	-0.099	0.616
Year: 2005	-0.071	0.397	0.396	0.398
Year: 2006	-0.375	0.489	0.766	0.513
Year: 2007	-0.655	0.477	-0.447	0.395
Year: 2008	-0.722	0.491		
Region: North Jutland	0.302	0.476	-0.149	0.414
Constant	1.967	2.369	1.701	2.341
Number of observations	568		486	
	596		492	
R-squared	0.28		0.37	

0.732	1.268	-0.348	0.888		
-0.466	0.662	-1.219	0.835	-2.046*	1.102
-0.110	0.765	0.094	1.078	0.476	1.728
-0.380	0.638	-0.805	0.743	-1.621	1.104
-0.392	1.233	-1.738	1.166		
-1.106	0.745	-0.892	0.915	0.618	1.723
-0.771	0.614	-0.101	0.904	-0.393	1.149
-0.065	0.461	-0.552	0.458		
-0.295	0.456				
-0.202	0.585	-1.178**	0.515	0.936	1.017
0.109	2.576	-1.334	2.900	-1.156	7.844
383		286		119	
386		293		129	
0.38		0.48		0.57	

Notes: *, **, *** denote statistical significance at the 10%, 5%, 1% significance level. All monetary values are CPI-adjusted to base year 2009.

Potential earnings effects

FIGURE 4.3 looks at the average salary developments (measured by the Statistics Denmark variable 'slon') of treatments and controls. We find that earnings profiles are highly similar for treatments and controls before year 0, and that VPs on average experience increasing salaries in association with programme participation. These increases are higher for treatments than controls. However, after two to three years after year 0, developments converge and individuals in the control group are doing as well as participants.[19]

A look at the dynamics of the salary distributions (instead of the means) in FIGURE 4.4 suggests that this increase is driven by VPs with low salaries in year 0. VPs in the bottom 25th percentile of the salary distribution in year 0 experience the largest salary increases in association with programme participation, which might be presumed to be a result of these individuals entering an employment relationship in association with the programme. On the other hand, there are fewer VPs with very high salaries after year 0 than is the case for controls.

[19] The estimations behind TABLE 4.3 are based on the total sample of treatments and controls except for individuals who experience extreme changes in their annual salaries (e.g. increases of more than DKK400,000 between year 0 and year 1 or more than DKK1,000,000 between year 0 and t=5). See TABLE 4.6 for results on a sample including these individuals.

FIGURE 4.3: Salary developments of treatments and controls, in DKK. Means. By years after year 0 (on horizontal axis)

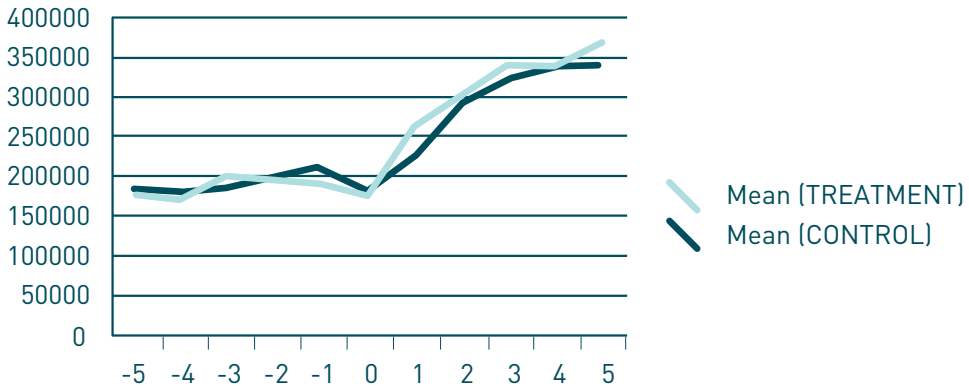
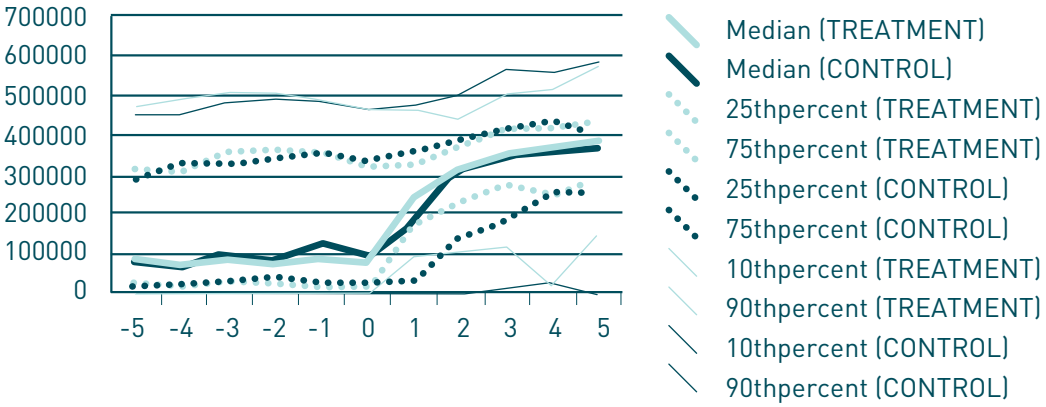


FIGURE 4.4: Salary developments of treatments and controls, in DKK. Distribution parameters. By year after year 0 (on horizontal axis)



The graphs suggest positive potential programme effects on salary in the years after treatment and an absence of long-run effects. TABLE 4.4 considers these potential effects in a more stringent way by means of a *conditional diff-in-diff* model. The parameters of interest are again those associated with the variable 'Treatment=1' that measures the potential programme effect on income for participating individuals.

TABLE 4.4: Linear regression results. Dependent variable: Salary ('slon') increase between t=0 and t=x, in DKK.

	Dependent variable: salary increase between t= 0 and t=1		Dependent variable: salary increase between t=0 and t=2	
	Coeff.	Ste.	Coeff.	Ste.
Treatment=1	56456***	8534	21773*	12193
Age	-2319**	942	-3131***	1156
Female	-18141*	10183	-16614	12261
Annual wage (DKK 1000)	-0.258***	0.04	-0.516***	0.05
(Years of unemployment before t=0)*1000	0.55	2.63	-10.52**	4.19
Years of experience since 1980	303	1308	4966***	1510
Married	2766	9953	11503	13036
Secondary education, no information	35814	53968	-38180	70676
Secondary education, elective direction: math	-9863	14459	-1468	20176
Secondary education, elective direction: languages	-17159	16908	-20279	21190
Secondary education: hf ("higher preparation")	-33721*	19976	-43647	28839
Secondary education: average grade	500	638	-329	855
Occupation				
Top level management (pstill=31, omitted category)				
Employee, high level (pstill=32)	-28418	35165	-88562**	37002
Employee, medium level (pstill=34)	-20162	36887	-120011***	41621

Dependent variable: salary increase between t=0 and t=3		Dependent variable: salary increase between t=0 and t=4		Dependent variable: salary increase between t=0 and t=5	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
25310*	14264	4721	18928	42096	34214
-5543***	1516	-6457***	2207	-8382**	3882
-33214**	15574	-41379**	19401	-43810	35452
-0.541***	0.06	-0.734***	0.10	-0.748***	0.19
-9.339*	5.61	-18.16**	7.54	-23.13*	12.00
5848***	2092	7111**	3105	6018	6024
489	15552	-34760	21773	-32646	32643
-106950	90991	36331	129246	-224476	224830
6464	22935	14275	28555	-10233	59345
-14886	29109	-31307	33005	-73838	67547
-16760	27138	-8739	24743	-6107	95472
-1126	1080	365	1447	-3405	2768
-58624	57540	-17487	58814	-46003	51369
-104792*	59370	-88445	67119	-334935***	57211

Employee, basic level (pstill=35)	-34889	38840	-111962***	41296
Employee, other (pstill=36)	-53589	40962	-179786***	49799
Salaried employee, no further information (pstill=37)	-59833	38815	-140168***	41893
Unemployed	-35792	38724	-91996**	43113
In education	-52257	38788	-157389***	47033
Self-employed	-98106**	43751	-216754***	60192
On leave, and other non-employed	-25577	40412	-64130	46789
Immigrant status: not an immigrant (omitted category)				
Immigrant status: first generation	-24764	20393	13383	25690
Immigrant status: second generation	18391	24869	106801***	20603
Year: 2005	28159**	12322	1196	13384
Year: 2006	24741*	14035	16645	16282
Year: 2007	41843***	14572	-8490	16329
Year: 2008	-15582	16977		
Region: North Jutland	-4876	14430	5762	15799
Constant	160822**	66487	432927***	86265
Number of observations	596		492	
R-squared	0.28		0.37	

-96960	61138	-93042	65682	-135173*	75067
-141922*	73440	-62744	73003	-116249*	61842
-98519	63464	-58705	70012	-82539	95957
-62057	62101	-76378	68055	-94949	73276
-77928	66937	-82241	73711	-92145	78694
-247578***	78454	-264535***	93911	-75841	78306
-15111	66071	28299	71073	-61067	87232
34296	28970	21333	42702	-16168	57123
39432	72979	-34498	99428	-141338*	73137
12203	16679	-23334	19795		
15943	19477				
-14781	22487	-2496	28343	-2139	43334
576595***	115808	552475***	148468	963247***	266452
386		293		129	
0.38		0.48		0.57	

Notes: *, **, *** denote statistical significance at the 10%, 5%, 1% significance level. All monetary values are CPI-adjusted to base year 2009.

Although potential employment effects are restricted to earlier employment for VPs, we find that potential salary effects are slightly more persistent, as coefficients come out statistically significant (albeit only at the ten percent level) for time leads of up to three years. TABLE 4.4 also allows calculating the total potential programme effect as the sum of the coefficient estimates. This is approximately DKK150,000 for the total sample of all treatments and controls, a number which might be related to the average cost of the programme.

Individual-level potential effects for different subsamples

As an extension of the previous analysis, the sample of VPs and associated controls is split up by a number of project-specific and VP-specific background characteristics. In particular, the following distinguishes between whether or not the VP-project was completed or terminated before schedule. The sample is also split up by the industrial sector of the companies that hire the VPs or the associated controls, and the education and gender of the VP and the associated controls.

Findings of the estimations on the subsamples are found in TABLE 4.5 for employment and 4.6 for salary increases. These tables are based on the same models that were estimated earlier, but only report the relevant coefficients associated with the treatment dummy variables.

It is found that that there is little heterogeneity in the estimated potential effects of the programme.[20] Only completed projects are associated with larger increases in employment. This indicates that uncompleted projects are not just aborted because of the VP moving to another employment relationship, but becoming unemployed. This is also reflected in the absence of any measurable potential salary effect for this group of individuals.

It is only possible to detect statistically significant potential employment effects in the year after treatment (t=2) for VPs with a technical sciences education. It is possible to detect positive potential salary effects in the years after treatment only for female VPs, VP-projects in 'other industries', and completed projects.

Although single coefficient estimates are in most cases not statistically significantly different from zero, the sum of the estimates of TABLE 4.6 are still the best guesses of any potential salary effects over the first five years after treatment. These potential effects are largest for female VPs and VPs who are employed in service industries, and lowest for VPs with degrees in arts and humanities or technical sciences, and VPs with a tertiary education.

[20] For a couple of estimations, not all coefficients could be estimated because of low variation in the data relative to the number of observations and the number of conditioning variables.

TABLE 4.5: Linear regression results. Dependent variable: The individual is employed in t=x. By subsamples. Results for treatment dummy variables

	Dependent variable: the individual is employed in t=1		Dependent variable: the individual is employed in t=2	
	Coeff.	Ste.	Coeff.	Ste.
All projects	2.365***	0.350	0.271	0.293
N	568		486	
Only completed projects	3.138***	0.471	0.507	0.346
N	449		377	
Only not completed projects	1.435	0.942	-0.358	0.810
N	99		87	
Manufacturing and construction			1.08	0.81
N			128	
Services			0.874	1.044
N			88	
Other industries			3.079*	1.864
N			122	
Males	2.371***	0.498	0.438	0.468
N	328		182	
Females	2.635***	0.551	0.072	0.439
N	212		213	
Tertiary-level education	2.264***	0.395	0.252	0.342
N	405		387	
Education in arts & humanities	2.008**	0.870	-0.086	0.786
N	116		98	
Education in social sciences	3.960**	1.935	-0.438	0.809
N	70		79	
Education in technical sciences	2.948***	0.717	1.182*	0.627
N	183		160	

Dependent variable: the individual is employed in t=3		Dependent variable: the individual is employed in t=4		Dependent variable: the individual is employed in t=5	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
0.577	0.354	-0.423	0.408	0.281	0.716
383		286		119	
1.019**	0.416	-0.423	0.460	-1.603	1.686
309		246		94	
1.45	0.98	-0.34	0.65		
115		94			
6.551	4.068	6.029***	2.109		
77		36			
0.796	1.150	-2.387*	1.390		
115		67			
0.160	0.502	-0.619	0.525	0.393	0.926
223		177		68	
1.406**	0.717	0.343	0.732		
131		89			
0.280	0.424	-0.451	0.485	-0.528	0.927
308		206		95	
1.108	1.292				
44					
-0.641	0.783	-1.234*	0.728		
108		99			

Notes: *, **, *** denote statistical significance at the 10%, 5%, 1% significance level.

TABLE 4.6: Linear regression results. Dependent variable: Salary ('slon') increase between t=0 and t=x, in DKK. By subsamples. Results for treatment dummy variables

	Dependent variable: salary increase between t=0 and t=1		Dependent variable: salary increase between t=0 and =2	
	Coeff.	Ste.	Coeff.	Ste.
All projects	56456***	8534	21773*	12193
N	596		492	
All projects, including outliers	48137***	9685	11877	13440
N	605		501	
Only completed projects	69542***	9659	33476**	13573
N	467		381	
Only not completed projects	8866	19561	-8478	29591
N	129		111	
Manufacturing and construction	23180	18829	14164	30675
N	136		125	
Services	67198***	17814	47811	30202
N	170		90	
Other industries	79337***	16158	69038***	22550
N	156		149	
Males	49065***	11794	11342	17030
N	349		277	
Females	63790***	13465	34185*	18891
N	247		215	
Tertiary-level education	55809***	9855	16325	14205
N	468		391	
Education in arts & humanities	43389*	22664	13979	30402
N	116		98	
Education in social sciences	44390**	18527	10731	30264
N	161		137	
Education in technical sciences	59315***	15017	5266	21677
N	205		168	

Dependent variable: salary increase between t=0 and t=3		Dependent variable: salary increase between t=0 and t=4		Dependent variable: salary increase between t=0 and t=5		Aggregated differences from t=1 to t=5
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	
25310*	14264	4721	18928	42096	34214	150356
386		293		129		
24982	15445	4721	18928	42096	34214	131813
393		293		129		
29125*	16547	9146	-21466	25853	39825	167142
311		248		106		
22334	33461	24120	56060	123197	103104	170039
75		45		23		
44672*	26317	11914	41021	19104	90804	113034
126		97		40		
-10601	38463	48873	39917	123624	135240	276905
89		64		26		
26789	25844	-7511	32362	13542	47681	181195
149		118		56		
19414	19759	-6218	26843	60274	53426	133877
232		181		79		
36790	22989	29105	28294	66325	44998	230195
154		112		50		
14992	16568	-7062	22172	20373	39581	100437
314		233		107		
-15664	43284	-53186	43560	-30421	169878	-41903
72		41		27		
3897	30019	4058	42777	61546	67346	124622
108		87		40		
12788	26287	-18634	34162	51668	87173	110403
144		115		45		

Notes: *, **, *** denote statistical significance at the 10%, 5%, 1% significance level. All monetary values are CPI-adjusted to base year 2009.

5. COMPANY-LEVEL ANALYSIS >

In the following, the setup and results of the company-level analysis are described. We briefly describe the model which aims at removing as much unobserved heterogeneity as possible from the statistical comparisons. We then take a look at the company-level data and inspect the sample for the subsequent analysis. Finally, we compare companies that participate (receive a *treatment*) in the programme ('*treatments*' or '*participants*' in the following) with highly similar companies that act as a control group. In particular, we compare developments in:

1. the number of highly educated employees
2. the number of employees
3. value added
4. net income (profit) and return on assets
5. average wage cost
6. labour productivity, measured as turnover per employee

The analysis addresses the question of how VP-companies perform in terms of these variables. This is answered by looking at the developments in these variables over time and comparing them to developments in a control group comprised of other, similar companies that do not participate in the VP programme.

It should be noted that the analysis of the number of (highly educated) employees, value added and net income gives highest weight to companies experiencing the largest changes in these variables. These are typically larger companies. For average wage cost, return on assets and labour productivity, companies are treated equally and, thus, higher weight is given to smaller companies.

Empirical specification

Company-level analysis: selection of controls

For the company-level analysis, the selection of controls is carried out in two steps. First, select a pool of potential controls in the Experian data. Second, apply a matching procedure.

Before applying the matching procedure, we go through the Experian data and exclude observations of companies in industries without participant companies, with ownership classifications where there are no participant companies, companies larger than 150 employees, and companies for which a set of additional conditions is not fulfilled.[21] The remaining sample is denoted the 'adjusted Experian sample'.

[21] These conditions are: equity being between DKK-20mio and 150mio., net income between DKK-20mio and 20mio., total assets between zero and DKK250 mio., short term debt between DKK15,000 and 70mio., an equity share between -2.5 and 0.9, return on assets between -1.2 and 1, the number of employees with at least a post-secondary education less than or equal to 25, the number of employees with a tertiary education less than or equal to 5, and firm age less than 150 years. Imposing these conditions does not affect the number of participants in the sample.

As a last step before the matching procedure, we exclude all observations of participants that do not belong to the last financial report before starting participation in a VP-project. We then estimate a binary choice model on the adjusted Experian sample which is used to predict a participation probability (a propensity score) for any given company for any given year in the reduced Experian population.

The population is then grouped by year and industry. Within each group, a matched twin is found for each participant company on the basis of the propensity score. This procedure ensures equality between the participants and controls in terms of the highly detailed industrial sector classification 'Dansk Branchekode' and timing.[22]

This procedure implies that we identify 316 control firms for 316 participants. These define the *analysis sample* of the study. The year in which a control company is selected is this company's year 0 (base year, t=0), which is the cut-off year for later before-after comparisons. For VP-companies, year 0 is simply the last year before participating in the programme.[23]

Company-level analysis: the empirical model

We chose a model with fully specified dynamics, which is highly similar to Kaiser and Kuhn, 2012.[24] This model is formulated as follows:

$$y_{i,t} - y_{i,t-1} = x_t + \sum_{n=1}^{5} \left(\alpha_n D\left(t_i = n\right) + \beta_n \left(D\left(treat_i = 1\right) \times D\left(t_i = n\right) \right) \right) + u_i + \varepsilon_{i,t}$$

where $y_{i,t}$ is the dependent variable, i is firm index, t is a time index, where $t=0$ is year 0, and x_t are year dummies to account for business cycle effects. The D are dummy variables assuming the value of 1 if the logical conditions in their brackets are fulfilled. This model is estimated subject to company-level fixed effects u_i and has statistical errors $\varepsilon_{i,t}$.

The α and β are estimation coefficients, where the β measures the potential treatment effects. Note that this model extends Kaiser and Kuhn's analysis by estimating post-year zero effects not just for participants but controls as well. These are measured by the coefficient vector α, while the vector β collects the conditional difference-in-difference estimators.[25]

[22] The observation period is characterised by considerable business cycle movements, which implies the need to match controls as exactly as possible with regard to the time when they are selected.

[23] To be specific, the base year of participants is defined by the closing date of the last financial report before the start of participation. This means the base year of participants is not necessarily the calender year before starting to participate in the programme.

[24] Kaiser, U., Kuhn, J.M., Long-run effects of public–private research joint ventures: The case of the Danish Innovation Consortia support scheme. Res. Policy (2012).

[25] Another minor extension is the clustering of statistical errors $\varepsilon_{i,t}$ within treatment-control twin pairs.

The fixed effects setup implies that all time-invariant factors drop out of the model, thus making the model robust to any omitted time-constant factors which might be correlated with the decision to participate in the programme. The set of dummy variables generates a difference-in-difference model setup, and the coefficients of the dummy variables in the vector β estimate the potential programme effect. Separate dummy variables for each year after the base year allow estimating the dynamics of the potential programme effect.[26]

Company-level analysis: descriptive statistics

Out of the 434 companies that have hosted VP-projects in the DASTI data, 370 can be found in the Experian data. The remaining 64 firms that cannot be found in these data are probably non-incorporated firms that are not obliged to publish their financial reports by submitting them to the Danish Business Authority. Of the firms found in the Experian data, 338 filed a report in the year prior to programme participation. Only these firms will be considered in the subsequent analysis comparing performance both before and after the start of participation.

