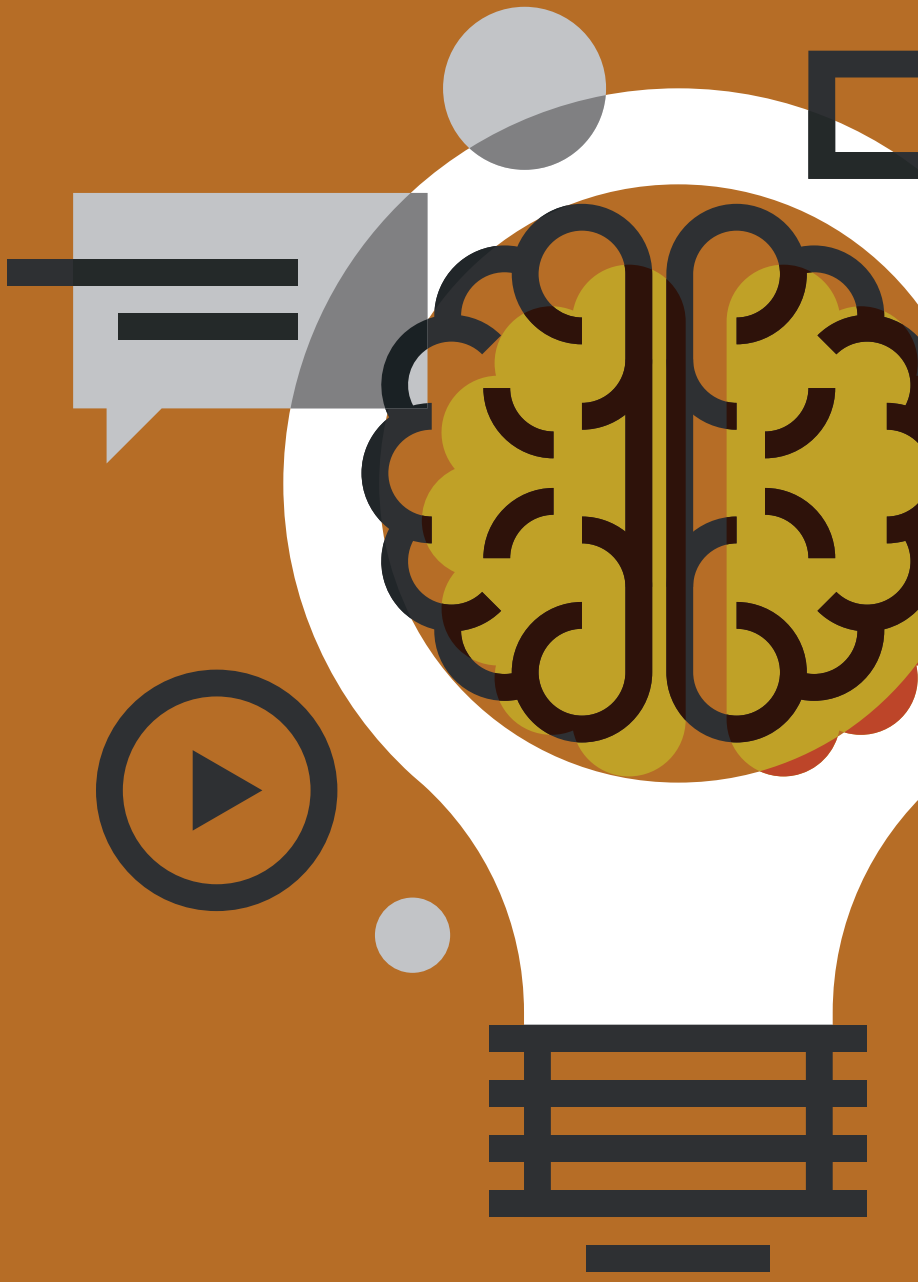
growth analysis

A part of the framework project **"How can public support measures stimulate increased collaboration in order to enhance innovation?"**



WORKING PAPER 2018:01 | Daniel Halvarsson | Patrik Tingvall | Erik Engberg

The effects of innovation subsidies on growth in small firms

What role does collaboration play?

SWEDISH INNOVATION POLICY has become increasingly characterized by various cooperative programs, where cooperation and "co-production" between organizations is meant to generate growth and spillovers. In this working paper we evaluate growth effects on small Swedish firms that have participated in a number of R&D subsidy programs administered by Vinnova.

About Growth Analysis' working paper series

The Swedish Agency for Growth Policy Analysis' (Growth Analysis) working paper series presents research reports that are written as parts of our framework projects.

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Under rubriken working paper presenterar Myndigheten för tillväxtpolitiska utvärderingar och analyser (Tillväxtanalys) forskningsuppsatser som utgör underlag i våra ramprojekt.

Materialet tas fram i samarbete med externa forskare och kvalitetsgranskas enligt gängse sätt i akademin. Författarna står själva för innehållet i publikationen och deras slutsatser och rekommendationer delas inte nödvändigtvis av Tillväxtanalys.

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Summary

In recent years, it has been suggested that increased collaboration and interaction among academia, industry and government is a key component of fostering innovation and growth. This notion of collaboration as a growth-enhancing engine has impacted the policies implemented in Sweden. For example, in prop. 2016/17:50, the Swedish Government pointed to the need for academia to strengthen its links with other parts of the economy, and several publicly sponsored support programmes include collaboration between business and academia as a key component. Such interventions are often driven by a sense that more needs to be done to ensure that publicly funded research in universities and research institutes "trickles down" and benefits the private sector.

The idea of the government as a financier and/or an intermediary connection point for collaboration in research and innovation is not new. In Sweden, as in most comparable countries, there has historically been substantial R&D cooperation between the government and business. Prior to the 1980s, the government subsidized large R&D investments in private firms developing technologies of strategic importance, such as energy, telecommunications and defence. Ever since, successive iterations of collaborative R&D programs have been instituted.

Given the efforts to achieve increased collaboration between business and academia – efforts where the government, to some extent, takes the role of an intermediary – there have been surprisingly few quantitative, counterfactual, firm-level studies on the real impact of subsidized R&D collaboration on firm performance and growth.

In this study, we analyse a specific form of collaboration, namely how the composition of project participants in publicly funded support programmes impacts the growth of small participating firms (firms with fewer than 50 employees). To this end, we have obtained detailed information on all participants, including universities, research institutes, and private firms, in all projects approved by the Swedish innovation agency Vinnova.

Specifically, we study 1,300 small firms, which participated in 65 publicly funded innovation aid programmes administered by Vinnova, the Swedish government innovation agency, during the period 2010–12. Over two thirds of the small firms applied for grants as part of R&D-consortia, with partners such as universities, research institutes and other firms. That is, projects run as collaborations between at least two participants are the dominant form of project group design.

As indicated above, a unique feature of these data is that we can identify the main applicant in each project and also have detailed information on all project members, their budget shares and their roles in the project. We are able to merge these data with register data on all firms in the economy, which gives us information on the number of employees, profits, skill composition, investments, etc. for the project participants as well as non-project participants. In combination, this information enables us, for the first time using Swedish data, to analyse how the composition of the project group influences the impact of a given grant; we are also able to compare the outcomes with those of similar non-treated firms.

Large R&D programmes typically have multiple objectives. Here, we limit the analysis to focus on three growth-related outcomes, namely sales, employment, and capital stock. Reasons for choosing these outcomes include not only ambiguity regarding what type of

growth the programmes are targeting but also the fact that the outcomes are interrelated aspects of the firm's production. The grants may have not only a direct impact on sales but also an indirect impact on sales via employment- and investment effects, which in turn may have an impact on sales. In this study, we will take a closer look at these inter-dependencies, broadening our view of the ways in which a grant can impact firm growth.

We also note that the government has instructed Vinnova to report changes in employment, sales, and value added among treated firms after programme completion.

In regard to project group composition and programme design, we will study how the impact of the grants varies with respect to the following:

- How many projects the firm has participated in.
- The number of project participants.
- Type of project participants (universities, large private firms, research institutes).
- Whether the studied firms had the role of project leader.
- Whether the studied firm is a subsidiary of a corporate group.

The study has two main goals:

- Increase our knowledge of how project group composition impacts growth among the small private firms participating.
- Give policy recommendations in order to enhance future programme evaluations.

The results of the study can be summarized as follows.

The results suggest that during the project period, the grants led, on average, to increased sales growth of about three percentage points, which, after the project ended, increased to approximately six percentage points. Looking at the firms' size distribution, the growth enhancing effect was largest among firms with 10–49 employees and not significant for micro firms with 1–9 employees. A possible explanation for this is that it may be difficult to identify firms with high growth potential when they are small and young, i.e., when they have a short history and there is a limited amount of information available about them.

Sales among firms that participated in only one project developed significantly more weakly than did sales among multi-project firms. This may be because firms that participate in a non-successful project do not return for further project participation; additionally, among returning firms, the agency may filter out firms with poor track records.

In regard to employment, there were mostly no significant employment effects.

Running project(s) with universities or research institutes seems to lead to decreases in physical capital stock. This could be because firms that seek this type of collaboration aim to strengthen their human capital rather than their physical capital stock.

We classified the programmes according to the extent to which they targeted the growth and/or the collaboration of participating firms. However, we did not find any significant relationship between the objectives of the programmes and their impacts on firm growth.

We would like to note that the results are not fully robust with respect to model formulation and estimation technique. Hence, the results should be interpreted with caution.

We would also like to emphasize that even if there are indications of positive growth effects, we cannot evaluate the overall welfare effects generated by these programmes. Although our findings on firm growth contribute to the picture, the subsidies may have important effects that we do not measure in this study.

As a final word, it is worth mentioning that there is a lack of deeper knowledge about the real effects on firm performance of different forms of collaboration. This is a knowledge gap that is not unique to Sweden, but it does have a silver lining. With the MISS database collected at the Swedish Agency for Growth Policy Analysis, featuring data on a wide range of selective firm subsidies, we are now able to – maybe for the first time with firm-level data – empirically study the real effects of different forms of collaboration.

Sammanfattning

Forskare och beslutsfattare har under senare tid alltmer argumenterat för att samverkan mellan stat, näringsliv och universitet utgör en viktig komponent för uppkomst och spridning av idéer, innovation och tillväxt. Det finns dock få tidigare kvantitativa studier som analyserat hur olika offentliga forskningsprogram, där samverkan varit en central ingrediens i programmets utformning, de facto påverkat företagens ekonomiska utfall.

Samverkan mellan staten och näringslivet inom forskning och utveckling är inte något nytt. Fram till 1980-talet var statens upphandling av nya tekniska lösningar och system inom försvar, telekommunikation, elkraft och järnvägar det ekonomiskt största bidraget från staten till att utveckla en internationellt konkurrenskraftig industri. Sedan dess har en rad nya generationer av offentliga samverkansprogram etablerats med nya former för samverkan mellan stat, universitet och näringsliv inom forskning och utveckling.

Syftet med denna rapport har varit att genomföra en effektutvärdering av tillväxteffekterna på svenska småföretag (högst 50 anställda) av ett antal av Vinnovas FoU-stödprogram. Vad vi sålunda fokuserar på är en specifik form av samverkan, nämligen programmens tillväxteffekter på småföretag som deltar i de finansierade stödprogrammen.

Analysen omfattar cirka 1 300 småföretag som deltog i 65 stycken statliga stödprogram, riktade mot näringslivet och administrerade av Vinnova under perioden 2010–12. Över två tredjedelar av småföretagen sökte stöd i samverkan med aktörer såsom andra företag, universitet och forskningsinstitut. Projekt sökta i samverkan med andra aktörer är sålunda den dominerande projektformen.

En unik egenskap i våra data är att vi inte bara kan se huvudsökande i respektive projekt, vi kan även följa övriga projektdeltagare, oavsett om det varit ett universitet, forskningsinstitut, stort privat företag etc. Detta betyder att vi, kanske för första gången, i detalj kan analysera hur projektgruppens sammansättning påverkar effekten av ett givet stöd. Spelar det någon roll för de små företagen om universitet eller ett forskningsinstitut deltar; vilken betydelse spelar deltagande av ett stort privat företag, hur går det för ensamsökande företag och vilken betydelse har programmens mål och inriktning?

Stora FoU-program har normalt flera olika mål och ambitioner. Den avgränsning som görs här är att studera reala utfall, som utgörs av stödprogrammens effekt på antal anställda, omsättning och kapitalstock. Ett skäl till att vi studerar dessa utfall är att begreppet tillväxt kan syfta på en rad olika aspekter, och det kan därför vara värdefullt att inte enbart se till ett utfall. Det finns även en systematisk koppling mellan dessa variabler som gör det intressant att länka samman dessa. Både sysselsättning och investeringar kan påverkas av stöden, samtidigt som dessa variabler är kopplade till företagens omsättning. Med en systemansats kan vi här följa hur stöden påverkar företagens omsättning, såväl direkt som via sysselsättning och investeringseffekter. Med denna ansats ges därför en bred insyn på hur stöd via olika mekanismer kan påverka företagens ekonomiska utfall. Valet av utfallsvariabler kan även motiveras med att regeringen i sitt regleringsbrev till Vinnova explicit anger att myndigheten ska rapportera hur stödföretagen förändrat antalet anställda, omsättningen och förädlingsvärdet efter att de mottagit ett stöd.[1]

[1] Att vi inte följer utvecklingen av företagens förädlingsvärde beror delvis på att den är nära förknippad med företagens omsättningsutveckling.

Vad gäller projektgruppens komposition och tidigare erfarenhet av projektdeltagande ser vi här närmare på hur effekten av stödinsatserna påverkats av:

- Hur många projekt företagen deltagit i.
- Antal projektdeltagande (företag, universitet, forskningsinstitut, etc.).
- Om det i projektgruppen ingått något forskningsinstitut eller universitet.
- Om det ingått ett större privat företag (minst 1000 anställda).
- Om företaget innehaft rollen som projektledare.
- Betydelsen av att ingå i en koncern.

Målet är att projektet ska:

- Leda till ny kunskap och lärande om hur gruppkonstellation kan påverka utfallet av hur ett givet stöd påverkar projektdeltagande företags tillväxt.
- Utmynna i rekommendationer om vilken typ av information som behövs för att underlätta framtida planering och design av liknande program.

Resultaten i rapporten kan sammanfattas på följande sätt:

Resultaten tyder på att stöden typiskt sett lett till att stödföretagen under pågående projektlöptid ökat sin omsättning med cirka tre procent i förhållande till kontrollgruppen. Efter avslutad projektlöptid ökade denna siffra till cirka sex procent. Tillväxteffekten var dock begränsad till de mindre småföretagen (10–50 anställda) och inte statistiskt säkerställd för mikroföretag med 1–9 anställda.

