PRODUCTIVITY COMMISSION

Statistical Analysis of the Use and Impact of Government Business Programs

Staff Research Paper

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The views expressed in this paper are those of the staff involved and do not necessarily reflect those of the Productivity Commission. Appropriate citation is indicated overleaf.

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Preface

This paper uses the *Business Longitudinal Survey* (BLS) from the Australian Bureau of Statistics to examine the characteristics of firms that use government business programs and to analyse how the use of such programs affects various aspects of their performance.

This paper follows other research in the Productivity Commission focused on the performance of Australian businesses and related policy issues. Previous research in this vein has been undertaken into the general results of the BLS (IC & DIST 1997), small business employment (Revesz and Lattimore 1997), innovation (Phillips 1997), regulation (Bickerdyke and Lattimore 1997), informal capital (Martin 1997), design principles for business programs (Lattimore, Madge, Martin and Mills 1998) business failure (Bickerdyke, Lattimore and Madge 2000), and how entry and exits affects aggregate productivity performance (Bland and Will 2001).

The authors wish to acknowledge the indispensable assistance of ABS staff who ran the computer programs used in this study and provided advice about the Business Longitudinal Survey. Particular thanks are due to Clem Tozer and John Purcell. Clem Tozer also acted as an external referee.

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Abbreviations

ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
ATO	Australian Tax Office
AGPS	Australian Government Publishing Service
BGAPS	Business Growth and Performance Survey
BIE	Bureau of Industry Economics
BLS	Business Longitudinal Survey
EMDG	Export Market Development Grant
GDP	Gross Domestic Product
IC	Industry Commission
ITES	International Trade Enhancement Scheme
NIES	National Industry Extension Service
OECD	Organisation for Economic Co-operation and Development
PC	Productivity Commission
R&D	Research and development

Key messages

- This report uses statistical evidence from a unique longitudinal data set for Australian firms to examine the use and impact of some major R&D and export facilitation programs from 1994-98. The programs examined included the EMDG scheme, Export Access, Austrade services, ITES (now discontinued), the R&D tax concession and R&D grants.
- Most firms in the target sectors of the government business programs do not make any use of the programs.
  - This is not necessarily a surprising or adverse result given that only certain firms will have the attributes that make program participation appropriate.
  - The most common reason for non-participation cited by firms is that they had no reason to seek assistance or that the program was inapplicable to their circumstances (about 60 per cent of the relevant respondents). Paperwork compliance costs and lack of knowledge about programs were also major sources of non-participation, particularly for smaller enterprises.
- Older, larger, domestically owned firms that had a strong accent on business planning and improvement were more likely to participate in both export and R&D programs. Certain industry sectors, such as electronics and chemicals, were also more likely to participate. Relatively capital intensive firms were more likely to participate in R&D programs, though this was not true for export programs. Firms with lower initial productivity levels also tended to have a higher chance of participating in programs.
- Controlling for a range of firm characteristics, participation in the EMDG scheme and in R&D programs appear to have significant effects on the exports and R&D of recipient firms.
  - However, the study estimates are likely to overstate the true impact of program participation, because firms with stronger export or R&D growth prospects are more likely to choose to participate in the programs.
- The study also found:
  - no robust evidence that the other export facilitation programs (Export Access, use of Austrade Services, or ITES) had had effects on the export growth of participants;
  - no apparent link between productivity growth and participation in business programs. (However, 'noise' in the productivity data and other methodological problems may partly explain this result);
  - that participation in a government business program did not, by itself, provide a significant source of protection from subsequent business failure; and
  - that, though they may be influential for some individual firms, the contribution of the programs to economy-wide changes — such as in sales, exports and productivity growth — is likely to be relatively small compared with other factors that drive the development of the economy.

Overview

This paper uses a unique Australian dataset — the Business Longitudinal Survey (BLS) — to examine the characteristics of firms that participate in government business programs and the effects such participation has on their performance. The BLS was collected by the Australian Bureau of Statistics and contains extensive accounting data and other longitudinal information on the sampled firms over the four years from 1994-5 to 1997-8.

The primary focus of the paper is on R&D and export facilitation programs. Accordingly, the BLS sample used in this study is restricted to trade oriented or R&D intensive sectors, including mining, manufacturing, computer services and engineering services. The BLS provided a sample of 1848 firms, including a sample of births and exits during the period of the survey. *There are some deficiencies in the BLS data, which mean that the qualitative aspects of the analytical results, rather than the precise estimates, are of prime interest.*

Participation in programs

Overwhelmingly, most firms in the target sectors of the business programs did not make any use of the programs. Thus, over the four years of the survey, 84 per cent of the target firms made no use of the EMDG scheme and 77 per cent made no use of the R&D tax concession — and these were by far the most popular programs. This is not necessarily a surprising or adverse result given that only certain firms have the attributes that make program participation appropriate.

Some programs, such as R&D grants and Export Access, were typically used by small firms that make one-off use of the program. Other programs, such as the R&D Tax Concession and the EMDG scheme were typically used by larger firms on a more continuous basis (continuing users of such programs outnumber new users by three to one).

Program participation tended to be higher in large firms than small ones. This is likely to reflect a number of factors. For example, large firms typically engage in more diversified activities than small ones and, thus, are more likely to engage in activities that are eligible for the relevant government programs. Moreover, the compliance burden associated with program participation has a fixed component.

This can be spread across a greater absolute subsidy for larger firms, making participation more attractive. However, the program participation size effect appears to diminish after a certain size for some programs, such as Export Access and the EMDG scheme — both of which have criteria that tend to filter out the largest firms.

Older domestically owned firms that had a strong accent on business planning and improvement were also more likely to participate in both export and R&D programs, as were certain industry sectors (such as electronics and chemicals). More capital intensive firms were more likely to participate in R&D programs, though this was not true for export programs. In general, firms with lower initial productivity levels tended to have a higher chance of participating in programs.

Firms that did not participate most commonly claimed that they had no reason to seek assistance or that the program was inapplicable to their circumstances (about 60 per cent of the relevant respondents). However, both paperwork compliance costs and lack of knowledge about programs were also major reasons for non-participation, particularly for smaller enterprises.

The effects of programs

While the business programs aim to increase exports and R&D, a major concern in the evaluation of such programs is that they may often displace R&D or exports that would have happened anyway, with no or small net impacts. However, controlling for a range of firm characteristics, it appears that participation in the EMDG scheme and in R&D programs did have significant effects on the target variables of these programs (exports and R&D). Based on analysis of the BLS data, it was estimated that:

- participation in the R&D Tax Concession was associated with large increases in R&D intensity, raising R&D by around 60 per cent; and
- EMDG participation was associated with an increase in the total exports by participants of 37 per cent (unweighted results) or 47 per cent (weighted results). However, these estimates are subject to considerable imprecision and are less statistically robust than the R&D results. The estimates for the overall effect of the EMDG scheme are about 50 per cent lower than found by Austrade's recent evaluation of the scheme. The paper examines closely why the results vary so significantly, pinpointing some methodological issues.

However, there are a number of reasons why it is likely that these estimates overstate the true impact of program participation. In particular, there is a concern that the sort of firms that choose to participate in these programs and that pass

government eligibility criteria are more likely to experience growth in exports and R&D, independently of the effects of the programs (the 'selection bias' problem).

The study found that the other export facilitation programs (Export Access, use of Austrade Services, or ITES) had no significant associations with the export growth of participants.

As well, the analysis found no apparent link between productivity growth and participation in business programs, though this is sometimes a justification for their existence. However, 'noise' in the productivity data and other methodological problems may partly explain this result.

If participation in government business programs confers an advantage in terms of the extended survival of firms, then firms with higher participation rates would have a reduced likelihood of exit. The data suggests that participation in a government business program is not, by itself, a significant source of protection from subsequent exit.

Another major issue is whether business programs make a significant difference to aggregate performance. This study finds that program participation explains only a tiny amount of the variation in aggregate export or R&D performance, so that other factors explain the bulk of movements in the R&D and export performance of Australian firms. This is not surprising as, overall, the total subsidies represented by the business programs concerned amount to less than 0.7 per cent of total value added and 0.2 per cent of total sales in the sample. This implies that the contribution of the programs to economy-wide changes, such as sales, exports and productivity growth is likely to be relatively small compared with other factors that drive the development of the economy.

1 Introduction

1.1 Objectives of the study

This paper examines two major issues. One is firm characteristics that influence participation in business programs. The other is the statistical association between participation and firm performance. These issues are investigated through analysis of data from the ABS Business Longitudinal Survey (BLS), a survey covering over 6 000 firms in manufacturing, mining and services over the four years from 1994-95 to 1997-98.

The study identifies firms' participation in the following six business support programs, aimed at fostering research and development (R&D) or export market development:

- the R&D tax concession;
- R&D grants;
- Austrade services;
- Export Market Development Grants (EMDG);
- Export Access; and
- the International Trade Enhancement Scheme (ITES).

One of the objectives of this paper is to provide an input for future evaluations of the programs concerned, by presenting relevant empirical material from a large survey that covers both program recipients and non-recipients. There are three major questions that are useful in program evaluations:

- What type of firms participate in government programs? This is useful for targeting measures, addressing gaps and in subsequent assessment of possible selection bias.
- What is the effect of participation in the program on the target variables, such as exports and R&D? If a program encourages significant *new* activity ('additionality' or 'inducement') in the targeted area, then it is at least achieving its proximate objective. If it has little or no effect, then the impact of the program is largely a transfer of taxpayers' funds to business owners. This

usually has an adverse economic effect because there are taxation distortions associated with financing these transfers.

- What is the effect of an increase in the target variable on economic welfare? Even if there is high additionality associated with a program, this will not have any positive economic efficiency effects unless there are benefits associated with the expansion of the target variable. This study is based on unit record data and so can only explore the benefits that may be experienced at the firm rather than the national level. The main performance variable examined in this study is labour productivity.

Unfortunately, data limitations suggest that at best only incomplete answers can be provided for these questions, particularly the last two. Methodological issues concerning the application of regression techniques to infer the effect of programs on firm performance are discussed in chapters 2 and 4.

This paper does not aim to present an evaluation of the programs concerned. While the description of the characteristics of recipients and the estimation of direct program impact on recipients are among the central issues addressed in program evaluation studies, there are a number of other issues taken up in the evaluations of business programs that are not covered in this paper. These include the analysis of social costs and benefits, the presence and size of externalities, the effectiveness/efficiency of program delivery and administrative arrangements.

Another objective of this study is to shed more light on the policy debate concerning business programs[1], a large portion of which are covered in the present study. Business support programs have become more prominent over the last twenty years, following the reduction of industry assistance through tariff protection. It is important to have a grasp of the micro-effects of such business programs and their potential effects on the economy as a whole.

The statistical material presented in this paper provides some indications about the direct effects of business programs on firms — providing an empirical basis for assessing whether business programs are likely to have first order effects on performance. It should, however, be noted that indirect effects of business programs — such as R&D externalities — are not captured by the methods used here. Other research shows that these may be substantial.

[1] For example, as discussed in Mortimer (1997) and Industry Commission (1997).

1.2 Previous studies

Although business programs are usually subject to an evaluation at least once every five years, few Australian studies have used regressions to identify the characteristics of program recipients or to estimate the impact of business programs on firm performance.

In program evaluation studies, some characteristics of recipients are described through tables and graphs (but not regressions), usually in considerably less detail than in this study.

Typically, the program impact on recipients has been assessed or estimated using less formal techniques than regression analysis, such as:

- comparison of the growth rates of recipients with general industry growth rates, usually from published data;
- comparison of changes in performance indicators before and after the establishment or expansion of the program;
- opinion surveys of recipients and other stakeholders; and
- inferences based on some combination of qualitative and quantitative information (sometimes, comparative data from other OECD countries).

Provided suitable data are available, regression analysis can provide more reliable estimates of program impact than the less sophisticated methods listed above, a subject that is discussed in chapter 2.

The two studies of the EMDG program conducted by Austrade (1994, 2000) are rare examples of Australian studies that use econometric methods to estimate program impact. However, the methodology and the control group used in these studies may have biased the results. The most recent Austrade study is further reviewed in chapter 4 and appendix F.

Another Australian regression analysis of program impact is contained in the Industry Commission (1996) submission to the mid-term review of the Rural Adjustment Scheme (RAS). In this submission, the Commission presented regressions linking the amount of subsidy received under RAS to the frequency of trading in rural land. The IC regressions showed that RAS recipients were less likely to buy or sell land than other farmers, which was taken to indicate that RAS is not particularly effective in facilitating rural adjustment.

The general methodological approach adopted in the productivity growth regressions of this paper is similar to the RAS study, with the key difference being sample construction and size:

- The RAS study used 84 observations, based on seven State averages, dissected by three size groups and four types of transactions.
- The present study uses 1 848 observations from individual respondents to the BLS survey.

Looking overseas, it appears that regression techniques are more commonly used in the United States than in Australia to identify the characteristics of recipients and to estimate the impact of business programs. Some of these studies are examined in chapter 2 and appendix F.[2]

1.3 The general framework of the present study

As noted earlier, this study relies to a large extent on regression analysis. Fairly simple techniques are used, such as logit regressions for participation and transitions and ordinary least squares (OLS) for productivity growth.

The regressions are supplemented by a range of diagnostic tests (for example, to assess correlations between 'independent' regressors and for non-constant variance). Some of the ratios appearing in the regressions were trimmed in the data processing program, in order to prevent the inclusion of unreasonably high outlier values. More details on the selection of observations and method of trimming are presented in chapters 2 and 4.

Some of this report is relatively technical in nature (chapter 2, section 3.4 and chapter 4). However, information on the characteristics of program recipients (chapter 3) and on continuing and exiting firms (section 4.5) is based mainly on simple cross tabulations. Otherwise the overview distils the main findings.

Logit and Poisson regressions of characteristics

Logit regressions are applied to predict participation or non-participation in each program (at least once over four years) as a function of various firm characteristics. The regressions are in the form:

$$p = \mu + \mathbf{z}\,\gamma + \varepsilon \qquad \{1\}$$

where p is a binary variable representing participation in the program at least once during the four year study period. μ is the intercept and ε is the error term. γ is the vector of regression coefficients associated with **z**, a vector of explanatory variables, which serve as predictors of participation or non-participation in the program. **z**

[2] A particular type of program impact studies are US studies which attempted to estimate the price elasticity of R&D expenditure using firm-based panel data. Due to the limitations of the data, these elasticity estimates are not particularly reliable.

includes type of industry, size and age of firm, majority ownership (domestic or foreign) as well as a set of binary managerial behaviour variables, indicating the adoption of non-technical innovations, regular budgeting, benchmarking against other firms, networking with other firms, business planning, increased staff training and the like. **z** also includes some ratios, such as value added per person, purchases per person, export-sales, profit-equity, debt-equity and non-R&D innovation expenditure to sales ratio. All these ratios relate to the first year of the study (1994-5) so as to reduce the risk that the ratios are the outcome of, rather than the influence for, participation in the program. With the exception of age of firm and the ratios mentioned above, all other variables in **z** are binary.

In addition to logit regressions, non-linear regressions based on the Poisson distribution are applied to investigate the factors influencing the *degree* of participation in programs. In the Poisson regressions, the dependent variable is the number of participation counts over four years. The independent variables (**z**) are the same as in the logit regressions.

Regressions based on transitions in program participation

These regressions examine how transitions between participation and non-participation over two consecutive years affect the changes in the exports-sales or R&D-sales ratios (as the dependent variables) over the same period. The objective of these equations is to estimate the short term impacts of program participation on exports and R&D.[3] A more complex methodology could have been used to examine short and long term effects by including lagged transitions. However, given the problems with missing data and the added complexity of such a time series approach, the simpler exploratory method was used in this study. Given the problems encountered in the data, it is unlikely that follow-up research based on more complex methodologies is warranted (chapter 2).

There are four transition possibilities between consecutive years, which can be expressed in a binary code as follows:

- 00 — non participation in both years;
- 01 — represents those who join or rejoin the program in the second year;
- 10 — represents those who leave the program in the second year; and
- 11 — participation in both years.

[3] The dependent variables are expressed not in terms of yearly growth rates but in terms of changes in ratios, with sales in the denominator, in order to avoid division by zero when the base year R&D or export figure is zero.

There are three transitions during the four year study period: between the first and second, second and third, and third and fourth years.[4] The transitions of all six programs appear among the regressors in the transition equations, with the 00 transition being the missing dummy variable. Apart from the transition variables, the regression contains most of the explanatory variables (the **z** vector) appearing in the logit and Poisson regressions of characteristics described earlier.

The regressions are in the form:

$$g = \mu + \mathbf{p}\alpha + \mathbf{z}\gamma + \varepsilon \qquad \{2\}$$

where g is the annual change in either the R&D-sales or export-sales ratios. **p** is the transition vector of the six programs over three years (comprising 3x6=18 variables), with α being the respective regression coefficients. The roles of **z,** γ and ε were described earlier. For the purpose of inferring program impact, the main interest is on the size and statistical significance of the α coefficients on the transition variables.

The productivity growth regressions

Although the results about program impact are more illustrative than definitive, ordinary least square regressions of productivity growth represent another element of this study. These regressions relate labour productivity growth as the dependent variable to various (potentially causal) independent variables. Among a range of explanators, a number of program participation variables are also included. One is the combined participation count in the two R&D programs over four years, while the second is the combined participation count in all four export marketing programs over four years. These participation counts are used as proxies for the intensity of reliance on business programs. In symbolic terms, the regression equations appear as follows:

$$g = \mu + \mathbf{p}\alpha + \mathbf{z}\gamma + \varepsilon \qquad \{3\}$$

where g denotes the growth rate between 1994-5 and 1997-8 in labour productivity (ie. the change in value added per person). The growth rates are measured in nominal terms, and are expressed in the form of logarithmic differences. μ is the intercept term. ε is the error term, while α, and γ are the estimated coefficient vectors. **p** is the combined participation counts over four years in R&D programs as one group and export programs as another group. These participation counts can

[4] The transitions are pooled, so that the data set is treated as one large cross-section of transitions.

range between zero and eight for the two R&D programs combined, and between zero and sixteen for the four export marketing programs combined.[5]

A raw count may seem a blunt measure of participation, given that there may be different effects from early or late participation on productivity.[6] For this reason, other ways of parameterising participation were also examined, such as giving greater or lesser weight to more recent participation. However, the simple count form could not be rejected over alternatives.

The roles of μ, $\mathbf{z}$, γ and ε were described earlier.[7] For the purpose of inferring program impact, the main focus of attention is on the size and statistical significance (t statistic) of the α coefficients multiplying the program participation counts.

Weighted and unweighted regressions

Each performance-related regression is run in two forms — weighted and unweighted. In the unweighted regressions the observations for all firms are counted the same regardless of firm size. In the weighted regressions each observation is weighted by the number of persons employed by the firm in 1997-8.

In contrast to the performance related regressions, the logit and Poisson regressions are run only in the unweighted form, since the objective is to predict participation on the basis of firm characteristics rather than to provide estimates of aggregate impacts.

There are sometimes significant differences between the results of the weighted and unweighted regressions. Generally, weighted regressions are better suited to estimate aggregate impact than unweighted regressions, but there is some merit in both approaches. Unweighted regressions are particularly well suited to identifying the distinguishing characteristics of participants, but bias results towards small firms.

The cross-tabulations in appendixes E and G present separately the mean values of unweighted and firm size weighted observations.

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5 Usually the combined counts do not exceed two or three and will exceed six only in exceptional cases.

6 The parameterisation used also implies that the effects of participation on productivity are permanent. If they were not then early participation followed by non-participation could be expected to have a negative impact on productivity.

7 Some of these variables are intended to measure ‘catch up’ or ‘mean reversion’ effects. For example, a firm with below average initial labour productivity might catch up to the average as it assimilates knowledge or methods from other firms.

With the BLS database, it is possible also to use other weighting schemes. Rogers and Tseng (2000) use ABS supplied sampling weights, defined by industry and firm size group, in regressions involving labour productivity. Their approach is likely to lead to similar results to the employment-weighted regressions applied in this study, however, the ABS weighting is better suited to raw data than to ratios (see table 2.4).

1.4 Outline of the report

Chapter 2 presents information on the data used in this study and data accuracy problems. Attention is also given to methodological problems related to estimating program impact(s) from the information available. While much of the discussion is concerned with highlighting estimation problems due to the limitations of the non-experimental data available, we also note the advantages of regression techniques over alternative methods for estimating program impacts.

Chapter 3 describes the six business programs and the main characteristics of firms that received support. Further analysis, based on probit and Poisson regressions, is used to highlight other characteristics that appear to be good predictors of participation in a program.

Chapter 4 presents some tentative estimates of the statistical associations between program proxies and a number of performance indicators. Detailed regression results and cross-tabulations are presented in appendixes E and G. While the discussion concentrates mainly on the regression coefficients and statistical significance of business programs, some attention is also given to the statistical significance of other variables.

Chapter 4 also compares the characteristics of firms that left the survey due to business closure (as a result of cessation, sale or liquidation) with firms that continue to operate.

2 Data and methodological issues

Before examining methodological problems related to estimating program impact, this chapter describes briefly the database used in the present study.

2.1 The Business Longitudinal Survey

Main features of the survey

The main information source for the present study is the ABS Business Growth and Performance Survey (BGAPS), which is commonly referred to as the Business Longitudinal Survey (BLS). Unlike other ABS surveys of business enterprises, the BLS is unique by virtue of being 'longitudinal', which means that it tracked the performance of the same enterprises over a number of years.[1] It includes a wealth of accounting information on sales, expenses, profits, assets and liabilities — in some cases at a fairly disaggregated level, like expenditure on R&D or expenditure on innovation. The survey also collected a range of business characteristics and behavioural information, including information about participation in government programs, industrial relations, business practices and intentions concerning marketing and modernisation. Data were collected from a large sample of manufacturing, mining and service industry firms over the four years from 1994-5 to 1997-8.

Published data from the BLS can be found in IC & DIST (1997), DEWRSB (1998), ABS (1999 and 2000). A number of studies by the Melbourne Institute of Applied Economic and Social Research investigated the BLS data, including Rogers (1998ab, 1999, 2000), Rogers and Tseng (2000) and Tseng and Wooden (2001). Analytical studies of the BLS by ABS staff is presented by Northwood (1999) and Northwood and O'Shea (1999). Will and Wilson (2001) discuss some of the 'tricks and traps' associated with use of the database. Bland and Will (2001) use the BLS to examine how differences in firm-level productivity between continuing and dying firms affect overall productivity. Other Productivity Commission research (Bensted et al 2000) used the BLS data to assess longitudinal changes in

[1] Though longitudinal records are not available for all firms in the initial sample (due to subsequent births, deaths and retirement from the sample).

employment. None of these studies are focused on the effects of business programs on firm performance.[2]

The BLS was conducted by the ABS under the Census and Statistics Act, which ensured high response rates (around 90 per cent) were maintained throughout the longitudinal study. The high response rate overcomes the risk of non-response bias. The ABS followed up on the telephone those who did not send in a form or provided incomplete answers. Where a response could not be obtained, various imputation methods were adopted.

The sample of firms used in this study

In the first year, the ABS selected around 13 000 firms to participate in the BLS. Information from this large sample was used to construct a smaller stratified sample for subsequent years.

The sample was reduced for year 2 because of the high cost of including the full sample in the ongoing survey. In the second year (1995-96), the sample had two distinct components. The main part was a sub-sample of continuing firms (selected from those surviving from the first survey) which included about 5 600 firms out of the 9 000 live responses received in the 1994-95 survey. To keep the sample representative of the population, a sample of newly established firms was drawn from those firms added to the ABS Business Register during the previous 12 months. This methodology of maintaining the sample of continuing firms and adding a sample of newly established firms was also used for the selection of the third and fourth surveys. Against the births added each year, more than 500 firms exited the survey each year as a result of closure, transfer of ownership or sometimes restructuring. One of the objectives when selecting the smaller stratified sample was to ensure adequate representation of export and innovation orientated firms. More information about the selection of the stratified BLS sample can be found in Tozer (1997) and Rogers and Tseng (2000).

Altogether, there are now records for 13 821 firms in the BLS database. However, from these only 1 848 were used in the regression analysis of this study. The reasons for the reduction in the population size is the exclusion of most service industries from this study and the stipulation that the firms examined must have reported positive sales every year from 1994-5 to 1997-8.

[2] Although Rogers (1998) does consider how the distribution of labour productivity is different for participants in government programs relative to non-participants. He finds a slightly higher level of average productivity. The results in this study are based only on firms in the sectors targeted by the programs, whereas Rogers' results relate to a larger dataset.

- The condition to have positive sales every year was stipulated in order to confine the regressions to firms that have longitudinal records over four years. This requirement eliminated a large number of firms that were taken out of the BLS after the first year. It also removed from the sample firms that went out of business or newly established firms that joined the BLS in later years. The population was further reduced by excluding firms that did not report at least one employed person in 1997-8, even if they had positive sales.[3] A separate analysis was carried out (see chapter 4) for firms that went out of business in the second, third and fourth year of the survey.
- The confinement of this study to manufacturing, mining, computer and engineering services is dictated by the nature of the subject. The business support programs examined in this report are concerned with stimulating research and development (R&D) or export market development. Since the large majority of firms in service industries, such as wholesale, retail, construction, internal transport as well as personal, business and community services, are neither engaged in R&D nor in exports, it was decided not to include these sectors in the study set. The motive is to avoid making comparisons between assistance recipients and non-recipients, where the bulk of non-recipients belong to sectors that do not receive R&D or export marketing assistance because of the nature of their activities.

The population of firms examined in this study belong to the following sectors:

- Mining (ANZSIC divisions 11 to 15);
- Manufacturing (ANZSIC divisions 21 to 29);
- Consulting Engineering and Technical Services (ANZSIC classes 7823 to 7829); and
- Computer Services (ANZSIC group 783).

The two service industries listed above were included in the study because they are engaged in significant R&D and export activities, in common with much of manufacturing and mining.

Due to the commercial confidentiality of the information provided by respondents, the Productivity Commission did not have direct access to the BLS database. The study was carried out by writing SAS computer codes for processing the BLS data. The programs were run by the ABS, which released summary tables and regression

[3] These non-employing businesses comprise non-employing subsidiaries of employing firms, small firms registering as employing businesses that don't actually become employing businesses and businesses that revert to non-employing businesses after having employees for some period.

results to the Productivity Commission, but no information about individual records.

The variables representing business support programs

One shortcoming of the BLS, for the purpose of estimating program impact, is the limited information in the survey about the amount of monetary assistance received under the programs. The main information from the survey is a binary response, indicating participation (or otherwise) in each program over the four years from 1993-4 to 1996-7.

Only in one year, 1996-7, is there information in the BLS about the amount of R&D expenditure that was claimed for the R&D tax concession and the amount of R&D grants received by respondents. Unfortunately, this information proved difficult for respondents to provide and is rather patchy (as discussed in Section 2.2) and accordingly the ABS has advised that it should not be used in this analysis. While the level of R&D subsidies in 1996-7 is not used in the regressions discussed in this paper, the ratio of R&D subsidies to income (in 1996-7) is used in some tables, where the ratio is expressed as follows:

$$\frac{R\,\&\,D\ subsidies}{Total\ income} = \frac{0.18\times(R\,\&\,D\ claimed\ \ for\ tax\ concession)+R\,\&\,D\ grants}{Total\ sales} \qquad (2.1)$$

The fraction 0.18 multiplying the R&D claimed for tax concession is obtained by multiplying 50 per cent of the R&D expenditure subject to concession by the 36 per cent corporate tax rate that applied in 1996-7. This yields an approximation to the average monetary value to firms of the 150 per cent R&D tax concession.[4]

In the absence of reliable data on the amount of subsidies received, we use various proxies in the regressions (section 1.3 in chapter 1).

2.2 Data accuracy problems

Large datasets, especially longitudinal ones, are affected often by data errors and missing data. These take a number of forms:

- sampling error means that some atypical business units can be sampled;
- incorrect and inconsistent data may be entered by respondents or they omit to give replies for certain questions;

[4] The actual subsidy to firms can vary somewhat from this, because of the clawback of concessions through the dividend imputation system and due to deferred benefits to firms currently in tax loss.

- data entry by the statistical agency can also be subject to error; and
- in the BLS the sampled enterprises are at the level of so called 'management units' rather than firms. Large firms may consist of several management units and this can sometimes distort performance analyses where income and expense details relate to a particular management unit and do not cover the finances of the whole business.[5]

While the ABS used a range of quality control measures for the BLS database, some statistical anomalies became apparent during this study. Interrogation of the database (through statistical summaries rather than the inspection of individual records[6]) revealed implausibly high positive or negative average values for some variables and inconsistencies with information from other sources, mainly published ABS data. Some of these apparent data errors are discussed in the following sections.

It should be emphasised that the presence of data problems for some variables does not necessarily imply serious data reliability problems overall, bearing in mind that the BLS survey contained more than 70 questions, many of them branching into sub-questions.

R&D expenditure

A serious data problem in the context of the present analysis is related to R&D expenditure. As shown in table 2.1, the total amount of R&D expenditure reported in the survey decreased by 23.2 per cent between 1995-6 and 1997-8, in contrast to only a 9.3 per cent decrease in nominal business R&D expenditure according to published ABS figures. As indicated from the dissection by firm size, most of the decrease in BLS R&D expenditure was recorded in the over 500 persons size group.