When setting the sampling criteria for this analysis, we need to decide how to treat outliers (extreme observations). This decision trades off robustness of later results with their representativeness. In the following, we choose to describe results for 'typical' VP-companies and to not consider companies in the financial sector (reducing the sample by eleven companies) nor companies with ownership codes that only occur very rarely in the sample of VP-companies (reducing the sample by five companies).[27]

After deleting financial sector companies and companies with atypical ownership codes, we are left with 319 observations. Of these, 318 have started their project before 2011 and can be followed for at least one year in the Experian data.

The controls for the latter analysis are found in the adjusted Experian sample. In these data, there are 296,000 company-level observations in the period from 2004 onwards that are roughly similar to the participants in a few dimensions, e.g. industrial sector and number of employees. For 316 of the 318 VP-companies, the matching procedure succeeds in finding controls for the analysis.

Means and standard deviations of a set of characteristics of these companies are described in the first columns of TABLE 5.1. This table also shows the characteristics of the adjusted Experian sample – which was selected in order to roughly resemble the group of participants, and used for the estimation of propensity scores for the matching procedure. TABLE 5.1 allows comparing the 316 programme participants with the two Experian samples and the control group of companies selected by the matching procedure.

[26] Also note that taking first-differences in the outcome variables addresses any potential problems of serially correlated unobserved characteristics.

[27] For example, we drop co-operations (two occurrences), funds (one occurrence), companies with limited liability (one occurrence), and one company with an unidentified ownership code.

A look at the raw figures shows that VP-companies are distributed over most industries, with relatively large shares in trade (21 percent), consultancies (12 percent) and IT services (9 percent). These shares follow the industry distribution of the total sample of companies in the Experian database. However, VP-companies are underrepresented in construction and overrepresented in manufacturing, metal, construction, advertising and cleaning.

At first sight, the VP-companies look healthy: On average, they are slightly larger (mean 15 employees) than the average company in the Experian database (mean 11 employees) and have survived longer (15 years vs. 10 years). Many (42 percent) are registered as exporters in the Experian database, and almost 50 to 100 percent are owned by other companies, e.g. holding companies (compared to 34 percent for all companies in the Experian data). Also, 11 percent own other companies (compared to 5-6 percent of all companies).

When it comes to employee characteristics, it is found that VP companies have a relatively large share of employees with at least a secondary education and also an above-average share of employees with a post-secondary or tertiary-level education. They have a relatively low share of technically trained employees.

The fact that VP-companies are not fully representative companies implies that, if one aims at comparing these companies with other companies, one must carefully construct a control group of similar companies for the comparison.

A first step in this process is the estimation of a binary choice model to estimate propensity scores. This model is based on the 239,000 company observations in the adjusted Experian sample and the 318 participants in the year before treatment.

The results of the binary choice model (formulated as a logit model) are displayed in the left hand side columns of TABLE 5.2. Findings largely agree with what was seen in the mean comparisons: Companies are most likely to participate if they are not in the construction industry, are incorporated as joint stock companies, are relatively large, have high returns on assets and a relatively low equity share, a low average employee age, a high share of highly educated employees, and a low share of employees with primary school as their highest level of education. The VP programme is relatively popular in rural districts, with high propensity on the island of Funen and both Southern and Northern Jutland.

The results of the logit model allow us to calculate predicted participation probabilities (propensity scores). These are used to select a control group of companies for the subsequent treatment-control analysis.

>

TABLE 5.1: Means and standard deviations of key characteristics of company-level samples

	Summary of all firms, N =296,087		Summary of adjusted sample, N = 238.375		Summary of treatments in analysis sample, N = 316		Summary of controls in analysis sample, N = 316	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Industry								
Construction	0.13	0.34	0.15	0.36	0.06	0.23	0.05	0.22
Trade	0.18	0.39	0.19	0.39	0.21	0.41	0.21	0.41
IT, services	0.07	0.26	0.07	0.25	0.09	0.29	0.09	0.28
Manufacturing	0.01	0.10	0.01	0.11	0.06	0.24	0.06	0.24
Metal industries	0.02	0.14	0.02	0.15	0.05	0.22	0.03	0.18
Furniture and related industries	0.02	0.12	0.02	0.13	0.06	0.23	0.08	0.27
Travel agencies, cleaning services	0.02	0.13	0.02	0.13	0.03	0.18	0.04	0.20
Advertisement	0.03	0.16	0.03	0.16	0.06	0.24	0.07	0.25
Consulting, business services	0.13	0.34	0.13	0.34	0.12	0.32	0.12	0.33
Paper&publishing	0.01	0.11	0.01	0.11	0.03	0.18	0.02	0.15
Other	0.38	0.48	0.35	0.48	0.22	0.42	0.23	0.42
Key figures								
Number of employees	11.21	64.13	7.02	12.80	14.75	18.39	13.96	17.46
No number of employees information	0.28	0.45	0.23	0.42	0.03	0.18	0.02	0.15
Number of employees=0	0.13	0.34	0.11	0.31	0.01	0.11	0.02	0.14
Number of highly educated employees[1]	0.19	0.31	0.17	0.30	0.22	0.27	0.22	0.29
Value added (DKK1,000)	4713	39920	2903	5941	6483	8425	6279	8304
No value added information	0.12	0.32	0.08	0.27	0.01	0.11	0.03	0.16
Net income (profit, DKK1,000)	676	25560	302	1654	457	2165	567	2070
Return on assets	-0.41	42.66	0.02	0.23	0.03	0.21	0.04	0.22

Notes: 1: "highly educated" refers to post-secondary education and tertiary-level education.

Wage cost per employee (DKK1,000)	410	1540	400	660	395	217	377	163
No wage cost per employee info.	0.43	0.49	0.37	0.48	0.09	0.29	0.09	0.28
Labour productivity (DKK1,000)	3096	97103	2623	65175	2056	5479	1867	2627
No labour prod. Info.	0.44	0.50	0.37	0.48	0.08	0.27	0.09	0.29
Total assets (DKK1 mio.)	17.07	219.76	7.79	16.29	13.06	20.31	13.05	21.51
Equity share	-1.23	99.71	0.28	0.38	0.22	0.35	0.23	0.34
Short term debt (DKK1,000)	7008	86627	3428	6928	6532	9240	6579	9931
Development in selected key figures (average annual increase in t=-3 to t=0)								
Number of employees	0.34	9.25	0.24	2.09	0.88	3.01	0.85	3.12
Number of highly educated employees	0.12	2.64	0.04	0.54	0.19	0.91	0.11	0.82
Value added (DKK1,000)	269	7602	154	1233	448	1876	506	1870
Net income (DKK1,000)	33.9	9435.8	2.1	860.6	-1.4	1412.6	89.0	995.0
Wage cost per employee (DKK1,000)	-4.2	1567.3	-4.2	1529.4	2.6	161.3	-17.3	239.7
Labour productivity (DKK1,000)	94.0	40919.0	74.4	22814.4	-114.0	2694.0	-721.3	11055.9
Year								
2005	0.11	0.31	0.11	0.32	0.24	0.43	0.24	0.43
2006	0.16	0.36	0.16	0.37	0.15	0.35	0.15	0.35
2007	0.18	0.39	0.18	0.39	0.15	0.36	0.15	0.36
2008	0.21	0.41	0.20	0.40	0.15	0.36	0.15	0.36
2009	0.23	0.42	0.22	0.41	0.16	0.37	0.16	0.37
Company age and ownership information								
Ownership code: joint stock	0.27	0.44	0.44	0.44	0.52	0.50	0.53	0.50
Company age	10.45	21.80	21.80	13.45	15.10	19.87	13.94	16.32
Company has mother company	0.34	0.47	0.47	0.48	0.48	0.50	0.49	0.50
Company is mother company	0.06	0.24	0.24	0.23	0.11	0.31	0.09	0.29
Company is exporter	0.12	0.32	0.32	0.32	0.42	0.49	0.39	0.49

Region								
Zealand N, Copenhagen	0.24	0.43	0.23	0.42	0.14	0.35	0.19	0.39
Zealand S	0.09	0.28	0.09	0.28	0.04	0.19	0.04	0.19
Funen, Bornholm	0.11	0.31	0.12	0.32	0.15	0.35	0.16	0.37
Jutland S	0.07	0.26	0.07	0.26	0.11	0.32	0.07	0.25
Jutland W	0.09	0.29	0.10	0.30	0.11	0.32	0.11	0.32
Jutland E	0.09	0.28	0.09	0.29	0.10	0.30	0.07	0.26
Jutland N	0.16	0.37	0.16	0.37	0.18	0.38	0.18	0.38
Region not specified, overseas departments	0.08	0.27	0.08	0.27	0.11	0.31	0.10	0.31
Employee characteristics								
Company: mean employee age (years)	40.1	9.6	40.0	9.5	37.5	6.6	37.6	7.1
Company: share of employees that is female	0.26	0.29	0.25	0.29	0.30	0.26	0.27	0.26
Company: share with a secondary education	0.26	0.34	0.24	0.33	0.31	0.28	0.30	0.32
Company: share with a post-secondary education	0.19	0.31	0.17	0.30	0.22	0.27	0.22	0.29
Company: share with a tertiary education	0.08	0.21	0.07	0.20				
Company: share social sciences	0.26	0.32	0.26	0.32	0.29	0.25	0.29	0.29
Company: share arts & humanities	0.03	0.12	0.03	0.12	0.05	0.14	0.05	0.14
Company: share technical sciences	0.35	0.35	0.35	0.35	0.30	0.28	0.32	0.33

TABLE 5.2: Company-level analysis. Logit estimation results. Dependent variable: The company participates in the VP-programme in the following year

	Adjusted sample N = 238,693		Treatments and controls sample N = 632	
	Mean	Std. Dev	Mean	Std. Dev
Industry				
Construction	-0.85***	0.28	0.46	0.46
Trade	-0.31*	0.19	0.02	0.28
IT, services	-0.16	0.25	0.28	0.40
Manufacturing	0.90***	0.28	0.23	0.41
Metal industries	0.16	0.30	0.66	0.47
Furniture and related industries	0.55*	0.28	-0.27	0.40
Travel agencies, cleaning services	0.48	0.34	-0.31	0.51
Advertisement	0.28	0.28	-0.08	0.42
Consulting, business services	-0.19	0.24	0.13	0.36
Paper&publishing	0.19	0.36	0.34	0.58
Other (omitted category)				

Key figures				
Number of employees	0.04***	0.01	0.00	0.02
Number of employees^2	0.00***	0.00	0.00	0.00
No employees information	-0.79	0.74	1.37	1.22
Number of employees=0	-1.18*	0.69	0.40	1.04
Value added (DKK 1 mio)	-0.01	0.02	0.02	0.03
No value added information	-0.70	0.63	-0.81	0.95
Net income (DKK 1 mio)	-0.04	0.04	-0.04	0.07
Return on assets	0.64**	0.32	0.32	0.53
Wage cost per employee (DKK1,000)	0.00	0.00	0.00	0.00
No wage cost per employee info.	0.74	0.48	0.02	0.93
Labour productivity (DKK1,000)	0.00	0.00	0.00	0.00
No labour prod. info.	-0.41	0.50	-1.16	0.78
Total assets (DKK 1 mio)	0.01	0.01	0.01	0.02
Total assets (DKK1,000)^2	0.00	0.00	0.00	0.00
Equity share	-0.57***	0.17	-0.35	0.33
Short term debt (DKK1,000)	0.00	0.00	0.00	0.00
Development in selected key figures (average annual increase in t=-3 to t=0)				
Number of employees	0.03	0.03	0.03	0.05
Number of employees, missing obs.	0.15	0.61	0.14	1.04
Number of highly educated employees	0.09	0.08	0.12	0.12
Number of highly educated employees, missing obs.	0.04	0.85	0.47	1.26
Value added (DKK 1 mio)	0.03	0.05	-0.06	0.09
Value added, missing obs.	0.17	0.42	-0.02	0.76
Net income (DKK 1 mio)	-0.03	0.08	0.00	0.11
Wage cost per employee (DKK1,000)	0.00	0.00	0.00	0.00
Wage cost per employee, missing obs.	0.74	0.48	0.02	0.93

Labour productivity (DKK 1 mio)	0.00	0.01	0.01	0.02
Labour productivity, missing obs.	1.49***	0.45	0.56	0.71
Year				
2005	0.53***	0.19	-0.06	0.29
2006	-0.27	0.21	-0.19	0.33
2007	-0.33	0.21	-0.10	0.32
2008	-0.34*	0.21	-0.22	0.34
2009	-0.23	0.20	-0.25	0.32
Company age and ownership information				
Ownership code: joint stock	0.30**	0.14	-0.13	0.21
Company age	0.00	0.01	-0.01	0.01
Company age^2	0.00	0.00	0.00	0.00
Company has mother company	0.06	0.12	-0.07	0.19
Company is mother company	0.18	0.19	0.23	0.31
Company is exporter	0.99***	0.14	0.12	0.20
Region (omitted category: Copenhagen)				
Zealand N	-0.24	0.27	-0.42	0.40
Zealand S	-0.44	0.38	-0.05	0.56
Funen, Bornholm	0.79***	0.28	-0.06	0.43
Jutland S	0.72**	0.29	0.64	0.46
Jutland W	0.41	0.29	0.14	0.44
Jutland E	0.23	0.30	0.44	0.46
Jutland N	0.34	0.27	0.06	0.40
Region not specified, overseas departments	0.67**	0.29	0.26	0.45

Employee characteristics				
Company: mean employee age (years)	-0.04***	0.01	0.00	0.01
Company: share of employees that is female	0.00	0.24	0.25	0.42
Company: share with a secondary education	0.16	0.38	0.03	0.64
Company: share with a post-secondary education	-0.53	0.41	-0.21	0.69
Company: share with a tertiary education	-0.67	0.41	0.49	0.70
Company: share social sciences	-0.08	0.31	0.04	0.55
Company: share technical sciences	-0.73**	0.35	-0.45	0.60

Before turning to the analysis, we need to establish an idea of just 'how similar' the groups of matched treatments and controls really are. Accordingly, we will compare the two groups of companies as follows:

First, we run a very simple test of the similarity of observable characteristics of the two groups of companies and estimate the same logit model as earlier, but this time on the matched treatment-control sample. The results of this exercise are displayed in the right hand side columns of TABLE 5.2. We find that all coefficients have decreased in absolute size and come out as insignificant, indicating an absence of considerable differences in these variables across the two groups of companies.

Second, we look at the similarity of the two groups of companies in the matched treatments-controls sample by simply comparing the means of observable characteristics of the two groups, displayed in the two right hand side columns of TABLE 5.1.

Inspection of TABLE 5.1 suggests that the matching procedure succeeded in finding matched twin companies that highly resemble the group of treatments in the year before treatment. Differences between the groups are typically one order of magnitude smaller than the corresponding standard deviations, implying that none of the differences are statistically different from zero.

So: If the VP programme significantly increases the performance variables of the analysis, we should be able to see this by higher growth in the performance variables after treatment than before treatment, and a greater growth increase around year 0 for treatments than for controls. This will be tested in the next section.

Company-level analysis: Results

In the following, developments in a number of performance variables for companies that have participated in the VP programme are compared with the group of controls selected by the matching procedure. These variables are: the number of highly educated employees (i.e. employees with an education at a post-secondary or tertiary level), the number of employees, value added, profits, return on assets, wage costs per employee, and labour productivity.

TABLE 5.4 displays the results of the *conditional diff-in-diff* model with company *fixed effects*. The coefficients *'TREAT=1 & t=1', 'TREAT=1 & t=2',..., 'TREAT=1 & t=5'* correspond to the potential treatment effect estimates β_n while the coefficients of 't+1', 't+2', etc. correspond to the α_n of the conditional diff-in-diff model described in the previous section. The results are based on the approximately 300 programme participants and the same number of associated control companies. But only companies that participated early in the programme can be observed after the very first years after treatment, so results for more than a few years after year 0 are based on a substantially reduced number of observations.

Before we look at the specific findings, it is necessary to consider how to treat outliers. We have to do with company level data which by its very nature is highly heterogenous, and the treatment of outliers is important to later results.[28]

TABLE 5.4 is based on VP-companies and companies in the control group with at most 50 employees that do not experience large year-to-year changes in their numbers of employees, as well as regression-specific conditions imposed to further reduce unobserved heterogeneity. Obviously, the results of the analysis depend on these sampling conditions, and when interpreting later results one must be aware that the results are only valid for companies that fulfil the conditions. In subsequent robustness checks, these conditions are relaxed.

The results of TABLE 5.4 are summarized in the following sections.

[28] Although there is a lot of background information in the data, we are unable to offer explanations (and, thus, cannot control for) for a large amount of heterogeneity in the data. Clearly, we do not want to base overall results of the analysis on single observations with extreme values - especially when it cannot be ruled out that these values are statistical noise (e.g. due to company mergers or organisational restructuring).

TABLE 5.4: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.458***	0.12	0.596**	0.30	219.3	217.2
Treat=1 & t=2	0.318**	0.14	0.00	0.34	374.1	239.6
Treat=1 & t=3	0.01	0.17	0.33	0.40	165.2	324.4
Treat=1 & t=4	-0.14	0.21	-0.45	0.60	124.0	448.2
Treat=1 & t=5	-0.22	0.26	-0.69	0.65	-563.1	580.3
t=1	-0.03	0.10	0.00	0.24	-20.5	194.5
t=2	-0.05	0.13	-0.15	0.32	-268.9	233.5
t=3	-0.14	0.17	-0.33	0.41	-10.5	324.3
t=4	-0.09	0.20	-0.11	0.56	243.0	393.0
t=5	0.02	0.25	0.86	0.59	468.9	528.6
Year dummies						
2003	0.01	0.12	0.00	0.24	-298.1	217.1
2004	0.06	0.11	0.36	0.28	308.3	221.5
2005	0.01	0.10	0.36	0.29	156.1	210.2
2006	0.01	0.12	0.43	0.34	348.7	243.1
2007	0.01	0.15	0.37	0.36	277.8	280.0
2008	-0.13	0.17	0.24	0.43	-285.7	309.8
2009	-0.14	0.20	-1.477***	0.50	-810.8**	370.5
Constant	0.12	0.09	0.34	0.25	240.8	187.6
Number of observations:	2609		2727		2611	
Number of companies:	535		546		533	
R-squared	0.03		0.08		0.04	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-48.5	95.2	-0.03	0.02	8.28	11.26	-27.92	93.59
136.5	111.4	-0.04	0.03	5.25	10.27	57.28	107.90
133.3	122.1	0.00	0.03	-21.34	13.79	-137.30	91.84
205.5	218.1	-0.04	0.04	16.06	17.18	-39.23	134.00
-103.5	189.2	-0.04	0.06	-19.32	29.92	-159.70	215.30
24.2	87.2	-0.01	0.02	-13.08	11.55	-36.00	87.17
-125.6	104.2	-0.03	0.03	1.67	11.32	88.66	91.22
38.2	129.0	-0.03	0.03	10.89	15.10	108.40	97.51
14.1	199.6	-0.02	0.04	-0.61	20.35	24.21	117.90
190.1	220.3	-0.07	0.05	2.41	27.05	97.65	203.20
-96.4	90.3	-0.0426*	0.02	16.90***	6.23	-141.0*	72.66
44.5	86.6	0.01	0.02	8.99	7.21	-34.30	58.79
65.2	84.0	0.01	0.02	8.00	7.97	-28.89	74.78
2.2	95.6	0.01	0.03	10.54	8.97	48.53	90.79
24.5	113.5	0.02	0.03	13.41	13.39	-65.07	96.66
-191.8	130.1	-0.02	0.03	4.35	15.66	-180.4*	108.80
-362.4**	159.9	-0.01	0.04	8.81	18.74	-90.63	122.50
78.7	70.7	0.01	0.02	-1.77	5.88	60.65	59.57
2553		2669		1494		1693	
542		544		346		323	
0.03		0.02		0.01		0.02	

2. Only observations with annual change in the value added by less than DKK 10 mio.
3. Only observations with annual change in net income by less than DKK 3 mio.
4. Only observations with annual change in return on assets by less than 1, and total assets > DKK100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

Potential employment effects

A first question addressed in the empirical analysis is whether companies participating in the programme do indeed increase the number of highly educated employees (employees with an education level categorised as at least 'post-secondary-non-tertiary and tertiary', ISCED 4-8) relative to companies in the control group.

