# Canada Small Business Financing Program: Updated and Extended Economic Impact Analysis

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## Acknowledgements

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# 1. Introduction

Access to external financing is critical for Small and Medium-sized Enterprises (SMEs) to both start up and grow. These types of businesses face many challenges that stem from their shortage of financial resources (D'Amboise 1991). SMEs play a major role in the Canadian economy: 99 percent of businesses in Canada have fewer than 500 employees and they employ 69.7 percent of workers in the private sector (Industry Canada 2013). The importance of government support to encourage private aggregate investment and to enhance firm performance is especially important for small businesses (Gale 1991). In addition, firms with greater access to financing grow more than those with limited access (Becchetti and Trovato 2002).

Numerous governmental programs have been put in place to facilitate access to financing, usually taking the form of a guarantee or loss-sharing program. Such programs are popular among governments because the involvement of the private sector adds credibility to the endeavour and because a small initial cash outlay can leverage a great number of loans (Honohan 2008). As such, in 1999, the Canada Small Business Financing Program (CSBFP) was launched to improve SMEs' access to financing. The CSBFP is a continuation of the Small Business Loans (SBL) program, which was implemented in 1961. In recognition of financial constraints and growth dilemma faced by SMEs in Canada, the program aims to increase the availability of financing for the establishment, expansion, modernization and improvement of small businesses.

Under the CSBFP, the government pays up to 85 percent of eligible losses incurred on loans that have defaulted. By transferring some of the risk exposure from the financial institution to the government, the CSBFP increases the availability of loans to SMEs that often would not have received financing without the Program. In addition, the Program aims to generate economic impacts by supporting economic growth and wealth creation rather than simply shifting the risk.

In order to help offset the cost of the CSBFP, the program requires the lender submit to the government a one-time registration fee of 2 percent, paid by the borrower (which can be financed as part of the loan), when the loan is registered under the program. In addition, lenders are required to pay an annual administration fee of 1.25 percent of the outstanding loan balance, which is included as part of the loan interest. These fees also help ensure that guarantees under the CSBFP are applied on loans that would not have transpired in the absence of the program (considered "incremental," meaning that the firm was not able to obtain financing from existing sources).[1] Finally, there is a cap on claims for loss that limits the loss rates for CSBFP loans. These measures ensure that CSBFP loans are provided to those businesses that have viable projects but are riskier, often due to lack of collateral, while very risky projects are simply refused financing. Since CSBFP loans are inherently riskier than non-CSBFP loans, financial forecasts carried out by Industry Canada have determined that the program is not fully

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1. The incrementality of the CSBFP has already been assessed at 75 percent (Riding et al. 2007), meaning that only 25 percent of CSBFP clients would have received a loan without the program.

cost recoverable. Consequently, an economic impact assessment of the CSBFP is routinely produced to demonstrate how CSBFP borrower firms contribute to the Canadian economy as compared to other similar non-CSBFP firms. The CSBFP operates on a statutory five-year review period and is now in its third review period (2009-2014).

For the previous lending period (2004-2009), the economic impact analysis (Chandler 2010) was conducted using data from the *Survey on Financing of Small and Medium Enterprises* (SFSME) 2004. Chandler's study found that participation in the program had a statistically significant positive effect on employment, salary and revenue growth. By assuming that three quarters of the loans (approximately 11,000 loans) guaranteed in 2004 were incremental, the analysis estimated that the CSBFP raised employment by around 5,000 jobs.

The current study was carried out on a more comprehensive dataset. While the majority of data are from the SFSME 2007, other data sources include the Business Register (BR), the Longitudinal Employment Analysis Program (LEAP), the General Index of Financial Information (GIFI), and the Exporter/Importer Register (EIR). The objective of this study is to measure the CSBFP's contribution to SME growth and to test the consistency and robustness of this positive impact during the economic downturn. The study attempts to answer the following questions:

1) *Does CSBFP participation lead to growth in revenue, employment, profits, salary, capital, value-added to output and labour productivity?*

2) *What is the actual growth generated by CSBFP participation in terms of growth in revenue, employment, profits, salary, capital, value-added to output and labour productivity?*

3) *Do CSBFP borrowers continue to invest in new capital assets? Do they become more productive?*

4) *Does the CSBFP support firm viability (i.e., firms that survive)?*

5) *Do CSBFP borrowers invest more in R&D?*

6) *Is economic performance stronger for firms using the CSBFP compared to those that do not?*

This paper is organized as follows: section 2 presents previous research findings on the impact assessment of financing programs; section 3 is dedicated to the data and descriptive analysis; section 4 introduces the methodology of the robust regression and logistic regression used, along with control variables in the regressions; section 5 interprets the empirical results generated from the robust regression and logistic regression; and section 6 presents key findings.

## 2. Theory and previous evidence

The CSBFP's mandate is to facilitate incremental funding to small businesses, but must ensure that there are significant positive economic impacts from this market intervention. Previous research, which is highlighted below, sought to assess the impact of financing programs from both macro and micro perspectives.

## 2.1 Macro perspective

Levitsky (1997) argued that commercial banks were generally reluctant to provide loans to SMEs because SMEs usually lack the necessary accounting records and collateral information. As a result, potentially profitable projects that did not meet selection conditions for loans may be unable to obtain financing. An SME loan guarantee scheme can help to overcome information asymmetries by minimizing the selection bias and enhancing SMEs' accessibility to loans.

Craig, Jackson and Thomson (2007a, 2007b) used both macro and micro approaches to look at the regional impact of participation in a guarantee program. The first paper analyzed the impact of the number of Small Business Administration (SBA) loans on the growth of regional per capita income, while the second study used the same method to examine the impact of the same variable on the average annual level of employment. In both cases, the authors concluded that the number of SBA loans was positively correlated to higher per capita income and higher employment. It was, however, impossible to say whether the SBA loans spurred economic development or whether the economic development increased the demand for SBA loans.

## 2.2 Micro perspective

The micro approach avoids the problem of conflicting causality. Larraín and Quiroz (2006) examined 700 firms in Chile which received funds through a credit guarantee fund managed by the commercial banks. Their findings indicated that the fund achieved economic additionality, referring to the extra loans that would not have come about without a credit guarantee scheme. On average, firms' sales increased by 32 percent and profits by 24 percent five years after benefitting from the fund. Bradshaw (2002) compared the employment and economic activity of 759 firms which used the California State Loan Guarantee Program before and after the loan. The program was estimated to be responsible for economic growth of 50 percent. The Korea Technology Credit Guarantee Fund was also found to have had a positive effect on firms in terms of sales and productivity growth and, in particular, its funding that supported technology implementation contributed to a high survival probability (Kang and Heshmati 2008).

As mentioned in Chandler's study, the challenge of the micro approach which is not addressed in the previous literature is to overcome the selection bias. Businesses that apply for guarantees are different from other businesses because they are oriented towards growth. Approximately 70 percent of SMEs, so-called lifestyle businesses, do not seek growth (McMahon 2001). In that sense, if a program attracts high-growth SMEs, an economic impact study might be biased by comparing these high-growth SMEs with lifestyle businesses. Coleman (1999) shows that not considering this selection bias in impact studies of microfinance strongly overestimates the impacts of the program.

This self-selection bias arises in this study as well. If we estimate the CSBFP's impact by comparing merely between CSBFP participants and all CSBFP non-participants, the comparison will lead to an overestimation of the impacts of the CSBFP on SME growth as many CSBFP non-participants are lifestyle businesses with no growth intentions. Given this issue, this study uses the micro approach but explicitly addresses the issue of self-selection. Firstly, it compares program participants with three groups: denied borrowers among CSBFP non-participants, approved borrowers among CSBFP non-participants, and all CSBFP non-participants. This way, CSBFP participants can be compared with non-participants with similar growth intentions, therefore mitigating the bias caused by diverse growth intentions. Secondly, it includes a lag variable for each growth indicator to capture growth persistency for businesses that have already experienced growth in previous years.

# 3. Data and Descriptive Statistics

## 3.1 Data

The majority of variables used in this study come from the *Survey on Financing of Small and Medium Enterprises* (SFSME) 2007 linked by Statistics Canada with other variables drawn from the Business Register (BR), Longitudinal Employment Analysis Program (LEAP), General Index of Financial Information (GIFI) and Exporter Register (ER).

**SFSME 2007**

Conducted by Statistics Canada, this survey collected "demand-side" information on SME financing activities to determine the types of financing that SMEs are using and on recent attempts by those SMEs to obtain new financing. In addition, information on firm profiles and demographic characteristics of SME ownership were also collected. The 2007 SFSME sample has a total of 15,799 SME respondents and includes incorporated and unincorporated enterprises.

The performance measures in this study were calculated using the data from linked tax files. Compared to unincorporated SMEs, the data information for incorporated firms were considerably richer in the tax files and posed fewer complications with regard to the interpretation of the results. Considering that unincorporated businesses account for less than 10 percent of CSBFP borrowers, this study focused on incorporated SMEs exclusively. Excluding the unincorporated SMEs reduced the sample size for this analysis (Table 1). In addition, more than half of the incorporated SMEs in the sample cannot be matched with their tax data. As a result, the analysis was conducted using unweighted[2] data.

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2. Due to a significant (68 percent) reduction in the original sample population, the original set of weight would not be appropriate with this population subset.

