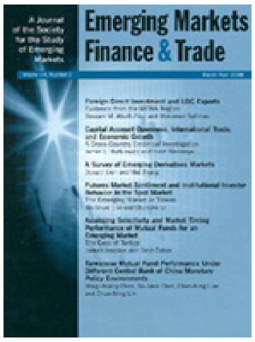

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Does Government Subsidy Affect Firm Survival? Evidence from Chinese Manufacturing Firms

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ABSTRACT: This article applies a matching approach to deal with the selection bias and use the complementary log-log model to analyze the impacts of subsidy on Chinese manufacturing firms' survival from 1998 to 2007. Our empirical results show that government subsidies significantly decrease the likelihood of firm exit. However, the effect decreases as the level of subsidies increases for private and foreign firms, but displays a nonlinear relationship across subsidy levels for SOEs. We also show the effects vary across the levels of institutional quality measured by the prevalence of rent seeking and government intervention. Further results suggest that the potential channels include increased investment in intangible and fixed assets as well as enhanced profitability.

KEY WORDS: firm survival, government connection, subsidy, China

Firm exit and entry are crucial components of industrial dynamics in both developed and developing countries (Caves 1998; Fernandes and Paunov 2015; Tybout 2000). The All China Federation of Industry and Commerce (ACFIC) reports that approximately 49.4% of firms cannot survive longer than 5 years; 32.9% of the firms survive from 5 to 10 years, and only 17.7% of firms are able to survive more than 10 years. The average age of all firms is approximately 6.09 years during the period 2008–2012; this number is rather smaller than that for the United States and Japan (approximately 40 and 30 years, respectively). To resolve market failure, spur firm growth and promote industrial restructuring, both central and local governments have spent considerable funds to narrow the funding gaps in China. However, the determinants of firm survival are still under investigation, and the relationship between subsidy and firm survival is ambiguous in the literature. It is particularly uncertain through which kinds of mechanisms subsidy may affect firm survival.

In the traditional economics literature, public support activities, for example, subsidies, are mainly justified by the existence of market failures (Hall and Lerner 2010). Through aid programs, public agencies implicitly certify these companies, which contributes to reducing information asymmetry and helping these firms overcome financial difficulties. Furthermore, obtaining a grant or subsidy may induce changes in firms' behavior or changes in the behavior of other firms or institutions towards the firms receiving grants or subsidies (e.g., Lerner 1999, 2002). Hence, in the presence of uncertainty, receiving a subsidy might act as an observable indicator of the applicant's unobservable quality (Hauessler, Harhoff, and Müller 2009). Consequently, granting subsidies addresses the information asymmetry that might have otherwise precluded providing financing (Feldmana and Kelley 2006). Public intervention could also have negative effects. Public support would displace private spending if firms awarded subsidies reduce their own fixed and intangible investment beyond the level that would have been performed without the aid (Zúñiga-Vicente et al. 2014). Particularly, innovation policy could be captured by permanent R&D performers, and politicians or interest groups may seek to allocate subsidies to benefit themselves (Lerner 2002), despite a low marginal contribution of public aid.

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While studies of subsidy programs have proliferated along with the programs themselves, there are still several important knowledge gaps in this literature. To contribute to this literature, in this article we investigate the role of specific subsidy schemes on firm survival, through illustrating firm performance and financial constraints mechanisms, as a way to test the implications of industry dynamics models. This relationship and the underlying mechanisms have not yet been clearly understood. In particular, to our knowledge, no previous empirical research exists examining the causal effects of subsidies on Chinese firms' survival. With the objective to fill this gap, we analyze the effect of subsidy among three types of ownership on the survival of Chinese firms. Specifically, we examine the heterogeneous effects of subsidies based on the amounts of subsidies received, that is, low, medium-high, and high. We further shed light on the underlying mechanisms to explain why different amounts of subsidy do not work equally well for different types of ownership. To deal with the potential selection bias, in this article we adopt the method of propensity score matching (PSM). Furthermore, we conduct a more rigorous test of the subsidy–survival relationship by applying the discrete-time hazard models with unobserved heterogeneity. Using a rich microlevel firm dataset, we focus on the impact of subsidies on firms' survival and investigate the mechanisms through which subsidies affect firms' survival. By using the National Bureau Survey (NBS) of Chinese Manufacturing Firms covering the period of 1998–2007, we use a complementary log-log (cloglog) model following Fernandes and Paunov (2015). Several findings emerge from our empirical results. First, we find strong evidence that receiving subsidies increases the likelihood of firms' survival. Second, the effect decreases as subsidy levels increase for private and foreign firms but display a U-shaped relationship across subsidy levels for SOEs. The seemingly surprising results for higher levels of subsidy may be attributed to the fact that as the amount of subsidy increases, the incentive distortion of recipient firms becomes more severe, since these firms may expect to receive more subsidies in the time of crisis, thus diverting some funds away from investments. We also show the effects are heterogeneous across the levels of institutional quality. Third, we find that the potential channels through which subsidy affects firm survival mainly include increased investment in intangible assets and fixed assets as well as enhanced profitability. As a result, with more available funds, the previously financially constrained firms are better able to invest in value-enhancing projects and innovation, thereby becoming more profitable and less likely to exit. Our results are robust to a battery of robustness checks, including alternative model specifications for firm exit (survival) and a control function approach to further deal with the endogeneity concern.

The remainder of this article is organized as follows. Section 2 provides a brief review of the related literature. In Section 3, we present our methodology and the baseline specification. Section 4 describes our data and provides some descriptive statistics. Section 5 presents our main empirical results. Section 6 shows a range of robustness tests. Section 7 concludes by summarizing the main findings and discussing the policy implications.

Literature Review

Theoretically, managing to break even determines the likelihood of firms' survival, and sufficient capital can decrease the bankruptcy risk through enhanced capability to repay expired debt. Thus, direct subsidy programs are among the most widely used and extensively studied policy interventions. Economic theory of subsidies suggests that subsidy would be socially optimal for allowing funding to flow to projects that offer high degrees of social returns (Stiglitz and Wallsten 1999).

Previous studies are more related to innovation subsidies and firm performance. Theoretically, investment in R&D can enhance a firm's survival as a result of productivity gains (Griliches 1979) and/or increased market power (Aghion et al. 2012). Two well-understood market failures are invoked to justify government intervention to support firm innovation activities. The first is the public goods problem associated with innovation investment. The "public good" nature of knowledge prevents full appropriation of rents from innovation, which pushes privately funded innovation below the socially optimal level. More specifically, because knowledge spillovers to potential competitors prevent organizations that invest in R&D from reaping the full returns associated with their investments, private incentives for innovation fall short of socially optimal levels (Arrow 1972).

The second market failure is that innovating companies may suffer from a financing deficit due to the presence of information asymmetry and moral hazard (Arrow 1972). Investors cannot anticipate the value of early-stage technologies with confidence, particularly when the prospects for success are highly uncertain, and the time horizons are long (Hall and Lerner 2010). This problem is exacerbated by the fact that R&D cannot be used for collateral (Hsu and Ziedonis 2013). Therefore, private financers may be reluctant to lend when the investment is concentrated essentially in intangible assets. This situation results in a higher cost of financing and a lower level of private funding of innovation activities. Consequently, capital markets for venture funding are unlikely to be optimally efficient.

Financial support (e.g., subsidies and fiscal incentives) constitutes the principal instrument for stimulating industrial R&D, and it has been actively used to promote R&D activities and innovation in most OECD countries (Nezu 1997). The main purpose of the government initiatives to provide financial support is to reduce the effective cost of R&D, thereby increasing firms' R&D spending. There are also reasons to be optimistic about the effectiveness of government subsidy policies in emerging economies where innovation-oriented ventures often tend to be financially constrained. In cases where financial markets are imperfect in allocating capital to the highest valued investments, signals from informed and neutral arbiters can be of particularly important (Zhao and Ziedonis 2014). Further, government review can reduce the potentially high fixed costs of evaluating risky ventures, enabling private funders to allocate their resources more effectively across potential investment targets (Lerner 1999). The partial solutions to these information and financing difficulties may, thus, have a particularly strong effect in the context of emerging economies.