TABLE 5.5.a: Potential effects on the number of highly educated employees. Further results

	Ordinary least squares regression		Firm fixed-effects model		Conditional diff-in-diff model	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.445***	0.109	0.436***	0.146	0.458***	0.115
Treat=1 & t=2	0.286**	0.108	0.413**	0.176	0.318**	0.143
Treat=1 & t=3	-0.118	0.113	0.097	0.233	0.005	0.169
Treat=1 & t=4	-0.241	0.124	0.092	0.300	-0.143	0.205
Treat=1 & t=5	-0.269	0.201	0.214	0.394	-0.221	0.257
Includes firm-fixed effects	no		yes		yes	
Includes year dummy variables	no		yes		yes	
Includes information from before year zero	no		yes		yes	
Includes observations of the control group	no		no		yes	
Number of observations:	631		1354		2609	
Number of companies:	274		274		535	
R2:	0.05		0.02		0.03	

Notes: Highly educated employees are employees with a post-secondary or tertiary-level education. Only observations with annual changes in the number of employees with a post-secondary and tertiary education < 5. Only observations with annual changes in the number of employees of less than 12.

*, **, *** denote statistical significance at the 10%, 5%, and 1% level.

The coefficients of a simple ordinary least squares regression, which are equivalent to the population means and found in the leftmost columns of TABLE 5.5.a, imply that participating companies increase their number of highly educated employees by (0.445+0.286=) 0.7 employees in the first two years after start of participation.

The results of a company fixed effects model, which implements a before-after comparison for programme participants, are presented in the middle columns of TABLE 5.5.a. The similarity of this model's results and the results of the simple ordinary least squares regression implies that the earlier finding of an increase in the number of highly educated employees in association with programme participation (the results of the full-fledged model of TABLE 5.4 are replicated on the right of TABLE 5.5.a) is not to be interpreted as a continuation of any before-participation growth trend.

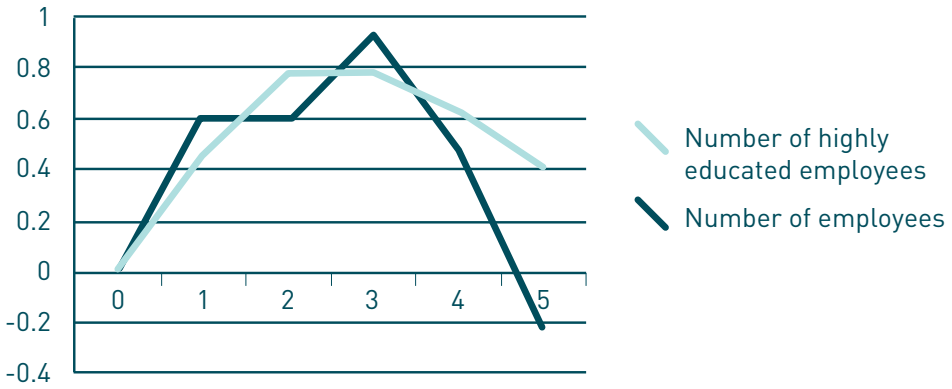
This allows the conclusion that the finding of positive potential programme effects with regard to highly educated employees is not just the result of the developments in (or the choice of) the group of control companies in the fully specified model behind TABLE 5.4. This observation, and non-positive coefficient estimates of the α_n-coefficient associated with *'t+1'*, *'t+2'* indicate an absence of behavioural additivity: Companies in the control group do not experience increases in the number of highly educated employees in the years after the selection into the control group.

Aggregated coefficients of the fully specified model are shown graphically in Figure 5.1.[29] Findings suggest that a participating company increases the number of highly educated employees by 0.46 additional individuals in the year of the treatment. The reason this number is not equal to 1.0 is that some of the projects (and associated employment relationships) last less than one year and have already been terminated before the census date of year 1. Also, as noted earlier, in some cases the information on highly educated employees is registered with time lags, if the data is from different sources (for instance, VP projects starting between the end of November and the closing date of the company's financial report). In these cases, potential effects occur between *t=0* and *t=2* instead of between *t=0* and *t=1*.[30]

[29] Figure 5.1 (just like the figures to follow in the next subsections) presents aggregated estimated treatment coefficients β_n. These measure the average deviation of the developments of treatment companies after treatment from the developments of the control group and the (company-specific) developments before treatment.

[30] The variable 'number of highly educated employees' is constructed from information from Statistics Denmark. This information can be a couple of months older than the closing date of the given company's financial report, which sets the time structure of the analysis. For example, VPs hired between Statistics Denmark's closing date at the end of November and the end of March will, in companies closing their books at the end of March, first occur in the data in the following year.

FIGURE 5.1: Number of employees. Aggregated estimated model coefficients. Years after treatment on horisontal axis.



As with the individual-level analysis, the coefficient estimates *'TREAT=1 & t=1', 'TREAT=1 & t=2',..., 'TREAT=1 & t=5'* can be summed up to calculate the total potential effect up to five years after treatment. This potential effect is an additional *(0.46+0.32=) 0.78* individuals in the first two years and an additional *(0.46+0.32+0.00-0.14-0.22 =) 0.42* individuals in the first five years after treatment.[31]

Accordingly, a first conclusion is that VP-companies on average increase the number of employees with a post-secondary education and above by an additional *0.8* employees in association with programme participation. However, there are no indications that participating companies continue to increase their number of employees in the years after programme participation: They have, on average, lower increases (greater declines) in the number of highly educated employees than companies in the reference group in year four and five after year zero, but this finding is not statistically significant.

Results for employment (independent of educational level) indicate that there is an immediate potential effect of *0.6* additional employees in the year of treatment, which is slightly larger than the potential effect found for highly educated employees. This indicates that VPs are often hired in association with company growth, or that some of the VPs are categorised as having an education below ISCED 5 or 6 in the Statistics Denmark education registers.

[31] These numbers are high in comparison with the previous finding that long-term relationships between VPs and their hosting companies are relatively uncommon, suggesting that VPs are replaced by other highly educated individuals after the end of their projects.

As is the case for highly educated employees, there is no sign that participating companies continue to increase the number of employees in the years after programme participation, with negative coefficients for year 4 and 5 after treatment resulting in an aggregate potential treatment effect over the first five years of -0.2 additional employees. Even though this number is not statistically different from zero, it is still the best guess of any long-run treatment effect of the programme.

TABLE 5.5.b: Potential effects on the number of employees. Further results

	Ordinary least squares regression		Firm fixed-effects model		Conditional diff-in-diff model		Conditional diff-in-diff model, dependent variable: annual employment growth in percent[1]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	1.164***	0.175	0.642**	0.278	0.596*	0.296	8.834***	2.929
Treat=1 & t=2	0.237	0.241	-0.118	0.411	0.001	0.335	1.517	2.934
Treat=1 & t=3	0.215	0.280	0.004	0.520	0.331	0.400	0.812	3.152
Treat=1 & t=4	-0.896**	0.383	-0.448	0.651	-0.446	0.596	-1.618	4.058
Treat=1 & t=5	-1.168***	0.421	0.436	0.789	-0.694	0.646	-5.425	6.459
Includes firm-fixed effects	no		yes		yes		yes	
Includes year dummy variables	no		yes		yes		yes	
Includes information from before year zero	no		yes		yes		yes	
Includes observations of the control group	no		no		yes		yes	
Number of observations:	650		1399		2727		2520	
Number of companies:	274		278		546		525	
R2:	0.07		0.08		0.08		0.07	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% signficance level.

1: Only observations with annual growth between -50 and 100 percent.

We are again interested in whether or not the results regarding the potential employment effects are because of higher growth in treatment companies after participation relative to before participation, or if the results are due to control companies having lower growth after year zero relative to before when compared to the treatment companies. For employment developments, we find again that the overall results do not depend on the choice of the control group, as the before-after comparison of the fixed effects model (on the subpopulation of treatment companies) gives estimators that are highly similar to the fully specified model.

Also, we are interested in learning how much the previous results depend on measuring employment growth as either absolute increases or percentage-point growth. Investigating absolute annual increases is the first choice for simple-to-implement cost-benefit calculations, but this also implies that smaller companies with small absolute changes in the performance parameters are given low weight in the statistical estimations.

When considering percentage-point employment growth, we find again a statistically highly significant positive potential employment effect in the years around treatment, suggesting that treatment companies grow by an additional 10 percent in the first two years after treatment. But also in this alternative model, there is no indication that treatment companies continue to increase their number of employees in year 4 and 5 after treatment.[32]

Potential effects on value added, net income (profits) and return on assets

We now turn to the financial performance variables. The results for these variables need to be interpreted with care, since they depend critically on the treatment of data - first and foremost the definition and treatment of outliers, i.e. companies experiencing large changes in the performance variables.

For the specific treatments of outliers and the given modelling choices, we find mostly positive, albeit statistically insignificant potential treatment effects for both value added[33] and net income (profits). Findings of TABLE 5.4 are depicted in FIGURE 5.2 and show that participating companies gained up to an additional DKK800,000 (EUR106,000) in annual value added and DKK400,000 (EUR53,000) in net income. But given the lack of statistical significance, these results should be interpreted as highly tentative.

[32] We will also present results for percentage-point growth rates for some of the other success parameters: gross profit, average wages, and labour productivity. There will be no such regressions for the performance measures number of highly educated employees, net income and return on assets, because these measures often assume the value zero or negative values – which implies that growth rates cannot be calculated.

[33] This variable is from the financial statements that companies file with the public authority, where it is called dækningsbidrag/bruttofortjeneste.

FIGURE 5.2: Gross profit and net income (DKK1,000) developments in small steady-going companies. Aggregated estimated model coefficients. Years after treatment on horisontal axis.

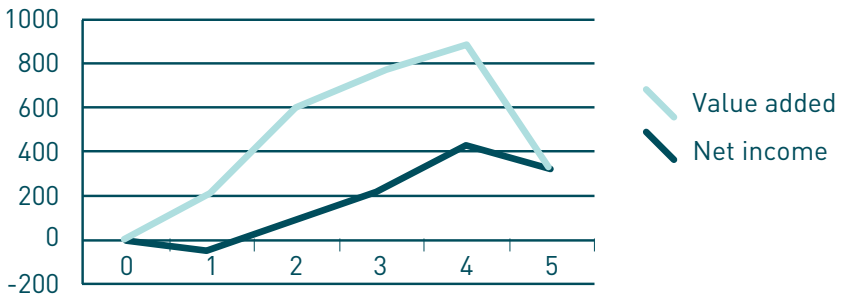
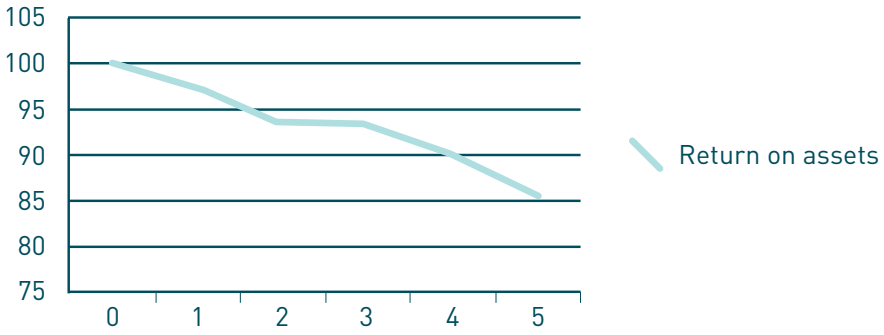


FIGURE 5.3: Return on assets developments (in percent) in small steady-going companies. Aggregated estimated model coefficients. Years after treatment on horisontal axis.



We also take a look at developments in return on assets, calculated as net income over total assets. The reasoning is that we have already looked at company growth variables, such as the number of employees and increases in value added, and that return on assets is largely independent of company size (which is obviously not the case for net income).

Cf. FIGURE 5.3, we find that companies that hire VPs on average do worse in terms of return on assets relative to companies in the control group of highly similar companies, but that coefficients are statistically insignificant.

TABLES 5.5.c-d further expand on the findings for value added, net income, and return on assets.

A look at the left hand side coefficients of TABLE 5.5.c suggests that value added developments are on average positive for treatment companies in the first three years after treatment, and negative more than three years after treatment. Part of the increases in the first years after treatment can be interpreted as a continuation of pre-treatment growth developments, as coefficients drop from DKK 421,702 to DKK 260,056 when controlling for company fixed effects. Controlling for developments in highly similar control companies, on the other hand, does not change the general picture, so the selection of the control group does not appear to be important to the overall result.

Also, for given sampling criteria, the previous (statistically insignificant) finding that treatment companies on average have higher value added growth is confirmed by the regression of percentage point value added growth. This regression even suggests the presence of positive and statistically significant potential effects for year two and four after treatment. The findings of a lack of significance for the model of absolute value added increases and the presence of significance for the growth rate model lends itself to the interpretation that companies with initially low value added gain the most in association with programme participation.

Turning to net income increases, we find that there is large heterogeneity in this variable, and as a consequence no statistically significant potential treatment effects can be detected for any of the different models. On average, absolute net income growth is negative for treatment companies after treatment. This can be explained by generally adverse business developments and company-specific time trends, as controlling with year dummies and for company-fixed effects in the regressions reverses the sign of the point estimates, making them positive. Again, taking into account the developments in the control group does not have any major impact on the overall results.

With regard to return on assets, it can be noted that the estimated coefficients are typically significantly negative in the pure before-after comparison of the company-fixed effects model: Treatment companies experience lower increases in return-on-assets after treatment relative to before treatment. This finding is not replicated in the fully specified conditional diff-in-diff model, where coefficients get closer to zero and are no longer statistically significant. This indicates that companies in the control group also experience adverse return-on-assets developments in the years after being chosen into the control group.

>

TABLE 5.5.c: Potential effects on value added (DKK1,000). Further results

	Ordinary least squares regression[1]		Firm fixed-effects model[1]		Conditional diff-in-diff model[1]		Conditional diff-in-diff model, dependent variable: annual value added growth in percent[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	421.702***	113.743	260.056	214.888	219.298	217.152	4.07	3.58
Treat=1 & t=2	239.746*	134.653	181.428	281.134	374.106	239.569	10.10**	4.30
Treat=1 & t=3	57.844	186.946	237.428	384.165	165.199	324.385	5.59	4.27
Treat=1 & t=4	-90.041	305.445	396.622	514.582	124.020	448.158	12.12**	5.18
Treat=1 & t=5	-884.891**	353.632	-72.243	630.232	-563.130	580.313	-2.81	7.20
Includes firm-fixed effects	no		yes		yes		yes	
Includes year dummy variables	no		yes		yes		yes	
Includes information from before year zero	no		yes		yes		yes	
Includes observations of the control group	no		no		yes		yes	
Number of observations:	620		1346		2611		2223	
Number of companies:	272		272		533		451	
R2:	0.03		0.02		0.03		0.03	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% level.

1: Only observations with annual change in value added of less than DKK 10 mio.
2: Only observations with annual growth between -50 and 100 percent.

>

TABLE 5.5.d: Potential effects on net income (DKK1,000). Further results

	Ordinary least squares regression		Firm fixed-effects model		Conditional diff-in-diff model	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	-48.481	48.225	6.965	98.949	-48.457	95.159
Treat=1 & t=2	-41.199	67.556	69.773	130.681	136.506	111.445
Treat=1 & t=3	51.065	81.233	229.337	166.055	133.285	122.101
Treat=1 & t=4	-36.775	126.978	262.090	227.975	205.536	218.128
Treat=1 & t=5	-277.485	152.530	171.135	267.157	-103.538	189.155
Includes firm-fixed effects	no		yes		yes	
Includes year dummy variables	no		yes		yes	
Includes information from before year zero	no		yes		yes	
Includes observations of the control group	no		no		yes	
Number of observations:	600		1322		2553	
Number of companies:	276		276		542	
R2:	0.03		0.02		0.02	

Notes: Only observations with annual changes in the number of employees of less than 12. Only observations with annual change in net income of less than DKK 3 mio.

>

TABLE 5.5.e: Potential effects on return on assets (profits over total assets). Further results

	Ordinary least squares regression		Firm fixed-effects model		Conditional diff-in-diff model	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	-0.027*	0.013	-0.038*	0.023	-0.029	0.023
Treat=1 & t=2	-0.039***	0.015	-0.066**	0.030	-0.036	0.026
Treat=1 & t=3	-0.017	0.021	-0.047	0.036	-0.001	0.028
Treat=1 & t=4	-0.036*	0.021	-0.082*	0.045	-0.036	0.039
Treat=1 & t=5	-0.099**	0.046	-0.141**	0.069	-0.042	0.060
Includes firm-fixed effects	no		yes		yes	
Includes year dummy variables	no		yes		yes	
Includes information from before year zero	no		yes		yes	
Includes observations of the control group	no		no		yes	
Number of observations:	630		1361		2669	
Number of companies:	277		277		544	
R2:	0.04		0.01		0.01	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% level.

Only observations with annual change in return on assets of less than 1, and total assets > DKK 100,000.

Potential effects on average wage costs and labour productivity

Results for average wage costs and labour productivity (measured as turnover per employee) are in the rightmost columns of TABLE 5.4, and illustrated in FIGURE 5.4.[34] With regard to the average wage costs per employee, it appears that any potential treatment effects are too small relative to the variation in the data and the number of observations. TABLE 5.5.f suggests that on average there are no substantial changes in wage cost per employee after treatment, a finding which is unaltered by the before-after comparisons for the subsample of treatment companies, or when considering growth rates rather than absolute changes.

[34] The variable ' wage cost per employee' is from the balance sheet information of the KOB/Experian database, and is characterised by a share of missing observations.

Labour productivity is measured as turnover per employee.[35] For absolute changes in labour productivity, it is not possible to demonstrate that VP-companies have higher productivity increases than the highly similar companies in the control group: Negative signs for t>2 indicate that VP-companies have lower increases than their counterparts in the reference group. However, this finding is not statistically significant and thus highly tentative. The picture also changes when we consider annual percentage-point growth in labour productivity rather than absolute annual increases: In this model specification, treatment companies generally outperform control companies in terms of labour productivity growth.

This finding – that treatment companies on average perform better than controls in terms of percentage-point growth and not significantly better in terms of absolute increases – implies that results are not robust with regard to model reformulation. This should advise us against drawing too strong conclusions on the basis of the statistical results. However, the fact that treatment companies seem to perform best when the performance is measured in percentage-point growth rather than absolute increases is an indication that it is in particular small companies that gain the most from programme participation.

[35] Turnover is from the Statistics Denmark registers instead of the Experian data. This is because (a) only companies above certain size thresholds are obliged to report this variable to the public authorities (which is why it is often missing in the Experian database) and (b) turnover is found for almost all companies in the Statistics Denmark registers (because VAT is registered for almost all companies).

FIGURE 5.4: Wage and labour productivity developments (DKK1,000). Aggregated estimated model coefficients. Years after treatment on horisontal axis.

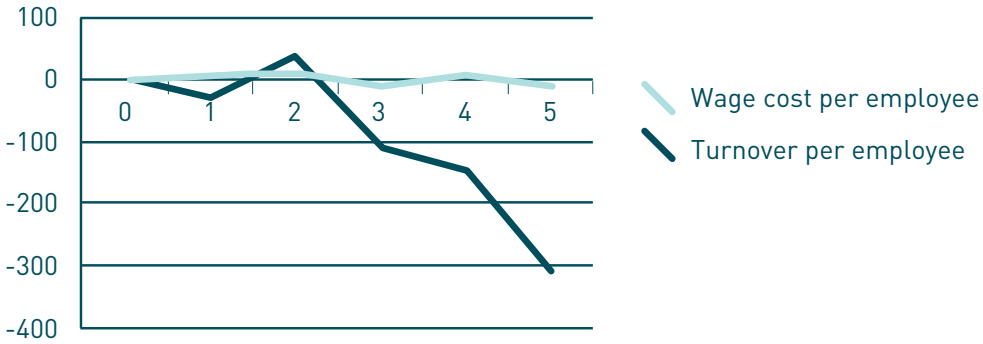


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TABLE 5.5.f: Potential effects on wage cost (DKK1,000) per employee. Further results

	Ordinary least squares regression[1]		Firm fixed-effects model[1]		Conditional diff-in-diff model[1]		Conditional diff-in-diff model, dependent variable: growth of wage cost per employee in percent[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	3.20	5.94	-8.96	10.86	8.28	11.26	-3.90	2.94
Treat=1 & t=2	14.98*	7.57	0.41	15.59	5.24	10.27	-0.43	2.41
Treat=1 & t=3	-6.34	9.74	-17.40	21.95	-21.34	13.79	-4.95	3.52
Treat=1 & t=4	16.04	12.27	7.09	24.88	16.06	17.18	1.36	4.50
Treat=1 & t=5	5.94	13.15	-26.35	35.12	-19.32	29.92	-5.15	6.70
Includes firm-fixed effects	no		yes		yes		yes	
Includes year dummy variables	no		yes		yes		yes	
Includes information from before year zero	no		yes		yes		yes	
Includes observations of the control group	no		no		yes		yes	
Number of observations:	355		794		1494		1474	
Number of companies:	190		190		346		343	
R2:	0.02		0.02		0.01		0.01	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1: Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
2: Only observations with annual growth between -50 and 100 percent.

