Foundation Ownership and Externalities: The Economic Impact of Industrial Foundations[1][2][3]

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Abstract

While many studies examine the impact of ownership structure on firm performance, we examine wider economic effects (spillovers) of a particular ownership structure, the Danish industrial foundations, that combines non-profit charitable activity with for-profit business activity. We look at industrial foundations, i.e., foundations that own business companies or conduct business activity, in Denmark in the period 2000-2011 and estimate their impact on economic activity and productivity. We use a novel and unique dataset covering (almost) all registered Danish industrial foundations and corporate subsidiaries compared to population data from the national company register. Social impact is measured as spillover effects at the firm and industry level. Foundation-owned firms have the advantage of having access to 'patient' capital and, supposedly, can follow other than short-run profit making objectives, which may lead to positive effects on the activities of other firms.

1. Introduction

There is a large and growing literature on corporate ownership and performance (see Thomsen and Conyon 2013, chapter 7 for an overview), but this literature has almost exclusively focused on the performance of the individual firm measured by firm value, accounting profitability, or productivity. In terms of welfare economics, current research has studied the *private* effects of ownership structure. In contrast, little is known about the *social* effects of alternative ownership forms, i.e. what effects corporate ownership structure may have on other firms as well as society in general. These effects could include both direct economic effects of increased demand or supply on suppliers or customers as well as indirect effects (so-called externalities) such as positive effects of knowledge diffusion, demonstration, economies of scale economies or negative effects from for example pollution.

The dominant focus on private performance can be justified if shareholder value is the legitimate objective for companies and economic externalities are small. However, the supremacy of shareholder value is increasingly being questioned. In a recent book, financial economist Colin Mayer (2013) argues that the unlimited pursuit of shareholder value is the root cause of corporate failures and value destruction around the world.

In this paper, we take a first step towards measuring indirect economic effects of a particular ownership structure, the Danish industrial foundations, which – we argue – may have positive spillover effects.

Industrial foundations are foundations that own business companies[7], a structure which is quite common in Northern Europe and particularly in Denmark. They are an interesting combination of for-profit business companies and the charitable or non-profit entities which own them. These entities resemble the "trust firms" advocated by Colin Mayer as a remedy for the excessive shareholder centricity of contemporary business firms. Previous papers have studied the private performance of foundation-owned companies in terms of profitability (Thomsen 1996, 1999, Hansmann and Thomsen 2013b), but this paper studies their social performance measured by spillover effects.

Thomsen (2013) shows the importance of this ownership form. Through the companies they own, industrial foundations account for an estimated 5-10 % of employment and value added, and for the bulk of the Danish stock market capitalization as well as total R&D expenditure. Moreover, their importance to Danish economy appears to have increased over time, and they appear to have weathered the financial crisis 2008-2009 better than other ownership categories (Thomsen 2013). Using population data reported to a comprehensive accounting database (Experian), we are able to track (almost) all of the 1200+ industrial foundations in Denmark.

We measure their indirect contribution to the Danish economy by estimating the effect of economic activity and productivity in foundation-owned firms on other, non-foundation-owned firms.

[7] For an explanation of the institutional structure and relevant theories see Thomsen (2012): What do We Know about Industrial Foundations?

2. Theory.

Spillovers (or externalities) are indirect, often unintended consequences of economic activity for third parties not directly involved in this activity through transactions. Thus the direct private gains (or losses) to an activity may be wholly or partially offset or enhanced by social losses (or gains).

Research on corporate governance, including ownership and boards structures, has largely focused on effects on private gains measured by performance indicators such as profitability and firm value. However, as the financial crisis has made clear, private activity may have large side effects on third parties.

In this paper we study the spillover effects of foundation ownership of business companies on the hypothesis that foundation ownership has positive spillover effects on other, non-foundation-owned businesses.

Spillovers

The literature has mostly been concerned with knowledge spillovers according to which higher productivity in one firm flows to other firms through learning, technology adoption, or imitation. A key mechanism is that employees in one firm talk to employees in another or alternatively that they change jobs from one company to another (Glaeser et al. 1992).

In the endogenous growth theory (Romer 1987) increasing returns to scale may arise at the industry level as knowledge generates more knowledge both within and between firms. Michael Porter (1990) has emphasized that intra industry competition may play a role in stimulating innovation. Positive effects of industrial districts (Marshall 1920), industry clusters, networks and so on are abound in the literature.

However, spillovers need not be limited to knowledge transfers. It is possible, for example, that increased activity may enable a finer division of labor so that suppliers can offer tailor made products or service that can help generate new business opportunities (Stigler 1951). Likewise with consumers where a broader set of preferences may perhaps be serviced. Governments might be more inclined to build infrastructure for large and growing industries and this would tend to stimulate further growth. Blomström and Kokko (1996) focus on (positive or negative) competition effects, (positive) demonstration effects (e.g. of superior technology) and (positive) labor mobility effects as above

Nor do spillovers have to be confined to a single industry. Glaeser et al (1992) make the important distinction between intra industry MAR (Marshall-Arrow-Romer) externalities and inter industry Jacobs externalities (Jacobs 1969) in the same location (city). For example the needs of US grain and cotton merchants for international exchange fostered the growth of financial services. Moreover many business functions like marketing or corporate finance or business practices like

internationalization appear to be transferable across industries. Glaeser et al. (1992) find that Jacobs externalities provides a better explanation for the growth of US cities.

Spillovers can also take place within firms and have been documented in economics and business studies, for example in the study of foreign direct investment, where it is argued that multinational subsidiaries have positive vertical spillovers on host country firms (Havranek and Irsova 2011). The spillover effects from industrial foundations may well be very different than those from multinational companies, however.

Industrial foundations

Industrial foundations are foundations which have business activity, either because they sell goods and services or because they own companies which do. According to their charters they can have distribution or activity goals. Activity goals can be running a company or a charitable service like a hospital. Distribution goals can be to donate to charitable goals like art, science or social programs or founding family members.

The combination of non-profit (charity) and for-profit (business) has implications for the way foundation-owned companies do business and their spillover effects on society. We conjecture that companies owned by foundations with charitable or business goals have less high powered incentives compared to for example owner-managed firms. This could mean that they are less aggressive competitors or business partners. They may be more likely to behave responsibly since foundation board members are paid a relatively low flat rate fee and thus do not partake in any short run profits generated by cutting corners, but have their reputation at stake.

Industrial foundations are quite heterogeneous as a group. Foundations are classified as industrial whenever they have sales of more than 250.000 DKK, so the population includes a large number of charitable or semi-charitable institutions such as museums, dormitories, medical establishments or homes for the elderly as well as some which own world class multinational companies. There are also mixed entities such as newspapers which combine business and charity though their business activity. In addition, the foundation structure can sometimes be a convenient way to organize partnerships or cooperatives in which the partners or members elect the foundation board.

However, because of a skewed size distribution (Thomsen 2012), the bulk of their business activity as well as social contribution is generated by the largest industrial foundations and their subsidiaries. Assessing their social impact therefore invites attention to these large entities either through size-weighted regressions or working with aggregated summary statistics.

According to the altruism model (Newhouse 1970) non-profits like foundations can be created out of "pure" altruism, but they can also be motivated by professional norms (e.g., the medical ethic of doctors) or a desire to advertise a family name and make it famous into posterity (Glaeser 2002). In any case, once established, non-profits differ from for-profits by having preferences with regard to the quantity and quality of output (e.g., running a hospital is a goal in itself, treating more patients is

better, ballet is preferable to soap operas). Many Scandinavian (and US) newspapers are owned by foundations (or trusts). It is regarded as a goal in itself to have the public read a newspaper of the desired quality, political orientation, or local interest.

It seems straightforward to generalize this logic to concerns for product quality, sustainability, employment security, labor standards, child labor etc. Inspection of foundation charters indicates that they often make special provisions about high ethical standards in the conduct of business, concern for employees and their families or for product quality. Such restrictions may also influence the way more normal business companies are run. The foundation-owned company Carlsberg, for example, is in this way committed to brewing beer of the highest quality. So a preference for high product quality could be a prediction of the altruism model (Malani, Philipson and David 2003). Industrial foundations may also have a size preference, when the activity goal is dominant, and it has indeed been found that US non-profits tend to be bigger than their for-profit competitors (Malani, Philipson and David 2003).

Even in the absence of charitable goals in the normal sense, we hypothesize that activity goals – such as the continuation and growth of a business company – will influence business behavior. We hypothesize that foundation-owned companies will be more likely to make long term investments such as research and development, human capital and reputation

Foundation-owned companies might be expected to underperform in terms of short run profitability since they trade off profits for other objectives. But for the same reason, they are likely to be more concerned with the social impact of their activity and to generate positive spillover effects.

It is of course possible that such idealistic goals will be dominated or at least moderated by agency problems, for example self-serving and opportunistic behavior by professional managers. Glaeser (2002) models US non-profits as employee cooperatives that are captured by elite employees (doctors, university professors or priests). The same can be said for other ownership structures such as public corporations so it is no surprise that industrial foundations also have governance problems (Hansmann and Thomsen 2013).

