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Who applies for abatement subsidies? Evidence from Swedish firms*

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Abstract

We provide new empirical evidence on the underlying factors that explain firms' participation in a Swedish government program providing grants for emission-reducing investment projects. Using Swedish firm-level register data matched with application data over the years 2016–2020, we estimate the impact of observable firm characteristics as determinants of applying for and obtaining grants. The findings suggest that firms with previous experience from applying and obtaining the grant are more likely to apply, as well as older and larger firms. Our results suggest that larger and more experienced firms are disproportionately represented among applicants and grantees.

Keywords: Climate subsidies, Policy evaluation, Firm participation, Firm characteristics, Self-selection

JEL codes: Q52, Q54, C25.

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1 Introduction

Climate policies are currently being implemented in many countries, and policies to reduce greenhouse gas (GHG) emissions receive more attention from policymakers than ever before. Although emissions pricing dominates, an abatement subsidy in the form of an investment subsidy has some advantages. First, it can be used to provide additional incentives to replace the capital stock with cleaner technology. A combination of taxes and subsidies can also be more politically palatable, as it can be seen as more "business-friendly" while still encouraging abatement. However, the most severe drawback of abatement subsidies is that they may be a relatively inefficient method of reducing GHG emissions if they are awarded to firms that would have made investments in the absence of the subsidy. When firms can decide for themselves whether or not to apply for an abatement subsidy, this problem of "self-selection" into subsidy programs can become an issue.

In addition to the goal of additionality, subsidy programs may also have important distributional implications if funding is disproportionally allocated to smaller or larger firms. It is therefore important to understand how subsidies are allocated among firms. Although several studies highlight the importance of the self-selection problem in the context of energy-saving or emissions-reducing abatement subsidies, these studies have not had access to the data on applications, which is necessary in order to analyze the firm determinants of applying for and participating in the subsidy scheme.

In this paper, we shed light on the firm-level characteristics that are related to a GHG abatement investment subsidy program in Sweden, using detailed data covering all applications by Swedish firms to the program, both approved and rejected. We combine the application data with firm-level register data that describes several key firm characteristics such as firm size and emissions.

The Swedish government has implemented environmental policies targeting GHG emissions since the 1990's. To increase the pace of GHG mitigation, the Swedish government issued the Klimatklivet policy in 2015 to financially support local climate investments made by Swedish organizations by subsidizing a fraction of the investment cost. By June 2022, 4500 projects were granted subsidies of a total amount of approximately SEK 10.2

billion (Swedish Environmental Protection Agency, 2024). The average granted investment has been subsidized by about 45 % of the total investment costs, implying that approximately SEK 22.7 billion has been invested in projects that reduce GHG emissions through the program.

Our work is the first to study application, participation, and self-selection into GHG abatement subsidy programs directed at firms, making it complementary to the small number of studies that evaluate the additionality of abatement subsidies at the firm level. Calel et al. (2024), for example, find that half of the Indian wind farms receiving grants via the Clean Development Mechanism (CDM) would have been built anyway. The authors note that self-selection of wind farm developers may partially explain the poor performance of carbon offsets in this context, but they lacked data on submissions in order to investigate this fully. Studies evaluating national GHG abatement subsidies are relatively rare, and the few existing studies lack data on rejected applications. Hintermann and Zarkovic (2020) find that abatement subsidies were more effective than carbon taxes in Switzerland. Marino et al. (2021) find that an abatement subsidy scheme in the Netherlands significantly increased abatement and environmental R&D investment in a sample of Dutch manufacturing firms between 1999 and 2011.

Our firm-level study is also complementary to a broader literature focusing on abatement subsidies directed toward households and individuals. In the context of a home energy retrofit program in Wisconsin, Allcott and Greenstone (2024) find strong self-selection effects, which they argue can partially explain the poor performance of the program. A summary of the literature on electric vehicle (EV) subsidies finds that higher-income households tend to benefit disproportionately from such programs (Sheldon et al., 2023).

Studies of firm participation in public funding schemes are more common in other policy areas, particularly in the context of R&D investment subsidies. One of the most robust findings from this literature is that larger firms are more likely to apply for R&D subsidies (Blanes and Busom, 2004; Aschhoff, 2009; Busom et al., 2017). One exception is Falk and Svensson (2020), which find that smaller firms are more likely to receive a R&D grant. A robust effect of firm size on the likelihood to apply has also been found in the context of other types of support schemes for businesses (Boter and Lundström, 2005).

The second robust finding in the program participation literature is that previous participation in a funding scheme is a significant predictor of future participation (Aschhoff, 2009; Busom et al., 2017). Koski and Tuuli (2010) find continuity in Finish firms' participation in the same support programs at both the application and acceptance stages.