However, there are also reasons to be particularly skeptical about the ability of subsidy programs to effectively boost innovation in emerging economies. First, state capacity is weaker in the emerging economies, and corruption is typically more widespread and rampant (Hellman, Jones, and Kaufmann 2003). Politicians and state officials may use public funding programs to advance their private interests or those of their friends, families or contacts (Johnson and Mitton 2003; Malesky and Taussig 2009). Second, the information asymmetry that frustrates venture financing is particularly salient in countries where the investment is carried out by government bureaucrats with limited technological and business expertise (Lerner 2009). Entrepreneurs could be highly motivated to misrepresent their information during the grant application in countries featuring weak legal institutions (Stuart and Wang 2016). Third, public financing, even if administered professionally, may be insufficient to promote firm innovation in countries with underdeveloped innovation ecosystems (Martin and Scott 2000). For example, capital infusion may not improve firm performance or innovative outcomes in the absence of institutions that can effectively protect intellectual property rights, promote information exchange and facilitate cross-organizational collaborations (Mcdermott, Rocha, and Urbonavicius 2010).

In contrast to the limited research on subsidy programs in emerging economies, the literature on subsidy programs in the developed world is wide-ranging. Antecedent results vary both because government programs differ in their details and regional contexts and because studies employ differing methodologies. The United States' Small Business Innovation Research and Advanced Technology Programs have received substantial attention from scholars (Feldman and Kelley, 2003; Lerner 1999), and so do the framework and programs of the European Union (Bayona-Sáez and García-Marco 2010; Czarnitzki and Lopes-Bento 2013) and specific programs in Belgium (Meuleman and Maeseneire 2012), Israel (Lach 2002), Finland (Takalo et al. 2013) and other countries. The range of these studies is broad, and the results they find are mixed. Some studies find that subsidy recipients invest more substantially in innovation, achieve higher innovative productivity, obtain future financing more easily and are more likely to improve their financial performance than control sample firms (e.g., Czarnitzki and Lopes Bento 2014; González-Benito and Óscar 2005; Howell 2015; Lerner 1999; Zhao and Ziedonis 2014). Others, however, conclude that government innovation grants do not appreciably improve firm outcomes (e.g., De Blasio, Fantino, and Pellegrini 2015; Görg and Strobl 2007; Klette, Møen, and Griliches 2000).

In China, policy-makers channel public subsidies towards firms in the hopes of mitigating the negative selection effect so that domestic firms can stay in the market long enough to take advantage of positive externalities (e.g., technological catch-up and product upgrading). While He and Yang (2015) show that state support programs directly improve the chances of firm survival in China, indicating that subsidy is an effective policy tool to help buffer domestic Chinese firms from negative effects of competition with foreign enterprises, they do not consider the heterogeneous effects of subsidy across different levels and do not investigate the underlying mechanisms.

Empirical Methodology and Baseline Specification

To correctly identify the effects of subsidies on firm survival, it is necessary to consider a hazard or duration model whose dependent variable is the time or period between firm entry and exit (Fernandes and Paunov 2015; Kiefer 1988). As explained in Fernandes and Paunov (2015), hazard models with firm random effects can overcome estimation bias caused by of OLS regressions, which ignores the right-censoring of observations.[1] This method can also appropriately deal with a sizable fraction of tied failure times, as discrete time hazard models can control for unobserved firm heterogeneity and address the issue of tied failure times (Lancaster 1990).[2] Therefore, we use hazard models with firm random effects as our baseline approach, as described further below.

Let a firm-survival period j be complete ($c_j = 1$) or right censored/incomplete ($c_j = 0$) and the number of years a firm survives (i.e., the time to a failure event) T be used in the definition of the discrete time survivor function, which is the probability of firm survival at least m years:

$$S_j(m) = Pr\left(T_j > m\right) = \prod_{k=1}^{m}\left(1 - h_{jk}\right), \tag{1}$$

where $T_j = min\left\{T_j^*, C_j^*\right\}$, T_j^* is a latent failure time, C_j^* denotes the latent censoring time for the firm survival period j, and h is the discrete time hazard rate of exiting in m years, conditional on survival for m-1 years, defined as follows:

$$\begin{aligned} h_j(m) &= Pr(m - 1 < T_i \leq m | T_i \geq \ m - 1) \\ &= Pr(m - 1 < T_i \leq m)/Pr(T_i > m - 1), \end{aligned} \tag{2}$$

When a binary dependent variable y_{jm} is defined to take the value of 1 if the firm survival spell j ends in year m and 0 otherwise, its log-likelihood function is given by

$$\text{logL} = \sum_{j=1}^{J}\sum_{k=1}^{m}\left[y_{im}\text{log}h_{jm} + \left(1 - y_{jm}\right)\text{log}\left(1 - h_{jm}\right)\right], \tag{3}$$

Equation (3) implies that discrete time hazard models for grouped duration times can be estimated using standard regression models for binary choice panel data, as Jenkins (1995) showed. To be fully estimable, the log-likelihood function requires the specification of a functional form for the discrete time hazard rate h_{jm} that links the exit probability to explanatory variables (time-varying firm and industry characteristics). We consider three functional forms—complementary log-log (cloglog) following Prentice and Gloeckler (1978), probit and logit—allowing in each case unobserved individual heterogeneity to be accounted for by firm random effects. For the cloglog model, our estimable equation is given by

$$\begin{aligned} c\text{loglog}[1 - h_m(X/v)] &= \log(-\log[1 - h_m(X/v)]) \\ &= X\beta + \gamma_m + \varepsilon\,, \end{aligned} \tag{4}$$

where X is a vector of characteristics during a firm's survival period, and they are time varying but constant within one-year survival periods (measured by X_{it}) and γ_m is the baseline hazard. To study the impact of subsidies on a firm's behavior, we define subsidy$_{it}$ the amount of subsidy received scaled by total assets (Howell 2017). Our choice of vector X_{it}, a series of control variables, is guided by the existing empirical literature on the determinants of firm survival. Firm-level Sales Growth$_{it}$ is controlled to capture the firm's growth opportunity (Fernandes and Paunov 2015). Firm Age$_{it}$ plays an important role in determining firm failures: firms with an established track record are less likely to fail than those that are younger because the former are more likely to have withstood past economic and financial downturns and therefore face a smaller liquidation risk (Görg and Strobl 2002; Tsoukas 2011). Age^2 is added to control the potential nonlinear effects. Further, Size$_{it}$ represents the size of firm i at time t, measured as the logarithm of total real assets. Because firms typically enter the market at a small size relative to their minimum efficient scale, small firms tend to be associated with a higher degree of information asymmetry and therefore are at a higher risk of failure than large firms (Clementi and Hopenhayn 2006). We also include the squared term of Size$_{it}$ to allow for non-linearity.[3] The Herfindahl–Hirschman Index (HHI) and industry growth rate measured at the three-digit CIC industry level are added to control the relevant industry-level characteristics. The former reflects the capability of competing against rivalries and firms' market power (Liu and Li, 2015) and the latter captures the industry growth potential. All the nominal variables used in this article are deflated by the corresponding deflators.[4]

Data and Summary Statistics

Data

We use a unique firm-level data set of Chinese manufacturing firms collected by the National Bureau of Statistics of China (NBS), covering the period of 1998–2007. This database is officially referred to as the "above-scale industrial enterprises database."[5] This source of information provides a unique window on the economic changes that have reshaped the Chinese manufacturing sector.

