Skill shortages: prevalence, causes, remedies and consequences for Australian businesses

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Cover design using artwork from the **'Owl'** series by Kerri Ann Wright

My work is focused around the environment and is a reflection of my personal views on the treatment by humankind towards animals and nature. Birds are a traditional motif throughout my work. They are traditional symbols of strength, wisdom and awe, but also represent fragility and innocence.

The owl in this artwork represents how the environment and all creatures are harmed by humans. The imagery suggests a holiness attached to bird, which is wise and knowing. The plants featured in the work are Australian wildflowers and again refer to fragility. The combination of the owl and the plants in my imagery suggest nature healing nature, hope and new life growing from wisdom and strength.

This work is from NCVER's collection which features artwork by VET students.

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Publisher's note

In March 2012, amendments were made to paragraphs on page 14 in relation to comments about Australia's data sources on vacancies and skill shortages.

To find other material of interest, search VOCED (the UNESCO/NCVER international database <http://www.voced.edu.au>) using the following keywords: business; econometrics; employment; labour market; longitudinal data; policy; skill shortage; skills and knowledge; small and medium enterprise; statistics; survey; workplace change.

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About the research

Skill shortages: prevalence, causes, remedies and consequences for Australian businesses

Joshua Healy, Kostas Mavromaras and Peter J Sloane, National Institute of Labour Studies, Flinders University

Despite the attention paid to skill shortages, the evidence used to evaluate their incidence and the causes and responses by firms remains thin.

This study, based on the answers from small to medium-sized businesses who responded to questions about skill shortages in the Australian Bureau of Statistics (ABS) Business Longitudinal Database, offers a business-level perspective on skill shortages. If a business reported that a shortage existed based on whether they 'experienced an insufficient supply of appropriately qualified workers available or willing to work', they were then asked to identify the causes and their responses to it.

Key messages

- While the causes of shortages are diverse, a lack of specialist knowledge is the dominant factor. The uncertainty in forecasting long-term demand, slow recruitment processes and high prevailing market wages are also involved.
- Complexity matters, with firms encountering either simple or complex shortages. Most firms respond to simple skill shortages by better utilisation of their existing workers, such as increasing their hours. More extreme options such as reducing output are only activated when there are multiple causes.
- Simpler skill shortages are an indication of firm success, are less persistent over time and are positively associated with firm survival, higher investment and higher sales.
- The implications of complex skill shortages are less clear, tend to be persistent over time and can be associated with firm decline.
- Agriculture, construction, and personal and other services are the industries most likely to report complex skill shortages.

Tom Karmel
Managing Director, NCVER

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Abstract

Although skill shortages are often portrayed as a significant problem for the Australian economy, there is surprisingly little evidence about their prevalence, causes and consequences. It is difficult to find robust evidence about where skill shortages occur, why they occur, what businesses try to do about them and whether their responses are effective. A severe barrier to understanding skill shortages has been the absence of representative survey data linking the observation of a skill shortage to the characteristics, behaviours and subsequent performance of the businesses that encounter them. The quality of policy responses to current and emerging skill shortages has been diminished by the haphazard nature of previous data collection and analysis.

The aim of this report is to improve understanding about the phenomenon of skill shortages, by using robust econometric methods to analyse an important new dataset: the Business Longitudinal Database (BLD), maintained by the Australian Bureau of Statistics. This database is an ongoing panel survey of small to medium-sized businesses containing information from two sources: a mail-out questionnaire completed annually by responding firms and administrative data taken mainly from the records of the Australian Taxation Office. The basis of this report is the first panel of the Business Longitudinal Database, which contains information for a sample of approximately 2700 firms with fewer than 200 employees, commencing in the 2004—05 financial year.

Central to the analysis in this report is the set of questions on skill shortages that were asked to firms on the 2004—05 questionnaire in the first panel of the Business Longitudinal Database. Respondents (generally the owner or senior manager) were first asked whether the business had skill shortages during the year, to 30 June 2005. A 'skill shortage' was defined as an: 'insufficient supply of appropriately qualified workers available or willing to work under existing market conditions'. Businesses that answered 'yes' to this question were then asked two follow-up questions about the causes of the reported skill shortage and their responses to it. In both cases, multiple-response options were listed on the survey questionnaire, with the instruction that respondents should select all factors that applied; they could also specify any 'other' factors not listed.

The responses to these three key survey questions are the basis of this analysis. The information that firms provided is used to: investigate the incidence of skill shortages; identify the main types of skill shortages reported; determine which business characteristics are most strongly associated with the propensity to report having skill shortages; count the number of different skill shortage causes reported by each firm and thereby identify which have more or less complex shortages; explore the relationships between the varieties of skill shortages and firms' responses to them; and examine whether firms with and without skill shortages perform differently on measures such as sales and investment during the three-year observation period currently available in the database.

A strong theme recurring throughout this report is that skill shortages are multifaceted and complex labour market phenomena. We argue against the conception of skill shortages as a homogenous or uni-dimensional problem and favour a more nuanced interpretation that distinguishes skill shortages with simple causes from those with more complex causes. Complexity matters, both in terms of how firms respond to skill shortages and their implications for short-term performance. Simpler skill shortages — those associated with a single cause — are a marker of firm success. They have benign performance implications, are less persistent over time and are typically resolved through internal management practices, such as increasing the hours worked by existing staff. By contrast, complex skill shortages — those attributed to multiple causes — have more ambiguous effects. Firms that contend

with these complex skill shortages are more likely to respond by reducing their outputs or production. These skill shortages are also more likely to be persistent, in the sense that the affected firms still report a lack of skilled persons one or two years later. While the data do not allow us to confidently identify the causal relationship between skill shortage complexity and firm performance, we argue that there is likely to be a two-way process taking place, whereby firms with complex skill shortages encounter performance difficulties that in turn erode their capacity to correct the skill shortage.

Introduction

The trajectory of Australian economic performance since the global recession has been unlike that of most other major industrialised countries. Where many Western democracies are seeking solutions for tepid economic growth and stubbornly high unemployment, Australia's economy has recovered quickly and is again approaching full employment. The unemployment rate has fallen to 5.1% in August 2011, from a recent peak of 5.8% in August 2009, and the employment-to-population ratio remains close to its highest level since 1978, at 62.2% (ABS 2011).

One of the major consequences of Australia's resilience during the global recession has been the persistence of concerns about the quality and distribution of the nation's workforce. The policy debate in Australia is not about creating enough jobs to bring the unemployed back to work, but about finding enough workers to meet the already strong and growing demand from employers. Industry groups, investors, monetary policy-makers and elected representatives are all focused on 'skill shortages' and their attendant problems: whether there will be enough workers, of the right quality, in the right locations, and at the right prices, to keep the national economy growing steadily and generating wealth for all Australians. Sustained mismatches between the demand for and supply of skills (in terms of quality, location or price) are likely to generate unwelcome economic outcomes, such as wage inflation, work intensification, and mounting pressures on the education and training system to increase the numbers of appropriately qualified people.

Despite the perceived importance of skill shortages in Australia, research on their causes and effects is sparse. This is a result of difficulties surrounding the definition of skill shortages and a lack of detailed statistics. In relation to definitions, employers may equate their inability to attract labour and their existing skill gaps or deficiencies in current employment with skill shortages. The former have more to do with training inadequacies than 'shortages'. In relation to data limitations, there are currently no representative national data on the duration of vacancies or vacancy-to-unemployment ratios for different occupations in Australia, thus precluding the production of a statistical series on the extent of skill shortages over time.

This study utilises a new dataset produced by the Australian Bureau of Statistics (ABS) — the Business Longitudinal Database (BLD) Confidentialised Unit Record File (CURF). At the time this analysis was undertaken, there were three waves of data available relating to firms in the first panel of the database, representing the 2004—05, 2005—06 and 2006—07 financial years. An appealing feature of this database is that it enables analysis of short-term firm performance over these three consecutive years. (A further two years of data will eventually be added to complete the planned five-wave panel.) The years covered by the data were characterised by steady growth in the Australian economy and by several signs of possible labour market overheating. The average unemployment rate was 4.9% between July 2004 and June 2007, the lowest rate since the 1970s, and skill shortages were prominent in the public debate (ABS 2011).

The dataset contains a panel of about 2700 small and medium-sized enterprises (SMEs) with up to 200 employees, and contains questions on business perceptions and performance in relation to skill shortages. A skill shortage is defined in the Business Longitudinal Database as 'an insufficient supply of appropriately qualified workers available or willing to work under existing market conditions'. The presence of a skill shortage is asked only once of each firm, in the financial year 2004—05, but there are repeat observations of business performance in the two subsequent years, both subjectively as

perceived by employers and objectively in terms of measures of costs and sales derived from Australian Taxation Office (ATO) records.

Using appropriate econometric techniques, we investigate:

- the perceived incidence and causes of skill shortages
- the strategies businesses employ to relieve them, including use of the training system
- the short-term consequences of shortages for business performance.

It should be noted at the outset that the question on skill shortages asked in the Business Longitudinal Database is limited to whether or not they exist in the mind of the employer. We cannot, for instance, say anything about the degree to which they are present in terms of the percentage of the workforce subject to them, whether or not there are skill gaps or deficiencies (defined below), or which occupations are affected. Further, the data are not split by gender, so we cannot know the extent to which men or women are in short supply. Similar considerations apply to large firms and the public sector.

The Business Longitudinal Database does, however, have compensating strengths. Respondents are asked detailed questions on the reasons for their skill shortages and on how they dealt with them. We are in the unique position of being able to establish whether the employer feels that a lack of skilled workers significantly hampered business performance. Finally, we are able to compare the performance of firms that do and do not report skill shortages, to test whether their occurrence produces deleterious effects, such as fewer sales.

This report is structured as follows. The next chapter provides a brief literature review. This is followed by a chapter that describes the Business Longitudinal Database and provides further descriptive analysis on the main skill shortages information in the dataset. The results of the analysis are then presented in three separate chapters.[1]

The first of these introduces the multivariate regression estimation methods and examines the incidence of skill shortages, both overall and in relation to their different causes. It focuses on the causes or types of skill shortages: those factors or forces to which businesses attributed the skill shortage(s) experienced during 2004—05. The causes of skill shortages are diverse. The dominant cause is a lack of specialist knowledge, but long-term demand uncertainties, slow recruitment processes and high prevailing market wages are also involved. A lack of training opportunity or training capacity is not seen as a major driver of skill shortages. We find that the causes vary with firm size and the degree of competitiveness within the product market in which firms operate. After controlling for firm size and market structure, certain industries, particularly agriculture, forestry and fishing, and construction are more likely to face complex skill shortages than comparable firms operating in other industries.

The next chapter of the results deals with firms' responses to skill shortages and explores the complex interactions between the causes of skill shortages and the responses to them. Most firms address skill shortages through better utilisation of their core workforce. This type of strategy is characterised by responses that are internal to the firm and its existing structures and employees, and included increasing working hours, improving wages and conditions, or offering internal training. Other firms engage a peripheral workforce when faced with skill shortages. They outsource work or hire on short-term contracts to meet expanding demand. A small but significant minority of firms

[1] Healy, Mavromaras and Sloane (2011) provide a more concise discussion of some of the results presented in this report.

respond to skill shortages by reducing output. Importantly, we find that the nature of firm responses is dependent on the complexity of their skill shortage. Some responses are utilised as stop-gap measures, irrespective of the type or the complexity of the shortage at hand. We liken these responses to a 'first line of defence' for firms that cannot meet increasing demand with their existing labour pool. As the underlying shortages become more complex and difficult, however, firms move along a spectrum of response options, gradually employing the strategies that are more costly or more risky, such as reducing output.

The third chapter describing the results deals with the short-term consequences of skill shortages. We look at the probability of firm closure during the period of observation, and (for surviving firms) the change in sales volume, the level of capital expenditure and the change in their wages bill. The results show that firms with simple skill shortages, whatever their particular cause, are more likely to grow and stay in business than comparable firms without any skill shortages.

This report finishes with some concluding observations.

Literature review

Despite its common usage, what constitutes a labour or skill shortage is far from straightforward. Broadly speaking, a shortage implies a disequilibrium situation, in which the demand for labour by an employer or group of employers is in excess of the supply of available workers at the ruling market wage. But what is the market wage? A situation in which a (low-wage) employer is not willing to pay the wage required to eliminate the shortage of workers should not be regarded as a true labour shortage. Further, recent literature emphasises the ubiquity of labour market monopsony, in which the labour supply curve facing the employer is upward sloping, even for many small firms. This means that in order to recruit extra workers the employer must raise wages, a situation which may well suggest to the employer that a labour shortage exists, when in reality supply and demand are in balance. However, raising pay to attract new workers may be costly if this means that the pay of existing employees must be raised too. Thus, Mavromaras, Oguzoglu and Webster (2007) found in relation to Australia that, while skill shortages were associated with wage increases in the occupation of shortage, there was also evidence that wage increases in one occupation flowed to other occupations in the same industry, which would be inflationary.

Employers may also view internal skill deficiencies (where the skills of their existing workers are below some optimal level) or skill gaps (where firms' existing workers lack sufficient skills to do their jobs effectively) as labour shortages. Yet, these are very different in their implications from skill shortages, although they are often conflated in practice (see Green, Machin & Wilkinson 1998, for the United Kingdom; Shah & Burke 2005, for Australia). It is also likely that hiring standards may be adjusted according to the state of the labour market. When demand is buoyant, employers may be forced to take on workers who lack experience or other desired personal attributes such as adaptability. By contrast, when demand is depressed and labour is abundant, employers may raise their expectations and look for qualities beyond those required in terms of the technical capacity to perform the job (Richardson 2007). This implies that in tight labour markets the number of undereducated and underskilled workers is likely to increase, while in slack labour markets the number of overeducated or overskilled workers is likely to increase. These imbalances will have implications for the likelihood of both internal and external training being offered as a response. What is acceptable in terms of hiring standards may vary, therefore, according to the stage of the business cycle. Likewise, the form of adjustment may be influenced by the cycle. Stevens (2007) analysed an unbalanced firm panel dataset for the United Kingdom over the period 1982—94 and found some support for the suggestion that non-wage adjustment is preferred when labour markets are tight, as under such circumstances it will be more costly and less effective to raise wages.