The survey figures in table 2.1 are obtained by summarising the BLS data using the 'flow' weights constructed by the ABS for the BLS. The application of these weights is intended to ensure that the estimated totals from the survey correspond fairly closely to aggregate national totals according to other ABS estimates. However, the weighted sums from the BLS survey amount to only around 50 per

5 The management unit is the highest level accounting unit within a business for which detailed accounts are maintained and used in ABS business surveys, including the BLS. Generally this coincides with the legal entity owning the business, and therefore the management unit is more aligned toward a 'firm' rather than 'establishment' or 'plant' concept. However, large businesses may have several management units, corresponding to a division, line of business or location by state. In these cases, the management unit will not necessarily coincide with the legal entity.

6 The full unit record data of the survey is only available to ABS officers.

cent of ABS estimates of business expenditure on R&D in manufacturing and mining. In part, the difference reflects the fact that for all years other than 1995-96, the BLS only requested expenditure on research and development associated with the introduction of new products or processes during the relevant year.[7] Moreover, around 20 per cent of the difference can be explained by the fact that the BLS data presented in table 2.1 does not cover all manufacturing and mining firms in the sample, but only those that were continuously operating between 1994-95 and 1997-98. However, it appears that data inaccuracies are likely to explain the residual differences between the estimated totals.

Table 2.1 R&D expenditure in the BLS compared with other ABS estimates

	From the BLS by firm size (number of employees)					*Other ABS data*
Year[a]	*1-20*	*21-100*	*101-500*	*Over 500*	*Total*	*Comparable firms*
	$M	$M	$M	$M	$M	$M
1995-6	124.9	247.3	218.0	835.4	1425.6	2837.8
1996-7	280.8	219.2	307.6	598.9	1406.6	2822.1
1997-8	210.4	302.7	303.0	279.0	1095.0	2573.6

[a] The R&D expenditure series starts from 1995-6 rather than 1994-5, because the R&D expenditure data in the BLS for 1994-5 is partial — it covers only manufacturing and mining, but not services. The survey figures presented in the table include computer and engineering services, which represent around 14 per cent of the totals.

Source: Unpublished data from the ABS BLS survey. ABS (*Research and Experimental Development — Business*, Cat. no. 8104.0 —manufacturing and mining only).

More detailed examination of the database revealed that the reporting of R&D expenditure in the BLS appears to be erratic. As shown in table 2.2, from the 860 firms that reported carrying out some R&D expenditure, only 11.7 per cent have reported performing R&D every year over the four year study period. Even among large firms (employing more than 500 persons), less than 10 per cent of R&D performers reported positive R&D expenditure every year. This does not seem to accord with other empirical observations, which suggest that many firms that carry out R&D do so consistently every year (BIE 1993a, p.41ff). It is possible that omissions in reporting R&D expenditure may explain the relatively small percentage of firms that reported performing R&D over three or four years. Omissions in reporting may also partly explain the large decrease in R&D expenditure over the years, shown in table 2.1, and the general underestimation of R&D expenditure in the survey shown in table 2.4.

[7] However, the fact that the under-enumeration is about as great in 1995-96 as other years, suggests that this definitional difference is not the major factor.

Table 2.2 **Number of times positive R&D expenditure was recorded by R&D performers over the four year study period**[a]

Positive R&D count	*1*	*2*	*3*	*4*	*No. of firms*
Employment size	%	%	%	%	Number
1-20	55.0	21.8	12.5	10.7	289
21-100	43.2	23.3	19.6	13.9	373
101-500	35.9	27.4	28.2	8.5	117
Over 500	23.5	29.6	37.0	9.9	81
Total	44.3	24.0	20.0	11.7	860

a R&D expenditure in 1994-5 has not been recorded in the survey for computer and engineering services. For the purpose of the present exercise, positive or zero count in 1994-5 in these industries is assumed to be the same as the one recorded in 1995-6.

Source: Unpublished data from the ABS BLS survey.

Participation in business programs

The variables measuring participation (or otherwise) in each business program are central to this report. There is some evidence of omissions in reporting, although the problem appears to be less severe than in the case of R&D expenditure. As shown in table B.3 in the appendix, most of the respondents that recorded positive participation in a program at least once, recorded only one or two participation counts, with considerably fewer recording three or four counts. A priori, one would expect the distribution of participation counts to be more even than that, since many of the programs are intended to be used for more than one year.

Table B.3 also reveals that among those that recorded a single count, most recorded the count in the third year (1995-6) in all program areas.[8] Again, on logical grounds one would expect a more uniform distribution of replies across four years.[9]

R&D expenditure and R&D subsidies in 1996-7

There are apparent inconsistencies between R&D expenditure recorded and program participation in 1996-7. From the 143 firms who received R&D subsidies in 1996-7, 36 did not report a positive R&D expenditure in 1996-7 (table 2.3). One possible explanation is that the expenditure referred to in some R&D support applications was carried out in an earlier year and that the BLS. Another is that the

8 This is shown in the table by the participation pattern 0010.

9 Data from the IR&D Board reveals that 1995-96 was a peak year for registrations for the R&D Tax Concession, but the difference in registrations is much smaller than the difference apparent in the BLS data.

R&D question related only to activity that generated a new product or process that year.

Table 2.3 **Number of firms which incurred R&D expenditure and/or received R&D subsidy in 1996-7**[a]

	Number of firms
No R&D expenditure and no R&D subsidy in 96-7	437
Positive R&D expenditure and positive subsidy in 96-7	107
Positive R&D expenditure but no R&D subsidy in 96-7	223
Positive R&D subsidy but no R&D expenditure in 96-7	36
Total	803

a The sample is restricted to firms which carried out R&D at least once between 1994-5 and 1997-8.

Source: Unpublished data from the ABS BLS survey.

Another possible data problem is that the value of R&D expenditure claimed for subsidies was less than 55 per cent of total R&D expenditure revealed in the survey in 1996-7.[10] This estimate does not accord with other information sources (for example BIE 1993a) which suggest that around 80 per cent of total R&D expenditure was eligible for government subsidies. This may reflect changing eligibility conditions or data errors.

Given the poor reliability of the R&D subsidy data, we decided not to use these data in the regressions. However, the cross-tabulations presented in tables G.13 and G.14 in the appendix show the relationship of various performance indicators to the ratio of R&D subsidies to sales in 1996-7.

R&D compliance costs

The most serious data problems are evident for estimated compliance costs associated with R&D programs. Compliance costs are important in the context of analysing business programs, because they can have a substantial bearing on the accessibility of a program and its overall net benefit.

10 Total R&D expenditure reported in the survey in 1996-7 was $414.2 million. The survey suggested that the value of R&D claimed for tax concession in 1996-7 was $198.8 million and that R&D grants approved in that year amounted to $9.1 million. Assuming (conservatively) that R&D grants amount to one third of relevant R&D expenditure, then the value of R&D expenditure covered by the grants is 9.1*3 = $27.3 million. From these figures, the ratio between the R&D claimed for subsidies and R&D expenditure in 1996-7 amounted to (198.8 + 27.3)/414.2 = 54.6 per cent.

The 1996-7 survey included a question about the 'application and on-going reporting costs' incurred by the firm in relation to R&D subsidies (that is, the R&D tax concession and R&D grants). These compliance costs have two components in the survey: the number of labour days spent on compliance and a general category of 'other costs'. However, these details proved too difficult to provide and the results were not considered sufficiently reliable to release.

The need to trim ratios

The fact that more than 10 per cent of calculated ratios, such as the profit-equity ratio, debt-equity ratio, value-added per person or purchases per person had to be trimmed in the SAS program, in order to avoid implausibly high positive or negative outlier values, suggests that in many cases the reporting by respondents of the relevant values was subject to considerable error.

One possible reason for the implausible ratios is connected with reporting by 'management units' that represent only part of the firm. ABS officers suggested that some 'management units' of large firms might have reported firm-wide figures on some variables, but only branch-level figures on others. This could have led to some implausible ratios.

Most ratios appear as minor explanatory variables in the regressions and their level of accuracy probably does not have much effect on the analysis of business programs. However, the change in labour productivity is used as a dependent variable in one set of regressions — and so its distribution was explored in some detail (figure 4.3). The distribution of changes in labour productivity rates is much wider than the range of –10 to +40 per cent that would appear plausible over three years in the light of general productivity trends. For the purpose of applying this variable in the regressions, the boundary values for logarithmic change are set to plus or minus one, corresponding to a change of plus 172 per cent or minus 63 per cent respectively. The fact that more than ten per cent of observations fall outside even this very wide range may reflect data quality problems.

Inconsistencies with other ABS data

Table 2.4 compares the BLS sample totals with summary data from a number of ABS publications. The motive is to assess the extent to which the BLS sample is representative of the two main sectors examined (that is, mining and manufacturing). For the purpose of this exercise, the summation of numbers in the

survey is carried out using weights established by the ABS for the BLS.[11] The function of these weights is to derive estimates from the sample data that are close to estimates from other ABS sources.

Table 2.4 **Comparing BLS weighted totals (using ABS supplied weights) with industry-wide totals from other ABS statistics**

	Sales (turnover) 1997-8	*Exports 1997-8*	*R&D expenditure 1997-8*	*Equivalent employment 1997-8*[b]
	$ billion	*$ billion*	*$ million*	*000s*
Total manufacturing based on the BLS	183.0	23.7	757	825.6
Total manufacturing from other ABS	213.0	53.3	2 181	980.6
BLS as a share of official estimate (%)	85.9	44.5	34.7	84.2
Total mining based on the BLS	31.2	15.7	225	70.5
Total mining from other ABS	35.8[a]	21.5	392	75.6
BLS as a share of official estimate (%)	87.1	73.0	57.4	93.2

[a] Based on total turnover in 1996-7 from ABS Cat. 8414.0, plus adjustment between 1996-7 and 1997-8 in accordance with the change in the value added of mining in the National Accounts (ABS Cat. 5204.0) in that year. [b] The equivalent employment figures are calculated by converting part-time employees into equivalent full-time employees, using a conversion rate of 0.43 (see appendix A)

Sources: Unpublished data from the ABS BLS survey; ABS (*International Merchandise Trade: June 1998*, Cat. no. 5422.0; *Labour Force: May 1998*, Cat. no. 6203.0; *Research and Experimental Development, Business Enterprises: 1996-97*, Cat. no. 8104.0, *Manufacturing Industry, 1997-98*, Cat. no. 8221.0, *Australian Mining Industry 1996-97*, Cat. no. 8414.0).

In respect to all the variables examined (that is, sales, exports, R&D expenditure and employment), the weighted totals from the survey in 1997-8 are consistently below the corresponding totals from ABS publications. The differences are much larger in manufacturing than mining, and are particularly pronounced for R&D and exports:

- The estimated manufacturing R&D expenditure from the survey represents only 34.7 per cent of the respective total from the ABS business R&D publication. The manufacturing R&D to sales ratio in the survey is 0.41 per cent compared with 1.02 per cent from published ABS data.
- Estimates of manufacturing exports from the BLS represent only 44.5 per cent of the respective figure from ABS trade statistics. The manufacturing exports-sales ratio in the BLS is 13 per cent compared with 25 per cent according to published trade data.

[11] Note, the ABS weighting is different from the weighting of firm size according to the number of persons employed discussed elsewhere in this paper.

These large differences reflect different definitions, survey coverage and to some extent sampling and non-sampling errors:

- The BLS excludes self-employed enterprises, which represent around 5 per cent of total manufacturing employment (ABS Cat. 1321.0). However, the exclusion of this group is unlikely to affect the estimates of manufacturing exports and R&D by much.
- The relevant question in the BLS asked about *direct* exports recorded by responding enterprises. But it appears that wholesalers (rather than the original manufacturers) carry out more than a third of manufactured exports. Analysis of BLS export data in ABS Catalogue 8154.0 (2000) reveals that while the estimated exports of manufacturers in the BLS in 1997-8 amounted to $23.7 billion, estimated exports by wholesalers amounted to $17.1 billion. Much of the exports of wholesalers originated from manufacturers. On the other hand, in the ABS international merchandise statistics (Catalogue 5422.0), which is used in the comparison in table 2.4, exports by industry refers to the originating sector and excludes wholesalers entirely. The inconsistency in the definition of exporting industries in the two information sources explains much of the difference between the estimates — and undermines the statistical validity of the BLS for estimates of total exports. However, the BLS may still provide reasonable estimates of the growth in the export to sales ratio (which is used in chapter 4). Moreover, any remaining systematic bias in the differenced data may be picked up in a regression context by a constant, without significant bias on the parameters of the key explanatory variables.
- In contrast to exports, no single explanation can be provided for the low aggregate R&D expenditure estimate in the BLS. One reason is related to the fact that the sample does not include all manufacturing firms in the BLS, but only those who reported positive employment and sales in 1994-5 and 1997-8. This may account for more than 20 per cent of the difference. A second possibility is that in 1997-98 the ABS only collected R&D expenditure associated with the development of a new product or process (though see footnote 6). As in the case of the exports, differencing may reduce the problems associated with the systematic bias in R&D measurement in the BLS, so that it may still be possible to generate reasonable estimates of the effect of program variables on R&D.

Some advantages of the data

Finally, it is appropriate to point out also some of the strengths of the BLS data. The sample of management units used in this study had over 200 000 employees and $56 billion of sales in 1997-8. In terms of the number of people employed, the BLS

sample covers around 16 per cent of manufacturing and 26 per cent of the mining workforce. Evidently, the sample is large, and judging from the figures in table 2.4, it appears to be fairly representative of the sectors covered in terms of sales and employment.

The data's longitudinal property also has significant value in that it allows the same management units to be followed over time (as contrasted with comparisons between time periods of aggregates based on different sets of firms) and the ability to control for those firms that exit the sample.

It also covers a rich set of qualitative variables that are rarely available (such as intentions and management improvement strategies).

2.3 Assessing program effects: some conceptual issues

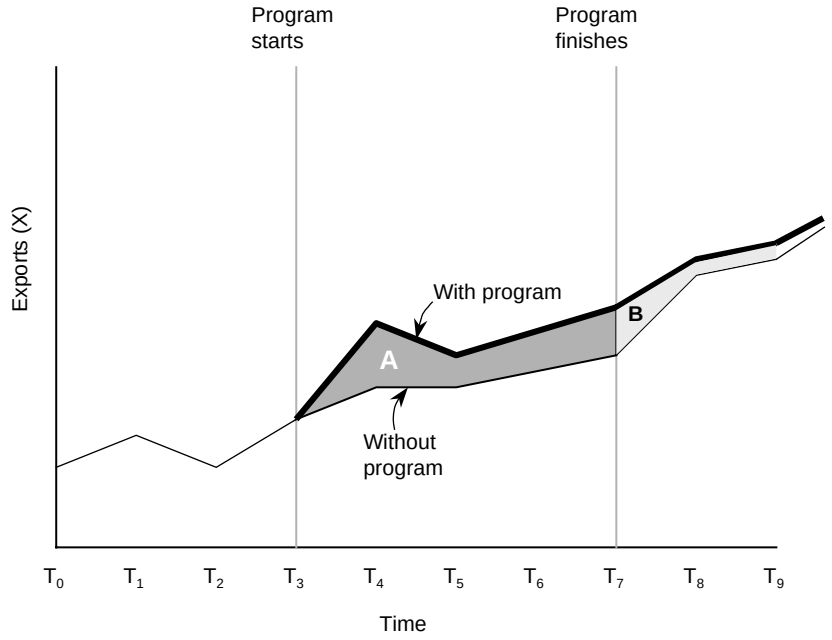
The key problem

The goal of program evaluation is to assess the effects of the program on some critical measures of performance.[12] Taking the EMDG program as an example, its direct objective is to increase export marketing expenditure and, consequently, stimulate overall exports.

Program evaluation aims to compare the outcome for the set of firms who take up business programs with the counterfactual of what would have happened had no program been available. The problem is illustrated in figure 2.1. An export program is taken up by a firm at time T_3, and is used until T_7. Over the period that the program runs, the impact of the program is the area A, which is the difference between exports with the program and exports that would have occurred without the program (assuming that these were known). However, the program may have permanent effects, so that even after it has ceased, the level of exports may be higher than would otherwise have been the case. For example, the program effect from time T_7 to T_9 is the area B.

12 The discussion in the following two sections on methodological problems related to estimating program impact(s) is based largely on Department of Finance (1989), Moffitt (1991) and Jarmin (1997).

Figure 2.1 **Illustrating the impact of programs**



Continuing the use of the export program as an example, the measurement of the export program effect at any period is:

$$X_{it}^{P} = X_{it}^{NP} + \alpha_{it} \qquad \{1\}$$

where X_{it}^{P} is the level of exports for firm *i* at time *t* and X_{it}^{NP} is the level of exports at the same time for the same firm if it had not entered the export program at any prior date. The effect of the export program on exports for that year is α_{it}, while its overall effect (S_i) on firm i up until time t is:

$$S_i = \sum_{t=s}^{T} \frac{\alpha_{it}}{(1+r)^{t-s+1}} \qquad \{2\}$$

where s is the initial time at which the program was used and r is a discount rate so that the present value of the effects can be estimated.[13]

There are many difficulties in estimating S, but the most problematic is trying to gauge the value of the unobserved variable X_{it}^{NP}.

The typical way in which S or α_{it} are estimated is to compare the exports of firms that were in the program with those of firms that were not in the program (or a

13 This expression ignores the relationship between the effect of the program and the intensity of its usage. This entails further complications.

'control' group). Thus, one way in which the export effects of the EMDG program could be estimated is to look at the average value of X_{it} for a group of firms (i = 1 to N) that participated in the program and the average value of X_{it} for a group that did not (i = N+1 to J):

$$\hat{\alpha}_t = \sum_{i=1}^{N} X_{it}^{P} - \sum_{i=N+1}^{J} X_{it}^{NP} \qquad \{3\}$$

However, this estimate is only unbiased if the control group is appropriate. For that to be the case, the expected value of exports for those that did not participate in the program must equal the value of exports that those firms that did participate would expect to have had, had they not participated. For example, if a large group of firms were randomly assigned to the export program or to the control group, then a good estimate of $\hat{\alpha}$ could be derived.[14] With this kind of experimental method, the reliability of the estimates will depend mainly on the size of the sample. Experimental methods of this kind are widely used in examining the effectiveness of medical treatments, but they have equal potential applicability to any intervention, including government business programs, education and labour market programs.

For example, a number of training and work experience schemes for unemployed people and other disadvantaged groups in the United States have incorporated random approval of applicants (Fay 1996 and Heckman 1993). In this situation, those who have been randomly rejected provide an appropriate control group. Their performance in the labour market can be compared with that of program participants in order to estimate the net impact(s) of the program. The main limitation of the experimental studies conducted so far is that the employment path of participants and the control group has been monitored for only a few years. Also, little attention has been given to alternative training channels used by unsuccessful applicants. But apart from these problems, this type of estimation of program impact is approaching the level of rigour of experimental studies in the physical and biological sciences. However, business support programs have not been subject to this kind of experimental design.

There are a number of ways in which experimental methods could be implemented for business programs:

- A pilot program could be set up that explicitly incorporates an experimental design to evaluate the program's effectiveness;

[14] More efficient estimates of program performance may be obtained by controlling for any random differences in the characteristics of the control and the 'treatment' groups.

- Where a program is budget capped and oversubscribed, some eligible applicants will miss out.[15] A condition for eligibility could be that firms agree to provide the relevant data even if they do miss out (for example, their exports or export marketing expenditure). The eligible firms that miss out due to budget capping are a reasonable control group.

Unfortunately, such experimental methods have not been used for evaluating Australian business programs. This means that the implicit or explicit 'control' groups that have been selected are unlikely to match the treatment group — and will lead to biased estimates if a simple estimator such as $\hat{\alpha}$ in {3} is used.

Despite their limitations, simple comparisons can convey some useful information in a readily understandable form, especially if there are reasonable priors about the direction of selection biases. Appendix G presents a number of cross-tabulations relating various performance indicators to the number of participation counts over four years or to the R&D subsidies to sales ratio in 1996-7.

Dealing with selection bias or 'treatment' effects

Outside the realm of experimental studies, the question arises as to how to select a control group whose performance can be compared with that of program recipients in a sensible manner. In most program evaluation studies, some non-experimental observations are selected for comparison, such as the performance of non-participating firms in the industry, or the performance of participants before joining the program, or before a substantial change has occurred in the program.

The selection of non-experimental observations for comparisons raises a number of difficult issues. A non-experimental 'control group' can differ from program recipients not only in terms of participation, but also in a host of other characteristics related to products, markets, technological capabilities, firm size, management and organisation. Some of these characteristics may be correlated with participation.[16] In this situation, any attempt to infer program impact by comparing the performance of participants with non-participants will produce biased estimates of the effects of the given program. This is a particular case of 'selection bias',

15 It may appear that such designs are not feasible for business programs because they might be perceived as discriminatory. However, if a program budget is capped and the cap binds, then some firms miss out anyway. The idea of experimental design is to achieve random allocation of limited program funds among eligible firms — which may be fairer than some alternatives (such as first-past-the-post).

16 Note, sample selection bias arises only if there is some systematic correlation between the unidentified characteristics and the program variable. If the overall effect of the unidentified characteristics on performance is random, then they do not bias the program impact estimates.

because the comparison groups of participants and non-participants do not represent unbiased random sampling from the population. The bias arises because participation is based on 'self selection' and government-determined eligibility conditions rather than random allocation.

For example, compared with non-applicants, a firm that participates in the EMDG program:

- is likely to have significant intentions for exporting;
- is likely to have a higher export intensity (in order for program participation to be attractive);
- may be better equipped to cope with the compliance burdens of government programs; and
- must satisfy eligibility conditions for the program.[17]

Therefore, quite independent of any real effects of the program, it is likely that export growth of EMDG participants will be higher than non-participants because applicants self-select participation in the program and must pass through some administrative filters that weed out those that are unlikely to increase exports significantly.

The goal of evaluation is to measure a program's effect while screening out the effects of the firm's propensity to choose the program. Moffitt (1991) and Heckman et al (1999) describe the problem in detail. One approach is to use panel data, such as the BLS, and to compare the growth in the variable of interest between participants and non-participants. For example, if interest is centred on exports, comparing export *growth* of EMDG participants versus non-participants deals with the impact of unobserved firm fixed effects that may bias the impact of the program on exports. However, as noted above, selection bias problems will probably remain in some cases, and are still suspected for export growth in the EMDG program.

The simplest method is to include in the export regression any variables that are likely to affect exports or participation in the program — what Heckman et al (1999, p. 143) have termed the 'kitchen sink' estimator. This regression method assesses whether there is a statistical relationship between program participation and a target variable when the effects of other variables on the target have been

[17] For example, to be eligible for the EMDG scheme, a firm must have income less than $50 million, exports of less than $25 million, have an acceptable export plan, have received less than 8 grants and spend above a certain marketing expenditure floor (information sourced from www.austrade.gov.au). The value of the grants after the 2nd year may fall substantially if the participant does not achieve sufficient export earnings (the 'export performance test'), so that with compliance burdens, firms with low export outcomes have incentives to exit the program.

controlled statistically. This is a regression-based technique for 'matching' non-participating (control) and participating firms. This approach can yield relatively good estimates of the true effect of participation (Heckman et al 1999, p. 144). It is the approach adopted in this study.

This approach is generally only appropriate when the major differences between control and participating groups are observable. If there are unobserved characteristics that explain program choice, then other methods, such as the Heckman two-step estimator (Heckman, Hotz and Dabos 1987; Jarmin 1997; Greene 1995, pp. 637ff) are warranted, but these require appropriate instruments, which may be lacking. For example, if a certain state business program is absent in some states because of political decisions, then location by state can be used as an instrument for identifying program impact. An ideal instrument has the property that it can influence participation in the program but not firm performance.

General equilibrium effects

Even if appropriate estimates of the genuine impact of a program on a firm can be obtained empirically, this need not say much about the aggregate economic effect of the program. This is largely because of displacement effects.[18] Resources are scarce, so that their use in one activity leads to their displacement from others. Accordingly, exports may rise among participating firms, but may be displaced elsewhere. Alternatively, if exports are not displaced, other output is likely to be displaced. Computable general equilibrium (CGE) models of the kind that are routinely used to examine trade policies take account of these effects, but are rarely used in the evaluation of business programs.

This report does not use a CGE approach, but cautions that the effects that may appear to hold for participants in programs may be weaker once general equilibrium effects have been considered.

Timing issues

The BLS covers a relatively short period. Most analysis is based on the effect of a program over a single year, although some analysis considers a four year time frame. One possible concern is that the BLS does not indicate whether a firm might have participated in the relevant program in the past. There may be biases in

[18] In some cases there may be positive feedback effects that mean that the national impact may be greater than the sum of the effects felt by the participating firms. That could be true, for example, if the R&D induced by an R&D program in one firm encouraged a competing non-program participant to increase its R&D.

measuring the impact of participation because some apparent 'non-participants' are really ex-participants. The bias may have two components:

- To the extent that a program has enduring impacts on the level of exports or R&D after participation has lapsed, then the measured level of the relevant performance variable in the 'control' group is higher than would be the case had none of the control group firms ever participated in the business program. However, this study has avoided examining *levels* of exports or R&D — where this criticism would be most relevant — and has examined changes in R&D and exports associated with transitions into or out of a program.
- To the extent that the effects of program participation on firm performance take some years to have their full effect, then the performance of the 'control' group during the observation period partly reflects the past participation of some of that group in business programs, while the performance of the 'treatment' group only incompletely captures the long-run effects of program participation. This brings the performance of the two groups closer together, underestimating the actual long-run effect of program participation. This problem is not solved through differencing.

The problem of lapsed participation also has the potential to bias the probit estimates of participation likelihood, because lapsed participants are treated as if they were like permanent non-participants.

2.4 The application of regressions to estimate program impact

The role of regressions

The goal of the regression analysis is to derive a parsimonious model of firm performance that measures the effects of participating in a business program, controlling for other factors that also shape performance. It is a simplification:

- Many variables are omitted, firstly because there are no data on them and secondly, having too many variables poses the risk of overfitting and finding spuriously 'significant' regressors. The problem of missing variables arises because of the lack of adequate quantitative information in the BLS (or for that matter, other information sources) about the factors driving the development of the firm. This is partly because of commercial confidentiality considerations and partly because of difficulties in quantifying factors like competitive pressures, organisational efficiency, managerial expertise, risk-taking, knowledge and skills. Some of the variables used in the regressions provide (rather imperfect)

proxies to these fundamental driving variables.[19] Good econometrics is not about maximising R^2, since this invariably leads to models in which every conceivable variable is thrown into an equation in an attempt to improve fit rather than understanding. The regression models used in this study are relatively simple: there are a small number of 'focus' variables which are our prime interest (the program proxies) and a modest set of 'nuisance' regressors (variables whose coefficients are not of prime interest, but which are intended to control for the other factors that shape firm performance).

- In the productivity growth regressions a simple log-linear functional form is adopted, which is at best a local approximation to the effects of government programs and other variables affecting firm performance.
- It is likely that the effects of programs will not be constant over time. The regressions in this paper pool across time periods. However, some analysis is conducted to test whether the timing of participation counts has any marked effects.
- There is significant noise in the data due to reporting errors and differences between accounting measures and their appropriate analogue in economic theory (for example, in measures of capital intensity).
- Causality is difficult to establish because firm performance can affect the likelihood of program participation, as well as responding to it (an issue we discuss further below). The fact that there is a possible two-way relationship between firm performance and participation in government business programs may lead to estimation biases.

Despite their limitations, the regression results are likely to provide more accurate estimates of program impact than comparisons of averages between 'treatment' and 'control' groups.

The minor importance of program variables

An important feature of the data that should be highlighted is the small size of business program subsidies compared with total value-added or turnover. As shown in table A.4 in the appendix, on average the six program subsidies combined amount to less than 0.7 per cent of total value added and 0.2 per cent of total sales in the sample. This implies that, unless dramatically successful, the contribution of

[19] A similar problem, concerning the limited explanatory power of BLS data to account for variations in innovation between firms, is reported by Rogers (2000). Another study (Phillips 1997), which used firm-based panel data from the ABS innovation survey, also found much 'idiosyncratic' variation between firms that could not be explained using the observations from the survey.

the programs to economywide changes, such as sales, exports and productivity growth is likely to be relatively small compared with other factors that drive the development of the economy. At the level of the firm, however, program support can be more significant, which is why firm-level data are a better vehicle for examining the impact of government business programs than aggregate data. However, even at the firm level, it is likely that coefficients on program variables will be subject to relatively large estimation errors that are probably not captured by the published standard errors. This is why the qualitative aspects of the regression findings rather than exact magnitudes are emphasised in chapter 4.

2.5 Performance indicators for program evaluation

In this study four performance indicators are used: the growth in exports, R&D expenditure, labour productivity and firm survival.[20] Before examining the regression results (chapters 3 and 4), it is useful to examine the relevance of the performance indicators selected for program evaluation.