Omsättningen bland företag som deltagit i endast ett projekt utvecklades signifikant sämre än bland företag som deltog i flera projekt. En tänkbar förklaring till detta ligger i att företag som inte deltar i ett lyckat projekt inte heller återkommer till ytterligare projektdeltagande samt att bland de företag som återkommer med en upprepad ansökan kan de sämsta företagen selekteras bort av anslagsgivaren. Överlag finner vi inga statistiskt säkerställda effekter på företagens sysselsättning.

Vad gäller betydelsen av deltagande från universitet och forskningsinstitut finner vi att företag som deltagit i projekt med universitet eller forskningsinstitut efter avslutat projekt har haft en svagare utveckling av sin kapitalstock än andra företag. En förklaring till detta kan ligga i att företag som söker samarbete med universitet och forskningsinstitut snarare söker stärka sitt humankapital än sitt fysiska kapital.

Vi finner vidare ingen evidens för att programmens inriktning påverkade tillväxten. Snarast är det projektdeltagandet som spelat roll medan programmens inriktning mot tillväxt eller samverkan haft en underordnad betydelse.

Överlag ger analysen stöd för slutsatsen att den positiva stödeffekten främst står att finna hos de större småföretagen med 10–50 anställda och som deltagit i flera projekt. Specifikt finner vi att i denna storleksklass var tillväxteffekten under pågående stödprogram cirka 5,5 procent för att efter avslutat program ha växt till cirka åtta procent. För de minsta företagen var tillväxteffekten inte statistiskt säkerställd. Dock är resultaten inte helt robusta med avseende på modellformulering och estimeringsteknik varför de bör tolkas med viss försiktighet.

Vi vill även understryka att även om positiva tillväxteffekter uppstår är det inte att likställa med att programmen varit samhällsekonomiskt lönsamma. Stödens positiva eller negativa effekt på företagens tillväxt är inte ett tillräckligt villkor för att dra slutsatser kring de samhällsekonomiska effekterna.

Vi vill understryka att det idag saknas en bredare och djupare kunskap om hur olika typer av samverkansstöd de facto påverkar företagens konkurrenskraft. Detta är en problematik som Sverige delar med många andra länder, men vi kan idag med kvantitativa metoder börja närma oss den frågan. Tillväxtanalys mikrodatabas över företagsstöd (MISS) möjliggör effektutvärderingar som tidigare inte har kunnat genomföras.

1 Introduction

In recent years, the argument has been made from several quarters that collaboration among government, the business world and academia plays an important role in the production and dissemination of new ideas and innovations. The fact that collaboration is regarded as important is highlighted in the government's research bill (prop. 2016/17:50), which emphasizes the urgency of stimulating collaboration between business and research institutions. In the instructions for the new national innovation council, established in February 2015, we also find the argument that one way to strengthen Sweden's competitiveness is via an active economic policy and research collaboration.[2]

So, what is meant by closer collaboration between different actors, and what is expected to be gained from such an effort? Collaboration is a broad concept that means "working towards a common goal." However, within enterprise policy, Etzkowitz's formulation of the Triple Helix concept constitutes a natural starting point (Etzkowitz, 2008). According to the Triple Helix model, interaction among government, business and the academic world is instrumental for the development and dissemination of ideas and technologies. In recent years, the government's role – as presented in this literature – has increasingly shifted from that of a controlling hand to more of an intermediary and creator of interfaces between relevant actors (Ranga and Etzkowitz, 2013).

The fact that ideas surrounding the importance of collaboration have had a substantial impact on policy is reflected in the policy executing agencies' work and instructions. For example, it is part of Vinnova's remit to "*enable different forms of collaboration between business, the public sector and the academic world within collaborative programmes"*. If we look at the policies implemented in Sweden, we have had, over the years, a number of state-financed actors, such as the "Technology bridging foundations", ALMI, incubators, and not least Vinnova, with objectives that include the promotion of increased collaboration. Similarly, there are organisations in the USA, such as SBIR (Small Business Innovation Research program), Advanced Technology Program (ATP) and Engineering Research Centres (ERCs), which try to play the role of technological intermediary.

How does Sweden compare to other countries in terms of research collaboration? In brief, there are indications that Sweden is a country that is well suited to innovative activities and where collaboration between academia and business is well developed. For example, in comparison with 33 OECD countries, Sweden ranks fourth in terms of both R&D expenditure as a proportion of GDP and the proportion of large companies that have innovative collaborations with universities or public research institutes (OECD, 2013). In terms of collaboration between business and universities, Finland tops this list, and Australia ranks last. With Australia's ranking in mind, it is hardly surprising that after reviewing its innovation system, Australia decided, on 6 May 2016, on a programme of measures intended to strengthen the country's innovation capacity, including measures aimed at strengthening collaboration between academia and business[3].

What do we know about the importance of collaboration within publicly funded R&D subsidy programmes? A number of qualitative studies in the field have shown that collaboration is often, but not always, perceived positively by the participating actors and

[2] http://www.regeringen.se/debattartiklar/2015/02/har-ar-mina-nya-innovationsradgivare-/
[3] https://www.education.gov.au/review-research-policy-and-funding-arrangements-0

that it has contributed to advancing R&D initiatives. For example, Laursen & Salter (2006) find that companies' knowledge-acquisition is positively related to their innovation capacity. In terms of learning, Love et al. (2014) find that companies that already have a history of collaboration seem to learn more through their collaborations.

If we look at the relationship between collaboration and outcome variables such as firm-level innovation and productivity, there is some evidence that collaboration with research institutions is associated with increased innovative capacity (Aschhoff & Schmidt, 2008; Lööf & Broström, 2008) and with increases in productivity (Arvanitis et al, 2008). Establishing the causality in these connections is challenging, however. The connection between collaboration and firm growth seems to be less researched than the connection between collaboration and innovation, and more detailed investigations of the impact of different types of collaboration – e.g., business-business vs. business-university – on growth are scarce. Hence, it seems relevant to analyse whether the impact of cooperation-oriented R&D subsidies on firm growth differs depending on the composition of actors in the funded R&D projects.

In light of this dearth of empirical evidence, there is a growing movement, not least within the OECD, that is emphasizing society's need for more evidence about the effects produced by various business-oriented policy instruments. As the OECD writes, "*Securing empirical evidence on the magnitude of R&D impacts and channels through which R&D promotes economic growth is a necessary first step for assessing the likely impact of public support for R&D and other policies intended to encourage R&D and innovation"* (page 3. OECD, 2015). The question of how effects are to be measured is high on the agenda of Swedish political debate, and a speech delivered by the Minister of Industry, Employment and Communications in 2016 was entitled "*from input to impact*".[4] The National Audit Office has also stressed the need for more evidence about the impacts of innovation policies (National Audit Office, 2016). We consequently recognize the urgency of using a counterfactual approach to tackle the question of how collaboration within state-funded R&D support programmes has influenced companies' growth. We are therefore focusing on a specific form of collaboration, namely growth effects in small companies that participate in state-funded R&D support programmes and where several collaborating actors participate in each R&D project.

1.1 Purpose and objective

Our intention in this report is to use a quantitative approach to assess whether participation in state-funded R&D support programmes affects companies' growth. Specifically, we want to study whether the project group's composition generates any added value for the small private companies that participate. The variables we specifically analyse are how subsidies and different forms of collaboration have affected companies' sales, employment and capital stock. In terms of the project group's composition and previous experience with project participation, we investigate how the effects of the subsidies have been affected by the following:

- How many subsidized R&D projects the companies have participated in.
- The number of project participants (company, university, research institute, etc.).
- Whether the project group included any research institute or university.

[4] "Rise day" with annual conference. Thursday 21 April 2016.

- Whether a large private company (at least 1,000 employees) has been involved.
- Whether the company held the role of project leader.

This report analyses approximately 1,300 small companies that participated in 65 publicly funded R&D support programmes, targeted at business and administered by Vinnova during the period 2010–12. The majority of the small companies applied for grants in consortia together with actors such as other companies, universities and research institutes. Our aim is thus to provide a picture of how the project group's composition de facto affects the growth of small companies when they participate in state-funded R&D support initiatives.

The aim is that the project will do the following:

- Lead to new knowledge and learning about how group constellations can affect how a particular subsidy programme affects the growth of participating companies.
- Result in recommendations regarding which type of information is needed to facilitate future planning and design of similar programmes.

1.2 Limitations

This report is delimited to specifically studying the effects of 65 support programmes during the period 2010–12. The effects studied are growth effects – with respect to sales, employment and capital stock – derived from grants for private companies with a maximum of 50 employees. Consequently, it is not possible to draw any conclusions about whether the programmes contributed to other desirable effects such as increased cross-sector collaboration, international positioning or addressing societal challenges, which constituted important objectives in some of the different programmes. That said, firm growth was a key objective for the vast majority of the studied programmes. In approximately 2/3 of the nearly 4,000 projects granted, more than one actor participated. Projects applied for in conjunction with other actors are thus the predominant project type. Our aim is to use this information to analyse more closely how different aspects of the project group's composition affect outcomes within state-funded R&D support programmes.

The section on previous studies is delimited to literature about R&D collaboration in general, particularly its effects on small companies, and to previous empirical studies on collaboration-promoting policies. The review is not exhaustive but does provide a good overview of the literature in the field. It shows that there is a need for more studies that evaluate the effects of collaboration-oriented R&D subsidies on companies and how these are modulated by different types of collaborative constellations.

One complication in regard to evaluations of selective business grants is determining the point in time when the support measures led to an actual effect on the outcome variables studied. Although the effects of some processes can be instantaneous, others can also take place with a certain time-lag. In a previous letter of regulation, Vinnova was requested to "give an account of changes in sales, number of employees and value added in the small and medium-sized companies to which Vinnova has contributed funding in the last three years" (Ministry of Enterprise and Innovation, 2013 p. 2). The new directives from the Government mean that the effects of the support measures must be measured 5–8 years after the funding has been dispensed. In our data, the support programmes run for a duration of 1–3 years. As our support data comprise the period 2010–12 and company data

extends until 2014, this means that we can follow the companies for 2–4 years after the end of the project. This is a limitation that diminishes as new annual data become available.

Nevertheless, it is important to discuss whether this limitation can affect the results, i.e., how great is the risk that we will misjudge the effect of the support measures when we follow the companies for 2–4 years after the support programme has been completed? We feel that the risk of such a misleading analysis is limited, as previous studies have shown that the development period for an innovation project for small and medium-sized companies is normally within the range of 6–26 months. Longer innovation processes are dominated by larger companies and by the development of genuinely new technologies, while small companies are all found in the lower time span (Griffin 2002). The average time to bring a new product (or process) to market after development is about four months (Griffin 2002), while the product's life cycle frequently varies from 1-10 years (Bilir 2013). In summary, this means that the period of 2–4 years during which we can follow the companies after they receive support can be viewed as sufficient for a meaningful analysis.

Finally, we would like to emphasise the report's limitations in regard to assessing the economic effects of the subsidies. We only study the outcomes for the companies that receive support, and thus we do not take into account any costs for *rent-seeking* and distortion of the competitive conditions that may arise. Nor do we analyse the potential positive spill-over effects to which the support measures can conceivably give rise.

1.3 Structure of the paper

The next section describes the relevant theory and previous studies in the field. The data are presented in section 3, including motivations for choice of dependent variables and a description of data. Section 4 discusses the method that has been applied, including the econometric model and the creation of the control group. The results are presented in section 5. Section 6 summarises the report's results.

2 Theory and previous research

This section provides an overview of theory and previous research that are relevant to this report. We start by discussing theory and research on collaboration in general and then focus on previous studies that have examined collaboration and state aid for business, focusing particularly on R&D subsidies.

2.1 Collaboration

Collaboration between the government and business within research and development is nothing new. Prior to the 1980s, the Swedish government's procurement of new technical solutions and systems within defence, telecommunications, electric power and railways was the government's largest economic contribution to the development of internationally competitive industry. Since then, successive generations of public programmes have been established, featuring new forms of cooperation among the government, academia and industry within research and development.

Collaboration is a wide-ranging term that fundamentally means "working towards a common goal". Within public policy, the term "public-private partnership" is common, where one or a number of private companies are given the task of financing, developing and operating a public utility over a substantial period of time. If we narrow our focus to policy for economic growth and collaboration among business, academia and government, Etzkowitz's formulation of the Triple Helix concept constitutes a natural starting point (Etzkowitz, 2008). The Triple Helix basically addresses the motivations for collaboration among government, business and academia; however, the discussion of how such collaboration should be designed has changed over time.

In a review of the Triple Helix literature, Etzkowitz and Leydesdorff (2000) show how it was initially thought that collaboration among government, academia and business could be largely directed top-down. However, this instrumental view was abandoned in favour of a softer approach, where it was instead argued that actors act within institutionally set parameters. These parameters can, however, be influenced by the state. Today, the Triple Helix literature has been shifted further towards a softer state role, whereby the government can use specific hybrid organisations to facilitate communication between the academic and business worlds. Here, the government becomes an intermediary; its role is to create such an interaction but not micromanage it.[5]

So, what is the aim of collaboration? The central theme is that interaction between different actors is viewed as instrumental for the genesis and dissemination of ideas and technologies, which are thus expected to stimulate innovation, technological development and economic growth. As noted above, an important task for the government is thus to create interfaces where such collaboration can be facilitated. As mentioned in the introduction, these ideas have had a significant impact on the policies implemented in Sweden and elsewhere.[6]

[5] Finally, we can mention Ranga och Etzkowitz (2013), where the Triple Helix concept is presented as an analytical tool, with the basic mechanism of the Triple Helix (government-academia-business) linked with more classical thinking in terms of innovation.

[6] For a more detailed review of the learning processes which are assumed to be linked with collaboration see (Johnson 2010) on the interactive nature of learning; learning via characterisation, feedback and searching

Despite R&D collaboration being a popular idea, there is currently no consensus about how collaboration should best be achieved and what it has de facto produced. One reason for this might be the lack of quantitative counterfactual evidence in the area. We therefore regard answering this question as particularly pressing. In this report, we focus on a specific form of collaboration, namely growth effects on small companies that participate in state-funded R&D support programmes and where several actors can participate in a particular project.