Contract failure theory (Hansmann 1980, Glaeser and Shleifer 2001) explains commercial nonprofits by a contract-failure argument: when the buyer is uncertain about the quality of a service provided to her, a market failure occurs since the producer has the capacity to reduce quality of the good in ways that cannot be detected by the buyer. To facilitate contracting under these circumstances the supplier may organize as a non-profit enterprise which is free of profit incentives to cheat on customers. Non-profit enterprise can therefore be seen as a binding commitment not to maximize profits opportunistically at the expense of buyers. It seems straightforward to generalize the argument to include safeguarding other economic relationships in which a company has decisive information advantages, i.e. with employees, suppliers or government agencies. The implication is that industrial foundations may enable business activity which would have been more difficult in other ownership forms, when information asymmetries are high.

All else equal we hypothesize positive spillover effects of industrial foundations, particularly with regard to supporting and related industries. Within the same industry strong activity goals may lead

foundation-owned firms to crowd out rivals because they are willing to accept lower rates of return. This, then would translate into negative horizontal spillovers.

Spillovers can be both positive and negative. Moreover, they can occur both horizontally (between firms in the same industry) and vertically (in the same value chain). Competing firms will experience adverse (negative) effects when a strong competitor enters and captures market share. They can also be more general, as the so called Jacobs externalities, which take place when firms learn from otherwise unrelated firms in other industries. Spillovers can affect firm productivity, but also other variables such as sales, employment or profitability. There are a number of potential mechanisms. Knowledge diffusion takes place when employees exchange information and change jobs. Less productive employees learn from those that are more productive, and new employees can use their skills and past experience in their new jobs. Companies can also imitate the practices and behavior of other companies (so called demonstration effects) which may make them more (or) less productive. Vertical demand spillovers can occur when companies purchase more in supporting or related industries. Vertical supply related spillover can arise when demand by one company induces suppliers develop to new products that can increase the productivity of other companies. Government investment, for example in infrastructure, to service some firms can also benefit other firms

3. Data sources

Our data is from 3 sources:

1. Danish Business Authority which regulates industrial foundations and maintains a list of Danish industrial foundations, which we have accessed from 2007 onward.
2. Experian A/S, a credit rating agency that collects data from the Danish Business Authority. This data includes information on company background variables, such as industry and legal form, annual financial statements information, and information on firm ownership.
3. A hand collected dataset of the 121 largest foundation-owned firms reported by Thomsen (2012), which we use to benchmark the above data. This data set excludes financial firms.

We use the list of foundations supplied by the business authorities and supplement it with a list of foundations that were identified by having ‘industrial foundation’ as their legal form in the Experian data.

As a next step, we exploit the presence of ownership information in the Experian data to identify Danish foundation-owned companies (subsidiaries). In Denmark, firms are obliged to register ownership stakes above 5 percent. The credit rating agency Experian A/S has made this information

accessible for research. Using these data, we define subsidiaries as companies that are, at any point in time within a given calendar year, at least 51 percent owned by a foundation.[8,9]

We find that, from year 2000 onward, there are 1,621 foundations in our data, with the annual number of foundations increasing from 1,126 in 2000 to 1,313 in 2011, see Figure 4.1. In the same time period, we can identify 836 Danish subsidiaries, and 737 Danish subsidiaries of subsidiaries.

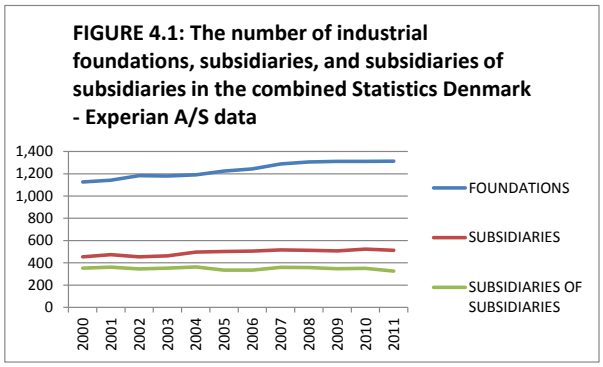
As previously noted, the industrial foundations are highly heterogeneous, covering housing cooperatives, local museums and provincial theatres on the one hand and foundations owning global players with thousands of employees on the other.

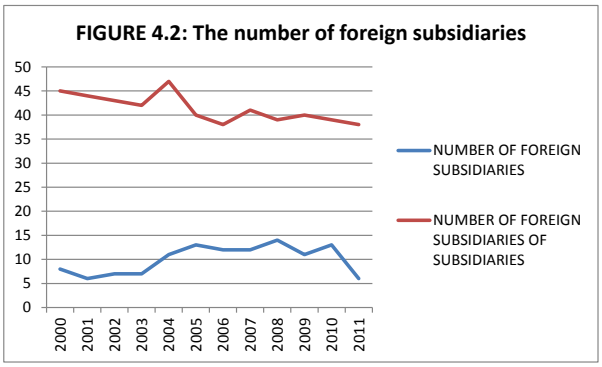
A large share of the industrial foundations is registered as social institutions. But there are also significant shares registered as financial and real estate companies, which is a pattern that is, likewise, found for subsidiaries, and, to a lesser extent, found for subsidiaries of subsidiaries.

It might be noted that only a small share of subsidiaries is located abroad, with less than 20 direct subsidiaries outside Danish borders (see Figure 2). Approximately ten percent of all subsidiaries of subsidiaries are located in other countries than Denmark, but this is still an obvious understatement. For these companies, there is no information in our data, and they will not enter the following examinations. This is an obvious limitation of our current data which leads to an understatement of the overall activity of foundation-owned firms both in Denmark and internationally. In fact, we find overall employment to be less than what is documented in Thomsen (2012) for the subsample of the 121 largest foundation-owned firms.

[8] The ownership data has information on firms' ownership of other firms. However, data are characterized by large shares of missing information regarding the precise ownership stakes. Companies that are owned by foundations, but for which this piece of ownership information is missing, are not considered subsidiaries.

[9] We only consider corporations as subsidiaries, if there is exact information on ownership stakes; for a share of ownership relationships, the only information in the data is that ownership is larger than five percent instead of listing the exact shares.





After having identified foundations and foundation-owned companies in the data, we add accounting/financial statement information from annual Experian database updates that the Centre for Economic and Business Research (CEBR) at the Copenhagen Business School has collected from 2003 onward.[10] There are both consolidated and unconsolidated financial statements in our data, which allows constructing different measures of economic activity, to be discussed further below.

We find that, even in restricted samples without financial and real estate firms, approximately half of the foundations' subsidiaries register having no employment in the Experian database. The remainder reports a highly skewed size distribution, but with large firms being overrepresented relative to the incorporated firms in the Experian database. In particular, 11 percent of all foundation-owned firms report having more than 1,000 employees, compared to 0.5 percent for the Experian database as a whole.

The financial accounts databases sample each corporation's five latest financial statements. So there is a backwards sampling mechanism in our data prior to 2003; however, the relatively small increase the number of foundations and subsidiaries in Figure 4.1 does not suggest this to a relevant problem.

In 2009, the list of variables of the financial statements that was included into Experian's annual deliveries to the CEBR was extended from 'standard' variables like equity, value added, profit, total assets and number of employees to more specific information like for example expenses on research and development.

Unconsolidated and consolidated accounts

While all foundations submit unconsolidated accounts, there are consolidated accounts for less than ten percent of all foundations, a fact which generally leads to understatement of their economic activity. Also, of all foundations that have – according to the Experian data's ownership information

[10] Just as it is the case for the ownership information, we chose the calendar year as the unit of time measurement, and associate annual accounts with given years by to the accounts' closing dates.

– subsidiaries, only approximately 20 per cent have consolidated statements information in the Experian registers. However, the latter are typically large foundations, so the choice of consolidated and unconsolidated accounts is far from trivial for later findings.

For the following examination, it should be noted that consolidated accounts are based on the parent company's influence in the subsidiary companies, while our data 'only' has information on ownership stakes. Thus, aggregation of subsidiaries' activities will in many cases not add up to the parent company's consolidated account.

4. Measures of economic activity

For the measurement of foundation-related economic activity, it is clear that the structure of the data requires some decisions. Economic activity can be measured at the level of the foundation, their subsidiary companies, or a combination of the two levels.

In the following, we employ two alternative measures of the economic activity of foundations and their subsidiaries:

a. MEASURE 1 (CONSOLIDATED ACCOUNTS): the consolidated activity of the foundation, if the foundation submits a consolidated financial statement to the government authority. Otherwise, the foundation's unconsolidated activity added the aggregated activity of the foundation's Danish subsidiaries. The activity of these subsidiaries is measured by the subsidiaries' consolidated statements. If a given subsidiary does not submit a consolidated statement to the authority, the activity of the subsidiary is measured by the aggregated activity of the Danish subsidiaries of the subsidiary. The activity of these second-degree subsidiaries is measured by these firms' consolidated financial information if available. Otherwise, we refer to their unconsolidated statements.
b. MEASURE 2 (UNCONSOLIDATED ACCOUNTS): the sum of the unconsolidated activities of the foundation, their subsidiaries, and the subsidiaries of the subsidiaries.