The ultimate objective of business programs is an increase in economic efficiency — measured as the ability to generate more output from existing inputs — even if the initial target objective is something else, such as more exports or R&D. A full program evaluation must therefore examine at least two major issues:[21]

- that the program affects the proposed target variables (such as R&D, export marketing or exports). If it does not, then the program has failed to achieve even its proximate objective; and
- that increasing the level of a target variable translates into greater economic efficiency. Even if a program is extremely effective in stimulating a target variable, such as exports, it may fail this criterion if the induced exports reduce national welfare — as they may well when they are subsidised.

This report mainly addresses the first issue. However, by also examining program impacts on labour productivity growth, the study also assesses the strength of a possible route by which stimulated exports or R&D might also affect economic efficiency. On the other hand, it should be emphasised that knowledge-based spillovers outside the firm may be important and are overlooked in a firm-based study of this kind.

[20] The change in labour productivity measure is nominal, thus ignoring the effect of inflation. This would be generally picked up by the constant in the regression, and in any case, there were low rates of inflation over the relevant sample period.

[21] A comprehensive treatment of the wider requirements for social cost-benefit assessments of business programs is in BIE (1993a), BIE (1993b) and Lattimore et al. (1998).

3 Program participants

This chapter examines the characteristics of firms that received support. The chapter first describes the six business programs examined in this paper (section 3.1), examines some theoretical priors about factors that may affect participation (section 3.2) and, finally, presents some modelling results.

3.1 The programs examined

R&D tax concession

The R&D tax concession is the Federal Government's principal incentive for business R&D. While its features have been changed over time, it offers a concessional rate of tax deduction for eligible R&D expenses. The concessional rate was 150 per cent prior to 1996-97, but then fell to 125 per cent (and has since been amended again). Companies must be registered with the Industrial Research and Development (IR&D) Board and demonstrate that the R&D activities satisfy statutory eligibility requirements.

The amounts recorded in the BLS for the tax concession refer to the value of the R&D expenditure that was *claimed* for the tax concession in 1996-7 by the management unit, rather than the subsidy value of the tax concession itself.

R&D grants

R&D grants cover between 20 and 50 per cent of the cost of selected R&D projects carried out by small and medium sized Australian enterprises. R&D grants are part of the *Start* program — a comprehensive merit-based assistance scheme. Applications for assistance are assessed by the IR&D Board. Expenditure on R&D grants amounted to $165 million in 1996-7.

Export Market Development Grants (EMDG)

The EMDG, run by Austrade, is the largest export marketing support program in Australia. In 1996-7 a total of $215 million in grants was paid to 3 553 companies — in 1997-8 a total of $147 million was paid to 3 029 companies.

Under the EMDG, up to 50 per cent of eligible promotional expenditure in excess of $15 000 is reimbursable to a maximum grant of $200 000 per year. Participating companies must spend at least $20 000 on eligible export promotion a year. Support is restricted to small and medium sized enterprises, because eligible firms must have export sales under $25 million and total income under $50 million a year. An export performance test applies after the third year, requiring applicants to exceed a certain minimum export-grant ratio in order to qualify for the full grant (section 4.3). A business may receive grants for up to eight years. After this, a further three grants for each new market development may be available (Austrade 1999).

Austrade services

Austrade provides market intelligence and a range of business and advisory services to Australian exporters through its network of offices around the world. Payments by clients cover part of the costs. The net operating costs of Austrade's International Business Services amounted to $65 million in 1996-7 and $100 million in 1997-8 (Austrade 1997 and 1998).

Export Access

Export Access — also administered by Austrade — is targeted at small business. The program employs specialist export consultants to help small companies enter export markets. In 1997-8, $3.7 million was allocated to Export Access. The program assisted over 400 enterprises in that year.

International Trade Enhancement Scheme (ITES)

ITES is a discretionary concessional loan scheme administered by Austrade. It provides loans at concessional rates of interest to assist export promotion and market research for established exporters. ITES support is given mainly to large enterprises. In June 1996, ITES had 94 clients, with commitments valued at $125 million. No new clients were admitted to the scheme after that time, but Austrade continues to provide funds under existing commitments (Austrade 1998).

Other programs

The BLS contains participation data on a number of other State and Federal government programs. Average participation counts are shown in chapter 4. Since the focus of these programs is neither on R&D nor on export market development, they are excluded from most of the analysis presented in this paper. The R&D concessional loan scheme is part of the excluded group, because there is not enough information in the BLS to analyse this program in detail.

3.2 Modelling participation in government programs

Participation in government programs is a complex process (figure 3.1). The nature of the program design, including its promotion, eligibility, subsidy levels and reporting requirements, affects which sorts of firms find it attractive. There should be no presumption that the existence of a subsidy necessarily makes a program attractive. Some firms face high transaction costs in finding out about programs, in applying and then meeting reporting or other requirements. These may be sufficiently high that participation is deterred. Some firms have characteristics that are more amenable to taking up a program. For example, a firm is more likely to find a program attractive if it:

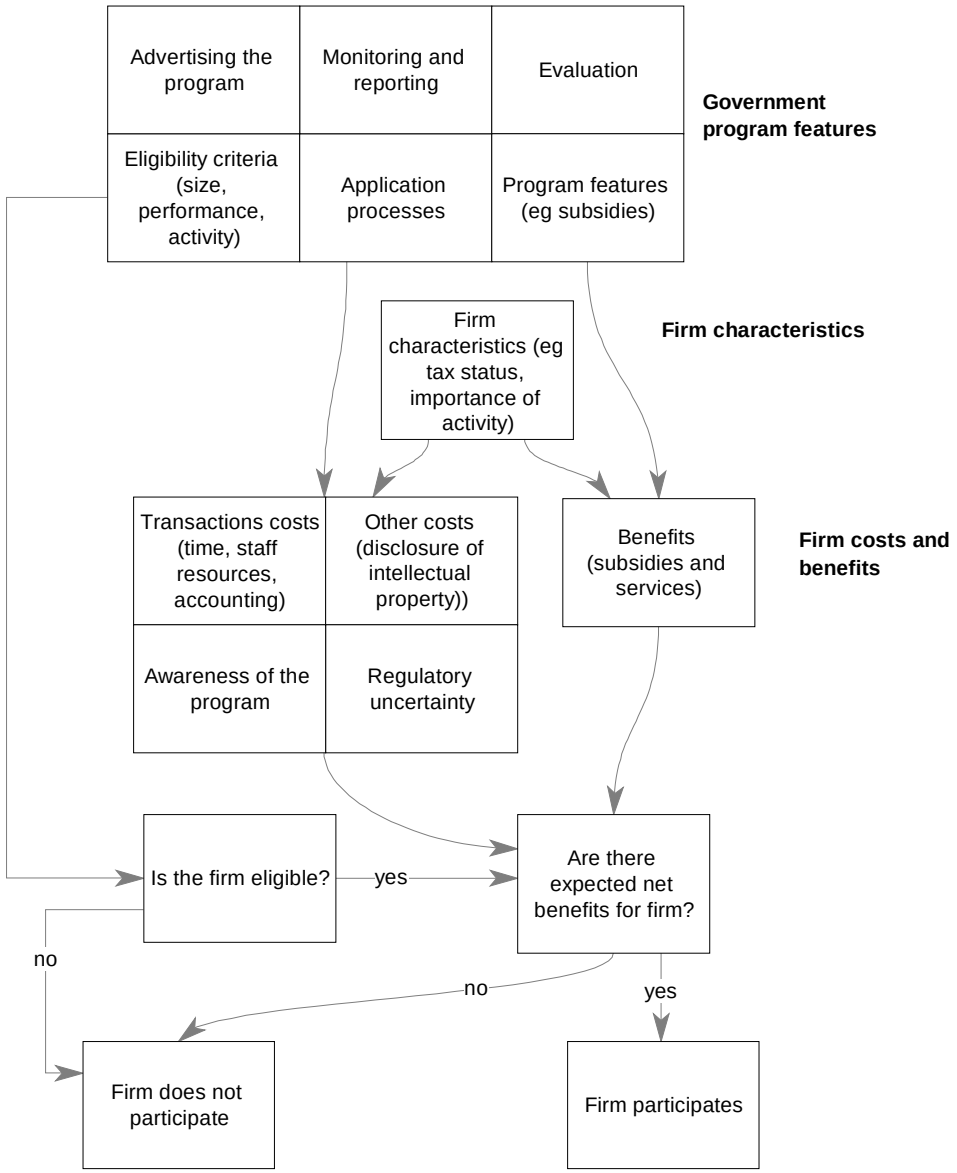
- has a comparative advantage in dealing with government (typically larger firms);
- can spread the costs of applications and other transactions costs across a bigger subsidy (larger firms again);
- considers that the subsidised activity is central to its business; and
- has the ability to benefit from the subsidy in the current period (for example, firms in tax loss would obtain only deferred benefits from the R&D tax concession).

The determination of whether a firm participates or not depends both on the filter posed by eligibility criteria and the judgement of firms about the net expected benefits of participation.

Observations on these underlying determinants of program takeup are not available. However, there is a range of proxies. For example, firm size and age of the business is likely to affect the magnitude of transaction costs relative to the benefits of program participation. The foreign status of companies may affect their eligibility in some cases (for example, whether they pass the national interest test for eligibility for the R&D tax concession). Certain industries undertake more of the activities at

which the business programs are targeted. Firms in tax loss would, all other things being equal, find tax concessions less attractive than grants.

Figure 3.1 **The decision to participate**



Also of substantial interest is whether the kind of firms that participate in government programs are high or low performers, since this may be subsequently confounded with the *effects* of program participation. This chapter explores the sorts of firms that participate in government business programs using both simple cross-tabulation results and more sophisticated statistical techniques.

3.3 Participation counts and transitions

As indicated in sections 1.3 and 2.1, two types of proxies for business programs are used in this study:

- the number of participation counts in each of the six programs over four years; and
- the transitions between participation and non-participation over consecutive years.

Transitions in participation

The sequence of participation levels over four years is presented in table B.2 in the appendix (participation in a given year is represented by one and non-participation by zero). Overwhelmingly, most firms in the sample of firms that are targeted by the business programs do not participate at all in any given program (table 3.1). The R&D tax concession is the most popular program, reflecting its generally unrestricted eligibility criteria.

Table 3.1 **Participation rate, 1993-94 to 1996-97**

	R&D tax concession	*R&D grants*	*EMDG*	*Austrade services*	*Export Access*	*ITES*
Participation rate (%)	23.2	7.0	16.2	13.7	5.8	1.6

a Share of firms participating at least once in the 4 years.

Source: Table B.2 in appendix B.

Table 3.2 presents the summary of transition counts. Given that there are 1848 firms in the sample, and each is subject to three consecutive transitions over four years (between the first-second, second-third and third-fourth years) the total number of transition counts amounts to 5544 for each program.

Table 3.2 **Number of occurrences of transitions in various programs: 1993-94 to 1996-97**

Transitions[a]	*R&D tax concession*	*R&D grants*	*EMDG*	*Austrade services*	*Export Access*	*ITES*
00	4490	5282	4878	5014	5332	5488
01	171	79	136	136	74	20
10	290	125	206	220	94	26
11	593	58	324	174	44	10
Total	5544	5544	5544	5544	5544	5544

a Positive participation is indicated by one, non-participation by zero.

Source: Table B.2 in the appendix.

Some programs, such as R&D grants and Export Access, are typically used by (small) firms that make one-off use of the program. Continuing users of such programs represent only 40 per cent of total program users in any given year. Other programs, such as the R&D Tax Concession and the EMDG program are more typically used by (larger) firms on a more continuous basis. Continuing users of such programs outnumber new users by three to one (that is, they comprise 75 per cent of total program users in any given year).

The number of firms that recorded leaving a program is around 30 per cent higher than those that recorded joining one. This suggests a declining number of participants. Information on the number of program participants over time was not collected from other sources to assess whether this is a genuine feature of the take-up of the relevant government programs or a survey artefact.

Participation counts

The number of participation counts over the four years of the BLS provides a proxy for the intensity of reliance by firms on government programs (table 3.3). These data provide another view on the degree to which firms make multiple usage of individual programs. For most programs, the probability of multiple usage is quite low. For example, the probability of getting an R&D grant on four occasions is about $1/80^{th}$ of a single usage. In contrast, the probability of multiple usage is high for the R&D tax concession and the EMDG scheme (with the probability of four successive uses being just a little less than that for a single use of the R&D tax concession).

Table 3.3 **Dissection of respondents by programs and participation counts in the full sample**

	Number of participation counts					
	0	*1*	*2*	*3*	*4*	*Non-zero*
R&D tax concession	1419	128	95	100	106	429
R&D grants	1719	82	35	11	1	129
EMDG grants	1549	117	73	56	53	299
Austrade services	1594	121	86	38	9	254
Export Access	1741	74	21	10	2	107
ITES loans	1819	22	4	3	0	29

Source: Unpublished data from the ABS BLS survey.

Program participation tends to be higher in large firms than small ones (table 3.4). This is likely to reflect a number of factors. For example, large firms are typically more diverse than small ones and thus more likely to engage in activities that are

eligible for the relevant government programs. They can also better economise on compliance costs of participation relative to the subsidy received. However, this size effect appears to diminish after a certain size for some programs, such as export access and the EMDG scheme — both of which have criteria that tend to filter out the largest firms. Moreover, when expressed as a participation count per 1000 employees, smaller firms, not larger ones, have a higher participation intensity.

The average subsidy rate is the best measure of the degree of relative support of differently sized firms. Unfortunately, the average subsidy rate is only available for R&D subsidies. This suggests that the highest degree of support is given to medium-sized enterprises, rather than the largest or smallest firms (table 3.4).

Table 3.4 **Number of participation counts by firm size**

Number of participation counts	*1-20*	*21-100*	*101-500*	*500+*	*All*
R&D tax concession	153	444	214	222	1033
R&D grants	37	83	39	29	188
EMDG grants	132	330	118	55	635
Austrade services	78	240	76	46	440
Export Access	42	86	15	10	153
ITES loans	7	10	11	11	39
All programs	449	1193	473	373	2488
Number of firms in the sample	886	675	181	106	1848
Counts per firm					
R&D tax concession	0.17	0.66	1.18	2.09	0.56
R&D grants	0.04	0.12	0.22	0.27	0.10
EMDG grants	0.15	0.49	0.65	0.52	0.35
Austrade services	0.09	0.36	0.42	0.43	0.24
Export Access	0.05	0.13	0.08	0.09	0.08
ITES loans	0.01	0.01	0.06	0.10	0.02
All programs	0.51	1.77	2.61	3.52	1.35
Counts per 1000 employees	68.5	37.8	12.3	3.1	12.5
R&D subsidies to sales in 96-7 (%)	0.10	0.22	0.38	0.26	0.18

Source: Unpublished data from the ABS BLS survey.

There are marked disparities between industries in both subsidy and participation rates (table 3.5).

Table 3.5 **Dissection by industry — share of R&D subsidies to sales in 1996-7 and participation rates in export programs over four years**

Industry	*R&D subsidies to sales*	*Participation rate EMDG*	*Participation rate Austrade*
	%	%	%
Mining	0.06	0.10	0.03
Processed food	0.05	0.57	0.37
Textiles & clothing	0.02	0.31	0.22
Wood and paper	0.02	0.18	0.11
Printing and publishing	0.00	0.18	0.08
Chemicals	0.17	0.36	0.21
Pharmaceuticals	0.00	0.29	0.86
Non metallic minerals	0.04	0.22	0.22
Basic metal processing	0.09	0.28	0.22
Machinery and transport equipmt	0.17	0.31	0.31
Scientific instruments	0.03	0.57	0.39
Electronic equipment	0.40	0.90	0.55
Furniture and miscel. manfg	0.01	0.33	0.20
Engineering services	0.00	0.27	0.15
Computer services	0.04	0.31	0.15
Total	0.08	0.35	0.24

Source: Table B.1 in the appendix..

3.4 Logit and Poisson regressions

One of the objectives of applying regression analysis in this study is to identify some of the more important characteristics of program participants that distinguish them from non-participants. Two types of regressions are used — logit and Poisson.

In the logit regressions discussed in this section, the dependent variable is a binary number (zero or one) denoting whether or not the firm participated at least once in the program during the four year study period. In the Poisson regressions, the dependent variable is the number of participation counts recorded by the firm during the study period.[1] This variable can range between zero and four for individual programs, but can reach higher values when the count of all R&D or all export programs are combined into an aggregate variable.

[1] The error term in Poisson regressions is assumed to conform to a Poisson distribution rather than a normal (Gaussian) distribution. Poisson regressions are well suited to model dependent variables whose value is usually zero or a small integer number, as is the case with participation counts.

The logit and Poisson regressions of R&D programs are restricted to a sub-sample of the population that has reported at least some R&D expenditure during the study period. Similarly, in the regressions of export programs, only firms that reported exporting at least in one year are included in the regression sample.

Table 3.6 identifies by pluses or minuses those variables that are statistically significant in R&D related participation regressions and their level of significance. The full set of results are presented in tables B.4 and B.7 in the appendix. The industry dummy variable that has been omitted from the regressions is textiles and clothing, which explains why most industry variables have a positive coefficient.[2]

Financial variables such as value added per person, value of assets per person, the profit-equity ratio, exports-sales ratio and non-R&D innovation expenditure per person, are based on results in the first year of the survey (1994-5). Using initial values improves the suitability of these variables to serve as predictors rather than outcomes of participation during the study period.

Despite the fact that the logit and Poisson regressions are based on different methods and different dependent variables, they tend to point to the same set of variables as being strong predictors of participation by R&D performing firms in R&D programs. Variables that show statistically significant positive links include: the age of the firm, initial R&D intensity, value of assets per person, export intensity, performance of formal business planning, increased on-the-job training and belonging to the chemicals, machinery/equipment, instruments or electronics industries. Statistically significant negative predictors of participation in R&D programs include foreign ownership, value added per person, non-R&D innovation expenditure per person and the introduction of non-technical innovations.

Significant positive predictors of participation in export marketing programs include initial export intensity, as well as carrying out business planning, export planning or budget forecasting (table 3.7).[3] Significant negative predictors include foreign ownership, purchases per person and increases in 'other' training. Among industries, positive predictors include electronics, processed food and miscellaneous manufacturing, while mining is a significant negative predictor of participation. These sectoral findings are in line with the dissection of export program participation rates by industry presented in table 3.5.

2 Not shown in table 3.5 are the firm size groups, because the relationship between participation and firm size is more clearly displayed in table 3.4 than in the regressions.

3 Table 3.7 shows the results for the two major export programs, the EMDG and Austrade services. The results for Export Access and ITES are presented in tables B.6 and B.9 in the appendix.

Table 3.6 **Logit and Poisson regressions of R&D programs**[a]

	All R&D programs		R&D tax concession		R&D grants	
	Logit	*Poiss*	*Logit*	*Poiss*	*Logit*	*Poiss*
Firm age		+ + +		+ + +		
Foreign ownership		- - -	- -	- - -	-	- - -
Log value added per person[b]	- -	- -		- -	- -	- -
Purchases per person[b]						
Assets per person[b]	+ +	+ + +	+ + +	+ + +		+ +
Profit-equity ratio[b]						
Non-R&D innovation expenditure per person[b]	- - -	- - -	- - -	- - -	- - -	- - -
Exports to sales ratio[b]	+ +	+ +	+	+	+	+ +
Debt-equity ratio[b]						
Firm size	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Industry: Mining						
Processed food						
Wood and paper products						
Printing and publishing						
Chemicals	+ + +	+ +	+ + +	+ + +		
Pharmaceuticals						
Non-metallic minerals			+			
Basic metal processing		+	+			
Machinery and transport equipment	+ + +	+ + +	+ + +	+ + +		+
Medical and scientific instruments		+ + +	+	+ + +		+ + +
Electronics	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Furniture and miscellaneous	+	+ +		+		
Engineering services						
Computer services	+ +	+ + +	+ +	+ + +		+ +
Over 20% of innovations from outside	-	- -		-		
Introduced non-technical innovations	- -	-	- - -	- -		
Performed formal business planning		+ +		+		+ +
Performed budget forecasting					+	+
Increased management training		- -		- - -		
Increased on-the-job training		+ + +	+	+ + +		+ +
Increased other training						
Networked with other firms				+		
Benchmarked against other firms						

a The sample is restricted to R&D performers. The symbols mean the following: + Significant at the 10 per cent probability level (positive). ++ Significant at the 5 per cent probability level (positive). +++ Significant at the 1 per cent level (positive). - Significant at the 10 per cent probability level (negative). - - Significant at the 5 per cent probability level (negative). - - - Significant at the 1 per cent level (negative)). **b** Financial variables are based on results in the first year of the study (1994-5).

Source: Tables B.4 and B.7 in the appendix.

Table 3.7 **Logit and Poisson regressions of export programs**[a]

	All export programs		EMDG		Austrade services	
	Logit	*Poiss*	*Logit*	*Poiss*	*Logit*	*Poiss*
Firm age			-	- -	+ +	+ +
Foreign ownership	- - -	- - -	- -	- - -	- - -	- - -
Log value added per person[b]						
Purchases per person[b]	- - -	- - -	- -	- - -	- -	- - -
Assets per person[b]						
Exports to sales ratio[b]	+ + +	+ + +	+ + +	+ + +	+ +	+ + +
R&D expenditure to sales ratio[b]						
Profit-equity ratio[b]			- -	-		
Debt-equity ratio[b]						
Firm size	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +
Industry: Mining	- - -	- - -	- -	- - -	- -	- - -
Processed food	+		+ +	+ +		
Wood and paper products						
Printing and publishing		- -			-	- -
Chemicals						
Pharmaceuticals	+				+	+ +
Non-metallic minerals						
Basic metal processing						
Machinery and transport equipment	+ +					+
Medical and scientific instruments					+	
Electronics	+ +	+ + +	+ + +	+ + +	+ +	+ +
Furniture and miscellaneous	+ + +	+ +	+ + +	+ +	+	
Engineering services			+ +	+ + +		
Computer services						
Performed formal business planning		+ + +		+ +		+ +
Performed budget forecasting	+	+ +	+ + +	+ + +		
Increased management training		+ +		+ + +		
Increased on-the-job training						
Increased other training		- -		-	- -	- -
Networked with other firms			+	+ + +		
Benchmarked against other firms						
Performed export planning	+ + +	+ + +	+ + +	+ + +	+ + +	+ + +

+ Significant at the 10 per cent probability level (positive). **++** Significant at the 5 per cent probability level (positive). **+++** Significant at the 1 per cent level (positive). **-** Negative significant at the 10 per cent probability level. **- -** Negative significant at the 5 per cent probability level. **- - -** Negative significant at the 1 per cent level. . **a** Financial variables are based on results in the first year of the study (1994-5). **b** The sample is restricted to exporters.

Source: Tables B.5 and B.8 in the appendix.

The finding that the undertaking of export planning is a strong positive predictor of participation is consistent with the fact that the preparation of an export plan is a pre-condition for receiving EMDG grants. Austrade also encourages clients of its other services to prepare export plans.

While the logit and Poisson regressions identify a number of factors which have a significant influence on participation in programs, the explanation of the factors underlying participation is still very partial. This is illustrated by the low to moderate goodness-of-fit regression indicators presented in appendix B.

3.5 Correlations between programs

There are significant positive correlations between the participation counts of all four programs examined, including between R&D and export programs (table 3.8), so that firms that use one program appear more likely to use other programs. The positive correlations between participation counts are partly due to the fact that large firms tend to record higher participation counts in a number of programs.

Table 3.8 **Correlations between key programs**

	R&D tax counts	*R&D grants*	*% R&D subsidies*	*EMDG counts*	*Austrade counts*
Unweighted					
Count of R&D tax concession	1.000	0.326	0.147	0.333	0.323
Count of R&D grants	0.326	1.000	0.129	0.264	0.221
% R&D support/income	0.147	0.129	1.000	0.114	0.067
Count of EMDG	0.333	0.264	0.114	1.000	0.454
Count of Austrade	0.323	0.221	0.067	0.454	1.000
Weighted					
Count of R&D tax concession	1.000	0.431	0.105	0.165	0.366
Count of R&D grants	0.431	1.000	0.043	0.179	0.478
% R&D support/income	0.105	0.043	1.000	0.045	-0.012
Count of EMDG	0.165	0.179	0.045	1.000	0.283
Count of Austrade	0.366	0.478	-0.012	0.283	1.000

Source: Table C.1 and C.2 in the appendix.

3.6 The influence of firm characteristics on transitions

Apart from investigating the influence of firm characteristics on participation counts, the links between firm characteristics and *transitions* in participation were also explored.

For the sake of comparative analysis, transitions can be divided into two groups. The first is positive or increasing participation, represented by the binary codes 11 and 01 (denoting positive transitions). The other category is zero or declining participation, represented by the codes 00 and 10 (denoting non-positive transitions). Given the close relationship between transitions and participation, not

surprisingly the findings are generally in line with those for participation counts discussed in the previous sections.

Tables D.5 and D.7 in the appendix present the logit regression results for positive transitions. For both transitions 01 and 11, statistically significant positive links are indicated with respect to firm size. Medium and high-tech industries, such as machinery, instruments and electronics show statistically significant positive links with consistent participation (code 11) in the R&D tax concession. Value added per person in the first year is negatively (and significantly) related to positive transitions, suggesting that (holding capital-labour ratios and other variables constant), firms with lower than average levels of productivity tend to select program participation. Assets per person is positively related to consistent participation (code 11).

Tables D.4 and D.6 in the appendix present the logit regression results for non-positive transitions. Consistent non-participation (code 00) is negatively and significantly related to firm size, in line with the earlier finding that small firms are less likely to participate in business programs. However, transition out of a program (code 10) is positively related to firm size, because to leave a program is by definition conditional on prior participation, which is more common among larger firms. Firm age and foreign ownership are positively related to consistent non-participation (code 00) but are negatively related to leaving a program (code 10).

3.7 Intentions and participation

The following six survey questions about intentions are analysed in this study:

- intentions to increase production;
- intentions to decrease production;
- intentions to increase exports;
- intentions to introduce new goods and/or services;
- intentions to sell the business; and
- intentions to close the business.

The binary responses to these questions were included among the explanatory variables in logit regressions of transitions in participation. The question about intentions appeared in all four survey forms. For the purpose of this analysis, intention is examined in the base year of participation. In other words, in the transition of participation from t to t+1 the relevant intentions were formed in year t.

As shown in tables D.5 and D.7, the intention to increase production or to increase exports is positively and significantly related to positive transitions (codes 01 and 11). Conversely, these intentions are negatively related to consistent non-participation (code 00 in table D.4). Transition out of the EMDG and Austrade services (code 10 in table D.6) is significantly and positively related to the intention to increase production and exports. This is a somewhat unexpected finding, but may reflect the ineligibility of firms for EMDG if their exports grow above a threshold.

Apart from the intentions regarding production and exports, other intentions tend not to show statistically significant associations. Negative intentions, such as the intention to decrease production or to sell or close the business, tend to be negatively related to positive transitions and positively related to non-positive transitions. However, the regression coefficients lack statistical significance.

A more detailed picture on intentions is presented in tables D.1, D.2 and D.3 in the appendix. These tables cover transitions in using the EMDG, Austrade services and the R&D tax concession. The tables show the frequency of positive replies (as a percentage of the total) to the six intention questions. The results from the tables are in line with those indicated by the logit regressions of transitions.

3.8 Reasons for not using business programs

The 1995-6 survey contained a question asking for the reason(s) for not using government programs. Eight optional answers were given, with the option to tick more than one box. The distribution of responses by firm size is shown in table 3.9.

As evident from these percentages, ‘no reason to seek assistance’ and ‘not applicable to this industry’, are the principal reasons given for not using programs. These replies came mainly from firms that have not undertaken any R&D or eligible export market development activities. Small firms were much more likely to cite lack of knowledge about programs or contacts and excessive paperwork requirements as barriers to program participation.

Analysis of the BLS database revealed that more than a quarter of the firms that indicated a reason for not using government programs have actually used some of the six programs examined here at least once during the four year study period. It appears that in many cases the reply about the reason for non-participation does not relate to all business programs, but only to some (unspecified) program that the respondent has decided not to use. Table 3.10 dissects the responses according to the status and timing of using business programs.

Table 3.9 **Percentage of respondents who indicated some reason for not using business programs**

	Firm size — number of persons employed				
	1-20	*21-100*	*101-500*	*500+*	*All*
	%	*%*	*%*	*%*	*%*
Not applicable to this industry	25.8	16.6	24.6	31.1	22.6
Programs poorly designed	5.2	4.2	2.2	1.9	4.3
Suitable only for big business	21.0	10.3	3.9	0.0	14.2
No reason to seek assistance	37.9	34.5	31.3	33.0	35.7
No knowledge about programs	19.7	13.7	10.1	4.7	15.7
Not knowing whom to contact	8.7	4.5	3.4	0.0	6.2
Too much paperwork required	19.2	18.0	8.4	5.7	16.9
Other reasons	2.5	3.7	2.2	2.8	2.9

Source: Unpublished data from the ABS BLS survey.