In Britain, where labour shortages have often been much higher than in other countries, several studies examined different measures of labour shortage. In 1989, for example, no less than 31% of firms reported that their output was constrained by a shortage of skilled labour. Haskel and Martin (1993a) used the 1984 Workplace Industrial Relations Survey (WIRS) to relate skill shortages to vacancy duration, noting that when labour is in short supply firms must wait longer than normal and (or) search more actively in order to hire workers. They found that unionised firms and those offering profit-related pay suffered less than others from labour shortages. They found, however, no evidence of firms raising wages to eliminate labour shortages, although shortages did diminish when local unemployment was higher. In another paper, Haskel and Martin (1993b) argued that skill shortages lower output in at least two ways: first, by increasing hiring costs for skilled workers, which causes them to be substituted by less skilled workers and, second, by increasing the bargaining power of

skilled workers, which enables them to choose an easier pace of work. Using a panel of 81 3-digit industries for the period 1980—86, they found that the increase in skilled labour shortages over this period reduced productivity growth by a not insubstantial 0.7% per annum. Haskel (2001) used data from the 1990 Workplace Employee Relations Survey (WERS) and the related 1991 Employee Manpower and Skills Practices Survey to investigate the links between technology and skill shortages in the United Kingdom. He found that skill shortages were higher for establishments that used advanced technology in the production process, in line with the skill-biased technological change argument. In this study, skill shortages, hiring difficulties and hard-to-fill vacancies were found to be closely related concepts. However, the correlations among them were somewhat low, lying between 0.3 and 0.4.

These same datasets were analysed in rather more detail by Green, Machin and Wilkinson (1998), who focused not just on the causes of skill shortages but also on the reasons for recruitment difficulties among establishments with hard-to-fill vacancies. They suggested that, while employers do not seem to have any difficulty in interpreting what is meant by the term 'labour shortage', this interpretation may differ from one employer to another. Many of them refer to motivational or attitudinal deficiencies, in relation to both existing and potential employees, suggesting that a lack of social skills is an important component of the skill shortages problem. These findings point to two shortcomings in the present literature: first, there are no adequate and widely accepted measurements of skill shortage and, second, there is no consistent understanding among employers as to what they choose to classify as a skill shortage.

Finally, it is possible that firms can reduce the problem of skill shortages if they can gain a reputation for being a good employer. Using a company dataset of 204 German firms, Backes-Gellner and Tuor (2010) showed that firms can reduce vacancy rates by signalling the good quality of their labour relations to potential employees. Relevant aspects included apprenticeship training and systematic continuing training programs, which signal that firms are not reliant on poaching skilled labour from elsewhere; the presence of a works council, which signals job security and a good working environment; and the overall skill intensity of the workplace, which signals a challenging and interesting environment. All three main variables are significant in reducing the vacancy rate.

Australia generally lacks data on the duration of vacancies or vacancy-to-unemployment ratios (the Beveridge Curve) for different occupations across the whole country. The Department of Education, Employment and Workplace Relations (DEEWR) produces data on the proportion of vacancies filled and on the number of suitable applicants per vacancy, as well as a regular publication, *Skill shortages Australia*. These are based on the results of the (telephone) Survey of Employers who have Recently Advertised (SERA). It assesses the labour market for between 120 and 150 skilled occupations, mainly in the trades and professions. Whether the vacancy is filled is measured six weeks after advertising, in the case of professional vacancies, and four weeks in the case of other occupations. However, the survey is not a random sample of employers and, as Coelli and Wilkins (2008, p.312) put it, 'the targeted nature of the survey instrument precludes the construction of quantitative estimates of skill shortages that reflect Australian employers overall'.

Despite the lack of nationally representative data that could be used for statistical research of the nature performed in this monograph, skill shortages are reported frequently and form the basis of a substantial part of Australian immigration policy, as partly reflected in visa subclass 457 provisions. These have operated since the 1990s and enable employers to fill nominated skilled posts with overseas immigrants for (renewable) periods of up to four years, as well as allowing entry for secondary (family member) applicants, who are also allowed to work or study. By 2007—08, the

number of primary grants had risen to a figure approaching 60 000 and that of secondary grants to nearly 50 000. The Deegan Review (2008) put forward a number of proposals for reform, including minimum salary levels for migrants, English language requirements, an accreditation system for employers, and new lists setting out occupations for which temporary work visas would be granted. Deegan noted a number of specific cases of skill shortages, particularly in engineering, where the Association of Consulting Engineers Australia (ACEA) reported in its Skills Survey 2008 that, on average, two-thirds of its members across Australia were either delaying projects, or even declining them altogether, because of a lack of workers; this was the third consecutive year this had occurred. However, Deegan also suggested that the evidence in some other occupations was contradictory. Thus, while it was claimed that chefs, cooks, and truck drivers were in short supply, *Australian jobs 2008* (published by the Department of Education, Employment and Workplace Relations) showed that unemployment in these occupations was above average or even high.

These examples are by no means atypical. Junankar (2009) observed that, although the resource-rich states of Western Australia and Queensland found it necessary to attract labour from other states and employers in these states were demanding increases in quotas and temporary 457 visas, real wages in the two states were increasing more slowly than productivity growth. In addition, employers were advertising jobs which were temporary, casual, often with peculiar shifts, located in difficult environments, and which required workers to provide their own equipment. Precisely why employers refuse to improve the attractiveness of their employment conditions in the face of labour shortages remains something of a puzzle.

In general, relying on migration to overcome skill shortages may not be the ideal solution. As Shah and Burke (2005) suggest, one problem resulting from such an approach is that the migrants may not arrive until after the shortage has been resolved in one way or another; the migrants may then have to work in alternative and possibly lower-skilled jobs. It is also possible that new migrant workers, especially those who are highly skilled and well motivated, may be poached by a sector where skill gaps are the real issue, but where the pay might be better, thus frustrating one of the objectives of the visa system. Another problem is that migrants generally prefer to settle in large metropolitan areas, while shortages often occur in regionally dispersed or remote locations. This means that employment relationships arising from targeted migration schemes may be short-lived.

Apart from improved pay and conditions, the provision of training opportunities is an important element in alleviating shortages. As Richardson (2007) observed, this may not resolve the problem immediately, as training takes some time in certain occupations. Further, as Mitchell and Quirk (2005) observed, the efficiency of the training may not be perfect, as around 50% of those commencing trades training fail to complete it, an issue which is currently being investigated for the National Centre for Vocational Education Research (NCVER). There may also be problems relating to the poaching of trained labour, particularly where the skills imparted by the training are of a general nature.

Data description

The Business Longitudinal Database

Our data source is the Expanded Confidentialised Unit Record File (CURF) of the Business Longitudinal Database.[2] The Business Longitudinal Database, a longitudinal dataset produced by the ABS, covers small and medium-sized enterprises. Its scope is restricted to businesses that are actively trading in the Australian economy, meaning those with an Australian Business Number (ABN) that are remitting the Goods and Services Tax (GST). Businesses with no employees are within its scope, but larger businesses (those with 200 or more employees) and businesses with complex structures (multiple ABNs) are excluded. Also outside the scope of the database are: government departments and authorities; financial entities (for example, banks, insurance corporations and investment funds); and not-for-profit organisations (for example, religious institutions, charities, clubs and societies, and trade unions).

The Business Longitudinal Database incorporates data from two key sources. The first is the Business Characteristics Survey (BCS), an annual mail-out survey conducted by the ABS to collect data on business characteristics and performance. This survey contains a core of questions repeatedly asked to businesses to enable longitudinal analysis of changes in their circumstances over time. In order to minimise respondent burden, much of the information collected in this survey is categorical in nature (requiring businesses to provide a simple yes/no response). The second key data source for the Business Longitudinal Database is administrative data, principally Australian Taxation Office information on aspects of business performance deriving from the business activity statements that businesses must complete for compliance with taxation law. The combination of these two data sources yields much information about how different Australian businesses perform and what factors may be associated with their growth or decline. The addition of a longitudinal element, meaning that the performance of each business can be followed over time, further increases the analytical appeal of the Business Longitudinal Database.

Up to three waves of data are currently available from the database and cover the financial years from 2004—05 to 2006—07. A further two waves of data will be added over time to complete the planned five-wave panel. This first panel has information for 2732 firms. (A second completely separate panel of firms was introduced to the database in the 2005—06 financial year; this second panel has information for 3432 firms.)

For all analyses in this report, we use the data for firms introduced to the database in 2004—05 (Panel One). This panel includes the key question on skill shortages from the Business Characteristics Survey completed by responding firms in 2004—05. The relevant question (answered yes/no) was:

> Did this business have skill shortages during the year to 30 June 2005?

A skill shortage was defined in the Business Characteristics Survey questionnaire as occurring 'when there is insufficient supply of appropriately qualified workers available or willing to work under existing market conditions'.

The firms that provided an affirmative response to the skill shortages question were then asked two further questions about the causes of and their responses to the shortages. Both are multiple-

[2] This section draws on the information provided in ABS (2009).

response questions, allowing firms to select more than one of the listed response options. First, businesses were asked: *Were this business's skill shortages due to any of the following factors?*, with a list of six possibilities provided and the further option to select *other (please specify)*. Second, businesses were asked: *How did this business address skill shortages during the year ended 30 June 2005?* and offered a list of seven possible responses, again with the further option to select *other (please specify)*.

The responses to these three variables provide the basis of our analyses in this report. We use firms' responses in various ways, including to: estimate the frequency of skill shortages; identify the main causes of reported skill shortages; determine which business characteristics are most strongly associated with the propensity to report having skill shortages; count the number of different causes of skill shortages reported by each firm and to identify which firms have more or less complex shortages; and link the causes of shortages to both their responses and the subsequent firm performance on measures of sales and investment taken from Tax Office records.

A further aspect of interest is the persistence of skill shortages over time. Unfortunately, the above questions on skill shortages were not repeated in the second and third waves of the Business Longitudinal Database. For this part of the analysis, we therefore use firms' responses in 2005—06 and 2006—07 to another question as a proxy for continuing skill shortages. We identify firms that selected the response option *Lack of skilled persons within the business* when answering the following question:

> During [the year] did any factors *significantly hamper* this business in: either (a) the development or introduction of new or significantly improved goods, services, processes or methods; or (b) other business activities or performance?

Our analysis of the Business Longitudinal Database was undertaken via the ABS Remote Access Data Laboratory (RADL), a secure online facility that allows users to submit statistical programs for interrogating confidentialised data.

Appendix 1 provides further details for all of the variables described above.

Limitations of the Business Longitudinal Database

The datasets used in the studies reviewed in the previous chapter differ from the Business Longitudinal Database dataset used in this study in several important ways. The latter is limited to small to medium-sized establishments, including some with no employees. We do not know whether a respondent actually advertised any vacancies over the previous 12-month period to which the main skill shortages question pertains; those which did not advertise may not be well informed about the true state of the labour market. The question relating to skill shortages in the Business Longitudinal Database dataset is a simple yes or no question; namely, whether the organisation had any skill shortages during the 2004—05 financial year. As mentioned earlier, it is possible that this concept may be confused either with skill gaps, a situation in which firms' existing workers do not have sufficient skills to do their jobs effectively, or with skill deficiencies, where existing skills are below some optimal level. As Green, Machin and Wilkinson (1998) noted, these concepts are quite different, although they are often conflated in practice. These other concepts are suggestive of a need for training or retraining.

As noted in the introductory chapter, it is not possible in the Business Longitudinal Database to establish the intensity of any skill shortage, such as the proportion of hard-to-fill vacancies, or the

average time taken to fill a vacancy. It is also not possible to establish the particular occupations in which skill shortages are manifest; furthermore, the data are not split by gender and there are no questions on the extent to which immigrant workers are used to overcome skill shortages.

Unlike any of the studies discussed in the literature review, however, the Business Longitudinal Database contains questions on how the respondents attempted to overcome their problems of skill shortages, and the impact that this had on business performance. This makes these data invaluable in assessing the overall impact of skill shortages. A further shortcoming, however, is that certain activities are observed only for the firms that reported having experienced a skill shortage. An important example is the use of external training programs. Ideally, we would investigate the efficacy of external training programs by comparing the incidence and persistence of skill shortages in firms that did and did not use training. However, because the use of external training programs is treated in the Business Longitudinal Database as one of several possible responses to skill shortages, it is only available for the subset of firms that reported experiencing a skill shortage in the initial period. Further limitations of this kind preclude other potentially useful comparisons from being undertaken using this dataset.

Incidence of skill shortages

Table 1 provides a first look at the data from the Business Longitudinal Database. Of 2732 firms in the sample: 438 (16%) reported having experienced a skill shortage in the relevant period; 1825 (67%) reported no skill shortage; and 469 (17%) did not answer the question. There is little that can be said about the firms that did not answer the question, other than by determining whether they are a random subset of the whole sample, which we do in appendix 2. The remaining cases are the focus of this research, especially the 438 firms that reported experiencing a skill shortage.

Table 1 Incidence of skill shortages by business size, unweighted frequency

	Did this business have skill shortages during the year to 30 June 2005?			
	No	Yes	Not answered	Total
Non-employer	410	27	136	573
0–4 employees	584	101	150	835
5–19 employees	452	156	91	699
20–199 employees	379	154	92	625
Total	**1825**	**438**	**469**	**2732**

Table 2 repeats table 1, but weights the observations using the sampling weight variable provided in the CURF. Weighting is necessary to obtain the representative distribution of businesses and to compare the incidence of skill shortages across different size categories. We see that the 438 instances of skill shortage translate to an estimated population of approximately 131 000 businesses. About half of these (66 000) were very small businesses with 0—4 employees.[3]

[3] This section uses a measure of business size that is based on Derived Size Benchmark (DSB) employment, rather than current employment. A DSB value is assigned to each business when it first appears on the ABS Business Register, from which the BLD sample is selected. This means that a DSB measure of employment is available for all firms and, unlike reported current employment, is not affected by survey non-response. However, the DSB is constant for each firm and thus does not reflect changes in employment over time.