**Table 1: Sample Size of CSBFP 2007**

|  | CSBFP participants | Non-CSBFP participants | Total |
|---|---|---|---|
| Total | 1,719 | 14,080 | 15,799 |
| Unincorporated | 304 | 4,196 | 4,500 |
| Incomplete records | 777 | 5,422 | 6,199 |
| Total usable records | 638 | 4,462 | 5,100 |

## *3.2 Descriptive Statistics*

Looking at incorporated SMEs in the sample, four groups of SMEs were identified in this study: CSBFP participants, denied borrowers (non-CSBFP SMEs that applied for debt financing but were declined), approved borrowers (non-CSBFP SMEs that applied for debt financing and were approved), and all non-CSBFP SMEs (the sum of denied and approved borrowers and businesses that did not seek debt financing). This section presents comparative statistics of the variables use in the analysis for these four groups (Table 2). This descriptive analysis does not take into account factors such as size, business age, or industry, as these explanatory factors are considered in Section 5. Issues related to sampling are detailed in Appendix B.

Between 2007 and 2009, CSBFP participants consistently outperformed non-participants for all growth indicators except profit. Most growth rates of CSBFP participants are significantly higher than the three comparison groups in CSBFP non-participants, with the largest growth gaps in the indicators of revenue (6.41 percent), salary (5.89 percent), capital (13.75 percent), and employment (0.32 percent). Denied borrowers, who had no external financing to rely on, are the most adversely affected by the depressed economy of this period as indicated by the negative growth in most firm indicators except for labour productivity and capital assets.

The analysis reveals that firms participating in the CSBFP, when compared with non-participants, tend to be younger (13 years of age for CSBFP participants versus 19 for non-participants), smaller (12 full-time employees for participants versus 36 for non-participants), and less likely to export (11 percent compared to 23 percent). Owners of SMEs who use the CSBFP are also more likely to be younger (average age of 45 years old for participants compared to 52 years old for non-participants) and are less likely to have a minority background. When compared with the distribution of all Canadian SMEs by industry, CSBFP users are significantly under-represented in primary sectors and professional services, while over-represented in the accommodation and food sector. Both CSBFP participants and non-participants spent 29 percent of total investments in research and development (R&D).

Lastly, positive growth of labour productivity is observed for CSBFP participants (6.55 percent), as revenue growth outpaced employment growth between 2007 and 2009. The rise in labour productivity implies that the efficiency of production processes increased for the CSBFP participants. This is in line with the counter-cyclical pattern of labour productivity identified by Mulligan[3] (2011) in the United States (U.S.) regarding the 2008-09 recession.

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3. In the Mulligan study, labour productivity was measured by the ratio of production to hours worked as opposed to the ratio of revenue to employment used in this study, but the definitions are considered comparable given that employment in this study was counted as full-time equivalent employment.

In other words, CSBFP participants tended to produce more with less labour. By comparison, labour productivity declined amongst CSBFP non-participants (-4.91 percent), because the contraction in revenue exceeded the drop in employment between 2007 and 2009.

**Table 2: Comparison of CSBFP participants and non-participants**

| Parameters | | CSBFP non-participants | | | (IV) CSBFP participants (N = 638) | Significant difference at the 10% level between column (I) and (IV) |
|---|---|---|---|---|---|---|
| | | (I) All SMEs (N = 4,462) | (II) Denied (N = 22) | (III) Approved (N = 869) | | |
| Growth Rates 2007-2009 | Number of employees | -5.54% | n/a | -5.67% | 0.32% | Yes |
| | Salaries | -5.83% | n/a | -4.98% | 5.89% | Yes |
| | Revenues | -7.53% | n/a | -6.08% | 6.41% | Yes |
| | Profit | 155.97% | n/a | 190.49% | 94.61% | Yes |
| | Capital | 8.05% | 7.11% | 8.21% | 13.75% | Yes |
| | Value-added | -8.88% | -40.48% | -34.34% | 11.44% | n/a |
| | Labour Productivity | -4.91% | 3.08% | -0.81% | 6.55% | n/a |
| Business Characteristics | Age of SME | 19 | 15 | 21 | 13 | Yes |
| | Size (Full-time equivalent) | 36 | 12 | 53 | 12 | Yes |
| | Investment in R&D (Binary) | 29.13% | n/a | 32.45% | 28.84% | Yes |
| | Exporter (Binary) | 22.90% | n/a | 29.34% | 11.29% | Yes |
| | Urban | 79.22% | n/a | 73.99% | 67.08% | Yes |
| | Return on asset | 11.35% | 6.60% | 8.66% | 10.37% | n/a |
| | Financial leverage | 0.80 | 1.26 | 0.75 | 0.86 | n/a |
| Owner Characteristics | Age of Owner | 52 | 47 | 52 | 45 | Yes |
| | Minority (Binary) | 10.80% | n/a | 6.44% | 5.17% | Yes |
| | Family (Binary) | 63.07% | n/a | 58.34% | 59.87% | Yes |
| Economic Sectors | Primary Sector | 10.35% | n/a | 14.27% | n/a | Yes |
| | Manufacturing | 13.00% | n/a | 13.81% | 10.66% | Yes |
| | Wholesale and Retail Trade | 18.20% | n/a | 15.30% | 19.59% | Yes |
| | Professional Services | 11.59% | n/a | 8.86% | 5.02% | Yes |
| | Knowledge-Based | 13.13% | n/a | 11.51% | 4.23% | Yes |
| | Accommodation and Food | 8.92% | n/a | 5.29% | 11.13% | Yes |
| | Others | 24.81% | n/a | 30.95% | 47.96% | Yes |
| Growth Intention | | 59.31% | 71.62% | 57.63% | 66.94% | Yes |

Note: "n/a" indicates that the data cannot be released by Statistics Canada due to confidentiality reasons.

## 4. Methodology

Similar to Chandler (2010), robust regressions are used to assess the economic impact of the program by quantifying the growth of key indicators to evaluate the performance of firms which used the CSBFP. In addition, logistic regressions were conducted to estimate the probability that CSBFP participation would increase the odds of firm survival and the likelihood of investing in R&D. A non-parametric matching technique is newly added to identify an unbiased counterpart to CSBFP participants amongst CSBFP non-participants. Using this method, the impact of the CSBFP identified by comparing two matching groups will consolidate findings from the robust regression as well as the logistic regression.

## *4.1 Robust Regression*

A series of robust regressions were conducted to measure the impact of CSBFP participation on firm growth indicators. These growth indicators—in addition to revenues, number of employees, total salary, and profit used in the analysis by Chandler—were expanded to include tangible capital assets, labour productivity, and value-added to output. Serving as dependent variables in the robust regressions, the growth indicators were measured over a three-year period, starting in 2007, to allow for a reasonable time for growth while minimizing survivorship bias[4] in the results.

Seeking to investigate how CSBFP participation affects the growth of SMEs in Canada as a whole, the study considers the key independent variable, CSBFP participation, as a dummy variable, with one representing CSBFP participants and zero representing non-participants. To better control for endogeneity and collinearity the independent variables in the robust regression models have been modified from the original models defined in Chandler. Given that our central object of statistical inference is to estimate one key parameter, impact of the CSBFP, the reduced form modelling approach has been adopted in this study. This eliminates the strong joint dependence between the CSBFP and other endogenous variables. As a result, the robust regression model in this study removes the bias of growth intention in Chandler's model, and includes regional variables to account for regional differences in terms of economic activities, industrial structure and access to financing.

## *4.2 Logistic Regression*

To better understand the impact of the CSBFP on firm viability and R&D investment, two binary logistic regression models were built. The first measures the degree to which CSBFP participation affects the odds of SMEs' survival. In this regression, the dependent variable indicating a viable SME equalled one when the firm existed in the year 2009 and zero for those SMEs which were no longer in business. The second measures the involvement of R&D. In this regression, the dependent variable is one when the firm had R&D investment, and zero if it does not. The logistic regression methodology is explained in more detail in Appendix C.

The estimates of coefficients listed in Appendix C do not measure the changes in the probability of a firm being a viable firm due to a unit change in the explanatory variables. This probability change is given by the partial derivative of the expression for prob($y$=1) with respect to $x_i$, which is not equal to $\beta_i$. For the logistic regression, this expression is $\beta_i\,[\text{prob}(y{=}1)]\,[1{-}\text{prob}(y{=}1)] = \beta_i\,e^{X\beta}\,(1 + e^{X\beta})^{-2}$. Therefore, only the odds ratios[5] are discussed in this paper.

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4. The existing survivorship bias is due to the fact that the failed SMEs over the three-year period (2007-2009) were excluded from the robust regression and this might inflate the estimated growth of observed indicators.

5. An odds ratio is a measure of association between an explanatory variable and an outcome. In the logistic regression, the odds ratio represents a percentage change of a dependent variable by changing one unit in the value of an independent variable when holding other independent variables unchanged.

To summarize, a robust regression model approach is used to assess the impact of CSBFP participation on growth variables (revenue, salary, profit, employment, labour productivity, capital assets and value-added to output) whereas the logistic regression approach is used to test the impact of CSBFP participation on firm viability and R&D investment.

The choice of other explanatory variables for both the robust and logistic regressions was determined by the literature review and the preliminary empirical studies, and is explained below.