Table 3.10 **Participation in programs by those who indicated some reason for non-participation**

	Participation status in programs			
	Did not use any program	*Used in 95-6 or 96-7*	*Already used in 93-4 or 94-5*	*No. of positive replies*
	%	%	%	
Not applicable to this industry	78.0	6.7	15.3	419
Programs poorly designed	68.8	5.0	26.3	80
Suitable only for big business	78.7	3.0	18.3	263
No reason to seek assistance	75.0	7.7	17.2	661
No knowledge about programs	74.2	8.2	17.5	291
Not knowing whom to contact	80.7	6.1	13.2	114
Too much paperwork required	68.4	4.5	27.2	313
Other reasons	72.2	5.6	22.2	54

Source: Unpublished data from the ABS BLS survey.

As indicated in table 3.10, around a quarter of those who indicated some reason for non-participation were actually involved in an R&D or export program, or both, during the study period. Interestingly, more than 27 per cent had already used a business program in the two years before the question was posed (1995-6). Among those who responded in the affirmative to the 'program poorly designed' or 'too much paperwork required' options, more than 31 per cent have used a business program during the study period.

Analysis of the reasons for non-participation in terms of various firm characteristics (presented in tables B.10 and B.11 in the appendix) suggests that:

- ‘middle-aged’ firms (aged 5-10 years), sole proprietor run businesses and partnerships tended to have less knowledge about programs than other firms;
- compared to other business types, sole proprietor businesses were more likely to claim that there were obstacles to participation in government programs. They claimed that they did not participate because they lacked the right contacts and perceived the programs as geared for big business, poorly designed and involving too much paperwork; and
- compared to domestically owned firms, foreign owned businesses gave most weight to the inapplicability of business programs or lack of interest as the motivation for non-participation, and least weight to factors such as lack of knowledge and contacts or poor program design.

4 Assessing the effects of programs on performance

4.1 Performance indicators and program proxies

This chapter presents exploratory analysis of the effects of business programs on aspects of firm performance. *Methodological difficulties in estimating program impact and the poor quality of data suggest considerable care in interpreting the results.*

The performance indicators used

Four performance indicators are used to examine the statistical links between programs and firm performance:

- The change in labour productivity over the three year period between 1994-5 and 1997-98:

$$\Delta \ln(LP) = \ln(LP)_{1997-98} - \ln(LP)_{1994-95} \quad \{1\}$$

  where LP is labour productivity measured as value added per person. Value added is extracted from the BLS by adding up the total wage bill and total derived profits of each firm. Both items were reported in the survey every year.

- Export growth is measured by annual changes in the exports-sales ratio between 1993-94 and 1996-97. This dependent variable appears in the regressions in the form of year-to-year changes, rather than the combined change over three years. The reasons for this choice will be clarified in the next section.

- R&D growth is measured by annual changes in the R&D expenditure to sales ratio between 1994-5 and 1996-7. Like the exports-sales ratio, the R&D-sales ratio appears in the regressions in the form of separate annual changes. Again, this choice is dictated by the selection of the relevant program proxy to be discussed shortly. Because the R&D expenditure data in the BLS starts from 1994-5, and the last R&D program data is from 1996-7, the R&D-sales ratio regressions cover only two years between 1994-5 and 1996-7.

- Differences in the degree of participation in programs for continuing versus exiting firms — which may test whether firms that participate tend on average to have higher survival probabilities than firms that do not.

All financial variables are expressed in nominal terms (that is, without inflation adjustment). Annual changes in the R&D-sales and export-sales ratios are selected as performance indicators, rather than using the commonly employed $\Delta\log$ specification, in order to avoid inadmissible infinite numbers when the base period figures are zero. This occurs quite frequently in the BLS export and R&D expenditure data. Division by zero is not a problem for value added per person, because the sample covers only firms which reported positive sales, costs and employment throughout the study period.

The choice of variables for program participation

As discussed in section 2.1, the BLS lacks reliable information about the amount of support received by the respondents through business programs. Most information about business programs takes the form of a binary response, indicating participation or non-participation in each program. The ABS advised against the use of the survey data on R&D subsidies in 1996-7, due to data reliability problems.

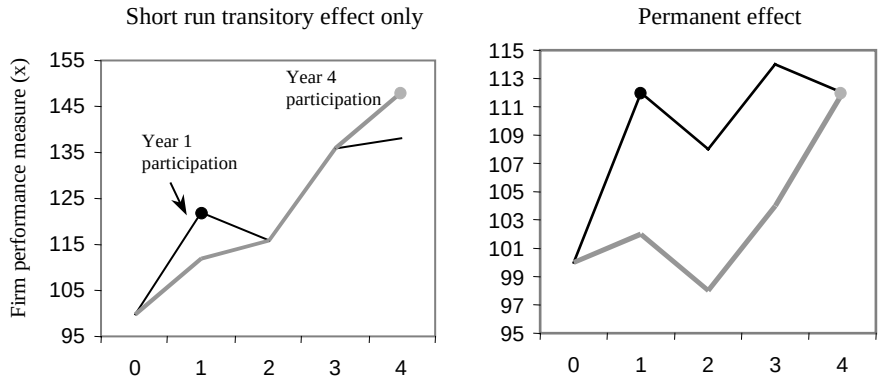
Having to rely on binary participation responses raises some difficult questions about how to choose the most appropriate proxies, if any, for the intensity of participation. One option is to add up participation counts in a program over four years. However this raises two problems.

First, it is not clear that the count total is an appropriate cardinal measure of intensity. Thus a count of four may not generate on the average a four times greater effect on the relevant firm performance measure than a count of one. This issue was examined using F tests for the labour productivity growth regression. The regression was initially specified with separate variables for a count of one, two, three and four. The zero count could be omitted as the 'surplus' dummy (given that the regression included a constant). Denoting the regression coefficients of the four count variables as α_I, the joint hypotheses subject to the F test were $\alpha_2 = 2\alpha_1$, $\alpha_3 = 3\alpha_1$ and $\alpha_4 = 4\alpha_1$. The results from the F tests suggest that in the productivity growth regressions, the hypothesis of proportional effect cannot be rejected at the 0.05 probability level. Consequently, the combined participation count was employed in these regressions.

Second, an aggregate count may confuse timing effects associated with participation in a business program. If participation occurred only in the first year, the effect on a performance measure that spanned several years, as in {1}, might be different from

the case in which the firm did not participate in the program in the first three years, but decided to join the program in the fourth year. If the effect of a program is transitory then the timing of participation is likely to be influential on the estimated program effect. It was considered that transitory effects were much more likely for exports and R&D than productivity. This is because R&D and export programs provide input subsidies (to R&D and marketing respectively) that increase factor demand. An opposite effect could be anticipated as prices rise after the withdrawal of the subsidy. In contrast, if participation in a program increases the stock of knowledge through firm learning, then this should have an effect on the level of productivity that survives the withdrawal from the program (figure 4.1).

Figure 4.1 **Illustrating the different impacts of participation**
as a function of the time series characteristics of the performance variable



a In the first process, illustrated by the left hand chart, the performance variable is trend stationary with the following specification: $x_t = a + bT + c\ D_t + \varepsilon_t$, where T is a time trend, D is a dummy variable indicating participation or not and ε is an error term. It is clear that with such a specification the growth rate in x from time 0 to 4 depends on *when* participation has occurred, even though the contemporaneous effect of participation on x is the same at any time. Indeed, had the firm participated in years 2 and 3 the change in (long-run) x would be the same as if they had not participated at all. In the second process, illustrated by the right hand chart, the performance variable follows a simple random walk: $x_t=x_{t-1} +c\ D_t +\varepsilon_t$. In this case, the long-run change in x is invariant to when participation occurred, because participation has a permanent effect on the performance variable.

After experimentation with regressions incorporating participation counts, participation lags and transitions in participation, it was confirmed that the combined participation count was the most suitable proxy in the labour productivity growth regressions, while transitions in participation were more suitable in the R&D and export growth regressions. As explained in section 1.3, transitions in participation are measured over two consecutive years, with there being four transition possibilities — non participation in both years (denoted 00), participation in both years (11), joining the program in the second year (01) or leaving the program in the second year (10). The annual changes in participation (put in the form of dummy variables) are related in the regressions to the change in the same year in the exports-sales or R&D-sales ratios. For example, the change in the

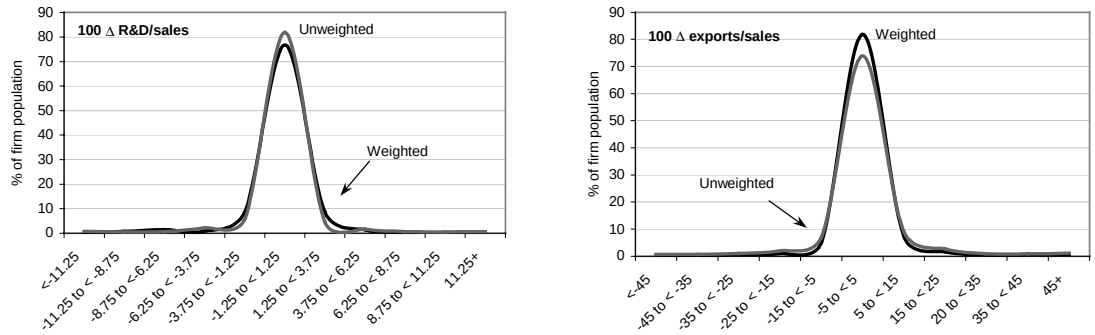
export-sales ratio between 1995-96 and 1996-97 is matched against the participation transition variables from 1995-96 to 1996-97. Note, both the dependent variable and the program variable represent first order (annual) differences. This formulation implies a close proximity in timing between change in participation and change in performance. In addition to these first order differences, the regressions also include several variables describing various firm characteristics.

The distribution of performance indicators

The statistical distributions of the three financial performance indicators employed in this study are shown in figures 4.2 and 4.3. These are illuminating on their own, and also indicate whether the underlying assumptions about the error term in the regressions are likely to be admissible.

It is evident from figure 4.2 that the export and R&D distributions cluster closely around the zero change mark and have excess kurtosis.

Figure 4.2 **Distribution of annual changes in R&D and export indicators**



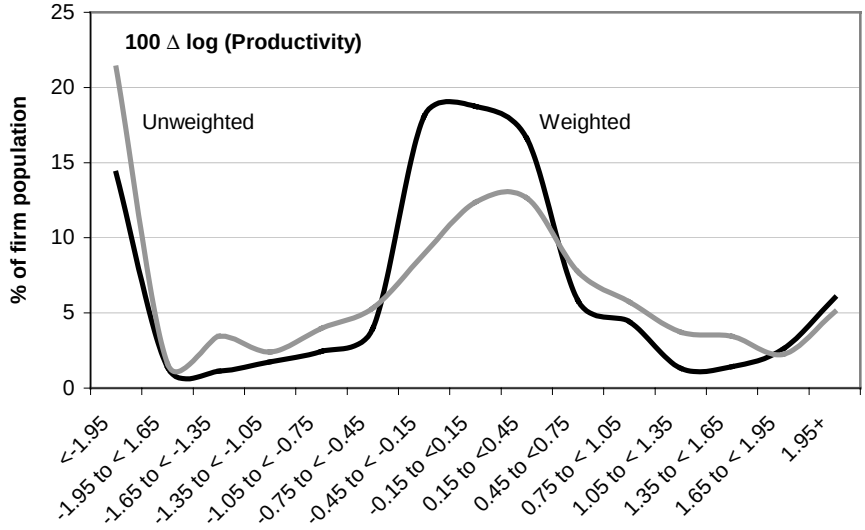
a The population of firms examined in the regressions where the change in the exports-sales ratio is the dependent variable, covers only those firms who exported at least once during the four year study period. There were 905 firms in this category from the total sample of 1848 firms. The weighted average of the distribution is +0.65 percentage points annual change. **b** The population of firms examined in the regressions where the change in the R&D-sales ratio is the dependent variable, covers only those firms who performed R&D at least once during the four year study period. There were 811 firms in this category from the total sample of 1848 firms. The weighted average of the distribution is –0.07 percentage points annual change.

Data source: Unpublished data from the ABS BLS survey.

In contrast, the distribution of changes in labour productivity has excess weight in the tails of the distribution, particularly for negative productivity growth (figure 4.3). In the productivity growth regressions, the boundary values for logarithmic change are set to plus or minus one, corresponding to a change of plus 172 per cent or minus 63 per cent respectively over three years. The fact that more than 10 per cent of observations fall outside this range may be due to data quality

problems. In any event, the trimming of outliers ensures that these do not carry too much weight in the regressions. Nonetheless, given the large dispersion, regressions were also run in which the outlier observations (above log +0.61 and below –0.61) were omitted. The results from these regressions do not differ much from the full sample regressions.

Figure 4.3 **Distribution of changes in log labour productivity between 1994-95 and 1997-98[a]**



a Most of the productivity growth regressions reported in this paper cover the entire sample of 1848 firms, which recorded positive sales and employment both in 1994-95 and 1997-98. The mean value of logarithmic productivity growth was 0.049 in unweighted and 0.002 in firm size weighted observations. These averages include the trimmed values of outliers (tables E1 and E2 in appendix E).

Data source: Unpublished data from the ABS BLS survey.

4.2 The effect of export programs on changes in the export-sales ratio

The main objective of export market development programs is to stimulate exports. The data from the BLS can be used to examine the statistical links between participation in export marketing programs and export growth.

In the regressions reported in this paper, both exports and program participation are expressed in terms of first order differences, for reasons that were discussed in section 4.1 (and in chapter 2). The first order difference for exports is the change in the exports-sales ratio between two consecutive years. As for program participation, the first order difference is represented by a dummy variable corresponding to the transition in participation between the same two years.

The regression results

Table 4.1 summarises the regression results for export programs. The regressions included also a number of other control variables not shown here (such as type of industry, size and age of firm and value added per person in 1994-95).[1] In each set of program dummies, the missing dummy is the 00 transition, representing non-participation in both years.

Table 4.1 **Regressions with the annual change in the export-sales ratio as the dependent variable** [ab]

	Unweighted		*Weighted*	
	Without intention[c]	*With intention*[d]	*Without intention*[c]	*With intention*[d]
	Coefficient	Coefficient	Coefficient	Coefficient
EMDG out → in	2.925 ***	2.911 ***	0.912	0.912
EMDG in → out	-0.751	-0.793	-0.995	-1.250
EMDG in → in	0.960	0.911	1.424 ***	1.276 *
Austrade services out → in	-0.427	-0.446	-0.217	-0.339
Austrade services in → out	0.687	0.658	-0.101	-0.317
Austrade services in → in	-1.900 *	-1.930 *	-0.831	-1.084
Export Access out → in	-0.404	-0.401	0.776	0.975
Export Access in → out	-1.425	-1.436	0.300	0.039
Export Access in → in	1.832	1.808	-0.058	-0.176
ITES out → in	2.151	2.146	0.927	0.669
ITES in → out	1.828	1.821	0.160	-0.135
ITES in → in	-0.888	-0.904	-0.971	-1.207
Intention to export at the base year		0.216		1.332 ***
Statistical indicators				
R^2	0.016	0.016	0.028	0.032
Adjusted R^2	0.001	0.001	0.014	0.017
Probability>F for all EMDG variables	0.025	0.026	0.050	0.044
Probability>F for all Austrade variables	0.230	0.224	0.775	0.598
Probability>F for all Export Access varias	0.608	0.611	0.959	0.934
Probability>F for all ITES variables	0.782	0.783	0.883	0.906
Probability>F for all program variables	0.198	0.203	0.668	0.560

a The exports sales ratio is in percentage form. The regressions cover only firms which exported at least once. **b** The missing dummy variable in each case is out → out. **c** Annual changes in three years from 1993-94 to 1996-97. **d** Annual changes in two years from 1994-95 to 1996-97. ***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level.

Source: Table E.11 in the appendix.

1 The full listing of the regression results is presented in table E.11 in the appendix, while cross-tabulations between transitions in participation and changes in the exports-sales ratio are in tables E.1 to E.6 in the appendix.

Four regression combinations were run. These combinations involve firm size weighted and unweighted regressions, as well as the inclusion or exclusion of a binary variable representing the intention to increase exports in the base year of each annual change (which might, given evidence from chapter 3, reduce the risk of selection bias). This binary variable is shown at the bottom line of the list of regressors.

Overall, as shown by the R^2, only a very small fraction of the year to year variation in export growth could be explained. While, in part, this is likely to reflect a large amount of noise in the data (which is accentuated by using differenced data), it is also likely to reflect the importance of unmeasured idiosyncratic factors that determine export performance. This suggests that export programs play a relatively minor role in explaining year to year movements in export performance in Australian firms. But it also suggests particular care in not treating the estimates as in any way precise, given the likely prominence of omitted variable bias and the simple nature of the specification adopted.[2]

The striking result indicated in table 4.1 is that with the exception of the EMDG, none of the other export marketing programs display a statistically significant effect on export growth. In a number of cases, even the signs of the coefficients are inconsistent with the premise that participation in these programs contributes to export growth.

The probability numbers in the bottom part of the table represent results from F tests, which were used to test the joint significance of each triplet of program variables. Like the t statistics, the F tests also indicate that only the EMDG shows a statistically significant association with export growth (at around the 0.025 probability level in the case of the unweighted results).

The apparent impacts of the EMDG program

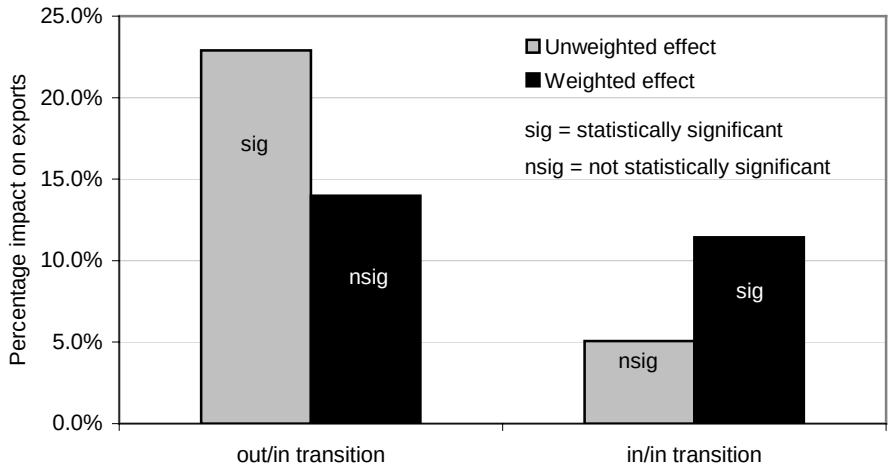
While participation in the EMDG program does not explain much of the variation in export growth among the BLS exporters in the whole population, the unweighted results still point to a statistically significant impact from the EMDG program on exports. Since the average export sales ratio is around 15.7 per cent, an increase of 2.9 percentage points suggests an increase in the export sales ratio of around 18 per cent from participation and a (short-run) increase in exports for EMDG participants

[2] In particular, the assumption of normal homoscedastic errors (on whose validity, inferences are based) warrants investigation.

stemming from EMDG involvement of around 22.7 per cent.[3] However, the weighted results — which are the appropriate guide to the effect of the program on aggregate exports — are not statistically significant, and point to a smaller short-run effect of the EMDG program on exports of 13.8 per cent.

The estimates relating to continuing involvement in the EMDG scheme (an EMDG in → in transition) suggest that continuing involvement has modest positive, but statistically insignificant, effects for most participants with about a 5 per cent impact on exports in the unweighted results — figure 4.4. However, when the results are weighted, the results suggest that continued participation increases exports by around 11 per cent per annum.

Figure 4.4 **Estimated impacts on exports from EMDG participation for EMDG participants**



a The estimates are based on the regression results that include the export intentions variable (since this was significant for the weighted regression).

To estimate the overall effect of the EMDG scheme on exports it is necessary to take account of the number of years that participating firms have been in the scheme. These data were obtained from Austrade (2000, p. 88) and with the findings above, used to derive an estimate of the overall effect of the scheme on the exports of participants. This method suggested that EMDG participation increased the exports of EMDG participants above what they would have been in the absence

3 The small difference is due to the fact that sales also includes exports. Let $X_0/(X_0+D_0) = a_0$ be the export sales ratio before participation in the EMDG scheme, where X is exports and D is domestic sales. Say that the new value of the ratio as a result of EMDG participation is $X_1/(X_1+D_0) = a_1$. We wish to calculate X_1/X_0-1. This is equal to $(a_1-a_0)/\{a_0(1-a_1)\}$. In the unweighted results, a_0 is around 0.157 and a_1 around 0.186, implying that the percentage growth rate in exports for an EMDG participant that can be traced to the scheme is around 22.7 per cent. For the weighted results, the percentage growth attributable to the scheme is 13.8 per cent.

of the program by 37 per cent (unweighted results) or 47 per cent (weighted results).[4] However, the standard error on these estimates is high, and so these should not be taken as a reliable indication of the impact of the scheme.

Quite apart from the imprecision in the estimates, there are factors that may lead to systematic biases in the estimates. Since explanatory variables are measured with error, this will lead to downwardly biased estimates of the effect of program participation.

Against this, the likelihood of sample selection bias points to a substantial risk that the estimates are biased upwards. The export regressions incorporate a range of variables, such as export intentions,[5] industry, age and foreign ownership (listed in appendix E), to deal with potential selectivity bias stemming from the fact that participants *choose* whether to participate or not (chapter 2). However, the existing control variables included in the regressions do not indicate substantial selectivity bias. A direct comparison of changes in the actual export to sales ratio associated with transitions in and out of programs (table E.1) are in line with those produced by the regression results. This result has three possible interpretations:

- It may be because estimating in difference form has dealt with some of the selection bias issues.
- Despite a priori concerns, selectivity bias may not be a very significant problem.
- The variables included in the regression to control for selectivity bias may not adequately cover the variables that jointly determine participation and export growth.

Of the three interpretations, the last one seems most likely. This is because there is evidence that selection bias is likely to be a problem. Austrade's (2000) review of

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4 The magnitude was calculated as:

$$V = 100 \times \left(\sum_{i=1}^{8} \left\{ \phi_i (1 + C_{01})(1 + C_{11})^{i-1} \right\} - 1 \right)$$

where C_{01} is the proportionate change in exports from an out $\rightarrow$ in transition, C_{11} is the corresponding change in exports from an in $\rightarrow$ in transition, and ϕ_i is the share of firms in 1997-98 that have i years of participation in the scheme. Weighted and unweighted estimates for C_{01} and C_{11} were used to derive the estimates in the text.

5 However, while it was considered that stated export intentions might summarise many otherwise unobservable traits of the firm as an exporter, its inclusion did not have much effect on the size or statistical significance of program coefficients. The differences between the coefficients are mainly due to the fact that the regressions with export intention cover two years of annual changes, while the regressions without the intention variable cover three years. This is because there is no intention data in the BLS for 1993-94, therefore the changes that occurred between 1993-94 and 1994-95 had to be omitted from the intention regressions, despite the availability of other data.

the EMDG program found that (premature) exiters and non-EMDG recipients tended to have much lower export propensities (p. 185) and placed less emphasis on a whole range of export promotion activities than new EMDG participants (p. 195). Non-EMDG participants often had problems with uncompetitive export products (p. 215), while exiters often ceased exporting because of problems in the export market or lack of financial viability (p. 215).

Not only is selectivity bias expected to arise due to the likely differing characteristics of those firms that choose to participate, but also because Austrade excludes exporters that do not have strong export growth prospects, both at entry and after the first two years of participation:

- The export performance test incorporated into the EMDG provides the greatest incentives for participants that have rapidly rising exports.[6] If a firm is not realising rapid export growth then typically the subsidy rate falls.[7] Indeed, at the margin, a firm with a slow export growth may decide to exit the scheme if its compliance costs exceed the diminishing grant value. This is an appropriate design feature, but it substantially complicates assessment of the actual efficacy of the program.
- A grants test was implemented in 1995-96 for first time applicants. It required an export plan, indications of financial viability and other criteria be met for eligibility. It is explicitly seen as a screening tool that rejects first-time applications by firms that have a high probability of failing in export marketing (Austrade 2000, p. 113). Around 6 per cent of firms fail the test. Of course many exporting firms will not even meet the eligibility criteria for the program (such as making export expenditures exceeding a threshold). This entry test is also a good feature of program design, but it too means that the exporters that are in the program at the outset are by design different from those that are outside it.

The impacts of these screening devices are probably less easily captured by observable firm characteristics. To this extent, the positive statistical association of the EMDG is likely to be partly related to the filters that are explicitly included in the program to remove low export growth firms, and so is likely to exaggerate the

6 In the first two years, the grant value (V) is V = (Eligible marketing expenditure- $15000)*0.5, while in subsequent years it is V = *min*{(Eligible expenditure-$15 000)*0.5, $\alpha_t X_t$} where X is exports and α is a share parameter set at 0.4 for year three, 0.2 for year four, 0.1 for year five, 0.075 for year six and 0.05 for years seven and eight. A firm that at the margin just qualified for the full EMDG in year three on the basis of its exports would need to increase exports by 100 per cent, 100 per cent, 33 per cent, 50 per cent and zero per cent in years four, five, six, seven and eight respectively in order to continue to receive the full grant value.

7 So long as the initial export to marketing expenditure ratio is sufficiently small.

actual impact of the program on export growth.[8] For that reason, it is unlikely that the overall impact of the EMDG scheme is to increase exports by participants by the estimated 40-50 per cent.

Even though they probably do not fully account for selection bias, the regression results suggest a responsiveness of exports to the EMDG that is less than one half of that found by the econometric analysis in Austrade (2000, pp. 220ff). Since that econometric study underpinned the favourable outcome of the Austrade review, it is appropriate to review its methodology and results, and compare them with those in this study. The detailed discussion is in appendix F, and only a summary is given here.

The Austrade econometric studies

Austrade has commissioned several econometric studies of the impact of the EMDG program (Austrade 1994, 2000). The studies have claimed very large impacts of the EMDG program on export promotion, with firms that use the EMDG scheme increasing promotion by around 100 per cent. The econometric evidence also suggests that every dollar of export promotion (whether subsidised or not) generates around $12.5 of exports. Overall, the Austrade review's results suggest that exports by EMDG participants (covered by the econometric study) were $4.07 billion instead of $2.02 billion had no scheme existed — or about double the level that would have occurred in the absence of the grants.

These results may be questioned on a number of grounds:

- The apparent links between EMDG participation and export growth may be partly illusory, reflecting selection biases. As in the results in table 4.1 above, there is a significant risk that firms that would have had high export growth anyway choose the EMDG scheme, while those that do not either fail to apply or exit the scheme prematurely. The econometric models used in the Austrade study did not control for these selection effects, with an expected upward bias in the results.
- Finding a certain average ratio of exports to exports promotion does not mean that this is the multiplier that can be applied to any *incremental* export promotion, as is assumed.

[8] To some extent this expectation is borne out by the findings from the regressions and by the figures presented in tables G.3 and G.4 in the appendix. Particularly in table G.3, which covers unweighted observations (and hence relates mainly to small firms), the export growth rates are clearly increasing with participation counts.

- The Austrade model is interpreted as suggesting that the export multiplier associated with contemporaneous marketing expenditure grows over time. An alternative explanation for rising values of exports to export promotion for EMDG participants over time is the effect of lagged participation in the scheme and exogenous factors that increase exports independently of promotion.
- The implicit degree of responsiveness of export promotion to the grant scheme seems too high to be credible. The Austrade estimates suggest that every dollar of subsidy to export promotion induces more than two dollars of new export promotion. It also implies that the elasticity of export promotion with respect to the price of promotion is around 5, which is very high. It would imply that a 10 per cent decrease in export promotion prices would induce a 50 per cent increase in export promotion — and by symmetry that a 10 per cent increase in export promotion prices would decrease export promotion by 50 per cent. The results do not appear consistent with results found for other business programs.

4.3 The effect of R&D programs on changes in the R&D-sales ratio

Table 4.2 shows the results for regressions where the dependent variable is the annual change in the R&D-sales ratio.[9] The conceptual framework for these regressions is the same as that for the export-sales ratio regressions discussed earlier. However, there are two minor differences compared with the export-sales regressions. First, there was no question in the BLS about the intention to increase R&D, but there was a question about the intention to introduce new products, which may pick up some innovation intentions (where innovation is not directed at production processes). Second, while the export growth regressions rely on three years of data, the R&D growth regressions are restricted to two years from 1994-95 to 1996-97, because there is no R&D expenditure data in the BLS for 1993-94.[10]

The results in table 4.2 are in contrast to those in table 4.1 for exports. Both R&D programs show highly significant positive statistical associations with changes in the R&D-sales ratio and all F tests indicate probabilities below 0.001.

[9] Cross-tabulations between transitions in participation and changes in the R&D-sales ratio are presented in tables E.7 to E.10 in the appendix.

[10] In fact, even the R&D expenditure data for 1994-95 are partial, covering only manufacturing but not mining or computer and engineering services. To overcome this problem, the 1994-95 figures for these omitted sectors were imputed by taking 95 per cent of the R&D expenditure recorded in 1995-96. While this is less than a perfect solution, it should be noted from table 2.4, that mining and services account for less than 30 per cent of R&D expenditure in the sample.

The inclusion of the variable denoting the intention to introduce new products had almost no effect on the coefficient estimates.