Recall that, to qualify as a subsidiary requires any given firm to be owned to at least 51 percent by a foundation at any point in the given calendar year, and that there is precise information on ownership stakes in the Experian Database.

MEASURE 1 (CONSOLIDATED ACCOUNTS) is more likely to include a larger share of activity outside the borders of Denmark, as consolidated accounts include any activities of foreign subsidiaries, but can be assumed to give a relatively precise picture of foundation-controlled activity.

However, in the later analysis of spillovers, we need to calculate the foundation-related activity in given industries relative to the total activity in the industry. For this purpose, the presence of

foreign activity in MEASURE 1 (CONSOLIDATED ACCOUNTS) makes this measure less suitable compared to MEASURE 2 (UNCONSOLIDATED ACCOUNTS).[11]

MEASURE 2 (UNCONSOLIDATED ACCOUNTS) is completely immune to foreign activities, and, thus, better suited for the measurement of foundation-related activity in given industry clusters. Given that most of the economic activity is in first and second-degree subsidiaries, the activity of these firms can be readily assigned their given industries.

MEASURE 2 (UNCONSOLIDATED ACCOUNTS) is a measure of foundation-related activity within Denmark, but it should of course be acknowledged (and kept in mind) that it does not capture third-level subsidiaries, and activities in subsidiaries with missing ownership information – which would imply that MEASURE 2 (UNCONSOLIDATED ACCOUNTS) is a lower bound of foundation-related activity. On the other hand, MEASURE 2 (UNCONSOLIDATED ACCOUNTS) is based on ownership information and not, as is the case for consolidated financial statements, on control. To the extent that foundations' control in their subsidiaries is different from ownership being equal or above 51 percent, MEASURE 2 (UNCONSOLIDATED ACCOUNTS) might over-estimate the foundation-related activity.

Industry distribution patterns

Of all approximately 1,300 foundations in 2011, 33 percent register themselves as being in the industry "social work activities without accommodation" (2-digit-NACE industry classification), 14 percent are in real estate, and 14 percent are in financial services. The other foundations are spread over a diverse array of industries like "libraries archives, museums and other" (3 percent), "activities of head offices" (2 percent), or "publishing activities" (2 percent).

Of the foundations' approximately 700 subsidiaries in 2011, 32 percent are in financial activities - these are presumably holding companies - and 23 are in real estate. The remainder is again distributed over large number of very different industries. Given the large share of financial industry firms in the group of subsidiaries, we consider it necessary to include the subsidiaries of these subsidiaries into the analysis. In this group of firms, the share of firms in financial services is down to 21 and the share of firms in real estate is down to 19 percent, while the remainder is again evenly distributed across industries.

Below, we will see that the number of foundations and their subsidiaries in a given industry only loosely reflects these organizations' industry-specific activity levels, as foundations and their subsidiaries have highly skewed size distributions.

[11] It is not just the presence of foreign activity, but also the problems of assessing the foundations' industry affiliations, and last not least the tremendous difficulties of applying MEASURE 1 (CONSOLIDATED ACCOUNTS)'s algorithm on the total non-foundation-related economy advises us to choose a more robust and intuitive measure of foundation-related activity.

The following considers employment shares of foundation-related activity by industry. Of a total of 1,693 subsidiaries, 841 are in financial activities or real estate. However, low employment in these industries that they do not steal the picture in terms of foundations-related activity, at least when this is measured in terms of employment.

Foundations and foundation-owned companies are having most of their employment in trade and pharmaceuticals (FIGURE 3.1). They have the lion's share of employment in pharmaceuticals, forestry and cultural institutions, and are well-represented in a couple of other industries.

The largest shares of foundations-related activity, when measured in terms of employment, are, see Figure 3.1, trade and pharmaceuticals (a finding driven by few large companies), while the remainder is an array of industries with highest weight on technical and manufacturing activities.

Foundation-related activity takes the lion's share of activity in pharmaceuticals (again driven by few large companies), forestry and cultural activities. But it is also well-represented in a number of other activities like certain manufacturing or service industries.

FIGURE 3.1: The industries with most foundation-related employment. MEASURE 2, absolute numbers, 2011.

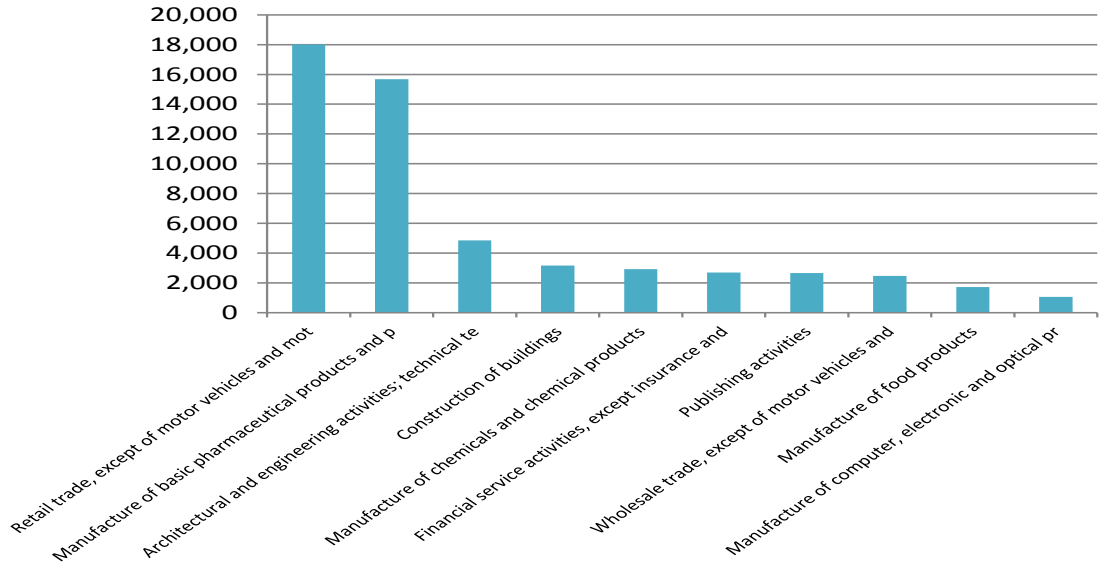
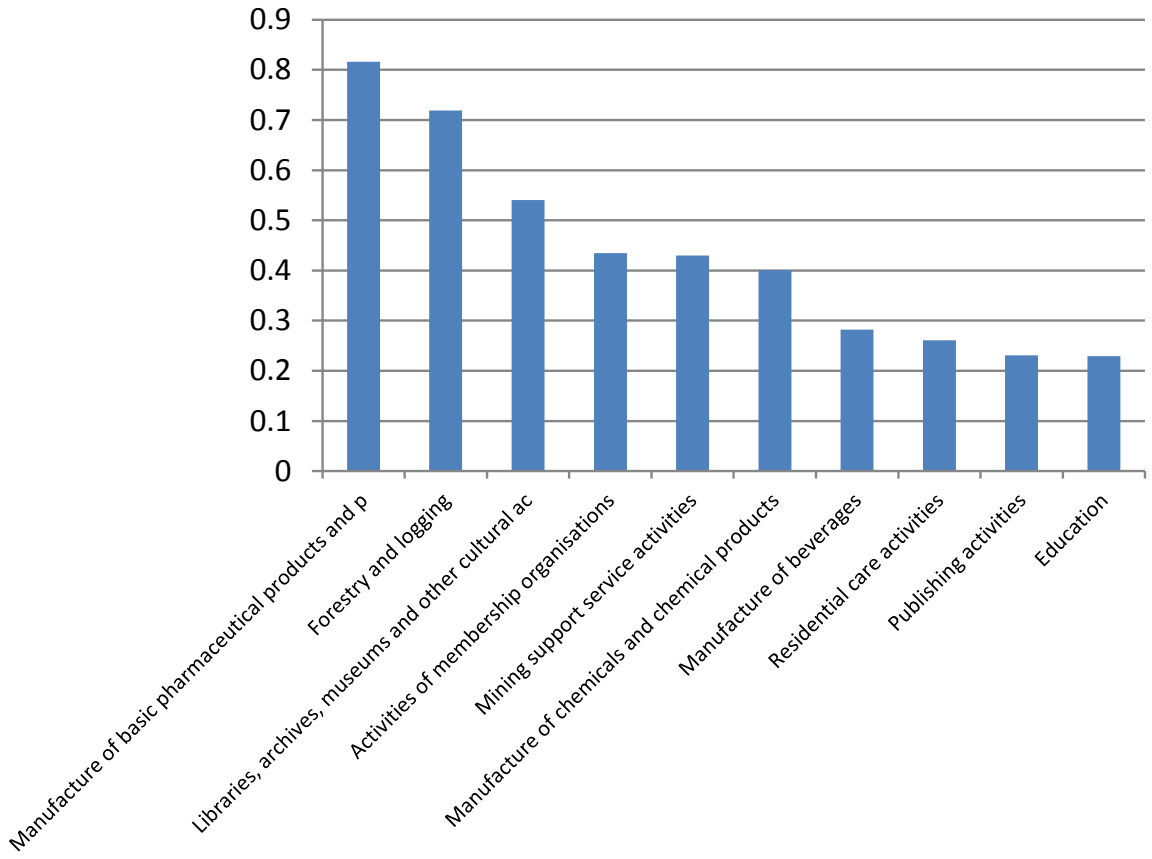


FIGURE 3.2: The industries with the highest share of foundation-related employment. MEASURE 2, relative numbers, 2011.