*Firm size:* As noted earlier, firm size plays a significant role in determining firm growth. A negative relation between firm growth and firm size was found in work from Tschoegl (1983), Mata (1994), Dunne et al. (1989), Evans (1987) and Hall (1987). In the robust regression, the number of full-time equivalent employees is used as a measurement of firm size. In the logistic regression, the logarithmic form of firm size is used as a control variable.

*Firm Age:* Empirical work has revealed a relationship between firm age and growth (Dunne and Hughes 1994, Evans 1987, Hall 1987, and Audretsch et al. 2004), as well as a relationship between firm age and R&D (Müller and Zimmermann 2009 and Brown et al. 2009). However, firm age did not show any impact on the survival of firms in the preliminary test of the logistic model, and therefore is eliminated from the regression. In the robust regression, the study uses the year that the business started to sell goods/services as a proxy to calculate the age of the business as of 2007.

*Industry dummies:* Empirical work has found that firm performance differs significantly by industry (Dunne and Hughes 1994, and Audretsch et al. 2004). In this study, North American Industy Classification System codes are used to group businesses into five different industry categories for both the robust and logistic regressions, enabling the author to isolate industry differences.

*Regions and urban/rural dummy variables:* Geographic characteristics affect firm growth (Audretsch and Dohse 2004, Almus and Nerlinger 1999), there are significant urban/rural effects on firm viability (Liedholm 2002, Hansen et al. 2004) and also on investment in R&D (Okamuro 2005, Almus and Nerlinger 1999). In the robust regression, the dummy variable is one if the firm is located in an urban area, and zero if it is a rural area.

*Exporter, access to foreign markets:* Firms with high propensities to export show continuously higher growth rates when compared to non-exporting firms (Schimke and Brenner 2011). A number of studies have also found that exports have a positive impact on firm viability and investment in R&D (Falvey et al. 2004, and Cohen and Levinthal 1989). The dummy variable is one if the firm exports, and zero if it does not.

*Research & Development (R&D):* Literature suggests that firms which make R&D investments significantly boost their chances of survival and growth (Cefis and Marsili 2006, Baldwin 1995). The Baldwin study also found that firm success is directly related to the amount of R&D investment it makes, and firms which previously invested in R&D were more likely to invest in R&D again. The dummy variable is one if the firm invests in R&D, and zero if it does not.

***Financial Leverage (FL):*** Barber et al. (1989) summarize the literature on the barriers to growth in SMEs, and suggest that financial constraints or pressures are one of the most important barriers to growth. According to several studies (Himmelberg and Petersen 1994, Baldwin et al. 2002, Hall 2005, Freel 2007, Müller and Zimmermann 2009), SMEs with R&D investments are particularly dependent on internal financial conditions such as debt condition. As an indicator of short-term debt, financial leverage is defined as the ratio between firm debt and assets, and is adopted as a control variable in both the robust and logistic regressions.

***Return on Assets (ROA):*** A study by Jovanovic (1982) asserts that new firms enter the market small and, depending on their profitability, decide to expand, contract or exit. A study by Carpenter and Petersen (2002) examined a sample of small firms and found that the growth and survival of small firms is constrained by internal financial profitability. For this study, a firm's profitability was calculated by comparing assets involved in production. This measurement defines net income as a percentage of total assets, or a return on assets. The return on assets is used as a control variable in both the robust and logistic regressions.

***Owner's characteristics:*** In a study by Storey (1994), the characteristics of a firm's owner are considered as one of the three key influences on the growth and survival of an SME. To determine the specific effects of an owner's characteristics on a business, this study incorporates the owner's age, minority status, and family involvement to investigate their impact on firm growth, viability and investment in R&D.

## 4.3 Non-parametric Matching

In the framework inherited from Chandler (2010), a key concern was whether robust regressions and logistic regressions provided unbiased estimates of CSBFP impacts. Due to missing data issues (Appendix B) related to the design of regressions, using a regression-dependent approach to adjust for imbalances in the baseline control variables (X) can be problematic (Rosenbaum and Rubin 1983). This is due to the fact that estimates can be very sensitive to the specification of control variables and parametric assumptions, especially if the balance of baseline control variables is distorted due to the loss of data.

As such, to verify the results from a regression-based approach, a non-parametric approach (Bérubé and Mohnen 2009) is developed in this study. This alternative approach attempts to estimate the causal effect of SME performance relative to a treatment condition—CSBFP participation.

Two groups of SMEs were selected from the SFSME 2007 data based on the matching process detailed in Appendix D. The goal was to match a counterpart (CSBFP=0) to a treated group (CSBFP=1) without losing too many observations. First, the relationship between treatment variables (T) and outcome variables (Y)[6] must be eliminated or reduced. By breaking and reducing the link between treatment variables and outcome variables,

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6. In this paper, the outcomes (Y) refer to dependent variables used in the robust regressions and logistic regressions. These dependent variables are SME growth indicators (revenue, number of employees, salary, capital, value-added, profit, and labour productivity) and investment in R&D.

matching makes estimates based on the subsequent parametric analyses far less dependent on modelling choices and specifications. In addition, two key assumptions should be held for an effective matching in this study:

(i) Independence assumption: the distribution of outcome variables (Y) of counterfactual non-participants is independent of CSBFP participation (T), conditional on control variables (X), and

(ii) Overlap assumption: there must be an overlap of control variables between those that received CSBFP loans and those that did not (Heckman, Ichimura and Todd 1998).

Effective matching[7] improves the balance between treated and untreated groups, thereby reducing the potential for bias and variance of estimated causal effects, and as a result lower mean squared error (Austin 2007).

# 5. Model Results

## *5.1 Growth Variables*

Significantly positive and consistent impacts of the CSBFP were identified on the growth of revenue, salary, profit, and value-added to output in all three scenarios. No significant impacts of the CSBFP were found on the growth of employment and capital assets.

### *CSBFP impact on the growth of revenue, salary, profit and value-added to output*

For the three comparison groups, CSBFP participation resulted in higher levels of growth. CSBFP borrowers had higher growth in revenue (12 percent), in salary (6 percent), in profit (14 percent), and in value-added to output (15 percent) when compared with denied SME borrowers. More strikingly, CSBFP borrowers recorded higher levels of growth in revenue (7 percent), in salary (4 percent), in profit (8 percent), and in value-added to output (8 percent) even when compared with SMEs who received financing through sources other than the CSBFP. This significant and positive impact again proves that access to the benefits offered by the CSBFP allows borrowers under the program to perform significantly better than other equally risky businesses (Appendix Tables A1, A2, A3 and A4).

The stability in CSBFP estimated coefficients among the three examined groups suggests that the impact of the model is similar whether participants are compared to all SMEs, to denied borrowers, or to accepted borrowers. This means that the self-selection problem was successfully addressed.

### *Growth in labour productivity*

A significant positive impact caused by the CSBFP was found for SMEs and approved borrowers but not for denied borrowers (Appendix Table A5). Labour productivity increased by 7 percent for all SMEs and by 5 percent

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7. The matching assumptions imply that average differences in outcomes (Y) between the treated group and the untreated group, with the same values for baseline control variables, are attributable to the treatment (CSBFP participation). The vector of control variables (X) in the non-parametric analysis is in line with independent variables used in the regression-based model except for the CSBFP flag because CSBFP participation becomes the treatment (T) effect in the non-parametric approach. Given that the treatment, CSBFP participation, satisfies weak forms of exogeneity and overlap assumptions, after matches are made, the average impact of the CSBFP can be calculated by comparing the means of outcomes (Y) across participants and their matches.

for the approved borrowers as a result of CSBFP participation. As discussed in the descriptive statistics section, the growth of labour productivity spiked during the 2008-09 recession for both CSBFP participants and denied borrowers. As such it is not clear if this finding regarding the impact of the CSBFP on the growth of labour productivity is independent of this overarching effect.

### *Growth in employment and capital assets*

The analysis indicated growth in employment and capital assets for all three groups is most likely the result of the economic cycle (Appendix Tables A6 and A7).

The recession in 2008-09 was characterized by a sharp drop in employment and international trade. The Canadian economy lost more than 400,000 jobs during this recession, most at the beginning of this period (Statistics Canada 2009). This drop overshadowed any possible positive impact due to CSBFP participation.

There was no evidence that the CSBFP had a significant impact on the growth of capital assets from 2007 to 2009. This is not surprising given the economic confidence of the period. Research undertaken by Forbs (2010) confirms that SMEs are more likely to rely on their cash reserves to weather recessions and finance their future growth. This tendency may have contributed to a trend of "excess liquidity" among Canadian SMEs as identified by Seens (2013).

Lastly, a Multivariate Analysis of Covariance (MANCOVA[8]) was implemented, and shows that the CSBFP consistently played a positive role in growth in salary when CSBFP participants are compared with all borrowers, denied borrowers, and approved borrowers.

**Table 3: MANCOVA results (p results of CSBFP) explaining growth rates between 2007 and 2009**

| Dependent variables | Comparison groups | | |
|---|---|---|---|
| | All SMEs (N=5,100) | Denied borrowers (N=660) | Approved borrowers (N=1,507) |
| Salary, revenue and profit | <0.0001 | 0.0085 | <0.0001 |
| Salary and revenue | <0.0001 | 0.0115 | <0.0001 |
| Salary | 0.0015 | 0.0039 | 0.0120 |

Note: The MANCOVA model includes the following variables: CSBFP participation, age of SME, employment, return on assets and financial leverage.