Table 4.2 **Regressions with annual changes in the R&D-sales ratio as the dependent variable**[ab]

	Unweighted		*Weighted*	
	Without intention	*With intention*	*Without intention*	*With intention*
R&D tax concession out → in	1.153 ***	1.148 ***	0.921 ***	0.911 ***
R&D tax concession in → out	-0.913 ***	-0.900 ***	-0.818 ***	-0.812 ***
R&D tax concession in → in	0.337	0.350	0.270 *	0.278 *
R&D grants out → in	0.577	0.581	0.403 *	0.398 *
R&D grants in → out	0.183	0.183	0.191	0.213
R&D grants in → in	3.121 ***	3.132 ***	3.594 ***	3.605 ***
Intends to introduce new products		-0.190		-0.115
Statistical indicators				
Adjusted R^2	0.039	0.039	0.102	0.102
Probability>F for all R&D tax variables	0.000	0.000	0.000	0.000
Probability>F for all R&D grant variables	0.000	0.000	0.000	0.000
Probability>F for all program variables	0.000	0.000	0.000	0.000

a The regressions cover only firms which performed R&D at least once. The period is from 1994-5 to 1996-7. **b** The missing dummy variable in each case is out → out. ***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level.

Source: Table E.12 in the appendix.

Given average opening ratios of R&D to sales of 1.88 per cent (table E.7 in appendix E), the apparent short-run impact of the R&D tax concession on R&D is substantial at around 60 per cent. Continuing use of the program has much smaller (and statistically insignificant) impacts on R&D to sales.

In comparison, the short-run impact of R&D grants is smaller (around 30 per cent) and not significant, while the impact of continuing use of grants is both statistically and economically significant.

These estimates suggest a much higher responsiveness of firms to the tax concession than that found by the BIE (1993a) and above that generally found in overseas studies. As in the case of the EMDG scheme, it appears likely that selection biases affect the estimates. It is probable that firms that are intending to undertake increased R&D make greater use of the concession — thereby exaggerating apparent program impacts.

Nevertheless, even if the size of the effect is not clear, the regressions of first order differences suggest a statistically significant positive association between R&D subsidies and R&D expenditure growth.

4.4 The links between participation in programs and labour productivity growth

As suggested in chapter 2, the effects of business programs on productivity growth is a more crucial policy issue than their effects on intermediate variables such as exports or R&D expenditure.

It is clear that increased R&D may increase labour productivity by either increasing the quality of output (product innovation) or by reducing the need for inputs per unit of output (process innovation). There is an extensive international literature that finds links between business R&D expenditure and productivity, both at the firm level and the national level.[11]

Participation in export programs may also have indirect effects on productivity by altering the environment in which firms operate (tough export markets may increase incentives for innovation and productivity growth) or by increasing information flows.[12]

This study undertook some preliminary investigations of the potential effects of programs on labour productivity growth (defined as the change in value added per person between 1994-95 and 1997-98).

In the regressions, program variables are represented by participation counts, for the reasons explained in section 4.1. Minimalist regressions (table 4.3) that tested the degree to which intensity of program participation affected the change in labour productivity, revealed no statistically significant links between productivity growth and program participation.

Some extensions to this analysis that incorporated other variables that might also explain labour productivity change — such as changing assets per person, industry dummies, firm age, firm size and firm behaviour variables (such as formal planning, undertaking management training and networking with firms) — also failed to reveal any robust links between labour productivity growth and participation in business programs. More surprisingly, other regressions failed to show robust links between productivity growth and changes in R&D intensity — though arguably the

[11] The interested reader can find extensive literature reviews and examples of empirical work in IC (1995, appendix Q), Chand, McCallum and Gretton (1998), Mairesse and Sassenou (1991), Rogers and Dowrick (1999), Griliches (1992, 1995) and Mairesse, Sassenou and Hall (1996).

[12] There is less convincing empirical evidence from other studies on this link. For example, Bernard and Wagner (1996) found that German exporters tended to be more productive than non-exporters (as did Rogers 1998 for Australian enterprises), but that this predated entry into the export market.

time period analysed might be too short for these effects to show up. As well, there was a negative correlation between the profit-equity ratio (mean value over four years) and average R&D intensity.

Table 4.3 **Minimalist regressions with logarithmic change in labour productivity between 1994-95 and 1997-98 as the dependent variable**[a]

	Unweighted		*Weighted*	
	Coefficient	t stat	Coefficient	t stat
Intercept	0.055 **	3.891	0.007	0.406
Count of R&D tax concession participation	-0.002	-0.176	0.009	1.109
Count of R&D grant participation	-0.010	-0.314	-0.038	-1.854
Count of EMDG grants	0.015	0.971	0.006	0.496
Count of Austrade services	-0.025	-1.163	-0.012	-0.904
Count of reporting an ITES loan	-0.031	-0.454	-0.090 *	-2.532
Count of Export Access support	-0.003	-0.090	0.022	0.927
Statistical indicators				
R^2	0.003		0.011	
Adjusted R^2	-0.001		0.007	
Probability >F for all R&D programs	0.496		0.201	
Probability >F for all export programs	0.712		0.029 *	

a The regressions cover the entire sample of 1848 firms. ***** Significant at the 5 per cent probability level. ****** Significant at the 1 per cent probability level.

Source: Unpublished data from the ABS BLS survey.

However, these results are preliminary and may not provide a good guide to the impact of participation or R&D on productivity (and profitability), especially given that:

- there are substantial data errors. Many observations on labour productivity growth were trimmed (or in other regression experiments, removed from the sample). The BLS R&D data also have some drawbacks, as discussed earlier;
- raw participation counts only indicate whether a firm was in or out of a program, not the intensity of their participation and relative importance of any subsidies they may have received;
- raw participation counts ignore the timing of participation, which may be salient (figure 4.1);
- it may take many years for R&D investments to have impacts on productivity (and profitability) — yet the BLS spans only a few years; and
- the small scale of business program subsidies compared with total sales and value added makes it difficult to detect program impact on firm-wide variables. To put them in perspective, the total value of program subsidies amounted to less

than 0.2 per cent of total sales and less than 0.7 per cent of total value added in the BLS sample in 1996-97. Even for subsidy recipients, the subsidies typically represent a small share of value added. Therefore, even were there to be positive labour productivity effects associated with participation in the programs, these would be hard to detect against background noise in the data.

Fortunately, it may be possible to further test some of the puzzling results from the BLS by using different data. Currently the Melbourne Institute of Applied Economic and Social Research is investigating a large scale database of tax returns by enterprises, which was released to the Melbourne Institute (subject to confidentiality restrictions) by the Australian Tax Office (ATO). The ATO database contains similar accounting information to the BLS. It also contains information on R&D expenditure claimed for the tax concession, which is a reasonable proxy for business R&D expenditure in general. The ATO data cover tax returns over six years from 1991-92 to 1996-97.

Given the availability of data on R&D expenditure in the ATO database, it could be used to explore the relationships between R&D intensity, productivity growth and profitability. Feeny, Harris and Loundes (2000) of the Melbourne Institute have explored the determinants of profitability using the ATO data, but this study did not include R&D expenditure as one of the explanatory variables. However, some preliminary research by the Melbourne Institute using the ATO data suggests that R&D and royalty payments show no consistent relationship with profitability. The regression coefficients tend to be negative, in line with the results from the BLS study. This puzzling outcome is clearly an area for further research.

4.5 Differences in program participation by exiting and continuing firms

Business programs may increase the potential for firm survival by raising the competitiveness of enterprises (either permanently by changing their behaviour in a way that increases their capabilities and efficiency, or temporarily by subsidising costs). This would be reflected in a lower incidence of bankruptcies and closures among firms that used such programs. This hypothesis can be partially tested using data from the BLS.

From the last three years of the survey, information is available on firms that participated in the survey in the previous year, but did not send in a form in the current year because of business closure. It is not clear from the information available about the nature of the closure (for example, it might have ceased to operate while being solvent). However, regardless of the type of business exit, it is

possible to check whether exiting firms had a pattern of participation in government business programs that was different from continuing enterprises.

Table 4.4 compares some indicators of participation in business programs of exiting firms with those of continuing enterprises.

Table 4.4 **Indicators for exiting and continuing firms — average yearly values from 1994-95 to 1996-97**[a]

	Continuing firms	*Exiting firms*
Average equivalent number of persons per firm	109.6	119.8
Ratios	*%*	*%*
Sales per person	236.7	269.9
% exports to sales ratio[b]	19.6	13.3
% R&D expenditure to sales ratio[b]	0.88	0.67
% innovation expenditure to sales ratio[c]	1.19	0.95
Assistance in 1996-7 as a percentage of sales		
R&D claimed for tax concession	0.42	0.22
R&D grants	0.02	0.00
Percentage of firms participating in the program		
R&D tax concession	13.2	11.6
R&D grants	1.7	0.6
Export Market Development Grants (EMDG)	7.7	7.6
Austrade services	5.6	4.1
Export Access	1.9	1.0
International Trade Enhancement (ITES)	0.5	0.6
National Industry Extension Service (NIES)	3.7	1.2
Best Practice Demonstration Program	0.5	0.6
New Enterprise Incentive Scheme (NEIS)	0.1	0.2
Export Finance and Insurance Corporation (EFIC)	2.4	2.2
Employment and other programs	9.1	11.4

a See Will and Wilson (2001) for some of the complexities in accounting for 'deaths' in the BLS. The totals in respect to participation in programs, as well as for sales, exports, R&D and innovation expenditure, are added up over the years from 1994-5 (the first year of the study) until the year before the exit was reported. This means adding up figures over the previous three years for continuing and exit firms in the 1997-98 survey, over two years in the 1996-7 survey, and over one year (1994-5) in the 1995-6 survey. The combined totals are then converted (by dividing the totals by the number of years covered) into the average yearly values shown above. The sample used in this dissection includes firms that joined the BLS after 1994-95, which explains why the average number of continuing firms is larger than the core sample of 1 848 firms used in the regressions. **b** R&D and export intensities are measured by dividing the financial totals of R&D expenditure and exports of continuing and exit firms by the total sales of the respective groups — and are thus weighted averages. **c** Innovation intensity is the ratio of total innovation expenditures to sales. Innovation expenditure in the BLS covers, in addition to R&D, expenditure on training, acquisition of technology from outside, tooling up, industrial engineering and the marketing of new products.

Source: Unpublished data from the ABS BLS survey.

Continuing firms tend to show a somewhat higher likelihood of participating in business programs. However, the differences between the two categories are not

large, with the exception of R&D grants and National Industry Extension Service (NIES). The latter program — an advisory and quality improvement program for small business — no longer exists.

Differences between the two groups are larger for R&D and export intensity. There is a difference of 24 per cent in the ratio of R&D expenditure to sales in favour of continuing firms. Moreover, continuing firms recorded 47 per cent higher average export intensity than exit firms. Export intensity seems to provide the most robust predictor of firm survival among the variables examined.

There is a large difference between exiting firms and continuing firms in regard to the level of R&D assistance received per unit sales in 1996-97. None of the 1997-98 exit cohort (comprising 183 firms) received any R&D grant in 1996-97.[13] In regard to the R&D tax concession per unit sales, exiting firms received only 52 per cent the level of assistance received by continuing firms, though the difference in R&D expenditure in 1996-97 was less than 15 per cent. It is possible that less than a year before winding up the business, many exit firms may have encountered difficulties in claiming the tax concession or the R&D grant. There is evidence that firms with intentions to close or sell participate less in government programs (appendix D). Also, it is possible that a firm in financial difficulty may tend to give less complete financial information, so that the under-reporting of R&D subsidies in the 1996-7 survey (noted in chapter 2) may be disproportionately located among exiting firms.

Overall, the exit data suggest that exiting firms have only a somewhat lesser likelihood of participating in business programs in years prior to their exit, but that they tend to use programs less intensively. The data suggest that participation in business programs is not, by itself, a highly significant source of protection from subsequent exit.

[13] Note, given that R&D subsidies appear only in the 1996-97 survey, the analysis of these data is restricted to the 1997-98 survey group, because earlier survey groups do not cover 1996-97 data.

A Summary statistics

The data presented in this appendix summarises the main characteristics of the sample employed in the regressions. As noted in chapter 1, this sub-group of the BLS includes only enterprises that recorded positive sales and employment both in 1994-5 and 1997-8. Table A.1 shows the distribution by firm size of the major performance indicators used in this study (as a percentage of the total) and the respective totals.

Table A.1 **Summary and distribution by firm size**

	Firm size — number of persons employed				
	1-20	*21-100*	*101-500*	*500+*	*All*
	%	*%*	*%*	*%*	*$ M*
Share of total sales in 1997-98	2.2	13.2	17.4	67.3	57 240
Share of total sales in 1994-95	2.4	13.7	17.5	66.5	50 556
% change in sales					13.2%
Share of total value added 1997-98	2.4	14.5	16.1	67.0	14 282
Share of total value added 1994-95	2.4	14.1	16.6	66.9	13 796
% change in value added					3.5%
Share of exports in 1997-98	1.0	12.6	10.8	75.5	11 978
Share of exports in 1994-95	1.4	13.7	10.5	74.4	10 146
% change in exports					18.1%
Share of R&D expenditure in 1997-98	3.0	19.6	18.5	59.0	335
Share of R&D expenditure in 1995-96	1.5	12.7	11.6	74.2	527
% change in R&D expenditure					-36.4%
					No. of firms
Share of firms in the regressions	47.9	36.5	9.8	5.7	1848
					No. employed
Share of full-time employed 1997-98	3.1	15.8	19.3	61.8	194 169
Share of part-time employed 1997-98	11.0	18.9	23.0	47.1	10 206
Share of equivalent employment 1997-98	3.3	15.9	19.3	61.5	198 574

Source: Unpublished data from the ABS BLS survey.

The bottom part of table A.1 shows the number of full-time and part-time employees and the converted number of equivalent employees in 1997-98. The

equivalent employment figures are calculated by converting part-time employees (defined as those working for less than 35 hours per week) into equivalent full-time employees using a conversion rate of 0.43. This is the ratio between the average number of hours worked by part-time and full-time employees in manufacturing according to the ABS labour force survey (ABS Cat. 6203.0). The equivalent number of persons employed in 1997-98 is used to allocate firms into four size groups. It is also used as the firm size-weighting factor in the weighted regressions and cross-tabulations.

The substantial decrease in total R&D expenditure in the BLS between 1995-96 and 1997-98 (table A.1) seems to be related partly to inconsistencies in the reporting of R&D expenditure (as discussed in chapter 2). The base year for measuring R&D expenditure growth is 1995-96 rather than 1994-95, because in 1994-95 the survey covered R&D expenditure in manufacturing, but not in mining or services.

Table A.2 presents the non-zero counts of exports and R&D expenditures in the sample. These figures suggest that, subject to variations from year to year, more than 40 per cent of the sampled firms recorded some exports, and more than 26 per cent carried out some R&D during the study period. The lower part of the table shows the number of positive answers to binary questions. These binary variables are employed in the participation regressions in appendix B and the 'long' performance regressions in appendix F.

Table A.2 **Number of non-zero counts in the sample**

Firm size	*1-20*	*21-100*	*101-500*	*500+*	*Total*	*Share of total*
	Counts	*Counts*	*Counts*	*Counts*	*Counts*	*%*
Exports in 1997-8	189	343	106	79	717	38.8
Exports in 1994-5	222	346	107	76	751	40.6
R&D expenditure in 1997-8	107	168	57	39	371	20.1
R&D expenditure in 1995-6	80	206	93	81	460	24.9
Binary variables						
Acquired innovations from outside	10	19	5	3	37	2.0
Increased management training	459	165	42	26	692	37.4
Increased on-the-job training	313	121	41	25	500	27.1
Increased other training	378	167	43	25	613	33.2
Applied non-technical innovations	870	629	159	84	1742	94.2
Used a business plan	290	428	139	94	951	51.4
Used budget forecasting	530	595	173	102	1400	75.8
Networked with other firms	226	315	122	84	747	40.4
Benchmarked against other firms	206	292	130	93	721	39.0
Used an export plan	174	301	100	78	653	35.3
All firms in the sample	886	675	181	106	1848	**100.0**

Source: Unpublished data from the ABS BLS survey.

Table A.3 presents a dissection of major items by industry.

Table A.3 **Summary of major items by industry**

	Number of firms	*Sales 1997-98*	*Exports 1997-98*	*R&D tax concession 1996-97*	*R&D expenditure 1996-97*	*Equivalent employment 1997-98*
Industry	*number*	*$M*	*$M*	*$M*	*$M*	*000s*
Food, Beverage, Tobacco	182	5 525	750	15	32	18
Textiles, Clothing, Footwear	141	2 190	727	2	3	11
Wood and Paper	98	5 866	362	6	6	20
Printing and Publishing,	131	4 015	72	1	4	16
Petroleum and Chemicals	207	7 177	557	47	75	22
Pharmaceuticals	7	43	10	0	0	1
Non-metallic Minerals	92	3 359	93	6	8	13
Metal Products	223	7 531	1830	35	50	25
Machinery and Equipment	296	3 015	469	22	33	18
Scientific Instruments	28	982	468	2	7	3
Electronic Equipment	86	2 008	481	23	75	8
Furniture and Misc. Mfg.	154	1 026	47	1	2	6
Total manufacturing	**1 645**	**42 739**	**5 866**	**159**	**296**	**159**
Mining	59	10 367	5 888	36	95	22
Engineering services	33	283	8	0	2	3
Computer services	111	2 779	216	4	20	15
Total all inclusive	**1 848**	**56 169**	**11 978**	**198**	**414**	**199**

Source: Unpublished data from the ABS BLS survey.

The fourth column in table A.3 presents the total value of R&D claimed for the tax concession in 1996-97, while the fifth column is the actual expenditure on R&D reported in that year. It appears from the respective totals that only 47.8 per cent of the R&D spent was actually claimed for the tax concession in 1996-97. As explained in chapter 2, this may be due to data reliability problems. The last column in table A.3 presents the equivalent number of persons employed.

The final set of figures presented in this appendix compares the value of support received under the six business programs with total turnover and value added. Only the value of R&D subsidies in 1996-7 is directly available from the BLS, though according to ABS officers, these figures are not particularly reliable. The amount of R&D tax concession claimed by respondents amounted to $198.4 million in the sample. According to the assessment adopted in this study (based on equation 2.1), only 18 per cent of this amount is the real monetary value of subsidy to recipients. This yields a net subsidy value of $35.7 million. The value of R&D grants in the sample totalled $9.1 million in 1996-7.

As for export market development programs, only participation counts but no monetary values are available from BLS. On the basis of information from other sources it is estimated that the sampled firms account for about 17 per cent of total expenditure on export market programs in 1996-97.

From the figures presented in section 3.1, total expenditure on the EMDG amounted to $215 million in 1996-7. The expenditure on Austrade services was $65 million and on Export Access $3.7 million in that year. Loans under ITES totalled $125 million in 1996-7. Assuming the annual value of the interest rate concession is five per cent of the principal, this yields a net ITES program expenditure estimate of $6.3 million per year. Summing up these figures indicates that the combined expenditure under the four programs amounted to $290 million in 1996-97. Assuming that the share of the sampled firms amounted to 17 per cent yields a net subsidy estimate for export market programs of $49.3 million.

Using these subsidy data, the average value of business program support amounted to less than 0.2 per cent of sales and to less than 0.7 per cent of value added in the sample (table A.4).

Table A.4 **The value of subsidies in 1996-97**[a]

	Value of subsidies	*Share of sales*	*Share of value added*	*Share of R&D expenditure*	*% of exports*
	$M	%	%	%	%
R&D tax concession	35.7	0.07	0.28	8.63	..
R&D grants	9.1	0.02	0.07	2.20	..
Export market programs	49.3	0.09	0.36	..	0.44
Total subsidies	94.1	0.17	0.69	..	..

a Total sales in the sample in 1996-97 amounted to $54 629 million, total value added to $13 602 million, total exports to $11 087 million and total R&D expenditure to $414 million.

Source: Unpublished data from the ABS BLS survey.

B Characteristics of participants

Table B.1 **R&D subsidies in 1996-97 and export program counts over the four years of the BLS**

Industry	*R&D grants 96-7*	*R&D Tax Conc. claims 96-7*	*Value of R&D subsidies*[a]	*% R&D subsidies to sales*	*Total counts of EMDG*	*Total counts of Austrade*
	$'000	$'000	$'000	%		
Mining	0	35 752	6 435	0.06	6	2
Processed Food	20	14 886	2 699	0.05	104	68
Textiles & Clothing	55	1 577	339	0.02	44	31
Wood and Paper	1	5 685	1 024	0.02	18	11
Printing and Publishing	9	525	104	0.00	24	10
Chemicals	3 000	47 114	11 481	0.17	75	43
Pharmaceuticals	0	0	0	0.00	2	6
Non metallic Minerals	180	5 553	1 180	0.04	20	20
Basic Metal Processing	0	35 435	6 378	0.09	62	48
Machinery and Equipment	817	22 414	4 852	0.17	93	91
Scientific Instruments	0	1 709	308	0.03	16	11
Electronics	4 858	23 224	9 038	0.40	77	47
Miscellaneous Mfg.	0	587	106	0.01	51	31
Engineering Services	0	0	0	0.00	9	5
Computer Services	150	3 932	858	0.04	34	16
Total	9 090	198 393	44 801	0.08	635	440

a The value of R&D subsidies = (R&D grants) + 0.18*(R&D tax concession), in accordance with equation 2.1 in chapter 2.

Source: Unpublished data from the ABS BLS survey.

Table B.2 **Sequence of participation counts over the four years from 1993-94 to 1996-97**

Sequence of counts[a]	*No. of counts*	*R&D tax*	*IR&D grants*	*EMDG*	*Austrade services*	*Export Access*	*ITES*
0000	0	1419	1719	1549	1594	1741	1819
0001	1	15	8	36	34	13	4
0010	1	89	59	60	61	41	13
0100	1	9	9	3	19	12	4
1000	1	16	7	18	7	8	1
0011	2	32	4	31	22	8	1
0101	2	1	0	1	2	1	0
0110	2	15	6	8	12	6	0
1001	2	0	0	0	0	0	0
1010	2	4	1	4	2	0	0
1100	2	44	23	29	48	6	3
0111	3	5	0	13	5	3	2
1011	3	0	0	4	1	1	0
1101	3	12	0	11	10	1	0
1110	3	81	11	28	22	5	1
1111	4	106	1	53	9	2	0
ALL		1848	1848	1848	1848	1848	1848
Positive counts		429	129	299	254	107	29
		Percentage distribution of all counts					
		%	%	%	%	%	%
0000	0	76.8	93.0	83.8	86.3	94.2	98.4
0001	1	0.8	0.4	1.9	1.8	0.7	0.2
0010	1	4.8	3.2	3.2	3.3	2.2	0.7
0100	1	0.5	0.5	0.2	1.0	0.6	0.2
1000	1	0.9	0.4	1.0	0.4	0.4	0.1
0011	2	1.7	0.2	1.7	1.2	0.4	0.1
0101	2	0.1	0.0	0.1	0.1	0.1	0.0
0110	2	0.8	0.3	0.4	0.6	0.3	0.0
1001	2	0.0	0.0	0.0	0.0	0.0	0.0
1010	2	0.2	0.1	0.2	0.1	0.0	0.0
1100	2	2.4	1.2	1.6	2.6	0.3	0.2
0111	3	0.3	0.0	0.7	0.3	0.2	0.1
1011	3	0.0	0.0	0.2	0.1	0.1	0.0
1101	3	0.6	0.0	0.6	0.5	0.1	0.0
1110	3	4.4	0.6	1.5	1.2	0.3	0.1
1111	4	5.7	0.1	2.9	0.5	0.1	0.0
ALL		100.0	100.0	100.0	100.0	100.0	100.0

[a] Positive participation is indicated by one, non-participation by zero.

Source: Unpublished data from the ABS BLS survey.

Table B.3 **Percentage distribution of the sequence of participation counts excluding those with only zero counts over the four years from 1993-94 to 1996-97**

Sequence of counts[a]	*No. of counts*	*R&D tax*	*IR&D grants*	*EMDG*	*Austrade services*	*Export Access*	*ITES*
		%	%	%	%	%	%
0001	1	3.5	6.2	12.0	13.4	12.1	13.8
0010	1	20.7	45.7	20.1	24.0	38.3	44.8
0100	1	2.1	7.0	1.0	7.5	11.2	13.8
1000	1	3.7	5.4	6.0	2.8	7.5	3.4
sub-total	1	30.1	64.3	39.1	47.6	69.2	75.9
0011	2	7.5	3.1	10.4	8.7	7.5	3.4
0101	2	0.2	0.0	0.3	0.8	0.9	0.0
0110	2	3.5	4.7	2.7	4.7	5.6	0.0
1001	2	0.0	0.0	0.0	0.0	0.0	0.0
1010	2	0.9	0.8	1.3	0.8	0.0	0.0
1100	2	10.3	17.8	9.7	18.9	5.6	10.3
sub-total	2	22.4	26.4	24.4	33.9	19.6	13.8
0111	2	1.2	0.0	4.3	2.0	2.8	6.9
1011	3	0.0	0.0	1.3	0.4	0.9	0.0
1101	3	2.8	0.0	3.7	3.9	0.9	0.0
1110	3	18.9	8.5	9.4	8.7	4.7	3.4
sub-total	3	22.8	8.5	18.7	15.0	9.3	10.3
1111	4	24.7	0.8	17.7	3.5	1.9	0.0
ALL		100.0	100.0	100.0	100.0	100.0	100.0

[a] Positive participation is indicated by one, non-participation by zero.

Source: Unpublished data from the ABS BLS survey.

Notes concerning tables B.4 to B.9

In the logit and Poisson regressions presented in the following pages, the omitted dummy variable among industries is Textiles and Clothing, and the omitted dummy variable among firm sizes is the 1 – 20 persons size group.

The goodness-of-fit measures presented with the logit regressions are defined in SAS (1990). Essentially, the concordance rate measures the proportion of regression answers that are closer to the actual zero-one observations than to their alternatives. The Tau-a indicator is similar to R^2 in the logit context.

Table B.4 Logit regression — dependent variable is participation (at least once) in R&D programs during the study period

	Standardised regression coefficients and significance level		
	Any R&D program	*R&D tax concession*	*R&D grants*
Firm age	0.044	0.062	-0.016
Log value added per person[a]	-0.108 **	-0.047	-0.112 **
Purchases per person[ab]	0.088	0.082	-0.015
Assets per person[a]	0.159 **	0.192 ***	0.140
Profit-equity ratio[a]	-0.039	-0.018	0.002
Non-R&D innov. expenditure per person[a]	-0.199 ***	-0.197 ***	-0.200 ***
Exports to sales ratio[a]	0.117 **	0.087 *	0.102 *
Debt-equity ratio[a]	-0.004	-0.009	-0.015
Binary variables			
Foreign ownership	-0.076	-0.104 **	-0.116 *
Firm size: 21 - 100 persons	0.279 ***	0.267 ***	0.139
101 - 500 persons	0.355 ***	0.339 ***	0.288 ***
over 500 persons	0.478 ***	0.477 ***	0.207 ***
Industry: Mining	0.031	0.058	-0.114
Processed Food	-0.049	-0.040	-0.006
Wood and Paper Products	0.051	0.070	0.038
Printing and Publishing	-0.024	-0.031	-0.070
Chemicals	0.226 ***	0.250 ***	-0.078
Pharmaceuticals	0.020	0.036	-0.658
Non-metallic Minerals	0.091	0.114 *	-0.036
Basic Metal Processing	0.117	0.141 *	0.029
Machinery and Transport Equipment	0.289 ***	0.297 ***	0.109
Medical and Scientific Instruments	0.087	0.096 *	0.079
Electronics	0.358 ***	0.322 ***	0.309 ***
Furniture and Miscellaneous	0.112 *	0.095	0.091
Engineering Services	0.040	0.044	0.029
Computer Services	0.147 **	0.144 **	0.066
Over 20% of innovations from outside	-0.089 *	-0.070	-0.100
Introduced some non-technical innovations	-0.133 **	-0.162 ***	0.005
Performed formal business planning	0.049	0.066	0.113
Performed budget forecasting	0.015	-0.033	0.165 *
Increased management training	-0.072	-0.101	0.038
Increased on-the-job training	0.051	0.181 *	0.051
Increased other training	-0.024	-0.134	-0.004
Networked with other firms	-0.004	0.023	-0.027
Benchmarked against other firms	0.008	-0.024	-0.026
Goodness of fit measures			
Concordant	0.813	0.817	0.776
Tau-a	0.314	0.317	0.133

* Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level. [a] Value at the first year of the study, that is 1994-5. [b] Purchases per person is defined as sales minus value-added per person.

Source: Unpublished data from the ABS BLS survey.