>

TABLE 5.5.g: Potential effects on labour productivity (DKK 1,000). Further results

	Ordinary least squares regression[1]		Firm fixed-effects model[1]		Conditional diff-in-diff model[1]		Conditional diff-in-diff model, dependent variable: annual labour productivity growth in percent[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	-67.67	53.38	-78.40	85.83	-27.92	93.59	2.50	3.71
Treat=1 & t=2	146.02*	78.44	127.63	128.59	57.28	107.95	6.64*	3.72
Treat=1 & t=3	-70.54	69.29	-45.92	124.43	-137.30	91.84	2.90	4.07
Treat=1 & t=4	-43.03	103.33	-46.98	176.48	-39.23	134.02	4.26	5.41
Treat=1 & t=5	-133.16	83.80	-115.44	202.26	-159.68	215.28	-7.57	11.12
Includes firm-fixed effects	no		yes		yes		yes	
Includes year dummy variables	no		yes		yes		yes	
Includes information from before year zero	no		yes		yes		yes	
Includes observations of the control group	no		no		yes		yes	
Number of observations:	369		898		1693		2186	
Number of companies:	171		171		323		483	
R2:	0.02		0.02		0.02		0.02	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.
2: Only observations with annual growth between -50 and 100 percent.

Results for subsamples

In the following, we look at whether previous findings are different for different industries, VP- and project-specific characteristics.

This functions as a robustness check of the previous results, but it also offers an opportunity to see under what circumstances the programme might be considered to be most successful. In particular, the previous regression models will be applied on the following samples:

1. All companies, with no outliers removed.
2. Only companies where the DASTI and Statistics Denmark data are in accordance with regard to the company-VP match.
3 Only VP-projects that were not aborted before schedule.
4. Only companies without any tertiary-level educated employees in the year prior to programme participation.
5. Only VP-projects in, respectively, manufacturing, services, and other industries.
6. Only male VPs, only female VPs.
7. Only VPs with a tertiary education.
8. Only VPs with education degrees in, respectively, arts and humanities, social sciences, and technical sciences subjects.

For ease of reading, the results can be found in the appendix of this report. Aggregated regression coefficients, which measure potential treatment effects, are for most of the subsamples illustrated graphically and discussed below.

Let us first turn our attention to the results for the sample of all companies, with no outliers removed. For this sample, estimated standard errors are often much larger than the absolute sizes of the coefficient estimates (TABLE A.1). Thus, for all participant companies (including the larger ones), it is not possible to make statements on the potential treatment effects with any degree of accuracy, with the exception of the employment of highly educated employees.

Potential effects on the number of highly educated employees

We find the largest potential treatment effects for companies without tertiary-level educated employees in the year prior to treatment, and for companies hiring male VPs, and for those hiring VPs with a technical sciences education. The lowest potential effects are found for those hiring VPs with an education in arts and humanities, and, especially over a time horizon beyond the very first years after treatment, female VPs. There is only a small immediate potential effect for service industries. However, companies in these industries increase the number of highly educated employees in the years after treatment.

FIGURE 5.5.a: Number of highly educated employees. Estimated potential treatment effects. Years after year zero on horisontal axis.

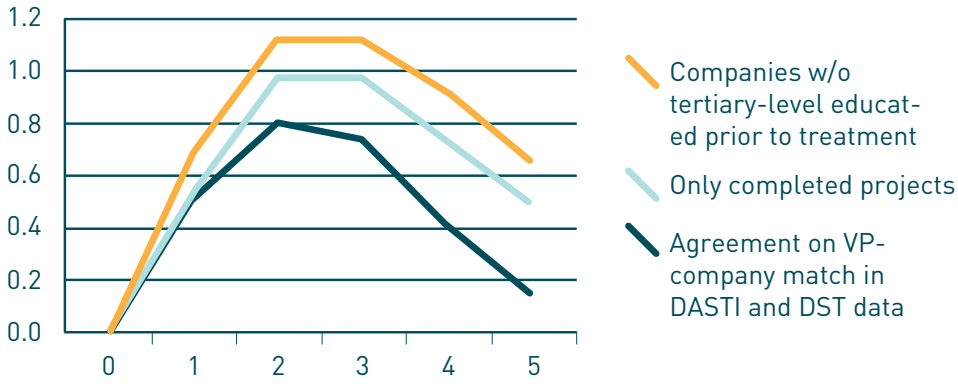


FIGURE 5.5.b: Number of highly educated employees. Estimated potential treatment effects. Years after year zero on horisontal axis.

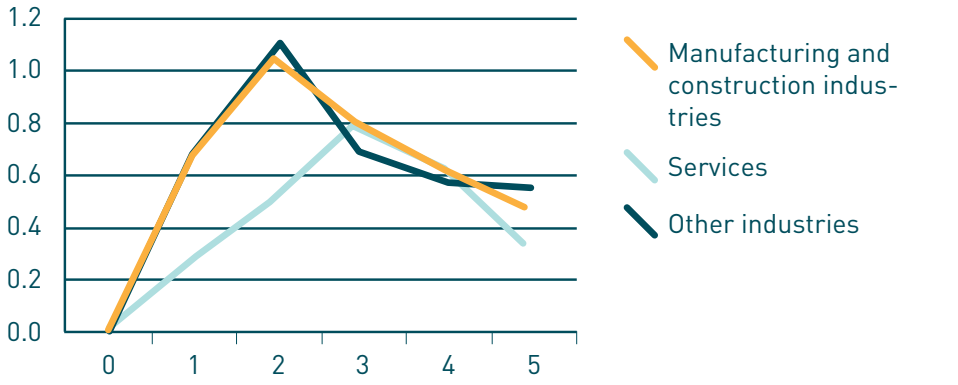


FIGURE 5.5.c: Number of highly educated employees. Estimated potential treatment effects. Years after year zero on horisontal axis.

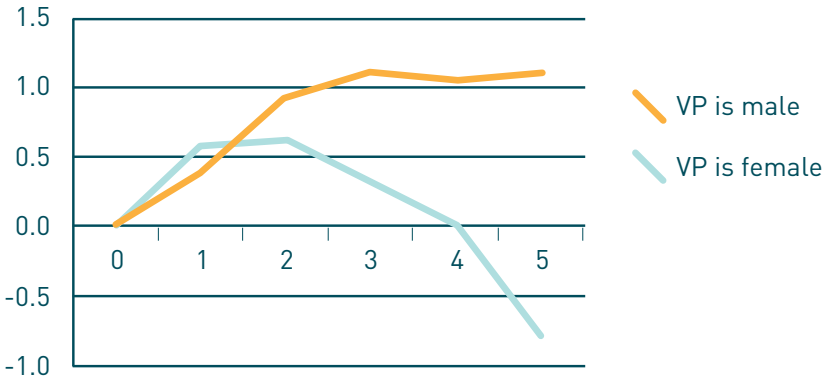
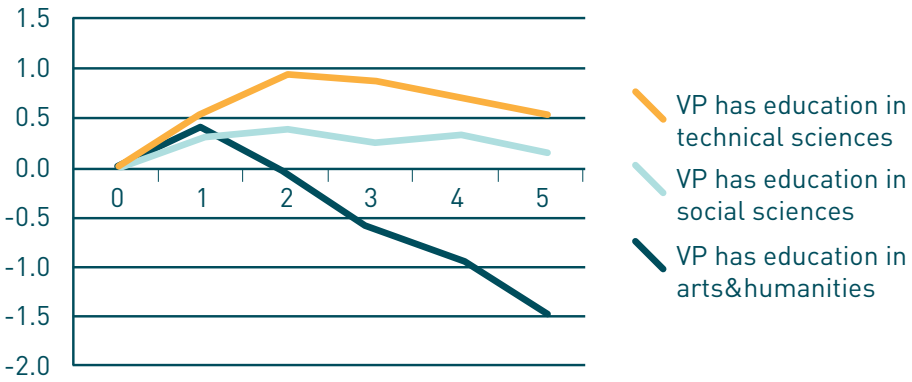


FIGURE 5.5.d: Number of highly educated employees. Estimated potential treatment effects. Years after year zero on horisontal axis.



Potential effects on the number of employees

For total employment, it proves to be important that the VP-project is completed and not aborted before schedule. Again, it is companies that hire female VPs and VPs with an education in arts and humanities that have the poorest growth performance. For VPs with a technical sciences education, a positive potential programme effect for highly educated employees and the absence of any detectable potential effect for employees of all educations indicate that companies that hire these VPs would have employed other individuals with lower educations in the counterfactual case of non-participation.

FIGURE 5.6.a: Number of employees. Estimated potential treatment effects. Years after year zero on horisontal axis.

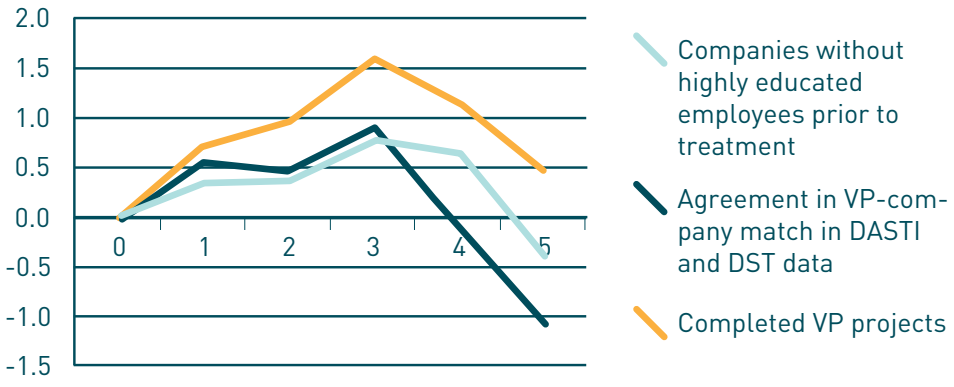


FIGURE 5.6.b: Number of employees. Estimated potential treatment effects. Years after year zero on horisontal axis.

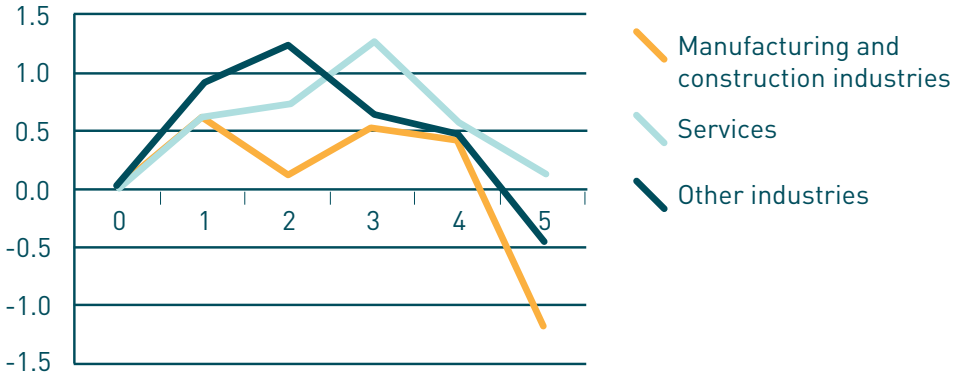


FIGURE 5.6.c: Number of employees. Estimated potential treatment effects. Years after year zero on horisontal axis.

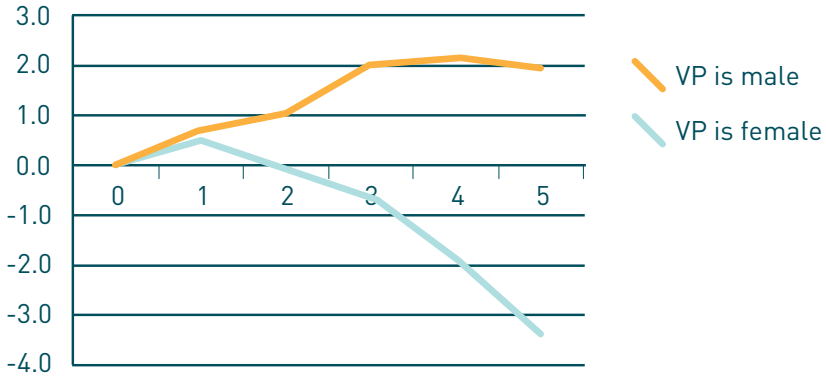
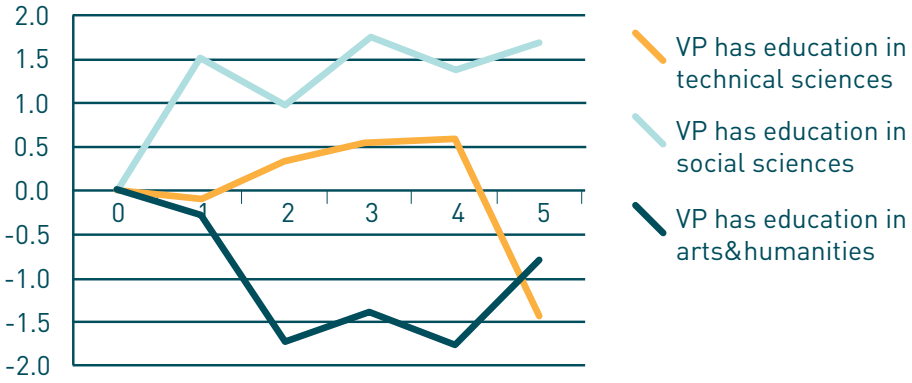


FIGURE 5.6.d: Number of employees. Estimated potential treatment effects. Years after year zero on horisontal axis.



Potential effects on value added

The comparison of potential value added effects agrees to large extent with the findings for employment: Subgroups of companies that are characterised by low average increases in the number of (highly educated) employees in association with programme participation are also characterised by low increases in value added. This is notably the case for companies hiring female VPs and VPs with an education categorised as within arts and humanities. The highest average increases are found in the manufacturing industries and for VPs with a social sciences-related education. With regard to value added, it is again important that the project was completed, while there is no indication that companies without tertiary educated employees prior to treatment gain the most in terms of value added.

FIGURE 5.7.a: Value added (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

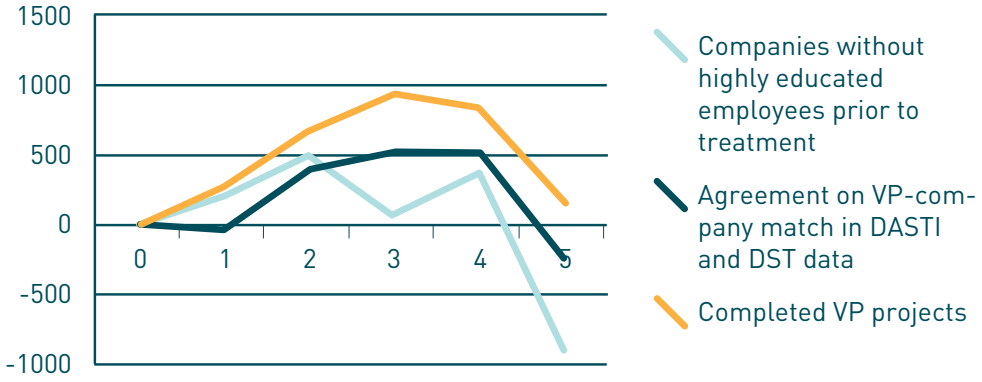


FIGURE 5.7.b: Value added (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

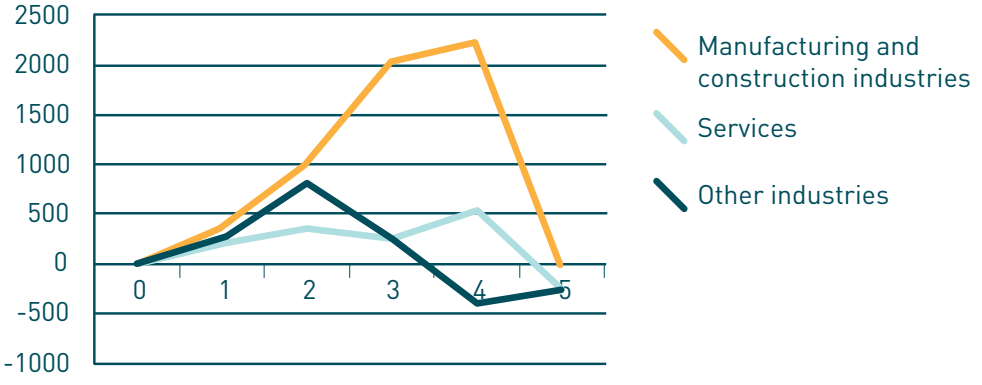


FIGURE 5.7.c: Value added (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

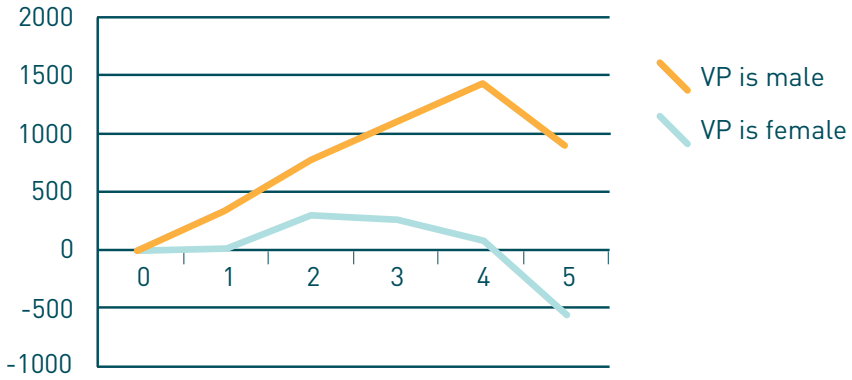
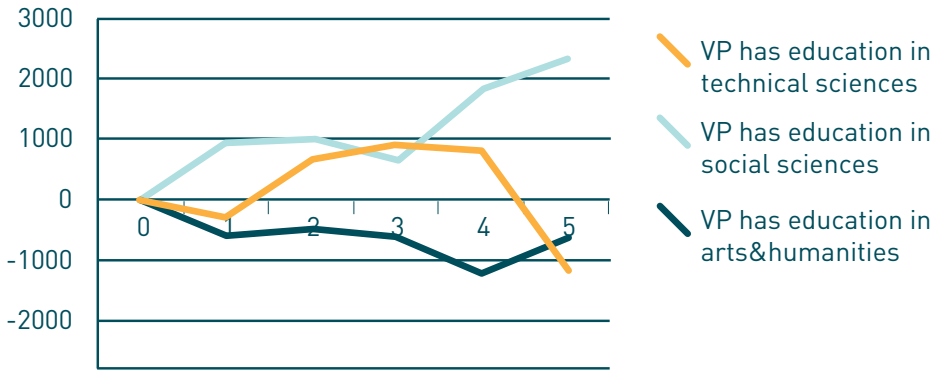


FIGURE 5.7.d: Value added (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis (year zero=100).



Potential effects on net income (profits) and return on assets

What was true for the developments of value added does not necessarily hold true for net income. For example, companies hiring female VPs are on average not characterised by less favourable net income developments. It can be noted that companies without tertiary-level educated employees prior to treatment and companies hiring VPs with a technical sciences education do best in terms of return-on-assets developments.