2.2 Collaboration and R&D subsidies

There is an abundance of international research into the effects of R&D subsidies (for example, see Zuñiga-Vicente at al., 2014, for an overview). However, the majority of these studies completely disregard collaboration and how different forms of collaboration can affect the outcome of the subsidies. The number of empirical studies of R&D subsidies that take the collaboration dimension into account is considerably smaller, particularly if quantitative analyses are included. This section will provide an overview of the empirical research into collaboration and R&D subsidies.

A handful of studies have used quantitative methods to try to determine whether state support for collaboration led to significantly increased collaboration. Several studies of collaboration in European countries have been conducted using data from the Community Innovation Survey (CIS), a questionnaire about innovation that is sent out to companies in large parts of Europe. The majority of these studies find a clear connection between state support and collaboration in the national innovation system. A central challenge for research is to demonstrate that it really is the support measures that are driving increased collaboration; to resolve this, the studies cited here apply various econometric methods, such as the creation of control groups.

Busom and Fernandez-Ribas (2008), for example, find that state innovation aid for Spanish manufacturing companies, some of which was targeted at stimulating collaboration, led to companies increasing their R&D collaboration with universities and research institutes.

Mohnen & Hoareau (2003) analyse data on collaboration from France, Germany, Ireland and Spain and find that R&D support was among the most important factors in explaining the companies' collaboration with public research institutions.

Similar results were produced by Marzucchi et al. (2015), who evaluate a regional Italian programme for innovation collaboration that contained incentives for collaboration with public research institutions. They too found that the support had a significant effect on companies' collaboration with research institutions, above all within the same region. Teirlinck & Spithoven (2010) reach similar conclusions with Belgian data.

Carboni (2012) reviews the data for Italy as a whole and also finds that receipt of R&D funding increased the likelihood of entering into R&D collaboration. However, the national R&D support measures had no requirements for collaboration, so the author's hypothesis is that as more R&D-intensive companies are more disposed to collaborate, the R&D support measures contributed indirectly to promoting collaboration, despite this not being an explicit aim.

(Lundvall, 1992); the relationship between large and small firms (Baumol, 2002); the government's role in bridging obstacles to innovation (Nelson och Winter, 1977, Nelson och Winter, 1982).

In 2006, the OECD published a comprehensive report (OECD, 2006) on how R&D support affects companies' behaviour (the term "behavioural additionality" is used to designate these types of effects), based on a dozen sub-studies from different countries. Two of the studies, from Germany and the USA, examined the effect of the support on companies' R&D collaboration and in both cases found that it was boosted.

Franco & Gussoni (2014) examined data from seven European countries and found that support promoted companies' collaboration with R&D partners in general, particularly within the services sector and in regard to collaboration between companies and researchers. The effect on collaboration between companies was, however, more heterogeneous across countries, which can be due to differences in industry structures or types of support.

Rõigas et al. (2014) conduct a comparative analysis of policies for collaboration between business and universities in 23 European countries. Their analysis is based on a number of indicators for collaboration, such as surveys, the amount of industry-financed R&D at universities, and joint publication of scientific findings. They identify a couple of countries, including Sweden, that they consider to have the most effective systems.

In addition to the above studies, a number of studies have been conducted, based on a range of methodological approaches, that illustrate different aspects of collaboration support. Some have utilised qualitative methods such as questionnaires or case studies in order to investigate how the companies perceived themselves to have been affected by collaboration.

Autio et al. (2008) for example, find that support for R&D collaboration benefitted Finnish companies, not just with regard to technological knowledge but also within other spheres of enterprise such as market knowledge and management.

Carayannis et al. (2000) present a theoretical model of R&D collaboration among companies, universities and public institutions, which they then test using case studies from several countries. They emphasise that collaboration can benefit innovation and argue that the state should ensure that there are interfaces between the different actors so that they can get to know each other and develop trusting relationships. However, how these should be best configured must be tailored from case to case, depending on local circumstances, R&D traditions and unique conditions for different industries.

Matt et al. (2012) compare EU-funded R&D partnerships between companies with partnerships that develop without support. They find that the subsidised partnerships tend to be more "explorative" and research-based. This finding supports the view that government has a role in promoting collaboration in R&D that is further from the market.

Sakakibara (1997) conducted a comprehensive survey of Japanese companies that were part of state-subsidised R&D consortia. Companies' R&D managers consistently stated that collaboration with other companies had been positive for the exchange of knowledge but was not critical for their competitiveness.

In terms of quantitative studies examining the impact of collaboration support on the participating companies, the majority focus on how collaboration support affects R&D; whether it leads to more R&D activity (Czarnitzki et al., 2007; Irwin & Klenow, 1996; Sakakibara, 2001; Scandura, 2016; Branstetter & Sakakibara 1998) and/or better R&D results (Bizan, 2003; Boschma et al., 2011; Czarnitzki et al., 2007; Schwartz et al., 2012; Kang & Park, 2012; Branstetter & Sakakibara 1998; Branstetter & Sakakibara 2002).

These studies have generally tended to find that in many cases, collaboration support has had positive effects on companies' R&D in terms of investments and results, with some nuances. Bizan (2003), for example, studies Israeli collaboration support programmes and concludes that subsidies should be targeted at younger companies to support their collaboration with larger, more established companies. Branstetter & Sakakibara (2002) focus on Japan and show that collaboration support has the most positive effect when there are beneficial conditions for "spillovers", i.e., that the collaborating companies can derive benefits from each other's R&D. They also argue that collaboration support should be targeted at basic research. Boschma et al. (2011) study German biotech companies and find that the collaborating actors should be "sufficiently different" to benefit from exchanging knowledge. There were also positive results if the companies were located in the same cluster, which confirms Branstetter & Sakakibara's (2002) view that the potential for spillovers is important for the success of collaboration-focused R&D subsidies.

Only a small number of studies have investigated the effect of collaboration support on aspects of companies' performance other than R&D.

Nishimura & Okamuro (2011) evaluate a Japanese policy to support the development of clusters. They find that indirect, "soft" support for companies in clusters – intended to help them strengthen their networks – led to better collaboration (with other companies, academia and public institutions) and significantly higher sales for the companies. Direct R&D support, on the other hand, only had a weak effect.

Colombo et al. (2009) analyse productivity development in Italian high-tech start-ups that participated in EU-funded collaboration projects. They find that subsidised international collaboration benefits the companies when they collaborate with partners in several countries, particularly if the countries are world leaders within a relevant field of knowledge. This result suggests that R&D collaboration can be beneficial to start-up firms even when they are not located in close geographical proximity to their R&D partners.

Irwin & Klenow (1996) evaluate an extensive R&D consortium between large American companies within electronics manufacturing, SEMATECH, which was subsidised by the American government. They examine a number of outcome variables: investments, R&D, productivity and profitability. They conclude that R&D collaboration benefited the participating companies, particularly as they combined their R&D resources instead of duplicating each other's work, but the government subsidies were not necessary.

Link & Scott (2013) study employment growth in small American companies that participated in the SBIR programme. The R&D subsidies stimulated employment growth in those cases when the company received additional R&D funding from private sources, and the R&D project generated very good results. The companies also benefited from collaborations with other companies.

To sum up: The empirical studies of collaboration support have tended to show that R&D grants can be an effective instrument to promote companies' R&D collaboration, particularly in regard to collaboration with public research institutions; however, in regard to collaboration with other companies, the results are more mixed. The research generally paints a positive picture of the effects of collaboration support on companies' R&D but identifies certain factors that are significant for the support measures to be effective. Only a small number of previous studies have examined the effect of collaboration support on aspects of companies' performance other than R&D, such as employment, sales and/or productivity; these studies also generally find positive effects, given certain conditions. As

is so often the case in regard to evaluation of policies, the effects of collaboration support seem to be dependent on precisely how the policy is designed, how it is executed, and the context in which it takes place.

3 Data and description

In this study we focus exclusively on subsidies allocated by Vinnova during the period 2010–12. This period was selected because it is the only one for which we have information about all participants in granted projects. We filter out the smallest by setting a minimum of 20 projects in each programme, which gives us a total of 65 programmes.

The statistical analysis studies how project participation affected the growth of small private companies with a maximum of 50 employees. This delimitation is chosen not only because the government specifically wants to follow up on companies of this type but also because we have a particular interest in observing how small companies are affected by participating in R&D projects together with large private companies.

Our variables describing the project groups' composition include indicators that show the project participation of (1) large private companies (at least 1,000 employees), (2) universities, (3) research institutes and (4) how many projects an individual company participated in. As far as we know, this type of detailed information about project groups has not previously been available, either in Sweden or internationally.

The data on subsidies described above derives from Vinnova's databases. Data are obtained, administered and developed by the Swedish Agency for Growth Policy Analysis (Growth Analysis) and constitute part of a database of public support to private business called MISS. MISS includes information about a large amount of business aid that is distributed by government agencies, notably Vinnova, the Swedish Agency for Economic and Regional Growth, and ALMI.

The information about public grants and support is linked with data from Growth Analysis' database, IFDB, which basically includes virtually all workplaces and companies in Sweden. The information in IFDB derives originally from Statistics Sweden's annual survey *Structural Business Statistics* and includes all forms of enterprise and types of companies, with detailed information about companies' accounts. This broad coverage is ensured by Swedish law (SFS 2001:99 and 2001:100), which obliges Swedish companies to provide Statistics Sweden with information. IFDB also includes registry data of companies' tax returns, which are obtained from the Swedish Tax Agency. In addition to data about Swedish companies, we have also used the RAMS database, which contains information (at the plant/workplace level) about the workforce's education, pay, age, gender distribution, etc. From the LISA database, which encompasses the entire work force (working individuals aged 16-65), additional information is added about the work force's education, employers, professional status and jobs, etc. All databases have been linked together using unique serial numbers, which identify the companies and are aggregated at the company-year level.

We have also set the requirement of being able to observe the companies for at least one year before aid is dispensed and for at least one year after the first payment (three years in total). The longest series of corporate data extends between 1997 and 2014, however, as the information about business aid only covers the years 2010–12; we have chosen to limit the corporate data backwards in time to 2008 and forward to 2014, which is currently the most recent year available. As the aid data extend between 2010 and 2012 and corporate data exists up to the end of 2014, the maximum period for which we can observe the

companies receiving aid is four years after the final input of state aid. On average, the companies receiving aid are observed for two years after the final input within a project.

As stated above, "principal programmes" (which in some cases included several sub-programmes) with fewer than 20 projects receiving funding have been excluded. Companies with no employees and companies for which there are no data on production inputs and output have also been excluded.

3.1 Description

During the period 2010–12, VINNOVA dispensed a total of approximately SEK 6.4 billion in R&D subsidies[7], equivalent to just over SEK two billion per year, which in turn was equivalent to 6–7 percent of the government's total R&D budget (SCB, 2012). The payments were made within approximately 100 different principal programmes. Within these programmes, some 4,000 projects were approved, which in turn involved 3,125 actors. The participating actors included 2,400 private companies, 52 colleges and universities, 37 research institutes, 348 miscellaneous public actors, and 288 others.

The ten largest principal programmes during 2010–12 are shown in table 1. They accounted for 49 percent of the total grants during the period.

Table 1 The ten largest principal programmes 2010–12

	Principal programme	**Amount of aid**	**Co-funding**	**# sub-programmes**	**# projects**	**# participants per project**
1	FFI – Strategic vehicle research and innov.	923	846	7	258	5.0
2	Research&Grow	377	429	8	544	1.1
3	VINN Excellence Centre	336	856	3	38	9.1
4	EUREKA and Eurostars	261	656	6	341	1.5
5	VINNVÄXT	239	267	7	48	3.5
6	Technical aviation research programme	212	217	5	97	2.2
7	Innovations for future health	205	158	2	42	1.7
8	Challenge-driven innovation	199	133	5	168	4.8
9	Incubators	192	5	2	10	1.5
10	VINNMER	180	95	7	190	1.1

Note: Amount dispensed during 2010–12, in millions of kronor.

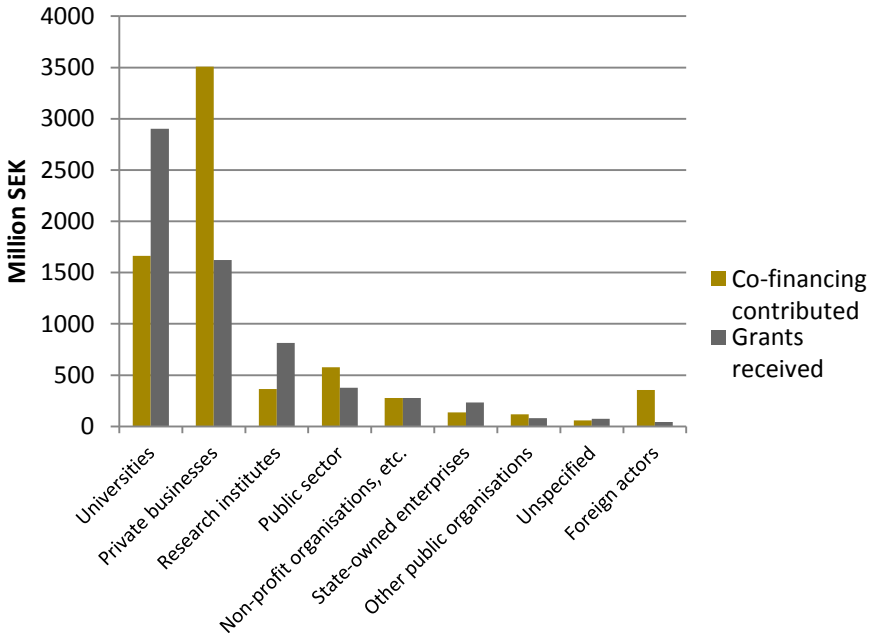
The five largest programmes include FFI, a programme directed at the automotive industry and the largest programme. FFI was followed by Research & Grow, an R&D programme directed at small and medium-sized companies. Vinn Excellence Centre supports basic, industry-related research in 17 research centres at universities, colleges and institutes. EUREKA and Eurostars are EU programmes that aim to stimulate international collaboration between companies and researchers within the EU. The aim of Vinnväxt was to support the development of a couple regional innovation clusters.

[7] https://www.vinnova.se/publikationer/arsredovisning-2010/ ;
https://www.vinnova.se/publikationer/arsredovisning-2011/ ;
https://www.vinnova.se/publikationer/arsredovisning-2012/

The funding went to companies, universities and other types of actors, which usually applied in various forms of joint consortia. The fact that several different actors were involved in a given project is governed, in some programmes, by a stated desire or requirement from Vinnova, and in other cases there is no such requirement. Private companies were the principal applicant in 45 percent of all project applications. The distribution of payments among different types of actors is presented in Figure 1, where it can be observed that Universities and colleges received the bulk of the funding, 45 percent[8], followed by private companies with 25 percent, research institutes with 13 percent, miscellaneous public actors with 11 percent, and others with 6 percent.