Three crucial features of our data set are important to note. First, our database is representative and large in that it includes all of the SOEs and non-state firms with annual sales of above 5 million Yuan, accounting for over 90% of the industrial output in China during the period of analysis. Second, our dataset contains numerous variables, including basic firm characteristics as well as accounting and financial variables. Thus, we can conduct more rigorous empirical tests on the related mechanisms and better alleviate the omitted variables problem. Third, as the focus of this article is firm exit, a key aspect of firm dynamics, it's important to have a panel dataset covering a relatively long period time. This dataset spanning 10 years from 1998–2007 could well serve our purpose. In the literature, public subsidies in China have been the focus among studies on the effects of public financing on firm innovation and performance. There are several reasons to prefer focusing on production-related public subsidies over R&D subsidies in the current article. First, compared to the R&D-based subsidies, public production-related subsidies are more widespread and likely to affect firm survival beyond the firm's innovation activities. Second, several recent studies have already investigated the effects of R&D subsidies on innovation in China (Guan and Yam 2015; Guo, Guo, and Jiang 2016). Due to data limitations, these studies are forced to rely on less representative data, such as data of publicly listed firms or surveys conducted in only several cities or provinces. While these studies might be able to study the effectiveness of policies designed specifically for encouraging innovation, they are not necessarily representative for China as a whole. By contrast, the Annual Survey of Industrial Firms (ASIF) is among the most comprehensive firm-level datasets available to the public, allowing the results to be more generalizable (Howell, 2017).

Propensity Score Matching Method

It is acknowledged that firms that receive state subsidies may systematically differ from those that do not receive any. For instance, industrial policy in China tends to support local industry leaders to make them more competitive against foreign firms. In our context, firms that receive subsidy from government are very likely to be of high quality, which will be more likely to survive than non-recipients in the absence of any subsidy. The selection bias therefore makes it difficult to identify the causal effects of subsidies on firm survival. To address this problem, a nonparametric propensity score matching technique is used to construct a control group of firms that closely resemble the treated firms based on observable characteristics.

A series of covariates are selected based on the literature to identify the factors that are found to significantly affect the probability of receiving subsidy. These covariates include a range of variables that help to control for different dimensions of firm attributes and industry characteristics. All the covariates are measured as the pretreatment mean (i.e., averages before receiving the subsidy). A probit model is estimated to generate the propensity score and each treated firm is matched to a control firm with the closest propensity score. The probit model is expressed as:

$$D\_Subsidy_{it} = \alpha_0 + \alpha_1{}'X_{it} + \varepsilon_{it} \,, \tag{5}$$

where $D\_Subsidy_{it}$ is a binary variable that equals 1 if firm i received a production subsidy in year t, and 0 otherwise. X_{it} includes a set of firm and industry covariates, and ε_{it} is the error term. Table 1 reports the estimation results from the probit model.

The results in columns 1–2 show that all the covariates indeed have significant explaining powers on the probability of receiving subsidy. Firms are more likely to receive subsidies if they are larger, younger, more profitable and productive (in terms of total factor productivity) and have higher sales growth. These results are consistent with the expectation that subsidy-receiving firms tend to be better performing firms. The better performing firms are more likely to receive subsidies because they are more likely to compete directly with foreign firms. In addition, firms are more likely to receive subsidies if they operate in an industry that is more R&D-intensive and export-intensive and that has a higher share of state-owned capital.

Based on the above matching procedure, a pairwise t-test between the treated and matched control firms is conducted to assess whether the observable characteristics are balanced upon matching. The results from the t-test in Table 1 reveal that there are no significant differences remaining in the chosen covariates between the treated and the matched controls, indicating that the matching procedure is valid (columns 3–4). In the following empirical analysis, we restrict our attention to the firms that fall within the common support of the distribution of the estimated propensity score to make the treated and control firms more comparable.

Descriptive Statistics

Table 2 displays the descriptive statistics of our key variables, where column 1 is for the whole sample and columns 2 and 3 are for firms that survived and firms that failed, respectively. The average yearly exit rate in the Chinese manufacturing sector is approximately 6.7%. Besides, we find that failing firms are smaller and older in line with the previous studies (e.g., Clementi and Hopenhayn 2006; Tsoukas 2011). In addition, failing firms have lower productivity, profitability and sales growth and are more leveraged.

Table 1. Balancing tests for propensity score matching before and after matching.

	Subsidy (0 = No, 1 = Yes)			Mean		*t*-test		
	Probit (1)	OLS (2)		Treated (3)	Controls (4)	Bias (%) (5)	T-statistics (6)	*P* value (7)
TFP	0.006***	0.002***	Before	2.412	2.386	3.3	13.41	0.000
	(0.002)	(0.000)	After	2.412	2.410	0.2	0.70	0.484
Export intensity	0.195***	0.039***	Before	0.216	0.178	10.7	44.83	0.000
	(0.004)	(0.001)	After	0.216	0. 222	−1.6	−0.62	0.533
Profit rate	0.223***	0.042***	Before	0.063	0.095	−13.5	−54.85	0.000
	(0.006)	(0.001)	After	0.063	0.061	0.9	0.61	0.451
Sales growth	0.008***	0.001*	Before	0.312	0.299	2.6	10.93	0.000
	(0.003)	(0.001)	After	0.312	0.311	0.2	0.48	0.628
Age	−0.041***	−0.009***	Before	2.270	2.147	15.5	64.73	0.000
	(0.002)	(0.000)	After	2.270	2.266	0.5	1.57	0.117
Size	0.227***	0.051***	Before	10.557	9.709	60.6	259.64	0.000
	(0.001)	(0.000)	After	10.557	10.552	0.3	1.00	0.317
Industrial SOE share	0.080***	0.023***	Before	0 .129	0.100	9.6	41.02	0.000
	(0.005)	(0.001)	After	0.129	0.127	0.6	1.88	0.060
Industrial R&D intensity	0.189***	0.053***	Before	0.088	0.080	8.8	37.31	0.000
	(0.040)	(0.009)	After	0.088	0.087	0.4	1.30	0.194
Year dummies	YES	YES						
Industry dummies	YES	YES						
Observations	1,421,446	1,421,446						
Pseudo/R-squared	0.068	0.057						

Notes: A probit model (OLS) is estimated to be used for the propensity score matching and a balancing test is conducted to see whether the PSM has effectively balanced the treatment and control group in terms of the observables. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively.

Regarding ownership (columns 4–6), the exit rate is the highest among SOEs (12.6%) and the lowest for foreign firms (4.2%). The foreign group has the highest TFP (2.562), whereas the SOE group has the lowest (2.188). In terms of ROA, the private group is the most profitable (0.362) and the SOE group performs the worst (0.121). This echoes the fact that, in China, SOEs generally have lower efficiency and profitability compared to firms with other types of ownership. In addition, SOEs display the lowest growth rates (0.173), only about half of that for private firms (0.326). Furthermore, the foreign group has the highest export intensity (0.516), and SOEs have the lowest coverage ratio (0.069). These findings are consistent with several previous studies (e.g., Chen and Guariglia 2013; Zhang and Liu 2017). Differences in all the variables between the above sub-samples are statistically significant in all cases.[6]

Figure 1 shows Kaplan-Meier survival rates for subsidized versus nonsubsidized firms and middle-highly versus highly subsidized firms. Compared to nonsubsidized firms, subsidized firms have higher survival odds, while highly subsidized firms are less likely to survive than medium-highly subsidized firms.

Regression Results

Baseline Results

Table 3 shows the estimation results of Equation (4). It presents the effect of subsidies on firm exit using the discrete time hazard model—cloglog, probit, and logit with firm random effects. Under each model, we present the results by ownership.

Table 2. Descriptive statistics.