FIGURE 5.8.a: Net income (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

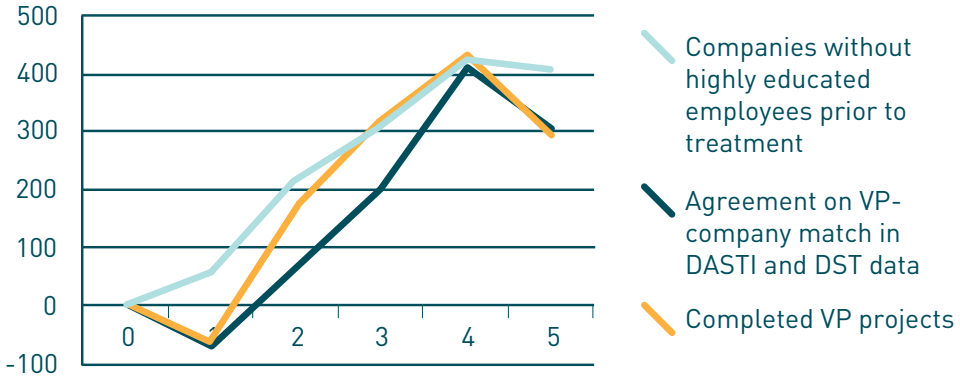


FIGURE 5.8.b: Net income (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

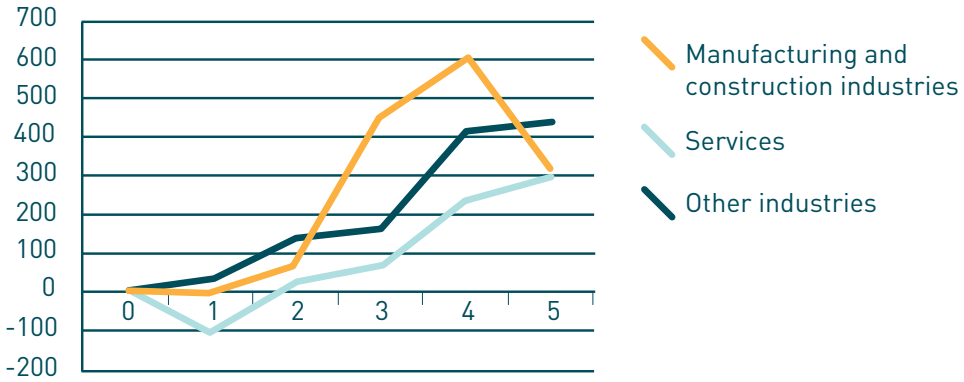


FIGURE 5.8.c: Net income (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

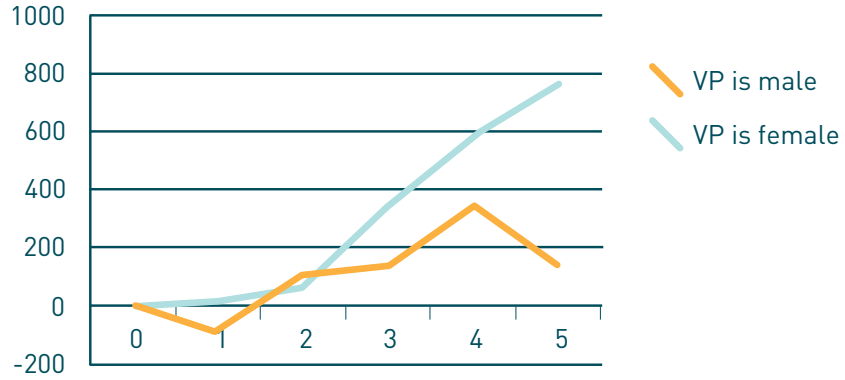


FIGURE 5.8.d: Net income (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

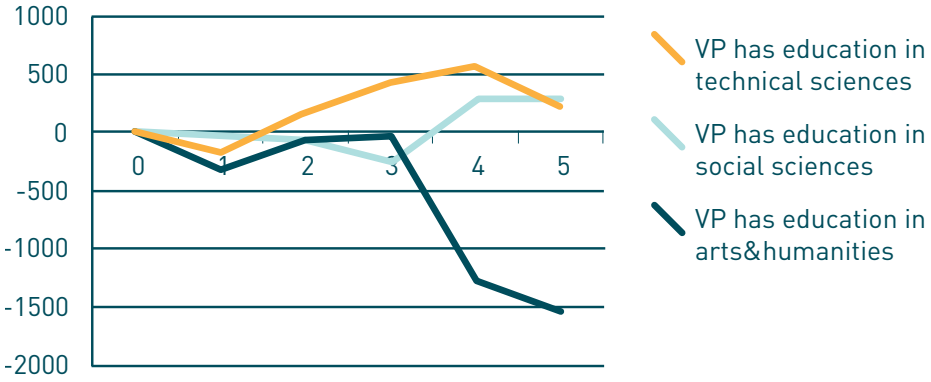


FIGURE 5.9.a: Return on assets. Estimated potential treatment effects. Years after year zero on horisontal axis.

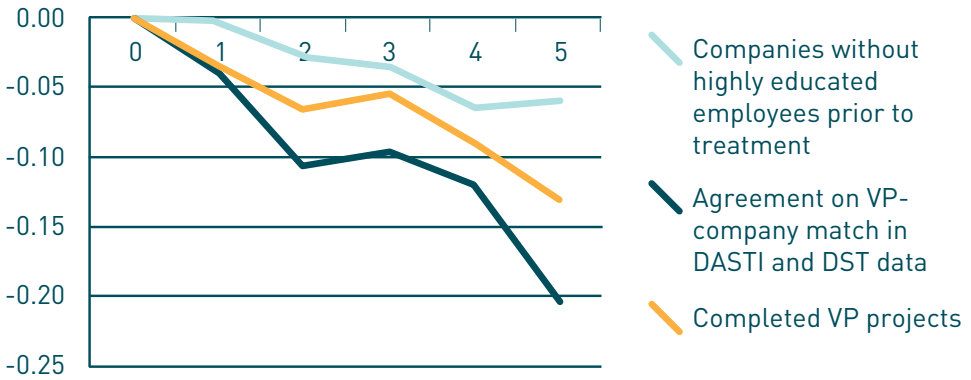


FIGURE 5.9.b: Return on assets. Estimated potential treatment effects. Years after year zero on horisontal axis.

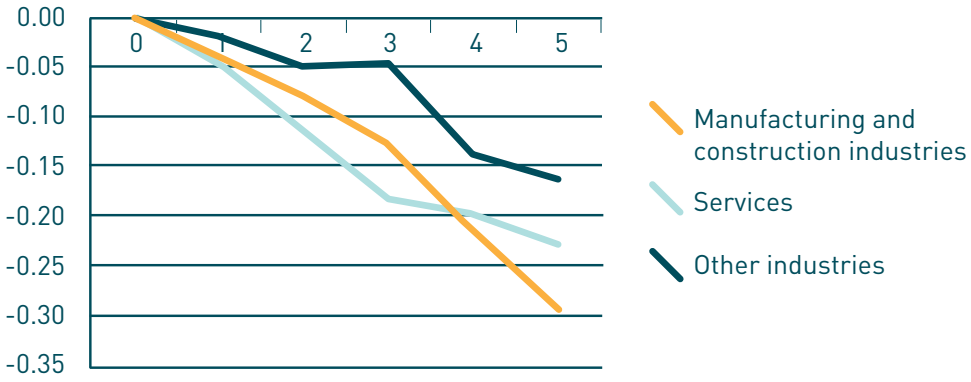


FIGURE 5.9.c: Return on assets. Estimated potential treatment effects. Years after year zero on horisontal axis.

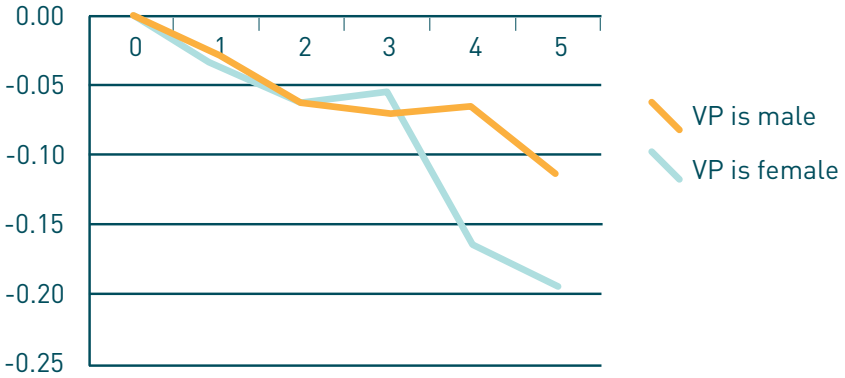
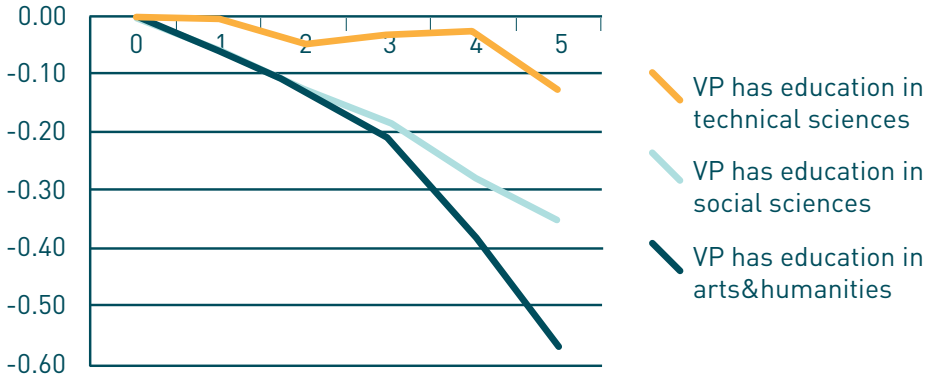


FIGURE 5.9.d: Return on assets. Estimated potential treatment effects. Years after year zero on horisontal axis.



Potential effects on wages and labour productivity

The comparison of wage costs per employee leaves us with no clear results. Instead, erratic movements in the estimates over time suggest that these are mostly due to statistical noise rather than underlying trends.

For labour productivity, we find that companies in other industries than manufacturing and services, and companies that hire VPs with technical educational degrees, do well relative to other companies. Those that hire VPs with an educational background in arts and humanities, and those in the service industry, are characterised by the most negative estimates.

FIGURE 5.10.a: Average wage cost per employee (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

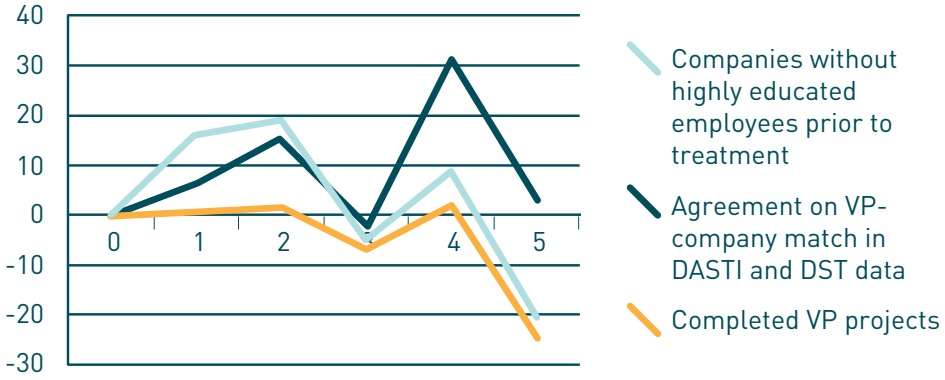


FIGURE 5.10.b: Average wage cost per employee (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

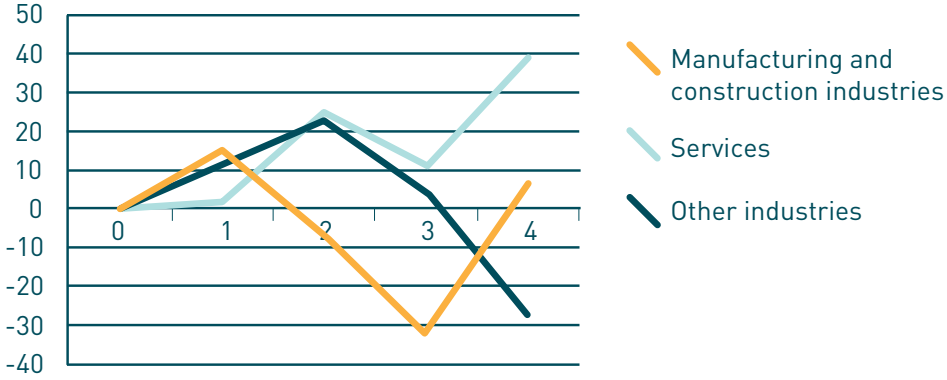


FIGURE 5.10.c: Average wage cost per employee (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

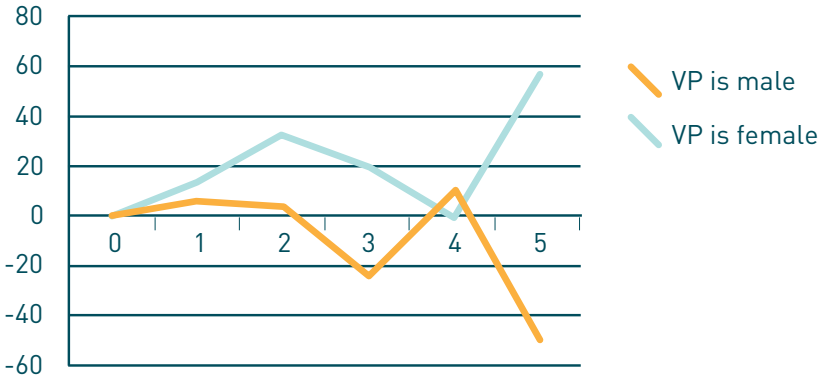


FIGURE 5.10.d: Average wage cost per employee (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

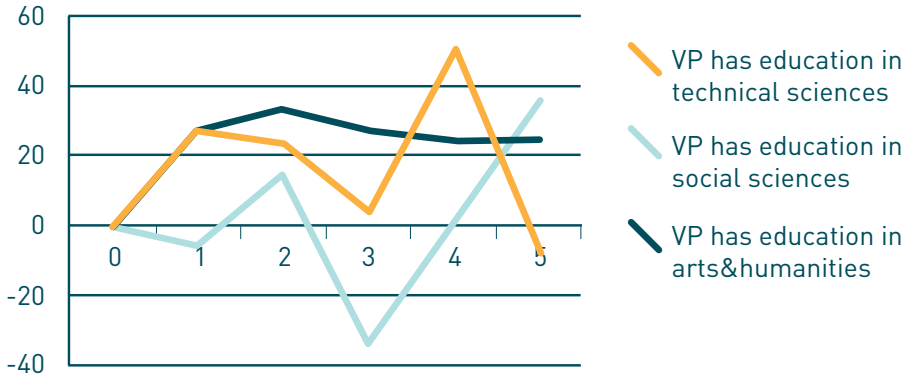


FIGURE 5.11.a: Labour productivity (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

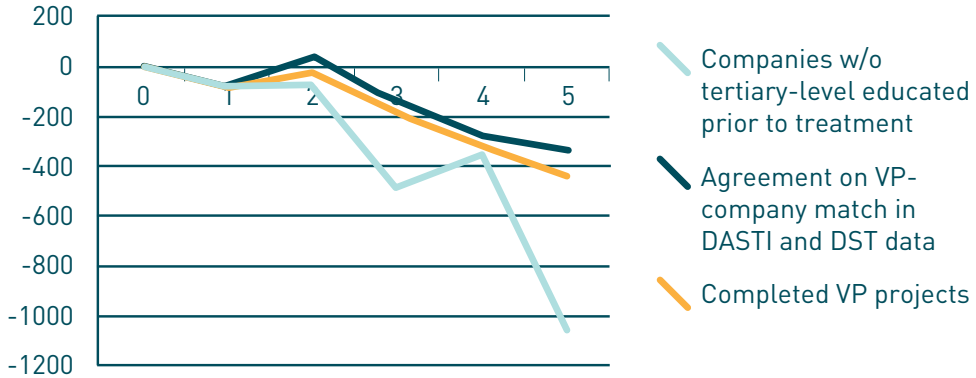


FIGURE 5.11.b: Labour productivity (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

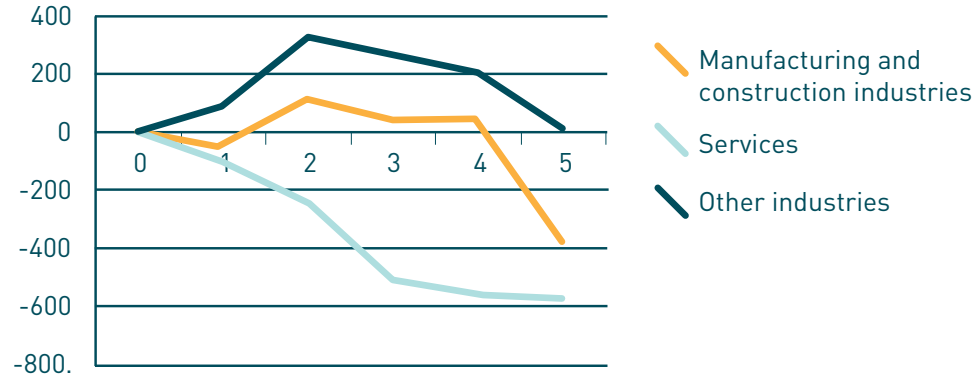


FIGURE 5.11.c: Labour productivity (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.

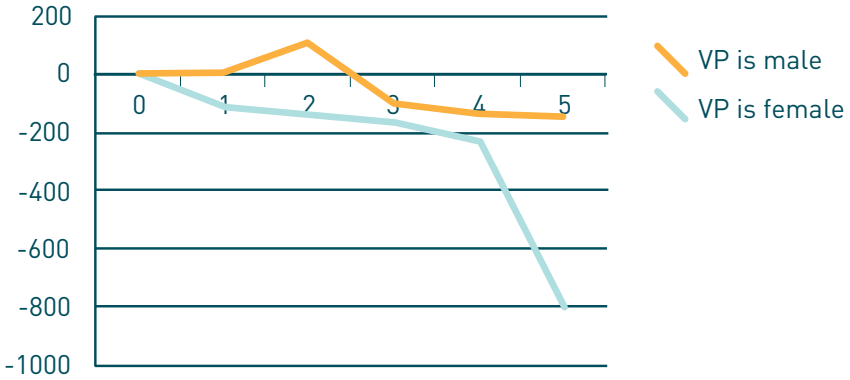
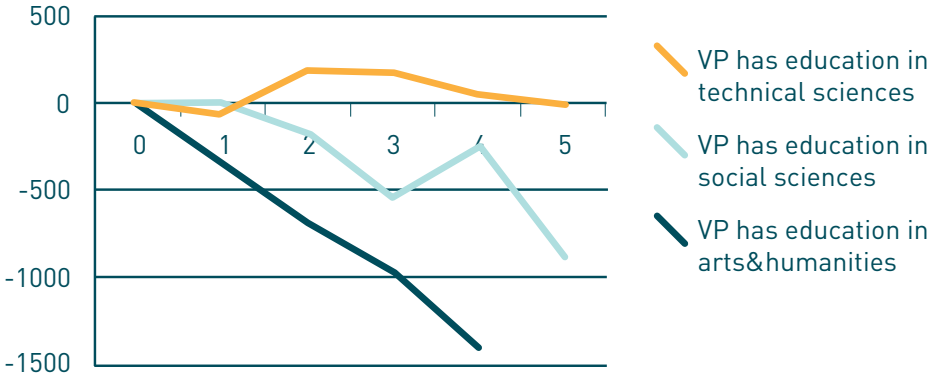


FIGURE 5.11.d: Labour productivity (DKK1,000). Estimated potential treatment effects. Years after year zero on horisontal axis.



The survival of VP-companies

As a first extension of the analysis, we look at the survival/closure rate of VP-companies in comparison with the reference group of control companies. This is achieved by simply comparing closure rates as depicted in Figure 6.1 and an estimation of a binary choice model which has company closure in a given year as its dependent variable.[36] The results of this regression are displayed in TABLE 6.1 and corroborate the finding that there are no significant differences between companies that hire VPs and other similar companies that do not participate in the programme.

[36] Closure is measured between year t and year t+1, where year t is the last year in which the company is found in the Experian database. The Experian database has information on the status of companies that allow distinguishing company closures from, for example, company sales or mergers.

FIGURE 6.1: Company closure rates, by year after year 0 (horizontal axis).

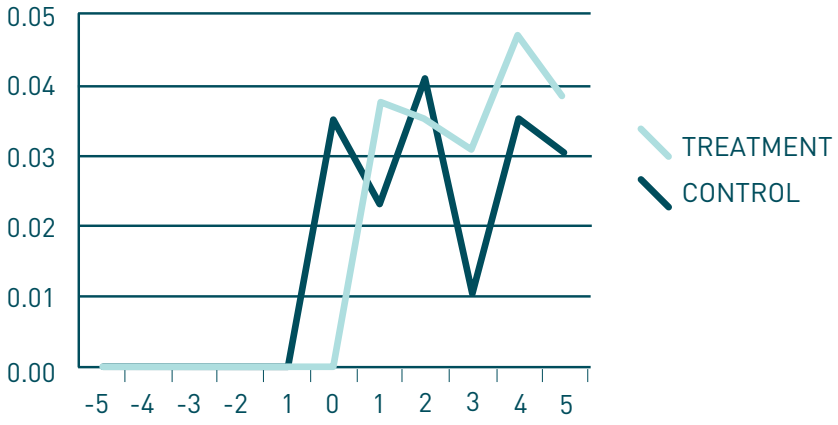


TABLE 6.1: Comparison of company closure probabilities of VP-companies and companies in the reference group. Logit binary choice regression results. Dependent variable: bankruptcy after t=x.