Finally, a third robust finding in the program participation literature is that firms with more business experience self-select into public programs that provide business services ((Bannò and Sgobbi, 2010; Capelleras et al., 2011*a*; Barbosa and Silva, 2018). In the same vein, firms with previous experience in R&D are more likely to apply for a R&D grant (Blanes and Busom, 2004; Aschhoff, 2009).

Our work is also related to descriptive studies of Klimatklivet, mainly in the form of internal evaluations (most recently Swedish Environmental Protection Agency (2024)) and commissioned reports (Isberg et al., 2017; Pädam et al., 2021). A recent academic study by Elofsson et al. (2024) analyses the project-related characteristics affecting approval, carbon mitigation cost heterogeneity, and the geographic distribution of grants. In contrast to all of these studies, we match the application data from Klimatklivet with firm-level balance sheet and emissions data. This unique combination of data allows us to study firm-level characteristics as determinants of applying and receiving a grant, and also allows us to compare participants with the population of Swedish firms.

2 Sweden's GHG abatement subsidy scheme

All types of organizations in Sweden, including private firms, municipalities, housing cooperatives, etc., are eligible to apply for a subsidy through Klimatklivet, regardless of their sector. Any organization that is willing to invest in a project aimed at reducing greenhouse gas (GHG) emissions is welcome to apply for a subsidy covering up to 70 % of the investment cost.

There is no charge for submitting an application; however, it is important to note that there are administrative costs associated with the application process in terms of time. Organizations are required to provide detailed information about the project for which they are seeking funding. This includes investment costs, the durability of the investment,

and an estimation of the annual emissions reduction resulting from the investment. Organizations are allowed to apply for multiple projects and may submit multiple applications. They are also permitted to re-apply for projects that were previously denied subsidies in earlier application rounds.

The Swedish Environmental Protection Agency (EPA) assesses all applications once each application round has concluded. In some cases, they may be assisted by the Swedish Energy Agency, the Swedish Board of Agriculture, or the Swedish Transport Administration. The assessment process involves verifying the information provided, checking the project's eligibility, and correcting any computational errors made by the applicants. The general principle is that financial aid is granted to applications demonstrating the highest efficiency in GHG emissions reductions per investment cost (in SEK).

Moreover, a project is only eligible for the subsidy if it fulfills the following conditions: i) the investment project cannot generate profitability within a period of fewer than five years, ii) the investment project does not qualify for the electricity certificate system, iii) the investment project cannot commence prior to receiving funding through Klimatklivet, and iv) the organizational activity is not covered by the European Union Emissions Trading Scheme (EU ETS).

3 Conceptual framework

A main concern with subsidy programs is that firms that do not need public support self-select into subsidy programs, which may potentially reduce the additionality of the subsidies. Large firms, experienced firms, and firms that have already received subsidies may not be the types of firms that the government aims to target. Although it may be the case that more established firms are best-suited to use public resources, the distributional implications of self-selection along these dimensions may themselves be problematic.

Previous studies suggest that firm characteristics affect a firm's likelihood to apply and submit a successful application to government subsidy programs. According to the literature, three main factors increase the likelihood that a firm applies for and receive a grant.

First, previous experience from applying successfully to public grants is hypothesized to generate learning effects (Bannò and Sgobbi, 2009). Skills and funding experience induce self-selection into Klimatklivet by reducing application costs. Moreover, the probability of obtaining a subsidy is increasing in funding experience, as more experienced firms have greater insights into which investments are suitable for the program and the rules of the program compared to a firm without experience. This information is likely asymmetric between firms with and without experience, which will increase the learning effect.

Firm size positively affects application capacity and skills, which increase the returns to scale by lowering the fixed costs of any application (Blanes and Busom, 2004; Aschhoff, 2009). Firm age is assumed to lower application costs through increased learning effects (Bannò and Sgobbi, 2010).

In sum, the theory predicts that larger and older firms, and firms with previous application experience, are more likely to apply for and receive a grant. With these predictions in hand, we now apply these theories in the context of Sweden's abatement subsidy program.

4 Data

The empirical analysis in this study relies on data from two databases, which are combined on a firm-year level. The first set of data comes from the Klimatklivet application software (KlivIT), which is generated and managed by the Swedish (EPA). The second dataset is the *Longitudinal Integrated Database for Health Insurance and Labour Market Studies* (LISA) from Statistics Sweden.