Table 2 Incidence of skill shortages by business size, weighted frequency

	Did this business have skill shortages during the year to 30 June 2005?			
	No	Yes	Not answered	Total
Non-employer	662 784	32 444	162 954	858 182
0–4 employees	383 498	65 791	97 080	546 369
5–19 employees	91 218	25 853	14 106	131 177
20–199 employees	17 851	6877	3400	28 129
Total	**1 155 352**	**130 965**	**277 540**	**1 563 857**

The relationship between business size and skill shortages is depicted more clearly in table 3, which converts the absolute numbers from table 2 into row percentages. We see that there is a clear, positive relationship between business size and the likelihood of skill shortages. Across the in-scope population of businesses, 8% reported that they had skill shortages in 2004—05. Note that this estimate is half the unweighted figure in table 1. The reason for the difference is the design of the Business Longitudinal Database sample, which is stratified by business size. Once the data are weighted to reflect this design element, and thus to represent the true population distribution, the number of small and very small businesses increases substantially as a proportion of the total. Table 3 suggests that small businesses are less likely to report skill shortages: their incidence in businesses with 0—4 employees (12%) is half that of businesses with 20—199 employees. Consequently, the overall incidence of skill shortages is reduced after weighting, from 16 to 8%, because of the lower incidence of shortages in (the relatively large population of) small firms.

Table 3 Incidence of skill shortages by business size, weighted row percentages

	Did this business have skill shortages during the year to 30 June 2005?			
	No	Yes	Not answered	Total
Non-employer	77	4	19	100
0–4 employees	70	12	18	100
5–19 employees	70	20	11	100
20–199 employees	63	24	12	100
Total	**74**	**8**	**18**	**100**

Tables 1 to 3 highlighted two further data complications. First, 'non-employing businesses' make up a significant proportion of all cases in the sample. For the purposes of the Business Longitudinal Database, these are defined as businesses with no active income tax withholding (ITW) role. There are 573 non-employing businesses in Panel One of the Business Longitudinal Database. They represent 21% of the unweighted sample, but over half (55%) of the weighted population. Because these non-employing businesses are a large group, our decision about how to treat them in the analysis will influence our conclusions about the prevalence and causes of skill shortages.

The difficulty lies in inferring what non-employing businesses mean when they say they have a skill shortage. We have assumed that these are businesses that wish to expand their employment, but (for whatever reason) cannot find the desired workers. On this basis, we have treated them as legitimate cases and have not deleted them from the dataset. It is important to recognise, however, that their retention in the dataset has the effect of reducing the overall estimate of skill shortage prevalence. The reason is that non-employing businesses are a large proportion of the total business population (table 2), but skill shortages are comparatively rare for them (table 3).

Although the smaller businesses are numerous, their number of employees is (necessarily) small and their significance as a proportion of the total workforce will be low. This will be a direct consequence

of using the business as the unit of observation. Table 4 provides an indication of the effect that the presence of many smaller workplaces has on the estimated incidence of skill shortages. Rather than treating the business as the unit of observation, we have reweighted the data in table 4 to reflect the approximate number of workers present in each business. This can only be done in a crude way with the Business Longitudinal Database data, given that workplace size is coded in ranges (for example, 5—19 workers), rather than as a continuous variable. We have assigned to firms the number of workers that corresponds to the mid-point value of the workplace size range in which each is found. For instance, firms in the category of 5—19 workers are assumed to have 12 workers for the purposes of table 4. This is an imperfect method, particularly for firms in the largest size category, which has the widest range (20—199 workers). However, it suffices, in the absence of ready alternatives, to illustrate the role of workplace size in estimating the incidence of skill shortages.

We see that, when the sample is reweighted by the approximate number of workers in each firm, rather than by the number of firms, the incidence of skill shortages rises considerably. The approximate proportion of workers in businesses with skill shortages in 2004—05 was 18% (table 4), as opposed to 8% of firms with skill shortages (table 3). This difference highlights further the positive relationship between workplace size and the probability of skill shortages.

Table 4 Incidence of skill shortages by business size, reweighted by approximate number of workers per business

	Did this business have skill shortages during the year to 30 June 2005?			
	No	Yes	Not answered	Total
Reweighted frequency	4 871 539	1 296 552	997 513	7 165 603
Reweighted row %	68	18	14	100

The second and perhaps more important data complication is the large number of businesses across all size categories that did not answer the skill shortages question. These cases are shown as 'missing due to respondent omission' in the CURF. This missing data problem applies to 469 businesses, or 17% of the unweighted sample (table 1). After weighting, the frequency of missing information on the skill shortages question is systematically higher for smaller businesses (table 3).

How should we treat these cases of missing data in the analysis? One option is simply to delete them from the dataset and recalculate the estimates of skill shortage incidence from table 3. (This is done in table 5.) This approach assumes that the missing responses contain no useful information. Deleting them leads to small increases in the incidence of skill shortages, both overall (from 8% to 10%) and for all categories of business size. The alternative is to leave the missing observations in the dataset and treat them as de facto negative responses. This approach gains support from a note in the Business Longitudinal Database CURF technical manual, which advises data users that 'investigations by the ABS into non-response at particular questions indicate that, in the majority of cases, non-response equates to a negative response' (ABS 2009, p.14).

Our investigations revealed that the firms which have not responded to the skill shortages question also have missing data for many other variables in the Business Longitudinal Database. *None* of the 469 businesses with missing data on the skill shortages question has *any* information on the variables relating to number of years of operation, number of trading locations, or number of competitors. These omissions strongly suggest that there is a group of businesses with inadequate responses to the self-reported component of the database and which should therefore be excluded from the analysis. These businesses are not only lacking information for the variable relating to skill shortages, but also for many of the other variables that we intend to use as controls in our multivariate estimations.

Accordingly, for the remainder of this section, we present estimates only for the businesses with valid observations. A separate analysis of the characteristics of businesses that did not answer the skill shortages question, which explores whether they are a random subset of the database sample, is presented in appendix 2.

Table 5 Incidence of skill shortages by business size, weighted row percentages, excluding missing cases

	Did this business have skill shortages during the year to 30 June 2005?		
	No	Yes	Total
Non-employer	95	5	100
0–4 employees	85	15	100
5–19 employees	78	22	100
20–199 employees	72	28	100
Total	**90**	**10**	**100**

Which businesses experience skill shortages?

In addition to measures of business size, the Business Longitudinal Database Expanded CURF has data on various other business attributes that can be usefully cross-tabulated with the skill shortages variable. Table 6 presents data on the industry distribution of businesses with responses to the question on skill shortages.[4] This preliminary evidence points to substantial variation in perceived skill shortages across the major industry divisions. Interestingly, the reported incidence of shortages appears to be higher in low-paid service sectors, such as hospitality and personal services, and in the construction industry, which was experiencing boom conditions during 2004—05 when these data were collected. Perhaps surprisingly, the property and business services industry had the lowest reported prevalence of skill shortages at this time, despite anecdotal evidence of a very active real estate sector.[5]

[4] The Business Longitudinal Database does not include all industries. The two main exclusions are education, and health and community services, both of which contain many larger publicly funded organisations outside the database's scope.

[5] Another surprising aspect of this result is that the largest occupations by numbers employed in the property and business services industry, according to data from the 2006 ABS Census of Population and Housing, were computer consultancy and accounting, both of which were thought to be in conditions of skill shortage at the time. The apparent contradiction may be explained by the shortages being manifested in larger firms that are above the 200-employee size restriction of the database.

Table 6 Incidence of skill shortages by main industry of operation, weighted row percentages, excluding missing cases

	Did this business have skill shortages during 2004–05?		
	No	Yes	Total
Agriculture, forestry, and fishing	92	8	100
Mining	89	11	100
Manufacturing	87	13	100
Construction	83	17	100
Wholesale trade	93	7	100
Retail trade	90	10	100
Accommodation, cafes and restaurants	81	19	100
Transport and storage	92	8	100
Communication services	89	11	100
Property and business services	96	4	100
Cultural and recreational services	92	8	100
Personal and other services	81	19	100
Total	**90**	**10**	**100**

Table 7 presents a cross-tabulation by age of business — measured by the years of operation under current ownership. The evidence here is suggestive of a mild negative association between business age and the likelihood of skill shortages. Businesses that have been operating for longer under their current ownership appear slightly less likely to encounter skill shortages. In the next chapter we explore whether this association holds independently of other factors, such as the size of the business and its number of competitors.

Table 7 Incidence of skill shortages by number of years operating under current ownership, weighted row percentages, excluding missing cases

	Did this business have skill shortages during 2004–05?		
	No	Yes	Total
Less than 5 years	88	12	100
5 to less than 10 years	89	11	100
10 to less than 20 years	91	9	100
20 or more years	93	7	100
Total	**90**	**10**	**100**

Some insight is available into market structure from the information that businesses are asked to provide about their competitors. Table 8 provides a cross-tabulation of these data against the skill shortages variable. Ignoring the businesses that were unsure of their competition, the preliminary evidence is that businesses operating in more competitive markets are more likely to encounter skill shortages. This result conforms to expectations, since businesses in highly competitive environments are likely to be price-takers who cannot easily raise their wages to attract more or higher-quality employees.

Table 8 Incidence of skill shortages by market structure, weighted row percentages, excluding missing cases

	Did this business have skill shortages during 2004–05?		
	No	Yes	Total
Don't know	98	2	100
Captive market/no effective competition	96	4	100
One or two competitors	89	11	100
Three or more competitors	83	17	100
Total	**90**	**10**	**100**

What are the causes of skill shortages?

For the remaining analyses, we restrict our attention to the businesses that reported skill shortages in the 2004—05 financial year. Table 9 looks at businesses' perceived reasons for their skill shortages. The responses have been ranked in descending order by frequency. (Multiple responses are allowed.) By far the most common explanation, given by 59% of businesses with skill shortages, is that these arose because of a requirement for specialised knowledge. A much less frequently reported set of reasons (each nominated by about a quarter of affected businesses) assigned responsibility for skill shortages to factors other than a pure deficit of the required skills, including such factors as slow recruitment processes, excessively high wage costs and uncertainty on the part of the business about likely future demand for its product. About one in four businesses with shortages nominated training inadequacies as one of their causes.[6] Few businesses see their geographic location as having contributed to skill shortages.[7]

Table 9 Causes of skill shortages, businesses with skill shortages only*

	Percentage of businesses with skill shortages (sorted in descending order by frequency)
Specialist knowledge required	59
Unsure of long-term demand for products or service	28
Recruitment too slow	27
Wages or salary costs too high for the business	26
Lack of availability of adequate training	23
Geographic location of business	13
Other (please specify)	8

Note: *Multiple responses permitted.

Another way of interrogating these data is to estimate the cumulative number of reasons (out of the maximum seven options listed in table 9) given for skill shortages by each business that experienced them. Table 10 provides this information. It shows that almost half (46%) of businesses affected by skill shortages attributed them to a single cause. Another third of affected businesses selected two explanations. A significant minority of the affected businesses (20%) believed that they faced complex skill shortages with multiple (three or more) causes.

[6] The data do not allow us to pinpoint whether these 'training inadequacies' relate to internal or external training provision. Responding firms simply nominated whether they faced a skill shortage that was due (in whole or in part) to a 'lack of availability of adequate training'.

[7] It might be expected that this response would exhibit a pattern according to the location of each business. However, the BLD does not contain any geographical information, even at the broad state or territory level, so this possibility cannot be explored.

Table 10 Number of causes of skill shortages reported, businesses with skill shortages only

	Percentage of businesses with skill shortages
One cause	46
Two causes	33
Three or more causes	20

We expand on this preliminary descriptive analysis of the causes of skill shortages in several later sections of this report. The next chapter explores whether different business attributes (for example, size, industry and market structure) are related to simple and complex forms of skill shortages. This is followed by a chapter that explores whether the responses to skill shortages differ, depending on whether they are seen to have simple or complex causes. Finally, in the second to last chapter we look at whether the consequences of skill shortages differ according to the complexity of their causes.

How do businesses respond to skill shortages?

The final issue we explore in this descriptive analysis is how businesses with skill shortages respond to them. Table 11 shows a ranking of the relevant response categories. Work intensification; that is, extending the working hours of, or demands on, existing workers, is by far the most common action taken by businesses facing skill shortages (49%). This makes sense, as it is the most flexible and easily withdrawn of the responses. By increasing the hours worked by their current employees, businesses avoid the costs of funding new training or increasing wages. About a third of businesses affected by skill shortages responded by subcontracting or outsourcing part of their work. About a quarter of affected businesses elected to increase their provision of on-the-job or internal training.

Increasing the use of external training programs is the least common of all the available response options (7%). From the point of view of the training system, this is a very interesting result, as it implies that employers are reluctant to engage with the external training system, even in the presence of self-reported skill shortages. Businesses affected by skill shortages are about twice as likely to increase their wages or conditions of employment as they are to increase their use of external training. This may reflect employers' concerns that, in conditions of widespread labour shortages, newly trained employees will be attractive poaching targets for rival businesses facing the same hiring constraints.

Table 11 Responses to skill shortages, businesses with skill shortages only*

	Percentage of businesses with skill shortages (sorted in descending order by frequency)
Existing workforce worked longer hours	49
Subcontracted or outsourced work to other businesses	31
More use of on-the-job or internal training of staff	27
Reduced outputs or production	20
Wages, salaries and/or conditions increased	16
Employed workers on short-term contracts	11
Other (please specify)	8
More use of external training of staff	7

Note: *Multiple responses permitted.

Table 12 provides further evidence about how businesses respond to skill shortages. Over half (54%) of the affected businesses use only one of the responses listed in table 11. Another third of them employ two of these response strategies. Relatively few affected businesses (13%) use a combination of three or more strategies when responding to perceived skill shortages.

Table 12 Number of responses to skill shortages reported, businesses with skill shortages only

	Percentage of businesses with skill shortages
One response	54
Two responses	33
Three or more responses	13

Combining the findings of the literature review with the examination of the Business Longitudinal Database in this chapter suggests that not all of the responses measured in the database have been examined in the relevant literature. It is worth noting that the use of longer working hours, outsourcing and short-term contracts, as responses to skill shortages, do not feature prominently in the relevant literature, despite their obvious prevalence in the data.

Multivariate analysis

Estimation methods

The descriptive analysis in the previous chapter showed that several types of skill shortage may be present within a single establishment. There may also be several responses to each type of shortage. The overall effect on performance is likely to depend on both the type(s) of shortage encountered and the response(s) elicited. The relationship between skill shortages and performance will also depend simultaneously on other factors, such as the size of the establishment and its product-market structure. This complex picture can only be reflected with some accuracy through the use of multivariate regression analysis, which allows the estimation of the relationship of any two factors of interest, while controlling for other relevant factors. Given the relatively limited data at hand, this research uses methods that are basic, but which have also proved to be robust to datasets that may be limited in their detail.