Dependent variables (in first differences):	All companies in treatment and control group		Companies with less than 50 employees	
	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.54	0.49	0.67	0.51
Treat=1 & t=2	-0.15	0.47	-0.20	0.50
Treat=1 & t=3	1.11	0.83	1.09	0.83
Treat=1 & t=4	0.30	0.61	0.41	0.66
Treat=1 & t=5	0.25	0.78	0.29	0.78
t=1 (omitted category)				
t=2	0.43	0.51	0.48	0.55
t=3	-1.33	0.82	-1.17	0.83
t=4	0.12	0.61	0.01	0.67
t=5	0.93	0.76	1.05	0.78
Year dummies				
2005 (omitted category)				
2006	0.13	1.17	0.13	1.17
2007	1.32	1.07	1.24	1.08
2008	2.24	1.05	2.16	1.05
2009	0.98	1.07	0.99	1.08
2010	-0.04	1.13	-0.26	1.15
Constant	-4.82	1.05	-4.816	1.054
Number of observations:	1987		1876	
Pseudo-r-squared	0.08		0.08	

A comparison of *VP-companies* and companies participating in *Innovation Networks*

For one of the extensions of the analysis, DASTI provided data on companies that have participated in the so-called *Innovation Networks*. These networks or clusters are financially supported by DASTI and have the purpose of increasing knowledge diffusion by providing a platform for collaborations between companies, knowledge institutions and other cluster participants.

These data consist of 1923 observations belonging to 1158 companies, the discrepancy owing itself to the fact that some firms participate in these networks more than once. In the following, these companies' *(IN-companies)* performance is compared with the performance of the VP-companies.

First, we compare developments in some of the performance variables between IN- and VP-companies. This comparison is highly informal since the two groups of companies differ in observable characteristics and must be assumed to differ in unobservable characteristics as well.

The left hand side columns of TABLE 6.2 compare VP-companies with all IN-companies present in the Experian data that participated in the clusters after 2004. We initially find that IN companies are on average significantly larger and have more highly educated employees than VP-companies. Also, a larger share of the IN-companies are in the IT industry.

To increase the comparability of the two groups of companies for the subsequent comparisons, only companies with a net income between DKK -7 million and DKK 7 million and a maximum size of 50 employees in the year before treatment (which is roughly the 99% percentile of the VP-companies' distribution of this variable) are considered.

Summary statistics of the adjusted sample used for the statistical comparison are in the right hand side columns of TABLE 6.2. The adjustments in terms of company size and profit have made the two groups of companies surprisingly similar in their observable characteristics in the year before treatment, with the exception that IN-companies are characterised by a higher share of highly educated employees.

The results of the new comparison are shown in TABLE 6.3 and are in concordance with earlier findings based on the comparison of VP-companies with a reference group of highly similar companies: VP-companies increase their numbers of highly educated employees in the year of treatment and sometimes in the first years after treatment.

However, it cannot be shown that VP-companies grow faster than IN-companies in the number of employees. On the contrary, they appear to have lower growth, i.e. shrink faster, than IN-companies more than three years after treatment. Additional regressions (not shown) further indicate that this finding becomes even more accentuated when considering percentage point employment growth rather than absolute increases in the number of employees.

Findings also suggest that VP-companies have a lower growth in value added and net income, but these findings are generally not statistically significant. VP-companies have wage developments and labour productivity (turnover/employees) developments approximately equal to the group of IN-companies in most years after treatment and higher in single years.

In sum, earlier findings that VP-companies do not have statistically significant higher increases in the set of financial success variables relative to the reference group of highly similar companies are replicated in the comparison with a sample of small companies that have participated in an Innovation Network.

TABLE 6.2: Summary statistics of companies participating in Innovation Networks (IN) vs. VP-companies, in year t=0.

	Raw data				Comparison sample[1]			
	VP-companies N=314		IN-companies N=828		VP-companies N=297		IN-companies N=479	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
Number of highly educated employees	2.42	2.42	58.98	239.96	1.72	2.19	4.34	6.54
Number of employees	17.45	17.45	246.88	1043.84	11.22	11.07	14.12	13.71
Turnover (DKK1,000)	43682.70	43682.70	598268.60	3897574.00	19600.08	40120.67	24178.86	29720.16
Value added (DKK1,000)	7896.05	7896.05	130868.60	793678.70	5234.49	5547.89	7304.33	8648.45
Net income (DKK,1,000)	2129.82	2129.82	26234.95	591004.40	357.50	1311.80	213.33	1871.56
Return on assets	0.28	0.28	-0.06	0.52	0.03	0.24	-0.07	0.55
Labour productivity (DKK1,000)	4898.19	4898.19	2063.51	2676.78	2175.00	5010.00	1821.75	1793.93
Wage cost per employee (DKK1,000)	218.67	218.67	477.04	387.54	396.27	220.95	447.00	205.25
Industry: Construction	0.23	0.23	0.02	0.14	0.06	0.23	0.01	0.11
Industry: Trade	0.41	0.41	0.18	0.38	0.23	0.42	0.20	0.40
Industry: IT	0.29	0.29	0.13	0.33	0.10	0.30	0.15	0.35
Industry: Manufacturing	0.25	0.25	0.06	0.24	0.07	0.26	0.05	0.21
Industry: Metal	0.22	0.22	0.02	0.15	0.05	0.21	0.02	0.15
Industry: Furniture	0.21	0.21	0.06	0.23	0.04	0.20	0.05	0.21
Industry: Service	0.19	0.19	0.02	0.15	0.04	0.19	0.02	0.14
Industry: Business service	0.23	0.23	0.03	0.16	0.06	0.23	0.04	0.20
Industry: Consulting	0.32	0.32	0.11	0.31	0.12	0.33	0.13	0.34
Industry: Wood/paper	0.18	0.18	0.03	0.18	0.03	0.16	0.04	0.19
Industry: Other	0.42	0.42	0.35	0.48	0.22	0.41	0.29	0.45

Notes: The comparison sample consists of companies with maximum 50 employees and net income between DKK 7 million and DKK 7 million in year zero.

TABLE 6.3: Diff-in-diff fixed effects regression results for VP- and IN-companies. Companies with up to 50 employees in year zero.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.508***	0.17	0.24	0.29	174.4	214.2
Treat=1 & t=2	0.33	0.22	-0.19	0.35	-455.1*	255.5
Treat=1 & t=3	0.502*	0.28	-0.53	0.44	-55.7	315.7
Treat=1 & t=4	-0.34	0.35	-1.285**	0.55	-156.5	386.7
Treat=1 & t=5	0.96	0.87	-0.91	0.80	-15.4	491.2
t=1	-0.05	0.13	0.02	0.22	255.2	165.7
t=2	0.07	0.18	0.29	0.29	522.9**	218.3
t=3	-0.506**	0.25	0.31	0.40	328.4	290.7
t=4	0.41	0.32	0.873*	0.51	855.2**	373.0
t=5	-0.68	0.84	0.57	0.76	786.4	487.8
Year dummies						
2005	0.15	0.10	0.07	0.18	-211.1	143.1
2006	0.08	0.10	0.347*	0.18	50.5	148.6
2007	0.173*	0.10	0.372**	0.19	-191.7	151.5
2008	-0.07	0.11	0.01	0.20	-662.9***	162.3
2009	-0.391***	0.13	-1.342***	0.24	-1652***	189.8
2010			-1.115***	0.33	-1252***	239.2
2011			-0.72	0.99	498.1	663.0
Constant	0.052	0.07	0.572***	0.13	731.9***	104.6
Number of observations:	3208		3706		4127	
R-squared	0.03		0.06		0.05	
Number of companies:	698		743		754	

Notes: Only observations with annual changes in the number of employees by less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-433.8	760.0	-0.0575**	0.03	-17.41	16.00	92.24	234.40
-110.1	904.9	0.00	0.03	-8.09	18.91	127.60	298.60
-279.2	1116.0	0.01	0.04	14.72	23.58	987.1***	375.40
-137.9	1365.0	-0.123**	0.05	11.02	28.84	-108.80	465.40
-580.6	1730.0	-0.09	0.06	10.40	41.93	425.60	1855.00
687.5	581.8	0.02	0.02	-9.66	11.81	13.37	171.60
413.5	767.8	-0.01	0.03	5.65	15.32	21.82	239.80
486.4	1025.0	0.02	0.04	-21.34	21.11	-1073***	326.80
352.7	1313.0	0.04	0.05	19.84	26.66	281.20	416.30
844.3	1717.0	0.05	0.06	-11.45	39.18	-661.30	1819.00
-41.2	506.2	-0.01	0.02	1.93	9.26	-138.40	124.40
-883.1*	523.9	-0.03	0.02	-6.76	9.64	-172.50	129.00
-413.5	533.2	-0.0569***	0.02	8.95	9.91	-331.2**	132.00
-944.5*	571.1	-0.0567***	0.02	4.42	10.62	-236.2*	141.90
-980.4	665.2	-0.0993***	0.02	-1.30	12.38	-202.40	166.60
-663.4	840.9	-0.04	0.03	12.71	16.92		
574.5	2357.0	0.04	0.08	28.23	49.73		
46.950	368.7	0.0216*	0.01	3.75	6.81	116.20	89.61
4224		4222		1917		2301	
0.0		0.02		0.02		0.01	
769		764		515		459	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

A comparison of VP-companies and an extended sample of control companies

Earlier findings were characterised by a large heterogeneity in the companies' financial success variables. This argues for a test of the robustness of earlier findings by running the same regressions on a larger control group of companies. This reduces the variance of the estimators but comes at the cost of lower similarity between the group of treatments and the group of controls.

In the following, we depart from the propensity scores calculated earlier and select five controls (instead of one) for each treatment into the control group. This time, matching is based purely on the propensity score, without additional conditions on industry etc.

This procedure selects 1,596 companies into the control group for the 318 participant companies. The similarity of the two groups can be assessed by inspecting TABLE 6.4. As expected, the two groups are not as similar as the sample of the earlier analysis, with e.g. slightly larger companies in the extended control group. However, the conditional diff-in-diff model still allows for a meaningful comparison between the two groups of companies, and its estimates should be less affected by statistical noise thanks to an increase in the sample size.

TABLE 6.4: Summary statistics of VP-companies and companies in the extended control group (5 controls per treatment). Companies with up to 50 employees.

	VP-companies N=300		Companies in the extended control group N=1,488	
	Mean	Std.	Mean	Std.
Number of highly educated employees	1.80	2.26	1.78	2.62
Number of employees	11.65	11.36	11.16	11.86
Turnover (DKK1,000)	18437.84	27033.64	18103.18	25721.50
Value added (DKK1,000)	5540.32	5739.63	5249.33	6234.30
Net income (DKK,1,000)	296.99	981.43	236.41	1139.21
Return on assets	0.04	0.21	0.03	0.23
Labour productivity (DKK1,000)	2165.72	4973.50	2037.00	3856.43
Wage cost per employee (DKK1,000)	395.80	220.14	397.12	390.80
Industry: Construction	0.06	0.23	0.04	0.20
Industry: Trade	0.22	0.41	0.22	0.41
Industry: IT	0.10	0.30	0.09	0.29
Industry: Manufacturing	0.07	0.25	0.05	0.21
Industry: Metal	0.05	0.21	0.04	0.20
Industry: Furniture	0.06	0.23	0.05	0.22
Industry: Service	0.03	0.18	0.04	0.19
Industry: Business service	0.06	0.24	0.07	0.26
Industry: Consulting	0.12	0.33	0.13	0.34
Industry: Wood/paper	0.03	0.16	0.03	0.18
Industry: Other	0.21	0.41	0.23	0.42

The results of the new comparisons are in TABLE 6.5. We find that increasing the sample size only marginally reduced the standard errors of the estimates, and that the results of this model do not alter the previous findings that VP-companies do in general not experience statistically significant positive developments in the financial success variables. However, for return on assets, positive (though insignificant) signs of the relevant coefficient estimates imply that the previous finding of treatment companies that experience lower growth in this variable in association with treatment is not robust to changes in how the control group is selected. Also, there are weak signs that participants experience higher growth in wage costs and value added, and lower growth in labour productivity.

TABLE 6.5: Diff-in-diff fixed effects regression results for VP-companies and companies in the extended control group (5 controls per treatment). Companies with up to 50 employees in year zero.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.510***	0.10	0.621***	0.21	235.8	145.6
Treat=1 & t=2	0.451***	0.13	0.25	0.27	33.7	172.7
Treat=1 & t=3	0.06	0.15	0.11	0.28	-47.5	190.2
Treat=1 & t=4	-0.01	0.16	-0.16	0.41	497.2**	251.8
Treat=1 & t=5	0.19	0.26	-0.975*	0.57	-325.1	331.9
t=1	-0.03	0.05	-0.17	0.12	63.3	82.1
t=2	-0.10	0.07	-0.23	0.16	51.2	108.8
t=3	-0.179**	0.09	-0.29	0.21	159.6	142.4
t=4	-0.09	0.12	-0.31	0.25	-11.5	174.6
t=5	-0.27	0.18	0.20	0.31	164.0	221.6
Year dummies						
2005	0.182***	0.05	0.455***	0.17	-11.5	87.3
2006	0.173***	0.05	0.781***	0.17	302.9***	97.1
2007	0.180***	0.07	0.645***	0.20	87.2	112.2
2008	0.02	0.08	0.614***	0.22	-343.7***	131.7
2009	0.00	0.10	-0.632**	0.26	-925.4***	168.1
2010			-0.51	0.34	-633.2***	189.9
2011			-2.452***	0.93	661.4	577.3
Constant	-0.045	0.04	0.036	0.15	304.5***	77.4
Number of observations:	7130		8088		8945	
R-squared	0.03		0.07		0.05	
Number of companies:	1633		1706		1709	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-85.9	85.2	-0.02	0.03	3.64	10.79	-301.50	248.00
-2.1	103.3	0.06	0.07	16.17	12.21	-251.70	304.70
-100.0	123.6	0.06	0.04	24.43*	13.01	-555.7**	272.90
29.7	152.0	0.00	0.05	29.97**	14.87	-126.40	205.40
-199.6	204.0	0.01	0.06	28.57	21.65	-282.50	493.90
13.0	51.4	-0.0248*	0.02	6.08	7.36	334.80	248.30
13.9	67.6	-0.08	0.06	0.49	8.82	414.90	349.10
28.8	83.4	-0.0555**	0.02	2.75	11.57	491.6**	222.50
-72.2	93.5	-0.0770***	0.03	5.91	14.76	272.50	188.70
152.1	108.8	-0.07	0.04	11.66	18.71	66.82	430.30
114.7	69.8	0.0444**	0.02	-7.87	6.26	-189.0*	105.80
129.1*	74.9	0.0513**	0.02	-4.08	6.95	-183.60	152.80
7.5	74.8	0.03	0.02	1.10	8.42	-314.50	259.40
-174.4**	86.0	0.01	0.02	-16.05	11.75	-365.6***	140.70
-221.3**	94.5	-0.0436*	0.03	-5.68	13.48	-272.3*	149.80
23.5	109.4	0.04	0.03	-17.47	18.33		
870.7***	289.8	0.11	0.08	82.72**	33.91		
-26.130	63.0	-0.0326***	0.01	3.15	4.84	67.26	77.79
7609		9094		3106		4500	
0.0		0.01		0.02		0.00	
1494.0		1748.00		1051.00		960.00	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

7. CONCLUSIONS >

This study has taken a look at the potential effects of the Danish Innovation Assistant Programme ('Videnpilotordningen', VP programme) on the individual and company level. For this purpose, the analysis considers the employment probabilities and salary developments of individuals participating in the programme (VPs) and follows a number of performance variables for participating companies.

To form an understanding of the absolute potential effects of the programme, we compare participating individuals and companies with highly similar individuals and companies that do not participate. These comparisons indicate that:

(a) Individuals who participate in the programme have higher employment probability than similar control individuals in the year after starting to participate. This is no surprise, since employment is a defining element of the programme.

(b) Individuals who participate in the programme do not have higher employment probability than controls more than one year after starting to participate in the programme, but earn higher wages in the first years. Here it should be noted that the observation period falls within an economic boom period with low unemployment. It might be assumed that the wage and employment developments of programme participants and non-participants do not converge at the same speed in the current economic slow-down.

(c) Participating companies increase their numbers of highly educated employees in association with programme participation. The analysis finds no signs of behavioural additivity of the programme, i.e. non-participants increasing their number of highly educated employees. There are no indications that companies continue to increase the number of highly educated employees in the years after programme participation.

(d) Participating companies increase the number of employees in association with programme participation. However, in this case there are also no indications that the companies continue to increase their employment in the years after programme participation.

(e) It is difficult to detect statistically significant positive potential effects of the programme on participating companies' financial performance variables. For subsamples of small companies that do not experience large year-to-year changes in employment or financial measures, participant companies on average increase their gross profit and net income in association with programme participation. Findings are again not statistically significant, and need to be interpreted with care.

(f) Participating companies do not experience increases in return on assets, wage costs per employee, or labour productivity in association with programme participation.

There are no strong findings about which particular projects are more successful than others, but it appears that VPs with a tertiary-level education gain less from participation than VPs with a post-secondary education, while females and VPs finding employment in service industries gain the most.

For companies, it is important to note that results related to specific characteristics of the VP or the hosting company are tentative, due to the presence of substantial statistical uncertainties. This said, one can note that the largest potential effect on the number of highly educated employees is estimated for small companies that hire VPs with a technical sciences education as well as male VPs, and for companies that had no tertiary-level educated employees before treatment.

Also, small companies in manufacturing do well in terms of value added and net income (profits) developments in association with programme participation, while participant companies that hire female VPs do relatively poorly in terms of value added and employment, but not net income. Companies that hire VPs with an educational background within arts and humanities are characterised by low growth in association with programme participation, while those hiring VPs with a technical sciences education do the best, not just in terms of increasing the number of highly educated employees, but also with regard to net income, return on assets and labour productivity developments.

The general finding that it is difficult to measure statistically significant potential effects of the programme proved to be robust to comparing participant companies with other companies that participated in a similar programme administered by DASTI (the *Innovation Network* programme) as well as an alternative control group consisting of several highly comparable control companies for each participant company.

The VP programme has been analysed earlier on the basis of less extensive data. This earlier study found potential effects of similar size to the present study. However, it also found large unexplained year-to-year variation in the performance variables, leading to statistically insignificant coefficient estimates.

The current analysis supports the earlier analysis' findings. But the fact that it is still difficult or impossible to establish statistical significance for most of the relevant financial variables implies that we still cannot be certain that increased company performance is a general feature of the programme.

So while there are indications of positive potential programme effects for restricted subsamples in our data, the general lack of statistical significance implies that any positive effects of hiring a VP on company performance are small in the face of the high data demands of our econometric model, a still very limited number of observations in our data, and the large variation in the companies' performance measures. The latter observation also suggests that other company developments, for example initiated by product developments, must be assumed often to be of major importance relative to the presence of a VP in the company.[37]

[37] Fox, J.T., V. Smeets, 2011, Does Input Quality Drive Measured Differences In Firm Productivity?, International Economic Review, vol. 52(4), 961-989.