Variables	All firms (1)	Exit = 0 (2)	Exit = 1 (3)	State (4)	Nonstate (5)	Foreign (6)
Exit	0 .067	0.000	1.000***	0.126***	0.062***	0.042***
Subsidy	0.512	0.519	0.427***	0.516***	0.534***	0.424***
TFP	2.404	2.416	2.239***	2.188***	2.404***	2.562***
Sales growth	0.303	0.321	0.053***	0.173***	0.326***	0.305***
ROA	0.312	0.316	0.283***	0.121***	0.362***	0.229***
Export intensity	0.216	0.220	0.151***	0.069***	0.166***	0.516***
Size	10.433	10.475	9.847***	10.848***	10.259***	10.823***
Age	2.250	2.239	2.403***	3.015***	2.171***	2.021***
Herfindahl index	0.448	0.446	0.474***	0.497***	0.435***	0.463***
Industry sales growth	0.310	0.312	0.281***	0.243***	0.319	0.320***
Industrial R&D intensity	0.087	0.087	0.078***	0.090***	0.085***	0.091*
Observations	349,354	324,463	24,891	43,560	243,005	62,789

Notes: This table reports the summary statistics for the sample firms during 1999–2007 and *t*-tests comparing SOEs, private firms and foreign firms. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively. The regressors are defined in Table A1.

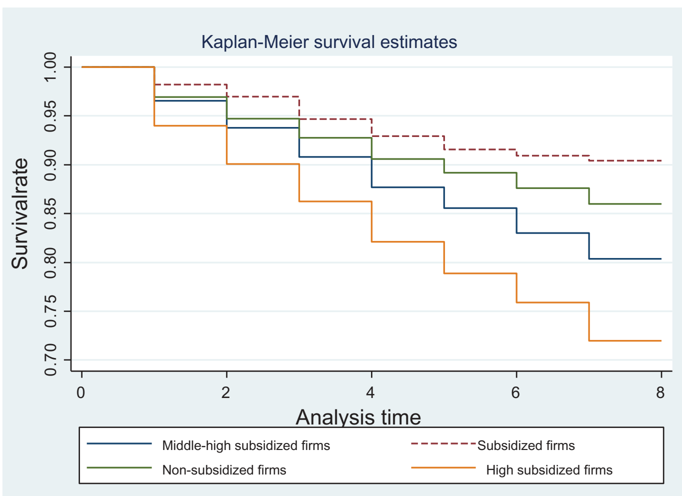

Figure 1. Kaplan-Meier survival estimates on firm survival.

Columns 1–3 show that subsidies significantly decrease the exit probability for Chinese firms. Keeping all the other variables constant, a one standard deviation increase in subsidy intensity would decrease its death probability by 1.6%, 0.7%, and 0.8% for SOEs, private firms, and foreign firms, respectively. The magnitude is nontrivial given that the average exit rates are 12.6%, 6.2%, and 4.2% for these three types of firms in the sample. Additionally, firms with higher sales growth and firms in industries with higher growth potential have a lower exit probability, and firms with higher export intensity are more likely to survive. However, firms in more concentrated industries are more likely to exit. The coefficients on Size and Size^2 enter with the expected signs, and both are statistically significant. Finally, the coefficients on Age^2 are positive and significant, suggesting significant nonlinearities (Tsoukas 2011; Liu and Li, 2015). Columns 4–9 show similar findings by the probit

Table 3. Benchmark results.

	cloglog			logit			probit		
	SOEs (1)	Non-state (2)	Foreign (3)	SOEs (4)	Non-state (5)	Foreign (6)	SOEs (7)	Non-state (8)	Foreign (9)
Subsidy	–0.356***	–0.353***	–0.476***	–0.412***	–0.360***	–0.499***	–0.224***	–0.181***	–0.268***
	(0.028)	(0.017)	(0.042)	(0.030)	(0.020)	(0.043)	(0.016)	(0.011)	(0.027)
TFP	–0.069***	–0.113***	–0.076**	–0.078***	–0.111***	–0.126***	–0.041***	–0.058***	–0.071***
	(0.019)	(0.019)	(0.034)	(0.016)	(0.014)	(0.029)	(0.008)	(0.007)	(0.016)
Sales growth	–0.294***	–0.721***	–0.952***	–0.297***	–0.702***	–0.969***	–0.125***	–0.298***	–0.370***
	(0.040)	(0.038)	(0.102)	(0.025)	(0.020)	(0.053)	(0.010)	(0.009)	(0.027)
Export intensity	–0.302***	–0.478***	–0.510***	–0.290***	–0.472***	–0.472***	–0.150***	–0.266***	–0.293***
	(0.084)	(0.031)	(0.050)	(0.081)	(0.033)	(0.047)	(0.042)	(0.019)	(0.032)
Size	–0.111	–1.388***	–1.387***	–0.159*	–1.859***	–1.730***	–0.152***	–1.092***	–1.219***
	(0.087)	(0.067)	(0.176)	(0.095)	(0.090)	(0.189)	(0.051)	(0.051)	(0.132)
$Size^2$	0.010**	0.052***	0.044***	–0.007	0.072***	0.059***	–0.000	0.043***	0.044***
	(0.004)	(0.003)	(0.008)	(0.005)	(0.004)	(0.009)	(0.002)	(0.002)	(0.006)
Age	0.025	–0.436***	–0.496***	0.088	–0.452***	–0.410**	0.051	–0.227***	–0.192
	(0.103)	(0.047)	(0.175)	(0.109)	(0.058)	(0.197)	(0.058)	(0.033)	(0.121)
Age^2	0.005	0.124***	0.177***	–0.012	0.136***	0.141***	–0.007	0.074***	0.087***
	(0.019)	(0.010)	(0.042)	(0.020)	(0.012)	(0.049)	(0.011)	(0.007)	(0.030)
Herfindahl index	0.050**	0.009	0.019	0.066***	0.081***	0.069***	0.038***	0.048***	0.046***
	(0.020)	(0.011)	(0.037)	(0.019)	(0.013)	(0.025)	(0.011)	(0.008)	(0.018)
Industry sales growth	–0.039	–0.061***	0.002	–0.055	–0.055***	0.012	–0.032*	–0.027***	0.009
	(0.034)	(0.019)	(0.036)	(0.036)	(0.019)	(0.037)	(0.019)	(0.010)	(0.022)
Industrial R&D intensity	–0.917**	–2.883***	0.191	–1.184***	–0.801***	0.210	–0.643***	–0.468***	0.117
	(0.425)	(0.251)	(0.566)	(0.179)	(0.129)	(0.251)	(0.094)	(0.072)	(0.156)
Constant	0.475	6.593***	8.188***	0.689	8.983***	9.400***	0.609**	5.079***	6.146***
	(0.465)	(0.353)	(0.972)	(0.511)	(0.452)	(0.997)	(0.280)	(0.259)	(0.688)
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Log pseudolikelihood	–15060.266	–53085.701	–9324.035	–15228.570	–53436.441	–9957.635	–15246.393	–53539.013	–10008.200
Observations	41,297	243,005	50,934	41,297	243,005	50,934	41,297	243,005	50,934

Notes: Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively. The specifications have a binary dependent variable that is equal to 1 in the year of exit and 0 otherwise. The regressors are defined in Table A1.

and logit models with firm random effects, and the log-likelihood values at the end of Table 3 suggest that the cloglog model provides the best fit to the data.

Further Investigation on the Relationship Between Subsidies and Survival

Table 4 further presents the estimation results on the heterogeneous survival effects of subsidy across different levels. There are two major findings from the empirical results: first, the effect for SOEs with medium-large amount of subsidy (in the 3rd quartile) is larger than that for SOEs with very low or very high levels of subsidy, that is, there is a U-shaped relationship between the amount of subsidy and its impact on exit rates. Thus, the optimal subsidy rate lies in somewhere in the middle. Second, among non-state and foreign firms, the effect is the most pronounced for firms with a low level of subsidy (less than median) and is the smallest for firms with the largest amount of subsidy (in the 4th quartile). This is likely due to the fact the incentive distortion becomes more severe as the level of subsidy grows. Put it differently, receiving too many subsidies reduces firms' incentives to pursue profit-maximizing objectives, as they incorporate an expectation that the state will intervene to bail them out in times of distresses (He and Yang 2015; Howell et al., 2018), thus diverting some funds away from investments.

Potential Mechanisms

In this section, we try to shed some light on the mechanisms through which subsidy affects the survival rates. Besides, we also aim to explain the patterns of the effects of subsidy on firm survival.