KlivIT consists of collected data from all Klimatklivet applications, including both granted and denied applications. Therefore, the provided data is cross-sectional at the application level for the period 2016–2021. The application software records the date of application submission and contains information about the climate investment projects provided by the firms[1]. The KlivIT data used in this paper covers the years 2016 to 2020, and the initial sample consists of 7917 applications, of which 3514 were granted funding,

[1]Variables concerning the investment project include what type of investment the firm wants to make, how much the investment reduces CO_2 emissions per year, investment costs in SEK, how many years the investment is durable, what share of investment is to be subsidized, and the timing of the investment project.

implying a grant rate of 44%. To anonymously match the application data with the second dataset, we use a firm identifier. In this process, we identified 3838 applications, of which 1681 were granted (again a grant rate of 44%).

The second dataset used in the analysis is the the longitudinal *Integrated database for Health Insurance and Labour Market Studies* (LISA), which provides a firm-year panel for almost all active firms in Sweden[2]. The firm-level data in LISA contain annual information on various firm characteristics, including variables such as profit, fixed assets, turnover (all in thousands of SEK), number of employees, sector, and firm age[3].

We collapse the KlivIT data into a firm-year panel and combine it with LISA, which provides a firm-year panel for the period 2016–2020. In the analysis, we only include firms in the 5-digit Swedish Standard Industrial Classification (SNI)[4] sectors where at least one firm applied for a Klimatklivet subsidy at some point during the study period. In the final sample, we include indicator dummy variables for i) whether a firm applied in a given year, ii) whether a firm's application was approved in a given year, iii) whether a firm had previous experience applying for Klimatklivet in a previous year, and iv) whether a firm obtained a subsidy in a previous year.

The majority of firms in the final dataset have never applied for a subsidy. The dataset consists of 489232 unique firms, of which 1930 firms have applied for a subsidy at least once, and the rate of firms applying at least once is 0.39 %. At the firm-year level, the records indicate that 2366 firms applied in any year. However, the data does not reflect firms applying multiple times per year. Among the 2366 applications recorded on a yearly basis, 1224 firms were granted a subsidy in a given year.

Table 1 shows descriptive statistics for the firm-level characteristics that we study. The first two columns report the mean and median values for firms that applied for a subsidy at least once, while columns 3 and 4 report the mean and median values for the firms that never applied. The test for equal means suggests that firm characteristics differ across the

[2]The exception is for firms in the financial sector, the public sector, or sole traders (enskild näringsidkare in Swedish) in all sectors except agriculture, hunting, forestry, and fishing.

[3]we construct a variable based on the first year they appear in the data, limiting the age variable to maximum 30 years

[4]The Swedish SNI 2007 industry classification corresponds to the NACE Rev.2 classification at the 4-digit level.

Table 1: Firm characteristics, full sample

	Applicants		Non-applicants		T-test on equal means	
Variables	Mean	Median	Mean	Median	difference in means	p-value
Total applications	2.1	1.0			-2.06***	0.000
Total granted	0.9	1.0			-0.89***	0.000
Age	20.4	24.0	11.5	8.0	-8.90***	0.000
Employees	165	20	4	1	-160.70***	0.000
Profit (M SEK)	68.0	1.7	0.7	0.2	-67.35***	0.000
Observations	1930		487302		489232	

Note: All values are firm averages over all reported years and are based on observations included in regression tables. *** p<0.01, ** p<0.05, * p<0.1.

groups for all included variables. Firms that applied for Klimatklivet are older and larger, both in terms of the number of employees and in terms of profit.

Table 2: Firm characteristics, emission sample

	Applicants		Non-applicants		T-test on equal means	
Variables	Mean	Median	Mean	Median	difference in means	p-value
Total applications	1.7	1.0			-1.72***	0.000
Total granted	0.8	1.0			-0.83***	0.000
Emissions (t CO_2 equivalents)	37134.0	219.5	1028.3	32.0	-36105.70	0.122
Age	25.2	29.0	21.8	26.0	-3.35***	0.000
Employees	494	72	57	22	-437.74***	0.000
Profit (M SEK)	246.5	8.0	12.5	1.7	-233.99**	0.005
Observations	333		3982		4315	

Note: All values are firm averages over all reported years and are based on observations included in regression tables. *** p<0.01, ** p<0.05, * p<0.1.

We also study a subset of firms for which emissions data is also available from Statistics Sweden's *Energy Use in Industry Survey*, in addition to the other firm-level characteristics shown in Table 1. The firm-level annual emissions data is collected from firms in the manufacturing industry (SNI 05–33) with at least 10 employees. After combining the emissions data with the balance sheet data and applicant data, this sample consists of 4315 firms, of which 333 applied for at least one subsidy.

Table 2 shows the descriptive statistics for the sample of firms for which we have data on firm-level CO2 emissions. We observe significant differences between the applicants and non-applicants for all included variables, with the exception of emissions. Besides emissions, this sample shows similar characteristics as the full sample in Table 1, applying

firms are on average older, larger, and more profitable.