APPENDIX 1: ADDITIONAL TABLES OF THE COMPANY-LEVEL ANALYSIS >

TABLE A.1: Comparison between VP-companies and companies in the reference group. All companies irrespective of outliers. Diff-in-diff fixed effects regression results

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.289*	0.17	0.14	0.74	48.9	302.4
Treat=1 & t=2	0.16	0.15	0.25	0.52	73.5	244.8
Treat=1 & t=3	-0.17	0.20	0.63	0.55	66.4	313.4
Treat=1 & t=4	-0.380*	0.23	-0.30	0.86	-43.8	473.8
Treat=1 & t=5	0.29	0.70	-0.88	1.41	-558.7	452.6
t=1	-0.09	0.12	-0.41	0.45	78.8	246.0
t=2	-0.07	0.15	-0.51	0.63	-394.6	288.3
t=3	-0.23	0.20	-0.60	0.80	-103.4	418.1
t=4	-0.05	0.25	-0.99	1.09	-13.9	451.8
t=5	-0.59	0.64	0.68	1.35	109.0	521.9
Year dummies						
2003	0.08	0.15	-0.33	0.53	-382.7	494.3
2004	0.02	0.11	0.49	0.52	219.7	492.3
2005	0.02	0.12	0.47	0.55	361.8	506.6
2006	0.17	0.16	1.185*	0.61	446.4	522.5
2007	0.14	0.18	0.56	0.74	251.4	571.0
2008	0.00	0.23	0.22	0.89	-207.5	592.5
2009	-0.10	0.22	-2.647**	1.07	-1024.0	654.6
Constant	0.12	0.10	0.53	0.50	338.2	481.1
Number of observations:	3046		2989		3664	
Number of companies:	596		580		611	
R-squared	0.02		0.08		0.03	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-52.7	124.2	-0.0580*	0.03	44.45	53.58	-664.00	680.20
12.3	162.3	0.05	0.04	-20.82	26.08	436.50	318.80
-53.7	221.0	0.00	0.04	16.87	23.68	125.50	315.90
-476.7	336.1	-0.04	0.06	30.80	25.34	-62.61	310.20
185.5	267.5	-2.39	2.38	44.40*	26.05	-71.96	593.80
35.8	132.2	0.02	0.04	3.72	16.63	821.50	814.70
57.8	169.7	-0.01	0.06	38.96	28.42	172.30	481.80
69.6	228.6	0.02	0.08	25.52	28.06	273.40	588.60
299.2	276.1	0.04	0.06	-16.65	24.65	209.60	614.10
10.5	269.5	0.09	0.17	-25.41	31.03	178.50	833.40
-333.5	259.2	0.19	0.13	10.05	12.95	-159.60	660.90
-29.1	253.6	0.16	0.11	-1.59	13.24	-53.96	524.50
54.4	257.4	0.14	0.09	-17.10	19.86	-240.10	508.60
0.3	278.0	0.12	0.08	-28.85	28.64	117.90	601.20
-152.3	291.4	0.147**	0.07	-32.51	39.48	-142.80	663.30
-468.2	308.2	0.05	0.07	-39.87	42.35	-331.50	813.00
-620.8*	326.0	0.22	0.19	9.14	25.26	227.80	673.60
177.9	246.3	-0.120***	0.04	8.19	12.37	-267.80	477.70
3799		3867		3107		2856	
626		627		588		567	
0.02		0.01		0.01		0.01	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.2: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Only companies with agreement on the VP-company-match in the DASTI and DST data.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.516***	0.15	0.57	0.37	-23.2	234.1
Treat=1 & t=2	0.283*	0.16	-0.10	0.40	413.1	257.1
Treat=1 & t=3	-0.06	0.20	0.42	0.42	127.0	366.9
Treat=1 & t=4	-0.34	0.24	-0.981*	0.54	-0.2	521.9
Treat=1 & t=5	-0.26	0.29	-0.96	0.77	-768.1	682.9
t=1	0.00	0.11	0.14	0.31	102.3	216.2
t=2	0.02	0.15	0.16	0.42	-248.9	275.6
t=3	-0.16	0.21	0.08	0.53	171.8	412.0
t=4	-0.07	0.24	0.64	0.71	443.6	453.0
t=5	-0.02	0.32	1.549*	0.90	475.8	663.0
Year dummies						
2003	-0.01	0.15	-0.18	0.26	-371.0	257.6
2004	-0.01	0.15	-0.18	0.26	-371.0	257.6
2005	0.02	0.13	0.15	0.31	401.6	257.2
2006	0.05	0.12	0.08	0.33	98.9	239.8
2007	-0.02	0.15	0.15	0.40	343.1	283.5
2008	0.01	0.18	0.15	0.47	272.3	354.3
2009	-0.15	0.22	-0.14	0.61	-270.2	413.8
Constant	0.10	0.10	0.34	0.25	95.9	203.6
Number of observations:	1632		1697		1627	
Number of companies:	289		294		290	
R-squared	0.05		0.09		0.04	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-67.7	114.2	-0.04	0.03	6.42	13.33	-80.61	124.30
208.0	131.1	-0.0656**	0.03	8.99	12.07	125.30	130.80
191.4	140.0	0.01	0.03	-17.89	15.11	-178.3*	105.30
258.7	256.9	-0.02	0.05	34.01*	19.80	-144.90	161.80
-104.8	222.2	-0.08	0.07	-28.68	34.35	-54.19	241.70
-29.0	113.3	-0.02	0.03	-12.53	13.70	-95.96	112.50
-277.0**	137.1	-0.04	0.03	-1.81	12.21	114.80	120.10
-81.9	177.0	-0.0709*	0.04	3.28	16.46	141.00	128.00
-177.5	252.0	-0.07	0.05	-26.61	22.88	48.66	152.70
-32.8	292.2	-0.113*	0.06	-12.68	31.07	122.60	262.00
-129.6	107.5	-0.0597**	0.03	13.46*	7.06	-175.6**	87.28
-129.6	107.5	-0.0597**	0.03	13.46*	7.06	-175.6**	87.28
99.0	101.3	0.02	0.02	13.24	8.06	-35.98	71.15
5.3	94.2	-0.01	0.02	13.22	9.19	-8.17	90.36
50.3	117.5	0.01	0.03	10.87	10.59	21.71	111.20
104.4	147.7	0.03	0.03	20.12	14.66	-77.02	117.50
-71.4	185.9	0.01	0.04	4.24	17.45	-154.30	145.40
66.0	74.9	0.02	0.02	-3.65	5.68	63.03	65.53
1579		1658		978		1052	
291		292		202		178	
0.02		0.03		0.03		0.04	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.3: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Only companies with completed VP-projects.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.555***	0.13	0.708**	0.33	273.2	245.3
Treat=1 & t=2	0.429***	0.16	0.26	0.34	374.5	255.4
Treat=1 & t=3	0.00	0.18	0.63	0.42	278.5	364.8
Treat=1 & t=4	-0.24	0.22	-0.45	0.65	-85.2	489.9
Treat=1 & t=5	-0.25	0.28	-0.68	0.61	-678.6	626.9
t=1	-0.13	0.11	0.06	0.26	92.7	207.0
t=2	-0.15	0.15	-0.16	0.35	-210.3	242.4
t=3	-0.25	0.19	-0.51	0.43	11.4	372.8
t=4	-0.24	0.23	-0.31	0.58	441.7	419.4
t=5	-0.16	0.29	0.84	0.58	571.3	581.9
Year dummies						
2003	-0.04	0.14	-0.04	0.23	-255.3	245.7
2004	0.02	0.12	0.22	0.27	390.3	242.5
2005	0.05	0.11	0.26	0.29	103.4	234.2
2006	0.06	0.14	0.21	0.34	279.2	260.6
2007	0.12	0.18	0.44	0.36	269.8	302.5
2008	-0.03	0.20	0.22	0.45	-226.3	347.1
2009	-0.01	0.24	-1.304**	0.52	-749.3*	429.8
Constant	0.12	0.10	0.38	0.23	204.9	207.3
Number of observations:	2122		2217		2120	
Number of companies:	431		440		359	
R-squared	0.04		0.08		0.04	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-58.8	107.2	-0.03	0.03	0.71	11.04	-72.72	114.10
228.1*	122.4	-0.03	0.03	0.47	11.92	52.31	140.10
148.0	124.9	0.01	0.03	-7.51	14.10	-163.7*	97.86
112.0	236.1	-0.04	0.04	8.34	19.07	-134.50	145.80
-134.4	195.4	-0.04	0.07	-26.68	31.65	-121.00	258.60
25.5	97.8	-0.02	0.02	3.99	11.48	-68.50	107.60
-142.4	116.1	-0.04	0.03	21.19*	12.35	73.53	116.40
45.2	146.5	-0.05	0.03	34.80**	16.25	88.85	115.30
123.6	216.8	-0.03	0.04	27.78	21.93	-7.39	144.10
271.5	240.7	-0.08	0.06	25.04	30.60	13.19	242.40
-129.2	101.3	-0.0530**	0.03	15.23**	6.89	-60.82	55.73
36.0	95.8	0.00	0.02	7.18	7.80	8.70	57.82
49.0	92.5	0.01	0.02	3.37	7.01	80.78	62.20
-15.1	106.1	0.00	0.03	-2.78	9.59	166.4*	95.99
-8.6	126.9	0.02	0.03	-7.74	13.91	3.10	104.70
-239.4	149.1	-0.02	0.04	-23.69	16.81	-82.71	116.70
-392.2**	184.5	-0.01	0.04	-16.50	20.86	39.04	133.70
105.5	78.6	0.01	0.02	3.29	6.02	-19.71	49.68
2084		2174		1175		1307	
438		439		274		386	
0.03		0.02		0.02		0.03	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.4: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. VPs in companies without employees with a tertiary education prior to programme participation.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.690***	0.12	0.35	0.37	52.5	255.3
Treat=1 & t=2	0.426***	0.16	0.02	0.41	449.0	316.4
Treat=1 & t=3	0.00	0.19	0.41	0.47	79.6	332.1
Treat=1 & t=4	-0.19	0.24	-0.13	0.73	181.5	594.6
Treat=1 & t=5	-0.27	0.34	-1.05	0.91	-478.5	729.5
t=1	0.02	0.10	0.27	0.31	132.5	218.4
t=2	0.03	0.13	0.03	0.43	-251.3	293.7
t=3	0.08	0.15	0.17	0.54	296.5	359.3
t=4	0.07	0.20	0.50	0.74	485.9	498.9
t=5	0.10	0.28	1.512*	0.85	112.8	625.3
Year dummies						
2003	0.07	0.10	-0.16	0.38	-475.2*	286.9
2004	0.09	0.10	0.33	0.41	117.2	270.9
2005	0.07	0.08	0.42	0.43	34.4	263.7
2006	0.05	0.11	0.46	0.49	307.5	321.8
2007	0.00	0.13	0.33	0.51	181.1	351.2
2008	-0.11	0.15	-0.08	0.61	-509.3	379.6
2009	-0.26	0.17	-2.371***	0.68	-1222***	453.6
Constant	0.03	0.07	0.33	0.36	327.3	240.6
Number of observations:	1711		1716		1671	
Number of companies:	347		348		342	
R-squared	0.07		0.12		0.07	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
58.0	126.6	0.00	0.03	15.72	13.69	9.63	91.46
155.5	145.1	-0.02	0.03	3.22	12.19	170.70	115.10
95.1	148.7	-0.01	0.03	-24.15	16.50	-58.23	95.90
114.6	284.5	-0.03	0.05	14.08	21.63	-37.22	140.10
-17.5	310.1	0.00	0.07	-29.47	36.69	-74.40	226.50
16.3	113.6	0.00	0.03	-15.93	15.31	-80.51	91.12
-124.6	121.6	-0.03	0.03	0.61	14.47	76.28	103.30
141.5	155.4	-0.02	0.03	19.23	18.95	101.50	108.50
161.9	253.2	0.00	0.04	-3.87	25.53	-108.10	129.00
126.8	271.7	-0.135**	0.06	0.94	34.50	51.62	236.80
-124.8	97.9	0.01	0.02	14.56*	7.53	-167.1*	89.11
-34.4	106.1	0.01	0.02	2.25	8.26	-60.30	66.77
-9.4	88.2	0.01	0.02	0.58	10.18	-73.07	92.82
-92.3	113.0	0.02	0.03	6.07	12.99	13.41	99.39
-86.0	127.4	-0.03	0.03	4.48	16.76	-107.60	116.80
-372.3**	149.0	-0.01	0.03	-4.13	20.49	-168.70	132.30
-551.5***	191.3	0.00	0.04	7.49	23.38	-81.89	134.90
161.7**	76.6	0.00	0.02	3.07	7.30	83.71	71.79
1620		1686		1010		1168	
345		347		230		215	
0.04		0.03		0.02		0.04	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.5: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Companies in manufacturing industries and contruction.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.675***	0.20	0.61	0.85	383.2	506.1
Treat=1 & t=2	0.37	0.29	-0.47	0.79	623.6	610.9
Treat=1 & t=3	-0.25	0.27	0.40	0.90	1010.0	760.4
Treat=1 & t=4	-0.18	0.43	-0.10	1.29	220.3	1454.0
Treat=1 & t=5	-0.14	0.49	-1.61	1.36	-2228.0	3169.0
t=1	-0.07	0.15	0.39	0.64	161.8	433.3
t=2	-0.22	0.22	0.29	0.86	-117.0	530.1
t=3	-0.03	0.21	1.09	1.05	385.7	709.5
t=4	-0.28	0.37	0.95	1.37	958.8	1008.0
t=5	0.02	0.23	3.974***	1.23	2767.0	2760.0
Year dummies						
2003	-0.11	0.27	0.45	0.72	-438.8	614.6
2004	0.09	0.25	0.91	0.82	480.5	598.5
2005	-0.05	0.21	1.43	0.88	212.1	617.4
2006	-0.07	0.22	1.40	0.99	987.6	660.3
2007	-0.04	0.27	1.06	0.97	491.2	686.3
2008	-0.07	0.27	0.14	1.24	-530.1	688.6
2009	-0.22	0.29	-3.382**	1.40	-1705**	845.5
Constant	0.15	0.20	-0.32	0.72	100.1	527.1
Number of observations:	643		667		640	
Number of companies:	125		128		126	
R-squared	0.07		0.17		0.11	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
0.2	200.4	-0.04	0.04	15.16	15.91	-48.80	102.20
67.4	226.3	-0.04	0.04	-21.46	14.91	165.80	101.60
378.3	257.3	-0.05	0.05	-25.78	22.17	-76.95	135.60
159.7	695.7	-0.09	0.09	38.30	29.98	-5.01	240.00
-289.4	393.7	-0.08	0.08	-160.2*	82.57	-417.10	409.70
176.8	172.5	-0.03	0.03	-19.52	15.82	-22.15	107.00
65.6	197.9	-0.04	0.04	-13.16	16.90	75.43	130.50
178.8	266.5	-0.05	0.05	7.90	23.95	26.12	184.40
274.7	560.0	-0.07	0.07	-42.36	27.50	39.84	244.60
0.0	0.0	-0.14	0.14	76.77	67.54	405.70	481.60
110.2	215.9	-0.03	0.03	14.69*	8.25	-45.30	68.40
100.8	231.5	-0.02	0.02	19.67**	9.03	49.33	69.99
139.5	173.5	-0.02	0.02	4.48	5.95	6.06	67.65
121.7	217.0	-0.03	0.03	29.13**	11.75	120.40	121.30
0.7	228.7	-0.03	0.03	34.80*	20.13	20.63	145.40
-294.3	272.4	-0.04	0.04	32.23	20.59	-74.83	194.10
-516.3	368.1	-0.05	0.05	31.22	24.77	-66.23	246.80
3.5	159.2	0.01	0.01	-7.64	5.32	24.76	64.36
612		660		463		532	
128		128		98		98	
0.04		0.05		0.07		0.05	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.6: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Companies in service industries

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.27	0.17	0.619**	0.28	178.0	271.4
Treat=1 & t=2	0.24	0.20	0.11	0.41	157.0	267.0
Treat=1 & t=3	0.30	0.25	0.55	0.45	-75.1	413.6
Treat=1 & t=4	-0.16	0.29	-0.69	0.65	269.1	407.7
Treat=1 & t=5	-0.30	0.30	-0.45	0.69	-758.7	565.8
t=1	0.03	0.15	-0.18	0.25	-95.7	250.1
t=2	0.00	0.18	-0.35	0.34	-134.4	254.9
t=3	-0.34	0.25	-0.775*	0.43	115.0	416.6
t=4	-0.01	0.26	-0.46	0.62	511.8	469.1
t=5	0.00	0.29	-0.07	0.64	878.6*	448.3
Year dummies						
2003	0.15	0.15	0.07	0.18	-288.5	243.6
2004	0.23	0.14	0.23	0.24	307.4	225.5
2005	0.22	0.14	0.02	0.24	65.0	206.1
2006	0.18	0.16	0.23	0.30	163.7	243.8
2007	0.23	0.21	0.22	0.36	83.9	291.3
2008	0.13	0.23	0.43	0.38	-373.1	365.6
2009	0.03	0.26	-0.49	0.45	-796.4**	399.1
Constant	-0.04	0.12	0.433**	0.21	340.2*	199.4
Number of observations:	1434		1492		1430	
Number of companies:	300		304		293	
R-squared	0.02		0.06		0.04	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-107.4	118.2	-0.04	0.03	1.60	22.15	-99.96	184.50
133.6	130.3	-0.0702*	0.04	23.14	19.69	-148.10	221.60
40.3	145.6	-0.0692*	0.04	-13.65	25.40	-255.60	172.20
161.7	224.9	-0.02	0.05	27.89	30.68	-53.12	255.70
65.6	236.3	-0.03	0.10	-5.02	41.22	-15.26	466.20
-76.4	111.0	-0.03	0.03	-18.10	22.37	-75.44	169.40
-178.6	131.9	-0.02	0.04	-2.07	21.77	162.60	177.30
-22.0	165.4	-0.03	0.04	-14.01	27.33	181.50	179.50
56.4	236.5	-0.05	0.05	-6.00	41.05	2.36	220.80
271.1	270.5	-0.10	0.08	-15.28	39.36	-113.40	356.90
-197.0*	118.3	-0.0709*	0.04	15.75	10.89	-176.80	116.90
179.0*	92.0	0.03	0.03	2.12	15.19	-32.71	121.00
65.3	103.4	0.01	0.04	14.59	16.26	49.76	124.00
100.1	118.0	0.03	0.04	4.45	16.37	126.20	157.40
32.1	134.5	0.02	0.04	18.34	23.56	-16.60	164.20
-105.6	156.8	0.00	0.05	2.49	29.14	-185.10	179.40
-335.3*	191.1	0.01	0.06	13.96	33.24	-5.86	187.10
59.4	86.5	0.01	0.03	1.98	12.72	13.71	107.70
1420		1444		634		722	
300		302		159		142	
0.05		0.03		0.03		0.03	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.7: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Companies in 'other' industries