5. Foundation-related activity

The following presents evidence on foundation-related activity. This is measured by employment, value added and total assets. Also, we are interested in research and development expenses and the donations of the foundations.

5.1 Employment

Employment in foundation-related firms defined according to MEASURE 1 (CONSOLIDATED ACCOUNTS) is approximately 100,000 up to 2004, followed by a dramatic increase from 2005, reaching 180,000 employees by the end of the observation period. See FIGURE 2.1. Numbers for the 'local' measure, MEASURE 2 (UNCONSOLIDATED ACCOUNTS) are smaller, and between 60,000 in the first half and 80,000 in the second half of the observation period.

The increase in MEASURE 1 (CONSOLIDATED ACCOUNTS) requires obviously further elaboration.

FIGURE 2.2 shows that the increase is due to increases in the consolidated accounts of the foundations themselves, rather than increasing employment in the subsidiaries, which add a relatively constant number of 30,000-40,000 employees to MEASURE 1 (CONSOLIDATED ACCOUNTS).

Also, FIGURE 2.3 shows that it is not the case that the pool of foundations publishing consolidated financial statements has increased over the observation period. This leaves job creation outside Denmark as the sole explanation for the massive employment increase of MEASURE 1 (CONSOLIDATED ACCOUNTS).

FIGURE 2.4 shows that employment numbers are – and we will see that this not only holds for employment - highly skewed, with few large foundations contributing the lion's share to foundation-related aggregate employment numbers, and being the drivers of the significant increase in employment in the second half of the observation period.

FIGURE 2.1. Employment in foundations and their subsidiaries

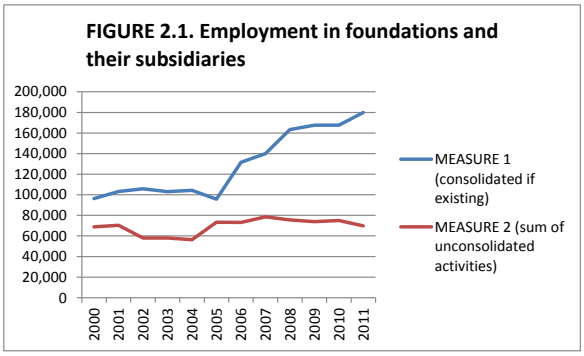
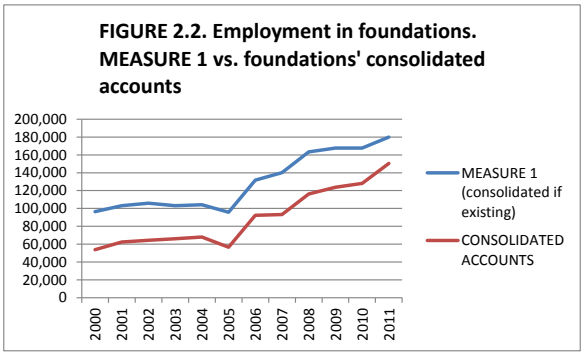
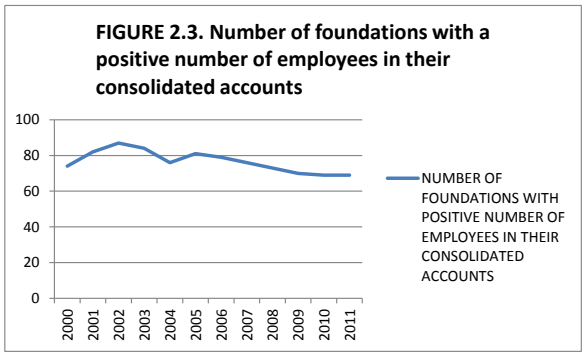
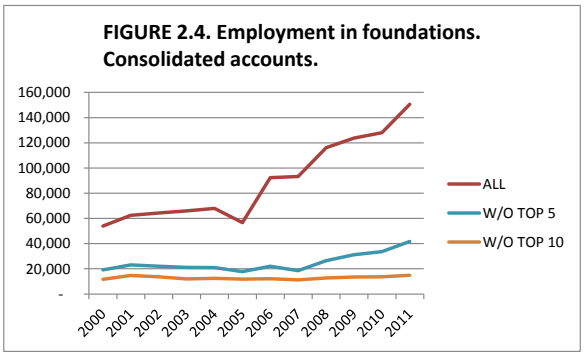


FIGURE 2.2. Employment in foundations. MEASURE 1 vs. foundations' consolidated accounts

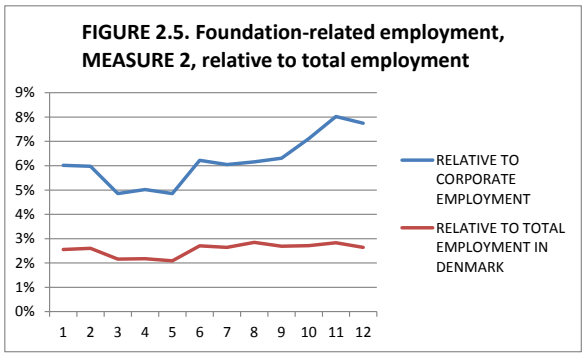






We are now ready to compare the employment in foundations and their subsidiaries with the total employment in the Experian database, and the Danish private sector economy (the latter numbers originating from Statistics Denmark).

These comparisons are based on MEASURE 2 (UNCONSOLIDATED ACCOUNTS). They reveal that there is an increase in foundation-related activity relative to corporate employment, which is measured as the total employment in all unconsolidated accounts in the Experian database. This is due to a dramatic decrease in aggregate employment in the Experian database, which drops from 1.3 million in 2007 to 900,000 employment relationships in 2011, rather than any significant increase in the employment, when measured by MEASURE 2 (UNCONSOLIDATED ACCOUNTS). Also, the share of employment inside Denmark relative to total Danish employment is constant at approximately 2-3 percent.



5.2 Total assets/Balance sum

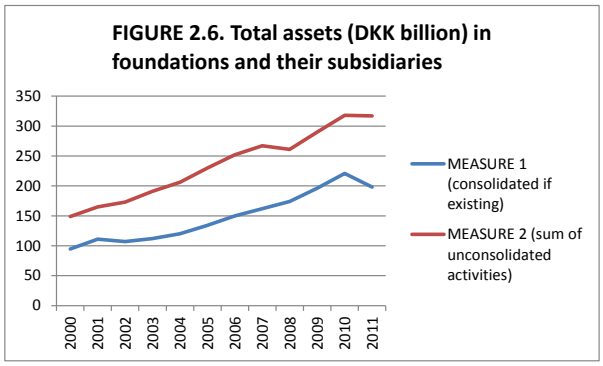
Results for total assets (balance sum) are based on all industries except financial services (excluding insurance) and real estate. Results are displayed in FIGURE 2.6-2.8. We find that MEASURE 2 (UNCONSOLIDATED ACCOUNTS) suggests larger aggregated total assets than MEASURE 1 (CONSOLIDATED ACCOUNTS) which can only be explained by some consolidated accounts having more modest numbers than the aggregated unconsolidated accounts of foundation-owned subsidiaries, which in the present study are defined by ownership, not control.

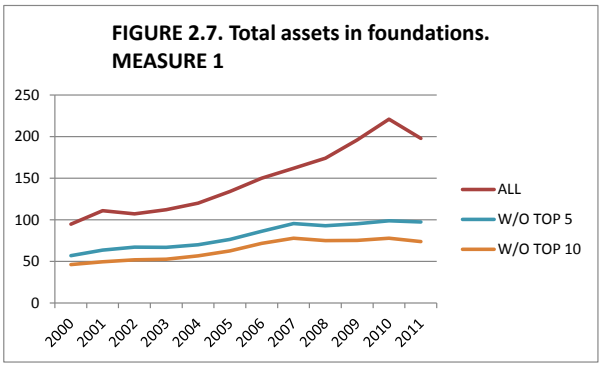
After having dropped financial and real estate firms, we find that half of total aggregated total assets are in the largest five firms in terms of total assets. We find a significant increase in total assets in foundations and their subsidiaries. In the beginning of the period, foundation-related total assets ownership also increases relative to the overall economy (FIGURE 2.8).[12] This increase continues after 2003, and thus, cannot be assumed to be a result of the backward-looking sampling scheme of our data prior to 2003.