## *5.2 Differences between CSBFP Participants and Denied Borrowers*

To quantify the impact of participation in the CSBFP, another series of robust regressions was conducted on the absolute difference of the indicators for the period 2007 to 2009.

When comparing CSBFP participants with denied borrowers over the period between 2007 and 2009, CSBFP participants recorded a significant absolute increase in revenue, salary, profit, and value-added to output, but no significant absolute increase in employment, capital assets and labour productivity (Appendix Table A8).

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8. MANCOVA is a measure used to test the main and interaction effects of independent variables on multiple dependent interval variables. It examines the difference between two or more groups in terms of their impacts on multiple dependent variables.

The impact of CSBFP participation is estimated to have increased revenues by almost $102,000, salaries by approximately $23,000, profit by $49,000, and value-added by roughly $53,000. These estimations are in line with the results from the regressions on growth rates.

## 5.3 R&D Involvement

Binary logistic regression analysis was used to examine the probability of SMEs investing in R&D in 2008, after being granted a CSBFP loan in 2007. The models were run by controlling for the CSBFP variable, firm size, firm age, owner characteristics, return on asset, financial leverage, and industry (Appendix Table A9).

CSBFP participation showed a consistent, positive impact on the probability that a firm invests in R&D in all three scenarios. In the model specification, the probability ratios indicated the likelihood of a firm investing in R&D is doubled when program users are compared with all CSBFP non-participants, and is increased by 88 percent when compared with non-CSBFP approved borrowers.

## 5.4 Economic Impact Using Non-parametric Matching

To estimate the average effect of CSBFP participation on the economic performance of SMEs and their investments in R&D, this paper distinguishes two groups of firms, those receiving CSBFP loans (CSBFP=1) and those not participating in the CSBFP (CSBFP=0). As a total of 638 samples of CSBFP participants were used in the robust regressions, an equivalent sample group was found in the 4,462 non-CSBFP participants. Appendix Tables A11 and A12 present the relevant firm characteristics (control variables or independent variables) and outcome variables before and after matching. The significance levels of diversity between the two groups were examined using a t-test on mean difference for continuous variables, and by a chi-square test of independence for categorical variables.

Before matching (Appendix Table A11), our two group samples showed significant differences for the majority of baseline covariates as indicated by p-values lower than 0.05. After using the non-parametric matching methodology, in which we succeeded in matching 634 out of 638 CSBFP firms, the statistical difference disappeared between the matched groups.

The mean and proportions of all the control variables showed no statistically significant differences. This indicates that the matched groups can be compared and the differences in the outcome variables will not be the result of observable differences between firm characteristics. The difference between these two groups is only attributed to the impact of receiving the treatment, participation in the CSBFP.

The comparison between the matched and the CSBFP groups shows that the outcome variables, such as revenue, salary, labour productivity and investment in R&D, are all significantly different between these two groups (Appendix Table A12). No significant impact of the CSBFP was found on employment and capital.[9] These findings are consistent with the positive impacts of the CSBFP identified in the robust regressions and logistic regression.

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9. This is because the p-values of difference tests on employment and capital between two matching groups are over 0.05 (Appendix Table A12).

## 5.5 Impact of the CSBFP on the Viability of Firms

The logistic regression was used to determine the viability of firms that survived in 2009, after being granted a CSBFP loan in 2007. No significant impact of CSBFP participation on firm viability was identified (Appendix Table A10).

# 6. Key Findings

This analysis set out to answer a series of research questions regarding the impact of CSBFP participation for the period 2007 to 2009.

1)  Does CSBFP participation lead to growth in revenue, employment, profits, salary, capital, value-added to output and labour productivity?

    CSBFP participation continues to have a positive impact on the growth of SMEs, increasing revenues by 12 percent, salaries by 6 percent, profit by 14 percent, and value-added by 15 percent. Despite the 2008-09 economic downturn, CSBFP participants are shown to be consistently better off than those financed by other sources or not financed at all.

    The impact of the CSBFP estimated by both non-parametric matching and parametric-based regression is summarized in Table 4.

**Table 4: Summary of CSBFP Impacts Tested from Parametric-Based Regression (Robust Regression) and Non-parametric Matching Models**

| | Significant Impact from the CSBFP | | | |
| | All SMEs vs CSBFP | | Denied vs CSBFP | Approved vs CSBFP |
| Variables | Non-parametric Matching | Parametric-Based Regressions | Parametric-Based Regressions | Parametric-Based Regressions |
|---|---|---|---|---|
| Revenue Growth | Yes | Yes | Yes | Yes |
| Salary Growth | Yes | Yes | Yes | Yes |
| Employment Growth | No | No | No | No |
| Labour Productivity Growth | Yes | Yes | No | Yes |
| Profit Growth | Yes | No | Yes | Yes |
| Value-added Growth | Yes | No | Yes | Yes |
| Capital Growth | No | No | No | No |
| Investment in R&D | Yes | Yes | Yes | Yes |

Note: Non-parametric matching is applicable only with all SMEs.

2)  What is the actual growth generated by CSBFP participation in terms of growth in revenue, employment, profits, salary, capital, value-added to output and labour productivity?

    CSBFP participation is estimated to have increased revenues by almost $102,000, salaries by $23,000, profit by $49,000, and value-added by $53,000. No significant impact on other variables was found.

3) Do CSBFP borrowers continue to invest in new capital assets? Do they become more productive?

CSBFP borrowers continued to invest in new capital assets between 2007 and 2009. This is evidenced by the average growth of 14 percent identified in capital assets amongst CSBFP borrowers. However, this growth in capital assets is three times lower than growth observed between 2005 and 2007. This is consistent with the hypothesis that SMEs tend to accumulate more cash during periods of economic uncertainty rather than invest more in capital assets. There is no evidence to suggest that the CSBFP had a significant impact on the growth of capital assets during 2007-09. More investigation is needed on this issue.

Positive growth of labour productivity was observed for SMEs during the 2008-09 period. However there is no evidence to suggest that CSBFP participation contributed to that growth.

4) Does the CSBFP support firm viability (i.e., firms that survive)?

There is no evidence to show that CSBFP participation has an impact on firm viability.

5) Do CSBFP borrowers invest more in R&D?

CSBFP users are more likely to invest in R&D as they were found to be twice as likely to invest in R&D when compared with all SMEs, and 88 percent more likely to invest when compared with non-CSBFP approved borrowers.

6) Is economic performance stronger for firms using the CSBFP compared to those that do not?

When looking at absolute growth differences, SMEs that received a CSBFP loan significantly outperformed non-participants for all growth indicators between 2007 and 2009. CSBFP participants grew substantially faster than non-participants, with the largest growth rate difference for the indicators of profit (26 percent), value-added (20 percent), revenue (14 percent) and salary (12 percent). However, as indicated in the analysis and response to question 1, not all of this growth can be attributed to participation in the CSBFP.

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## Appendix A: Regression output tables

### Table A1: Impact of the CSBFP on revenue growth between 2007 and 2009

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Intercept | 0.19*** | 0.00 | 0.31 | -0.12*** | 0.22** | 0.02* |
| | (0.01) | (0.82) | (0.18) | (0.05) | (0.01) | (0.11) |
| CSBFP participation (Binary) | 0.09*** | 0.17*** | 0.12** | 0.28*** | 0.07*** | 0.15*** |
| | (0.00) | (0.00) | (0.07) | (0.00) | (0.00) | (0.00) |
| Lag growth (2005-2006) | 0.07*** | | 0.08** | | 0.07*** | |
| | (0.00) | | (0.02) | | (0.00) | |
| Size of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.62) | | (0.85) | | (0.43) | |
| Age of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.26) | | (0.63) | | (0.31) | |
| Exporter (Binary) | -0.02 | | -0.04 | | -0.02 | |
| | (0.43) | | (0.42) | | (0.46) | |
| Investment in R&D | 0.06*** | | 0.08*** | | 0.08*** | |
| | (0.00) | | (0.01) | | (0.00) | |
| Minority | -0.02 | | -0.09* | | -0.03 | |
| | (0.58) | | (0.12) | | (0.36) | |
| Family | -0.02 | | -0.03 | | -0.03** | |
| | (0.29) | | (0.34) | | (0.09) | |
| Age of Owner | -0.0022*** | | -0.0051*** | | -0.0024*** | |
| | (0.01) | | (0.00) | | (0.01) | |
| Return on Asset | -0.03 | | -0.03 | | -0.09*** | |
| | (0.28) | | (0.37) | | (0.00) | |
| Financial Leverage | 0.02*** | | 0.02*** | | 0.04*** | |
| | (0.03) | | (0.03) | | (0.00) | |
| Urban | 0.02 | | 0.03 | | 0.01 | |
| | (0.43) | | (0.34) | | (0.51) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.034 | 0.014 | 0.056 | 0.008 | 0.046 | 0.014 |
| Percentage of Outliers | 8.54% | 9.56% | 9.22% | 8.87% | 7.97% | 9.46% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