Table 3: Correlation matrix, full sample

	Previous applicant	Granted previously	Age	Employees	Profit
Previous applicant	1				
Granted previously	0.343***	1			
Age	0.0442***	0.0162***	1		
Employees	0.101***	0.0620***	0.0467***	1	
Profit	0.0649***	0.0394***	0.0197***	0.229***	1

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

Table 4: Correlation matrix, emission sample

	Previous applicant	Granted previously	Emissions	Age	Employees	Profit
Previous applicant	1					
Granted previously	0.259***	1				
Emissions	0.0560***	0.00653	1			
Age	0.0718***	0.0110	0.00432	1		
Employees	0.175***	0.0944***	0.196***	0.0490***	1	
Profit	0.111***	0.0385***	0.0338***	0.0365***	0.345***	1

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

Correlation matrices are presented for the two sets of data in this paper, where the full sample is in Table 3 and the emission sample in Table 4. The correlation is positive between age, number of employees, profit, and emissions.

The firm characteristics of age, size, profit and emissions are skewed. Additionally, we lack complete information on firm age for firms older than 30 years. Due to the skewed nature of these variables and the need to account for non-linear effects, we categorize them for use in the analysis. Following the existing literature, we construct a dummy variable

Table 5: Number of observations by firm size and age categories

	Full sample	Emission sample
Firm size		
Firm size (0-9)	1499098	705
Firm size (10-49)	129193	9741
Firm size (50-249)	21851	3865
Firm size (>249)	4194	1098
Firm age		
Old (>5 years)	1044486	14468
Young (0–5 years)	609850	941
Total	1654336	15409

for firms younger than 5 years for the age variable. For firm size in terms of number of employees, we construct bins to categorize firms as micro (0–9 employees), small (10–49 employees), medium (50–249 employees), and large (250 employees or more). Table 5 reports the distribution across these size and age categories. In the full sample, we observe that the majority of firms are micro-sized, with the number of firms decreasing in each subsequent category. Interestingly, in the emission sample, we find a fraction of micro-sized firms (0–9 employees), which can be attributed to the panel structure of the data where firms may increase or decrease their number of employees while continuing to report emission data. Across both samples, we find that most firms are older than 5 years. To facilitate interpretation, we divide the profit variable into equal frequency bins using quartiles.

5 Empirical model

To estimate the determinants of applying for a subsidy, we assume that each firm faces the decision to apply for a subsidy, and puts sufficient effort into the application, with some

probability. Firm i will apply if the net value of submitting an application y_{it}^* in year t. We cannot observe the net value of submitting an application (y_{it}^*) but it is a function of observable firm characteristics X_{it} according to the following expression:

$$y_{it}^* = \beta_0 + \gamma_1 y_{iexperience} + \beta_1 X_{it} + \epsilon_{it} \tag{1}$$

where $y_{iexperience}$ is past experiences of applying or being granted a subsidy in the program, X_{it} is a vector of firm characteristics with the corresponding, unknown, coefficients γ and β and ϵ_{it} , the error term, absorbing unobserved characteristics that affect the decision.

We cannot observe the net value of submitting an application or the net value of putting enough effort into the application to make it successful. However, we observe a binary outcome, y_{it} , which is firm i's decision to apply for a climate subsidy in year t so we formulate a binary outcome y_{it} according to the following rule:

$$y_{it} = \begin{cases} 1 & \text{if } y_{it}^* \geq 1 \quad \text{applied} \\ 0 & \text{otherwise} \quad \text{not applied} \end{cases} \tag{2}$$

where y_{it} takes the value 1 if the firm apply for the subsidy and 0 otherwise. A probit model can then link the observed dependent variable to the underlying net value of applying a climate subsidy according to:

$$\Pr(Y_{it} = 1 | X_{it}) = \phi(X_{it}^{'} \beta_j) \tag{3}$$

where X_{it} is the firm-specific characteristics (including previous experience of the subsidy program) and ϕ is the standard normal cumulative distribution.

The empirical baseline model derived from this theoretical approach is :

$$y_{it} = \beta_0 + \gamma_1 y_{iappliedbefore} + \gamma_2 y_{igrantedbefore} + \beta_j X_{it} + \epsilon_{it} \tag{4}$$

We estimate equation 4 using a probit model with standard errors clustered at the firm level. To estimate the probability of applying and receiving a grant, we include firm-

specific characteristics, including previous application and participation in the program.

The key variables explaining the probability of applying and receiving a grant are previous experience in applying or receiving a grant, firm size, if the firm is older than 5 years prior to applying, and firm emission levels. Sector and year dummies are added to control for the sector-specific effects as well as time trends.

6 Results

Table 6 and Table 7 present the results of estimating the determinants of applying for a climate investment subsidy. The reported estimates represent the marginal effects from pooled probit regressions, with the corresponding z statistics shown in parentheses. All specifications include time-fixed effects, and standard errors are clustered at the firm level.