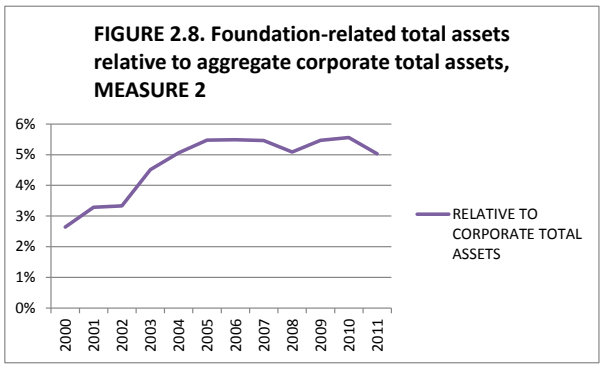
In sum, we find that foundations and their subsidiaries control about 5 to 6 percent of all total assets listed in Danish firms' unconsolidated financial statements. This share might be compared to these organizations' share of total equity (book values), and, see FIGURE 2.9, we find that foundation-related organizations have considerably lower debt ratios compared to the rest of the economy, and that these organizations control significantly larger shares of total equity compared to total assets.

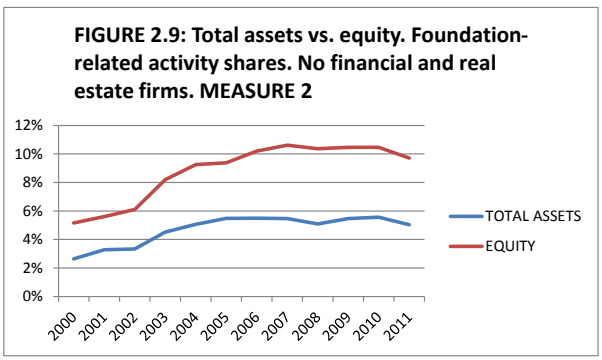
Also, FIGURE 2.7 shows that subsidiaries have shares of total assets similar to the shares of employment, and FIGURE 2.8 shows the extreme skewness in total assets, with the ten largest companies holding between 80 to 85 percent of all foundation-related assets. Foundations and their subsidiaries hold approximately 6 percent of the corporate economy's total assets, which agrees with their employment share shown earlier, and suggest the foundation-related economy to be neither more or less capital intensive than the total economy.

[12] It is not completely clear, whether or not the dip at the very end of the series of MEASURE 1 for total assets indicates a trend-shift in the variable's growth regime. We did not succeed in isolating any large single foundation or subsidiary being able to explain the drop in the series, but, still, cannot rule out that the drop is an artifact of the data.







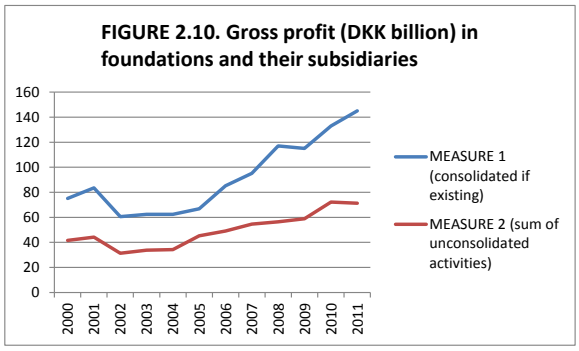


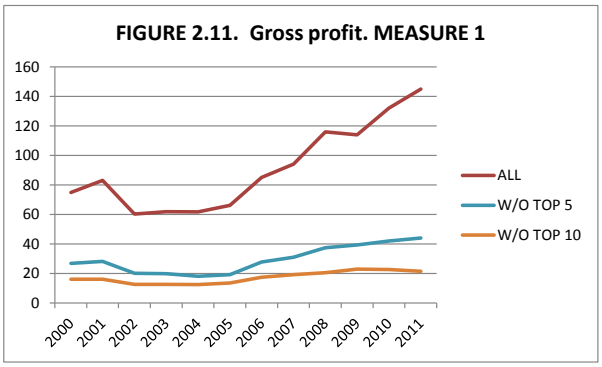
5.3 Value added (gross profit)

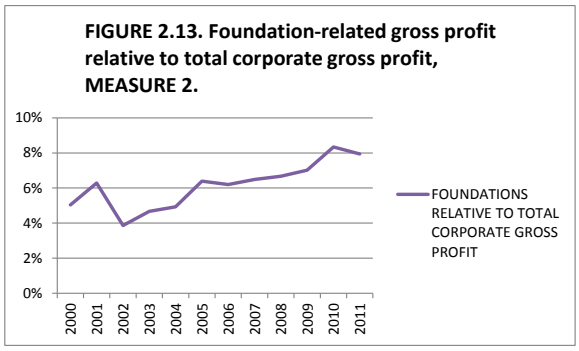
Findings for value added suggest a large share of foundation-related value added being generated outside Denmark, cf. the large differences between MEASURE 1 (CONSOLIDATED ACCOUNTS) and 2 in FIGURE 2.10. Also, Danish subsidiaries of foundations not submitting consolidated accounts only contribute relatively little to MEASURE 1 (CONSOLIDATED ACCOUNTS), as witnessed by FIGURE 2.11.

Just as it was the case for employment, there is a dramatic increase in gross profit in the second half of the observation period for MEASURE 1. But for gross profit, there is also a substantial increase for the 'local' measure, MEASURE 2 (FIGURE 2.10). This implies that the share of foundations' relative to total corporate gross profit has been increasing (FIGURE 2.13), and climbs up to approximately 8 percent of aggregate value added in the Experian database.

Again, numbers are mainly driven by few foundations, with the largest (in terms of gross profit) ten foundations in 2011 generating almost 85 percent of total corporate gross profit.







5.4 Research and development

Just as all financial information in the Experian database, research and development (R&D) expenses are from the published annual financial statements that corporations are obliged to submit to the government authorities.

It is the case that only a tiny minority of firms explicitly states these expenses in their annual reports.[13] For example, in 2011, only 190 firms in the entire database report positive research expenses on their financial accounts, and only 16 of these firms are foundations.

But these firms are – see FIGURE 2.14 and 2.15 – contributing the majority of published corporate research expenses with a total R&D volume of approximately DKK15 billion. Given the small selection of firms that submit R&D expenses, these numbers should be taken with care. However, they are clear indication that foundation-owned firms are contributing a large, if not the largest share of Danish private sector R&D.

[13] This distinguishes the Experian database as a source of R&D information from an alternative data source, which is survey information from Statistics Denmark. Here, only a share of all firms was asked to reveal research expenses, but – asked directly – a larger number of firms are stating having positive R&D expenses in the Statistics Denmark data. The aggregate private sector research expenses in 2010 (the last year for which there is information in the Statistics Denmark data) is DKK37 billion according to Statistics Denmark, and DKK21 billion according to Experian, MEASURE 2 (i.e., domestic R&D).

FIGURE 2.14. Published research and development expenses (DKK billion) in foundations and their subsidiaries

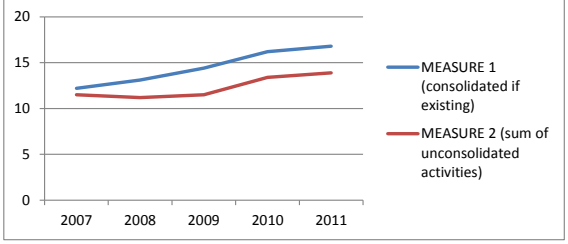
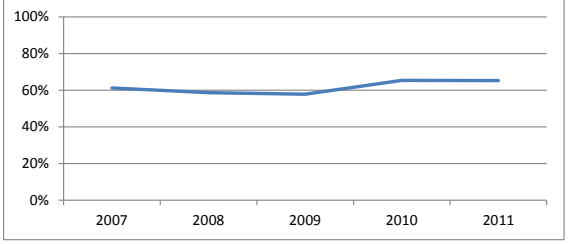


FIGURE 2.15. Foundation-related published R&D expenses relative to total published R&D expenses, MEASURE 2.



6 The characteristics of foundation-owned corporations

This section compares foundation-owned companies with other companies in the Experian database in 2011. These comparisons should give us an idea of the general characteristics of foundation-owned companies. They are based on all incorporated firms in Denmark in 2011, except firms in finance and real estate. Also foundations themselves are not considered.

A first look at the data reveals that subsidiaries are (see TABLE 4.1 for descriptive statistics) large, pay high wages, and have relatively low return on equity (net income over equity) and return on assets (net income over total assets).[14]

TABLE 4.1. Foundation-owned firms vs. other firms in the Experian database[1], 2011

	MEANS		MEANS, FIRMS WITH 250+ EMPLOYEES		MEDIANS		MEDIANS, FIRMS WITH 250+ EMPLOYEES	
	Subsidiaries	Other	Subsidiaries	Other	Subsidiaries	Other	Subsidiaries	Other
Number of employees	245	12	2,885	1,150	1	0	1,205	481
Wage costs per employees	473	398	437	446	444	365	444	419
Equity (DKK1,000)	292,333	17,644	2,961,116	1,066,556	7,972	402	559,744	194,000
Profit (DKK1,000)	39,878	959	634,018	105,100	101	18	42,744	19,826
Return on equity[2]	0.02	0.16	0.13	0.08	0.03	0.08	0.11	0.10
Return on assets[3]	-0.03	-0.03	0.06	0.04	0.01	0.01	0.05	0.04
N	*490*	*118,386*	*47*	*614*	*490*	*118,386*	*47*	*614*

Notes:
1: No companies in real estate and the financial sector and no foundations.
2: No companies with return on equity<-5 and return on equity>5.
3: No companies with return on assets>10 and return on assets<-10.