For most programmes, Vinnova set requirements that the actors receiving funds should co-finance the projects for which they received support, and in many cases, the co-financing could be in the form of their own work. The distribution of aid received and co-financing provided among different types of actors is displayed in Figure 1. Private companies contributed to the R&D projects with about twice as much funding as they received; for colleges, universities and research institutes, the reverse applied.

Figure 1 Co-financing contributed and grants received for different types of actors within the aid programmes, 2010–12



Note: Concerns all actors that participated in one of the programmes analysed.

A total of about SEK 13.5 billion was invested during 2010–12 within the funded R&D projects, including 6.4 billion from Vinnova and the remaining 7.1 billion in co-financing from the participants. SEK 13.5 billion is equivalent to approximately 4 percent of all R&D investments in Sweden during the same period.[9]

[8] According to SCB, this was equivalent to 3 percent of the universities' and colleges' R&D funds (SCB, 2013). Contributions from private companies within Vinnova projects are additional.
[9] These amounted to SEK 119 billion during 2011 and SEK 121 billion during 2012 according to SCB (2013b).

If we look more closely at the private companies' participation, we find that private companies participated in 60 percent of the projects. Of these private companies, 74 percent were small companies (up to 49 employees), 8 percent were medium-sized companies (between 50 and 249 employees), and 8 percent were large companies (at least 250 employees). If money dispensed to companies is considered, 61 percent went to small companies, 9 percent to medium-sized companies and 30 percent to large companies. The small companies, which are the focus of this report, accounted for a total of approximately 18 percent of the funds invested in all projects. In accordance with the delimitations described in the previous section, our analysis includes 1,301 small companies (with a maximum of 50 employees) that participated in 65 principal programmes. These companies received a total of SEK 799 million in aid from Vinnova between 2010 and 2012, which corresponds to SEK 614 thousand per company, on average. The companies contributed SEK 1,138 million in co-financing to the projects, which corresponds to SEK 875 thousand per company on average. The median value is considerably lower: SEK 100 thousand in aid and SEK 113 thousand in co-financing.

However, 29 percent of the companies in our analysis did not receive any funding from Vinnova but rather participated in the projects solely as co-financiers. Among the companies that actually received aid, the median amount was SEK 300 thousand. A total of 30 percent received aid but did not contribute any co-financing; the remaining 41 percent both received aid and contributed their own financing. If we combine aid and co-financing, we obtain a picture of how large the projects were, in total, for a typical company; the median company turned over SEK 363 thousand within the R&D projects financed by Vinnova. This is equivalent to 4 percent of the median company's annual sales. On average, the companies participated in the projects for 1.45 years.

Another way to measure the significance of the amount of aid is to consider the amount per employee. Focusing on this measure, we find that the median is SEK 25,000 per employee; at the 75- and 90-percentiles, the amounts rise to SEK 125 and 614 thousand, respectively, per employee, and the highest amount dispensed per employee is SEK 4.27 million.

One important and unique aspect of our data lies in the detailed information about the composition of the project groups. If we look at the number of project participants, 29 percent of the companies were sole applicants, and the median is three project members per group (in total throughout all projects in which the companies were involved); at the 75- and 90-percentiles, the numbers of project members rose to 16 and 45 project participants, respectively. The highest number of actors registered in an individual project was 200 actors. If we look more closely at the composition of the project groups, we find the following:

- 37 percent of the companies were involved in a project together with a university.
- 21 percent of the companies were involved in a project together with a research institute.
- 24 percent of the companies were involved in a project together with a large company (at least 1,000 employees).
- 54 percent of the companies were the principal applicant in at least one project in which they participated.
    - × 51 percent of these were the sole applicant in their projects. The remaining 49 percent were the principal applicant in a collaborative project group.

- 29 percent of the companies worked alone in all their projects.
- 81 percent of the companies participated in just one project.
  - × The average number of projects per company was 1.3.

Table 2 summarises the key variables in our analysis. We divide the companies into three groups: (1) companies that received aid, (2) control companies and (3) all companies in the economy. The median company in our analysis is a company with eight employees and SEK 9 million in sales. It has a quite small, but nevertheless positive, profit margin and a high proportion of employees with post-secondary school education. It also emerges that the group of control companies is considerably more similar to the companies receiving aid than to companies in general.

Table 2 Descriptive statistics

Variable	**Company receiving aid**	**Control company**	**All companies**
Sales (Y)	9,176 (23,368)	6,536 (20,482)	1,862 (15,950)
Number of employees (L)	8 (12.9)	6 (11.2)	2 (9.4)
Capital (K)	2,700 (91,592)	1,714 (32,362)	404 (11,673)
Profit margin (Profit/sales)	0.021 (-7.435)	0.054 (-2.053)	0.067 (-0.548)
Proportion post-secondary ed.	0.78 (0.67)	0.77 (0.65)	0.09 (0.30)
Pay/employee (w)	405 (455)	363 (395)	259 (265)
Liabilities	4,572 (105,040)	2,552 (39,542)	701 (19,536)
Value added (VA)	3,697 (7,740)	3,099 (7,600)	911 (6,065)
Productivity (VA/L)	532 (518)	547 (665)	415 (508)
Number of companies	1,301	486	467,968
No. of observations	7,500	3,632	1,909,618

Note: Median value. *Average value in brackets (.). All monetary variables are in thousands of SEK.*

4 Method

4.1 Matching

To achieve a counterfactual analysis of the causal effects, it is necessary to select a method that can handle situations where the companies receiving aid have unique properties, which in turn can affect the outcome. This is a classic selection problem, where, to the greatest extent possible, we want to separate the effect of unique company properties from the causal effect of the support measures. In this respect, so-called matching is appropriate. The aim of the matching is to identify a control group of companies with properties similar to those of the companies receiving aid, where the only observable difference between the groups is that the control companies have not received any aid. This matching should ideally take place just before the subsidy applications are approved. With successful matching, the difference between the outcomes in the two groups therefore constitutes a suitable evaluation of the effect of receiving a subsidy.

A series of articles (Iacus et al., 2011, 2013; Blackwell et al., 2009) discusses a class of matching methods called *Monotonic Imbalance Bounding (MIB).* MIB has a number of attractive features guaranteeing that the balance is improved throughout the entire selection by improving the balance in each individual covariate. In this the report, we use an MIB procedure called Coarsened Exact Matching (CEM) (Iacus et al. 2011, 2012). The fact that we have data on the entire population of Swedish companies creates excellent conditions for identifying suitable control companies that are similar to the companies in our analysis receiving aid.

The matching was performed as follows. First, we identify the year before a company began to receive aid; then, matching is implemented based on that year. Selection of matching variables is somewhat different depending on whether the outcome variable in the analysis is sales, employment or capital stock.

A description of the results of the matching is presented in table 3. To be as transparent as possible, we avoid using individually defined strata and stick to the generic algorithm proposed by the CEM module. For more detailed information about this procedure, see Blackwell et al. (2009).

In developing an overview of the matching, it is interesting to note how the distance between our treatment and control groups, with respect to matched variables, changes after matching. What is relevant is thus the change in the distance measurement rather than its absolute level, even though it is obviously desirable to obtain as small a distance as possible.

The aim when matching is to match variables that can contribute to explaining the outcome of interest in the analysis, as well as to match variables that are of importance for selection into the treatment group. Matching the outcome variables studied should also be avoided (Iacus et al., 2011, 2012). As we consider several different outcome variables in this report, we will consequently accommodate the control group with respect to the different outcome variables.

The variables we use to match for the sales regressions are as follows:

- Capital stock and number of employees.
  - × These are basic variables in the production function.
- Proportion of highly educated workers and industry (exact matching of industry, defined as the company's single digit SNI code).
  - × Provides information about the company's operations.
- Profit ratio.
  - × Provides information about the company's profitability.
- Year (exact matching).
  - × Guarantees that control and treatment groups are synchronised with regard to time.
- Growth in employment.
  - × Captures common trends and counteracts shrinking companies being matched with fast-growing companies. Growth can also be viewed as a beauty contest variable, which can be of significance for selection for support measures.

For the employment and capital stock regressions, we match the following variables:

- Value added and pay.
  - × These are basic variables in the employment and capital stock regressions.
- Proportion of highly educated workers and industry (exact matching for sector).
- Profit quota.
- Year (exact matching).
- Growth in sales.

We have a few observations to make here. (i) For year and industry (single digit SNI/NACE code), we intended to make an exact match so that our control companies could be observed for the same year that we study the company receiving aid; however, not all observations matched successfully by year and industry. (ii) For all covariates, the distance diminishes after matching is performed, which indicates that the control group is more similar to the companies receiving aid than the company population as a whole. We can also add that despite the reduced imbalance among individual variables, the global balance indicates the difficulty of obtaining a multidimensional overlap.

Table 3 CEM Matching

	L1 distance before matching	*L1 distance after matching*	
Matching variable		Outcome variable: K and L	Outcome variable: Sales
***ln* (value added)**	0.38	0.08	
***ln* (salary per employee)**	0.37	0.07	
Sales growth	0.13	0.12	
Proportion of highly educated	0.51	0.04	0.04
Profit quota	0.07	0.03	0.01
Industry	0.38	0.06	0.06
Year	0.52	0.33	0.39
***ln* (Number of employees)**	0.36		0.06
Growth in number of employees	0.31		0.14
***ln* (capital stock)**	0.38		0.10
Description of the matching			
Multivariate distance		0.95	0.87
Matched obs.		972	975
Unmatched obs.		138	174

4.2 Empirical model

After creating our control group, we estimate the effect of the aid on our outcome variables. This is done in part through a so-called *difference-in-differences* (DiD) analysis, in which we compare the treated companies with the control group before and after they receive support. We also perform fixed-effect estimates solely for the companies that received capital. The latter strategy aims to identify breaks in the trend caused by contributions from the subsidy rather than to compare development between two groups (Growth Analysis, 2014).

Our DiD estimates can be described as follows,

$$Y_{i,t} = \alpha + \boldsymbol{\beta X_{i,t}} + \gamma T_i + \delta(TR_{i,t}) + \theta(PTR_{i,t}) + \epsilon_{i,t} \qquad (1)$$

where $Y_{i,t}$ is our dependent/outcome variable and $\boldsymbol{X_{i,t}}$ is a vector of independent variables included in the respective empirical model (Woolridge 2002; Bandick and Karpaty 2011). The control variables included in $\boldsymbol{X_{i,t}}$ vary with respect to which outcome variable is studied. The variable T_i is an indicator variable that assumes the value 1 if the company receives a grant at any time during the period and zero for all other companies. This variable thus captures any remaining differences between the control group and the companies that received support. To capture effects of the aid during the course of the programme, we use the variable "TR" (treatment), which in the base specification assumes the value of one during the period a company is participating in a programme and the value zero otherwise. The effect upon completion of a project (post-treatment) is captured by the variable PTR, which correspondingly assumes the value one in the years after completion

of the project and zero for other years. In this way, we distinguish between the effects of aid during and after the treatment period.

4.3 Outcome variables

To measure how participation in one of the analysed programmes affected the companies' growth and competitiveness, we focus on the outcome variable of changes in companies' sales. Sales is an outcome variable that captures the market's acceptance of the company's product or service. Consequently, there is a link between successful product development and the development of sales (Delmar et al. 2003). Support measures can also affect companies' investments in capital and labour, which in turn can be expected to influence sales as production capacity expands.[10]

As mentioned above, support measures can impact sales not only directly but also indirectly through their effect on employment and capital. Estimating a structural equation system that links together these channels gives a clearer picture of where in companies' production we have the greatest chance of observing an effect from the support measures and to what extent this affects the companies' sales.

The model specifications we selected follow the empirical literature within the respective areas. As the choice of model is central to the analysis, a more detailed description of the models we have chosen is provided below.

4.3.1 Effects on sales

Our choice of empirical model is based on a production function approach and follows Liu and Yoon (2000), Griliches and Mairesse, (1997) and Frankel and Romer (1999). We estimate the following model:

$$ln(Y_{i,t}) = \alpha + B_1 ln(L_{i,t}) + B_2 ln(K_{i,t}) + B_3 H_{i,t} + B_4 ln(Liabilities_{i,t}) + B_4 \pi_{i,t} + B_5 TR_{i,t} + B_6 PTR_{i,t} + v_i + \gamma_t + \varepsilon_{i,t} \quad (1)$$

Where $Y_{i,t}$ captures company *i*'s sales in year *t*, and *K* and *L* capture the company's capital stock and employment, respectively, *H* captures the proportion of highly educated workers, *Liabilities* measures indebtedness and π the companies' profit ratio (profit divided by sales). The treatment effects during the current project are captured by the "treatment variable" *TR*, and the effects after completion of the project are captured by the post-treatment variable *PTR*. Fixed company effects and year-specific effects are captured by v_i and γ_t respectively.