## Table A2: Impact of the CSBFP on salary growth between 2007 and 2009

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Intercept | 0.14** | 0.03*** | 0.32 | -0.19*** | 0.13** | 0.05*** |
| | (0.06) | (0.00) | (0.19) | (0.01) | (0.09) | (0.00) |
| CSBFP participation (Binary) | 0.06*** | 0.15*** | 0.06*** | 0.35*** | 0.04*** | 0.11*** |
| | (0.01) | (0.00) | (0.00) | (0.00) | (0.05) | (0.00) |
| Lag growth (2005-2006) | 0.10*** | | 0.04 | | 0.07*** | |
| | (0.00) | | (0.23) | | (0.00) | |
| Size of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.40) | | (0.38) | | (0.56) | |
| Age of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.93) | | (0.99) | | (0.98) | |
| Exporter (Binary) | -0.01 | | -0.02 | | -0.01 | |
| | (0.82) | | (0.72) | | (0.63) | |
| Investment in R&D | 0.02 | | 0.05* | | 0.03** | |
| | (0.40) | | (0.13) | | (0.10) | |
| Minority | -0.01 | | 0.01 | | -0.03 | |
| | (0.88) | | (0.84) | | (0.49) | |
| Family | -0.03** | | -0.01 | | -0.04*** | |
| | (0.09) | | (0.85) | | (0.05) | |
| Age of Owner | 0.00 | | -0.0033*** | | 0.00 | |
| | (0.55) | | (0.04) | | (0.54) | |
| Return on Asset | 0.00 | | -0.09* | | -0.02 | |
| | (0.98) | | (0.15) | | (0.57) | |
| Financial Leverage | -0.01 | | -0.04 | | -0.02 | |
| | (0.56) | | (0.20) | | (0.39) | |
| Urban | 0.02 | | 0.02 | | 0.02 | |
| | (0.24) | | (0.54) | | (0.36) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.0341 | 0.0133 | 0.0518 | 0.0132 | 0.0350 | 0.0103 |
| Percentage of Outliers | 6.70% | 7.30% | 6.16% | 5.35% | 6.72% | 7.23% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

## Table A3: Impact of the CSBFP on profit growth between 2007 and 2009

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** | **V** | **VI** |
| Intercept | 0.19*** | -0.03*** | 0.26 | -0.16*** | 0.22*** | -0.02 |
| | (0.04) | (0.04) | (0.39) | (0.03) | (0.04) | (0.30) |
| CSBFP participation (Binary) | 0.08*** | 0.18*** | 0.14* | 0.32*** | 0.08*** | 0.17*** |
| | (0.01) | (0.00) | (0.12) | (0.00) | (0.01) | (0.00) |
| Lag growth (2005-2006) | 0.00 | | 0.06** | | 0.00 | |
| | (0.44) | | (0.06) | | (0.67) | |
| Size of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.52) | | (0.46) | | (0.25) | |
| Age of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.23) | | (0.50) | | (0.80) | |
| Exporter (Binary) | 0.01 | | -0.01 | | 0.03 | |
| | (0.66) | | (0.90) | | (0.42) | |
| Investment in R&D | 0.06*** | | 0.05 | | 0.07*** | |
| | (0.01) | | (0.25) | | (0.01) | |
| Minority | -0.03 | | -0.10 | | -0.01 | |
| | (0.47) | | (0.19) | | (0.79) | |
| Family | -0.04** | | 0.00 | | -0.05*** | |
| | (0.06) | | (0.96) | | (0.02) | |
| Age of Owner | -0.0031*** | | -0.01*** | | -0.0026*** | |
| | (0.00) | | (0.01) | | (0.04) | |
| Return on Asset | -0.01 | | -0.03 | | -0.04 | |
| | (0.81) | | (0.51) | | (0.25) | |
| Financial Leverage | 0.03*** | | 0.02 | | 0.02*** | |
| | (0.03) | | (0.18) | | (0.05) | |
| Urban | 0.01 | | 0.03 | | 0.03 | |
| | (0.63) | | (0.38) | | (0.30) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.0251 | 0.0109 | 0.0410 | 0.0074 | 0.0347 | 0.0114 |
| Percentage of Outliers | 10.10% | 11.02% | 8.47% | 8.24% | 9.38% | 10.29% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

**Table A4: Impact of the CSBFP on value-added growth between 2007 and 2009**

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Intercept | 0.20*** | -0.02** | 0.22 | -0.148*** | 0.20*** | -0.02 |
| | (0.03) | (0.09) | (0.46) | (0.05) | (0.05) | (0.33) |
| CSBFP participation (Binary) | 0.08*** | 0.18*** | 0.15** | 0.30*** | 0.08*** | 0.17*** |
| | (0.01) | (0.00) | (0.10) | (0.00) | (0.01) | (0.00) |
| Lag growth (2005-2006) | 0.02 | | 0.03 | | 0.02 | |
| | (0.26) | | (0.39) | | (0.39) | |
| Size of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.61) | | (0.47) | | (0.60) | |
| Age of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.16) | | (0.42) | | (0.62) | |
| Exporter (Binary) | 0.01 | | 0.00 | | 0.03 | |
| | (0.63) | | (0.99) | | (0.45) | |
| Investment in R&D | 0.05*** | | 0.03 | | 0.07*** | |
| | (0.03) | | (0.40) | | (0.01) | |
| Minority | -0.03 | | -0.09 | | -0.01 | |
| | (0.53) | | (0.21) | | (0.77) | |
| Family | -0.04* | | 0.00 | | -0.05*** | |
| | (0.11) | | (0.96) | | (0.03) | |
| Age of Owner | -0.0031*** | | -0.0045*** | | -0.0024*** | |
| | (0.00) | | (0.02) | | (0.05) | |
| Return on Asset | 0.01 | | -0.03 | | -0.03 | |
| | (0.85) | | (0.59) | | (0.48) | |
| Financial Leverage | 0.03** | | 0.02 | | 0.02 | |
| | (0.07) | | (0.26) | | (0.16) | |
| Urban | 0.0191 | | 0.028 | | 0.0394 | |
| | (0.45) | | (0.47) | | (0.16) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.0272 | 0.0125 | 0.0407 | 0.0076 | 0.0374 | 0.0134 |
| Percentage of Outliers | 9.41% | 9.00% | 7.81% | 5.98% | 9.10% | 8.10% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

**Table A5: Impact of the CSBFP on labour productivity growth between 2007 and 2009**

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Intercept | 0.01 | 0.00 | 0.04 | 0.06*** | 0.08 | 0.01 |
| | (0.83) | (0.79) | (0.86) | (0.03) | (0.31) | (0.36) |
| CSBFP participation (Binary) | 0.07*** | 0.07*** | 0.07 | 0.41 | 0.05*** | 0.07*** |
| | (0.00) | (0.00) | (0.35) | (0.69) | (0.01) | (0.00) |
| Lag growth (2005-2006) | 0.02 | | -0.09*** | | 0.02 | |
| | (0.43) | | (0.01) | | (0.46) | |
| Size of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.45) | | (0.72) | | (0.33) | |
| Age of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.35) | | (0.61) | | (0.64) | |
| Exporter (Binary) | 0.00 | | -0.08** | | 0.00 | |
| | (0.85) | | (0.07) | | (0.99) | |
| Investment in R&D | 0.04*** | | 0.07*** | | 0.06*** | |
| | (0.02) | | (0.03) | | (0.00) | |
| Minority | -0.03 | | 0.00 | | -0.01 | |
| | (0.30) | | (0.98) | | (0.85) | |
| Family | 0.02 | | 0.00 | | 0.01 | |
| | (0.28) | | (0.96) | | (0.49) | |
| Age of Owner | -0.0011* | | -0.0038*** | | -0.0024*** | |
| | (0.15) | | (0.01) | | (0.01) | |
| Return on Asset | -0.07*** | | -0.04 | | -0.07** | |
| | (0.02) | | (0.53) | | (0.10) | |
| Financial Leverage | 0.03 | | 0.05** | | 0.04** | |
| | (0.18) | | (0.09) | | (0.09) | |
| Urban | 0.01 | | -0.01 | | 0.02 | |
| | (0.60) | | (0.78) | | (0.33) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.0173 | 0.0036 | 0.0426 | 0.0001 | 0.0226 | 0.0043 |
| Percentage of Outliers | 6.42% | 7.78% | 7.35% | 6.32% | 6.44% | 7.57% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

**Table A6: Impact of the CSBFP on employment growth between 2007 and 2009**

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Intercept | 0.14*** | -0.0002*** | 0.36* | -0.08** | 0.12** | 0.01*** |
| | (0.02) | (0.00) | (0.12) | (0.01) | (0.09) | (0.00) |
| CSBFP participation (Binary) | 0.01 | 0.09 | 0.03 | 0.16 | 0.01 | 0.07 |
| | (0.73) | (0.98) | (0.64) | (0.22) | (0.55) | (0.36) |
| Lag growth (2005-2006) | 0.09*** | | 0.03 | | 0.09*** | |
| | (0.00) | | (0.34) | | (0.00) | |
| Size of SME | -0.0003 | | 0.00 | | -0.0001** | |
| | (0.02) | | (0.36) | | (0.06) | |
| Age of SME | 0.00 | | 0.00 | | 0.00 | |
| | (0.49) | | (0.45) | | (0.88) | |
| Exporter (Binary) | 0.00 | | 0.01 | | 0.00 | |
| | (0.91) | | (0.77) | | (0.96) | |
| Investment in R&D | 0.02* | | 0.04 | | 0.02 | |
| | (0.13) | | (0.24) | | (0.18) | |
| Minority | 0.01 | | -0.03 | | -0.02 | |
| | (0.78) | | (0.63) | | (0.53) | |
| Family | -0.02* | | -0.02 | | -0.02 | |
| | (0.14) | | (0.42) | | (0.20) | |
| Age of Owner | 0.00 | | 0.00 | | 0.00 | |
| | (0.44) | | (0.27) | | (0.98) | |
| Return on Asset | 0.05*** | | 0.00 | | 0.04 | |
| | (0.05) | | (0.94) | | (0.31) | |
| Financial Leverage | -0.04*** | | -0.01 | | -0.04** | |
| | (0.02) | | (0.72) | | (0.07) | |
| Urban | 0.00 | | -0.01 | | -0.01 | |
| | (0.78) | | (0.71) | | (0.73) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.0271 | 0.0070 | 0.0263 | 0.0042 | 0.0249 | 0.0050 |
| Percentage of Outliers | 6.77% | 7.79% | 5.60% | 5.86% | 6.74% | 6.89% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