If subsidy mainly affects firm survival through alleviating firms' financial constraints, then we may find firms to engage in more investment after receiving subsidy, which otherwise cannot be afforded on their own. In addition to fixed investment, this is especially the case for intangible investment. Financial support, particularly government subsidy, constitutes the principal policy instrument for stimulating innovation activities. Innovating companies may suffer from financing deficits due to the presence of information asymmetry and moral hazard (Arrow 1972). This problem is further exacerbated by the fact that intangible assets cannot be used for collateral (Hsu and Ziedonis 2013). Therefore, private financers may be reluctant to lend when the investment is concentrated essentially on intangible assets. In the face of financial constraints for innovative projects, firms may have to reject or scale down their innovation projects (Feldmana and Kelley 2006), thereby hampering growth in employment, sales, exports and economic welfare, resulting in a higher probability of exit . Therefore, we test whether subsidies decrease the survival rates through facilitating more investments in fixed and intangible investments by alleviating financial constraints. Besides, as selection depends more on profitability, we also test whether subsidy can improve firm performance measured by return on assets (ROA).

In Table 5, we estimate the effect of subsidy on firms' investment in intangible and fixed assets as well as profits. To deal with potential endogeneity, we apply the system Generalized Methods of Moments (GMM) to run the estimations. In general, we find positive effects of subsidy on investment in intangible assets (columns 1–3) and fixed assets (columns 4–6) as well as on firm profitability (columns 7–9). This is consistent with our hypothesis that subsidy makes firms better able to engage in more value-enhancing investment by alleviating their financial constraints. This in turn enhances firm profitability and reduces their exit rates.

However, the results also display heterogeneous effects of subsidy across different subsidy levels among three types of firms. The effect is the largest for SOEs receiving medium-high amount of subsidy (except for ROA). In contrast, among private and foreign firms, the effect proves to be the most pronounced for those receiving a low amount (for all of the three dependent variables). Recall that this is highly consistent with our results in Table 4 where we find the effect of subsidy on firm exit is the most pronounced for SOEs receiving medium-high amount of

Table 4. Heterogeneous effects across subsidy levels.

	Hazard Models for Firms Exit with Random Effects		
	SOEs (1)	**Non-state (2)**	**Foreign (3)**
Subsidy	−0.278***	−0.561***	−0.760***
	(0.009)	(0.024)	(0.006)
Subsidy medium-high	−0.250***	0.115***	0.216***
	(0.007)	(0.033)	(0.005)
Subsidy high	−0.052***	0.277***	0.492***
	(0.008)	(0.007)	(0.016)
TFP	−0.070***	−0.111***	−0.075***
	(0.011)	(0.015)	(0.011)
Sales growth	−0.298***	−0.715***	−0.936***
	(0.009)	(0.133)	(0.046)
Export intensity	−0.237***	−0.450***	−0.498***
	(0.003)	(0.027)	(0.016)
Size	−0.082***	−1.403***	−1.394***
	(0.015)	(0.207)	(0.142)
$Size^2$	0.009***	0.053***	0.044***
	(0.001)	(0.009)	(0.007)
Age	0.076	−0.441***	−0.488***
	(0.120)	(0.076)	(0.013)
Age^2	−0.011	0.124***	0.175***
	(0.022)	(0.012)	(0.004)
Herfindahl index	0.056***	0.009***	0.019
	(0.000)	(0.003)	(0.024)
Industry sales growth	−0.049***	−0.061***	0.003
	(0.001)	(0.004)	(0.012)
Industrial R&D intensity	−1.057***	−2.879***	0.195
	(0.033)	(0.148)	(0.439)
Constant	0.055	6.661***	8.158***
	(0.253)	(1.224)	(0.494)
Year dummies	YES	YES	YES
Industry dummies	YES	YES	YES
Region dummies	YES	YES	YES
Log pseudolikelihood	−15211.848	−53064.992	−9316.460
Observations	41,297	243,005	50,934

Notes: Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively. The specifications have a binary dependent variable that is equal to 1 in the year of exit and 0 otherwise. The regressors are defined in Table A1.

subsidy while the effect on exit decreases as the amount of subsidy increases for private and foreign firms. In terms of the economic significance, subsidy mainly has an economically large and significant effect on fixed investment for SOEs and on intangible investment for private and foreign firms. For example, a one standard deviation (SD) increase in subsidy leads to 0.25 SD increases in fixed investment for SOEs (with medium-high amount of subsidy) and leads to 0.64 SD and 0.18 SD increases in intangible investment for private and foreign firms (with subsidy less than the median), respectively. Among private and foreign firms, the effect on profitability is also nontrivial. As discussed before, this result may be attributed to the fact that as the amount of subsidy increases, the incentive distortion of recipient firms becomes more severe, as these firms

Table 5. Channels through which subsidy affects firm survival.

	Intangible Investment			Fixed Investment			ROA		
VARIABLES	SOEs (1)	Non-state (2)	Foreign (3)	SOEs (4)	Non-state (5)	Foreign (6)	SOEs (7)	Nonstate (8)	Foreign (9)
Lag.dep	0.437*	0.917***	0.620***	0.157***	0.338***	0.076	0.169***	0.381***	0.448***
	(0.262)	(0.059)	(0.110)	(0.047)	(0.023)	(0.050)	(0.059)	(0.019)	(0.043)
Subsidy	–0.006	0.108***	0.024**	0.070*	0.076*	0.047*	0.002	0.029**	0.103*
	(0.005)	(0.021)	(0.010)	(0.038)	(0.043)	(0.027)	(0.003)	(0.014)	(0.057)
Subsidy medium-high	0.009*	–0.091***	–0.016*	0.058*	–0.068*	–0.035*	0.002	–0.025**	–0.110*
	(0.005)	(0.019)	(0.008)	(0.034)	(0.037)	(0.020)	(0.002)	(0.013)	(0.058)
Subsidy high	0.003	–0.094***	–0.017**	–0.052	–0.065*	–0.038*	0.006**	–0.017	–0.137*
	(0.006)	(0.019)	(0.008)	(0.035)	(0.038)	(0.022)	(0.003)	(0.013)	(0.078)
TFP	–0.006	0.006***	0.003	–0.003*	–0.014***	–0.006*	0.002	0.011***	0.012***
	(0.007)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)
Sales growth	0.002	0.001	–0.002	–0.001	0.008***	–0.002	0.008***	0.025***	0.027***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.005)	(0.001)	(0.001)	(0.003)
Export intensity	–0.006	–0.002	–0.001	–0.019	–0.020	0.037	0.036	–0.013	0.008
	(0.077)	(0.004)	(0.003)	(0.050)	(0.018)	(0.027)	(0.025)	(0.010)	(0.007)
Size	0.401*	0.048***	0.033	–0.077	0.198***	–0.208	0.016	0.182***	–0.056
	(0.218)	(0.013)	(0.024)	(0.304)	(0.058)	(0.207)	(0.165)	(0.031)	(0.062)
$Size^2$	–0.022**	–0.003***	–0.002*	0.002	–0.007***	0.007	–0.001	–0.007***	0.002
	(0.010)	(0.001)	(0.001)	(0.013)	(0.003)	(0.009)	(0.007)	(0.001)	(0.003)
Age	0.004	0.035***	0.003	0.014	0.040**	0.057	0.052**	–0.002	–0.004
	(0.037)	(0.007)	(0.016)	(0.041)	(0.016)	(0.037)	(0.024)	(0.008)	(0.018)
Age^2	–0.000	–0.005***	–0.004	–0.003	–0.006	–0.019*	–0.012**	0.001	–0.001
	(0.008)	(0.002)	(0.004)	(0.009)	(0.004)	(0.011)	(0.005)	(0.002)	(0.004)
Herfindahl index	0.015	–0.001	–0.002	–0.005	–0.009	–0.029	0.001	–0.001	–0.006**
	(0.013)	(0.002)	(0.002)	(0.011)	(0.006)	(0.029)	(0.005)	(0.002)	(0.003)
Industry sales growth	0.009	–0.001	0.000	0.001	0.000	–0.001	–0.002	0.001	–0.002

	(0.008)	(0.001)	(0.001)	(0.003)	(0.001)	(0.003)	(0.002)	(0.001)	(0.002)
Industrial R&D intensity	0.117	–0.016	–0.016	0.073	0.006	0.139	–0.088	0.021	0.003
	(0.110)	(0.016)	(0.018)	(0.104)	(0.055)	(0.121)	(0.057)	(0.031)	(0.033)
Observations	6,431	36,600	7,364	6,431	36,600	7,364	6,431	36,600	7,364
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
AR(2)	0.332	0.075	0.054	0.823	0.060	0.861	0.904	0.164	0.213
Hansen J Test	0.089	0.110	0.044	0.205	0.098	0.196	0.641	0.102	0.211

Notes: System-GMM method is used to estimate in the table. Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively.

may expect to receive more subsidies in the event of a crisis, thus diverting some funds away from investments. This is highly likely in China where corporate governance proves to be weak and ineffective, and managers can appropriate funds to benefit themselves at the expense of their companies.