Table 6: Determinants of applying to Klimatklivet: pooled probit model, full sample

	(1)	(2)	(3)	(4)	(5)
Previous applicant	0.00615***	0.00587***	0.00317***	0.00309***	0.00219***
	(30.928)	(29.949)	(16.082)	(16.012)	(11.007)
Granted previously	0.00775***	0.00769***	0.00651***	0.00641***	0.00562***
	(25.671)	(25.600)	(20.816)	(21.022)	(17.857)
Young firm (0-5 years)		-0.00137***	-0.00051***	-0.00042***	-0.00017**
		(-17.530)	(-6.905)	(-5.786)	(-2.336)
Firm size (omitted category: 0-9 employees)					
Firm size (10-49)			0.00482***	0.00338***	0.00370***
			(23.812)	(19.454)	(18.023)
Firm size (50-249)			0.01604***	0.01115***	0.01052***
			(19.478)	(16.982)	(15.896)
Firm size (¿249)			0.03514***	0.02506***	0.02517***
			(13.845)	(12.721)	(12.200)
Profit quartiles=1				-0.00054***	-0.00044***
				(-7.271)	(-5.928)
Profit quartiles=2				-0.00043***	-0.00030***
				(-5.726)	(-3.992)
Profit quartiles=3				0.00067***	0.00069***
				(8.194)	(8.320)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
18 Industry dummies	No	No	No	No	Yes
Observations	1654336	1654336	1654336	1654336	1654336
Pseudo R^2	0.117	0.128	0.239	0.246	0.284

Note: Estimates clustered at the panel level in all specifications.

** p<0.01, ** p<0.05, * p<0.1.

Table 6 shows the marginal effects of firm characteristics on the probability of apply-

ing using the full sample. The first column only includes previous experience from the subsidy program for prior years and in the following columns (2–4) we add other firm characteristics. We control for year-specific effects in each column. The marginal effects from the preferred specification are reported in column (5).

All columns in Table 6 indicate that previous experience in the program significantly determines the probability of applying. The marginal effect from being an applicant in a previous year, in column (5), suggests that the experience increases the probability of applying again by 0.2 percentage points. Firms with experience of already being granted a climate subsidy previously increase the probability of applying again by 0.6 percentage points. The marginal effects are robust to adding controls in each column. The effects of previous experience from the subsidy program are relatively large compared to the low probability of applying for Klimatklivet, 0.14 % on a yearly basis, in our sample.

The marginal effects in Table 6 suggest that the application rate to the program significantly depends on firms' characteristics. Overall, the marginal effects indicate that firms with more experience and more capacity are more likely to apply.

Firms that are younger than five years are significantly less likely to apply for a climate subsidy, the probability of applying for a climate subsidy decreases by less than 0.1 percentage point for young firms indicating that firms with more experience in terms of years apply. This type of experience is of lesser importance than previous experience applying for or receiving a grant from the Klimatklivet program.

The marginal effects of firm size show that larger firms, in terms of the number of employees, are more likely to apply for a subsidy compared to small-sized firms (0–9 employees), which is the omitted category. Column (5) indicates that the probability of applying increases by 2 percentage points for firms with 250 employees or more, 1 percentage point for firms with 50–249 employees, and 0.4 percentage points for firms with 10–49 employees, compared to small-sized firms.

We include yearly profits in Table 6 column (3–5). The marginal effects in column (5) suggest that the probability of application positively depends on firm profits for the highest quartile compared to the lowest quartile but firms in the two middle quartiles are negative determinants of applying for a subsidy, compared to the lowest quartile.

Table 7: Determinants of applying to Klimatklivet: pooled probit model, emissions data sample