We use two types of estimation. The first one focuses on the *incidence* of specific types of skill shortages and specific types of *responses* to skill shortages. The aim of the incidence and responses estimations is to discover what factors may be associated with each type of skill shortage and what firms do about them. For example, is each type of skill shortage evenly spread across industry sectors, or are there industries that are more likely to experience them? Descriptive data tell us that larger firms (table 3) and firms that face more competition (table 8) are more likely to experience skill shortages. But at the same time we know that firm size and competitive position are interdependent, which is where multivariate regression is required to distinguish the association between skill shortages and firm size from the association between skill shortages and competitive position. To estimate incidence (of type or response) we use the probit method, which allows us to derive readily interpretable 'marginal effects' for each variable that may be associated with the presence or not of a type of skill shortage or a type of response. We use two different probit estimation methods: the binary probit to estimate if a type of shortage is present or not within a firm and the ordered probit to estimate the intensity of skill shortages, manifested by how many different types of skill shortages are reported simultaneously by each business. Probit estimation is a well-understood and widely used and trusted methodology in econometrics.

The estimation of the consequences of skill shortages employs similar methods to those already described. Where the outcome of interest is binary (that is, either present or not present), the simple probit is used. Where the variable of interest is continuous, such as a change in sales of a firm, then linear regression by the method of ordinary least squares (OLS) is used.

There are some methodological points that need to be considered regarding the estimation results this report presents. Consider first the estimations of: (i) whether there are skill shortages, (ii) what type of shortages they may be, and (iii) what type of responses they may have generated. Given that the information provided by the data on causes of and responses to skill shortages was collected during the first time period, the data cannot be used to estimate any causal relationship in the form of factors that have caused skill shortages to appear, or the specific types of skill shortages that have caused particular responses. We can only estimate associations. This is an important feature of the estimations on the incidence of skill shortages in this report. In order to think in a causal way we would need to introduce additional information to the analysis. This would have to be either in the form of more data, or in the form of a specific interpretation of the existing data, based on external information or knowledge. While in the case of the causes of and responses to skill shortages we do

not have such further information, in the case of the outcomes of skill shortages we do. The Tax Office records provided in the dataset are both independently collected and also collected up to three years after the causes of and responses to skill shortages were reported. This feature of the data is utilised in the chapter, 'Consequences of skill shortages'.

The incidence of skill shortages

The first question we ask is: where do we find skill shortages in the data? We restrict the analysis to the part of the sample that answered the question relating to skill shortages. The dataset contains a great deal of information about the type of firm that reported skill shortages and about the circumstances that surrounded these firms when they reported their skill shortages. The first step in the incidence analysis is to examine what variables are associated with the firm having reported any skill shortages at all. The second step in the incidence analysis is to distinguish between the different types of reported skill shortages, as well as the number of skill shortages that were simultaneously reported. The objective of the analyses is to examine whether there are any patterns in the estimated associations. As we do not have any strong priors to distinguish between the different variables in the dataset, we present several alternative model specifications and compare them.

Table 13 reports estimation results from six different models. The overall statistical properties of all six models appear to be very similar. We focus our discussion on Model 6, simply because it contains the largest number of explanatory variables. Table 13 shows some clear patterns.[8]

[8] The 'explained' or 'dependent' variable in the estimation is whether the firm reported in the first wave of the data that it had experienced a skill shortage (value is 1) or not (value is 0). The reported marginal effects are estimates of the change in the probability of reporting a skill shortage for different values of the 'explanatory' or 'independent' variables listed in the first column of table 13. For example, the agriculture variable in Model 1 has a marginal effect of 0.135. This means that firms in the agriculture industry are on average 13.5% more likely to have reported a skill shortage than are firms in the manufacturing industry (the reference category). The p-values reflect the statistical significance of each marginal effect (the lower, the more accurate the estimate). Given the rather small sample size and the large number of variables, we regard p-values below 0.10 as sufficiently different from zero to be regarded as statistically significant. See appendix 3 for further discussion of this issue.

Table 13 Probit estimations of the incidence of skill shortages

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	0.135	0.000	0.144	0.000	0.139	0.000	0.139	0.000	0.132	0.000	0.147	0.000
Mining	0.048	0.361	0.046	0.385	0.046	0.382	0.049	0.350	0.045	0.391	0.043	0.414
Construction	0.199	0.000	0.199	0.000	0.197	0.000	0.202	0.000	0.200	0.000	0.201	0.000
Wholesale trade	-0.063	0.066	-0.064	0.064	-0.065	0.058	-0.064	0.063	-0.064	0.061	-0.067	0.051
Retail trade	-0.014	0.734	-0.012	0.777	-0.012	0.770	-0.014	0.738	-0.015	0.709	-0.011	0.786
Accommodation, cafes and restaurants	0.064	0.124	0.068	0.107	0.064	0.128	0.064	0.124	0.068	0.107	0.069	0.099
Transport and storage	0.048	0.283	0.047	0.295	0.050	0.268	0.049	0.275	0.043	0.339	0.044	0.322
Communication services	0.044	0.387	0.042	0.414	0.044	0.393	0.041	0.419	0.041	0.424	0.036	0.481
Property and business services	-0.040	0.342	-0.038	0.368	-0.041	0.334	-0.041	0.328	-0.041	0.323	-0.041	0.330
Cultural and recreational services	-0.065	0.123	-0.065	0.123	-0.062	0.149	-0.067	0.112	-0.065	0.123	-0.063	0.137
Personal and other services	0.206	0.000	0.203	0.000	0.210	0.000	0.204	0.000	0.201	0.000	0.201	0.000
Business size (Reference category: fewer than 5 employees)												
5–19 employees	0.166	0.000	0.166	0.000	0.164	0.000	0.164	0.000	0.163	0.000	0.161	0.000
20–199 employees	0.276	0.000	0.272	0.000	0.271	0.000	0.270	0.000	0.270	0.000	0.258	0.000
Single decision-maker	0.037	0.043	0.030	0.107	0.037	0.043	0.038	0.038	0.038	0.039	0.033	0.082
Natural logarithm of total sales	0.007	0.235	0.008	0.217	0.009	0.152	0.007	0.281	0.007	0.291	0.008	0.215
Market structure (Reference category: no competitors)												
One or two competitors	0.131	0.001	0.130	0.001	0.133	0.001	0.130	0.001	0.130	0.001	0.131	0.001
Three or more competitors	0.141	0.000	0.140	0.000	0.141	0.000	0.139	0.000	0.140	0.000	0.139	0.000
Type of legal organisation (Reference category: registered company)												
Sole proprietor		-	0.017	0.605	-	-	-	-	-	-	0.017	0.614
Partnership	-	-	-0.031	0.262	-	-	-	-	-	-	-0.026	0.336
Trusts, other unincorporated entity	-	-	-0.013	0.576	-	-	-	-	-	-	-0.012	0.618

Years of operation (Reference category: 20 years or more)												
Less than 5 years	-	-	-	-	0.025	0.363	-	-	-	-	0.021	0.441
5 to less than 10 years	-	-	-	-	-0.022	0.395	-	-	-	-	-0.022	0.384
10 to less than 20 years	-	-	-	-	0.006	0.775	-	-	-	-	0.004	0.867
Business has a web presence	-	-	-	-	-	-	0.018	0.400	-	-	0.016	0.455
Business operated at multiple locations	-	-	-	-	-	-	-	-	0.026	0.290	0.023	0.339
Observed P	0.210		0.210		0.210		0.210		0.210		0.210	
Predicted P	0.174		0.174		0.174		0.174		0.174		0.173	
Sample size	1941		1941		1941		1941		1941		1941	
Pseudo R2	0.127		0.128		0.128		0.127		0.127		0.130	

There are some relatively clear differences by industry, but not all industries are different from manufacturing (the reference category) in a statistically significant manner. A firm in agriculture, forestry and fishing is clearly 14.7% more likely to report skill shortages than is the average firm in manufacturing. Similarly, clearly more likely to report skill shortages are firms in construction (20%), in accommodation, cafes and restaurants (7%) and in personal and other services (20%). The only industry that is clearly less likely to report skill shortages than manufacturing is wholesale trade.[9]

The reference category for the firm-size variables is firms with up to four employees. Firms with five to 19 employees are 16.1% more likely to report skill shortages, while firms with 20 to 199 employees are 25.8% more likely to report skill shortages. So the problem of skill shortages increases with firm size, consistent with our previous descriptive findings and general intuition, even after other relevant factors have been accounted for within the multivariate regression framework. There are several explanations for this finding, including that the increased specialisation present in larger firms increases the need for more specific skills. It should be noted, however, that this result may simply reflect the way the skill shortages question was asked when the data were collected, which only allowed the firm to report if there had been *any skill shortage at all*, irrespective of the number of occurrences, so that we cannot estimate whether there is a difference in the incidence of skill shortages *per employee*. It follows that the positive association estimated here could also appear because of the size of the firm.

We find that the type of legal entity of the firm is not associated with the probability of reporting skill shortages. Similarly, whether a firm operates from multiple locations is not associated with the probability of reporting skill shortages. While the last two results may appear surprising, it is worth noting that the multivariate nature of the analysis suggests that other variables do a better job of explaining the variation in the way skill shortages have been reported in the data. The presence of a single manager/decision-maker/responsible person in the firm increases the chance of reporting skill shortages by 3.3%. This finding may be related to the quality and (or) style of management, including the effect of delegation in handling the problems relating to skill shortages. We find that whether a firm has a web presence is not associated with the probability of reporting skill shortages. This result suggests that firms with an online presence do not increase their visibility to potential recruits enough to significantly reduce their likelihood of facing skill shortages.

The level of sales is not associated with the probability of reporting skill shortages. Again, it must be noted that the regression results suggest that other variables that we would expect to be associated with sales (for example, number of employees) are probably doing a better job of explaining skill shortages. The implication is that it is not the level of sales that matters, but the number of employees. The age of the firm is not associated with the probability of reporting skill shortages.

Market competition (at the product level) increases the probability of reporting skill shortages. The reference category is firms without a competitor in their market. Firms with one or two competitors are 13% more likely to report skill shortages, while firms with three or more competitors are only marginally more likely, at 13.9%. There are many routes through which market competition may eventually influence skill shortages. These include the depressing product-price effect of competition, which in turn can have a depressing (derived) effect on wages. Lower wages can reduce the number of people who are willing to work for a firm, which can be manifested as a skill shortage. Similarly, a more competitive market could also suffer from higher levels of poaching of skilled labour, which can

[9] There is statistically weak evidence that cultural and recreational services firms are 6.3% less likely to report skill shortages than are manufacturing firms (p-value = 0.137).

lead to direct skill shortages as workers leave, and indirect skill shortages, as the employer may be less willing to support training.

The overall conclusion from the different models presented in table 13 is that the estimation results are not sensitive to the model specification used. Industry, firm size, firm leadership and the structure of the product market are each consistently associated with the incidence of skill shortages, while the level of sales, the type of organisation, the age of the firm, the web presence of the firm, and the number of locations are not associated with skill shortages.

We now examine the specific types of skill shortages reported. We use Model 1 from table 13, as it is the most parsimonious model and contains all variables that show a statistically significant association with skill shortages. We deepen the analysis by exploring not only which businesses have reported skill shortages, but also which particular kind of skill shortage they experience. One of our objectives is to investigate whether there are any pronounced differences in the incidence of each specific type of skill shortage. We naturally use the same estimating sample (with 1941 observations) as was used for estimating the overall probability of skill shortages (in table 13).[10]

Table 14 shows results from seven separate probit regression estimations: one is for each cause of skill shortage that Business Longitudinal Database respondents are able to nominate (with multiple causes allowed). In each model, the dependent variable is the occurrence of a different reported cause of skill shortage. The dependent variables are coded 1 if that cause of skill shortage is present and 0 otherwise, which may include the presence of another cause of skill shortage or no skill shortage at all. Note that by also retaining in the estimation sample those firms that experienced no skill shortage of *any type*, we are estimating the probability of a firm experiencing a specific cause of skill shortage as opposed to that firm not experiencing *that* specific cause.[11] This estimation allows us to test whether there are significant qualitative differences in relation to where exactly in the economy the various causes of skill shortages appear.

[10] This is the number of firms in the BLD sample with complete information on all variables shown in table 13.

[11] The alternative estimation of the probability of experiencing a particular type of skill shortage, given that a skill shortage has been experienced, would be too limiting. It would restrict the sample size considerably and complicate the necessary modelling through the introduction of a selection process. The lack of richness of the background information in the BLD precludes us from following this estimation route.