We also compare productivity of foundations-related firms with other incorporated firms. Productivity is measured by the Solow residual of an estimation of a Cobb-Douglas production function. This function is added flexibility by including second order terms and an interaction term.[15] TABLE 4.2 summarizes results.

[14] Return on assets is also often defined as income before financial expenses over total assets.
[15] The production function follows Christensen, Jorgenson and Lau, 1973, and is specified as

We find that subsidiaries are characterized by approximately three percent lower productivity, but this difference is not statistically significant from zero. Note that the productivity difference cannot be explained by reference to foundation-owned firms being located in low-productivity industries to start with – as the relevant coefficient of the regression with industry fixed effects is of similar size as the estimate of the pooled regression.

This picture changes when one considers firms with at least 250 employees. Given the Danish industry structure with mostly small firms, this is a very minor share of all firms; only 46 foundation-owned subsidiaries enter the regressions of Model 3 and 4.

These large foundation-owned firms are characterized by a (exp(0.26)=1.30) 30 percent higher productivity than other large incorporated firms. However, a large share of this difference is explained by industry affiliation, as the relevant coefficient drops from 0.26 to 0.13 and becomes statistically insignificant when first one controls for industry-level fixed effects in Model 4. This is an indication of large foundation-owned firms being to some extent over-represented in high-productivity industries.

TABLE 4.2. Production function regressions with a dummy variable for foundation-owned companies. Dependent variable: Log(value added). Sample: Incorporated firms, no firms in real estate and the financial sector.

	Model 1: Pooled regression		Model 2: Regression with industry-fixed effects[1]		Model 3: Pooled regression; only firms with 250+ employees		Model 4: Regression with industry-fixed effects; only firms with 250+ employees	
	Coefficient[2]	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Log(total assets)	0.32 ***	0.04	0.38 ***	0.02	0.31	0.30	-0.04	0.30
Log(number of employees)	0.91 ***	0.05	0.90 ***	0.03	0.21	0.23	0.46 **	0.20
Log(total assets)^2	0.00	0.00	0.00	0.00	-0.01	0.01	0.00	0.01
Log(number of employees)^2	-0.02 ***	0.01	-0.03 ***	0.00	-0.05 ***	0.02	-0.04 ***	0.01
Log(total assets)*log(employees)	-0.01	0.01	0.00	0.00	0.08 ***	0.02	0.05 **	0.02
Dummy variable: the firm is foundation-owned	-0.03	0.04	-0.04	0.04	0.26 ***	0.10	0.13	0.13
Constant	3.63 ***	0.14	3.39 ***	0.08	5.17 ***	1.80	6.89 ***	1.93
Number of observations	25,888		25,888		556		556	
R2	0.82		0.82		0.76		0.76	

*Notes:1.: industry fixed effects on NACE 2-digit level.2: ***=significant at 1%, **=significant at 5%.*

7. Industry-level spillover effects of foundations and foundation-owned enterprises

In this section, we document to what extent foundation-related activity in a given 2-digit NACE industry is associated with positive growth in that given industry. This investigation is motivated by the hypothesis that foundation-related firms create positive externalities that increase growth and productivity in other firms.

$$\log(Y_i)=A+a_1*\log(K_i) +b_1*\log(L_i) + a_2(\log(K_i))^2 +b_2*(\log(L_i))^2 + c*(\log(K_i) *(\log(L_i))+ e_i,$$

with Y gross profit, K total assets and L employees, and a, b, and c being coefficients. The constant term A is average productivity, i is a firm index, and e_i is firm *i*'s approximately percentage-wise deviation from average productivity. For the estimation of TABLE 4.2, $e_i=d*D_{i(\text{foundation owned})}+ \varepsilon_i$, where $D_{i(\text{foundation owned})}$ takes the value one if firm i is foundation-owned, and zero otherwise, *d* is a coefficient, and the firm-idiosyncratic productivity factorial ε_i fulfilling standard assumptions.

Our approach departs from the notion of external economies of scale, often referred to as 'Marshallian externalities' or 'agglomeration externalities'. Prominent examples of these externalities are knowledge spill-overs, the creation of markets, infrastructure, or the pooling of specialized labor.

The fact that foundations are financed by patient capital and having a long-term investment perspective, being associated with, e.g., relatively high investments in research and development, has led us to hypothesize that foundations are generating positive knowledge spill-overs. On the other hand, well-financed foundation-owned companies might crowd out competitors and deter entry of other firms into the same markets.

The implications of externalities have been tested in earlier studies – concentrating typically on the analysis of industry agglomeration effects and the implications of foreign direct investment on local markets (e.g., Caballero and Lyons 1990, Havranek and Irsova 2011, Meyer and Sinani 2009).

We chose three different approaches to investigate potential spill-overs of foundation-owned companies on other firms:

1. Production function regressions in the footsteps of previous research, summarized in Havranek and Irsova (2011). These are firm-level regressions, where the productivity of non-foundation-related firms is regressed on activity shares of foundation-related firms in the same industry.
2. Simple industry-level regression of different growth measures on foundation-presence in given industries.
3. Regressions that exploit the dynamics in our industry-level panels to test for Granger causality.

The first two approaches have in common that they require definitions of foundation-related activity at the industry level. We will use the following two measures:

a. The share of employment, S^E_i, in industry *i* in foundations and foundation-owned firms.
b. The share of assets, S^T_i, in the industry that is owned by foundations and foundation-owned firms.

An important aspect in the modeling of spillovers is the definition of industry. To allow for vertical spill-overs, we chose a relative broad industry classification, and base the following investigation on 2-digit NACE classifications, with a total of 83 different industries.

Production function regressions

The first step of the spillover analysis is in the footsteps of analyses reviewed in Havranek and Irsova (2011) and Meyer and Sinani (2009) such as Görg and Greenway (2004), Smeets (2008) and Kamal (2013).

We follow these papers and relate the productivity performance of non-foundation-related firms to the foundation-related activity in the same industry. We specify the production function, as in the earlier section, as a Cobb-Douglas type with second-order terms and an interaction term to account for scale economies.

We estimate the following production function at the firm level, augmented by the measures of industry-level foundation-related activity:

$$\ln Y_{itc} = f(K_{itc}, L_{itc}) + \gamma A_{tc} + \varepsilon_{ti},$$

with

$$f(K_{itc}, L_{itc}) = \beta_0 + \beta_1 \ln K_{itc} + \beta_2 \ln L_{itc} + \beta_3 (\ln K_{itc})^2 + \beta_4 (\ln L_{itc})^2 + \beta_5 (\ln L_{itc} * \ln K_{itc}),$$

where Y is value added, K capital, L number of employees, i firm index, t time index, and c industry index. Further, A_{tc} is the measure of foundation-related activity in industry c at time t, taking values between zero and one.

Thus, γ measures the semi-elasticity of productivity with regards to changes in foundation-related activity in the given industry. This association is of course statistical rather than causal if for example foundations are located in industries having high/low productivity for other reasons than foundation-related activity.

However, given that Denmark is a small country, there is no way of controlling for industry effects by use regional variation in activity as in Kamal (2013). Instead, we can test for whether or not changes in foundation-related activity are associated with changes in the productivity of non-foundation-related firms. And we can test for whether or not firms in industries with high foundation-related activity back in time were characterized by high or low productivity growth.

For these purposes, we formulate a dynamic version of the above regression model, with

$$\ln Y_{ic,t=2011} - \ln Y_{ic,t=2006} = f(K_{ic,t=2011} - K_{ic,t=2006}, L_{ic,t=2011} - L_{ic,t=2006}) + \gamma (A_{c,t=2011} - A_{c,t=2006}) + \varepsilon_i$$

for testing the association of growth of productivity in association with changes in foundations-related activity, and

$$\ln Y_{ic,t=2011} - \ln Y_{ic,t=2006} = f(K_{ic,t=2011} - K_{ic,t=2006}, L_{ic,t=2011} - L_{ic,t=2006}) + \gamma A_{c,t=2006} + \varepsilon_i$$

for the association of past foundation-related activity and productivity growth.[16]

The results of the productivity regressions are summarized in TABLE 8.1.a and b. These results are generated on basis of firms that are not owned by foundations (independent of ownership share), and that have positive numbers of employees and total assets. Firms in the financial sector and real estate are not considered.

We find, cf. Model 1 in TABLE 8.1, that firms in 2-digit NACE-industries with high shares of foundation-related activity are characterized by significantly lower productivity. In 2011, a ten percent increase in the share of foundation-related employment in a given industry is associated with (0.1*0.430=) 4 percent lower productivity of non-foundation-related companies in the same industry.

This association is weaker when one considers all data from 2000 and onward (Model 2), and industry fixed effects (Model 4), where the latter estimates the relationship between changes in a given industry's share of foundation-related activity and firm productivity in the given industry. When following single firms over time, see Model 4, we finds that changes in foundation-related activity are strongly negatively associated with firms' productivity.

So, the general finding is that firms in industries with a high foundation-related activity have a lower productivity compared to firms in industries with low foundation-related activity. But this is not the complete story because, as noted earlier, foundation-owned firms are highly heterogeneous – as are the other firms in the data for that matter. And any correlations between foundation-related activity and productivity performance cannot be expected to be symmetrical across all types of firms.