Table B.5 **Logit regression — dependent variable is participation (at least once) in export marketing programs during the study period**

	Standardised regression coefficients and significance level		
	Any export program	*EMDG grants*	*Austrade services*
Firm age	0.047	-0.080 *	0.095 **
Log value added per person[a]	-0.025	-0.024	0.022
Purchases per person[ab]	-0.170 ***	-0.139 **	-0.147 **
Assets per person[a]	0.046	0.016	0.006
Exports to sales ratio[a]	0.227 ***	0.231 ***	0.126 **
R&D expenditure to sales ratio[a]	0.348	-0.051	0.420
Profit-equity ratio[a]	-0.052	-0.104 **	0.026
Debt-equity ratio[a]	0.053	0.057	-0.020
Binary variables			
Foreign ownership	-0.164 ***	-0.116 **	-0.149 ***
Firm size: 21 - 100 persons	0.170 ***	0.203 ***	0.214 ***
101 - 500 persons	0.195 ***	0.234 ***	0.211 ***
over 500 persons	0.074	0.067	0.140 **
Industry: Mining	-0.171 ***	-0.166 **	-0.266 **
Processed Food	0.118 *	0.160 **	0.087
Wood and Paper Products	0.039	0.015	-0.027
Printing and Publishing	0.001	0.069	-0.145 *
Chemicals	0.070	0.073	-0.063
Pharmaceuticals	0.088 *	-0.033	0.076 *
Non-metallic Minerals	-0.006	0.046	0.013
Basic Metal Processing	0.096	0.066	0.029
Machinery and Transport Equipment	0.136 **	0.081	0.097
Medical and Scientific Instruments	0.030	0.000	0.076 *
Electronics	0.142 **	0.186 ***	0.132 **
Furniture and Miscellaneous	0.146 ***	0.168 ***	0.107 *
Engineering Services	0.078	0.102 **	0.008
Computer Services	0.021	0.052	-0.008
Performed formal business planning	0.022	0.060	0.044
Performed budget forecasting	0.104 *	0.189 ***	0.035
Increased management training	0.077	0.055	0.123
Increased on-the-job training	0.022	0.027	0.036
Increased other training	-0.072	-0.015	-0.218 **
Networked with other firms	0.053	0.095 *	-0.074
Benchmarked against other firms	0.000	-0.053	0.075
Performed export planning	0.450 ***	0.515 ***	0.369 ***
Goodness of fit measures			
Concordant	0.791	0.808	0.773
Tau-a	0.285	0.263	0.207

***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level. **a** Value at the first year of the study, that is 1994-5. **b** Purchases per person is defined as sales minus value-added per person.

Source: Unpublished data from the ABS BLS survey.

Table B.6 **Logit regression — dependent variable is participation (at least once) in export marketing programs during the study period**

	Regression coefficients and significance levels	
	ITES loan	*Export Access*
Firm age	0.014	-0.016
Log value added per person[a]	-0.091	0.020
Purchases per person[ab]	-0.283	0.018
Assets per person[a]	0.418 **	-0.126
Exports to sales ratio[a]	0.039	-0.045
R&D expenditure to sales ratio[a]	0.059	0.365
Profit-equity ratio[a]	0.002	-0.146 * *
Debt-equity ratio[a]	-0.016	0.015
Binary variables		
Foreign ownership	-0.378 **	-0.099
Firm size: 21 - 100 persons	0.339	0.105
101 - 500 persons	0.562 ***	-0.042
over 500 persons	0.453 ***	-0.079
Industry: Mining	-1.293	-0.081
Processed Food	-0.171	-0.040
Wood and Paper Products	-1.262	0.040
Printing and Publishing	-1.479	-0.117
Chemicals	-0.375	-0.084
Pharmaceuticals	-0.473	-0.003
Non-metallic Minerals	-0.015	-0.008
Basic Metal Processing	-0.008	0.003
Machinery and Transport Equipment	0.041	0.007
Medical and Scientific Instruments	-0.864	-0.082
Electronics	0.105	-0.045
Furniture and Miscellaneous	0.025	-0.010
Engineering Services	-0.765	-0.966
Computer Services	0.066	-0.240 *
Performed formal business planning	0.038	0.115
Performed budget forecasting	1.924	0.016
Increased management training	-0.709 **	-0.062
Increased on-the-job training	0.383	0.086
Increased other training	0.101	0.059
Networked with other firms	-0.029	-0.005
Benchmarked against other firms	-0.085	0.086
Performed export planning	0.268	0.399 * * *
Goodness of fit measures		
Concordant	0.885	0.750
Tau-a	0.043	0.092

* Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level. [a] Value at the first year of the study, that is 1994-5. [b] Purchases per person is defined as sales minus value-added per person.

Source: Unpublished data from the ABS BLS survey.

Table B.7 **Poisson regression — dependent variable is the participation count of R&D programs during the study period**

	Regression coefficients and significance level		
	Any R&D program	*R&D tax concession*	*R&D grants*
Intercept	-2.921 ***	-3.007 ***	-5.220 ***
Firm age	0.004 ***	0.004 ***	0.004
Log value added per person[a]	-0.050 **	-0.048 **	-0.102 **
Sales less value added per person[ab]	0.000	0.000	0.000
Assets per person[a]	0.246 ***	0.249 ***	0.221 **
Profit-equity ratio[a]	0.001	0.001	0.000
Non-R&D innovation expenditure per pers[a]	-0.005 ***	-0.005 ***	-0.009 ***
Exports to sales ratio[a]	0.003 **	0.002 *	0.008 **
Debt-equity ratio[a]	0.000	0.000	0.000
Binary variables			
Foreign ownership	-0.296 ***	-0.263 ***	-0.770 ***
Firm size: 21 - 100 persons	0.569 ***	0.611 ***	0.389 *
101 - 500 persons	0.870 ***	0.875 ***	0.843 ***
over 500 persons	1.107 ***	1.152 ***	0.900 ***
Industry: Mining	0.140	0.217	-0.602
Processed Food	-0.074	-0.090	0.182
Wood and Paper Products	0.172	0.127	0.631
Printing and Publishing	-0.329	-0.302	-0.553
Chemicals	0.458 **	0.511 ***	0.031
Pharmaceuticals	0.103	0.306	-12.501
Non-metallic Minerals	0.227	0.239	0.476
Basic Metal Processing	0.315 *	0.315	0.456
Machinery and Transport Equipment	0.745 ***	0.752 ***	0.845 *
Medical and Scientific Instruments	0.849 ***	0.790 ***	1.616 ***
Electronics	1.194 ***	1.069 ***	2.071 ***
Furniture and Miscellaneous	0.481 **	0.416 *	0.899
Engineering Services	0.314	0.284	0.665
Computer Services	0.846 ***	0.832 ***	1.207 **
Over 20% of innovations from outside	-0.569 **	-0.516 *	-0.170
Introduced some non-technical innovations	-0.172 *	-0.213 **	-0.047
Performed formal business planning	0.183 **	0.161 *	0.509 **
Performed budget forecasting	-0.017	-0.134	0.823 *
Increased management training	-0.432 **	-0.544 ***	-0.256
Increased on-the-job training	0.532 ***	0.583 ***	0.916 **
Increased other training	-0.202	-0.219	-0.417
Networked with other firms	0.114	0.136 *	-0.029
Benchmarked against other firms	-0.108	-0.122	-0.173
Pseudo R^2	0.461	0.434	0.131

***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level. **a** Value at the first year of the study, that is 1994-5. **b** Purchases per person is defined as sales minus value-added per person.

Source: Unpublished data from the ABS BLS survey.

Table B.8 **Poisson regression — dependent variable is the participation count of export programs during the study period**

	Regression coefficients and significance level		
	Any export programs	*EMDG grants*	*Austrade services*
Intercept	-1.854 ***	-3.276 ***	-2.937 ***
Firm age	0.000	-0.004 **	0.005 **
Log value added per person[a]	-0.017	-0.025	0.050
Purchases per person[ab]	0.000 ***	0.000 ***	0.000 ***
Assets per person[a]	0.042	0.066	-0.007
Exports to sales ratio[a]	0.009 ***	0.011 ***	0.009 ***
R&D expenditure to sales ratio[a]	0.001	-0.002	0.001
Profit-equity ratio[a]	-0.001	-0.002 *	0.001
Debt-equity ratio[a]	0.000	0.000	0.000
Binary variables			
Foreign ownership	-0.490 ***	-0.486 ***	-0.415 ***
Firm size: 21 - 100 persons	0.370 ***	0.365 ***	0.562 ***
101 - 500 persons	0.562 ***	0.595 ***	0.757 ***
over 500 persons	0.352 ***	0.285	0.596 ***
Industry: Mining	-2.005 ***	-1.731 ***	-2.936 ***
Processed Food	0.216	0.427 **	0.297
Wood and Paper Products	-0.251	-0.077	-0.626
Printing and Publishing	-0.432 **	0.033	-0.908 **
Chemicals	-0.092	0.136	-0.072
Pharmaceuticals	0.431	-0.531	1.156 **
Non-metallic Minerals	0.088	0.096	0.230
Basic Metal Processing	0.132	0.128	0.094
Machinery and Transport Equipment	0.112	0.120	0.350 *
Medical and Scientific Instruments	0.021	0.196	0.239
Electronics	0.457 ***	0.748 ***	0.600 **
Furniture and Miscellaneous	0.330 **	0.476 **	0.378
Engineering Services	0.360	0.875 ***	-0.013
Computer Services	-0.190	-0.055	-0.260
Performed formal business planning	0.277 ***	0.288 **	0.283 **
Performed budget forecasting	0.353 **	0.689 ***	0.184
Increased management training	0.275 **	0.452 ***	0.207
Increased on-the-job training	-0.008	-0.094	0.269
Increased other training	-0.297 **	-0.322 *	-0.610 **
Networked with other firms	0.077	0.267 ***	-0.087
Benchmarked against other firms	-0.025	-0.102	0.098
Performed export planning	1.309 ***	1.461 ***	1.177 ***
Pseudo R^2	0.387	0.290	0.237

* Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level. [a] Value at the first year of the study, that is 1994-5. [b] Purchases per person is defined as sales minus value-added per person.

Source: Unpublished data from the ABS BLS survey.

Table B.9 **Poisson regression — dependent variable is the participation count of export programs during the study period**

	Regression coefficients and significance levels			
	ITES loan		*Export Access*	
Intercept	-29.954		-1.634	
Firm age	0.003		0.001	
Log value added per person[a]	-0.162		0.056	
Purchases per person[ab]	0.000	* *	0.000	
Assets per person[a]	1.011	* **	-0.197	
Exports to sales ratio[a]	0.001		-0.003	
R&D expenditure to sales ratio[a]	0.003		0.002	* * *
Profit-equity ratio[a]	0.000		-0.005	* *
Debt-equity ratio[a]	0.000		0.000	
Binary variables				
Foreign ownership	-1.989	* **	-0.571	*
Firm size: 21 - 100 persons	1.120		0.168	
101 - 500 persons	2.887	* **	-0.520	
over 500 persons	3.031	* **	-0.417	
Industry: Mining	-19.715		-1.094	
Processed Food	-0.786		-0.282	
Wood and Paper Products	-18.907		0.273	
Printing and Publishing	-18.165		-0.752	
Chemicals	-2.142	*	-0.156	
Pharmaceuticals	-17.145		0.671	
Non-metallic Minerals	-0.346		-0.173	
Basic Metal Processing	-0.421		0.377	
Machinery and Transport Equipment	0.313		-0.048	
Medical and Scientific Instruments	-17.796		-0.691	
Electronics	0.545		-0.170	
Furniture and Miscellaneous	-0.022		-0.130	
Engineering Services	-17.341		-14.175	
Computer Services	0.726		-2.179	* *
Performed formal business planning	0.426		0.705	* * *
Performed budget forecasting	15.351	* **	-0.268	
Increased management training	-2.650	* *	0.005	
Increased on-the-job training	2.184	* *	0.032	
Increased other training	0.224		0.329	
Networked with other firms	-0.236		0.049	
Benchmarked against other firms	-0.746		0.231	
Performed export planning	1.212	*	1.547	* * *
Pseudo R^2	0.036		0.087	

***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level. **a** Value at the first year of the study, that is 1994-5. **b** Purchases per person is defined as sales minus value-added per person.

Source: Unpublished data from the ABS BLS survey.

Table B.10 **Dissection of the reasons for non-participation in business programs — percentage of respondents who indicated some reason**

	Not applicable	Program poorly designed	Only for big business	Not seeking assistance	No knowledge of program	Don't know contact	Too much paperwork	Other reasons
	%	%	%	%	%	%	%	%
Age of business								
Less than 2 yrs	16.1	2.6	8.3	26.6	12.0	6.3	8.9	4.2
2 – 5 years	27.7	2.4	19.3	30.1	13.3	9.6	13.3	6.0
5 – 10 years	23.9	5.8	18.3	37.8	20.7	8.4	17.6	1.9
10 – 20 years	22.9	5.1	13.5	36.6	15.3	4.9	19.1	3.4
20 – 40 years	22.8	2.9	13.2	39.2	13.8	6.1	18.3	1.6
Over 40 years	24.4	4.7	13.4	32.6	15.1	3.5	15.1	3.5
Type of business								
Public company	29.1	4.3	4.3	29.8	9.2	3.5	11.3	4.3
Other incorportd	21.4	4.1	13.1	35.2	14.1	5.2	17.0	2.6
Sole proprietor	19.1	10.6	31.9	34.0	34.0	19.1	21.3	4.3
Partnership	26.2	4.9	27.0	41.0	25.4	13.9	18.9	3.3
Trust	23.7	4.7	16.8	39.5	20.5	7.4	18.9	2.6
Other	41.7	-	12.5	41.7	16.7	-	4.2	8.3
Family business								
No	21.4	3.2	9.9	32.4	12.8	4.4	13.4	2.5
Yes	24.4	5.8	19.4	39.5	19.2	8.3	21.0	3.4
Ownership								
Domestic	22.3	4.7	15.2	35.7	16.3	6.7	17.4	2.7
Foreign	26.9	1.6	5.9	35.5	11.3	1.1	11.8	4.3
Loss status								
No loss	22.4	4.6	13.1	37.9	16.3	6.1	17.3	2.3
Loss in 94-5	20.3	3.5	18.6	32.0	18.0	8.7	20.9	5.8
Loss in 95-6	27.7	3.8	16.2	36.2	14.9	5.1	14.9	3.0
Loss in both yrs	21.4	4.3	15.5	23.5	11.2	5.9	12.8	4.3
ALL	22.7	4.4	14.2	35.7	15.8	6.2	16.9	2.9

Source: Unpublished data from the ABS BLS survey.

Table B.11 **Dissection of the reasons for non-participation in business programs – expressed as a percentage of the overall average**

	Not applicable	Program poorly designed	Only for big business	Not seeking assistance	No knowledge of program	Don't know contact	Too much paperwork	Other
	%	%	%	%	%	%	%	%
Age of business								
Less than 2 yrs	71	60	59	74	76	101	53	144
2 – 5 years	122	55	135	84	84	156	79	208
5 – 10 years	105	133	129	106	131	137	104	67
10 – 20 years	101	116	95	103	97	79	113	117
20 – 40 years	100	67	93	110	87	99	108	55
Over 40 years	107	107	94	91	96	57	90	121
Type of business								
Public company	128	98	30	83	58	58	67	147
Other incorportd	94	95	92	99	90	84	101	90
Sole proprietor	84	244	224	95	216	311	126	147
Partnership	115	113	190	115	161	226	112	113
Trust	104	109	118	111	130	120	112	91
Other	183	-	88	117	106	-	25	288
Family business								
No	94	73	70	91	81	71	80	87
Yes	107	132	137	111	122	134	125	116
Ownership								
Domestic	98	107	107	100	103	109	103	94
Foreign	118	37	42	99	72	17	70	149
Loss status								
No loss	98	105	92	106	103	98	102	78
Loss in 94-5	89	80	131	90	114	141	124	201
Loss in 95-6	122	88	114	101	94	83	88	103
Loss in both yrs	94	98	109	66	71	95	76	148
ALL	100	100	100	100	100	100	100	100

Source: Unpublished data from the ABS BLS survey.

C Correlations

Table C.1 **Correlations between some key variables — not weighted by firm size**

	R&D tax counts	*R&D grants counts*	*% R&D support*	*EMDG counts*	*Austrade counts*
Counts of R&D tax conces	1.000	0.326	0.147	0.333	0.323
R&D grants	0.326	1.000	0.129	0.264	0.221
% R&D support/sales 96-7	0.147	0.129	1.000	0.114	0.067
Counts of EMDG	0.333	0.264	0.114	1.000	0.454
Counts of Austrade	0.323	0.221	0.067	0.454	1.000
Counts of ITES	0.194	0.245	0.045	0.154	0.222
Counts of Export Access	0.108	0.111	0.029	0.194	0.282
Total count of R&D progs	0.966	0.542	0.163	0.359	0.337
Total count of export progs	0.382	0.295	0.118	0.846	0.774
Change in sales	0.001	-0.018	0.001	0.037	0.027
Change in productivity	-0.016	-0.017	-0.035	0.002	-0.029
Change in R&D	-0.241	-0.098	-0.018	-0.035	-0.073
Change in exports	0.105	0.037	0.050	0.069	0.062
Exports/sales ratio	0.245	0.166	0.038	0.332	0.233
R&D/sales ratio	0.293	0.219	0.390	0.182	0.102

	ITES counts	*Export Access*	*Total R&D prog counts*	*Total export prog count*	*Change in sales*
Counts of R&D tax conces	0.194	0.108	0.966	0.382	0.001
R&D grants	0.245	0.111	0.542	0.295	-0.018
% R&D support/sales 96-7	0.045	0.029	0.163	0.118	0.001
Counts of EMDG	0.154	0.194	0.359	0.846	0.037
Counts of Austrade	0.222	0.282	0.337	0.774	0.027
Counts of ITES	1.000	0.105	0.215	0.296	-0.027
Counts of Export Access	0.105	1.000	0.125	0.476	-0.013
Total count of R&D progs	0.215	0.125	1.000	0.411	0.002
Total count of export progs	0.296	0.476	0.411	1.000	0.034
Change in sales	-0.027	-0.013	0.002	0.096	1.000
Change in productivity	-0.019	-0.010	-0.019	-0.060	0.335
Change in R&D	0.001	-0.004	-0.242	0.321	0.053
Change in exports	0.006	0.077	0.103	0.172	0.147
Export/sales ratio	0.085	0.049	0.255	0.034	0.046
R&D/sales ratio	0.056	0.043	0.316	-0.018	0.050

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Table C.1 (continued)

	Change in productivity	*Change in R&D*	*Change in exports*	*Exports/ sales*	*R&D exp/ sales*
Counts of R&D tax conces	-0.016	-0.241	0.105	0.245	0.293
R&D grants	-0.017	-0.098	0.037	0.166	0.219
% R&D support/sales 96-7	-0.035	-0.018	0.050	0.038	0.390
Counts of EMDG	0.002	-0.035	0.069	0.332	0.182
Counts of Austrade	-0.029	-0.073	0.062	0.233	0.102
Counts of ITES	-0.019	0.001	0.006	0.085	0.056
Counts of Export Access	-0.010	-0.004	0.077	0.049	0.043
Total count of R&D progs	-0.019	-0.242	0.103	0.255	0.316
Total count of export progs	-0.018	-0.060	0.096	0.321	0.172
Change in sales	0.335	0.053	0.147	0.046	0.050
Change in productivity	1.000	0.024	0.041	0.007	-0.010
Change in R&D	0.024	1.000	0.015	-0.016	0.007
Change in exports	0.041	0.015	1.000	-0.056	0.067
Export/sales ratio	0.007	-0.016	-0.056	1.000	0.129
R&D/sales ratio	-0.010	0.007	0.067	0.129	1.000

Source: Unpublished data from the ABS BLS survey.

Table C.2 **Correlations between some key variables —weighted by firm size**

	R&D tax counts	*R&D grants counts*	*% R&D support*	*EMDG counts*	*Austrade counts*
Counts of R&D tax conces	1.000	0.431	0.105	0.165	0.366
R&D grants	0.431	1.000	0.043	0.179	0.478
% R&D support/sales 96-7	0.105	0.043	1.000	0.045	-0.012
Counts of EMDG	0.165	0.179	0.045	1.000	0.283
Counts of Austrade	0.366	0.478	-0.012	0.283	1.000
Counts of ITES	0.248	0.340	0.009	0.096	0.463
Counts of Export Access	0.209	0.277	0.040	0.262	0.210
Total count of R&D progs	0.969	0.619	0.104	0.194	0.408
Total count of export progs	0.367	0.460	0.028	0.720	0.807
Change in sales	-0.194	-0.170	-0.056	-0.095	-0.147
Change in productivity	-0.015	-0.068	-0.020	-0.001	-0.064
Change in R&D	-0.342	-0.270	-0.008	0.020	-0.190
Change in exports	0.032	0.028	-0.011	0.001	-0.059
Exports/sales ratio	0.240	0.148	0.020	-0.032	0.100
R&D/sales ratio	0.229	0.024	0.307	0.057	-0.007

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Table C.2 (continued)

	ITES counts	*Export Access*	*Total R&D prog counts*	*Total export prog count*	*Change in sales*
Counts of R&D tax conces	0.248	0.209	0.969	0.367	-0.194
R&D grants	0.340	0.277	0.619	0.460	-0.170
% R&D support/sales 96-7	0.009	0.040	0.104	0.028	-0.056
Counts of EMDG	0.096	0.262	0.194	0.720	-0.095
Counts of Austrade	0.463	0.210	0.408	0.807	-0.147
Counts of ITES	1.000	0.155	0.271	0.496	-0.102
Counts of Export Access	0.155	1.000	0.236	0.440	-0.114
Total count of R&D progs	0.271	0.236	1.000	0.416	-0.207
Total count of export progs	0.496	0.440	0.416	1.000	-0.170
Change in sales	-0.102	-0.114	-0.207	-0.170	1.000
Change in productivity	-0.086	0.001	-0.022	-0.047	0.323
Change in R&D	-0.084	-0.101	-0.362	-0.147	0.209
Change in exports	0.005	0.009	0.038	-0.019	0.190
Export/sales ratio	0.039	-0.012	0.234	0.038	-0.039
R&D/sales ratio	0.036	0.002	0.203	0.021	0.209

	Change in productivity	*Change in R&D*	*Change in exports*	*Exports/ sales*	*R&D exp/ sales*
Counts of R&D tax conces	-0.015	-0.342	0.032	0.240	0.229
R&D grants	-0.068	-0.270	0.028	0.148	0.024
% R&D support/sales 96-7	-0.020	-0.008	-0.011	0.020	0.307
Counts of EMDG	-0.001	0.020	0.001	-0.032	0.057
Counts of Austrade	-0.064	-0.190	-0.059	0.100	-0.007
Counts of ITES	-0.086	-0.084	0.005	0.039	0.036
Counts of Export Access	0.001	-0.101	0.009	-0.012	0.002
Total count of R&D progs	-0.022	-0.362	0.038	0.234	0.203
Total count of export progs	-0.047	-0.147	-0.019	0.038	0.021
Change in sales	0.323	0.209	0.190	-0.039	0.209
Change in productivity	1.000	0.103	0.111	0.092	0.028
Change in R&D	0.103	1.000	0.156	-0.089	-0.016
Change in exports	0.111	0.156	1.000	-0.080	-0.015
Export/sales ratio	0.092	-0.089	-0.080	1.000	0.008
R&D/sales ratio	0.028	-0.016	-0.015	0.008	1.000

Source: Unpublished data from the ABS BLS survey.

D Intentions and transitions

Table D.1 **Percentage of respondents reporting a certain intention against transition of participation in the EMDG**[a]

Participation in EMDG over two years[b]	*Intends to increase output*	*Intends to decrease output*	*Intends to expand exports*	*Intends to introduce new goods*	*Intends to sell business*	*Intends to close business*
00	50.6	2.3	53.8	47.8	4.4	0.8
01	66.9	1.5	63.9	56.2	0.8	0.0
10	66.2	4.5	79.7	60.9	6.8	0.0
11	69.3	0.5	84.2	67.8	3.0	0.0
ALL	55.0	2.2	59.8	51.6	4.1	0.6
			As a percentage of the overall average			
00	92.0	104.1	89.9	92.7	106.0	134.4
01	121.7	69.7	106.8	108.8	18.6	0.0
10	120.4	204.1	133.3	118.0	163.5	0.0
11	126.1	22.6	140.8	131.4	71.7	0.0

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. The intention is measured in the base year of participation. In other words, in the transition of participation from P_t to P_{t+1} the relevant expectation is that made in year t for subsequent years. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table D.2 **Percentage of respondents reporting a certain intention against transition of participation in Austrade services**[a]

Participation in Austrade over two years[b]	*Intends to increase output*	*Intends to decrease output*	*Intends to expand exports*	*Intends to introduce new goods*	*Intends to sell business*	*Intends to close business*
00	51.2	2.3	55.1	49.4	4.3	0.7
01	68.4	1.7	71.8	52.1	2.6	0.0
10	70.0	1.9	80.6	63.8	5.0	0.6
11	72.3	1.2	84.3	66.3	2.4	0.0
ALL	55.0	2.2	59.8	51.6	4.1	0.6
			As a percentage of the overall average			
00	93.2	105.9	92.2	95.7	103.4	113.1
01	124.4	77.4	120.1	101.0	61.8	0.0
10	127.3	85.1	134.9	123.5	120.8	103.3
11	131.5	54.3	141.1	128.4	58.2	0.0

a See a in table D.1. **b** See b in table D.1.

Source: Unpublished data from the ABS BLS survey.

Table D.3 **Percentage of respondents reporting a certain intention against transition of participation in the R&D tax concession**[a]

Usage of R&D tax over two years[b]	*Intends to increase output*	*Intends to decrease output*	*Intends to expand exports*	*Intends to introduce new goods*	*Intends to sell business*	*Intends to close business*
00	56.7	2.2	45.6	58.0	5.9	2.1
01	58.0	1.4	51.1	53.2	0.7	0.7
10	57.6	2.3	60.8	59.9	5.5	0.9
11	65.4	2.3	66.0	58.8	2.3	0.0
ALL	58.6	2.2	52.4	57.8	4.6	1.4
			As a percentage of the overall average			
00	96.6	100.5	87.0	100.2	126.6	151.5
01	99.0	64.8	97.4	91.9	15.2	51.5
10	98.2	106.5	116.1	103.6	119.7	67.6
11	111.6	106.9	125.9	101.7	50.0	0.0

a See a in table D.1. **b** See b in table D.1.

Source: Unpublished data from the ABS BLS survey.

Table D.4 **Logit regression — dependent variable is no participation in either year (transition 00)**[a]

	Standardised regression coefficient and significance level			
	EMDG	Austrade	R&D tax	R&D grants
Firm age	0.037	-0.135 ***	-0.068 **	0.039
Log value-added per person[b]	0.085 **	-0.043	0.015	0.114 ***
Log value of assets per person[b]	-0.049	0.027	-0.248 ***	-0.196 ***
Multiple locations	-0.063 *	0.009	-0.081	0.007
Binary variables				
Firm size: 21 - 100 persons	-0.209 ***	-0.234 ***	-0.260 ***	-0.140 **
101 - 500 persons	-0.243 ***	-0.229 ***	-0.318 ***	-0.259 ***
over 500 persons	-0.091 *	-0.169 ***	-0.388 ***	-0.173 ***
Foreign ownership	0.075 **	0.112 ***	0.096 ***	0.097 *
Family business	0.032	0.073	0.061	0.108 *
Industry: Mining	0.138 **	0.196 **	-0.117 **	0.023
Processed Food	-0.072	-0.066	0.054	0.043
Wood and Paper Products	0.043	0.024	-0.039	-0.051
Printing and Publishing	0.053	0.145 **	0.023	0.078
Chemicals	0.064	0.083	-0.191 ***	0.087
Pharmaceuticals	0.032	-0.065 **	-0.026	0.648
Non-metallic Minerals	-0.002	0.009	-0.109 **	0.028
Basic Metal Processing	0.033	-0.003	-0.097 *	-0.015
Machinery and Transport Equipment	0.027	-0.070	-0.232 ***	-0.121
Medical and Scientific Instruments	-0.024	-0.069 **	-0.102 ***	-0.057
Electronics	-0.119 ***	-0.102 **	-0.296 ***	-0.267 ***
Furniture and Miscellaneous	-0.084 **	-0.036	-0.067	-0.115 *
Engineering Services	-0.055 *	-0.001	0.010	-0.039
Computer Services	0.004	0.060	-0.145 ***	-0.081
Intentions				
Intends to increase production	-0.127 ***	-0.172 ***	-0.064 *	-0.135 **
Intends to decrease production	-0.033	0.004	-0.012	-0.014
Intends to increase exports	-0.244 ***	-0.255 ***	-0.161 ***	-0.058
Intends to introduce new goods	-0.061 *	0.010	0.008	0.027
Intends to sell the business	-0.001	0.006	0.042	0.039
Intends to close the business	0.649	0.000	0.038	0.035
Goodness of fit measures				
Concordant	0.718	0.735	0.792	0.744
Tau-a	0.168	0.151	0.287	0.096

a The regressions of export programs cover only firms that exported at least in one year between 1993-94 and 1996-97 — those of R&D programs cover only firms that carried out R&D at least in one year between 1994-95 and 1996-97. **b** Value at the first year of the survey (1994-95). * Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level.