Table 14 Probit estimations of the incidences of different causes of skill shortages

	Specialist knowledge		Geographic location		Wages too high		Training availability		Long-term demand		Recruitment too slow		Other reasons	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Industry (Reference category: manufacturing)														
Agriculture, forestry and fishing	0.048	0.071	0.109	0.000	0.038	0.029	0.045	0.015	0.015	0.198	0.067	0.002	0.051	0.000
Mining	0.055	0.214	0.063	0.036	0.010	0.707	0.020	0.507	0.002	0.898	0.085	0.024		(1)
Construction	0.102	0.009	0.034	0.135	0.009	0.680	0.029	0.260	0.043	0.028	0.065	0.032		(1)
Wholesale trade	-0.031	0.256	-0.013	0.369	-0.029	0.078	-0.028	0.127	-0.013	0.260	0.005	0.818	0.009	0.513
Retail trade	-0.030	0.325	-0.010	0.589	-0.031	0.094	0.002	0.944	-0.018	0.189	0.022	0.407	0.019	0.252
Accommodation, cafes and restaurants	-0.018	0.562	0.044	0.045	0.047	0.040	0.061	0.018	0.016	0.325	0.037	0.157	0.003	0.855
Transport and storage	0.008	0.824	0.045	0.055	0.008	0.736	0.034	0.180	0.023	0.203	0.042	0.141	0.053	0.012
Communication services	0.021	0.601	0.011	0.614	0.030	0.257	0.036	0.219	-0.012	0.457	0.040	0.208	0.006	0.753
Property and business services	-0.019	0.565	0.007	0.740	-0.023	0.278	0.021	0.422	-0.016	0.280	0.007	0.786	-0.004	0.807
Cultural and recreational services	-0.034	0.319	0.014	0.511	-0.035	0.074	-0.006	0.810	-0.017	0.210	-0.007	0.786		*
Personal and other services	0.068	0.065	-0.006	0.755	0.047	0.053	0.035	0.169	-0.007	0.618	0.098	0.002	0.097	0.000
Business size (Reference category: fewer than 5 employees)														
5–19 employees	0.132	0.000	0.052	0.000	0.064	0.000	0.035	0.017	0.018	0.059	0.080	0.000	0.008	0.309
20–199 employees	0.204	0.000	0.071	0.001	0.056	0.009	0.051	0.019	-0.009	0.460	0.118	0.000	0.056	0.000
Single decision-maker	0.031	0.034	-0.007	0.276	0.006	0.481	0.016	0.091	0.008	0.237	0.011	0.268	-0.001	0.851
Natural logarithm of total sales	0.005	0.376	0.002	0.481	-0.002	0.541	0.003	0.393	0.000	0.986	0.001	0.727	-0.001	0.708
Market structure (Reference category: no competitors)														
One or two competitors	0.088	0.008	0.059	0.003	0.060	0.009	0.079	0.002	0.022	0.143	0.038	0.093	0.006	0.653
Three or more competitors	0.087	0.000	0.026	0.008	0.047	0.000	0.044	0.001	0.016	0.061	0.037	0.008	0.016	0.027
Observed P	0.139		0.048		0.061		0.058		0.030		0.068		0.025	
Predicted P	0.113		0.028		0.045		0.046		0.023		0.051		0.015	
Sample size	1941		1941		1941		1941		1941		1941		1652	
Pseudo R2	0.099		0.137		0.085		0.068		0.068		0.086		0.113	

Note: * Insufficient number of observations precluded estimation.

There are several interesting differences between the causes of skill shortages by industry. The first one is what causes are reported by what industries, and the second is how many causes are reported by each industry. To get a better picture of the results in table 14, the reader should at this point recall the content of table 6, which shows the prevalence of skill shortages by industry. The reader is also reminded that all industry results use 'manufacturing' as the reference category, and that the results reflect differences in the reporting of skill shortages after we control for several other factors that may also differ systematically between industries (firm size, leadership, level of sales and product-market competition).[12]

There are several statistically significant differences in the causes reported in table 14. Two sectors, communications services, and property and business services, do not differ from manufacturing in the causes of skill shortages they report. This is interesting, because they both belong to the services part of the economy and both report a varied level of skill shortages: 13% of all manufacturing firms report skill shortages (one of the highest percentages in the economy), against 4% by property and business services (the lowest percentage in the economy by far) and 11% by communication services. Firms in agriculture, accommodation, cafes and restaurants, and personal and other services are significantly more likely to report wages too high as a cause of skill shortages. This is a problematic statement, as one has to wonder why wages are not then increased to attract workers. By contrast, the retail and wholesale trade industries, and cultural and recreation services are less likely to report wages too high as a cause of skill shortages. Two more patterns are evident in table 14: too slow recruitment (agriculture, mining, construction and personal and other services) and geographic location (agriculture, mining, accommodation, cafes and restaurants, and transport and storage) are more prevalent as causes of skill shortages in each of at least four industries.

The patterns exhibited by industry largely accord with intuition. The novel message that they convey is that there are differences by industry over and above the structural differences (for example, firm size) for which we have already controlled via the multivariate regression. Agriculture is shown to suffer more from lack of specialist knowledge, isolated geographic location, prevailing wages being too high, lack of training availability, and recruitment being too slow. For mining, it is geographic location and slow recruitment. Construction reports lack of specialist knowledge, uncertain long-term demand, and slow recruitment. Accommodation, cafes and restaurants firms are most affected by geographic location, high wages, and a lack of training availability. Transport and storage firms report the same causes as in manufacturing, with the exception of problems caused by their geographic location. Cultural and recreation services firms show little difference from manufacturing, with the exception of their lower probability to select too high wages as a cause of skill shortages. Personal and other services firms report higher rates of lack of specialist knowledge, too high wages, and too slow recruitment.

The results in table 14 suggest considerable differences in the reasons why firms experience skill shortages, after we have controlled for their industry. Larger firms are considerably more likely to suffer from skill shortages due to lack of specialist knowledge (13—20% higher) and slow recruitment (8—12% higher) than their smaller counterparts are. (Recall that the sample contains firms with up to

[12] All results refer to the differences between a given industry and manufacturing. For example, agriculture shows a marginal effect of 0.048 in skill shortages caused by the lack of specialist knowledge. This result should be interpreted as: If we randomly pick a firm in agriculture, it is 4.8% more likely to have reported a skill shortage caused by lack of specialist knowledge than is a randomly picked firm in manufacturing. Or, similarly: The average firm in agriculture is 4.8% more likely to have reported a skill shortage caused by lack of specialist knowledge than is the average firm in manufacturing.

200 employees only.) Geographic location and too high wages appear to be more prominent causes of skill shortages among larger firms. It is not clear why larger firms would be more susceptible to skill shortages caused by disadvantageous geographic location. The impact of wages could arise because offering higher wages to new recruits would also require increasing the wages of those already employed, who are doing similar jobs; hence, larger firms would be more likely to be constrained by comparative justice issues. It appears that long-term demand as a cause of skill shortages is not dependent on firm size.

The presence of a single leader in the firm appears to influence only marginally the presence of skill shortages caused by lack of specialist knowledge and training availability, but not in the expected direction. Single leadership is associated with higher rates of skill shortages than when a more developed hierarchical management structure is present. Given that we have controlled for other relevant factors (for example, firm size), we presume that this factor could reflect lower-quality management. The level of sales makes no difference to the cause of skill shortages.

Finally, we find that the effect of market competition is clearly estimated to increase the incidence of skill shortages. This means that monopolistic power is inversely related to skill shortages. There are many routes by which this may happen and they are clearly delineated in the estimation results. Before we look at the results in table 14, it is worth noting the specific way that this term should be interpreted in the present context. Given that the largest firm in the Business Longitudinal Database would employ 200 workers, we are hardly likely to be dealing with firms with market-wide monopoly power. The correct interpretation is to think that we are dealing with a question that defines local monopoly power, which is the only such power that small firms may enjoy. Hence, a firm suggesting that they have no competitors may well be a small firm employing a small number of people, and with few or no competitors in the vicinity. The data confirm this view, as we find that there is more monopoly power reported by the smaller firms than by the larger ones. The larger firms in the sample are more likely to have to compete in a broader market (as one would expect medium-sized firms to have to do) than are the smaller ones, which may enjoy a local monopoly or oligopoly position.

In table 14, we see that too high prevailing market wages are less likely to be a cause of skill shortages for firms with monopoly power than for firms facing competition. Lack of specialist knowledge and training availability are greater problems for firms that face more competition.[13] This will be the case because each of the competing firms is more likely to lose its better-trained workers to competitors through poaching, such that all competing firms are jointly less willing to offer internal training. This is a typical failure in the training market, and these two causes of skill shortages (related to lack of specialist knowledge and training availability) are the ones most strongly influenced by the competitiveness of the product market in which different firms are operating, followed by wages and geographic location.

Complexity in the causes of skill shortages

When employers were asked about the causes of the skill shortages they experienced, they were able to select as many of the six causes identified in the Business Longitudinal Database questionnaire as they saw fit. A majority chose more than one cause, and a sizeable 20% reported three or more causes (see tables 9 and 10 for the relevant frequencies). The causes listed in the questionnaire appear to

[13] Note that in the estimations for both of these skill shortage causes, the effect sizes are larger for firms with one to two competitors than for firms with three or more competitors. One plausible interpretation of these results is that skilled workers can be more easily poached when there are only a few identifiable competitors.

have been chosen well, as only 8% of employers reported causes of skill shortages that were not in the original list of six causes (by ticking a seventh category named 'other'). It is worth noting that multiple causes are relatively evenly distributed, with little bunching, as is indicated by the correlation matrix shown in table 15. The highest correlation coefficient is 0.242, implying a weak positive association.

Table 15 Correlations between the causes of skill shortages

	Specialist knowledge	Geographic location	Wages too high	Training availability	Long-term demand	Recruitment too slow	Other reasons
Specialist knowledge	1.000						
Geographic location	0.020	1.000					
Wages too high	0.001	0.058	1.000				
Training availability	0.047	0.012	0.108	1.000			
Long-term demand	0.028	***0.122***	***0.242***	***0.134***	1.000		
Recruitment too slow	***-0.151***	0.031	***-0.099***	0.074	-0.032	1.000	
Other reasons	***-0.237***	-0.033	-0.023	***-0.102***	-0.048	0.024	1.000

Note: Sample consists of the 407 firms that reported at least one type of skill shortage. Italicised text shows correlation coefficients that are significant at the $p < 0.1$ level.

To examine the presence of multiple causes of skill shortages we regress the number of causes reported by each firm against the main characteristics found earlier in the report to be empirically important in the incidence of skill shortages. These characteristics are: industry, firm size, leadership, sales and market competition. Table 16 presents the results from the estimation of an ordered probit model, with the number of simultaneously reported causes of skill shortages as the dependent variable.[14]

There are considerable differences in the complexity of the causes of skill shortages by industry. Agriculture, construction, and personal and other services are the industries that are most likely to report skill shortages with multiple and more complex causes. Mining, accommodation, cafes and restaurants, transport and storage, community services, and personal and other services are also more likely to report multiple causes of skill shortages. Wholesale trade, retail trade, property and business services, and cultural and recreation services are less likely to report multiple skill shortages.[15] These results reinforce the results presented earlier for the factors associated with each separate cause of a skill shortage. Industries with fewer complex skill shortages (table 16) also have lower incidences of the most prevalent individual causes (table 14). For example, lack of specialist knowledge and wages too high have negative (positive) signs in table 14 for industries that also report negative (positive) signs in the ordered probit estimation results shown in table 16.

[14] The interpretation of the ordered probit model needs to be explained. As we cannot know if a firm that reports two causes of skill shortages at the same time faces a problem that is doubly as complex as those that reported one (or half as complex as those that reported four), we need to use the method of ordered probit, which does not make any assumptions about the intensity of these differences. It simply estimates, making the assumption that 1 is less than 2, which is less than 3, and so on. This is a far less restrictive assumption about the process that generated the data than the usual linear model, which would treat the dependent variable simply as a number where 1 is half of 2 etc. The less restrictive assumptions underlying the ordered probit estimation add to the confidence that we can place on the results (we are less likely to get it wrong) and it also allows us to test whether the different values of the dependent variable are statistically significant from one another.

[15] Some estimates with marginal statistical significance, reflected by P-values around the 0.10 level, are discussed and interpreted here in view of the small sample size involved in the estimation. Reasons and caveats are explained in appendix 3.

With respect to the other model covariates, table 16 reports that multiple causes are more likely to be present in larger firms. This result can be read in two ways, both of which are plausible. Larger firms will have more complex production processes, so that multiple causes would be more likely for them. Larger firms will also have higher turnover in absolute terms, so that different causes would be more likely, simply because of these larger numbers. It is interesting to note a positive association between the complexity of skill shortages and the presence of a single leader in the firm. The association between the level of sales and skill shortages complexity is not significant.

Table 16 Ordered probit estimation of the number of skill shortage causes reported

	Coefficient	P>|z|	Lower bound confidence interval	Upper bound confidence interval
Industry (Reference category: manufacturing)				
Agriculture, forestry and fishing	0.488	0.000	0.271	0.704
Mining	0.181	0.335	-0.188	0.550
Construction	0.490	0.001	0.206	0.773
Wholesale trade	-0.249	0.076	-0.525	0.027
Retail trade	-0.096	0.534	-0.399	0.207
Accommodation, cafes and restaurants	0.207	0.148	-0.073	0.487
Transport and storage	0.217	0.156	-0.083	0.518
Communication services	0.179	0.302	-0.161	0.519
Property and business services	-0.152	0.388	-0.498	0.194
Cultural and recreational services	-0.291	0.107	-0.644	0.062
Personal and other services	0.525	0.000	0.248	0.802
Business size (Reference category: fewer than 5 employees)				
5–19 employees	0.590	0.000	0.413	0.767
20–199 employees	0.784	0.000	0.550	1.019
Single decision-maker	0.113	0.096	-0.020	0.246
Natural logarithm of total sales	0.028	0.208	-0.016	0.072
Market structure (Reference category: no competitors)				
One or two competitors	0.469	0.000	0.222	0.716
Three or more competitors	0.565	0.000	0.368	0.763
Cut 1	2.081	-	1.736	2.425
Cut 2	2.463	-	2.115	2.812
Cut 3	2.908	-	2.554	3.263
Sample size		1941		
Pseudo R2		0.081		

Note: Values of the dependent variable are: 0 = no skill shortage; 1 = one cause of skill shortage; 2 = two causes; 3 = three or more causes.

Finally, table 16 reports that firms operating in a more competitive environment are more likely to encounter multiple skill shortages. Note that the threshold for this result is between the very small firms (0—4 employees) and all others, as the coefficients of the 5—19 and the 20—199 worker categories are not (statistically significantly) different from one another. It is worth recalling that this result appears after we control for different industries and for different firm sizes. It is also worth recalling that smaller firms report operating in less competitive environments than do larger firms, presumably because they enjoy some form of local market power. The results in table 16 could thus be indicative of a number of possibilities. It could be that firms that have to compete for customers with other firms

in the same product market will probably require similar types of skills from their employees. If so, this would increase the likelihood of poaching and would reduce the probability that any single firm will offer internal training. The outcome would then be more skill shortages (indicated by table 14), and more complex skill shortages (indicated by table 16) for firms that encounter greater competition in their product market and hence in their labour market for prospective workers.

Responses to skill shortages

This section builds on the multivariate analysis of the causes of skill shortages in the previous chapter by introducing businesses' responses to each of these causes. The Business Longitudinal Database is a dataset that provides unique information for Australia, in that it does not only report on several distinct causes of skill shortages, but it also reports on several distinct responses for each one of the reported causes. This allows the analysis to link specific causes with specific responses. There is added complexity in the information contained in the database, as each firm is allowed to report multiple causes and multiple responses. Each individual cause of skill shortages may trigger multiple responses, and each individual response may equally be the result of multiple causes.