**Table A7: Impact of the CSBFP on capital asset growth between 2007 and 2009**

| Explanatory Variable | All SMEs | | Denied borrowers | | Approved borrowers | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Intercept | 0.22*** | 0.11*** | 0.46*** | 0.04** | 0.22*** | 0.01*** |
| | (0.00) | (0.00) | (0.01) | (0.10) | (0.00) | (0.00) |
| CSBFP participation (Binary) | 0.02 | 0.01 | 0.00 | 0.05** | 0.00 | -0.01* |
| | (0.16) | (0.20) | (0.99) | (0.08) | (0.90) | (0.12) |
| Lag growth (2005-2006) | 0.04*** | | 0.04*** | | 0.05*** | |
| | (0.00) | | (0.03) | | (0.00) | |
| Size of SME | 0.0002*** | | 0.00 | | 0.00 | |
| | (0.04) | | (0.22) | | (0.18) | |
| Age of SME | -0.0007*** | | 0.00 | | 0.00 | |
| | (0.01) | | (0.13) | | (0.16) | |
| Exporter (Binary) | -0.01 | | 0.00 | | -0.01 | |
| | (0.47) | | (0.98) | | (0.43) | |
| Investment in R&D | 0.00 | | 0.02 | | 0.02 | |
| | (0.97) | | (0.38) | | (0.19) | |
| Minority | -0.02 | | -0.07** | | -0.03 | |
| | (0.20) | | (0.06) | | (0.11) | |
| Family | -0.01 | | -0.01 | | -0.01 | |
| | (0.30) | | (0.64) | | (0.32) | |
| Age of Owner | 0.00 | | 0.00 | | 0.00 | |
| | (0.14) | | (0.29) | | (0.26) | |
| Return on Asset | -0.01 | | 0.06 | | -0.04*** | |
| | (0.47) | | (0.13) | | (0.03) | |
| Financial Leverage | 0.00 | | 0.02 | | 0.00 | |
| | (0.77) | | (0.31) | | (0.68) | |
| Urban | 0.00 | | -0.01 | | 0.00 | |
| | (0.86) | | (0.74) | | (0.75) | |
| Industry | Yes | No | Yes | No | Yes | No |
| Region | Yes | No | Yes | No | Yes | No |
| R² | 0.0149 | 0.0003 | 0.0401 | 0.0012 | 0.0161 | 0.0004 |
| Percentage of Outliers | 13.85% | 17.69% | 9.60% | 19.67% | 13.15% | 18.57% |
| N | 5,100 | 5,100 | 660 | 660 | 1,507 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent.

## Table A8: Impact of the CSBFP on indicators difference between 2007 and 2009

| Explanatory Variable | Revenue | Salary | Employment | Profit | Value-added | Capital Assets | Labour Productivity |
|---|---|---|---|---|---|---|---|
| Intercept | 411,881.4*** | 326,417.2*** | 5.68*** | -36,567.70 | -89,231.8 | 598,819.1*** | 16,324.99 |
| | (0.04) | (0.00) | (0.00) | (0.68) | (0.44) | (0.00) | (0.47) |
| CSBFP participation (Binary) | 101,920.8** | 23,169.67** | 0.47 | 48,551.78** | 53,247.74* | 147.73 | -2,062.56 |
| | (0.08) | (0.10) | (0.45) | (0.07) | (0.14) | (0.99) | (0.78) |
| Lag growth (2005-2006) | 0.01 | 0.17*** | 0.04*** | -0.08*** | -0.11*** | 0.03* | -0.11*** |
| | (0.57) | (0.00) | (0.02) | (0.00) | (0.00) | (0.11) | (0.00) |
| Size of SME | 2,614.07*** | 656.72*** | -0.09*** | n/a | 2,084.89*** | 1,062.53*** | -22.41 |
| | (0.00) | (0.00) | (0.00) | n/a | (0.00) | (0.00) | (0.79) |
| Age of SME | 322.17 | 169.49 | 0.00 | 36.89 | -363.438 | -80.98 | -75.31 |
| | (0.74) | (0.44) | (0.98) | (0.94) | (0.52) | (0.75) | (0.49) |
| Exporter (Binary) | -38,768.70 | 543.24 | 0.29 | -5,336.48 | -15,605.2 | 3,829.08 | -7,065.72* |
| | (0.31) | (0.95) | (0.44) | (0.78) | (0.50) | (0.71) | (0.11) |
| Investment in R&D | 57,777.67*** | 4,931.50 | 0.44** | 4,790.83 | -3,167.42 | 75.58 | 8,070.44*** |
| | (0.03) | (0.41) | (0.09) | (0.71) | (0.84) | (0.99) | (0.01) |
| Minority | -73,974.2* | 9,931.79 | 0.09 | -6,659.23 | -31,901.9 | -13,127.10 | -2,478.54 |
| | (0.12) | (0.37) | (0.86) | (0.75) | (0.25) | (0.31) | (0.67) |
| Family | -38,863.8* | -6,383.57 | n/a | -3,825.76 | -10,617.7 | 1,682.32 | -2,819.76 |
| | (0.11) | (0.24) | n/a | (0.75) | (0.45) | (0.79) | (0.31) |
| Age of Owner | -5,103.81*** | -536.12** | -0.01 | -1,633.8*** | -2,298*** | -140.27 | -438.19*** |
| | (0.00) | (0.06) | (0.61) | (0.01) | (0.00) | (0.68) | (0.00) |
| Return on Asset | 55,321.82** | 0.23 | -1.21*** | -3,834.68 | 2,777.428 | 16,640.23 | 6,858.76 |
| | (0.10) | (1.00) | (0.02) | (0.76) | (0.90) | (0.23) | (0.26) |
| Financial Leverage | -11,726.70 | -11,474*** | -0.84*** | -1,409.36 | -472.538 | 3,834.12 | 3,425.02 |
| | (0.24) | (0.05) | (0.00) | (0.87) | (0.94) | (0.51) | (0.24) |
| Urban | 3,054.23 | 2,155.92 | 0.06 | 10,208.84 | 10,874.47 | -4,018.68 | -1,580.25 |
| | (0.91) | (0.71) | (0.82) | (0.43) | (0.47) | (0.56) | (0.60) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Region | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| R² | 0.0423 | 0.0446 | 0.052 | 0.0227 | 0.0462 | 0.0159 | 0.0316 |
| Percentage of Outliers | 13.10% | 12.75% | 11.76% | 14.57% | 10.36% | 20.30% | 13.32% |
| N | 660 | 660 | 660 | 660 | 660 | 660 | 660 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent. "n/a" indicates that the data cannot be released by Statistics Canada due to confidentiality reasons.

## Table A9: Impact of the CSBFP on R&D involvement

| Explanatory Variable | | Odds Ratio | | |
|---|---|---|---|---|
| | | **All SMEs** | **Denied borrowers** | **Approved borrowers** |
| **CSBFP participation** | Yes | 3.02*** | n/a | 1.88*** |
| | | (0.0000) | n/a | (0.0125) |
| | (No) | — | — | — |
| **Exporter** | Yes | 3.02*** | n/a | 2.83*** |
| | | (0.0000) | n/a | (0.0000) |
| | (No) | — | — | — |
| **Investment in R&D in previous year** | Yes | 4.86*** | 5.30*** | 5.67*** |
| | | (0.0000) | (0.0000) | (0.0000) |
| | (No) | — | — | — |
| **Minority** | Yes | 1.09 | n/a | 1.02 |
| | | (0.6607) | n/a | (0.9694) |
| | (No) | — | — | — |
| **Family** | Yes | 0.89 | 0.618 | 0.74* |
| | | (0.3545) | (0.1568) | (0.1408) |
| | (No) | — | — | — |
| **Urban** | Yes | 1.40*** | 0.89*** | 1.44* |
| | | (0.0487) | (0.7464) | (0.1404) |
| | (No) | — | — | — |
| **Age of SME** | 0-5 | 0.92 | 1.74 | 0.73 |
| | | (0.6830) | (0.2719) | (0.3220) |
| | 6-10 | 1.04 | 1.81 | 1.13 |
| | | (0.8272) | (0.2293) | (0.6781) |
| | 11-20 | 0.87 | 0.80 | 0.74 |
| | | (0.3599) | (0.6773) | (0.2503) |
| | >20 | — | — | — |
| **Age of Owner** | 20-40 | 1.376 | 0.23*** | 1.03 |
| | | (0.1542) | (0.0139) | (0.9306) |
| | 41-50 | 0.926 | 0.17*** | 0.79 |
| | | (0.6765) | (0.0022) | (0.4717) |
| | 51-75 | 1.183 | 0.25*** | 1.17 |
| | | (0.3436) | (0.0182) | (0.6234) |
| | >75 | — | — | — |
| **Return on Asset** | Quartile 1 | 1.89*** | 1.41 | 2.27*** |
| | | (0.0021) | (0.5372) | (0.0191) |
| | Quartile 2 | 1.19 | 1.42 | 1.55 |
| | | (0.3674) | (0.4931) | (0.1901) |
| | Quartile 3 | 1.16 | 0.77 | 1.22 |
| | | (0.4033) | (0.5859) | (0.5238) |
| | (Quartile 4) | — | — | — |
| **Financial Leverage** | Quartile 1 | 1.54** | n/a | 1.10 |
| | | (0.0543) | n/a | (0.8250) |
| | Quartile 2 | 1.34 | 2.26 | 1.48 |
| | | (0.1660) | (0.1284) | (0.2332) |
| | Quartile 3 | 1.13 | 1.67 | 1.10 |
| | | (0.5537) | (0.3112) | (0.7636) |
| | (Quartile 4) | — | — | — |
| **log (emp)** | | 1.73*** | 2.03*** | 1.56*** |
| | | (0.0000) | (0.0003) | (0.0000) |
| **Industry** | | Yes | Yes | Yes |
| **Pseudo R²** | | 0.2023 | 0.1710 | 0.2299 |
| **N** | | 5,100 | 660 | 1,507 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent. "n/a" indicates that the data cannot be released by Statistics Canada due to confidentiality reasons. "—" indicates reference group.