	(1)	(2)	(3)	(4)	(5)	(6)
Previous applicant	0.02506***	0.01074**	0.01066**	0.00606	0.00612	0.00428
	(4.775)	(2.044)	(2.025)	(1.123)	(1.130)	(0.783)
Granted previously	0.12870***	0.11848***	0.11795***	0.11107***	0.11054***	0.10902***
	(10.023)	(9.381)	(9.351)	(8.488)	(8.535)	(8.300)
Emissions quartlies=1		0.00241	0.00239	0.00261	0.00257	0.00229
		(1.151)	(1.139)	(1.110)	(1.083)	(0.981)
Emissions quartlies=2		0.01927***	0.01917***	0.01895***	0.01874***	0.01840***
		(6.842)	(6.788)	(6.368)	(6.337)	(6.410)
Emissions quartlies=3		0.05125***	0.05111***	0.03986***	0.03943***	0.04049***
		(12.926)	(12.925)	(8.855)	(8.775)	(8.828)
Young firm (0-5 years)			-0.01186*	-0.01076*	-0.01025*	-0.01335**
			(-1.895)	(-1.767)	(-1.680)	(-2.142)
Firm size (Omitted category: 0-9 employees)						
Firm size (10-49)				0.00346	0.00248	0.00243
				(0.588)	(0.391)	(0.374)
Firm size (50-249)				0.00868	0.00652	0.00585
				(1.365)	(0.926)	(0.813)
Firm size (¿249)				0.03196***	0.02827***	0.02380**
				(3.598)	(2.973)	(2.560)
Profit quartiles=1					0.00143	0.00139
					(0.382)	(0.370)
Profit quartiles=2					0.00611*	0.00610*
					(1.735)	(1.728)
Profit quartiles=3					0.00610*	0.00552
					(1.755)	(1.584)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
8 Industry dummies	No	No	No	No	No	Yes
Observations	15409	15409	15409	15409	15409	15409
Pseudo R^2	0.078	0.148	0.149	0.158	0.159	0.167

Note: Estimates clustered at the panel level in all specifications.

** p<0.01, ** p<0.05, * p<0.1.

To test for differences between different sectors we include 18 industry dummies and the omitted sector is agriculture, forestry and fishing. The marginal effects shown in the last column of Table 6 imply that firms belonging to the sectors mining quarrying, electricity gas steam, water sewage waste, and real estate are all significantly more likely to apply for a subsidy compared to the omitted sector and it increases the probability of applying by 0.1-0.3 percentage points. Firms that are active in construction, retail, accommodation food service, information communication, science, administration service, education, and health social work are all less likely to apply for a subsidy compared to the omitted category, with a negative marginal effect of 0.1—0.2 percentage points.

To estimate if firm emission levels are a determinant of applying for a climate subsidy,

we estimate a probit model using data on firm emissions in tonnes CO2 equivalent in Table 7. Only a fraction of Swedish firms are obliged to report firm emission levels, hence the observations used to estimate the marginal effects in Table 7 are a subset of the sample used for the reported results in Table 6, and it only includes firms in manufacturing industry and firms with more than 10 employees. As shown in the descriptive statistics in Table 2, this restricted sample consists of larger firms. The marginal effects for our preferred specification are shown in column (6) including the same firm characteristics as in Table 6, plus emissions, including year fixed effects 8 industry dummies. The estimates in the last column of Table 7 again suggest that the probability of applying positively and significantly depends on previous program experience. The marginal effect for firms that previously applied and were granted a Klimatklivet subsidy increase the probability of applying again by 11 percentage points. These results are robust for all specifications.

The estimates reported in Table 7 suggests that the more the firms emit, the more likely they are to apply for a subsidy. The firms that emit the most, the firms in the top quartile, are 4 percentage points more likely to apply for a subsidy compared to firms in the quartile that emit the least. Firms in the third quartile are 2 percentage points more likely to apply for a subsidy than firms in the lowest emitting quartile.

In Table 7 we find again that the probability of applying decreases by 2 percentage points for young firms, indicating that older and more experienced firms in terms of active years apply. However, the marginal effects in the last column of Table 7 imply that firm size in terms of the number of employees is not a significant determinant of applying for Klimatklivet. The estimates suggest that firm profit is neither a significant determinant of the probability of applying for a subsidy. We include 8 industry dummies to test for differences between different sectors in Column (6) The estimates in the last column of Table 7 suggest that firms belonging to some sectors are significant determinants of applying for a subsidy.

The estimates in Table 6 and Table 7, suggest that previous experience of obtaining a climate investment subsidy is robust and a positive significant determinant of applying. However, previous experience from applying for a subsidy is only significant when we use the full sample. Older firms are more likely to apply in both samples. The full sample

Table 8: Determinants of receiving a grant: pooled probit model, full sample

	(1)	(2)	(3)	(4)	(5)
Previous applicant	-0.43936***	-0.43933***	-0.44660***	-0.44745***	-0.47268***
	(-49.894)	(-49.828)	(-49.935)	(-49.958)	(-49.762)
Granted previously	0.48348***	0.48348***	0.46725***	0.46682***	0.43132***
	(33.055)	(33.058)	(31.790)	(31.652)	(27.684)
Young firm (0-5 years)		0.00071	0.01996*	0.01973*	0.00940
		(0.068)	(1.792)	(1.762)	(0.821)
Firm size (omitted category: 0-9 employees)					
Firm size (10-49)			0.01931**	0.01729*	0.01183
			(2.115)	(1.810)	(1.123)
Firm size (50-249)			0.05125***	0.04816***	0.03950***
			(4.584)	(4.074)	(3.081)
Firm size (>249)			0.09728***	0.09470***	0.09487***
			(6.030)	(5.692)	(5.286)
Firm profit (omitted category: 1st quartile)					
Profit quartile 2				-0.01401	0.00005
				(-0.684)	(0.002)
Profit quartile 3				-0.04815***	-0.03261**
				(-2.971)	(-1.983)
Profit quartile 4				-0.01784	-0.01314
				(-1.618)	(-1.186)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
8 Industry dummies	No	No	No	No	Yes
Observations	9081	9081	9081	9081	9081
Pseudo R^2	0.200	0.200	0.204	0.205	0.221

Note: Estimates clustered at the panel level in all specifications.