The obvious scope for analysis provided by a dataset of this nature is limited, for two reasons. First, the questions about skill shortages and responses were only asked in one of the three waves of the survey, so that the contemporaneous nature of the information limits its value. Information on the longer-run persistence of causes and the success of responses in addressing them is not present. The sequential nature of the process, whereby some causes will be countered by one type of response first, and if that fails by another, is not traceable either: the data only reveal for each firm the causes and responses that coexisted at the time of the data collection. In terms of modelling the complex structure of multiple causes that may trigger multiple responses, this is a serious data shortcoming. Second, when analysing the responses to skill shortages, the useable sample size is limited to only those firms that reported some skill shortages, which in the following estimations equates to 407 firms. With these caveats on the scope resulting from the uniqueness of the data and the limitations of its design, the remainder of this chapter investigates the responses that firms make to skill shortages.

Illustrative comparisons

The first question we ask is: what are the most likely responses for each specific cause of skill shortage? Table 17 calculates (separately for each of the causes of skill shortages) the percentage of firms that took each of eight possible responses. This approach tells us which response types are the most frequently observed for each of the respective causes. By comparing these proportions to the *overall* incidence of each response (shown at the bottom of table 17), we develop a sense of which causes are most strongly connected to each of the different responses. This arrangement of the data allows us to see in a simple way what actions firms take (and do not take) when confronted with the different types of skill shortages. The estimates are read within each row of table 17. For instance, the 0.55 in the top left cell indicates that, of the firms that reported a lack of specialised knowledge, 55% used the response of longer hours. To keep these comparisons in some perspective, the right-hand side column of table 17 shows the weighted incidence of each of the different causes. The response categories (columns) have been ordered by decreasing overall prevalence.

Table 17 Relationships between skill shortage causes and responses

Mean response frequency for each cause	Longer hours	Outsource work	Internal training	Reduce output	Raise wages	Short-term contracts	Other response	External training	Percentage with cause
Specialist knowledge	0.55	0.22	0.34	0.25	0.23	0.11	0.08	0.11	60
Geographic location	0.57	0.21	0.56	0.31	0.37	0.18	0.05	0.11	13
Wages too high	0.52	0.50	0.18	0.23	0.21	0.20	0.11	0.09	27
Training availability	0.56	0.30	0.35	0.36	0.31	0.21	0.03	0.18	22
Long-term demand	0.41	0.69	0.15	0.17	0.11	0.15	0.06	0.05	30
Recruitment too slow	0.63	0.14	0.43	0.32	0.27	0.13	0.09	0.14	26
Other reasons	0.84	0.05	0.12	0.13	0.07	0.04	0.48	0.01	8
All with skill shortages	**0.49**	**0.32**	**0.27**	**0.19**	**0.16**	**0.10**	**0.08**	**0.07**	**100**

Notes: Results are weighted using population weights and based on a sample of 407 firms. Response categories are sorted by frequency, from most to least common. Percentages are read within each row. For example, 55% of firms that had 'Specialist knowledge' as a cause of their skill shortage responded with 'Longer hours'.

The simple comparisons between the responses to specific causes of skill shortages and response frequencies to all skill shortages are instructive in several ways. It is clear that increasing the working hours of current employees is easily the most popular response to skill shortages. It was the response made by 49% of firms with skill shortages, by comparison with 32% for the next most common response (outsourcing). The appeal of longer working hours to firms facing a skill shortage is easy to understand. Although longer hours usually entail a higher rate of pay, they entail minimal additional training and adjustment costs and generate minimal additional risks, as the worker is already known to the firm and the job is known to the worker. The cause of skill shortages that is least likely to be associated with the use of longer hours is uncertain long-term demand. This is not surprising, because it is a cause that will either influence inventories, if the risk is perceived to be temporary (for example, seasonal), or overall production levels, if the risk is perceived to be of a more permanent or unknown nature.

Moving right through the columns of table 17, we see that subcontracting or outsourcing work is the second most popular response to skill shortages, used by 32% of firms that reported a skill shortage. A high proportion of all firms (69%) that are unsure of the long-term demand for their product choose to respond by subcontracting when demand rises. This begs the question of why the subcontracting firm should find it profitable to operate in that market when the parent firm itself does not, unless there is a reason why the subcontractor may enjoy a lower cost structure. It may be that subcontractors can spread the demand for specialist skills across numerous industries or markets and thereby reduce their risk (a key characteristic of labour-hire firms).

Firms that find the wages and salary costs too high for the business are also very likely to respond by outsourcing some of their work (50%). A similar puzzle arises: what is the competitive advantage of the firm that undertakes the outsourced work? Where the reason for the skill shortage is that the firm cannot afford to pay market wage rates, the suggestion from table 17 is that the firm that ends up doing the work has managed to find a way to be more efficient. It could also be that the firm that does the outsourcing has a high-quality range of products produced in house and outsources its lower-quality production, possibly in order to avoid mixing the high standard of in-house production with the less demanding production of the lower-price or lower-quality range.

On-the-job training, or internal training, provides another popular response, which was used by 27% of all firms that reported a skill shortage. Fifty-six per cent of firms that reported skill shortages due to their geographic location used internal training, as did 43% of firms with problems with slow recruitment and 35% of firms that reported a lack of training availability as a cause of their skill shortage.[16] Finally, 34% of the firms that reported a lack of specialist knowledge chose to address this deficiency by building their skill capacity internally.

A most serious response to skill shortages is when a firm decides to reduce outputs or cease production altogether. In overall terms, an alarming 19% of firms that experienced any skill shortage reported having reduced outputs or production. The main causes of skill shortages associated with this response were slow recruitment (32%), the unfavourable geographic location of the firm (31%) and a lack of training availability (36%). Indeed, the unfavourable geographic location and the lack of training availability may be two faces of the same problem, which could be corrected through training provided in the relevant location. This might also address the problem of unsatisfactory recruitment

[16] Although the dataset is ambiguous as to whether the 'lack of availability of adequate training' refers to internal or external training provision, for firms that have responded to skill shortages by increasing their use of internal training, a plausible inference is that they have done so due to perceived inadequacies in the external training system.

speed, which would be influenced by the lack of appropriate candidates in the immediate vicinity of the firm. The result that around one in five firms with a skill shortage in 2004—05 elected to reduce output has potentially serious ramifications for national productivity. The policy implication seems to be the need for improved training provision at a possibly narrower local level than is currently available, including in areas that are difficult to serve due to their remoteness.

Improving wages, salaries and working conditions is one of the chosen responses for 16% of all firms that report skill shortages. It is mainly used to address the shortages caused by the geographic location of the firm (37% of firms with this cause) and by slow recruitment (27%), presumably as a way of enticing new workers to the area and to the specific vacancy. Lack of training availability also appears to be handled by firms improving their job offers, presumably in these cases as a way of retaining workers who are already trained (and hence attractive to competitors), rather than as a way of finding new recruits.

Finally, another three types of potential response are recorded in the Business Longitudinal Database: the use of short-term contracts, more external training, and other responses. The number of firms that reported these three categories of responses was too small to make them useable in a statistical manner. We note only that these were not the preferred responses to skill shortages. The reason for not employing short-term contract workers could be because there were too few workers ready to accept such contracts in a period of strong labour demand. Noting that the data refer to the year 2004—05 when the economy was operating at near-full capacity, this does not seem implausible. Similarly, the use of external training may not have been as available as the firms experiencing skill shortages would have wished it to be. Indeed, the data reveal a seeming contradiction, in that 18% of firms reporting a lack of training availability as a cause of their skill shortage also reported that they had tried to overcome it through more use of external training. This result can only be consistent if responding firms tried to overcome the limited availability of external training and failed to do so, which makes them report both cause and response at the same time.

Multivariate analysis

We now turn to the first part of the multivariate regression estimations relating the causes of skill shortages to their responses. We begin by estimating the probability of encountering each specific response, independently of other responses, given the simultaneous presence of all causes of skill shortage for each individual firm. We control in the following estimations for firm size, product-market competition and industry. Given the small sample size, we have compressed the industry variables into three sectors: primary, secondary and tertiary (with the primary sector as the reference category).[17]

Table 18 shows the results from the eight independent probit estimations, where the dependent variable is whether or not a firm responded to its skill shortage in the manner indicated; the independent variables are the specific causes of skill shortages and the control variables mentioned above. Our examination of the estimation results focuses on the associations that are statistically significant at the 10% level or better (that is, with an estimated P>|z| statistic that is lower than 0.10). The sample size used for this regression is small, so we can expect low statistical significance in the estimates. See appendix 3 for further discussion of this issue.

[17] Primary sector is agriculture, forestry and fishing and mining; secondary sector is manufacturing and construction; and tertiary sector is all remaining industries covered by the BLD. We remind readers that we have only 407 firms that reported a skill shortage and that this is our full sample for the responses estimations. Firms that did not face a skill shortage were naturally not asked about their responses.

Table 18 Probit estimations of the incidences of different responses to skill shortages (1)

	Longer hours		Outsource work		Internal training		Reduce output		Raise wages		Short-term contracts		Other response		External training	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Causes of skill shortage																
Specialist knowledge	0.034	0.551	0.134	0.004	0.220	0.000	0.017	0.725	0.096	0.043	0.034	0.325	0.014	0.573	0.021	0.394
Geographic location	0.082	0.202	0.009	0.864	0.096	0.137	0.062	0.263	0.082	0.156	-0.002	0.959	0.035	0.282	0.060	0.075
Wages too high	0.073	0.204	0.127	0.015	-0.101	0.080	0.060	0.229	0.113	0.029	0.020	0.604	-0.006	0.811	0.042	0.166
Training availability	0.002	0.970	-0.019	0.709	0.097	0.093	0.095	0.063	0.060	0.241	0.065	0.100	-0.010	0.717	0.002	0.937
Long-term demand	0.188	0.014	0.187	0.009	-0.042	0.584	0.195	0.005	0.036	0.592	0.060	0.251	-0.017	0.602	-0.001	0.965
Recruitment too slow	0.119	0.030	0.079	0.106	0.072	0.198	0.119	0.017	0.133	0.007	0.081	0.025	-0.007	0.778	0.018	0.488
Other reasons	0.094	0.294	0.000	0.998	-0.074	0.363	0.180	0.022	0.056	0.501	-0.027	0.647	0.188	0.000	-0.034	0.371
Business size (Reference category: fewer than 5 employees)																
5–19 employees	0.125	0.060	-0.044	0.450	0.170	0.014	-0.102	0.058	0.180	0.004	0.032	0.467	-0.054	0.064	-0.019	0.560
20–199 employees	0.064	0.356	0.061	0.311	0.255	0.000	-0.084	0.149	0.188	0.005	0.024	0.608	-0.017	0.565	0.051	0.158
Market structure (Reference category: no competitors)																
One or two competitors	-0.020	0.851	0.182	0.082	0.075	0.514	-0.024	0.793	0.009	0.920	0.001	0.989	-0.072	0.059	0.018	0.768
Three or more competitors	0.049	0.581	0.048	0.537	0.100	0.287	-0.011	0.885	0.036	0.643	-0.012	0.827	-0.015	0.684	-0.006	0.906
Sector (Reference category: primary sector)																
Secondary sector	0.100	0.183	0.005	0.941	0.005	0.953	-0.016	0.806	0.020	0.770	-0.076	0.074	-0.035	0.271	0.066	0.129
Tertiary sector	-0.021	0.755	-0.062	0.265	0.085	0.198	-0.061	0.273	0.015	0.801	-0.108	0.010	-0.037	0.223	0.099	0.004
Observed P	0.553		0.265		0.400		0.258		0.268		0.138		0.086		0.086	
Predicted P	0.556		0.250		0.384		0.243		0.252		0.123		0.064		0.069	
Sample size	407		407		407		407		407		407		407		407	
Pseudo R2	0.047		0.072		0.093		0.081		0.070		0.071		0.127		0.078	

Recall from table 17 that resorting to longer working hours is the most frequent response of firms facing skill shortages. When firms have long-term demand fluctuations and when recruitment is too slow, they call on their current workers to help out through overtime. Outsourcing work is used to obtain specialist knowledge, to obtain cheaper labour, to smooth product-demand fluctuations and where recruitment is too slow.[18] Internal training is used when specialist knowledge is needed and not available (hence the skill shortage). We note that when high wages are the cause of a skill shortage, the firm is less likely to respond by offering internal training. In a high-wage market, the firm will want workers to pay for their training, as they are afraid that trainees will otherwise be poached and leave the firm with no return from its training outlay. The estimations also indicate that, when firms face a lack of availability of adequate training, they respond by providing internal and on-the-job training. Firms appear to be most likely to reduce output when they are faced with skill shortages caused by a lack of training availability, by long-term demand uncertainty, by slow recruitment, and by 'other' (unspecified) reasons. The fact that 'other reasons' as a cause category is statistically significant only for the reduced-output response suggests that the Business Longitudinal Database questionnaire has not listed all causes of skill shortages that lead to reduced output (but not causes that lead to other responses), thus forcing the firms whose experience does not fit the listed responses to select the indeterminate 'other reasons'.[19]

Raising wages and improving conditions are other popular responses that seem to be triggered by a requirement for specialist knowledge. Interestingly, skill shortages caused by high market wages are associated with an *increased* probability of raising wages or improving conditions. The implication here is that firms currently paying less than the prevailing market wage are forced into paying that wage in order to find or retain workers. Slow recruitment processes are also countered by improving wages and (or) employment conditions. Short-term contracts appear more likely to be used when firms face a lack of availability of adequate training and when recruitment is too slow. In the latter case, firms may hire on short-term arrangements until a slow recruitment process resolves with the preferred long-term employee in place.

In general, after controlling for other firm characteristics, the industry sector does not appear to be an important determinant of firms' responses to skill shortages. The main exception relates to the use of short-term contracts, for which the industry sector is significant. Short-term contracts are 8% less likely to be used by firms in the secondary sector and 11% less likely to be used by those in the tertiary sector, when compared with firms in the primary sector. The difference perhaps reflects the seasonality of production (and hence of skill shortages) in the agriculture industry.

We do not discuss in further detail the results for the two remaining response categories — 'other' and more use of external training — because the sample numbers are simply too small to generate statistically trustworthy estimates. Both responses have very low observed frequencies. (Both were selected by 35 firms.)