And the results of Model 4 are indeed highly influenced by size effects, as the relevant coefficient turns positive and significant for large firms. There might be presumed a couple of reasons for this striking change in the results in dependence of firm size. E.g., the size threshold also changes the industry mix of the firms in the estimation sample and other firm characteristics, and small firms in high-foundation-activity-industries might be presumed to be less profit-oriented than larger ones.

But at this place, it might be sufficient to note that for large firms, the finding of a positive association agrees with the hypothesis of positive spill-over effects.

[16] An important aspect in the modeling of spill-overs is assumptions on the time that is required for potential spill-overs to materialize. Spill-overs might be presumed to take time to take effect, so we chose the most recent five-year period in our data as the starting point of the investigation – with subsequent robustness checks using alternative time periods.

TABLE 8.1.a Production function regressions with industry-level foundation-related activity shares. Foundation-related activity share measured by foundation-related employment over total employment in given NACE-2-digit industry. Dependent variable: Log(value added)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Cross section 2011		Pooled regression 2000-2011		Pooled regression 2000-2011, firms with 250+ employees		Firm fixed effects, 2000-2011		Firm fixed effects, 2000-2011, firms with 250+ employees	
	Coefficient	Ste.	Coefficient	Ste.	Coefficient	Ste.	Coefficient	Ste.	Coefficient	Ste.
Log(total assets)	0.333 ***	0.041	0.400 ***	0.012	0.168	0.120	0.503 ***	0.009	-0.175	0.150
Log(number of employees)	0.904 ***	0.049	0.734 ***	0.013	0.232 **	0.101	0.793 ***	0.010	0.328 ***	0.124
(Log(total assets))^2	0.001	0.003	-0.003 ***	0.001	-0.008	0.005	-0.002 ***	0.001	0.011 *	0.006
(Log(number of employees))^2	-0.027 ***	0.006	-0.037 ***	0.002	-0.053 ***	0.006	0.013 ***	0.001	-0.008	0.006
*Log(total assets)*Log(number of employees)*	-0.007	0.008	0.011 ***	0.002	0.074 ***	0.010	-0.027 ***	0.002	0.025 **	0.010
Foundation-related activity share	-0.430 ***	0.047	-0.228 ***	0.010	0.229 ***	0.070	-0.080 ***	0.025	0.552 ***	0.185
Constant	3.610 ***	0.141								
Year dummies	no		yes		yes		yes		yes	
Number of observations	25,507		508,999		5,862		508,999		5,838	
R^2	0.816		0.777		0.689		0.772		0.680	

*Notes: ***=significant at 1%, **=significant at 5%, *=significant at 1%.*

Obviously, the positive association of foundation-presence in given industries and productivity for larger firms might be due to foundations selecting into specific industries characterized by high productivity of larger firms. Thus, a logical next step in the analysis is asking whether firms in industries with a high presence of foundations not just are characterized by high or low productivity, but high or low *growth* in productivity.

We find, see Model 6, TABLE 8.1.b that firms in industries with increasing foundation-related activity had decreasing, though statistically insignificant, productivity over the period 2006-2011. But when we weight firms by their employment in 2006 (Model 7), the picture changes: just as it was the case for the estimations in levels, results provide evidence of large firms in industries with high foundation-presence having experienced increasing productivity. Also, a semi-elasticity of approximately one suggests that associations are not just statistically, but also economically significant.[17]

As a final model, we consider productivity growth in dependence of past foundation-related activity in 2006. Again, we find high foundation-presence in 2006 being associated with significantly lower productivity growth for all firms (Model 8), and significantly higher productivity growth for large firms.

[17] The size of the 'spill-over-coefficient' is driven by large firms above size 5000 employees, but remains statistically significant when these large firms are not considered in the estimations. The coefficient for a subsample of firms above size 250 employees in 2006 is statistically insignificant, which might also be due to this threshold considerably reducing the sample size.

TABLE 8.1.b Dynamic production function regressions with industry-level foundation-related activity shares. Foundation-related activity share measured by foundation-related employment over total employment in given NACE-2-digit industry. Dependent variable: Log(value added, 2011)-Log(value added,2006)

	Model 6		Model 7		Model 8		Model 9	
	Change in foundation related activity		Change in foundation related activity; regression weighted by number of employees in 2006		Foundation related activity in 2006		Foundation related activity in 2006; regression weighted by number of employees in 2006	
	Coefficient	Ste.	Coefficient	Ste.	Coefficient	Ste.	Coefficient	Ste.
Log(total assets,2011)- Log(total assets, 2006)	0.444 ***	0.085	-0.235 ***	0.012	0.445 ***	0.085	-0.265 ***	0.012
Log(number of employees,2011)-Log(number of employees,2006)	1.017 ***	0.086	1.540 ***	0.011	1.016 ***	0.086	1.567 ***	0.011
(Log(total assets,2011))^2-(Log(total assets,2006))^2	0.004	0.006	0.049 ***	0.001	0.004	0.006	0.051 ***	0.001
(Log(number of employees,2011))^2-(Log(number of employees,2006))^2	0.014	0.010	0.073 ***	0.001	0.014	0.010	0.073 ***	0.001
*Log(total assets,2011)*Log(number of employees,2011)-Log(total assets,2006)*Log(number of employees,2006)*	-0.050 ***	0.013	-0.134 ***	0.001	-0.050 ***	0.013	-0.137 ***	0.001
Foundation-related activity share, 2011-foundation-related activity share, 2006	-0.188	0.162	1.190 ***	0.019				
Foundation-related activity share, 2006					-0.100 ***	0.049	0.224 ***	0.006
Constant	-0.030 ***	0.007	0.003 ***	0.001	-0.028 ***	0.007	0.017 ***	0.001
Number of observations [1]	16,462		719,943		16,332		719,943	
R^2	0.405		0.472		0.406		0.469	

*Notes: ***=significant at 1%, **=significant at 5%.*

1: For weighted regressions: total number of employees 2006

We conclude that the production function approach has not revealed any general presence of positive association between foundation-presence in any given industry and productivity of other firms in the same industry. Instead, there are positive associations for larger firms.

To the extent that these relationships are driven by spill-overs rather than the industry-distribution of foundations being orthogonal to industry-level productivity and productivity delevlopments, the results indicate negative spill-overs for small and positive spill-overs for larger firms.

Industry-level regressions

As an alternative to the firm-level production function regressions, we look at industry-level growth in some selected performance variables. Performance is measured as the growth in one of these variables between time t and t+x.

The performance variables, *Y*, under investigation are

i. Employment growth in non-foundation-related firms, measured as the difference in employment in the pool of non-foundation-related firms in industry i at time t and the employment in the pool of all non-foundation-related firms in the same industry at t+x.
ii. Growth in total assets, measured in the same way as employment growth
iii. Increase of productivity of non-foundation-related firms, measured by Solow residuals
iv. Growth in return on assets, also measured in the same way as employment growth

As a starting point, we relate foundation-related activity to performance by simple linear regression, with

$$Y_i = \alpha + \beta S_i^k + \varepsilon_i ,$$

with Y_i being the performance variable, $k=E,T$, α and β being coefficients, and ε_i being an error fulfilling standard assumptions.

Two additional issues should be noted at this place:

1. Industries are very different in size. This implies that one might weight larger industries more than smaller industries in the regressions. The hypothesis of a presence of spill-overs does not suggest any weighting; however, smaller industries might be weighted less in the regressions by the argument of measurement of foundation-related activity being driven by only small numbers of foundation-related firms.
2. Some industries have no foundation-related activity at time t, and others have almost all their activity in foundation-related firms. This might induce non-linearities in the model, which can be modelled by dummy variables for positive foundation-related activity at time t, and a dummy for high foundation-related activity at time t.

The results of the industry-level regressions are summarized in TABLE 8.2. These regressions are run on the 84 2-digit NACE-industries (without financial and real estate firms). Coefficients are for employment, total assets and gross profit, the percentage point changes in the growth of these variables in association with changes in foundation-related activity in 2006. For example, a ten percent increase in the share of foundation-related employment in an industry in 2006 is associated with a (0.1*0.758=) 7.58 percent drop in the growth of total assets over the period 2006-2011.

The general finding of the industry-level regressions is that industries with high employment shares in foundation-owned firms in 2006 did not experience higher growth than industries with lower employment shares. However, there are a couple of large industries with high foundation-related employment shares in 2006 that experienced high growth in all the performance variables: when weighted by the size of the industry, the relationship between foundation presence in the industry and growth of the performance variables is significantly positive.