Heterogeneous Effects of Subsidy on Firm Survival Across Levels of Institutional Quality

In this section, we try to shed some light on the role of institutional factors on the relationship between subsidy and firm survival examined in the previous sections. Institutional quality within China, which is the largest developing economy in the world with unbalanced development across its regions, varies tremendously across provinces. The literature shows that in China local governments in regions with less developed markets exert a more significant influence on the local economy and also have more controlling power over the firms in their jurisdiction (see, e.g., Lau, Qian, and Roland 2000). On the one hand, local government agencies may impose high tax rates, informal levies and extralegal payments on nonstate firms to increase both budgetary and off-budgetary revenues (Du, Lu, and Tao 2015). On the other hand, in regions that have difficulty in attracting investment and retaining profitable businesses, government agencies have strong incentives to grant subsidies to companies in their jurisdictions to boost local economic development as their chances of promotion depend, to a great extent, on GDP growth. Based on the above reasoning, it's reasonable to hypothesize that in regions with less developed markets and more government intervention, local governments may play a more determining role on firms' survival and thus the effect of subsidy is expected to be larger.

ETC is widely used in the literature to measure corruption or rent seeking. ETC is a mix that includes "grease money" to obtain better government services, "protection money" to lower tax rates, managerial excesses and normal business expenditures to build relational capital with suppliers and clients (Cai, Fang, and Xu 2011; Xu, Zhang, and Yano 2017). For example, Chen, Liu, and Su (2013) argue that corruption acts as the proverbial grease for the bureaucratic wheels of an otherwise unmotivated banking system and find that credit is allocated in accordance with entertainment and travel costs (ETC) of Chinese private firms. We thus use the variable ETC from the 2005 World Bank Survey as a measure of institutional quality, more specifically, the extent of rent-seeking or/and corruption, in our analysis. As an alternative indicator, we also employ another variable in the same survey—the time a firm spends on government assignments and communications.[7] We divide firms into two groups based on the medians of the above two variables respectively, with higher values indicating lower institutional quality (more government intervention and corruption and less developed markets).

Results using the two indicators are presented in Tables 6 and 7, respectively. While the two indicators may capture somewhat different aspects of institutional quality, we do find the results to be consistent with our hypothesis: the effect of subsidy on firm exit is quantitatively larger for firms located in regions with lower institutional quality, regardless of the indicators used to categorize firms. This lends support to our previous conjecture that in these regions, due to a lack of efficient market mechanisms, local governments may play a more significant role in the economy and thus firms that receive government support, e.g., subsidies, are more likely to survive than those that operate in provinces with more developed markets. Nevertheless, the difference in the effect of subsidy between regions of low and high institutional quality is the largest and statistically significant for SOEs when we use ETC to classify the sample firms. This is so for private and foreign firms when the time of communication with governments is used.

Table 6. Heterogeneous effects across levels of ETC.

	Hazard Models for Firms Exit with Random Effects (ETC)					
	SOEs		Nonstate		Foreign	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
Subsidy	−0.362***	−1.311***	−0.316***	−0.352***	−0.468***	−0.473***
	(0.031)	(0.025)	(0.014)	(0.071)	(0.053)	(0.020)
TFP	−0.069***	−1.524***	−0.031***	−0.125***	−0.112***	−0.177***
	(0.020)	(0.226)	(0.002)	(0.024)	(0.038)	(0.050)
Sales growth	−0.297***	−2.216**	−0.306***	−0.857***	−0.946***	−0.880***
	(0.056)	(0.863)	(0.014)	(0.134)	(0.099)	(0.118)
Export intensity	−0.284***	−3.620	−0.493***	−0.399***	−0.510***	−0.395***
	(0.089)	(3.753)	(0.129)	(0.067)	(0.057)	(0.027)
Size	−0.053	−14.795***	−0.726***	−1.551***	−1.338***	−1.697***
	(0.081)	(5.105)	(0.082)	(0.188)	(0.192)	(0.472)
$Size^2$	0.011***	0.679***	0.022***	0.060***	0.041***	0.059***
	(0.004)	(0.252)	(0.002)	(0.008)	(0.009)	(0.021)
Age	0.087	−10.517*	0.011	−0.478***	−0.439*	−0.258***
	(0.118)	(5.932)	(0.177)	(0.031)	(0.233)	(0.023)
Age^2	−0.013	−3.130**	0.009	−0.128***	−0.141**	−0.143***
	(0.022)	(1.553)	(0.034)	(0.004)	(0.058)	(0.014)
Herfindahl index	0.051***	3.541***	0.015***	0.065***	0.028	0.026***
	(0.010)	(1.175)	(0.001)	(0.010)	(0.022)	(0.009)
Industry sales growth	−0.049	−2.710***	0.009	−0.059***	0.009	−0.017
	(0.039)	(0.301)	(0.044)	(0.004)	(0.049)	(0.052)
Industrial R&D intensity	−1.030***	1.678	−0.218***	−0.600	−0.925	−0.440
	(0.088)	(1.036)	(0.034)	(0.423)	(0.915)	(1.459)
Constant	−0.117	−8.628***	2.697***	7.712***	8.081***	8.471***
	(0.439)	(3.189)	(0.740)	(1.018)	(0.928)	(1.347)
Year Dummies	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES
Region Dummies	YES	YES	YES	YES	YES	YES
Log pseudolikelihood	−13257.970	−1655.392	−8108.170	−44808.37	−8173.471	−1552.511
Observations	37,991	5,405	34,481	208,387	51,283	11,389

Notes: Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively. The specifications have a binary dependent variable that is equal to 1 in the year of exit and 0 otherwise. The regressors are defined in Table A1.

Table 7. Heterogeneous effects across severity of government intervention.