[18] Some estimates with marginal statistical significance, reflected by P-values around the 0.10 level, are discussed and interpreted here in view of the small sample size involved in the estimation. Reasons and caveats are explained in appendix 3.

[19] We could view the statistical significance of the 'other reasons' variable as a test of the completeness of the list of causes against each of the stated responses to skill shortages. While reduced output has not defined its possible causes well, outsourcing of work has done so extremely well (with an estimated p-value of 0.998).

Complexity in the causes of and responses to skill shortages

The next questions we ask relate to the interplay between the complexity of causes of skill shortages and the complexity of responses to skill shortages. For many firms, there are complex and multiple causes of skill shortages, which lead to complex and multifaceted responses. It would be a very complicated exercise to model these interactions explicitly, and the limitations of the current data weigh further against such an approach. We therefore analyse the issue of skill shortage complexity in a piecemeal way, through a set of regressions each focusing on a different aspect of complexity.

We first examine whether the complexity or 'depth' of skill shortages, as measured by the presence of multiple causes in a single firm, plays any role in their choice of particular responses. We address this question using multivariate analysis with a modification of the response estimations presented in table 18. The modification is to replace the *individual* causes of skill shortages on the right-hand side of the regression equation with two indicator variables that reflect the complexity of causes of skill shortages. The first variable captures firms for which two simultaneous causes of skill shortages were reported. The second variable captures firms that reported three or more simultaneous causes of skill shortages. The reference category is firms that reported only one cause of skill shortages. The logic of this approach follows that used previously in the estimation of complex causes (table 16).

Table 19 shows clearly that most responses are sensitive to the presence of multiple causes of skill shortages, but that response sensitivity increases on some occasions when experiencing between one or two causes of skill shortages and on other occasions when experiencing between one and three causes of skill shortages. Longer working hours, which is the most common response to begin with, is estimated to be 14% more likely to be used when a second cause of skill shortages is present (than when only one is present), and is a further 6.5% more likely when three or more causes are present (bringing the total to 20.5%). A similar picture is apparent for raising wages and (or) improving working conditions as a response to skill shortages. This analysis suggests that longer hours and higher wages and improved conditions can be likened to a 'first line of defence' for firms experiencing skill shortages. In the same vein, we find that the likelihood of using internal training increases by 6.4% in the presence of two skill shortage causes and by a further 4.1% in the presence of three (or more) causes.[20] The common characteristic of these responses is that they all involve using existing employees, which reduces the uncertainty and the costs associated with hiring new workers or outsourcing. In all these responses, the firm retains managerial control of the situation and, to the degree that increased production also results in some extra profit for the firm, part of the extra profit is distributed to employees through increased pay, conditions and, in some cases, training.

[20] Some estimates with marginal statistical significance, reflected by P-values around the 0.10 level, are discussed and interpreted here in view of the small sample size involved in the estimation. Reasons and caveats are explained in appendix 3.

Table 19 Probit estimations of the incidences of different responses to skill shortages (2)

	Longer hours		Outsource work		Internal training		Reduce output		Raise wages		Short-term contracts		Other response		External training	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Number of skill shortage causes (Reference category: one cause)																
Two causes	0.140	0.016	0.108	0.049	0.064	0.284	0.046	0.391	0.183	0.001	0.062	0.158	-0.011	0.707	0.010	0.747
Three or more causes	0.205	0.001	0.229	0.000	0.105	0.094	0.238	0.000	0.213	0.000	0.141	0.003	0.022	0.473	0.036	0.280
Business size (Reference category: fewer than 5 employees)																
5–19 employees	0.125	0.052	-0.044	0.442	0.182	0.007	-0.123	0.019	0.200	0.001	0.030	0.502	-0.062	0.038	-0.009	0.800
20–199 employees	0.043	0.518	0.035	0.547	0.283	0.000	-0.104	0.059	0.195	0.003	0.017	0.707	-0.007	0.807	0.056	0.126
Market structure (Reference category: no competitors)																
One or two competitors	-0.024	0.824	0.164	0.102	0.090	0.417	-0.029	0.747	0.027	0.774	-0.001	0.987	-0.080	0.047	0.036	0.580
Three or more competitors	0.049	0.584	0.046	0.549	0.091	0.313	-0.017	0.819	0.041	0.588	-0.015	0.779	-0.019	0.649	0.004	0.939
Sector (Reference category: primary sector)																
Secondary sector	0.083	0.243	0.034	0.588	0.010	0.888	-0.040	0.505	-0.007	0.907	-0.070	0.082	-0.055	0.069	0.044	0.325
Tertiary sector	-0.034	0.586	-0.046	0.390	0.073	0.245	-0.070	0.189	0.008	0.891	-0.095	0.017	-0.048	0.105	0.083	0.025
Observed P	0.553		0.265		0.400		0.258		0.268		0.138		0.086		0.086	
Predicted P	0.555		0.255		0.394		0.246		0.252		0.124		0.070		0.075	
Sample size	407		407		407		407		407		407		407		407	
Pseudo R2	0.038		0.049		0.046		0.060		0.061		0.059		0.071		0.051	

Consider now the responses where the firm sacrifices some managerial control or retains none at all and assumes additional risks. Table 19 suggests that an additional cause of skill shortages increases the probability of outsourcing by 10.8%, but does not increase significantly the probability of short-term hires, reduced output, or using external training. The likelihood of outsourcing more than doubles when three or more causes of skill shortages are encountered (rising from 10.8 to 22.9%), as does the likelihood of short-term contracts (rising from 6.2 to 14.1%). The likelihood of external training being used remains very small and is not statistically significant. The likelihood of reducing output, which we regard as the most serious response, becomes significant only for firms reporting three or more causes of skill shortages. The implication is that firms take this response reluctantly, and only when confronted with complex, intractable skill shortages. There is, however, a very sharp increase in the probability of reducing output for firms that do face complex skill shortages. (It has the largest marginal effect in table 19, at 23.8%.)

The intuition of the results in table 19 is as clear as it is important. Complexity of the causes of skill shortages matters. Firms will initially respond by looking at their internal resources, by utilising and motivating more intensely their existing employees. Internal training is among the first lines of defence, but using those workers who are already trained more intensively and motivating them through various means such as improved conditions are also used as primary responses. When skill shortages become more complex, firms use their own workers still more and they pay them higher wages, but results suggest that these responses have their limits (for example, moving from two causes of skill shortages to three or more increases the probability that better wages and conditions are used by a mere 3% of firms). Firms then begin to use other strategies, which often entail higher costs and uncertainty, such as outsourcing and short-term contracts. External training is not a response option that many firms exercise, presumably because they prefer to train their own workers and also expect new hires to arrive fully trained. Finally, when all else fails, firms resort to output reductions. This appears to happen only when firms experience highly complex skill shortages with a minimum of three reported causes. It is clear that firms will try out many other responses before they resort to reducing output.

Another way to view complexity is by examining the probability that each individual cause of skill shortages may trigger multiple responses by the firm. We define a new variable, which takes the value 1 if only one response was reported, 2 if two responses were reported and 3 if three or more responses were reported. The specification labelled Model 1 in table 20 uses the full list of causes of skill shortages as explanatory variables (as in table 18); a second specification labelled Model 2 uses the reduced set of two variables (as in table 19) to reflect the complexity of causes of skill shortages. Model 2 in essence estimates how the complexity of causes is associated with the complexity of responses.

The results for Model 1 in table 20 suggest that complex responses are most likely when firms are faced with skill shortages caused by long-term product-demand uncertainty. This is not surprising, as this type of problem is amenable to planning and implementing simultaneously short- and medium-term responses. Closer examination of table 18 shows that firms with this problem are likely to use longer hours, outsourced work and reduced output in their portfolio of responses. The next most likely causes for multiple responses are the lack of specialist knowledge and slow recruitment. Again, these results are consistent with the earlier results in table 18. At the other extreme, the least likely cause of skill shortages to trigger multiple responses is the lack of training availability, which table 18 shows to elicit (weakly) two responses: internal training and the use of short-term contracts.

Similarly, being constrained by skill shortages caused by high market wages and (to a lesser extent) by geographic location does not appear to trigger multiple responses from firms.[21]

Table 20 Ordered probit estimations of the complexity of skill shortage causes and responses

Number of responses to skill shortage	Model 1		Model 2	
	Coefficient	P>|z|	Coefficient	P>|z|
Causes of skill shortage				
Specialist knowledge	0.57	0.000	-	-
Geographic location	0.44	0.003	-	-
Wages too high	0.31	0.018	-	-
Training availability	0.20	0.131	-	-
Long-term demand	0.64	0.000	-	-
Recruitment too slow	0.53	0.000	-	-
Other reasons	0.55	0.006	-	-
Number of skill shortage causes (Reference category: one cause)				
Two causes	-	-	0.68	0.000
Three or more causes	-	-	1.14	0.000
Business size (Reference category: fewer than 5 employees)				
5–19 employees	0.46	0.003	0.49	0.002
20–199 employees	0.73	0.000	0.72	0.000
Market structure (Reference category: no competitors)				
One or two competitors	0.13	0.597	0.14	0.569
Three or more competitors	0.17	0.405	0.18	0.401
Sector (Reference category: primary sector)				
Secondary sector	-0.18	0.294	-0.23	0.162
Tertiary sector	-0.31	0.045	-0.33	0.022
Cut 1	1.04 (0.26)		0.62 (0.24)	
Cut 2	2.01 (0.27)		1.59 (0.25)	
Sample size	407		407	
Pseudo R2	0.1035		0.0980	

Note: Estimating sample is firms with skill shortages. Dependent variable is complexity of responses; it takes the values of: 1 = one response; 2 = two responses; 3 = three or more responses. Standard errors for cut-off point are shown in brackets.

Model 2 in table 20 summarises the relationship between complexity of causes and responses. The more complex causes are associated with more complex responses, even after we have controlled for differences due to firm size (which appears to be statistically significant), product competition (which does not appear to be significant) and sector (which appears to be significant).

[21] Note that the cut-off points in both Model 1 and Model 2 of table 20 are very precisely estimated, that is, they are statistically significantly different from one another. This means that the way we have divided the dependent variable is borne out by the data; in other words, the data suggest that there are three distinctly ordered categories of complexity, which supports our modelling strategy and choice of model specification.

Consequences of skill shortages

The final section of our analysis considers the consequences or outcomes of skill shortages. The data allow us to ask several questions about the possible consequences of skill shortages. We begin with a consequence that is probably both the most severe and the least likely: whether skill shortages are in any way associated with the probability of firm survival over time. Since we are working with data for small and medium-sized firms, this is not such a far-fetched possibility for examination. Firm survival and growth are crucial issues for smaller firms. These firms represent a great deal of promise and vulnerability at the same time. The smaller the firm, the more likely it is to grow rapidly, but it is also more likely that such a firm shrinks rapidly, with the extreme outcome being a complete cessation of business.

A second consequence of skill shortages we examine is their persistence. Are skill shortages quickly resolved, or are they longer-lived phenomena? To what extent does their persistence depend on the number and (or) the type of indicated causes for the initial shortage? For firms that remained 'live' for the three waves of data currently available in the Business Longitudinal Database, we investigate the strength of the association between having a skill shortage (as reported in the first wave) and having a continuing lack of skilled persons within the business in the subsequent two years.

A third set of outcomes relating to skill shortages examined in this chapter relates to their impact on firm growth and performance. The Business Longitudinal Database makes available a number of performance measures derived from the records of the Australian Taxation Office. We regard these as 'objective' measures of performance, in the sense that they are documented, verifiable, and required by law for administrative purposes (with penalties for non-compliance). Our interest is in whether (conditional on their survival) firms that reported skill shortages in the first wave of the Business Longitudinal Database are systematically different in their performance from firms that did not. The three indicators of performance examined in this section are the change in sales over time (indicating firm growth); the level of capital purchases (representing investment); and, for firms with employees, the change in their total labour costs (indicating the extent of upward pressure on wages).

Skill shortages and firm survival

The question we ask here is whether those firms that reported a skill shortage in 2004—05 are more likely to have gone out of business one year or two years later. To answer this question, we estimate the probability that a firm which was operating normally during 2004—05 ceased operations in the following year (by 30 June 2006) or the next year (by 30 June 2007).[22] The estimation should not be interpreted as an attempt to establish and test a causal relationship between firm survival and skill shortages (that is, whether skill shortages are the cause of firm closures), as the data would not support such a demand. We are simply establishing a correlation between firm survival and reported skill shortages, one which also controls for some factors that we know are important in relation to the incidence of skill shortages. To this purpose, table 21 begins with a simple association between skill shortages and firm survival (no other variables are included in the regression) and progresses to include in the estimation other factors that may influence the likelihood of survival, namely, the size of the firm, the intensity of competition in the product market and the industry.

[22] For this purpose we define business 'deaths' as firms that had ceased trading under their original ABN by either of these evaluation dates. Firms that were dormant (identified as 'nils' in the BLD) are treated as surviving firms, not as deaths.

Table 21 Probit estimations of the probability of business death (1)

	Ceased operations by 30 June 2006						Ceased operations by 30 June 2007					
	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Skill shortage	-0.010	0.431	0.000	0.975	0.004	0.784	-0.046	0.010	-0.027	0.148	-0.025	0.197
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	-0.020	0.085	-0.023	0.044	-	-	-0.039	0.017	-0.043	0.007
20–199 employees	-	-	-0.043	0.002	-0.046	0.000	-	-	-0.070	0.000	-0.077	0.000
Market structure (Reference category: no competitors)												
One or two competitors	-	-	-0.002	0.906	-0.003	0.859	-	-	-0.026	0.270	-0.028	0.242
Three or more competitors	-	-	0.008	0.525	0.007	0.585	-	-	-0.002	0.924	-0.006	0.754
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	-0.020	0.215	-	-	-	-	-0.043	0.050
Mining	-	-	-	-	-0.019	0.463	-	-	-	-	-0.072	0.033
Construction	-	-	-	-	-0.027	0.241	-	-	-	-	-0.026	0.435
Wholesale trade	-	-	-	-	-0.027	0.128	-	-	-	-	-0.050	0.047
Retail trade	-	-	-	-	0.012	0.607	-	-	-	-	0.029	0.364
Accommodation, cafes and restaurants	-	-	-	-	0.013	0.573	-	-	-	-	-0.009	0.772
Transport and storage	-	-	-	-	0.002	0.920	-	-	-	-	0.012	0.726
Communication services	-	-	-	-	-0.023	0.321	-	-	-	-	-0.030	0.376
Property and business services	-	-	-	-	0.020	0.425	-	-	-	-	0.030	0.380
Cultural and recreational services	-	-	-	-	-0.008	0.724	-	-	-	-	-0.037	0.252
Personal and other services	-	-	-	-	-0.012	0.588	-	-	-	-	-0.010	0.747
Observed P	0.060		0.060		0.060		0.120		0.120		0.120	
Predicted P	0.060		0.057		0.055		0.119		0.116		0.112	
Sample size	1941		1941		1941		1941		1941		1941	
Pseudo R2	0.001		0.014		0.026		0.005		0.018		0.032	

Model 1 in table 21 starts with the simplest specification, containing only skill shortages as an explanatory variable; Model 2 adds firm size and competition; and Model 3 adds industry. We repeat these same model specifications for two time periods. The results labelled Models 1A—3A estimate the probability of firm death by 30 June 2006, while the results labelled Models 1B—3B estimate this probability with respect to 30 June 2007.