** p<0.01, ** p<0.05, * p<0.1.

suggests that firm size and firm profit are significant determinants of applying for a subsidy. Interestingly, when we control for emission levels in Table 7 we do not find size and profit significant but emission levels are positive and significant.

We also study the determinants of the probability of receiving a grant by estimating equation 4 where y_{it} is instead a dummy for firm i obtaining a subsidy in year t. We use a sub-sample where we only include firms that applied at least once and we use a pooled probit model. Tables 8 and 9 report the marginal effects of the probability of obtaining a subsidy for the full sample and emissions data sample respectively. All specifications include time-fixed effects and standard errors are clustered at the firm level.

Table 8 shows the average marginal effects for the largest set of data available. The preferred specification with the full set of controls is reported in column (5). The probability of receiving a climate subsidy significantly decreases by 47 percentage points for

Table 9: Determinants of receiving a grant: pooled probit model, emissions data sample)

	(1)	(2)	(3)	(4)	(5)	(6)
Previous applicant	-0.45829***	-0.46571***	-0.46674***	-0.46878***	-0.47582***	-0.47863***
	(-24.707)	(-25.368)	(-25.343)	(-24.393)	(-24.891)	(-24.495)
Granted previously	0.55145***	0.53468***	0.53680***	0.52397***	0.52597***	0.53056***
	(13.041)	(12.442)	(12.522)	(11.956)	(11.804)	(12.056)
Emissions quartile 2		0.04239	0.04326	0.04371	0.04602	0.04007
		(0.899)	(0.911)	(0.899)	(0.934)	(0.804)
Emissions quartile 3		0.03828	0.03730	0.03634	0.03495	0.02778
		(1.189)	(1.159)	(1.083)	(1.014)	(0.800)
Emissions quartile 4		0.09947***	0.09795***	0.08834**	0.08440**	0.08407**
		(3.240)	(3.171)	(2.541)	(2.369)	(2.324)
Young firm (0-5 years)			0.07760*	0.07257*	0.07363*	0.04544
			(1.683)	(1.703)	(1.769)	(0.940)
Firm size (Omitted category: 0-9 employees)						
Firm size (10-49)				-0.15965	-0.15028	-0.15034
				(-1.285)	(-1.199)	(-1.193)
Firm size (50-249)				-0.17020	-0.16889	-0.17042
				(-1.389)	(-1.371)	(-1.375)
Firm size (>249)				-0.12829	-0.12661	-0.13587
				(-1.043)	(-1.019)	(-1.087)
Firm profit (omitted category: 1st quartile)						
Profit quartile 2					-0.05887	-0.06145
					(-1.541)	(-1.606)
Profit quartile 3					-0.07715**	-0.07897**
					(-2.258)	(-2.303)
Profit quartile 4					-0.04864	-0.05107*
					(-1.596)	(-1.660)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
8 Industry dummies	No	No	No	No	No	Yes
Observations	1536	1536	1536	1536	1536	1536
Pseudo R^2	0.247	0.254	0.256	0.258	0.262	0.267

Note: Estimates clustered at the panel level in all specifications.

** p<0.01, ** p<0.05, * p<0.1.

firms that applied in a previous year. But firms with at least one granted application in a previous year are about 43 percentage points more likely to obtain a climate investment subsidy. This implies that the positive marginal effect of a firm that submitted a successful application is canceled out since a firm that obtained a subsidy in a previous year also applied in a previous year. The estimated marginal effects are robust for all specifications.

Larger firms are more likely to obtain a subsidy. Large-sized firms (250 employees or more) are 9 percentage points more likely to receive funding, and medium-sized firms (50–249 employees) are 4 percentage points more likely to receive funding, compared to small-sized firms (with 0–9 employees). We see some negative marginal effects of higher profits, but only for firms the second quartile compared to the lowest quartile.