	Hazard Models for Firms Exit with Random Effects					
	SOEs		Nonstate		Foreign	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
Subsidy	–0.320***	–0.409***	–0.269***	–0.458***	–0.358***	–0.521***
	(0.111)	(0.025)	(0.022)	(0.099)	(0.074)	(0.010)
TFP	–0.145***	–0.037***	–0.175***	–0.051***	–0.042	–0.159
	(0.012)	(0.005)	(0.026)	(0.016)	(0.060)	(0.149)
Sales growth	–0.280***	–0.307***	–0.743***	–0.682***	–1.247***	–0.862***
	(0.059)	(0.033)	(0.052)	(0.094)	(0.211)	(0.118)
Export intensity	–0.201***	–0.358***	–0.446***	–0.456***	–0.507***	–0.424***
	(0.027)	(0.012)	(0.042)	(0.050)	(0.088)	(0.006)
Size	0.087	–0.192***	–1.359***	–1.395***	–1.522***	–1.573***
	(0.122)	(0.006)	(0.090)	(0.181)	(0.312)	(0.440)
$Size^2$	0.017***	0.004***	0.050***	0.053***	0.053***	0.051**
	(0.005)	(0.001)	(0.004)	(0.008)	(0.015)	(0.021)
Age	–0.039	–0.131***	–0.468***	–0.374***	–0.290	–0.367
	(0.034)	(0.029)	(0.064)	(0.144)	(0.295)	(0.333)
Age^2	0.009	–0.019***	–0.131***	–0.106***	–0.126*	0.121
	(0.006)	(0.003)	(0.014)	(0.029)	(0.071)	(0.083)
Herfindahl index	0.031**	0.075***	–0.011	0.033*	0.070**	0.064***
	(0.012)	(0.008)	(0.015)	(0.019)	(0.034)	(0.008)
Industry sales growth	0.027	–0.085***	–0.067***	–0.047*	0.077	–0.025
	(0.052)	(0.029)	(0.025)	(0.024)	(0.069)	(0.028)
Industrial R&D intensity	–1.044***	–1.076***	–2.746***	–2.919***	–0.495	0.460
	(0.128)	(0.056)	(0.329)	(0.121)	(0.484)	(0.385)
Constant	–0.513	0.662***	6.571***	6.537***	7.530***	8.624***
	(0.771)	(0.036)	(0.470)	(1.222)	(1.635)	(2.208)
Year Dummies	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES
Region Dummies	YES	YES	YES	YES	YES	YES
Log pseudolikelihood	–6221.937	–9227.699	–28701.392	–24431.748	–7161.253	–2092.900
Observations	16,711	26,103	122,703	120,302	39,221	11,546

Notes: Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively. The specifications have a binary dependent variable that is equal to 1 in the year of exit and 0 otherwise. The regressors are defined in Table A1.

Robustness Tests

The additional robustness checks in this section involve a control function approach to further deal with the endogeneity concern and alternative econometric models.

A Control Function Approach

While we have used the propensity score matching to partially deal with the potential endogeneity problem, if there are unobserved variables that affect the selection of subsidy and firm exit, the results could be still biased. In order to address this concern, we adopt a control function approach. This approach proceeds in two steps: First, the potential endogenous variable (subsidy in our case) is regressed on the exogenous variables and additional instrumental variables, and the residual term is obtained; Second, this residual is added to the original regression as an additional regressor. Besides, a statistically significant coefficient of this residual is indicative of endogeneity in the original model. Two instrumental variables are adopted in this article. First, the level of affiliation of a firm reflects its connection with different levels of government or administrative unit. Firms with higher levels of government (central, province and prefecture) are more likely to obtain subsidies than firms affiliated with lower levels (town and villages) or without any affiliation.[8] At the same time, this variable is unlikely to directly affect firm survival, particularly conditional on ownership (as we did here). Furthermore, Girma et al. (2009) use the level of employee social welfare as an instrument for the amount of subsidy. Firms that receive a higher level of social benefits from local and central governments are also likely to receive more production subsidies. On the other hand, providing social welfare benefits, such as housing and medical care, should not have a direct relationship with survival conditional on subsidies and on the vector of firm-level characteristics. The results are presented in Table 8. In columns 4–6, the two IVs are significantly correlated with the amount of subsidy with the expected signs. In the second stage regression (cloumns 1-3), the coefficient of subsidy continues to be significant and negative with similar magnitudes as the baseline. Importantly, the first stage residual is in fact indistinguishable from 0, indicating that the propensity score matching has adequately balanced the treated and controls based on the observed covariates. Thus, we are confident our previous results are less likely to be biased due to endogeneity.

Alternative Estimation Methods

We then check whether our results are senstive to alternative estimation methods in Table 9. To verify the robustness of our main findings, we estimate an OLS regression for survival up to a fixed number of years, which also allows to control for firm fixed effects (columns 1–3). We also present the estimates from a continuous-time hazard model with a parametric baseline hazard function (assuming Weibull distribution) that can control for unobserved firm heterogeneity in columns 4–6 and estimates from the Cox model correcting the partial likelihood function for ties using the method of Breslow (1974) in columns 7–9. The negative and significant impact of subsidy on firm exit is maintained across all these models.

Conclusions

Understanding the effects of subsidy policies for firms is crucial to assess the effectiveness of public policy to stimulate growth. In this article, we have examined whether subsidies have a positive impact on survival at the firm level and further investigated the mechanisms through which subsidies impact firms' survival. Based on the survival analysis, our results suggest that receiving subsidies significantly decreases the likelihood of exit. However, the effect decreases as the level of subsidies increases for private and foreign firms, but displays a nonlinear relationship across subsidy levels for SOEs. We also show the effects vary across the levels of institutional quality measured by the

Table 8. Robustness checks: A control function approach.

	Hazard Models for Firms Exit with Random Effects			Dependent Variable = Subsidy			
	SOEs (1)	Nonstate (2)	Foreign (3)		SOEs (4)	Nonstate (5)	Foreign (6)
Subsidy	–0.451***	–0.397***	–0.224*	Affiliation	–0.025***	–0.022***	–0.008***
	(0.070)	(0.046)	(0.118)		(0.004)	(0.001)	(0.003)
Residual	–0.032	–0.057	–0.069	Welfare	0.004**	0.013***	0.000***
	(0.071)	(0.047)	(0.121)		(0.001)	(0.001)	(0.000)
TFP	–0.062*	0.035	–0.103	TFP	–0.000	–0.003**	0.008***
	(0.035)	(0.028)	(0.088)		(0.002)	(0.001)	(0.002)
Sales growth	–0.442***	–1.328***	–1.782***	Sales growth	0.001	–0.026***	–0.016***
	(0.104)	(0.091)	(0.290)		(0.003)	(0.001)	(0.003)
Export intensity	–0.275*	–0.530***	–0.371***	Export intensity	0.026**	0.062***	–0.006
	(0.156)	(0.064)	(0.137)		(0.012)	(0.003)	(0.005)
Size	–0.228	–1.589***	–2.047***	Size	–0.302***	–0.022**	–0.080***
	(0.154)	(0.139)	(0.458)		(0.015)	(0.009)	(0.019)
Size2	–0.003	0.060***	0.071***	Size2	0.014***	–0.000	0.002**
	(0.007)	(0.007)	(0.021)		(0.001)	(0.000)	(0.001)
Age	0.124	–0.353***	0.531	Age	–0.033*	–0.083***	–0.022
	(0.207)	(0.104)	(0.499)		(0.017)	(0.006)	(0.020)
Age2	–0.010	0.082***	–0.094	Age2	0.007**	0.020***	0.009*
	(0.038)	(0.022)	(0.116)		(0.003)	(0.001)	(0.005)
Herfindahl index	0.061	0.019	–0.179	Herfindahl index	–0.022***	–0.007***	0.000
	(0.062)	(0.024)	(0.178)		(0.004)	(0.002)	(0.003)
Industry sales growth	–0.016	–0.034	–0.010	Industry sales growth	–0.017***	–0.008***	–0.013***
	(0.058)	(0.031)	(0.097)		(0.005)	(0.002)	(0.004)
Industrial R&D intensity	–1.915**	–0.511	3.591**	Industrial R&D intensity	–0.036	0.037***	0.038*
	(0.857)	(0.513)	(1.675)		(0.026)	(0.012)	(0.023)
Constant	1.983**	7.735***	–2.345	Constant	–0.025***	–0.022***	–0.008***
	(0.854)	(0.754)	(2.552)		(0.004)	(0.001)	(0.003)
Year dummies	YES	YES	YES	Year dummies	YES	YES	YES
Industry dummies	YES	YES	YES	Industry dummies	YES	YES	YES
Region dummies	YES	YES	YES	Region dummies	YES	YES	YES
Log pseudolikelihood	–15046.216	–49187.569	–9321.510	R-square	0.015	0.016	0.030
Observations	43,719	243,005	62,789	Observations	43,719	243,005	62,789

Notes: Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively.

Table 9. Robustness checks: Alternative models.