4.3.2 Demand for labour and capital

As mentioned above, the subsidies can affect companies' investments in labour and capital; these input factors in the production can, in turn, also affect sales. It is therefore of interest to study more closely how the subsidies have affected the companies' employment and capital stock. The empirical model is based on a model of the companies' demand for

[10] An alternative would have been to link the aid dispensed with measurements of innovation input, innovation output, productivity, sales and any exports, i.e. an approach similar to Crépon et al (1998) and Lööf och Heshmati (2006). However, we do not regard this procedure as viable, primarily for technical reasons related to the data (more precisely, because R&D data (innovation input) are only available for a very small proportion of the company population and because the coverage for small and newly-started companies is negligible). One alternative might be to use patent data, and a project is currently underway within Growth Analysis to implement this type of analysis, with patents as the outcome variable.

labour, with adjustment costs for changes in employment (Cahuc & Zylberberg, 2004; Hijzen & Swaim, 2008). In our estimates, the introduction of adjustment costs entails a dynamic lag in the number of employees (*t-1*) being added as a variable (Cahuc & Zylberberg, 2004). For the companies' demand for capital, we use the same approach as for labour, with the difference that here we drop the assumption about adjustment costs and thus abandon the dynamic specification. With this as background, we estimate the following models:

$$ln(L_{i,t}) = \alpha + \beta_L\, ln\left(L_{i,t-1}\right) + \beta_w \ln(w_{i,t}) + \beta_y \ln(y_{i,t}) + B_H H_{i,t} + B_S\, ln\left(Liabilities_{i,t}\right) + B_\pi \pi_{i,t} + B_1 TR_{i,t} + B_2 PTR_{i,t} + v_i + \gamma_t + \varepsilon_{i,t} \quad (2)$$

$$ln(K_{i,t}) = \alpha + \beta_w\, ln(w_{i,t}) + \beta_y \ln(y_{i,t}) + B_H H_{i,t} + B_S\, ln\left(Liabilities_{i,t}\right) + B_\pi \pi_{i,t} + B_1 TR_{i,t} + B_2 PTR_{i,t} + v_i + \gamma_t + \varepsilon_{i,t} \quad (3)$$

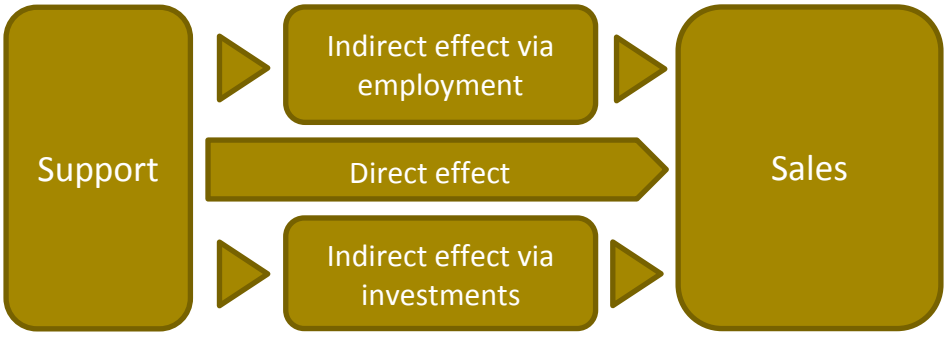
where $L_{i,t}$ is the number of employees in company *i* during year *t*, $w_{i,t}$ indicates the average salary, capital stock is given by $K_{i,t}$ and value added by $y_{i,t}$.

A well-known problem associated with dynamic regressions based on these types of equations is endogeneity, as the dependent variable occurs among the explanatory variables displaced one period back in time. To obtain correct estimates when estimating the employment effects, we therefore use a dynamic panel data estimator based on a differentiation technique; this approach follows Han et al. (2014).[11]

4.3.3 Structural model

After analysis of the aid's effects on sales, employment and capital, we link these variables by constructing a structural equation system (SEM) where we estimate the effect of the subsidies on sales, while taking into account the fact that subsidies can affect sales both directly and indirectly via changes in employment and investments in physical capital. To eliminate non-observable heterogeneity and be analytically close to the FE estimates, the SEM-models are estimated in the first difference. For details on SEM models, see (Acock, 2013; Kline, R.B., 2011; Matsueda and Press, 2012).

Figure 2 Direct and indirect effects of the support measures on sales



[11] In relation to the sys GMM estimator (Arrelano and Bond, 1991; Blundell and Bond, 1998), the *long-differencing* estimator applied has beneficial properties when used with small samples and also when the autocorrelation coefficient is close to a unit root.

5 Results

In analysing our results, our goal is to observe the effect of the grants on small firms' sales, employment and investments/capital stock; we also attempt to study whether these effects vary depending on the project group's composition. Does it make any difference whether it is a university or a research institute that is participating? What significance does the participation of a large private company have, and what is the outcome for companies applying on their own? We will also analyse whether the growth effects of aid have varied with the programmes' aims and foci.

A further question concerns when the effect of programme participation can be expected to arise. When we measure the effect of the support measures, we divide the analysis based on what happens to the companies during the period they are involved in a programme and thus receiving funds; we also consider what happens after completion of the project. If it takes time before the support measures have an impact on employment, sales and capital stock, then this is detected in the post-support dummy, post treatment (PTR), while the immediate effect is detected by the direct support dummy, treatment (TR). Finally, we present the results from a number of sensitivity analyses, where alternative model specifications are tested.

Despite the fact that purpose and objectives vary among the analysed programmes, we see that besides stimulating collaboration between academia and business, several programmes are focused on the production of new products and innovations, as well as on measures to increase know-how. Such activities are often encumbered with an investment cost. The companies' financial situations and skills profiles thus constitute factors that should be accounted for in the analysis. With this observation as background, the following analyses are based on the model specifications that occur commonly in the literature, where we have also chosen to include companies' profit margins and proportions of highly educated employees as additional control variables.

5.1 Effect on sales

When we study how the support programmes affect the sales of the companies that receive subsidies, a relatively coherent picture emerges. While support programmes (*TR*) are on-going, the support measures tend to have a positive effect on sales, with approximately 3–4 percent increased growth. Making the step from three to four percent growth depends on whether the comparison is based solely on an analysis of the companies receiving aid (about three percent growth) or whether those companies are compared to a matched control group of similar "twin companies" (approximately 3.6 per cent growth, statistical significance at the ten percent level). In the choice between these measurements, the comparison with a matched control group is regarded as the preferred comparison (Iacus et al. 2011, 2012). As noted in the description, average sales among the companies receiving aid is about SEK 9.2 million, which means that the change in sales measured during the duration of the project (on average 1.45 years, as mentioned earlier) amounts to roughly SEK 330 thousand. This can be compared with the median subsidy of SEK 100 thousand and with the R&D projects' median turnover within the small firms of SEK 363 thousand, which includes both support and the company's co-financing.

If we look more closely at this growth during the duration of the projects, there are significant and positive growth effects (up to five percent growth) among companies with

11–50 employees; however, it is not possible to demonstrate any statistically significant effect in the micro-companies with 1–10 employees. One interpretation of this finding is that among small and young companies, it can be particularly difficult to determine which companies are most likely to develop and flourish (Coad, 2009).

One interesting observation is that when we compare the companies receiving aid with a control group of similar companies, there are indications that the companies receiving aid continue to benefit after the programmes have ended: we observe a so-called post-treatment effect (PTR) of about six percent in the years following project completion (on average, two years after completion). Once again, the effect is somewhat greater among companies with 11–50 employees than for micro-companies with 1–10 employees.

In summary, the results in table 4 indicate that the companies receiving aid have grown somewhat faster than they would have if they had not received any support, with the reservation that the effect is only statistically significant when we compare the companies receiving aid with a relevant control group (model 3) and not via trend breaks within the treatment group (model 2).

In terms of the control variables, the results in table 4 indicate the expected positive signs for number of employees and capital stock (more production input is associated with greater output); we also note that the connection between sales and the proportion of highly educated employees is somewhat unclear, which can be explained by the fact that the proportion of highly educated employees has more to do with *what* is produced than with the volume of the production. If we consider our financial measures of profitability and indebtedness, we find that sales are positively correlated to companies' profit ratios, which indicates that companies with a high level of market acceptance for their products are also more profitable. In terms of debts, here we also find a positive connection. As our estimated coefficient for indebtedness is less than "1", the interpretation is that companies' sales tend to grow faster than their debts, which in turn signals that the highest indebtedness ratio is typically to be found among the smaller companies with modest sales. In summary, we find that the coefficients on our control variables display reasonable and expected signs (positive, negative or neutral) and results.

Table 4 Base models. Dependent variable, sales.

	1.	**2.**	**3.**	**4.**	**5.**
	Only companies receiving aid		*Contra. CEM-matched control group*		
Model →	Basic spec.	Full spec.	Full Spec.	10≤L≤ 50	L<10
TR	0.0477*	0.0288	0.0359*	0.0540***	0.0119
	(0.0279)	(0.0266)	(0.0207)	(0.0184)	(0.0342)
PTR	0.0567	0.0337	0.0617**	0.0794***	0.0585
	(0.0407)	(0.0384)	(0.0259)	(0.0258)	(0.0413)
***ln*(K)**	0.1271***	0.1105***	0.1137***	0.1156***	0.1178***
	(0.0151)	(0.0149)	(0.0124)	(0.0158)	(0.0171)
***ln*(L)**	0.6967***	0.5931***	0.6066***	0.5824***	0.5804***
	(0.0403)	(0.0438)	(0.0398)	(0.0452)	(0.0432)
Proportion of highly educated		-0.0476	-0.0847	-0.2814**	0.0401
		(0.0862)	(0.0920)	(0.1274)	(0.0743)
Profit quota		0.0009***	0.0010***	0.0041***	0.0009***
		(0.0003)	(0.0003)	(0.0007)	(0.0002)
***ln*(Debt)**		0.1865***	0.2120***	0.1900***	0.2256***
		(0.0207)	(0.0173)	(0.0244)	(0.0212)
NB.	7,238	7,055	9,919	4,257	5,324
R^2 overall	0.65	0.70	0.71	0.49	0.41

*Note: *, **, *** indicate significance of 10, 5, 1 percent significance level. Standard error clustered at company level within brackets (.). Company- and year fixed effects included in all models. TR = years during which the company participates in a project; PTR = years after support has been received.*

5.1.1 Group composition

In table 5, we proceed to study whether the effects of the support measures for small companies vary depending on how many, and which, other actors participate in the project. More precisely, the effect of the support measures is analysed with respect to the following characteristics:

1. How many projects did the companies participate in? Were the companies only involved in one project?
2. How many participants (other companies, universities, research institutes, etc.) were involved in the projects in which the small companies participated? Did the companies apply alone?
3. Have the companies participated in projects that included a research institute?
4. Have the companies participated in projects that included a university?
5. Have the companies participated in projects that included a large private company (at least 1,000 employees)?
6. Did the company have the role of project leader?

In table 5 columns 3–8, the variables sub-group TR and sub-group PTR show the direct effects of support on the group of receiving companies that are specifically studied in the respective column (companies applying alone, companies collaborating with universities, etc.). Correspondingly, TR and PTR in columns 3–8 show how other companies receiving support, which are not part of the sub-group in focus for that column, are affected by the

support measures. Finally, our interaction variables in columns 3–8 (interaction#TR) and (interaction#PTR), respectively, display the difference for each column between these two groups of companies receiving support.

In columns 1–2, the variables TR and PTR show the support's effect on the companies receiving support in relation to the control group, and the interaction variables show whether the effect of support increases or decreases with respect to the number of grants received (column 1) and number of project participants (column 2).

To take a concrete example, for the sub-group of companies that received support and participated in just one project (Equation 3), we observe a non-significant growth effect of approximately 1.90 percent during the support period, while companies that were not single applicants achieved significant growth of 10.4 percent during the support period. The interaction variable thus shows that companies applying alone obtained a growth effect that is approximately 8.5 percentage points (-0.0848) lower than that of companies receiving multiple grants, and this difference is statistically significant.

If we allow ourselves to speculate, we can suggest at least two reasons why the companies with single grants display weaker results than do the companies receiving multiple grants. First, it is reasonable to assume that companies that participated in "unsuccessful" projects will not return with further applications. This negative filter can then be reinforced by the fact that when the authorities process the repeat companies, they in turn filter out the weakest ones. Overall, both of these mechanisms work to filter out the weakest companies and to ensure that the stronger companies are selected into the group that receives multiple grants.

When we review the other results in table 5, our interaction variables indicate that there is no significant effect that can be specifically linked to any of the following:

- having several project participants
- receiving more grants
- collaborating with universities or research institutes
- acting as project leader
- being sole applicant in the project

Thus, what is most important seems to be participating in a project, while the project group's composition seems to be of secondary significance.

Table 5 Group effects. CEM-matched DiD-models. FE-estimates. Dependent variable, sales.

Sub-group/ model →	**1.Multiple grants**	**2. No. of participants**	**3. One project**	**4.Research institute**	**5. Univ.**	**6. Large company**	**7. Project leader**	**8. Alone**
TR[a, d]	0.0204 (0.0271)	0.0249 (0.0268)	0.1038*** (0.0395)	0.0291 (0.0239)	0.0162 (0.0272)	0.0331 (0.0245)	0.0273 (0.0213)	0.0424** (0.0209)
PTR[a, d]	0.0405 (0.0321)	0.0539* (0.0321)	0.1667*** (0.0549)	0.0517* (0.0288)	0.0424 (0.0317)	0.0589** (0.0289)	0.0658** (0.0265)	0.0792*** (0.0266)
Sub-group TR[b, d]	n.a	n.a	0.0190 (0.0223)	0.0580** (0.0278)	0.0680*** (0.0235)	0.0437* (0.0261)	0.0415 (0.0308)	0.0140 (0.0430)
Sub-group PTR[b, d]	n.a	n.a	0.0404 (0.0263)	0.1015*** (0.0351)	0.0948*** (0.0316)	0.0707** (0.0358)	0.0575 (0.0381)	0.0201 (0.0489)
Interaction #TR[c, d]	0.0115 (0.0122)	0.0007 (0.0007)	-0.0848** (0.0414)	0.0290 (0.0325)	0.0518 (0.0317)	0.0106 (0.0313)	0.0141 (0.0331)	-0.0284 (0.0443)
interaction #PTR[c, d]	0.0166 (0.0157)	0.0005 (0.0008)	-0.1263** (0.0546)	0.0497 (0.0387)	0.0525 (0.0378)	0.0118 (0.0390)	-0.0082 (0.0397)	-0.0590 (0.0507)
***ln*(K)**	0.1136*** (0.0124)	0.1137*** (0.0124)	0.1135*** (0.0124)	0.1141*** (0.0124)	0.1142*** (0.0124)	0.1138*** (0.0124)	0.1138*** (0.0124)	0.1140 (0.0124)
***ln* (L)**	0.6060*** (0.0398)	0.6066*** (0.0398)	0.6052*** (0.0397)	0.6066*** (0.0398)	0.6062*** (0.0398)	0.6065*** (0.0398)	0.6068*** (0.0399)	0.6057*** (0.0397)
Skill share	-0.0840 (0.0920)	-0.0838 (0.0921)	-0.0805 (0.0920)	-0.0837 (0.0920)	-0.0818 (0.0920)	-0.0844 (0.0920)	-0.0848 (0.0920)	-0.0815 (0.0922)
Profit quota	0.0010*** (0.0003)	0.0010*** (0.0003)	0.0010*** (0.0003)	0.0010*** (0.0003)	0.0010*** (0.0003)	0.0010*** (0.0003)	0.0010*** (0.0003)	0.0010*** (0.0003)
***ln*(Debt)**	0.2119*** (0.0173)	0.2120*** (0.0173)	0.2112*** (0.0173)	0.2120*** (0.0173)	0.2124*** (0.0173)	0.2121*** (0.0173)	0.2120*** (0.0173)	0.2125*** (0.0173)
OBS.	9,919	9,919	9,919	9,919	9,919	9,919	9,919	9,919
R^2 overall	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71

*Note: *, **, *** indicate significance of 10, 5, 1 percent significance level. Standard error clustered at company level within brackets (.). Company- and year fixed effects included in all models. TR = period during which the company receives support; PTR = years after support has been received. Includes CEM-matched control group.*
a) Effects for other companies, which are not a part of the relevant sub-group.
b) Effect for companies included in the sub-group.
c) The difference in effect between the sub-group and others.
d) The interpretations above apply to models 3-8.