## Table A10: Impact of the CSBFP on viable firms

| Explanatory Variable | | Odds Ratio | | |
|---|---|---|---|---|
| | | **All SMEs** | **Denied borrowers** | **Approved borrowers** |
| **CSBFP participation** | Yes | 1.80*** | n/a | 1.62 |
| | | (0.0332) | (0.9804) | (0.1786) |
| | (No) | — | — | — |
| **Exporter** | Yes | 1.68*** | n/a | n/a |
| | | (0.0231) | n/a | n/a |
| | (No) | — | — | — |
| **Investment in R&D in previous year** | Yes | 0.89 | n/a | 0.90 |
| | | (0.4892) | n/a | (0.7512) |
| | (No) | — | — | — |
| **Minority** | Yes | 0.75 | n/a | n/a |
| | | (0.1349) | n/a | n/a |
| | (No) | — | — | — |
| **Family** | Yes | 1.32** | n/a | 1.34* |
| | | (0.0613) | n/a | (0.3385) |
| | (No) | — | — | — |
| **Urban** | Yes | 0.71** | n/a | 0.87* |
| | | (0.0912) | n/a | (0.6887) |
| | (No) | — | — | — |
| **Age of SME** | 0-5 | 0.49*** | n/a | 0.82 |
| | | (0.0015) | n/a | (0.6434) |
| | 6-10 | 0.56*** | n/a | 0.81 |
| | | (0.0156) | n/a | (0.6492) |
| | 11-20 | 0.73 | n/a | n/a |
| | | (0.1811) | n/a | n/a |
| | >20 | — | — | — |
| **Age of Owner** | 20-40 | 1.34 | n/a | n/a |
| | | (0.2630) | n/a | n/a |
| | 41-50 | 1.12 | n/a | 0.64 |
| | | (0.6042) | n/a | (0.3664) |
| | 51-75 | 1.21 | n/a | 0.80 |
| | | (0.3899) | n/a | (0.6583) |
| | >75 | — | — | — |
| **Return on Asset** | Quartile 1 | 0.44*** | n/a | 0.35*** |
| | | (0.0000) | n/a | (0.0109) |
| | Quartile 2 | 0.73 | n/a | 0.35*** |
| | | (0.1280) | n/a | (0.0062) |
| | Quartile 3 | n/a | n/a | n/a |
| | | n/a | n/a | n/a |
| | (Quartile 4) | — | — | — |
| **Financial Leverage** | Quartile 1 | 1.61*** | n/a | n/a |
| | | (0.0312) | n/a | n/a |
| | Quartile 2 | 1.73*** | n/a | 2.26*** |
| | | (0.0126) | n/a | (0.0578) |
| | Quartile 3 | 2.20*** | n/a | 2.80*** |
| | | (0.0005) | n/a | (0.0139) |
| | (Quartile 4) | — | — | — |
| **log (emp)** | | 0.97 | 1.31 | 0.86 |
| | | (0.5388) | (0.2267) | (0.1421) |
| **Industry** | | Yes | Yes | Yes |
| **Pseudo R²** | | 0.0155 | 0.0269 | 0.0162 |
| **N** | | 7,677 | 904 | 2,128 |

Note: p value, representing the significance of the cœfficient, is given in parentheses: * p < 15 percent; ** p < 10 percent; *** p < 5 percent. "n/a" indicates that the data cannot be released by Statistics Canada due to confidentiality reasons. "—" indicates reference group.

## Table A11: Means and proportions of relevant characteristics for non-parametric matching

| Variables | | All CSBFP non-participants before matching (N=4,462) | CSBFP participants (N=638) | p-value before matching | All CSBFP non-participants after matching (N=634) | p-value after matching |
|---|---|---|---|---|---|---|
| Lnemp | | 2.33 | 1.97 | < 0.0001 | 2.05 | 0.3183 |
| Exporter | | 23% | 11% | < 0.0001 | 10% | 0.3227 |
| Investment in R&D | | 11% | 5% | < 0.0001 | 6% | 0.3249 |
| Minority | | 63% | 60% | 0.1190 | 62% | 0.5573 |
| Family | | 29% | 29% | 0.8781 | 28% | 0.5992 |
| Urban | | 79% | 67% | < 0.0001 | 67% | 0.9211 |
| Age of SME | 1-5 | 16% | 28% | < 0.0001 | 26% | 0.4675 |
| | 5-10 | 20% | 28% | < 0.0001 | 26% | 0.4777 |
| | 10-20 | 28% | 26% | 0.5684 | 28% | 0.4687 |
| | 20-100 | 36% | 16% | < 0.0001 | 20% | 0.1366 |
| Age of Owner | 20-39 | 14% | 29% | < 0.0001 | 28% | 0.5570 |
| | 40-49 | 32% | 41% | < 0.0001 | 41% | 0.9459 |
| | 50-59 | 34% | 24% | < 0.0001 | 26% | 0.3814 |
| | >60 | 20% | 6% | < 0.0001 | 6% | 0.7350 |
| Industry | Manufacturing | 13% | 11% | 0.0969 | 10% | 0.6583 |
| | Wholesale and Retail Trade | 18% | 20% | 0.3950 | 18% | 0.4440 |
| | Professional Services | 12% | 5% | < 0.0001 | 5% | 0.7031 |
| | Knowledge-Based | 13% | 4% | < 0.0001 | 3% | 0.4732 |
| | Accommodation and Food | 9% | 11% | 0.0709 | 13% | 0.3325 |
| | Others | 25% | 48% | < 0.0001 | 50% | 0.2620 |
| Region | Atlantic | 13% | 10% | 0.0354 | 12% | 0.5164 |
| | Quebec | 18% | 50% | < 0.0001 | 49% | 0.8658 |
| | Ontario | 29% | 19% | < 0.0001 | 18% | 0.7935 |
| | Prairies | 22% | 14% | < 0.0001 | 14% | 0.7637 |
| | BC | 13% | 6% | < 0.0001 | 7% | 0.6442 |
| Return on Asset | Quartile 1 | 19% | 18% | 0.8945 | 18% | 0.8479 |
| | Quartile 2 | 24% | 23% | 0.6018 | 22% | 0.6100 |
| | Quartile 3 | 33% | 35% | 0.4827 | 35% | 0.8738 |
| | Quartile 4 | 24% | 24% | 0.8922 | 25% | 0.6256 |
| Financial Leverage | Quartile 1 | 26% | 8% | < 0.0001 | 8% | 0.7432 |
| | Quartile 2 | 32% | 35% | 0.1415 | 35% | 0.9204 |
| | Quartile 3 | 25% | 36% | < 0.0001 | 32% | 0.1347 |
| | Quartile 4 | 17% | 21% | 0.0054 | 24% | 0.1715 |

## Table A12: Proportions of relevant outcome measures for non-parametric matching

| Variables | All CSBFP non-participants before matching (N=4,462) | CSBFP participants (N=638) | p-value before matching | All CSBFP non-participants after matching (N=634) | p-value after matching |
|---|---|---|---|---|---|
| Revenue | n/a | n/a | n/a | -3.81% | < 0.0001 |
| Salary | -5.83% | 5.89% | < 0.0001 | -1.07% | 0.0103 |
| Employment | -5.54% | 0.32% | 0.0008 | -2.81% | 0.2074 |
| Labour productivity | -4.91% | 6.55% | < 0.0001 | -1.74% | 0.0008 |
| Profit | 155.97% | 94.61% | 0.8529 | n/a | n/a |
| Value-added | n/a | n/a | n/a | n/a | n/a |
| Capital | 8.05% | 13.75% | 0.0038 | 10.36% | 0.1628 |
| Investment in R&D | 9.01% | 8.93% | 0.9505 | 4.10% | 0.0005 |

Note: "n/a" indicates that the data cannot be released by Statistics Canada due to confidentiality reasons.