	Alternative Models for Firms Exit or Survival								
	Cox			Weibull with Unobserved Heterogeneity			OLS with Fixed Effects		
VARIABLES	**SOEs (1)**	**Nonstate (2)**	**Foreign (3)**	**SOEs (4)**	**Nonstate (5)**	**Foreign (6)**	**SOEs (7)**	**Nonstate (8)**	**Foreign (9)**
Subsidy	–0.249***	–0.176***	–0.158***	–0.059**	–0.039***	–0.199***	–0.041***	–0.021***	–0.019***
	(0.049)	(0.023)	(0.042)	(0.027)	(0.015)	(0.042)	(0.003)	(0.001)	(0.002)
TFP	–0.162***	–0.208***	–0.202***	–0.255***	–0.273***	–0.229***	–0.009***	–0.008***	–0.006***
	(0.016)	(0.014)	(0.030)	(0.017)	(0.015)	(0.030)	(0.002)	(0.001)	(0.001)
Sales growth	–0.295***	–0.787***	–1.017***	–0.315***	–0.812***	–1.010***	–0.024***	–0.020***	–0.016***
	(0.024)	(0.019)	(0.051)	(0.025)	(0.019)	(0.051)	(0.002)	(0.001)	(0.001)
Export intensity	–0.109	–0.236***	–0.331***	–0.125*	–0.310***	–0.331***	–0.030***	–0.028***	–0.023***
	(0.075)	(0.027)	(0.045)	(0.075)	(0.027)	(0.045)	(0.008)	(0.002)	(0.002)
Size	–0.153*	–1.404***	–1.447***	–0.173**	–1.422***	–1.496***	–0.109***	–0.146***	–0.140***
	(0.084)	(0.068)	(0.177)	(0.084)	(0.068)	(0.177)	(0.011)	(0.005)	(0.010)
$Size^2$	–0.003	0.059***	0.052***	–0.004	0.057***	0.053***	0.003***	0.006***	0.006***
	(0.004)	(0.003)	(0.008)	(0.004)	(0.003)	(0.008)	(0.001)	(0.000)	(0.000)
Age	–0.294***	–0.209***	–0.507**	–0.226**	–0.410***	–0.545**	0.000	–0.030***	–0.020**
	(0.102)	(0.049)	(0.218)	(0.101)	(0.049)	(0.222)	(0.011)	(0.003)	(0.008)
Age^2	–0.029	0.114***	–0.057	–0.013	0.157***	–0.080	0.001	0.008***	0.007***
	(0.019)	(0.010)	(0.054)	(0.018)	(0.010)	(0.055)	(0.002)	(0.001)	(0.002)
Herfindahl index	0.035**	0.059***	0.062***	0.040***	0.063***	0.065***	0.007**	0.002	0.001
	(0.015)	(0.009)	(0.022)	(0.015)	(0.009)	(0.022)	(0.003)	(0.001)	(0.002)
Industry sales growth	–0.292***	–0.147***	–0.017	–0.510***	–0.161***	–0.006	–0.001	–0.004***	0.000
	(0.042)	(0.020)	(0.041)	(0.052)	(0.022)	(0.043)	(0.003)	(0.001)	(0.002)
Industrial R&D intensity	–1.451***	–1.032***	–0.536**	–1.767***	–1.331***	–0.826***	–0.103**	–0.177***	–0.044**
	(0.167)	(0.109)	(0.257)	(0.169)	(0.112)	(0.263)	(0.042)	(0.015)	(0.021)
Constant				6.619***	6.465***	6.571***	0.956***	0.971***	0.988***
				(0.010)	(0.010)	(0.018)	(0.066)	(0.029)	(0.063)
Firm fixed effects							YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES

(*Continued*)

Table 9. Robustness checks: Alternative models. (Continued)

	Alternative Models for Firms Exit or Survival								
	Cox			Weibull with Unobserved Heterogeneity			OLS with Fixed Effects		
VARIABLES	SOEs (1)	Nonstate (2)	Foreign (3)	SOEs (4)	Nonstate (5)	Foreign (6)	SOEs (7)	Nonstate (8)	Foreign (9)
Log-Pseusdo-Likelihood	−47397.529	−162587.720	−25627.181	−20352.134	−40020.482	−6505.017			
R square							0.048	0.028	0.030
Observations	43,719	243,005	62,789	43,719	243,005	62,789	43,719	243,005	62,789

Notes: Robust standard errors in parentheses. ***, **, and * denote significance levels at the 1%, 5%, and 10%, respectively. The specifications have a binary dependent variable that is equal to 1 in the year of exit and 0 otherwise. The regressors are defined in Table A1.

prevalence of rent seeking and government intervention. Further results suggest that the potential channels include increased investment in intangible and fixed assets as well as enhanced profitability. Our results are robust to a battery of robustness checks, including alternative models for firm exit (survival) and a control function approach to further deal with the potential endogeneity.

The findings of this study point to some useful policy implications. The first stems from the positive relation between government subsidies and firm survival rates. It suggests that government subsidy improves firms' financing environment (e.g., by sending good signals to the market), and thus help firms survive in the fierce competition. Another policy implication focuses on the allocation and management of subsidy. Our findings suggest that it is *not* that the more subsidy firms receive, the better their performance and the lower their exit rates. Larger amounts of subsidy may result in more severely distorted incentives and given that the corporate governance in China is not effective enough to well discipline the managers, these funds are likely to be appropriated and diverted to personal use. It's thus imperative to come up with more effective mechanisms to discipline managers as well as to monitor and track the use of the subsidy.

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Notes

1. At the end of our observation period, some of the firms could still be in operation. However, we cannot observe enough information.
2. In robustness tests, we will obtain estimates based on continuous-time hazard models with a parametric baseline hazard function that can control for unobserved firm heterogeneity and estimates based on the Cox model correcting the partial likelihood function for ties using the method of Breslow (1974) for comparability with previous studies.
3. In China, because of the planned economy before the 1980s, numerous older firms are mainly state-owned. Since the 1990s, China has started to promote reforms in the SOEs, and this is an essential part of China's economic transition. During this process, a large number of SOEs have been privatized, merged or reorganized, resulting in massive exits of older firms. Moreover, as older firms or larger firms may suffer from x-inefficiency, squared terms of size and age are included in our estimations (Liu and Li, 2015).
4. Appendix 1 defines all the variables used in this aticle. Our data have been deflated by the deflators taken from the China Statistical Yearbook (various issues) published by the National Bureau of Statistics of China. We use the provincial capital goods deflator to deflate the capital variables and the gross domestic product (GDP) deflator to deflate other variables.
5. Detailed information of the NBS database and its cleaning procedures are well summarized by Brandt et al. (2014).
6. All the correlation coefficients are less than 0.44, and most of them are very small, alleviating the concern of the multicollinearity problem when they are used simultaneously in the same regression.
7. The data come from World bank (2006).
8. We group the levels of affiliation into four groups with higher values indicating affiliation with lower level: (1) central and provincial level; (2) prefectural and county level; (3) street, town and village and below; (4) no affiliation.

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Appendix 1

Table A1. Variable definition.

Variable	Definition
Exit	A dummy variable equals 1 if the firm is in the sample in year *t* but not in year *t + 1*, and 0 otherwise.
Subsidy	Government subsidies scaled by total assets.
TFP	Total Factor productivity constructed using the Olley and Pakes (1996) method.
Sales growth	Sales in period *t* and *t*-1 over sales in period *t*-1.
Export intensity	Shares of exported value over sales in year *t*.
Profit rate	Share of firms' net profit over total sales.
Firm Size	Natural logarithm of total assets
Firm Age	Natural logarithm of the number of years since the open year
Industrial R&D intensity	Average share of firms introducing new products and processes in each three-digit CIC industry and year.
Industry sales growth	Industry sales in period *t* and *t*-1 over sales in period *t*-1, where industry sales are constructed by all *N* firms in the three-digit CIC industry and year.
Herfindahl index	The sum of the squares of the markets shares of all *N* firms in the three-digit CIC industry and year.
Industrial SOE share	Share of state-owned capital.