Despite the fact that the difference in effects between sub-groups is not statistically significant in most cases, the estimated effects for the sub-groups do provide some information of interest. We may note that for projects where universities or research institutes are included, the participating small companies obtained significant growth during the support period, while the growth was not significantly separated from zero for other companies receiving support. This result becomes even clearer in the post-treatment period, where we observe that the presence of both universities and research institutes was associated with sales growth of approximately 10 percent ($\beta_{universities} = 0.09$; $\beta_{research\ institutes} = 0.10$), while we do not observe any significant effect among other companies receiving support after the end of projects.

In summary, this means that on average, sales in companies that participated in R&D consortia with universities or research institutes grew by approximately 6–7 percent more than did the sales of equivalent companies that did not receive any support during the duration of the project; furthermore, after the project ended, this figure increased to approximately 10 percent.

If we continue to models 6–8, the results in table 5 show that in projects where small companies collaborated with a large private company, acted as project leader, or were solo applicants, there are no significant deviations in growth effects compared to other group compositions.

5.2 Effects on employment

How do the support measures affect employment in the companies that received support within the programmes studied? The answer to this question can most simply be divided into two parts: general employment effects of having participated in a programme and group composition effects.

The results of models 1-3 in table 6 do not demonstrate any significant employment effects, neither during nor after the project. Furthermore, we do not observe any difference between micro companies and other small companies.

As for the group and interaction effects that are analysed in models 4–11 in table 6, the consistent result is that our interaction variables do not reveal any statistically significant differences between the different groups, apart from two cases.

One exception is a trend showing that the employment effect during on-going projects falls with the number of projects in which a company is involved (column 4). In column 5, we furthermore observe that single-project companies increased their employment by approximately 2.4 percent compared to the control group. If we combine these results with the results surrounding sales, we find that companies with multiple grants enjoyed relatively weak employment growth but high sales growth. In brief, this indicates increased productivity.

Table 6 Employment effects. Han-Philips dynamic panel models, CEM-matched DiD-models.

	1. Full model.	2. 10≤L≤ 50	3. L<10	4. Multi grant	5. One project	6. No. of participants	7. Alone	8. SEK millions/L	9. Research institute	10. Univ.	11. Large company	12. Proj. leader
TR	0.0160	-0.0006	0.0221	0.0466***	-0.0212	0.0227**	0.0109	0.0012	0.0170*	0.0196*	0.0145	0.0171
	(0.0090)	(0.0090)	(0.0157)	(0.0169)	(0.0200)	(0.0114)	(0.0102)	(0.0126)	(0.0101)	(0.0111)	(0.0103)	(0.0120)
PTR	0.0202	-0.0031	0.0341	0.0443*	-0.0055	0.0269	0.0194	0.0119	0.0189	0.0233	0.0186	0.0240
	(0.0139)	(0.0137)	(0.0238)	(0.0247)	(0.0296)	(0.0168)	(0.0156)	(0.0202)	(0.0153)	(0.0169)	(0.0156)	(0.0182)
Sub-group TR	n.a	n.a	n.a	n.a	0.0238**	n.a	0.0307*	n.a	0.0125	0.0100	0.0201	0.0147
					(0.0098)		(0.0170)		(0.0174)	(0.0139)	(0.0165)	(0.0127)
Sub-group PTR	n.a	n.a	n.a	n.a	0.0262*	n.a	0.0244	n.a	0.0253	0.0152	0.0245	0.0162
					(0.0150)		(0.0253)		(0.0261)	(0.0207)	(0.0245)	(0.0188)
Interaction #TR	n.a	n.a	n.a	-0.0246**	0.0449**	-0.0004	0.0197	0.0494	-0.0045	-0.0096	0.0055	-0.0024
				(0.0114)	(0.0217)	(0.0004)	(0.0192)	(0.0378)	(0.0195)	(0.0170)	(0.0187)	(0.0168)
interaction #PTR	n.a	n.a	n.a	-0.0190	0.0316	-0.0004	0.0050	0.0724	0.0064	-0.0081	0.0059	-0.0078
				(0.0163)	(0.0317)	(0.0006)	(0.0284)	(0.0516)	(0.0287)	(0.0250)	(0.0275)	(0.0245)
***ln*(L)(t-1)**	0.7968***	0.7335***	0.7590***	0.7985***	0.7985***	0.7966***	0.7967***	0.8639***	0.7966***	0.7968***	0.7970***	0.7969***
	(0.0480)	(0.0578)	(0.0563)	(0.0480)	(0.0480)	(0.0479)	(0.0480)	(0.0610)	(0.0479)	(0.0480)	(0.0480)	(0.0480)
***ln*(va)**	0.3851***	0.3607***	0.3579***	0.3853***	0.3849***	0.3850***	0.3853***	0.3736***	0.3852***	0.3852***	0.3851***	0.3851***
	(0.0069)	(0.0096)	(0.0101)	(0.0069)	(0.0069)	(0.0069)	(0.0069)	(0.0096)	(0.0069)	(0.0069)	(0.0069)	(0.0069)
***ln*(w)**	-0.5356***	-0.6214***	-0.4643***	-0.5360***	-0.5360***	-0.5356***	-0.5355***	-0.5450***	-0.5356***	-0.5356***	-0.5355***	-0.5356***
	(0.0110)	(0.0167)	(0.0154)	(0.0109)	(0.0110)	(0.0110)	(0.0110)	(0.0154)	(0.0110)	(0.0110)	(0.0110)	(0.0110)
Skillshare	-0.0515**	-0.0238	-0.0359	-0.0512**	-0.0516**	-0.0514**	-0.0518**	-0.0037	-0.0517**	-0.0520**	-0.0515**	-0.0516**
	(0.0252)	(0.0494)	(0.0326)	(0.0252)	(0.0252)	(0.0252)	(0.0252)	(0.0366)	(0.0252)	(0.0252)	(0.0252)	(0.0252)
Profit quota	-0.7342***	-0.7319***	-0.6629***	-0.7343***	-0.7340***	-0.7339***	-0.7346***	-0.6952***	-0.7344***	-0.7345***	-0.7341***	-0.7344***
	(0.0173)	(0.0247)	(0.0243)	(0.0172)	(0.0173)	(0.0173)	(0.0173)	(0.0230)	(0.0173)	(0.0173)	(0.0173)	(0.0173)
***ln*(Debt)**	0.0495***	0.0318***	0.0483***	0.0493***	0.0494***	0.0494***	0.0493***	0.0479***	0.0494***	0.0494***	0.0495***	0.0495***
	(0.0047)	(0.0059)	(0.0071)	(0.0047)	(0.0047)	(0.0047)	(0.0047)	(0.0069)	(0.0047)	(0.0047)	(0.0047)	(0.0047)
Buse R^2	0.38	0.39	0.33	0.38	0.38	0.37	0.37	0.36	0.37	0.37	0.37	0.37
NB.	7,805	3,652	3,907	7,805	7,805	7,805	7,805	4,248	7,805	7,805	7,805	7,805

*Note: *, **, *** indicate significance of 10, 5, 1 percent significance level. Standard error clustered at company level within brackets (.). Company- and year fixed effects included in all models. TR = The period during which the company receives support; PTR = The years after support has been received. Includes CEM-matched control group.*

5.3 Effects on capital and investments

One aim of some of the support measures is to help companies to develop a new product or change their production processes. In both cases, such changes can be associated with an investment requirement. In contrast to, for example, the connection between support and sales, it can therefore seem that the link between support input and effect on capital is fairly direct. Furthermore, investments in capital can also have an indirect impact on companies' sales as a strengthened capital stock increases companies' production capacity.[12]

In conformity with the analysis of employment effects, this analysis is divided into two parts: general effects on companies' capital stock, and composition effects.

One overall result of this analysis is that it is difficult to find significant effects on companies' capital stock. If we consider the results in table 7, we find in models 1–3 that it is not possible to find any statistically significant effects on companies' capital stock for the population as a whole, micro-companies or other small companies (10–50 employees). This applies both during on-going project and after project completion.

However, when we proceed to study composition effects, we find some interesting results:

- The companies that participated in projects with research institutes or universities significantly reduced their investments in capital in relation to the control group. The results thus indicate that companies that participate in projects with universities and research institutes are not trying to increase their capital investments. One conceivable explanation for this is that companies that engage in projects together with universities and research institutes are trying to strengthen their human capital base rather than their physical capital.
- Finally, we note that small companies that acted as project leader have significantly increased their capital stock after completion of the support programme.

[12] In accordance with Hall et al. (2001), we estimate a model of companies' demand for production factors without conversion costs (see Cahuc & Zylberberg, 2004; Hijzen & Swaim 2008).

Table 7 Effect on capital stock and investments. CEM-matched DiD-models. FE-estimates.

	1. Full model.	**2. 10≤L≤ 50**	**3. L<10**	**4.Multiple grants**	**5. No. of Participants**	**6. Single-project**	**7.Research institute**	**8. Univ.**	**9. Large company**	**10. Proj. leader**	**11. Solo (alone)**
TR	0.0175* (0.0305)	0.0019 (0.0391)	0.0213 (0.0463)	-0.0061 (0.0504)	0.0153 (0.0396)	0.0182 (0.0619)	0.0247 (0.0347)	0.0483 (0.0386)	0.0304 (0.0351)	-0.0080 (0.0352)	0.0174 (0.0335)
PTR	0.0386 (0.0383)	-0.0172 (0.0520)	0.0740 (0.0562)	0.0579 (0.0639)	0.0434 (0.0446)	0.0039 (0.0774)	0.0656 (0.0408)	0.0935** (0.0434)	0.0572 (0.0404)	-0.0294 (0.0458)	0.0118 (0.0416)
Sub-grp. TR	n.a	n.a	n.a	n.a	n.a	0.0158 (0.0330)	-0.0067 (0.0485)	-0.0350 (0.0414)	-0.0191 (0.0485)	0.0593 (0.0432)	0.0287 (0.0599)
Sub-grp. PTR	n.a	n.a	n.a	n.a	n.a	0.0443 (0.0399)	-0.0680 (0.0665)	-0.0531 (0.0540)	-0.0220 (0.0670)	0.1191** (0.0490)	0.1100* (0.0614)
Interact. #TR	n.a	n.a	n.a	0.0170 (0.0313)	0.0002 (0.0013)	-0.0025 (0.0663)	-0.0314 (0.0547)	-0.0834 (0.0518)	-0.0495 (0.0549)	0.0673 (0.0508)	0.0113 (0.0658)
Interact. #PTR	n.a	n.a	n.a	-0.0166 (0.0433)	-0.0003 (0.0014)	0.0403 (0.0785)	-0.1336* (0.0685)	-0.1466** (0.0587)	-0.0792 (0.0683)	0.1485*** (0.0560)	0.0982 (0.0646)
***ln*(va)**	0.2722*** (0.0315)	0.2057*** (0.0722)	0.1094** (0.0504)	0.2723*** (0.0314)	0.2723*** (0.0315)	0.2726*** (0.0315)	0.2722*** (0.0314)	0.2742*** (0.0315)	0.2727*** (0.0315)	0.2715*** (0.0314)	0.2733*** (0.0316)
***ln*(w)**	0.0746 (0.0508)	0.3089** (0.1384)	0.1710** (0.0727)	0.0756 (0.0507)	0.0746 (0.0508)	0.0751 (0.0508)	0.0763 (0.0507)	0.0753 (0.0508)	0.0728 (0.0507)	0.0740 (0.0505)	0.0736 (0.0507)
Skill-share	0.0448 (0.1000)	0.3037 (0.2842)	0.0017 (0.1074)	0.0433 (0.1000)	0.0438 (0.1002)	0.0448 (0.1001)	0.0438 (0.0999)	0.0390 (0.0999)	0.0416 (0.1000)	0.0388 (0.1000)	0.0401 (0.1001)
Profit quota	-0.0750 (0.0672)	0.2049 (0.1338)	0.1242 (0.0959)	-0.0758 (0.0672)	-0.0753 (0.0673)	-0.0757 (0.0672)	-0.0740 (0.0668)	-0.0745 (0.0667)	-0.0738 (0.0670)	-0.0700 (0.0662)	-0.0747 (0.0676)
***ln*(Debt)**	0.1939*** (0.0297)	-0.0101 (0.0583)	0.2436*** (0.0355)	0.1942*** (0.0297)	0.1939*** (0.0297)	0.1940*** (0.0300)	0.1935*** (0.0297)	0.1923*** (0.0297)	0.1939*** (0.0296)	0.1921*** (0.0298)	0.1931*** (0.0297)
NB.	9,287	4,284	4,727	9,287	9,287	9,287	9,287	9,287	9,287	9,287	9,287
R^2 overall	0.51	0.10	0.32	0.51	0.51	0.51	0.51	0.50	0.51	0.50	0.51

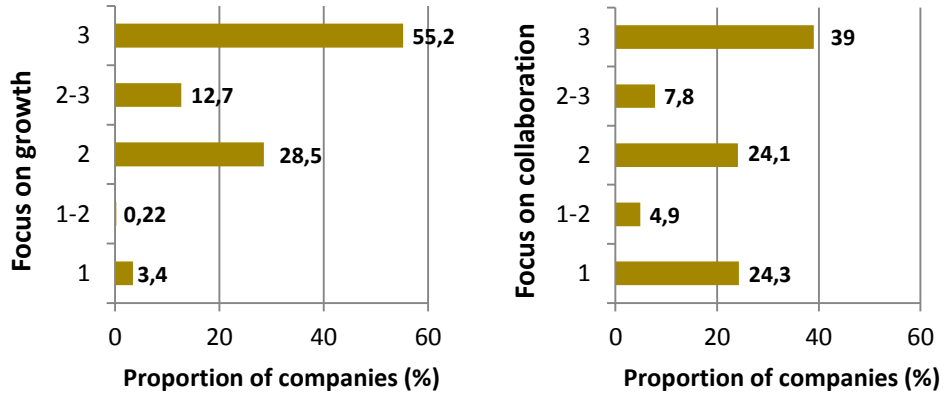
*Note: *, **, *** indicate significance of 10, 5, 1 percent significance level. Standard error clustered at company level within brackets (.). Company- and year fixed effects included in all models. TR = The period during which the company receives support; PTR = The years after support has been received. Includes CEM-matched control group.*

5.4 Programme profile and the impact of being part of a large corporation

As discussed above, there are reasons to believe that the project group's composition could be significant for how the companies are affected by project participation. However, the group's composition is not entirely random. One factor that affects which actors participate in a project is the underlying programme's design and objective/focus. Among the programmes studied, we have chosen to classify the programmes using a three-point scale according to their focus on the participating companies' growth and collaboration, respectively (where the value three represents a high degree of focus on growth or collaboration, and the value one represents a low degree of focus on respective objective). Programmes with a low degree of focus on the participating companies' growth were focused on other societal benefits, e.g., policy-relevant research regarding financial markets. Companies that participated in several projects under different programmes were allocated the average points for the programmes in which they participated. We have also chosen to specifically classify programmes targeted at international collaboration rather than collaboration with domestic actors, as well as programmes with a clear focus on longer-term growth. This grading of the programmes' focus is based on an analysis of the programmes' official calls for applications. For the programmes for which there is no such documentation, other Vinnova sources have been used, principally Vinnova's website. For a minority of the programmes, it was not possible to find sufficiently good information to assess their focus. See the appendix (table 2) for a list of all programmes included and how they have been classified.