We also study if emission levels are a determinant of obtaining a subsidy by using a sub-sample of the data used for the estimation in Table 8 of the firms that report yearly emissions. Table 9 shows the marginal effects of obtaining a subsidy and the preferred specification is column (6). Again, previous experience of applying for a subsidy in a previous year decreases the probability of obtaining it by 48 percentage points but a firm that had a granted subsidy in a previous year has a 53 percentage point higher probability of receiving a grant again. This implies that firms with a granted subsidy have an increased probability of obtaining a subsidy by 5 percentage points in total. The marginal effects in column (6) imply that the firms that emit the most, in the top quartile, are 8 percentage points more likely to obtain a subsidy compared to the lowest-emitting firms. Furthermore, firms in the top quartiles of profit are more likely to obtain a subsidy. Firms in the first and second quartiles have a 5 and 8 percentage points higher probability of obtaining a subsidy compared to the lowest quartile.

7 Discussion

The analysis suggests that previous experience with the climate subsidy program increases the probability of applying for a subsidy. Interestingly, the probability of obtaining a subsidy is decreasing with previous experience of applying in a previous year but increases if a firm was granted a subsidy in a previous year. The latter is in line with previous research on R&D subsidies found by Aschhoff (2009) and Busom et al. (2017), who find that firms become stable beneficiaries of R&D subsidies.

Firms without previous experience in applying for, and receiving a grant, are less likely to apply for a subsidy. The results hold for the full set of data and the sample where the firms report emissions data. We argue that there are multiple reasons at play here. First of all, firms that applied but were denied a grant might apply for the same investment project again. Second, there might be learning effects from applying. The firms with experience from the program learn from previous successes and failures and thereby accumulate skills that lower the costs of applying again. Firms with previous experience in applying and/or receiving a Klimatklivet subsidy might also be more aware or exposed

to other potential climate investments with the potential to be subsidized while the firms without this experience are not aware. If this is the case, it might not be in line with policy goals. The main goal of the policy is to decrease emissions as much as possible, in the most cost-efficient way. This is done by subsidizing firms with the highest reduction of emissions per invested SEK. If there are a lot of firms who are not aware of the program, it might be the case that firms with potentially more effective emission-reducing investments do not apply for subsidies and thereby not make the most emission-reducing investments.

High-emission firms are more likely to apply for a subsidy and are more likely to obtain the subsidy. This indicates that the highest emitting firms are more prone to invest in projects that reduce emissions. This could be an effect of higher running costs for the firms from highly emitting machinery etc compared to the less emitting equivalents. This is in line with the policy goals.

Older firms are more likely to apply, implying that market experience might be an important factor when it comes to knowledge about subsidies or other policies. However, firm age is not a significant determinant for obtaining a climate subsidy once we control for firm industry.

Firm size is a significant determinant of applying for and obtaining a subsidy, especially for the largest-sized firms. This is in line with previous literature. It might be the case that larger firms make more investments in general, and therefore they have more investment projects eligible for a Klimatklivet subsidy. If larger firms apply for multiple projects and do so in multiple years, it might explain the positive and significant marginal effects since it would increase the probability of obtaining at least one subsidy. Further, it is more likely that firms with many employees have personnel who have both the administrative skills to submit an application and technically specialized personnel who have the skills to contribute to a successful application.

Our results yield conflicting results for firm profit as a determinant of applying for a subsidy. In the full sample, firms with the largest profits are more likely to apply for a subsidy compared to the firms with the lowest profit but the firms in the middle quartiles are less likely to apply compared to the lowest quartile. The positive marginal effects could be because firms with the highest profits also have more funding for investments

compared to the lowest quartile. The negative marginal effects might stem from the fact that the firms with the absolute lowest profit have to apply for a subsidy to invest whereas the firms in the two middle quartiles do not. When we control for emission levels, profit is not a significant determinant of application. The estimates suggests that firms in the second largest profit quartile are less likely to obtain a subsidy compared to the lowest profit quartile. This might suggest that firms do not need to be somewhat profitable to submit a successful application.

8 Conclusions

Although abatement subsidies can be an effective policy instrument to reduce GHG emissions in theory, there is a concern the self-selection of firms into the policy can lead to poor efficiency or distributional outcomes. In this study, we examine the determinants of applying for a GHG abatement subsidy program in Sweden, using a unique combination of firm-level and application-level data.

Our results suggest that a previous successful application is a significant determinant of applying in the future. We also find that older, larger, and more profitable firms are more likely to apply for the abatement subsidy. Overall, our results suggest that firms with more experience and resources are disproportionately represented among the applicants to the Swedish GHG abatement subsidy program.

Given our findings that more established firms are over-represented among applicants and grantees, this may be problematic from both an efficiency perspective and a distributional perspective. It may be the case that these firms have the resources to invest in profitable abatement technologies even without the subsidy, which could reduce the additionality of the program. We leave an analysis of the additionality of the subsidy program for future research. Depending on which firms the policy aims to target, the results may also suggest that the subsidy may not be reaching those types of firms.

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