TABLE 8.2.Industry-level regressions. Growth in performance variable 2006-2011 as dependent variables and share of employment in foundation-owned firms in the given industry being the sole explanatory variable

	Model 1: unweighted		Model 2: weighted by industry-employment in 2006	
	Coefficient	Ste.	Coefficient	Ste.
Dependent performance variable:				
Growth in employment	-0.018	0.366	0.480 ***	0.002
Growth in total assets	-0.758	1.356	0.026 ***	0.006
Growth in gross profit	0.007	1.047	0.525 ***	0.007
Increase in productivity (TFP)	0.331	0.251	0.178 ***	0.001

*Notes: ***=significant at 1% level.*

Granger causality tests

Here, we exploit our time series data to test for Granger causality (Granger, 1969). These tests are similar in spirit to the previous industry-level regressions although with some notable differences. With time series data we can make stronger statements about causality simply by exploiting the fact that time does not run backward. In general terms, the logic is as follows: If event X happens before event Y, then it is possible that X is causing Y. However, it is not possible that Y is causing X. X is said to Granger cause Y if past values of X can help explain Y. In this section, we apply this logic to various activity measures for firms owned and not owned by foundations.

Model selection

First, we need to determine the lag structure, i.e., how many past values of X to include in the model of Y. The temporal pattern is not obvious from the theory and econometrically it is not set in stone. We can do an F-test of the hypothesis that the joint significance of all past values is equal to zero. We can also look for the lag structure that minimizes the AIC. However, these two selection criteria do not always yield the same result. We also need to consider that lags introduce correlation between the exogenous variables, leading to inaccurate estimates and too large standard errors, which may cause us to accept a falls null hypothesis, i.e., conclude that there is no effect when there is in fact an effect. Balancing these considerations and recalling that the time increment in our data is in years rather than days, months or quarters, and that adding another lag to a time series with 12 periods considerably reduces the number of observations for the estimation, we have chosen to include one lag. The model is thus AR(1).

Second, the functional form is logarithmic, which means that we model elasticities. We do this for the standard reasons, i.e. to reduce heteroskedasticity, to normalize the conditional distributions, and to narrow the range of the variables, making estimates less sensitive to outliers.

Estimation procedure

We set up a two-equation system of linear equations.

$$\log(Y_{i,t}) = c_1 + \sum_{j=1}^{p} \alpha_j \log(X_{i,t-j}) + \sum_{j=1}^{p} \beta_j \log(Y_{i,t-j}) + Industry_i + t + u_{1,i,t} \quad (3)$$

$$\log(X_{i,t}) = c_2 + \sum_{j=1}^{p} \alpha_j \log(X_{i,t-j}) + \sum_{j=1}^{p} \beta_j \log(Y_{i,t-j}) + Industry_i + t + u_{2,i,t} \quad (4)$$

Y is the industry aggregate for firms not owned by foundations and X is the corresponding value for firms owned by foundations. When estimating the system, we exclude industry(i)-year(t)-observations where both types of ownership are not present. In using fixed effects we eliminate any time invariant element of the industry that is correlated with one or both of the exogenous variables. This is important because some industries are more capital or labor intensive than others. Finally, some series contain a time trend that we have to control for to avoid serial correlation in the error term. We do this simply by adding a time variable.

Despite controlling for industry and time specific unobservable variables, time varying unobservable variables correlated with the error term remains a concern. If the dependent variable is unexpectedly high for one period, then it is likely to be above average (for given levels of the independent variables) for the next period, and then standard errors in the above system are invalid. Testing for serial correlation shows that this is indeed a valid concern.[18] Thus, we estimate the system using FGLS, which allows us to define a variance-covariance structure with AR(1) serial correlation in the error terms.

Table 7.1 presents the results for employment, total assets, value added, and productivity, respectively. As before, productivity is estimated using the flexible transcendental logarithmic production function. If $\beta_1 \neq 0$ and $\beta_4 = 0$, we infer Granger causality from firms owned by foundations to other firms. If $\beta_1 > 0$, the spillover effect is positive. If $\beta_1 = 0$ and $\beta_4 \neq 0$, we infer Granger causality from other firms to firms owned by foundations. Finally, if $\beta_1 \neq 0$ and $\beta_4 \neq 0$, it is ambiguous which variable causes which.

Table 7. 1. Granger causality tests. Industry level. Unweighted.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Employment		Total assets		Value added		Productivity	
	Y	X	Y	X	Y	X	Y	X
X(1)	0.058***	0.737***						
	(0.000)	(0.000)						
Y(1)	0.553***	0.116**						
	(0.000)	(0.024)						
X(1)			0.005	0.665***				
			(0.752)	(0.000)				
Y(1)			0.751***	0.039				
			(0.000)	(0.340)				
X(1)					-0.007	0.515***		
					(0.592)	(0.000)		
Y(1)					0.563***	0.098		

[18] Wooldridge (2002) derives a test for serial correlation in panel data models, where he regress the pooled (OLS) model in first difference and predicts the residuals, and then regress the residuals on its first lag and test the coefficient of those lagged residuals. Drukker (2003) implements it.

		(0.000)	(0.206)		
X(1)				0.005	0.400***
				(0.732)	(0.000)
Y(1)				0.515***	0.182**
				(0.000)	(0.04)

Note: 2000-2011. Y is the industry aggregate for firms not owned by foundations and X is the corresponding value for firms owned by foundations.

Table 8.1 reports the results from an unweighted (equally weighted) estimation of the system. There is two-way Granger causality for employment and no relationship for total assets. It is ambiguous which type of ownership Granger causes which when past employment in foundation-owned firms affects current employment in other firms and past employment in other firms affects current employment in foundation-owned firms. It should be note that the impact of foundation-owned firms on other firms is smaller than the other way around. We can also think about Granger causality as timing of events. Who is the first-mover if there is a shock to a variable? In the case of employment, the two types move together. There is no relationship for value added. There is one-way Granger causality for productivity from firms not owned by foundations to firms owned by foundations, suggesting that firms owned by foundations increase their productivity after other firms; that they learn from these other firms.

As we have seen many times by now, foundation-owned firms are a heterogeneous group and it is probable that an equally weighted estimation of the system distorts the picture by not focusing on the economic impact or significance of certain important firms or industries. To see if there is a notable size effect, table 8.2 reports the results form a size weighted estimation of the system. For employment, results are unchanged. For total assets, there is now one-way Granger causality from firms owned by foundations to other firms. There is no relationship for value added. For productivity, there is now one-way Granger causality from firms owned by foundations to other firms, turning the result from the equally weighted estimation around. In other words, when we allow the largest foundation-owned industries (in terms of employment) to weigh more than the smaller ones, the results suggest positive productivity spillovers from foundations-owned firms to other firms.

Table 7. 2. Granger causality tests. Industry level. Weighted by employment.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Employment		Total assets		Value added		Productivity	
	Y	X	Y	X	Y	X	Y	X
X(1)	0.039***	0.345***						
	(0.008)	(0.000)						
Y(1)	0.197***	0.222***						
	(0.000)	(0.000)						
X(1)			0.055***	0.543***				
			(0.005)	(0.000)				
Y(1)			0.680***	0.052				
			(0.000)	(0.142)				
X(1)					0.017	0.460***		
					(0.118)	(0.000)		
Y(1)					0.284***	0.044		
					(0.000)	(0.504)		
X(1)							0.053***	0.506***
							(0.000)	(0.000)
Y(1)							0.376***	0.038
							(0.000)	(0.704)

8. Discussion

This paper is the first to present data on the total population of Danish foundation-owned firms. Over the time period from 2000 to 2011, there are 1,621 industrial foundations in Denmark owning 836 firms in Denmark. These 836 firms own another 737 firms. The foundations and their firms in our sample employ between 60,000 and 80,000 people, which corresponds to 2 to 3 per cent of total employment and 5 to 8 per cent of corporate employment, which is however an understatement of their overall economic activity compared to Thomsen (2012). The share of corporate employment is increasing through the crises years, suggesting that industrial foundations hold on to more employees than other firms. The share of total assets varies between 4 and 7 per cent of corporate total assets, which considering the similar share of employment suggests that the foundation-related economy is about as capital intensive as the rest of the corporate economy. The share of gross profit increases through the decade from 5 to 8 per cent of total corporate gross profit indicating better profitability performance.

We find substantial heterogeneity in the population. There is a huge difference between museums, student homes or property foundations and the holding foundations which own multinational business companies. The first group dominates in numbers. The second group dominates in size. As a rough measure, the ten largest industrial foundations account for 90 per cent of the population total.

Considering the total population, foundation-owned firms are generally larger than other firms. They have higher wage cost per employee and lower return on equity. Their productivity is also lower; 3 per cent on average, which is not statistically different from zero though.

However, if we restrict the analyses to firms with 250 employees or more, the picture changes dramatically. Foundation-owned firms are still larger, but the wage cost per employee is smaller, return on equity is higher as is productivity; 30 per cent on average and statistically different from zero. This superior productivity disappears when we control for industry fixed effects, showing that the large foundation-owned firms are over-represented in high-productivity industries.

We also estimated the economic impact that foundation-owned firms may have on firms with other types of ownership. There is no first-best solution to how to do this, so we approach it in three different ways. All of them agree that overall there are no significant positive spillovers from the overall popopulation of foundation-owned firms but that there are positive spillovers from the largest industrial foundations, the holding foundations. At the firm level, productivity is higher when the share of foundation-related activity (employment) in an industry is higher. At the industry level, subsequent growth rates in employment, total assets, gross profit, and productivity are higher when the share of foundation-related employment is higher. Also at the industry level, we find that productivity in foundation-owned firms Granger causes productivity in non-foundation-owned firms.

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