Figure 3 shows the distribution of the small companies in our analysis according to the focus of the support programmes. We note that the vast majority of the companies participated in programmes that were focused on promoting the companies' growth. In regard to the programmes' focus on collaboration, the distribution was more even.

Figure 3 Focus of the support programmes in which the companies participated



Note: 1 = low, 2 = medium, 3 = high. The score for each company is calculated as the average over the programmes in which the company participated.

In addition, 31 percent of the companies participated in projects focused on international collaboration (mostly within the EUREKA and Eurostars programmes); 11 percent of the companies participated in projects focused on long-term growth. For 13 percent of the companies, it was not possible to find information about the programmes' focus.

The question we pose in this analysis is whether it is possible to detect any difference in the effect on growth of participation in a project depending on the programme's focus on growth and collaboration, respectively. As a framework for this analysis, we present the following hypotheses:

H1. The growth effect is expected to rise with the programmes' focus on growth.

H2. For programmes with long-term growth as their objective, the growth effect is principally expected to arise after the project is completed.

H3. For collaboration-focused programmes, the expected growth effect is somewhat unclear; however, taking into account the fact that collaboration is often intended to strengthen companies in the long-term, potential growth effects are primarily expected to arise after the project is completed.

The results, which are displayed in table 8, are clear. We do not observe any statistically significant difference in growth effect depending on whether the programmes in which the companies participated had different degrees of focus on growth or collaboration.

To provide a more nuanced picture of how companies' growth varies with respect to the focus of the projects in which the companies participate, figure 4 shows in detail how the growth effects varied, both during and after the duration of the project, with respect to the portfolio's focus on growth and collaboration. From figure 4, the following observations are made.

- The growth effect seems to increase with the degree of focus on growth, but the increase is too weak to produce any statistically significant difference in effect.
- The growth effect seems to decline with the degree of focus on collaboration, but the decrease is too weak to produce any statistically significant effects.
- The overall observation is, however, that the growth observed in the companies appears to be due to having participated in a programme rather than to the focus of that programme.

Table 8 The programmes' focus and the companies' group affiliation

	1. FE (a)	**2. FE (b)**	**3. FE (c)**	**4. FE (d)**	**5. FE**
Interaction variable →	Degree of focus on growth	Long-term growth	Degree of collaboration	International collaboration	Company with group
TR	-0.0050	0.0282	0.1181*	0.0188	0.0307
	(0.0914)	(0.0279)	(0.0713)	(0.0294)	(0.0274)
PTR	-0.0641	0.0335	0.1670*	0.0248	0.0582*
	(0.0946)	(0.0399)	(0.0969)	(0.0406)	(0.0302)
Sub-group TR	n.a.	-0.0072	n.a.	0.0336	0.0393
		(0.0438)		(0.0364)	(0.0242)
Sub-group. PTR	n.a.	0.0455	n.a.	0.0550	0.0635**
		(0.0614)		(0.0527)	(0.0303)
Interact. #TR	0.0151	-0.0354	-0.0423	0.0148	0.0087
	(0.0351)	(0.0430)	(0.0277)	(0.0365)	(0.0305)
Interact. #PTR	0.0455	0.0120	-0.0560	0.0302	0.0053
	(0.0346)	(0.0529)	(0.0348)	(0.0451)	(0.0325)
ln(K)	0.1005***	0.1072***	0.0948***	0.1073***	0.1137***
	(0.0174)	(0.0154)	(0.0189)	(0.0154)	(0.0124)
ln (L)	0.5625***	0.5916***	0.5487***	0.5916***	0.6066***
	(0.0512)	(0.0454)	(0.0595)	(0.0453)	(0.0397)
Skillshare	0.0624	-0.0356	-0.0373	-0.0382 (0.0874)	-0.0852
	(0.1041)	(0.0875)	(0.1124)		(0.0921)
Profit quota	0.0009***	0.0009***	0.0009***	0.0009***	0.0010***
	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
ln(debts)	0.1821***	0.1942***	0.1714***	0.1943***	0.2120***
	(0.0234)	(0.0209)	(0.0252)	(0.0209)	(0.0173)
R^2 Overall	0.69	0.69	0.68	0.69	0.71
NB.	5,593	6,872	4,472	6,872	9,919

Note:, **, *** indicate significance of 10, 5, 1 percent significance level. Dependent variable, sales. CEM-matched DiD-models, FE-estimates. Standard error clustered at company level. TR = The period during which the company receives support; PTR = The years after support has been received.*
(a) Interaction with average degree of focus on growth in the programmes in which the company participates.
(b) Interaction with dummy indicating that the company participates in a programme focused on long-term growth.
(c) Interaction with average degree of focus on collaboration in the programmes in which the company participates.
(d) Interaction with dummy indicating that the company participates in a programme focused on international collaboration.

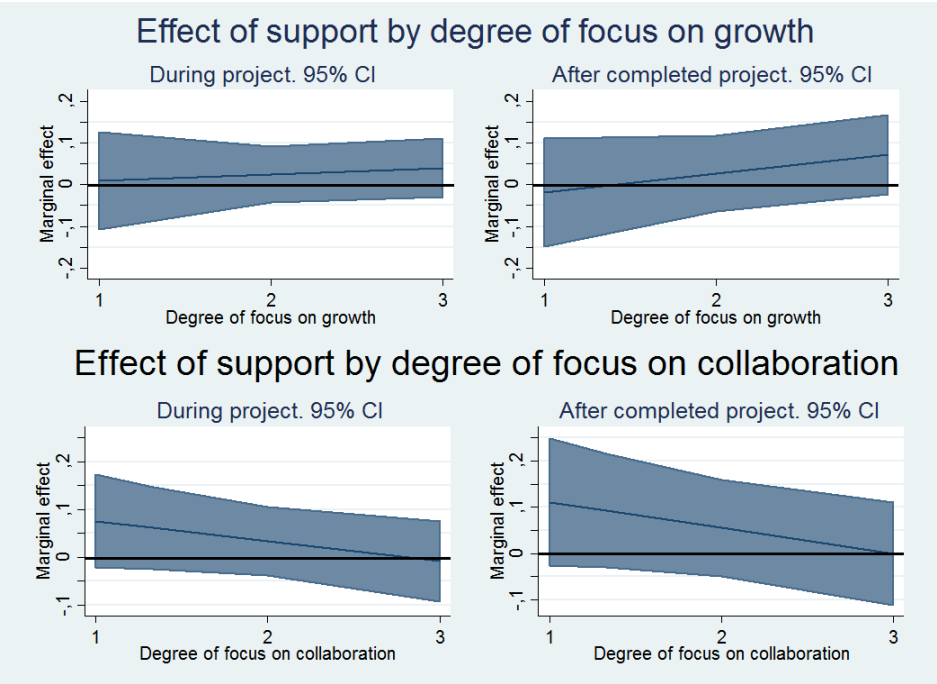
Finally, in table 8, we study the significance of corporate group affiliation. In the total population, about ten percent of the companies are part of a corporate group, either as a subsidiary or a parent company, while the corresponding figure for our sample of companies receiving support is 44 percent. Group-affiliated companies are thus overrepresented, and it might therefore be of particular interest to investigate whether this overrepresentation influences the effect of the support measures.

One hypothesis is that for companies that are part of a corporate group, the effect of the support measures tends to be weaker than for other companies. The reason for this is that within a group, it is possible to allocate activities so that the real effects of the support are produced in another part of the group rather than in the legal entity (which to us looks like a "company") receiving the support. For example, a large corporation might set up a separate company for its R&D department, while production and sales are registered in another company within the group.

With this as background, in model 5, we study how group-affiliated companies differ from stand-alone companies. The model is rather like those that have previously been used to analyse sub-groups; in this case, it is companies that are part of a corporate group that constitute the sub-group. We observe that the growth effect of support is slightly greater in

the group of companies that are part of a corporate group, but the difference between the two groups is negligible. We can therefore conclude that whether the companies are part of a group has no significance for the results of our analysis.

Figure 4 Effect of support and the programmes' focus



Note: The figure is based on the results from table 8. CI stands for confidence interval.

5.5 Indirect effects and endogeneity

5.5.1 Indirect effects

In this section, we return to the companies' sales and also allow employment and capital investments to affect sales. This analysis is conducted by estimating a structural equation system (SEM).

When we study the results from the SEM models in table 1, two tendencies emerge. In part, this estimation technique reveals somewhat weaker growth effects in relation to the fixed-effects estimates performed in table 4. In table 4, we had a growth effect on sales equivalent to approximately 3.6 percent over the duration of the programme and 6.2 percent after the project ended. Here, these estimates fall to 2.1 percent over the duration of the project and to a non-significant growth level of 0.9 percent after the project ends. The results are thus somewhat sensitive to the choice of model.

The other observation is that when we take into account indirect sales effects via employment and investment effects, the estimated growth effects increase by approximately 70 percent. This applies both during the project period and after completion of the project. After completion of the project, the effect is not significantly separated from zero, which is why it is not possible to definitively demonstrate any positive remaining sales effects after project completion.

Table 1 Robustness: Indirect and total effects, and endogeneity. CEM-matched DiD-models, FE-estimates.

	1. FD-SEM[a]			2. FE [b]	3. GMM [c]	4. GMM [d]
	1A. Direct effect	1B.Indir. eff. over (K,L)	1C. Total effect	Lagged K and L	K, L endog.	K, L, Y_{t-1} endog.
$(Sales)_{t-1}$						*0.1920****
						(0.0259)
TR	0.0210*	0.0149***	0.0359***	*0.0396**	*0.0375**	*0.0037*
	(0.0114)	(0.0046)	(0.0123)	*(0.0225)*	*(0.0219)*	*(0.0223)*
PTR	0.0098	0.0068	0.0166	*0.0407*	*0.0774***	*0.0014*
	(0.0095)	(0.0045)	(0.0102)	*(0.0274)*	*(0.0306)*	*(0.0277)*
ln(K)	0.0923***			*0.0196**	*0.1365****	*0.1066****
	(0.0096)			*(0.0119)*	*(0.0203)*	*(0.0178)*
ln (L)	0.4930***			*0.3542****	*0.6348****	*0.2900****
	(0.0222)			*(0.0338)*	*(0.0760)*	*(0.0850)*
Skillshare	0.0208**			*-0.1661*	*-0.4422*	*-0.0649*
	(0.0103)			*(0.1119)*	*(0.8245)*	*(0.7595)*
Profit quota	0.5200***			*0.0012***	*0.0014***	*0.0019***
	(0.0937)			*(0.0006)*	*(0.0006)*	*(0.0009)*
ln(debts)	0.1723***			*0.2783****	*0.1506*	*0.4383****
	(0.0127)			*(0.0176)*	*(0.1137)*	*(0.1125)*
AR(2)						*0.76*
Hansen						*0.29*
thesis NB.	7,127			*8,202*	*8,092*	*6,414*

Note:, **, *** indicate significance of 10, 5, 1 percent significance level. Standard error clustered at company level. TR = The period during which the company receives support; PTR = The years after support has been received.*
(a) Structural equation system (SEM-model) estimated with first difference taken on all time-varying variables (model 1).
(b) Company- and year fixed effects included. K and L lagged one period (model 2).
(c) Company- and year fixed effects included. K, L, TR, PTR endogenous (model 3).
(d) Company- and year fixed effects included. K, L, TR, PTR, Sales (t-1) endogenous (model 4).

5.5.2 Endogeneity

A controversial econometric question is whether capital and employment can be viewed as endogenous variables, i.e., if they are governed by factors that lie outside the theoretically derived and estimated model. If this is the case, then there is a risk that the results may be misleading. Here, we will take two approaches to analysing the endogeneity problem. A comparatively simple way to manage endogeneity is to shift the variables one period back in time. This achieves two purposes. In part, it allows changes in these variables to affect the companies' sales with a certain time lag, and it also strengthens these variables' exogeneity (Hendry 1995).

When we time lag the capital and employment variables one period back in time, the estimated effect of the support measures remains in the interval of 3–4 percent growth. However, the estimates become more uncertain, making it impossible to observe any statistically significant growth effect for the period after the programme is completed.

A somewhat more effective way to manage the endogeneity problem is via a system-GMM estimation (Blundell and Bond 1998). table 1 presents two system-GMM estimates: in model 3, we address capital and employment as endogenous variables, and in model 4, we expand this approach to a fully dynamic model with a time lag dependent variable on the right side. Estimating a fully dynamic model where we allow the previous year's sales to

explain this year's sales can be justified through the presence of adjustment costs, something that might seem natural given major production changes.

When we apply a system-GMM approach, we recover statistically significant treatment effects of the support measures of about four percent during the duration of the project and eight percent on completion of the project. However, these results are not completely robust. If we allow a dynamic model specification (model 4), the estimated treatment effect falls back towards zero and becomes insignificant.

To summarize this robustness analysis, it appears that in many cases, the support measures led to increased sales among the companies receiving support. These results should, however, be interpreted with some caution, as the results are not entirely robust with respect to estimation method and model formulation.

6 Conclusions

The aim of this report has been to evaluate the growth effects on small Swedish companies (maximum 50 employees) of participation in a number of Vinnova's R&D support programmes, where collaboration among the public sector, academia and business is a central component of the programmes' organisation and formulation.