**Table A13: Logit Model on CSBFP Participation (Observation = 5,100, LR Test: $X^2$ = 94.9653)**

| Variables | | Estimate | p-value |
|---|---|---|---|
| **Intercept** | | -3.954 | < 0.0001 |
| **Lnemp2006** | | -0.1566 | < 0.0001 |
| **Exporter** | | -0.5241 | 0.0005 |
| **Investment in R&D** | | 0.2579 | 0.0197 |
| **Minority** | | -0.6329 | 0.0018 |
| **Family** | | 0.0146 | 0.8854 |
| **Urban** | | -0.5368 | < 0.0001 |
| **Age of SME** | **1-5** | 0.7234 | < 0.0001 |
| | **5-10** | 0.7029 | < 0.0001 |
| | **10-20** | 0.4558 | 0.0011 |
| | **20-100** | Reference | Reference |
| **Age of Owner** | **20-39** | 1.4803 | < 0.0001 |
| | **40-49** | 1.1463 | < 0.0001 |
| | **50-59** | 0.621 | 0.0014 |
| | **>60** | Reference | Reference |
| **Industry** | **Primary Sector** | n/a | n/a |
| | **Manufacturing** | -0.8101 | < 0.0001 |
| | **Wholesale and Retail Trade** | -0.5366 | < 0.0001 |
| | **Professional Services** | -1.434 | < 0.0001 |
| | **Knowledge-Based** | -1.8902 | < 0.0001 |
| | **Accommodation and Food** | -0.3868 | 0.0238 |
| | **Others** | Reference | Reference |
| **Region** | **Atlantic** | n/a | n/a |
| | **Quebec** | n/a | n/a |
| | **Ontario** | n/a | n/a |
| | **Prairies** | n/a | n/a |
| | **BC** | n/a | n/a |
| | **Territories** | n/a | n/a |
| **Return on Asset** | **Quartile 1** | -0.2728 | 0.0856 |
| | **Quartile 2** | -0.2632 | 0.0751 |
| | **Quartile 3** | -0.0245 | 0.8522 |
| | **Quartile 4** | Reference | Reference |
| **Financial Leverage** | **Quartile 1** | -1.3498 | < 0.0001 |
| | **Quartile 2** | -0.2212 | 0.1403 |
| | **Quartile 3** | 0.1312 | 0.361 |
| | **Quartile 4** | Reference | Reference |

Note: "n/a" indicates that the data cannot be released by Statistics Canada due to confidentiality reasons.

# Appendix B: Data issues

The sampling method adopted in the 2007 SFSME led to oversampling of CSBFP participants. To ensure adequate representation of program participants, on one hand, the sampling frame in the 2007 SFSME was stratified by CSBFP participation before the survey to create oversampling of CSBFP participants in the sample. On the other hand, efforts to reduce response burden, thereby maximizing the response rate, were made by designating two sections of the questionnaire to be conducted with a modular approach, by which non-CSBFP respondents were randomly chosen to complete the two sections. Finally, only about one third of the respondents provided responses for these two sections. As a result, overrepresented CSBFP participants and under-represented denied borrowers may cause overestimation of the CSBFP's impact.

Losing samples (Table B1) is also an issue affecting the quality of models implemented in the paper from a technical perspective. The model design for estimating the CSBFP's impact on firm growth indicators only considers SMEs having existed over 2007 to 2009, leading to a sample loss of SMEs that failed between 2007 and 2009. In addition, most of the performance measures applied in this study were calculated using the information from the tax data file. Since a few indicators are not mandatory fields in the tax file and therefore missing values, a large amount of samples cannot be used in models even though the SMEs still exist. As a result, non-parametric matching is incorporated to consolidate the findings from robust regression and unweighted results are interpreted in this paper.

**Table B1: Sample Size of CSBFP Participants and Non-participants**

| | CSBFP Non-participants | | | CSBFP participants |
|---|---|---|---|---|
| | **All SMEs** | **Denied borrowers** | **Approved borrowers** | |
| **Survey Samples** | 9,884 | 79 | 1,678 | 1,415 |
| **Samples used in the robust regression and logistic regression for having investment in R&D** | 4,462 | 22 | 869 | 638 |
| **Samples used in the logistic regression for firm survival** | 6,819 | 46 | 1,270 | 858 |

In the end, to what extent such a mixture of effects may distort the magnitude of the impact of the CSBFP remains unclear, and cannot be addressed by this paper.

## Appendix C: Logistic regression

The probability of being a viable firm $P_i$ can be represented as follows:

$$P_i = E(Y = 1|X_i) = \frac{e^{z_i}}{1 + e^{z_i}} \tag{1}$$

where $Z_i = X_i'\beta$. It is easy to understand that $X_i$ is a $K \times 1$ vector denoting the set of measured characteristics (regressors) for the $i^{\text{th}}$ individual, and $\beta$ is a $K \times 1$ vector of coefficients, which is constant across individuals i=1,2,…n. Equation (1) represents the cumulative logistic distribution.

It follows that the odds ratio in favour of being a viable firm is defined as

$$\frac{P_i}{1 + P_i} = e^{z_i} \tag{2}$$

Where upon the log-odds $L_i$ can be obtained by taking the natural logarithm of (2), namely

$$L_i = \ln\left(\frac{P_i}{1 + P_i}\right) = Z_i = X_i'\beta \tag{3}$$

For estimation purposes, equation (3) can be written as

$$L_i = \ln\left(\frac{P_i}{1 + P_i}\right) = X_i'\beta + u_i \tag{4}$$

Since the probability of an event is the limit of the relative frequency as the sample size becomes infinitely large, the relative incidence of obtaining the highest income can be an estimate of the true $P_i$ corresponding to each $X_i$. Using the estimated $P_i$, we can obtain estimated logit as

$$\hat{L}_i = \ln\left(\frac{\hat{P}_i}{1 + \hat{P}_i}\right) = X_i'\hat{\beta} \tag{5}$$

In order to avoid heteroscedasticity of the disturbance term, estimation of the logistic model was achieved by weighted least squares (WLS).

## Appendix D: Non-parametric Matching

Let $Y_i(1)$ be a vector of economic performance and investment in R&D of a firm $i$ if it is a CSBFP participant, and $Y_i(0)$ be the vector of the firm $i$ if it is a CSBFP non-participant. Ideally, the effect of using the CSBFP would be calculated by $E[Y_i(1) - Y_i(0) | CSBFP = 1]$, also named Sample Average Treatment Effect on the Treated (SATT). Alternatively, SATT can be estimated by

$$SATT = \frac{1}{N} \sum_{i=1}^{n} [Y_i(1) - Y_i(0)] \tag{6}$$

N being the number of the CSBFP treated group.

However, only one of two outcomes, meaning $Y_i(1)$ and $Y_i(0)$, is observed for each firm $i$, as ordinary observational data do not provide a counterpart for the missing counterfactual (Heckman, Ichimura and Todd 1997). The solution to estimating the SATT would be to find an equivalent counterpart to the CSBFP sample group among CSBFP non-participants. The matching result makes it possible given the fact that two groups are one-on-one matched without losing too many observations, and two matched groups are considered to be statistically identical except for having diverse CSBFP treatment (Appendix Tables A11 and A12). A vector of baseline characteristics $X_i$ has been adopted to apply the matching process. Because this study only investigates the impact of CSBFP participation, two weaker forms of assumptions should be held to obtain consistent and valid estimation (Heckman, Ichimura and Todd 1997), and they are

  i)  *independence: E(Y(0) | T = 1, X) = E(Y(0) | T = 0, X), and*

  ii)  *overlap: Pr(T = 1 | X) < 1.*

Assumption (i) states the mean of the counterfactual should be independent of CSBFP participation conditional on specific control variables. Assumption (ii) ensures joint distribution between treated and untreated. These two assumptions are sufficient for identification of SATT, because the moments of $Y(1)$ distribution for CSBFP participants can be estimated directly (Imbens 2004).

Under two assumptions, we can rewrite (6) as the mean difference of the matched samples:

$$SATT = \frac{1}{N} \sum_{i=1}^{n} [(Y_i(1) \mid CSBFP = 1, X = x) - (Y_i(0) \mid CSBFP = 0, X = x)]$$

The process of matching, therefore, becomes picking for each CSBFP participant the most similar firm within CSBFP non-participants based on baseline characteristic $X$. The probabilities of CSBFP treatment, named propensity scores, are estimated through a logistic model with all available independent variables that may affect the choice of CSBFP participation in the dataset. The non-participants with propensity scores under one quarter of the standard deviation are retained for each CSBFP participant. The pairing process may result in three scenarios: 1) multiple matches are identified for one CSBFP participant; 2) one match is identified for one participant; and 3) no match is found. Mahalanobis distance is adopted to find the best pairing by combining propensity scores of multiple control variables. Mahalanobis distance is defined as a generalization of the standardized distance from the origin of an $n$-dimensional space to a point where the coordinates represent the values for a particular observation (Cochran and Rubin 1973). The match with the shortest Mahalanobis distance is retained as a final match to the specific CSBFP participant until each firm is exhausted in the participant group.

SAS has been used to apply the non-parametric matching. The procedures, PROC PRINCOMP and PROC SCORE, are applied to obtain the principal components' scores, and PROC FASTCLUS to calculate Euclidean distances from the pool of potential candidates.