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.670***	0.23	0.93	0.74	253.8	451.0
Treat=1 & t=2	0.44	0.33	0.30	0.64	541.6	546.5
Treat=1 & t=3	-0.42	0.38	-0.57	0.94	-548.7	581.5
Treat=1 & t=4	-0.11	0.37	-0.18	1.57	-656.4	839.1
Treat=1 & t=5	-0.03	0.65	-0.92	1.58	150.0	733.3
t=1	-0.04	0.23	-0.02	0.60	-70.8	416.4
t=2	0.07	0.27	-0.06	0.71	-467.1	616.7
t=3	0.28	0.39	-0.18	0.92	-210.0	640.7
t=4	0.06	0.53	0.43	1.21	-651.9	799.8
t=5	0.19	0.72	0.91	1.25	-1383.0	1119.0
Year dummies						
2003	-0.08	0.26	-0.61	0.47	-182.5	335.3
2004	-0.25	0.20	-0.01	0.53	57.0	434.0
2005	-0.35	0.23	-0.13	0.51	282.4	393.3
2006	-0.28	0.30	-0.44	0.63	-85.5	485.6
2007	-0.45	0.37	-0.24	0.82	324.9	612.0
2008	-0.806*	0.46	-0.61	0.96	-105.5	660.1
2009	-0.45	0.55	-2.684***	0.97	-257.5	906.3
Constant	0.374*	0.19	0.914**	0.44	233.3	298.5
Number of observations:	532		568		541	
Number of companies:	110		114		114	
R-squared	0.07		0.12		0.06	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
33.9	251.8	-0.02	0.05	10.97	14.59	91.45	142.50
101.2	298.5	-0.03	0.05	12.11	14.07	238.20	175.10
26.8	336.2	0.00	0.05	-18.98	19.72	-61.10	177.20
248.8	413.3	-0.09	0.09	-31.56	32.56	-63.79	152.20
24.6	241.0	-0.03	0.03	40.93	34.04	-188.00	264.70
154.2	237.0	0.01	0.05	2.13	19.13	59.35	144.00
-44.4	282.5	-0.06	0.07	18.42	17.63	21.04	162.50
140.6	318.4	-0.03	0.06	41.87	26.48	186.10	161.50
-266.0	432.8	-0.02	0.08	49.64	32.94	89.03	170.50
-259.3	459.0	-0.08	0.07	8.49	39.20	265.60	287.80
-108.7	174.2	-0.03	0.04	21.23*	12.66	-201.00	189.30
-354.1**	171.2	-0.04	0.05	7.11	11.21	-124.40	107.80
6.3	227.6	0.02	0.04	-2.79	14.73	-218.50	201.00
-401.5*	240.2	-0.01	0.05	-6.87	16.59	-158.40	215.50
26.0	344.1	0.03	0.06	-23.19	24.68	-279.20	204.20
-307.0	357.7	-0.02	0.06	-27.97	27.68	-311.00	226.30
-273.9	409.5	0.02	0.07	-23.52	36.09	-315.10	258.40
189.3	166.5	0.00	0.03	2.66	10.41	173.80	141.40
521		565		405		439	
114		114		89		83	
0.06		0.03		0.04		0.03	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.8: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Male VPs.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.390**	0.15	0.665*	0.40	354.9	310.2
Treat=1 & t=2	0.523***	0.18	0.39	0.44	429.9	301.0
Treat=1 & t=3	0.18	0.24	0.933*	0.52	308.0	436.8
Treat=1 & t=4	-0.05	0.26	0.13	0.68	333.1	605.4
Treat=1 & t=5	0.05	0.28	-0.19	0.78	-532.8	635.7
t=1	-0.09	0.13	-0.07	0.32	-215.0	280.9
t=2	-0.21	0.18	-0.41	0.44	-391.1	316.6
t=3	-0.31	0.23	-0.68	0.54	-281.8	456.2
t=4	-0.17	0.25	-0.32	0.71	329.6	516.9
t=5	-0.16	0.32	0.32	0.75	254.0	628.9
Year dummies						
2003	0.02	0.18	0.11	0.32	-284.2	315.5
2004	0.16	0.15	0.55	0.38	545.6*	311.3
2005	0.06	0.14	0.50	0.41	247.3	309.1
2006	0.07	0.17	0.66	0.48	723.6**	351.6
2007	0.24	0.20	0.71	0.48	513.9	401.7
2008	-0.04	0.23	0.61	0.57	-48.9	429.1
2009	0.02	0.26	-0.89	0.65	-631.3	529.3
Constant	0.05	0.13	0.08	0.34	81.5	269.0
Number of observations:	1605		1666		1585	
Number of companies:	331		336		327	
R-squared	0.03		0.06		0.05	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-90.9	130.5	-0.03	0.03	5.67	17.47	3.25	122.90
192.3	144.9	-0.04	0.04	-2.21	14.71	104.10	139.50
39.8	153.4	-0.01	0.04	-27.79	18.29	-211.8*	117.10
198.4	283.4	0.00	0.05	33.80	21.22	-28.19	181.00
-208.6	233.9	-0.05	0.08	-59.65	36.94	-8.74	276.50
96.0	119.4	-0.02	0.03	-22.36	18.49	3.28	114.80
-108.7	146.8	-0.06	0.04	3.95	17.31	140.50	134.70
188.9	169.9	-0.04	0.04	13.10	22.52	165.40	136.30
263.3	253.6	-0.03	0.05	-14.17	28.77	51.63	162.10
552.6*	290.8	-0.08	0.06	13.29	36.89	84.58	251.20
-115.0	126.4	-0.03	0.03	16.51**	7.78	-97.60	66.09
78.4	121.8	0.02	0.02	6.10	10.08	-44.83	71.81
-12.9	112.2	0.01	0.03	11.56	12.43	-18.77	78.32
19.6	133.4	0.05	0.03	15.95	13.89	120.10	105.90
-79.9	152.2	0.04	0.04	13.88	19.70	-135.60	125.40
-295.5*	171.3	-0.01	0.04	10.00	23.55	-218.40	139.40
-608.3***	214.6	0.00	0.05	2.84	28.28	-135.40	154.00
113.9	95.1	-0.01	0.02	-1.53	8.62	46.79	63.64
1547		1628		898		1032	
334		336		214		199	
0.04		0.03		0.03		0.05	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.9: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. Female VPs.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.580***	0.17	0.51	0.45	24.4	279.2
Treat=1 & t=2	0.03	0.22	-0.54	0.52	277.6	393.4
Treat=1 & t=3	-0.29	0.21	-0.58	0.61	-31.2	464.4
Treat=1 & t=4	-0.30	0.35	-1.27	1.12	-192.4	658.6
Treat=1 & t=5	-0.80	0.49	-1.53	1.02	-642.9	1242.0
t=1	0.07	0.14	0.10	0.36	248.3	240.5
t=2	0.16	0.19	0.27	0.45	-140.2	344.3
t=3	0.11	0.23	0.22	0.64	330.3	440.7
t=4	0.01	0.33	0.13	0.94	-39.9	601.3
t=5	0.31	0.32	1.674*	0.86	827.2	1072.0
Year dummies						
2003	-0.03	0.14	-0.25	0.36	-381.7	233.4
2004	-0.09	0.14	0.04	0.37	-72.9	249.8
2005	-0.06	0.14	0.12	0.38	7.5	210.1
2006	-0.06	0.18	0.06	0.43	-216.8	270.9
2007	-0.361*	0.21	-0.21	0.57	-60.3	331.7
2008	-0.25	0.25	-0.38	0.65	-645.1	396.8
2009	-0.36	0.32	-2.392***	0.77	-1034**	434.4
Constant	0.229*	0.12	0.747**	0.35	498.4**	192.7
Number of observations:	1004		1061		1026	
Number of companies:	204		210		206	
R-squared	0.06		0.14		0.05	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
15.0	134.2	-0.03	0.03	13.67	12.56	-117.00	147.30
51.2	175.9	-0.03	0.04	18.14	13.81	-23.48	165.90
279.7	200.8	0.01	0.04	-12.73	19.98	-23.92	148.50
241.2	347.2	-0.108*	0.06	-20.79	29.18	-63.13	194.40
176.7	297.4	-0.03	0.11	58.27	36.94	-571.6*	313.80
-74.9	119.5	0.01	0.03	0.98	11.76	-108.10	134.00
-173.5	143.0	0.01	0.03	-4.02	13.02	-14.89	110.10
-217.4	191.9	-0.03	0.04	7.51	17.31	-3.76	133.50
-418.2	324.6	0.01	0.06	24.47	26.46	-33.94	164.80
-497.3*	270.9	-0.05	0.10	-35.51	32.44	249.60	323.70
-63.7	125.3	-0.06	0.04	19.05*	9.62	-209.30	163.20
11.3	115.4	0.00	0.04	14.57	8.94	-17.98	107.20
183.9	125.5	0.00	0.03	3.99	8.03	-48.35	155.80
-28.7	131.5	-0.04	0.04	3.92	10.40	-63.25	169.10
192.6	168.6	-0.01	0.04	11.08	16.59	61.72	161.40
-28.4	188.8	-0.04	0.05	-5.40	17.29	-93.17	180.10
21.2	218.8	-0.01	0.05	19.74	20.54	-8.21	206.20
23.1	102.8	0.02	0.03	-2.26	6.70	84.41	124.00
1006		1039		597		661	
208		208		132		124	
0.03		0.03		0.04		0.03	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.10: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. VPs with a tertiary education.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.533***	0.18	0.48	0.43	206.2	287.9
Treat=1 & t=2	-0.06	0.21	-0.63	0.52	281.6	376.1
Treat=1 & t=3	-0.28	0.29	0.27	0.51	-432.1	399.5
Treat=1 & t=4	-0.15	0.31	-1.577**	0.64	313.6	397.5
Treat=1 & t=5	-0.570**	0.29	-1.20	1.02	-1277*	711.0
t=1	-0.07	0.15	-0.16	0.31	-211.0	259.5
t=2	-0.05	0.18	-0.37	0.37	-440.3	332.4
t=3	-0.21	0.25	-0.62	0.49	383.1	436.5
t=4	-0.16	0.25	0.50	0.60	294.4	489.5
t=5	0.04	0.28	0.55	0.67	1023**	498.8
Year dummies						
2003	0.26	0.16	-0.42	0.37	-87.3	272.5
2004	0.10	0.17	0.02	0.40	328.3	264.6
2005	0.26	0.18	-0.05	0.35	179.6	240.2
2006	0.23	0.20	-0.01	0.41	198.6	279.3
2007	0.30	0.23	0.19	0.51	313.0	365.7
2008	0.02	0.27	0.24	0.52	-320.2	404.2
2009	0.14	0.30	-1.182*	0.63	-696.4	473.5
Constant	-0.06	0.16	0.577*	0.34	219.8	214.3
Number of observations:	1177		1239		1186	
Number of companies:	251		257		250	
R-squared	0.05		0.08		0.05	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
146.6	146.6	-0.04	0.04	20.51	21.29	-79.42	162.80
164.1	164.1	-0.06	0.05	6.89	20.56	7.22	184.90
197.4	197.4	-0.01	0.05	-35.96	30.15	-413.1**	175.80
296.2	296.2	-0.03	0.06	13.84	31.59	140.30	237.30
236.7	236.7	-0.167*	0.09	-22.74	60.93	-714.2**	309.20
140.3	140.3	-0.03	0.03	-20.35	21.33	-0.79	155.20
148.6	148.6	-0.06	0.04	-6.48	19.92	239.30	154.70
199.4	199.4	-0.05	0.04	-3.69	23.96	301.7*	164.50
274.7	274.7	-0.04	0.06	-9.57	36.18	-6.43	194.90
343.0	343.0	-0.10	0.06	4.62	29.02	679.1**	299.60
164.9	164.9	-0.06	0.04	10.16	12.16	-220.4*	127.40
130.6	130.6	0.00	0.04	-1.77	15.68	-203.5*	116.70
126.1	126.1	0.00	0.04	6.54	16.66	-116.30	132.30
142.1	142.1	0.02	0.04	0.26	16.46	-90.73	151.20
167.1	167.1	0.02	0.05	26.97	22.13	-204.00	147.50
189.6	189.6	0.01	0.05	-3.31	25.36	-343.4*	178.30
234.3	234.3	0.03	0.06	15.84	26.69	-216.70	182.00
111.3	111.3	0.01	0.03	-0.83	12.81	172.20	117.50
1179		1208		624		732	
256		256		157		146	
0.04		0.03		0.04		0.05	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.11: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. VPs with degrees in art&humanities

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.40	0.33	-0.24	0.74	-585.4	479.1
Treat=1 & t=2	-0.473*	0.26	-1.486*	0.76	90.0	532.2
Treat=1 & t=3	-0.53	0.32	0.33	0.68	-118.4	734.4
Treat=1 & t=4	-0.32	0.69	-0.36	1.15	-588.1	1190.0
Treat=1 & t=5	-0.53	0.71	0.96	1.17	541.7	952.4
t=1	-0.13	0.21	0.15	0.42	220.7	396.2
t=2	-0.11	0.23	-0.24	0.52	-519.9	485.4
t=3	-0.04	0.29	-0.69	0.64	-241.8	629.0
t=4	-0.22	0.49	-1.830*	0.98	619.9	795.6
t=5	-0.11	0.36	-0.13	0.98	316.3	759.0
Year dummies						
2003	0.16	0.26	0.90	0.61	78.5	370.6
2004	0.22	0.23	0.87	0.63	175.4	307.9
2005	0.580**	0.22	0.81	0.68	-59.8	302.1
2006	0.27	0.32	0.84	0.68	-98.9	369.8
2007	0.38	0.32	1.20	0.83	128.9	439.7
2008	0.18	0.36	1.38	0.89	-171.3	557.0
2009	0.43	0.39	0.00	0.96	-285.9	464.9
Constant	-0.16	0.21	-0.18	0.62	349.3	270.5
Number of observations:	366		377		374	
Number of companies:	79		80		78	
R-squared	0.06		0.14		0.04	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-310.9	241.5	-0.06	0.06	26.45	25.89	-332.90	304.30
225.6	252.0	-0.07	0.07	6.66	27.80	-339.00	432.00
56.4	356.6	-0.08	0.08	-5.97	54.10	-293.00	323.30
-1233.0	849.7	-0.17	0.17	-2.70	67.91	-435.9*	255.10
-250.1	847.8	-0.19	0.19	0.00	0.00	0.00	0.00
-130.5	243.6	-0.05	0.05	-12.28	24.17	31.47	376.00
-423.7*	215.5	-0.07	0.07	-24.61	27.57	392.70	409.80
-304.1	338.8	-0.07	0.07	-15.68	43.30	156.80	361.60
909.4	674.0	-0.18	0.18	4.38	39.65	63.65	232.50
341.1	703.5	-0.10	0.10	-16.95	45.84	495.30	327.90
18.3	176.9	-0.08	0.08	-3.70	26.77	-2.09	351.50
47.2	134.7	-0.08	0.08	-12.41	32.46	-11.39	312.40
99.2	147.3	-0.08	0.08	-19.93	21.77	95.89	316.00
143.3	166.6	-0.09	0.09	-17.82	27.03	194.20	393.80
102.2	221.8	-0.09	0.09	6.56	33.61	195.40	316.70
145.3	260.5	-0.10	0.10	-16.19	42.94	14.77	379.90
76.8	294.6	-0.11	0.11	29.41	49.11	56.61	392.80
18.2	113.1	0.08	0.08	6.67	21.30	-87.24	320.30
370		365		183		224	
79		79		44		44	
0.06		0.08		0.07		0.06	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.12: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. VPs with degrees in social sciences.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.32	0.26	1.512***	0.52	896.0**	389.2
Treat=1 & t=2	0.05	0.30	-0.55	0.78	89.0	490.5
Treat=1 & t=3	-0.12	0.39	0.79	0.78	-333.9	435.6
Treat=1 & t=4	0.07	0.43	-0.38	1.01	1194*	661.3
Treat=1 & t=5	-0.16	0.33	0.31	1.55	449.3	899.2
t=1	-0.11	0.22	-0.997**	0.41	-805.9**	350.7
t=2	-0.04	0.28	-0.828*	0.45	-582.5	447.8
t=3	-0.67	0.41	-1.286**	0.53	353.1	461.1
t=4	-0.46	0.39	-0.59	0.85	-487.7	753.3
t=5	-0.18	0.45	-1.65	1.17	-22.4	921.3
Year dummies						
2003	0.01	0.23	-0.45	0.39	-506.4	362.3
2004	0.07	0.22	-0.02	0.49	32.3	283.6
2005	0.13	0.21	0.07	0.42	137.4	259.4
2006	0.18	0.24	0.26	0.50	228.8	342.6
2007	0.12	0.32	0.37	0.56	249.2	461.9
2008	0.22	0.36	0.67	0.57	-470.2	523.0
2009	0.12	0.43	-0.61	0.67	-610.7	668.2
Constant	0.10	0.18	0.65	0.40	444.6*	239.0
Number of observations:	630		658		621	
Number of companies:	127		130		124	
R-squared	0.04		0.09		0.07	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-31.8	206.1	-0.06	0.04	-6.09	27.41	-2.87	213.40
-32.2	204.4	-0.07	0.06	20.51	30.54	-155.00	242.20
-213.2	259.8	-0.05	0.04	-48.35	32.39	-387.40	239.20
541.7	364.3	-0.09	0.08	35.91	29.57	297.70	301.30
24.8	390.6	-0.07	0.05	33.74	21.08	-636.4*	323.10
-176.0	204.1	-0.02	0.04	-21.91	26.86	-25.13	148.10
-169.5	223.3	-0.04	0.05	9.09	25.73	321.1**	141.70
369.5	261.0	-0.01	0.05	-5.14	31.11	395.6**	196.90
-25.2	373.0	-0.03	0.07	-13.95	43.11	-126.50	183.50
273.3	452.1	-0.09	0.10	13.19	38.30	581.0*	339.10
32.6	160.9	0.0578*	0.02	-1.98	15.25	-191.30	131.00
172.8	148.7	0.0863**	0.03	-5.47	18.16	-73.31	145.50
257.8*	145.2	0.0983**	0.04	11.68	22.17	-90.01	162.80
152.4	168.3	0.07	0.04	-3.27	20.85	-154.90	157.80
117.9	226.0	0.05	0.05	22.46	28.50	-257.90	177.00
-212.0	237.9	0.11	0.05	-4.65	33.52	-421.0*	224.20
-364.7	317.6	-0.0649***	0.07	5.39	36.33	-215.60	218.40
12.3	117.2	-0.0649***	0.02	0.76	15.95	172.10	125.10
626		638		368		416	
129		130		85		79	
0.07		0.03		0.09		0.06	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

TABLE A.13: Comparison between VP-companies and companies in the reference group. Companies with up to 50 employees in year zero. Diff-in-diff fixed effects regression results. VPs with degrees in technical sciences.

Dependent variables (in first differences):	Number of highly educated employees[1]		Number of employees		Value added (DKK1,000)[2]	
	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
Treat=1 & t=1	0.516**	0.21	-0.11	0.58	-282.6	383.9
Treat=1 & t=2	0.417*	0.24	0.44	0.53	915.7*	466.0
Treat=1 & t=3	-0.08	0.30	0.19	0.72	283.7	645.6
Treat=1 & t=4	-0.17	0.34	0.05	0.93	-103.5	904.3
Treat=1 & t=5	-0.17	0.39	-2.006***	0.70	-1962*	991.6
t=1	0.09	0.17	0.921*	0.51	745.2**	355.2
t=2	0.19	0.23	0.35	0.72	-154.7	441.8
t=3	0.09	0.25	0.89	0.88	517.3	673.9
t=4	0.11	0.31	0.96	1.06	1157*	692.2
t=5	0.08	0.40	3.272***	1.00	2082**	858.6
Year dummies						
2003	-0.10	0.23	-0.01	0.45	-441.7	393.0
2004	0.06	0.19	0.31	0.52	579.8	443.9
2005	-0.14	0.18	0.47	0.57	104.6	419.3
2006	-0.20	0.22	0.32	0.73	552.6	489.5
2007	-0.16	0.26	-0.06	0.79	207.8	538.8
2008	-0.41	0.29	-0.58	0.90	-625.7	566.5
2009	-0.31	0.30	-2.893***	1.05	-1549**	666.5
Constant	0.14	0.17	0.30	0.45	129.1	352.2
Number of observations:	932		985		926	
Number of companies:	187		193		190	
R-squared	0.05		0.10		0.09	

Notes: Only observations with annual changes in the number of employees of less than 12. *, **, *** denote statistical significance at the 10%, 5%, and 1% significance level.

1. Employees with post-secondary or tertiary education. Only observations with annual changes in the number of employees with post-secondary and tertiary education < 5.

Net income (DKK1,000)[3]		Return on assets[4]		Wage per employee (DKK1,000)[5]		Labour productivity (DKK1,000)[6]	
Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.	Coeff.	Ste.
-168.3	172.7	-0.01	0.04	27.09	19.75	-55.06	130.90
337.1	217.5	-0.04	0.05	-3.78	14.09	230.80	148.80
260.3	206.9	0.01	0.05	-19.81	23.65	-12.40	97.78
134.9	414.8	0.01	0.06	47.24*	27.10	-104.30	205.20
-333.1	230.7	-0.10	0.10	-58.75	49.85	-63.98	370.80
413.9***	150.8	0.00	0.04	-29.64	20.67	50.05	137.80
-6.6	186.6	-0.01	0.05	-23.62	19.63	-8.47	160.20
339.9	208.4	0.00	0.05	-3.06	26.29	-10.69	176.70
403.0	339.2	0.04	0.06	-57.71*	32.57	63.38	235.40
701.6**	276.1	0.03	0.07	-20.32	52.61	82.76	352.10
-218.3	167.4	-0.0717*	0.04	21.43***	7.97	-203.60	123.00
35.5	166.6	0.00	0.03	23.56***	8.29	-31.67	84.93
-169.1	144.1	-0.05	0.04	15.60*	8.73	-155.00	125.70
-171.8	174.6	-0.03	0.05	40.25***	15.14	111.30	154.60
-260.2	176.9	0.00	0.05	36.60	22.51	-105.00	192.80
-497.4**	220.2	-0.09	0.05	39.29	28.01	-143.90	204.90
-874.0***	264.0	-0.09	0.07	39.78	31.08	-130.50	246.20
188.7	118.9	0.04	0.03	-11.02*	6.52	76.85	95.41
894		977		557		647	
192		193		125		119	
0.06		0.03		0.04		0.05	

2. Only observations with annual change in the value added of less than DKK 10 mio.
3. Only observations with annual change in net income of less than DKK 3 mio.
4. Only observations with annual change in roa of less than 1, and total assets > DKK 100,000.
5. Only observations with number of employees > 5. Only observations with change in average wage < DKK 500,000.
6. Only observations with number of employees > 5 and change in labour productivity < DKK 3 mio.

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