A unique feature of the data to which we have access is that we can follow the main applicants as well as other project participants. This means that, perhaps for the first time, we can analyse in detail whether the project group's composition modulates the effects of the support measures. Does it make any difference to the small companies if universities or research institutes participate? What significance does the participation of a large private company have? How do single applicant companies fare, and what significance do the programmes' aim and focus have?

Collaboration is regarded as important is emphasised in the government's research bill (prop. 2016/17:50, p. 53), which emphasizes the urgency of stimulating the universities' and colleges' collaboration with business and the surrounding society. We also note that it is part of Vinnova's remit to *"enable different forms of collaboration between business, public activities and the academic world within collaborative programmes".*

Despite collaboration being a well-used term, there is not currently a consensus on how this collaboration should best be achieved and what it has de facto led to. One reason for this debate might lie in the lack of quantitative counterfactual evidence in the area. With this as background, it is therefore both urgent and pertinent that, by means of detailed micro-data, we analyse whether the effect of support interacts with the project group's composition and the project's focus.

The dependent/outcome variables that are analysed in this study are the programmes' effects on number of employees, sales and capital stock. The results of the report can be summarised as follows:

- Sales
  - × The results suggest that the companies receiving aid increased their sales during the duration of the project by an average of about three percent in relation to the control group. In the years following the end of the project, this figure increased to about six percent.
  - × The growth effect was greatest for the smaller companies (10–50 employees) and was not statistically significant for micro-companies with 1–9 employees.
  - × The development in sales among companies that participated in just one project was significantly inferior than that among companies that participated in several projects. One possible explanation for this lies in the fact that companies that do not participate in a successful project do not return to participate in future projects; additionally, the agency can reject less successful companies that reapply for support.
- Employment
  - × There are signs that companies that participate in several projects have relatively weak employment growth and strong sales growth.

- Capital stock and investments
  - × Companies that consistently participated in projects with universities or research institutes have had, upon completion of the project, weaker development of their capital stock compared to other companies. One explanation for this might be that companies that apply for collaboration with universities and research institutes are trying to strengthen their human capital rather than their physical capital.
- The project's focus on growth and collaboration
  - × The overall observation is that the growth in the companies appears to be due to participation in a programme rather than the particular focus of the program.
- Group affiliation
  - × Whether the companies are part of a group as parent company or subsidiary had no significance for the results.
- Robustness
  - × The analysis generally provides support for the conclusion that companies that participated in a project have enjoyed faster growth than other similar companies that did not participate in a support programme. However, the results are not entirely robust with respect to model formulation and estimation technique, which is why the results should be interpreted with some caution. The positive effects also seem to be limited to companies with 10–50 employees.

Finally, we would like to emphasise that wider and deeper knowledge of how different types of collaboration *de facto* affect the companies' competitiveness is not available. This is a problem that Sweden shares with many other countries; however, today we can use quantitative methods to begin to address the issue. Using Growth Analysis' micro-database of state subsidies (MISS), we can evaluate effects of state support measures on firms in ways that were not previously possible.

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Appendix

Table 2 Classification of support programmes according to focus on the participating companies' growth and collaboration, respectively.

Principal programme	**Sub-programme[a]**	**Degree of focus[b] on: Collaboration**	**Growth**
Berzelii Centra	Berzelii Centra 2005	HIGH	HIGH - Long-term
Citizens` Services	Citizen-Centric eGovernment Services	HIGH	LOW
Designed materials including nanomaterials	Designed materials - Follow-up investments	No information	No information
	Designed materials - Feasibility study and concept verification 2008	LOW	MEDIUM
	Designed materials incl. nanomaterials – Industrialisation	HIGH	HIGH
	Designed materials including nanomaterials – Other	No information	No information
	MNT ERA-NET Transnational Call	HIGH - Intl.	HIGH
	Swedish-Chinese materials collaboration	HIGH - Intl.	No information
Dynamic innovation systems in transformation		MEDIUM	LOW
e-Administration	Innovative users in a collaborative e-administration	HIGH	LOW
EUREKA and Eurostars		HIGH - Intl.	HIGH
EU-relationships	COST Special initiatives	HIGH - Intl.	MEDIUM
	EU special initiatives	No information	No information
	Knowledge Innovation Communities (KIC)	HIGH - Intl.	MEDIUM
	SMINT - Planning grants for small and medium-sized companies for application to the EU's seventh framework programme	HIGH - Intl.	MEDIUM
	SMINT 2011	HIGH - Intl.	MEDIUM
Technical aviation research programme	FLUD - Technical aviation development and Demonstration Programme	No information	No information
	NFFP – SME	LOW	HIGH
	NFFP 5, 2009-2012	MEDIUM	HIGH
Strategic vehicle research and innovation	FFI - Energy and environment	MEDIUM	HIGH
	FFI - Vehicle & Traffic Safety	MEDIUM	HIGH
	FFI – Vehicle development	MEDIUM	HIGH
	FFI - Sustainable production technology	MEDIUM	HIGH
	FFI - Projects initiated by boards	MEDIUM	HIGH
	FFI – Transport efficiency	MEDIUM	HIGH
	Enabling electronics	MEDIUM	HIGH
Research&Grow		LOW	HIGH

Principal programme	Sub-programme[a]	Degree of focus[b] on: Collaboration	Growth
Communication of the future	IMT-Advanced and Beyond 2008-2011	HIGH - Intl.	MEDIUM
	Mobility, mobile communication and broadband	HIGH	HIGH - Long-term
	Smarter, faster, convergent solutions	HIGH	HIGH
	Strategy and follow-up investments	No information	No information
Transportation of people in the future		HIGH	LOW
Gender and diversity for innovation	Research into female entrepreneurship (announcement)	LOW	LOW
	Gender and Innovation – other	No information	No information
	Gender perspective on innovation system and equality - research and development project	No information	No information
	Applied gender research within strong R&I environments - Stage 2 (announcement)	MEDIUM	MEDIUM
Global collaborations		No information	No information
Mine programme	Strategic Mine research programme	HIGH	HIGH - Long-term
Health innovations and development of care		No information	No information
ICT Industry programme		No information	No information
ICT Strategic initiatives programme	ICT Strategic initiatives	No information	No information
	Industry driven R&D project and SiC Power Centre	HIGH	HIGH
Industrial bioengineering	Industrial bioengineering announcement 2007	HIGH	MEDIUM
Industry Excellence Centre		HIGH	HIGH - Long-term
Innovations for a sustainable future	Eco-innovations	MEDIUM	HIGH
Innovations for future health		LOW	HIGH
Innovation capacity in public operations	Innovation capacity in public operations - specific initiatives	No information	No information
Innovation processes and entrepreneurship	LEKA - Leadership, creativity and organisation of work	HIGH	HIGH
	Open and distributed innovation processes (announcement)	MEDIUM	LOW
Innovation gateways and test beds	Innovation gateways within medical and health care Government commission	HIGH	LOW
	Government commission Test beds within medical and health care and geriatric care	HIGH	HIGH
	Test beds within medical and health care and geriatric care	HIGH	HIGH

Principal programme	Sub-programme[a]	Degree of focus[b] on: Collaboration	Growth
Innovative foodstuffs	Innovative foodstuffs – Other	No information	No information
	TvärLivs 2011 Formas	HIGH	HIGH
	TvärLivs 2013	HIGH	HIGH
Innovative logistics systems and freight transportation	Sustainable freight transportation – announcement	HIGH	HIGH
	Innovative logistics systems and freight transportation, Other	No information	No information
	Innovative logistics systems and freight transportation, specific initiatives	No information	No information
	Innovative logistics systems and freight transportation, announcement 2005	No information	No information
Innovative SMEs	Innovation vouchers	LOW	HIGH
	Innovation vouchers for national distributors	LOW	HIGH
	Innovative SMEs – Other	LOW	HIGH
	Innovative SMEs announcement 2011–2012 OTHER	No information	No information
	Pilots VINN Export	No information	No information
	Government commission IPR as strategic business tool 2012-2013	No information	No information
	Growth pilot	No information	No information
International collaboration for environmental innovations	International collaboration for environmental innovations 2012	HIGH – Intl.	HIGH - Long-term
International programme	International – Other	No information	No information
JTI ICT	ARTEMIS	HIGH - Intl.	MEDIUM
	ENIAC	HIGH - Intl.	MEDIUM
Creativity and entrepreneurship	Creativity and entrepreneurship – Other	No information	No information
	YOUNG PEOPLE'S innovation capacity specific initiatives 2011 Announcement	LOW	MEDIUM
Enabling ICT	Pioneering information and communications technology	HIGH	HIGH - Long-term
	Micro- and nanoelectronics – Other	No information	No information
	MyFab SME Access 2010	HIGH	HIGH
	NORDITE – Announcement level	HIGH - Intl.	HIGH
	Software products – Other	No information	No information
	Strategic Indo-Swedish Cooperative Research Programme in the field of Embedded Systems 2010	HIGH - Intl.	HIGH - Long-term
	Strategic projects and follow-up investments within Enabling ICT	No information	No information

Principal programme	Sub-programme[a]	Degree of focus[b] on: Collaboration	Growth
National innovation programme - Construction innovation		HIGH	HIGH
Key actors programme	Universities' infrastructure for collaboration for growth	HIGH	HIGH - Long-term
	International Innovation practices 2010	HIGH - Intl.	LOW
	International Innovation practices 2011	HIGH - Intl.	LOW
	Key actors programme- other announcement	HIGH - Intl.	LOW
Conversion capacity and skills provision (programme)		MEDIUM	LOW
Production strategies and models for product development	Announcement: "Sustainable production strategies - Hypothesis testing 2010"	MEDIUM	HIGH - Long-term
	Sustainable production strategies	HIGH	HIGH - Long-term
	Sustainable production strategies and manufacturing in constant change 2011	HIGH	HIGH - Long-term
	Innovative product development	MEDIUM	HIGH - Long-term
Programme for financial markets research		HIGH	LOW
Programme Manufacturing in constant change		MEDIUM	HIGH - Long-term
Programme Production and Materials Follow-up investments and miscellaneous matters	Announcement Lean and innovation capacity - obstacles, opportunities and knowledge gaps	No information	No information
	Announcement. Production and Materials Follow-up investments and miscellaneous matters	No information	No information
SAMBIO		HIGH	HIGH
Forestry and wood programme	Industry research programme for the forestry and wood industries	HIGH	HIGH - Long-term
	Sub-announcement within the industry research programme for the forestry and wood industries	HIGH	HIGH - Long-term
	Streamlining of the application procedure for EU projects within the forestry and wood industries	No information	No information
	Announcement: Knowledge transfer and utilization	No information	No information
SMINT, Promotion grant and COST		HIGH - Intl.	MEDIUM
Strategic collaboration communication		No information	No information
Strategic Innovation programmes	Strategic research and innovation agendas	HIGH	MEDIUM
Security and Emergency Preparedness	Security and Emergency Preparedness - product- and service demonstrators	HIGH	MEDIUM

Principal programme	Sub-programme[a]	Degree of focus[b] on: Collaboration	Growth
	Security research 2007	No information	No information
	Security solutions with ICT	HIGH	HIGH
Test market	Innovation project 2012- follow-up funding	MEDIUM	MEDIUM
	Concept development 2012	MEDIUM	MEDIUM
	Pilots 2012	MEDIUM	MEDIUM
Services and ICT strategic projects		No information	No information
The service society's innovations	Sustainable operational and business models for e-services	HIGH	HIGH
	Service innovations 2007	HIGH	HIGH
	The service society's innovations – Other	No information	No information
	The service society's Innovations specific initiatives and follow-up investments.	No information	No information
TM - International collaboration programme	International.	No information	No information
TM - Test beds within environmental engineering	Test beds within environmental engineering-2012	MEDIUM	HIGH
Transport - Other		No information	No information
Transport and Environment-related centres	CLOSER	No information	No information
	Innovative vehicles, vessels and systems – Misc.	HIGH	HIGH - Long-term
	Public transport centre	No information	No information
	SAFER	No information	No information
Transport Policy and collaboration	Infrastructure and effective transport systems – early	MEDIUM	LOW
	Infrastructure and effective transport systems 2006	MEDIUM	LOW
	Logistics and Collaboration	No information	No information
	Policy basis for sustainable and effective transport systems	MEDIUM	LOW
	Transport policy – misc.	No information	No information
	Transport collaboration (Forum, CTS etc.)	No information	No information
Wood manufacturing	Acoustics and vibrations in light structures	HIGH	MEDIUM
	Lean Wood Manufacturing Discipline	HIGH	MEDIUM
Challenge-driven innovation - Social challenges as growth	Social Integration meets digital innovation	No information	No information
	Challenge-driven innovation	HIGH	HIGH

Principal programme	Sub-programme[a]	Degree of focus[b] on: Collaboration	Growth
opportunities	Challenge-driven innovation- specific initiatives	HIGH	HIGH
	Challenge-driven Innovation spring 2012	HIGH	HIGH
	Open Innovation 2011	HIGH	HIGH
Development of innovation systems in regions	Markets for ecosystem services	No information	No information
	Regional Innovation capacity	No information	No information
	VINNVINN	No information	No information
Everyday IT		HIGH	HIGH
Verification for growth	VINN-Verification announcement	HIGH	HIGH
Operational management and organisation of work		HIGH	MEDIUM
VINN Excellence Centre		HIGH	HIGH
VINN NU		LOW	HIGH
VINNMER	Innovation-driven mobility between Industry and Research institutes	HIGH	MEDIUM
	VINNMER - International research qualification	HIGH - Intl.	MEDIUM
	VINNMER - National research qualification	HIGH	MEDIUM
	VINNMER – misc.	HIGH	MEDIUM
	VINNMER Marie Curie Chair	HIGH	MEDIUM
	VINNMER Marie Curie international qualification	HIGH - Intl.	MEDIUM
	VINNMER national qualification	HIGH	MEDIUM
VINNVÄXT		HIGH	HIGH
Elderly	AAL- Ambient Assisted Living	HIGH - Intl.	MEDIUM
Open Innovation	Open innovation and lead users 2012	MEDIUM	MEDIUM
	Open innovation specific initiatives 2012	MEDIUM	MEDIUM
	Open data sources 2012	MEDIUM	MEDIUM

a With some exceptions sub-programmes are only listed in those cases where different sub-programmes within the same principal programme have a different classification.

b ”Intl.” means international. ”No information” means that it was not possible to find sufficiently good information to be able to classify the programme.

Growth Analysis is an agency that evaluates and analyses Swedish growth policy. We provide the government and other stakeholders in the growth policy process with an advanced knowledge base and recommendations to streamline and develop the state's work to promote sustainable growth and business development.

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