Table D.5 Logit regression — dependent variable is moving from no participation to participation (transition 01)[a]

	Standardised regression coefficient and significance level			
	EMDG	Austrade	R&D tax	R&D grants
Firm age	0.026	0.141 ***	-0.028	-0.137
Log value-added per person[b]	-0.060	0.085	0.078	-0.114 **
Log value of assets per person[b]	-0.077	-0.012	-0.013	0.089
Multiple locations	0.060	-0.004	-0.082	-0.020
Binary variables				
Firm size: 21 - 100 persons	0.162 **	0.199 **	0.181 **	0.136
101 - 500 persons	0.181 ***	0.198 ***	0.203 ***	0.282 ***
over 500 persons	0.009	0.132 *	0.149 **	0.187 **
Foreign ownership	-0.016	-0.142 **	-0.043	-0.001
Family business	-0.026	-0.107 *	-0.110 *	0.005
Industry: Mining	-0.101	-0.170	-0.055	-0.003
Processed Food	0.031	0.040	-0.026	-0.059
Wood and Paper Products	-0.052	0.026	0.038	0.009
Printing and Publishing	0.002	-0.178 *	0.006	-0.042
Chemicals	-0.050	-0.128	0.122	-0.172
Pharmaceuticals	-0.590	0.027	0.018	-0.625
Non-metallic Minerals	0.061	-0.067	0.111 *	-0.107
Basic Metal Processing	-0.023	-0.030	0.059	-0.063
Machinery and Transport Equipment	-0.009	0.044	0.107	0.039
Medical and Scientific Instruments	-0.061	0.060	-0.945	-0.897
Electronics	0.023	0.067	0.100	0.102
Furniture and Miscellaneous	0.066	0.014	-0.061	0.041
Engineering Services	-0.007	-0.057	-0.601	0.038
Computer Services	-0.028	-0.113	0.050	-0.005
Intentions				
Intends to increase production	0.142 **	0.169 ***	-0.004	0.113
Intends to decrease production	0.008	-0.007	-0.042	0.058
Intends to increase exports	0.010	0.126 **	-0.017	-0.007
Intends to introduce new goods	0.008	-0.105 *	-0.065	-0.010
Intends to sell the business	-0.189	-0.040	-0.236 **	-1.460
Intends to close the business	-0.565	-0.555	0.008	-0.755
Goodness of fit measures				
Concordant	0.658	0.717	0.674	0.711
Tau-a	0.044	0.054	0.058	0.033

a The regressions of export programs cover only firms that exported at least in one year between 1993-94 and 1996-97.— those of R&D programs cover only firms that carried out R&D at least in one year between 1994-95 and 1996-97. **b** Value at the first year of the survey (1994-95). * Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level.

Table D.6 **Logit regression — dependent variable is moving from participation to no participation (transition 10)**[a]

	Standardised regression coefficient and significance level			
	EMDG	Austrade	R&D tax	R&D grants
Firm age	-0.033	0.086 *	-0.001	-0.039
Log value-added per person[b]	0.046	-0.018	0.008	-0.063
Log value of assets per person[b]	0.009	-0.028	0.098 *	0.200 **
Multiple locations	0.022	-0.005	-0.005	0.000
Binary variables				
Firm size: 21 - 100 persons	0.132 *	0.128 **	0.181 ***	0.170 *
101 - 500 persons	0.263 ***	0.165 ***	0.232 ***	0.248 ***
over 500 persons	0.193 ***	0.139 **	0.155 ***	0.195 **
Foreign ownership	-0.065	-0.091	-0.059	-0.107 *
Family business	-0.027	-0.050	-0.053	-0.147 *
Industry: Mining	-0.066	-0.140	0.077	-0.012
Processed Food	0.138 *	0.075	0.037	0.000
Wood and Paper Products	0.013	-0.027	0.109 **	0.084
Printing and Publishing	-0.053	-0.093	0.022	-0.098
Chemicals	0.038	0.038	0.184 **	-0.015
Pharmaceuticals	0.019	0.048	0.050	-0.627
Non-metallic Minerals	-0.014	0.021	0.096	-0.013
Basic Metal Processing	0.047	0.055	0.081	0.075
Machinery and Transport Equipment	0.088	0.073	0.158 *	0.132
Medical and Scientific Instruments	0.021	0.070	0.066	0.065
Electronics	0.069	0.100	0.133 *	0.269 ***
Furniture and Miscellaneous	0.130 *	0.088	0.094	0.143
Engineering Services	0.092 *	0.045	0.052	0.044
Computer Services	0.049	0.022	0.104 *	0.119
Intentions				
Intends to increase production	0.099 *	0.127 **	-0.052	0.092
Intends to decrease production	0.106 ***	0.011	0.002	-0.001
Intends to increase exports	0.266 ***	0.255 ***	0.107 **	0.106
Intends to introduce new goods	0.020	0.031	0.040	-0.046
Intends to sell the business	0.095 **	0.037	0.053	0.054
Intends to close the business	-0.589	0.023	0.004	0.011
Goodness of fit measures				
Concordant	0.709	0.694	0.669	0.751
Tau-a	0.058	0.064	0.080	0.056

a The regressions of export programs cover only firms that exported at least in one year between 1993-94 and 1996-97 — those of R&D programs cover only firms that carried out R&D at least in one year between 1994-95 and 1996-97. **b** Value at the first year of the survey (1994-95). * Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level.

Table D.7 **Logit regression — dependent variable is participation in both years (transition 11)**[a]

	Standardised regression coefficient and significance level			
	EMDG	Austrade	R&D tax	R&D grants
Firm age	-0.072	0.084	0.119 ***	0.345 **
Log value-added per person[b]	-0.109 ***	0.112	-0.077 **	-0.234 **
Log value of assets per person[b]	0.127 **	-0.057	0.296 ***	0.423 **
Multiple locations	0.053	-0.024	0.106 ***	-0.001
Binary variables				
Firm size: 21 - 100 persons	0.184 ***	0.337 ***	0.212 ***	-0.071
101 - 500 persons	0.121 **	0.238 ***	0.196 ***	0.001
over 500 persons	0.011	0.180 *	0.275 ***	-0.218
Foreign ownership	-0.077	-0.017	-0.057	-0.352 *
Family business	-0.015	-0.006	-0.002	-0.226
Industry: Mining	-0.184 *	-1.338	0.087 *	-0.127
Processed Food	0.018	0.042	-0.096	-0.072
Wood and Paper Products	-0.050	-0.132	-0.065	-0.036
Printing and Publishing	-0.078	-0.111	-0.069	-0.111
Chemicals	-0.103	-0.213	0.081	2.002
Pharmaceuticals	-0.028	0.063	-0.020	0.023
Non-metallic Minerals	-0.038	0.020	0.003	1.380
Basic Metal Processing	-0.069	-0.039	0.050	1.696
Machinery and Transport Equipment	-0.104	0.051	0.178 **	2.506
Medical and Scientific Instruments	0.041	0.020	0.103 ***	0.911
Electronics	0.122 **	0.066	0.236 ***	1.915
Furniture and Miscellaneous	0.017	-0.072	0.049	1.537
Engineering Services	0.031	-0.014	-0.024	-0.030
Computer Services	-0.015	-0.154	0.118 **	1.305
Intentions				
Intends to increase production	0.070	0.130	0.138 ***	0.350 **
Intends to decrease production	-0.094	-0.033	0.037	-0.865
Intends to increase exports	0.313 ***	0.300 ***	0.150 ***	-0.014
Intends to introduce new goods	0.095 **	0.043	0.001	-0.022
Intends to sell the business	-0.010	-0.057	-0.051	-1.274
Intends to close the business	-0.634	-0.527	-0.920	-0.658
Goodness of fit measures				
Concordant	0.737	0.767	0.778	0.879
Tau-a	0.095	0.048	0.188	0.019

a The regressions of export programs cover only firms that exported at least in one year between 1993-94 and 1996-97. — those of R&D programs cover only firms that carried out R&D at least in one year between 1994-95 and 1996-97. **b** Value at the first year of the survey (1994-95). * Significant at the 10 per cent probability level. ** Significant at the 5 per cent probability level. *** Significant at the 1 per cent probability level.

E The effect of changes in participation

Table E.1 **Transitions in EMDG participation against the corresponding annual changes in exports-sales ratios — unweighted**[a]

Participation status over two years[b]	*Change exports-sales*	*Opening balance exports-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	0.47	12.53	3.8	1804
01	3.44	15.72	21.9	146
10	-0.24	19.29	-1.2	149
11	1.27	25.90	4.9	310
ALL	0.71	14.86	4.8	2409

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.2 **Transitions in EMDG participation against the corresponding annual changes in exports-sales ratios — weighted**[a]

Participation status over two years[b]	*Change exports-sales*	*Opening balance exports-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	0.51	19.43	2.6	1804
01	1.68	7.09	23.7	146
10	-0.53	13.07	-4.1	149
11	1.80	13.02	13.8	310
ALL	0.64	17.67	3.6	2409

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.3 Transitions in using Austrade services against the corresponding annual changes in exports-sales ratios — unweighted[a]

Participation status over two years[b]	*Change exports-sales*	*Opening balance exports-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	0.69	13.88	5.0	1947
01	1.08	15.28	7.1	135
10	1.67	17.89	9.3	167
11	-0.41	23.24	-1.8	160
ALL	0.71	14.86	4.8	2409

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.4 Transitions in using Austrade services against the corresponding annual changes in exports-sales ratios — weighted[a]

Participation status over two years[b]	*Change exports-sales*	*Opening balance exports-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	0.75	17.53	4.3	1947
01	1.26	12.20	10.3	135
10	0.64	16.23	3.9	167
11	-0.43	22.28	-1.9	160
ALL	0.64	17.67	3.6	2409

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.5 **Transitions in using Export Access against the corresponding annual changes in exports-sales ratios — unweighted**[a]

Participation status over two years[b]	*Change exports-sales*	*Opening balance exports-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	0.70	14.98	4.7	2241
01	1.19	14.91	8.0	64
10	-0.29	13.37	-2.2	66
11	2.36	9.95	23.7	38
ALL	0.71	14.86	4.8	2409

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.6 **Transitions in using Export Access against the corresponding annual changes in exports-sales ratios — weighted**[a]

Participation status over two years[b]	*Change exports-sales*	*Opening balance exports-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	0.63	17.91	3.5	2241
01	2.69	10.37	25.9	64
10	0.81	13.86	5.8	66
11	-0.76	17.27	-4.4	38
ALL	0.64	17.67	3.6	2409

a The sample is restricted to respondents who exported at least once during the four years from 1993-94 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.7 Transitions in using the R&D tax concession against the corresponding annual changes in R&D-sales ratios — unweighted[a]

Participation status over two years[b]	*Change R&D-sales ratio*	*Opening balance R&D-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	-0.44	1.33	-33.1	923
01	1.05	1.88	55.9	135
10	-1.19	2.74	-43.4	217
11	0.27	3.54	7.6	347
ALL	-0.27	2.04	-13.2	1622

a The sample is restricted to respondents who carried out R&D at least once during the three years from 1994-95 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.8 Transitions in using the R&D tax concession against the corresponding annual changes in R&D-sales ratios — weighted[a]

Participation status over two years[b]	*Change R&D-sales ratio*	*Opening balance R&D-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	-0.10	0.44	-22.7	923
01	0.86	0.84	102.4	135
10	-1.09	1.75	-62.3	217
11	0.16	1.92	8.3	347
ALL	-0.07	1.42	-4.9	1622

a The sample is restricted to respondents who carried out R&D at least once during the three years from 1994-5 to 1996-7. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.9 **Transitions in using R&D grants against the corresponding annual changes in the R&D-sales ratios — unweighted**[a]

Participation status over two years[b]	*Change R&D-sales ratio*	*Opening balance R&D-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	-0.35	1.93	-18.1	1446
01	0.57	1.78	32.0	62
10	-0.24	3.30	-7.3	94
11	2.93	4.80	61.0	20
ALL	-0.27	2.04	-13.2	1622

a The sample is restricted to respondents who carried out R&D at least once during the three years from 1994-95 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Table E.10 **Transitions in using R&D grants against the corresponding annual changes in R&D-sales ratios — weighted**[a]

Participation status over two years[b]	*Change R&D-sales ratio*	*Opening balance R&D-sales*	*Change over opening balance*	*Number of counts*
	%	%	%	No.
00	-0.15	1.48	-10.1	1446
01	0.43	0.84	51.2	62
10	0.06	1.12	5.4	94
11	3.01	3.34	90.1	20
ALL	-0.07	1.42	-4.9	1622

a The sample is restricted to respondents who carried out R&D at least once during the three years from 1994-95 to 1996-97. **b** One denotes participation, zero denotes non-participation.

Source: Unpublished data from the ABS BLS survey.

Explanations about the independent variables in the regressions

Variables that do not refer to a ratio or a change are all binary variables. These include type of industry, firm size group and various enterprise improvement practices such as the adoption of business planning or increased staff training.

The dummy variable omitted from the firm size groups is for 1–20 persons. The omitted dummy variable among industries is textiles and clothing.

Table E.11 **Regressions with the dependent variable being annual changes in the exports-sales ratio**[a]

	Unweighted		*Weighted*	
	Without intentions	*With intentions*	*Without intentions*	*With intentions*
	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	0.250	0.203	-5.016	-6.243
Program transition variables[b]				
EMDG out → in	2.925 ***	2.911 ***	0.912	0.912
EMDG in → out	-0.751	-0.793	-0.995	-1.250
EMDG in → in	0.960	0.911	1.424 ***	1.276 *
Austrade services out → in	-0.427	-0.446	-0.217	-0.339
Austrade services in → out	0.687	0.658	-0.101	-0.317
Austrade services in → in	-1.900 *	-1.930 *	-0.831	-1.084
Export Access out → in	-0.404	-0.401	0.776	0.975
Export Access in → out	-1.425	-1.436	0.300	0.039
Export Access in → in	1.832	1.808	-0.058	-0.176
ITES out → in	2.151	2.146	0.927	0.669
ITES in → out	1.828	1.821	0.160	-0.135
ITES in → in	-0.888	-0.904	-0.971	-1.207
Other variables				
Firm size: 21 - 100 persons	0.652	0.661	-0.004	0.015
101 - 500 persons	0.837	0.866	0.841	1.015
over 500 persons	-0.752	-0.739	-0.466	-0.424
Firm age	-0.003	-0.003	0.025 ***	0.024 ***
Foreign ownership	0.612	0.611	-0.097	-0.095
Log value-added per person[c]	0.078	0.076	0.44	0.567 **
Log value of assets per person[c]	-0.077	-0.081	0.12	0.078
Family business	0.032	0.024	0.738	0.754
Multiple locations	0.033	0.032	0.002	-0.004
Industry: Mining	3.647 **	3.651 **	-1.356	-1.824
Processed Food	0.361	0.323	-0.218	-0.637
Wood and Paper Products	-0.434	-0.454	-1.088	-1.523
Printing and Publishing	-1.320	-1.329	-1.958 *	-2.560 **
Chemicals	-0.275	-0.288	-1.560	-2.021
Pharmaceuticals	0.299	0.270	0.742	0.183
Non-metallic Minerals	-0.835	-0.852	-1.696	-2.016
Basic metal Processing	-0.225	-0.246	-3.793 ***	-4.230 ***
Machinery and Transport Eqpmt	-0.127	-0.152	-1.177	-1.654
Medical and Scientific Instrums	1.164	1.138	0.209	0.352
Electronics	0.649	0.622	1.532	1.007
Furniture and Miscellaneous	-0.012	-0.019	-0.099	-0.298
Engineering Services	-3.936 *	-3.910 *	-2.401	-2.181
Computer Services	-2.723 *	-2.729 *	-0.919	-1.149
Intention to export at the start of the year		0.216		1.332 ***

(Continued next page)

Table E.11 (continued)

Statistical indicators				
R^2	0.016	0.016	0.028	0.032
Adjusted R^2	0.001	0.001	0.014	0.017
Probability>F (EMDG variables)	0.025	0.026	0.050	0.044
Probability>F (Austrade variables)	0.230	0.224	0.775	0.598
Probability>F (Export Access vars)	0.608	0.611	0.959	0.934
Probability>F (ITES variables)	0.782	0.783	0.883	0.906
Probability>F for all program variables	0.198	0.203	0.668	0.560

a The regressions cover only firms which exported at least once. **b** The missing dummy variable in each case is out → out. **c** Based on the value in the first year, that is 1994-95. ***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level.

Source: Unpublished data from the ABS BLS survey.

Table E.12 **Regressions with the dependent variable being annual changes in the R&D-sales ratio**[a]

	Unweighted				*Weighted*			
	Without intention		*With intention*		*Without intention*		*With intention*	
R&D tax concession out → in	1.153	***	1.148	***	0.921	***	0.911	***
R&D tax concession in → out	-0.913	***	-0.900	***	-0.818	***	-0.812	***
R&D tax concession in → in	0.337		0.350		0.270	*	0.278	*
R&D grants out → in	0.577		0.581		0.403	*	0.398	*
R&D grants in → out	0.183		0.183		0.191		0.213	
R&D grants in → in	3.121	***	3.132	***	3.594	***	3.605	***
Other variables[b]								
Firm size: 21 - 100 persons	0.358	*	0.365	*	0.130		0.136	
101 - 500 persons	0.328		0.328		0.204		0.205	
over 500 persons	0.034		0.051		-0.221		-0.204	
Firm age	0.004		0.003		-0.002		-0.002	
Foreign ownership	-0.050		-0.058		-0.089		-0.103	
Log value-added per person	0.153	**	0.155	***	0.130	***	0.132	***
Log value of assets per person	0.184	*	0.175	*	0.162	**	0.158	**
Family business	-0.140		-0.129		-0.235		-0.225	
Multiple locations	0.004		0.004		0.005		0.005	
Industry: Mining	-0.404		-0.464		-0.459		-0.473	
Processed Food	-0.258		-0.238		0.179		0.225	
Wood and Paper Products	-0.362		-0.353		-0.258		-0.212	
Printing and Publishing	-0.425		-0.397		-0.221		-0.165	
Chemicals	-0.309		-0.285		-0.105		-0.083	
Pharmaceuticals	0.000		0.060		-0.037		0.008	
Non-metallic Minerals	-0.630		-0.614		-0.713	**	-0.687	**
Basic metal Processing	-0.073		-0.063		-0.013		-0.016	
Machinery and Transport Eqpmt	-0.162		-0.151		-0.125		-0.104	
Medical and Scientific Instrums	-0.415		-0.361		0.404		0.392	
Electronics	-0.555		-0.517		-1.602	***	-1.548	***
Furniture and Miscellaneous	-0.086		-0.073		-0.186		-0.167	
Engineering Services	1.025		1.010		0.213		0.176	
Computer Services	-0.006		0.027		0.053		0.115	
Intends to introduce new products			-0.190				-0.115	
Statistical indicators								
R^2	0.056		0.057		0.118		0.118	
Adjusted R^2	0.039		0.039		0.102		0.102	
Probability>F for all R&D tax variables	0.000		0.000		0.000		0.000	
Probability>F for all R&D grant variables	0.000		0.000		0.000		0.000	
Probability>F for all program variables	0.000		0.000		0.000		0.000	

a The regressions cover only firms which performed R&D at least once. The period is from 1994-95 to 1996-97. **b** The missing dummy variable in each case is out → out. ***** Significant at the 10 per cent probability level. ****** Significant at the 5 per cent probability level. ******* Significant at the 1 per cent probability level.

Source: Unpublished data from the ABS BLS survey.

F Austrade's EMDG evaluation

Austrade has commissioned two major econometric studies of the impact of the EMDG program (Austrade 1994, 2000). The results suggest that firms are substantially more responsive to the EMDG scheme than is suggested by the results based on the BLS presented in chapter 4. This appendix focuses on the most recent study, since Lattimore et al. (1998, pp. 134ff) have examined aspects of their earlier study.

Austrade's modelling was based on participants in the EMDG program and a control group of non-participating exporters. The modelling had two phases:

- The first phase attempted to estimate the extent to which an increase in promotion expenditure increased exports. The log of the ratio of exports to promotional expenditure was regressed against years in the scheme and industry dummies for each cohort of participants.[1] The modelling suggested that (for 1997-98) the ratio of exports to promotional expenditure was about 12.50, averaging across all industries and averaging over the years spent by firms in the scheme. The ratio was higher for later years in the scheme[2] and higher for some industries than others.[3]
- The second phase attempted to estimate the extent to which participation in the EMDG scheme increased promotion expenditure, on the grounds that even if promotion expenditure itself was very successful in prompting exports, the EMDG would only be effective if the promotion expenditure funded by it would otherwise not have occurred. This was tested by regressing the log of promotional expenditure against a dummy variable, GRANT, representing participation in the EMDG program, the logged value of turnover, a time trend and a number of other variables.[4] It was found that the coefficient on GRANT

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1 The data were very noisy, so cell averages of exports and marketing expenditure for different years and industries were used instead of unit record data from firms (as in this study).

2 For example, it was 17.3 for the 8th year in the scheme in services compared with 4.5 in the 1st year — a nearly fourfold increase in apparent 'returns' from promotional expenditure (Austrade 2000, p. 241).

3 For example, it was 23.8 in the first year in primary industries and 4.5 in the services sector in the first year, a difference of more than five times (ibid, p. 241).

4 Again, as with the regressions on the export to marketing expenditure ratio, grouped data rather than unit records were used.

was around 0.7. This implies that an EMDG recipient firm spends around 101 per cent[5] more than it would otherwise have done, and this in turn implies an average grant multiplier (the additional expenditure as a ratio to the grant) of 1.226.[6]

The Austrade study assumed that the average ratio of exports to promotional expenditure was maintained for incremental promotional expenditure, so that on average every dollar of induced promotional expenditure yielded about $12.50 of additional exports. Assuming that the model and its assumptions are correct, this implies that in 1997-98, the EMDG scheme would have generated $164 million of incremental marketing expenditure and $2.05 billion of additional exports.[7]

However, there are a number of factors that suggest that these measured multiplier effects are likely to overstate significantly the real impact of the EMDG program.

Restrictive assumptions about the causal relationship between exports and promotion

The econometric study uses the following functional form for estimating the relationship between exports (X) and marketing (M):

$$\frac{X}{M} = \lambda \Rightarrow X = \lambda \times M \ \ where \ \lambda = \exp^{(\alpha - \beta \exp^{-\varphi t})} \qquad \{1\}$$

In this formulation, λ is interpreted as an export multiplier that increases with the number of years in the scheme (t), but asymptotes to e^{α} as $t \to \infty$.[8] The implied elasticity of exports with respect to marketing is unity — that is, a ten per cent increase in marketing will generate a ten per cent increase in exports.

This appears at odds with other empirical research (which mainly relates to primary goods). Le, Kaiser and Tomek (1998) examine promotion elasticities for primary

5 The Austrade study interpreted the 0.7 coefficient as meaning that an EMDG recipient firm spends 70 per cent more than it would otherwise have done, but this is an incorrect interpretation of the results. The correct percentage change given by the modelling (Austrade 2000, p. 235) is actually 100 exp(0.7)-1=101 percent.

6 The average promotional expenditure was $113 730 and the average grant was $46 602 (Austrade 2000, p. 238). Therefore, the average amount of promotion expenditure in the absence of the EMDG scheme would be $113 730/2.01 = $56 258, implying induced expenditure of $57 148. The average grant multiplier is therefore 57 148/46 602= 1.226 (not 1.005 as noted by Austrade, which is based on the incorrect use of the 0.7 parameter).

7 Again, these numbers vary from those cited in Austrade (2000, pp. 240-1) because of the error regarding the interpretation of their econometric results.

8 In fact, the data are only describing the 8 years that a firm can be in the program.

products for the United States, summarising past results and generating some additional estimates. The average promotion elasticity of the 25 estimates presented is 0.15, the median estimate (which is less affected by outliers) is 0.07, the mode is 0.014 and the maximum estimate is below 0.6. Dwyer (1994) finds an export promotion elasticity of 0.15 for high value agricultural products as a whole. Richards, Ispelen and Kagan (1997) find similarly small promotion elasticities for US apples. However, in one of the very few studies suggesting a substantial elasticity, Richards and Patterson (1998) find somewhat larger long run elasticities (exceeding one) for wine and apples.

While there is considerable variation in the international literature, most studies find promotion elasticities that are less than one. In this light, the implicit assumption of a unitary elasticity in the Austrade study is probably unwarranted.

The main possible problem with the approach adopted in {1} is the assumption that the observed ratio of exports to marketing is a 'multiplier'. While there is obviously some connection between export marketing and exports, using the simple ratio model like {1} above is likely to distort the true relationship. As an illustration, consider the use of paper clips, which would be used by all firms. There is some ratio of exports in a firm to its use of paper clips. This ratio would be very large indeed — say 100 000. But this ratio does not mean that a subsidy for paper clip use that encouraged a $100 increase in paper clip use in a firm would generate a $10 million increase in exports. Similarly, observed ratios of total exports to total marketing may be a poor guide to the effect of a marketing subsidy.

A common approach (as in Le, Kaiser and Tomek) when examining promotion elasticities is to specify a log linear import demand function for the foreign destination market of the following form:

$$X = \lambda P^{-\beta} M^{\varepsilon} \qquad \{2\}$$

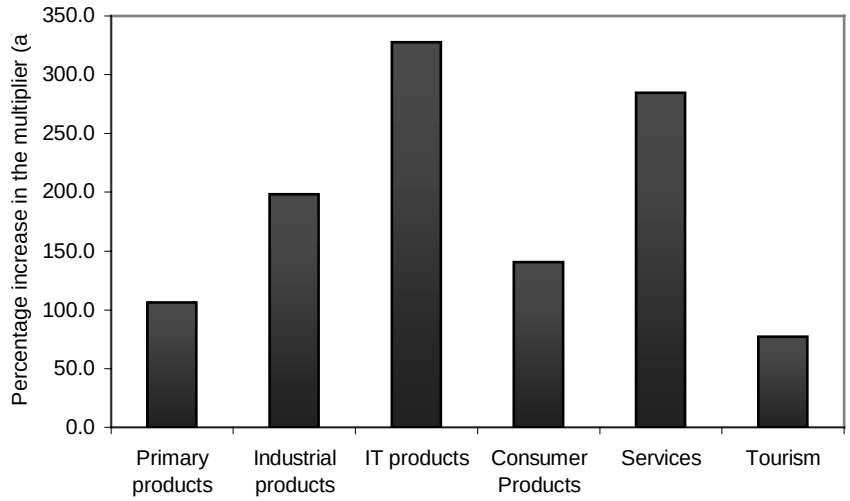
In an Australian context, X is the value of imports of the relevant Australian goods (exports from Australia), P is the foreign currency price and M is the level of marketing expenditure. The promotion elasticity is ε, while the marginal gross rate of return to promotional expenditures is ε X/M. Only where ε is equal to one is the export to promotion expenditure ratio the correct measure of the responsiveness of exports to incremental promotion expenditure. Were ε to be akin to the average value found by Le, Kaiser and Tomek (of 0.15), then for an average X/M of 12.5, the change in exports attributable to a dollar of export promotion would be about $1.88 (or about one seventh of that found by Austrade).

Curious temporal effects of marketing expenditure

The Austrade model has the implication that the export multiplier associated with contemporaneous marketing expenditure grows over time. For example, it is estimated that one dollar of marketing generates $4.50 of exports in the service sector for a first year EMDG participant (where the subsidy is 50 per cent) and $17.30 for an eighth year participant (Austrade 2000, p. 241). This is despite the fact that returns to factors usually exhibit decreasing returns.

If Austrade's characterisation of the multiplier effects were correct, then reductions in the subsidy for early years and greater subsidies for later years would encourage marketing in years when it apparently had its greatest impact (figure F.1).[9]

Figure F.1 **Apparent returns from shifting subsidies from the first to the last year**



a The return is the percentage increase in the export multiplier in year 8 over year one.

Data source: Based on Austrade (2000, p. 241).

However, this curious result is likely to be an artefact of three factors.

First, the export/promotion ratio is probably a poor guide to the genuine export multiplier for the reasons given above.

Second, export marketing is likely to have enduring impacts, so that first year marketing probably has effects on subsequent years' exports. In this case, apparent

9 Similarly, the export/promotion ratios would imply large gains from making the EMDG program only accessible to mature primary product exporters, where the 'multiplier' is 49.1.

year 8 effects are probably an amalgam of effects from year 8 and previous years' export marketing.

Third, expenditure on export marketing is only one way in which product recognition grows and export growth occurs. If there are any factors exogenous to export marketing that lead to export growth over time, then these will be confused with export marketing effects (box F.1).

Subsidised marketing may have different effects to unsubsidised marketing

Subsidised promotional activity applies only to certain, more readily auditable promotional activities, compared to unsubsidised promotional activity. It may be that the subset of allowable expenditures have lower average export returns than the full set of promotional expenditures that might be selected by an unsubsidised firm.

Moreover, to avoid fraudulent claims, the EMDG scheme has record keeping and other requirements that impose some compliance burdens on firms. To some extent, these may deflect management attention away from their core strategic objectives, somewhat reducing the beneficial impacts of increased promotional expenditure on exports.

Finally, the marginal returns from promotional expenditure are likely to be less than the average return, so that as promotion expenditure increases, its returns fall. The current specification used by Austrade for the effects of export promotion does not permit such an effect and equates marginal and average returns.

Selection biases

As noted in the main report, gauging the impact of the EMDG scheme requires estimating the outcomes under the counterfactual of no support for export marketing. The counterfactual case is provided by an apparent control group of firms that exported but did not participate in the EMDG scheme. However, the very fact that firms choose to apply for the EMDG and are subject to selection processes by Austrade suggests that those firms that apply are inherently different from those that do not. Austrade provides evidence for this case itself (2000, p. 185, p. 195, p. 215).

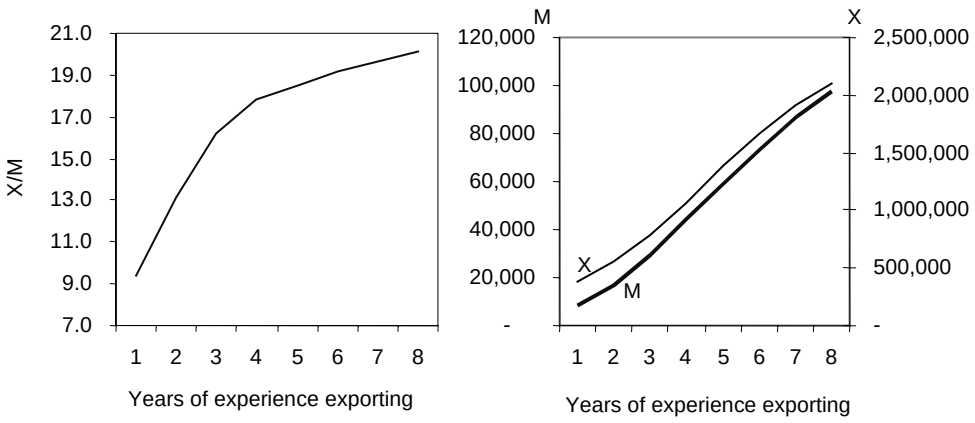
Box F.1 An example of high initial export growth spurred by factors other than marketing

Suppose that the data generating process (DGP) for exports is:

$$\Delta \ln X_t = \alpha + \gamma_1 \Delta \ln M_t + \gamma_2 \Delta \ln Y_t - \gamma 3 \Delta \ln P_t - \lambda (\ln X_{\tau-1} - \{\beta_0+\beta_1 \ln M_{\tau-1}+\beta_2 \ln Y_{t-1}-\beta_3 \ln P_{\tau-1}\})$$

where $\alpha=\phi/(1-A \exp(-\omega T))$, X is exports, M is marketing expenditure, P is the relative price of the export good to other goods in the export market, Y is income in the export market and T is the number of years of experience exporting the good. This equation equilibrates supply and demand in an error correction framework. Excess demand or supply prompts changes in subsequent export levels. Moreover, it is assumed that in the early years of the supply of an exportable, export growth is very high, reflecting large gains associated with export experience, early excess capacity, and absence of market saturation. These factors are represented by the term α and follow the usual logistic function for sales penetration in a market. Similarly, in the initial years, export marketing growth is high, and accommodates rather than causes the export growth. This equation has sensible long run properties and yet can also explain the possible dynamics of export growth well. With such a functional form it is very easy to get a pattern of exports and marketing that follows that found by Austrade, but without the implied causality from marketing to exports. Exports were simulated under the following assumptions: $\phi=0.03$, A=0.9, w=0.05, T=1 to 8, $\gamma_1=\beta_1=0.1$, $\gamma_2=\beta_2=1$, $\gamma_3=\beta_3=0.4$, $\beta_0=8.5$, $\lambda=0.25$, $X_0=60000$, $M_0=12000$, $M_1=18000$, $M_2=27000$, $M_3=37800$, $M_4=51030$, $M_5=66339$, $M_6=79607$, $M_7=91548$ and $M_8=100703$. The figure below shows the value of exports and marketing (and their ratio) for a firm exporting to a new market under these assumptions. However, while the export to marketing ratio climbs rapidly to around 20, an extra 10 per cent increase in the value of marketing over the eight year period generates only a 0.7 per cent increase in exports.

Finding an alternative DGP that can also account for the data does not mean that the specification in Austrade's evaluation is necessarily wrong. However, it may be that alternative specifications that take account of other factors than marketing should be tested if the data are rich enough to allow this.



One way of controlling for selection bias is to include variables in the relevant regression that might explain which firms choose participation in the scheme. The

Austrade regression does include some additional variables, such as industry dummies and turnover. However, grouped data rather than unit records are employed, which is likely to weaken the capacity of the regressions to deal with selection bias by including nuisance variables.[10] This suggests that selection bias may affect the estimates of additionality, and the likely effect is an exaggeration of the extent to which the EMDG scheme increases export promotion.

The implied 'bang for a buck' and export promotion elasticities appear excessive

A critical measure of the effectiveness of businesses subsidies is the extent to which one dollar of net subsidy creates additional activity in the relevant variable. As noted previously the average estimated 'bang' or additional export promotion induced as a result of the scheme is $57 148 per firm. The average grant value was $46 602. However, since the grant is taxed and payment is deferred until after expenditure by about one year, the net value (S) to the firm of the promotion subsidy is around:

$$S = \frac{\$46\,602 \times (1-\tau)}{(1+d)}$$

where d is the discount rate and τ is the corporate tax rate. With reasonable parameters,[11] S = $27 113 so that the bang for a buck is 2.1 — that is every dollar of subsidy apparently induces more than two dollars of new export promotion. This is high by the usual standards of business programs. For example, the Bureau of Industry Economics' Review (1993a, p. 103) of the then 150 per cent tax concession for R&D found a bang for a buck of between 60 cents and $1 — which was typical of other similar support schemes around the world.[12] Kinnucan and Xiao (1996) investigated the extent to which US export promotion subsidies affected export and domestic promotion. They found that a dollar of export promotion subsidy increased export promotion by around 62 cents (a bang for a buck of 0.6).[13]

Another way of looking at the apparent responsiveness of export promotion to subsidies is to estimate the implied elasticity of demand for export promotion with respect to the 'price' of export promotion. The average price reduction stemming

[10] For example the variation in turnover between cells will be much less than in unit record data.

[11] With d=0.10 and τ=0.36 (at the time).

[12] For 1987-88, when the R&D scheme offered an R&D subsidy that was about as generous as the current EMDG scheme is to export promotion, the bang for a buck was at best around 84 cents (based on data in BIE, 1993a, p. 66; p. 100).

[13] Curiously, they also found that it also stimulated domestic promotion (by 92 cents), though that was not the target of the subsidy.

from the scheme, C, is equal to the subsidy value less compliance costs divided by promotional expenditure:

C = (S-C)/113 730 = (27 113 - 3 164)/113 730= 21.06 per cent.

That is, the EMDG scheme reduces the costs of undertaking export promotion by roughly one fifth. The average increase in export promotion as a result of this subsidy is 101 per cent. Accordingly, the implied elasticity is around 4.8 — a decrease in the costs of promotion of around 10 per cent increases export promotion demand by around 48 per cent. This appears to be unrealistically responsive:

- by contrast, the BIE study of the R&D Tax Concession implies an elasticity of R&D with respect to the price of R&D of 1.2.[14]
- There is little direct empirical evidence about the extent to which advertising or marketing responds to the price of marketing. However, in one study examining a particular form of marketing — TV advertising — Hendry (1994) finds an elasticity of 2. Previous studies in that area found elasticities of around 0.5.

Summary

Austrade's modelling of the EMDG scheme's impact represents one of the few Australian cases where an attempt has been made to use statistical techniques to measure the performance of a business program. Austrade finds firms are highly responsive to EMDG subsidies and these subsidies in turn produce large increases in exports. However, the results may be partly an artefact of the methods used and more than likely exaggerate the real impact of the program.

It may be that some refinements to the methods used by Austrade could yield improved estimates of the effects of the EMDG scheme. More attention would need to be focussed on trying to model selection bias, or to create a legitimate control group (Productivity Commission 2000, p. 17ff). Moreover, the impact of grant subsidies on overall exports should be modelled in a single regression, rather than using the estimated additional promotion associated with the scheme and applying a potentially spurious export 'multiplier'.

[14] Using the 3 per cent compliance cost estimate from BIE (1993a, p. 127) and the other parameters noted in the previous footnote.

G Tabulations of outcomes

A few explanations about the variables

In the tables presented in this appendix, changes are measured over the period from 1994-95 to 1997-98, with the exception of changes in R&D which are measured over two years from 1995-96 to 1997-98. The export-sales, R&D-sales and profit-equity ratios represent averages over four years from 1994-95 to 1997-98. Persons per firm, sales per person and value added per person refer to the respective values in 1997-98.

In the weighted tables, the weighting by firm size is determined according to the equivalent number of persons employed in 1997-98, as in the weighted regressions.

The population of firms examined in the tables is confined to those who exported or performed R&D in at least one year.

Over 20 per cent of the population in the export program tables and over 40 per cent in the R&D program tables reached the permissible boundary values (2.0) for logarithmic changes in exports or R&D. The high proportion of boundary values can distort the calculation of the mean values of R&D and export growth. In order to provide the reader with a clearer picture about the dependence of growth on participation counts, the tables also present alternative measures of export and R&D growth, where similar distortions do not occur. These are the change in the exports-sales ratio and the change in the R&D expenditure to sales ratio over three years. The reader should inspect both sets of figures to assess changes in R&D and exports.

Table G.1 **Mean values depending on export status – unweighted averages**

	Non- exporters	*All exporters*	*Entire sample*
Number of firms	934	905	1848
Log change in sales	0.077	0.108	0.091
Log change in productivity	0.053	0.047	0.049
Log change in exports	0.000	0.058	0.028
Log change in R&D expenditure	-0.01	-0.1	-0.067
% change in the exports/sales ratio	0.0	0.4	0.2
% change in the R&D/sales ratio	-0.2	-0.2	-0.2
% average exports/sales ratio	0.0	14.6	7.2
% average R&D/sales ratio	0.8	1.6	1.2
% average profit/equity ratio	24.9	26.0	25.4
Number of persons per firm	46.4	171.5	107.5
Average sales per person in $000s	136.5	233.1	183.7
Value added per person in $000s	38.9	57.8	48.2

Source: Unpublished data from the ABS BLS survey.

Table G.2 **Mean values depending on export status – weighted by firm size**

	Non- exporters	*All exporters*	*Entire sample*
Total persons in the group in 000s	43.3	155.2	198.6
Log change in sales	0.280	0.165	0.190
Log change in productivity	-0.068	0.021	0.002
Log change in exports	0.000	0.175	0.137
Log change in R&D expenditure	-0.212	-0.563	-0.486
% change in the exports/sales ratio	0.0	0.8	0.6
% change in the R&D/sales ratio	-2.6	-0.3	-0.8
% average exports/sales ratio	0.0	17.8	13.9
% average R&D/sales ratio	2.5	0.9	1.3
% average profit/equity ratio	24.8	25.0	24.9
Number of persons per firm	46.4	171.5	107.5
Average sales per person in $000s	195.1	304.8	280.8
Value added per person in $000s	53.5	73.4	69.0

Source: Unpublished data from the ABS BLS survey.

Table G.3 **Mean values depending on participation in the EMDG – unweighted averages**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Number of firms	627	99	70	56	53	905
Log change in sales	0.084	0.189	0.169	0.151	0.109	0.108
Log change in productivity	0.047	0.013	0.044	0.070	0.097	0.047
Log change in exports	-0.007	0.141	0.348	0.127	0.213	0.058
Log change in R&D expenditure	-0.1	-0.1	0.1	-0.4	-0.1	-0.1
% change in the exports/sales ratio	0.4	0.4	-1.5	1.7	1.1	0.4
% change in the R&D/sales ratio	-0.1	0.3	1.1	-1.0	-3.0	-0.2
% average exports/sales ratio	11.8	15.7	21.4	23.2	28.0	14.6
% average R&D/sales ratio	1.1	1.3	2.8	2.7	5.3	1.6
% average profit/equity ratio	25.6	29.3	23.5	29.0	24.6	26.0
Number of persons per firm	178.6	112.0	216.5	199.3	110.6	171.5
Average sales per person in $000s	228.9	227.7	262.9	255.8	229.0	233.1
Value added per person in $000s	59.6	50.5	60.5	55.8	48.4	57.8

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.4 **Mean values depending on participation in the EMDG – weighted by firm size**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Total persons in the group in 000s	112.0	11.1	15.2	11.2	5.9	155.2
Log change in sales	0.185	0.184	0.057	0.133	0.097	0.165
Log change in productivity	0.025	-0.025	0.069	-0.024	-0.005	0.021
Log change in exports	0.184	0.194	0.220	-0.081	0.332	0.175
Log change in R&D expenditure	-0.629	-0.387	-0.122	-0.951	-0.049	-0.563
% change in the exports/sales ratio	0.7	0.6	1.2	0.0	4.0	0.8
% change in the R&D/sales ratio	-0.2	-0.2	0.1	-1.6	-1.3	-0.3
% average exports/sales ratio	19.9	9.1	11.8	15.4	14.0	17.8
% average R&D/sales ratio	0.7	0.8	1.0	2.4	3.3	0.9
% average profit/equity ratio	23.4	35.6	22.7	30.9	29.5	25.0
Number of persons per firm	178.6	112.0	216.5	199.3	110.6	171.5
Average sales per person in $000s	324.3	203.3	338.0	225.8	188.8	304.8
Value added per person in $000s	79.2	52.0	64.7	61.0	48.0	73.4

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.5 Mean values depending on the usage of Austrade services – unweighted averages[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Number of firms	676	100	82	38	9	905
Log change in sales	0.095	0.178	0.099	0.163	0.090	0.108
Log change in productivity	0.054	0.067	-0.014	-0.012	0.120	0.047
Log change in exports	0.000	0.257	0.273	0.054	0.274	0.058
Log change in R&D expenditure	-0.077	-0.404	-0.054	-0.260	-0.973	-0.128
% change in the exports/sales ratio	0.2	0.4	1.0	3.3	-0.3	0.4
% change in the R&D/sales ratio	-0.1	-1.3	0.9	-0.3	-2.5	-0.2
% average exports/sales ratio	13.4	13.9	20.2	20.5	35.2	14.6
% average R&D/sales ratio	1.4	1.8	2.9	1.9	5.4	1.6
% average profit/equity ratio	25.5	28.7	24.6	31.4	28.2	26.0
Number of persons per firm	159.2	184.1	174.6	188.6	856.6	171.5
Average sales per person in $000s	238.1	221.8	222.1	191.3	258.6	233.1
Value added per person in $000s	60.8	48.2	47.1	49.1	74.9	57.8

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.6 Mean values depending on the usage of Austrade services – weighted by firm size[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Total persons in the group in 000s	107.6	18.4	14.3	7.2	7.7	155.2
Log change in sales	0.202	0.157	0.053	0.062	-0.026	0.165
Log change in productivity	0.045	0.007	-0.026	0.003	-0.166	0.021
Log change in exports	0.181	0.533	0.087	-0.318	-0.146	0.175
Log change in R&D expenditure	-0.432	-0.829	-0.617	-0.300	-1.905	-0.563
% change in the exports/sales ratio	0.7	1.3	1.4	4.0	-2.9	0.8
% change in the R&D/sales ratio	-0.5	-0.9	1.3	0.0	-0.5	-0.3
% average exports/sales ratio	18.2	9.9	21.3	17.0	25.1	17.8
% average R&D/sales ratio	0.8	1.2	2.1	1.1	0.6	0.9
% average profit/equity ratio	24.2	27.5	25.2	36.7	17.9	25.0
Number of persons per firm	159.2	184.1	174.6	188.6	856.6	171.5
Average sales per person in $000s	314.0	276.5	315.4	184.1	336.5	304.8
Value added per person in $000s	74.8	59.5	73.0	51.7	108.0	73.4

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.7 **Mean values depending on participation in Export Access – unweighted averages**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Number of firms	814	59	21	9	2	905
Log change in sales	0.107	0.117	0.113	0.09	-0.078	0.108
Log change in productivity	0.048	0.057	-0.026	0.109	0.085	0.047
Log change in exports	0.022	0.344	0.357	0.572	0.637	0.058
Log change in R&D expenditure	-0.136	0.009	-0.197	-0.066	-0.144	-0.128
% change in the exports/sales ratio	0.1	3.4	1.2	4.1	5.7	0.4
% change in the R&D/sales ratio	-0.2	0.2	-0.5	-0.4	0.1	-0.2
% average exports/sales ratio	14.6	16.7	12.2	9.3	11.1	14.6
% average R&D/sales ratio	1.6	1.6	3.9	1.1	0.8	1.6
% average profit/equity ratio	26.6	20.6	26.0	11.6	16.0	26.0
Number of persons per firm	174.3	103.3	182.5	369.5	20.5	171.5
Average sales per person in $000s	233.9	235.5	195.3	249.9	170.4	233.1
Value added per person in $000s	58.1	62.0	39.9	49.3	41.5	57.8

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.8 **Mean values depending on participation in Export Access – weighted by firm size**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Total persons in the group in 000s	141.9	6.1	3.8	3.3	0.0	155.2
Log change in sales	0.180	0.060	-0.023	-0.060	-0.072	0.165
Log change in productivity	0.028	-0.201	0.055	0.094	0.085	0.021
Log change in exports	0.160	0.691	0.098	-0.065	0.660	0.175
Log change in R&D expenditure	-0.542	-0.347	-0.620	-1.810	-0.157	-0.563
% change in the exports/sales ratio	0.6	6.9	1.9	-0.8	5.8	0.8
% change in the R&D/sales ratio	-0.3	0.5	-0.7	-1.2	0.1	-0.3
% average exports/sales ratio	18.2	13.6	7.8	20.2	11.0	17.8
% average R&D/sales ratio	0.9	2.2	1.3	0.7	0.8	0.9
% average profit/equity ratio	25.7	20.9	13.4	14.2	16.6	25.0
Number of persons per firm	174.3	103.3	182.5	369.5	20.5	171.5
Average sales per person in $000s	300.9	247.7	269.5	619.1	171.5	304.8
Value added per person in $000s	73.2	54.6	74.2	113.8	41.9	73.4

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.9 Mean values depending on the usage of ITES – unweighted averages[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Number of firms	879	19	4	3	0	905
Log change in sales	0.108	0.213	-0.110	-0.271		0.108
Log change in productivity	0.048	0.116	-0.158	-0.270		0.047
Log change in exports	0.059	-0.066	0.540	-0.014		0.058
Log change in R&D expenditure	-0.132	0.106	0.164	-0.616		-0.128
% change in the exports/sales ratio	0.3	-1.9	12.2	13.4		0.4
% change in the R&D/sales ratio	-0.2	0.2	4.8	1.3		-0.2
% average exports/sales ratio	14.5	12.9	20.2	44.5		14.6
% average R&D/sales ratio	1.6	2.0	2.8	8.2		1.6
% average profit/equity ratio	26.1	29.0	18.0	2.5		26.0
Number of persons per firm	161.3	531.0	650.6	255.8		171.5
Average sales per person in $000s	233.5	199.8	342.6	177.0		233.1
Value added per person in $000s	57.8	59.9	62.3	40.7		57.8

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.10 Mean values depending on the usage of ITES – weighted by firm size[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All exporters*
Total persons in the group in 000s	141.8	10.1	2.6	0.8	0	155.2
Log change in sales	0.181	0.009	0.046	-0.192		0.165
Log change in productivity	0.034	-0.086	0.000	-0.895		0.021
Log change in exports	0.190	-0.217	0.782	0.388		0.175
Log change in R&D expenditure	-0.511	-1.351	-0.331	-0.558		-0.563
% change in the exports/sales ratio	0.7	-2.9	10.8	26.1		0.8
% change in the R&D/sales ratio	-0.4	-0.3	0.2	3.4		-0.3
% average exports/sales ratio	17.7	19.2	14.5	36.7		17.8
% average R&D/sales ratio	0.9	0.7	0.6	11.3		0.9
% average profit/equity ratio	25.6	23.2	3.2	10.7		25.0
Number of persons per firm	161.3	531.0	650.6	255.8		171.5
Average sales per person in $000s	304.8	297.0	390.5	120.6		304.8
Value added per person in $000s	72.3	94.6	65.2	14.8		73.4

a The population of firms is restricted to those who exported at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.11 **Mean values depending on R&D status – unweighted averages**[a]

	Non R&D performers	*All R&D performers*	*Entire sample*
Number of firms	1037	811	1848
Log change in sales	0.074	0.109	0.091
Log change in productivity	0.063	0.035	0.049
Log change in exports	-0.067	0.143	0.028
Log change in R&D expenditure	0.000	-0.153	-0.067
% change in the exports/sales ratio	0.0	0.4	0.2
% change in the R&D/sales ratio	0.0	-0.5	-0.2
% average exports/sales ratio	4.1	11.2	7.2
% average R&D/sales ratio	0.0	2.7	1.2
% average profit/equity ratio	25.1	25.6	25.4
Number of persons per firm	51.6	180.0	107.5
Average sales per person in $000s	156.8	218.9	183.7
Value added per person in $000s	44.2	53.6	48.2

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.12 **Mean values depending on R&D status – weighted by firm size**[a]

	Non R&D performers	*All R&D performers*	*Entire sample*
Total persons in the group in 000s	52.1	146.0	198.6
Log change in sales	0.208	0.183	0.190
Log change in productivity	-0.025	0.011	0.002
Log change in exports	0.015	0.178	0.137
Log change in R&D expenditure	0.000	-0.661	-0.486
% change in the exports/sales ratio	0.5	0.7	0.6
% change in the R&D/sales ratio	0.0	-1.1	-0.8
% average exports/sales ratio	7.0	16.4	13.9
% average R&D/sales ratio	0.0	1.7	1.3
% average profit/equity ratio	31.8	22.5	24.9
Number of persons per firm	51.6	180.0	107.5
Average sales per person in $000s	201.4	309.6	280.8
Value added per person in $000s	56.3	73.7	69.0

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.13 **Mean values depending on the ratio of R&D subsidies to sales — unweighted averages**[a]

	% R&D subsidies to sales in 1996-7					
	0	0% – 0.2%	0.2% – 0.5%	0.5% – 1.1%	Above 1.1%	R&D perfor-mers
Number of firms	621	81	35	28	46	811
Log change in sales	0.103	0.089	0.082	0.199	0.194	0.109
Log change in productivity	0.029	0.017	0.104	0.189	-0.009	0.035
Log change in exports	0.096	0.160	0.427	0.196	0.504	0.143
Log change in R&D expenditure	-0.090	-0.547	-0.435	-0.359	0.035	-0.153
% change in the exports/sales ratio	0.3	0.9	1.1	-1.4	1.4	0.4
% change in the R&D/sales ratio	-0.5	0.0	0.0	-0.1	-1.3	-0.5
% average exports/sales ratio	8.8	16.0	20.9	23.3	20.3	11.2
% average R&D/sales ratio	2.1	1.1	2.0	4.9	12.9	2.7
% average profit/equity ratio	25.8	27.0	23.7	29.7	18.5	25.6
Number of persons per firm	130.5	622.2	169.0	130.6	108.9	180.0
Average sales per person in $000s	209.7	325.2	261.8	180.3	146.0	218.9
Value added per person in $000s	48.9	79.5	84.9	56.7	45.3	53.6

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.14 **Mean values depending on the ratio of R&D subsidies to sales — weighted by firm size**[a]

	% R&D subsidies to sales in 1996-7					
	0	0% – 0.2%	0.2% – 0.5%	0.5% – 1.1%	Above 1.1%	R&D perfor-mers
Total persons in the group in 000s	81.0	50.4	5.9	3.7	5.0	146.0
Log change in sales	0.244	0.125	0.110	0.112	-0.073	0.183
Log change in productivity	0.011	0.012	0.295	-0.108	-0.242	0.011
Log change in exports	0.165	0.214	0.299	0.012	0.008	0.178
Log change in R&D expenditure	-0.686	-0.792	0.382	-0.018	-0.657	-0.661
% change in the exports/sales ratio	-0.6	3.7	-3.0	5.7	-9.0	0.7
% change in the R&D/sales ratio	-2.1	0.1	-0.1	2.1	-0.9	-1.1
% average exports/sales ratio	14.7	18.5	16.3	17.8	23.3	16.4
% average R&D/sales ratio	1.5	1.0	1.0	4.9	11.1	1.7
% average profit/equity ratio	23.7	22.7	15.8	28.5	4.4	22.5
Number of persons per firm	130.5	622.2	169.0	130.6	108.9	180.0
Average sales per person in $000s	301.8	350.1	282.6	207.1	133.8	309.6
Value added per person in $000s	67.3	85.9	90.1	62.9	42.7	73.7

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.15 **Mean values depending on usage of the R&D tax concession – unweighted averages**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All R&D perform-ers*
Number of firms	428	103	78	96	106	811
Log change in sales	0.130	0.094	0.060	0.114	0.072	0.109
Log change in productivity	0.035	0.053	-0.039	0.030	0.075	0.035
Log change in exports	0.081	0.129	0.119	0.197	0.374	0.143
Log change in R&D expenditure	0.185	-0.425	-0.419	-0.574	-0.675	-0.153
% change in the exports/sales ratio	0.4	-0.5	-1.7	2.1	1.0	0.4
% change in the R&D/sales ratio	0.3	-0.7	-1.1	-1.5	-1.9	-0.5
% average exports/sales ratio	8.0	11.7	12.0	13.3	21.0	11.2
% average R&D/sales ratio	1.7	3.0	2.9	3.7	5.3	2.7
% average profit/equity ratio	26.7	23.3	25.4	24.3	24.1	25.6
Number of persons per firm	62.6	211.0	300.1	299.6	427.6	180.0
Average sales per person in $000s	191.2	260.5	245.4	227.8	262.3	218.9
Value added per person in $000s	44.4	59.3	58.3	63.3	72.9	53.6

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.16 **Mean values depending on usage of the R&D tax concession – weighted by firm size**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All R&D perform-ers*
Total persons in the group in 000s	26.8	21.7	23.4	28.8	45.3	146.0
Log change in sales	0.383	0.268	0.239	0.073	0.066	0.183
Log change in productivity	0.044	-0.018	-0.036	0.021	0.024	0.011
Log change in exports	0.313	-0.111	0.220	0.163	0.224	0.178
Log change in R&D expenditure	0.342	-0.857	-0.461	-0.981	-1.061	-0.661
% change in the exports/sales ratio	0.6	-3.0	-1.3	0.9	3.4	0.7
% change in the R&D/sales ratio	0.2	-0.7	-0.9	-0.6	-2.4	-1.1
% average exports/sales ratio	13.1	9.3	7.0	23.6	22.2	16.4
% average R&D/sales ratio	0.5	0.7	1.0	2.0	3.1	1.7
% average profit/equity ratio	31.8	27.8	19.0	14.8	21.1	22.5
Number of persons per firm	659.3	1656.4	1370.0	1163.3	2141.0	1480.9
Average sales per person in $000s	239.9	332.4	316.5	302.6	340.5	309.6
Value added per person in $000s	56.9	79.0	73.2	65.7	86.4	73.7

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.17 **Mean values depending on R&D grants – unweighted averages**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All R&D performers*
Number of firms	699	69	33	9	1	811
Log change in sales	0.117	0.147	-0.043	-0.142	-0.267	0.109
Log change in productivity	0.041	-0.001	0.000	-0.144	1.000	0.035
Log change in exports	0.137	0.079	0.322	0.440	-0.188	0.143
Log change in R&D expenditure	-0.097	-0.491	-0.513	-0.609	0.085	-0.153
% change in the exports/sales ratio	0.4	-1.8	3.0	9.3	4.7	0.4
% change in the R&D/sales ratio	-0.5	-0.5	1.8	-3.7	0.2	-0.5
% average exports/sales ratio	10.2	14.5	14.4	41.3	68.6	11.2
% average R&D/sales ratio	2.3	3.7	6.2	11.0	6.6	2.7
% average profit/equity ratio	25.2	28.4	28.0	23.9	-23.5	25.6
Number of persons per firm	158.7	214.0	583.1	115.7	18.3	180.0
Average sales per person in $000s	216.1	238.3	234.5	215.9	297.8	218.9
Value added per person in $000s	53.0	54.6	64.9	46.7	88.7	53.6

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

Table G.18 **Mean values depending on R&D grants – weighted by firm size**[a]

	Number of times participation was recorded					
	0	*1*	*2*	*3*	*4*	*All R&D performers*
Total persons in the group in 000s	111.0	14.8	19.2	1.0	0.0	146.0
Log change in sales	0.237	0.065	-0.023	-0.043	-0.267	0.183
Log change in productivity	0.032	0.039	-0.106	-0.473	1.000	0.011
Log change in exports	0.151	0.437	0.117	0.560	-0.188	0.178
Log change in R&D expenditure	-0.478	-0.774	-1.635	-0.614	0.085	-0.661
% change in the exports/sales ratio	-0.8	11.8	-0.5	22.6	4.7	0.7
% change in the R&D/sales ratio	-1.4	-0.5	-0.3	0.9	0.2	-1.1
% average exports/sales ratio	14.9	16.6	23.5	49.1	68.6	16.4
% average R&D/sales ratio	1.8	1.3	1.1	10.6	6.6	1.7
% average profit/equity ratio	22.7	24.7	19.6	25.0	-23.5	22.5
Number of persons per firm	158.7	214.0	583.1	115.7	18.3	180.0
Average sales per person $000s	298.3	318.3	375.1	172.2	297.8	309.6
Value added per person $000s	67.2	98.3	94.3	34.5	88.7	73.7

a The population of firms is restricted to those who performed R&D at least once.

Source: Unpublished data from the ABS BLS survey.

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