The results from Models 1A—3A suggest that the presence of skill shortages in 2004—05 was not significantly associated with business death by 30 June 2006, as none of the coefficients on the skill shortages variable are statistically significant. Simply put, our estimations do not trace any short-run association between skill shortages and firm survival. The results for Models 1B—3B suggest that firms which reported skill shortages in 2004—05 were *less* likely to be out of business by 30 June 2007 than were other similar firms without skill shortages. The statistical significance of the coefficient on the skill shortages variable is reduced substantially when firm size and market competition are introduced into the model, however, which implies that the association between skill shortages and being out of business is an indirect association, possibly working its way through other factors that are present in the estimation (most likely firm size and industry), or other factors that are omitted from the estimation, but are themselves associated with firm size and industry.

The result that firms which report skill shortages are more likely to have survived two years later needs careful interpretation. The result clearly rejects the broad hypothesis that skill shortages may be directly forcing firms to close down. We find no evidence of this outcome; indeed, our results suggest that the opposite is true. However, it would not make sense to suggest that there may be a causal process at work, whereby the presence of skill shortages would directly make a firm stronger and therefore more likely to stay in business. There is enough evidence already in the literature, and we have presented new evidence earlier in this report, to suggest that skill shortages are a problem for firms. As we have shown, firms respond in ways that can be either expensive (for example, raising wages), or risky (for example, outsourcing), or both (for example, hiring new people). The most likely interpretation is that firms that report skill shortages are firms that face a healthy and possibly increasing demand for their product and cannot satisfy it without expansion, or without the implementation of an improved production process that needs a more skilled workforce. Simply put, we believe that the most likely interpretation of the estimates in table 21 is that skill shortages are the outcome of healthy demand faced by successful businesses.

Before leaving this proposition (to which we will return later with additional evidence), we present, in table 22, results complementary to table 21. The presentation of the results is nearly identical, except that the single variable indicating the presence or absence of a skill shortage in 2004—05 has been replaced by three variables representing the complexity of skill shortages (as given by the number of different causes reported).

Table 22 Probit estimations of the probability of business death (2)

	Ceased operations by 30 June 2006						Ceased operations by 30 June 2007					
	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Number of skill shortage causes (Reference category: no skill shortage)												
One cause	-0.019	0.316	-0.010	0.619	-0.007	0.705	-0.055	0.033	-0.039	0.151	-0.039	0.141
Two causes	-0.015	0.487	-0.004	0.863	-0.002	0.931	-0.049	0.083	-0.032	0.295	-0.031	0.305
Three or more causes	0.007	0.746	0.019	0.437	0.024	0.324	-0.024	0.426	-0.005	0.877	0.003	0.919
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	-0.021	0.078	-0.023	0.038	-	-	-0.039	0.016	-0.044	0.005
20–199 employees	-	-	-0.042	0.002	-0.046	0.001	-	-	-0.070	0.000	-0.077	0.000
Market structure (Reference category: no competitors)												
One or two	-	-	-0.002	0.895	-0.004	0.833	-	-	-0.027	0.261	-0.029	0.224
Three or more	-	-	0.008	0.509	0.007	0.578	-	-	-0.002	0.932	-0.006	0.751
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	-0.021	0.189	-	-	-	-	-0.045	0.041
Mining	-	-	-	-	-0.019	0.442	-	-	-	-	-0.073	0.029
Construction	-	-	-	-	-0.026	0.263	-	-	-	-	-0.025	0.451
Wholesale trade	-	-	-	-	-0.028	0.124	-	-	-	-	-0.050	0.045
Retail trade	-	-	-	-	0.012	0.590	-	-	-	-	0.030	0.350
Accommodation, cafes and restaurants	-	-	-	-	0.014	0.570	-	-	-	-	-0.009	0.771
Transport and storage	-	-	-	-	0.001	0.956	-	-	-	-	0.010	0.764
Communication services	-	-	-	-	-0.024	0.315	-	-	-	-	-0.030	0.372
Property and business services	-	-	-	-	0.020	0.431	-	-	-	-	0.029	0.394
Cultural and recreational services	-	-	-	-	-0.008	0.728	-	-	-	-	-0.037	0.252
Personal and other services	-	-	-	-	-0.010	0.636	-	-	-	-	-0.009	0.790
Observed P	0.060		0.060		0.060		0.120		0.120		0.120	
Predicted P	0.059		0.057		0.055		0.119		0.115		0.112	
Sample size	1941		1941		1941		1941		1941		1941	
Pseudo R2	0.002		0.015		0.027		0.006		0.019		0.032	

The estimates in table 22 are on the verge of statistical significance, but their signs (and the lack of statistical significance, where it occurs) are noteworthy. It is clear that the positive association between reported skill shortages and a higher probability of firm survival is stronger for firms that reported fewer causes of (that is, less complex) skill shortages. For both sets of results, the variable for single-cause skill shortages has the strongest (negative) association with the probability of business death, while the variable representing highly complex skill shortages either has the opposite sign or is statistically much weaker in its effects. It can be inferred that simple, single-cause skill shortages are driving the association between skill shortage complexity and the probability of firm survival.

It should be emphasised, however, that the results in table 22 are statistically very weak. One possible reason for this weakness is that the incidence of firms going out of business in the data is about 6% and the incidence of firms reporting a skill shortage is about 20%. Hence, there will be few cases to support the estimation and, indeed, it would have been surprising if there had been a strong statistical result. Nevertheless, an association is clearly indicated by the sign and magnitude of the cause variables' coefficients, so with the caveat of low statistical significance in mind we offer a speculative interpretation of this finding. The firms with the simplest causes are those that respond (as shown in tables 18 and 19) by building their businesses through better wages and conditions, training and, where necessary, outsourcing. This is the type of business that expects to grow and can afford the more 'expensive' responses, presumably through increasing either their sales or profitability, or both. We also see that these responses are those that are implemented more readily than 'other' responses. (Recall the argument about improving wages and conditions, and the evidence in table 19 for skill shortages with multiple causes.) We test some of these hypotheses later in this chapter.

Persistence of skill shortages over time

Another important question about skill shortages is how persistent they are. Do firms that report skill shortages manage to overcome them, or are they a continuing problem that they must endure? To address this issue, we utilise a question that was asked to Business Longitudinal Database respondents in the second and third waves of data collection (that is, in 2005—06 and 2006—07); namely, whether performance was hampered by a 'lack of skilled persons within [this] business'. In table 23 we estimate the association of this variable with the presence of a reported skills shortage one and two periods earlier. The presentation of the results is very similar to that in table 21: Models 1A—3A estimate the probability that businesses reported a lack of skilled persons in 2005—06, and Models 1B—3B repeat this analysis in relation to 2006—07. We repeat the modelling strategy of adding explanatory variables in sets to show more accurately where the associations are.

Table 23 Probit estimations of the probability of skill shortage persistence (1)

	Lack of skilled persons within business during 2005–06						Lack of skilled persons within business during 2006–07					
	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Skill shortage	0.295	0.000	0.243	0.000	0.243	0.000	0.261	0.000	0.203	0.000	0.202	0.000
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	0.064	0.004	0.060	0.007	-	-	0.106	0.000	0.100	0.000
20–199 employees	-	-	0.117	0.000	0.113	0.000	-	-	0.143	0.000	0.134	0.000
Market structure (Reference category: no competitors)												
One or two competitors	-	-	0.080	0.028	0.080	0.029	-	-	0.036	0.323	0.027	0.463
Three or more competitors	-	-	0.074	0.003	0.075	0.002	-	-	0.076	0.003	0.071	0.006
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	-0.022	0.420	-	-	-	-	-0.051	0.067
Mining	-	-	-	-	-0.064	0.162	-	-	-	-	-0.008	0.880
Construction	-	-	-	-	-0.035	0.341	-	-	-	-	0.031	0.479
Wholesale trade	-	-	-	-	-0.048	0.112	-	-	-	-	-0.028	0.400
Retail trade	-	-	-	-	-0.043	0.217	-	-	-	-	-0.070	0.052
Accommodation, cafes and restaurants	-	-	-	-	-0.041	0.255	-	-	-	-	-0.051	0.175
Transport and storage	-	-	-	-	-0.015	0.706	-	-	-	-	0.010	0.810
Communication services	-	-	-	-	-0.057	0.159	-	-	-	-	-0.048	0.233
Property and business services	-	-	-	-	-0.040	0.319	-	-	-	-	0.035	0.451
Cultural and recreational services	-	-	-	-	-0.002	0.963	-	-	-	-	0.009	0.824
Personal and other services	-	-	-	-	-0.012	0.753	-	-	-	-	0.052	0.220
Observed P	0.175		0.175		0.175		0.174		0.174		0.174	
Predicted P	0.156		0.149		0.147		0.159		0.148		0.145	
Sample size	1740		1740		1740		1601		1601		1601	
Pseudo R2	0.096		0.120		0.124		0.077		0.112		0.125	

The results in table 23 show clearly that skill shortages are mildly persistent. A firm that reported a skill shortage in 2004—05 is 24.3% more likely (Models 2A and 3A) to report a lack of skilled persons in 2005—06 than a comparable firm.[23] This percentage is only reduced to 20.2% after a further year (Model 3B). The implication of this result is that firms have to learn to live with skill shortages, which is an important result, especially in the knowledge that many of the causes and responses can be indicative of reduced productivity. The immediate question that arises is what happens to more or less complex skill shortages. To answer this question, we replace the single-skill shortages variable with three variables representing their complexity and depth (as earlier). These results are displayed in table 24.

Focusing on the results for Model 3 (the most detailed specification) in table 24, we estimate that by comparison with a firm with no skill shortage in 2004—05, a firm with a single-cause skill shortage was 21.2% more likely to have reported a lack of skilled persons in 2005—06, and 10.4% more likely to have done so in 2006—07. Note the substantial (10.8 percentage points) decline in this probability between the two years. This suggests that single-cause skill shortages are less persistent; after two years, firms with shortages of this kind have, on average, managed to substantially reduce their probability of still reporting a lack of skilled persons. A similar point can be made in relation to dual-cause shortages. Looking at the results for Models 3A and 3B in table 24, we see that firms that reported this type of skill shortage in 2004—05 (compared with those with no skill shortage) were 25.9% and 20.5% more likely to report a lack of skilled persons in 2005—06 and 2006—07, respectively. For these firms, we again observe the 'tapering' effect over time in the probability of a persistent lack of skills within the business. Now compare these patterns with the results for firms that reported having complex skill shortages (three or more causes) in 2004—05. For these firms, the probability of experiencing a persistent lack of skilled persons *increases* with time (from 34.5% to 40.2%). This difference suggests that multiple and complex skill shortages are distinct from simpler skill shortages, in terms of their persistence and likely negative impact on firm performance.

[23] Multivariate regression allows for comparisons after the other variables have been 'controlled for', or using the expression 'all other things equal'. In plain English, and by way of example, in our case this would mean that, if we take two firms in manufacturing with 20—199 employees and with one competitor only, where the first firm reported a skill shortage in 2004—05 and the second firm did not, our model suggests that the first firm is 24.3% more likely to report a 'lack of skilled persons' in 2005—06 than is the second firm.

Table 24 Probit estimations of the probability of skill shortage persistence (2)

	Lack of skilled persons within business during 2005–06						Lack of skilled persons within business during 2006–07					
	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Number of skill shortage causes (Reference category: no skill shortage)												
One cause	0.274	0.000	0.213	0.000	0.212	0.000	0.176	0.000	0.114	0.001	0.104	0.002
Two causes	0.318	0.000	0.260	0.000	0.259	0.000	0.272	0.000	0.208	0.000	0.205	0.000
Three or more causes	0.393	0.000	0.343	0.000	0.345	0.000	0.445	0.000	0.386	0.000	0.402	0.000
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	0.061	0.006	0.057	0.010	-	-	0.100	0.000	0.093	0.000
20–199 employees	-	-	0.120	0.000	0.115	0.000	-	-	0.149	0.000	0.139	0.000
Market structure (Reference category: no competitors)												
One or two competitors	-	-	0.079	0.030	0.077	0.034	-	-	0.030	0.418	0.017	0.633
Three or more competitors	-	-	0.074	0.003	0.075	0.002	-	-	0.077	0.003	0.069	0.007
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	-0.025	0.356	-	-	-	-	-0.059	0.034
Mining	-	-	-	-	-0.065	0.155	-	-	-	-	-0.005	0.918
Construction	-	-	-	-	-0.033	0.372	-	-	-	-	0.043	0.336
Wholesale trade	-	-	-	-	-0.049	0.103	-	-	-	-	-0.030	0.366
Retail trade	-	-	-	-	-0.041	0.240	-	-	-	-	-0.065	0.075
Accommodation, cafes and restaurants	-	-	-	-	-0.042	0.243	-	-	-	-	-0.054	0.145
Transport and storage	-	-	-	-	-0.018	0.643	-	-	-	-	0.003	0.939
Communication services	-	-	-	-	-0.059	0.151	-	-	-	-	-0.051	0.202
Property and business services	-	-	-	-	-0.040	0.312	-	-	-	-	0.035	0.445
Cultural and recreational services	-	-	-	-	-0.001	0.971	-	-	-	-	0.013	0.759
Personal and other services	-	-	-	-	-0.009	0.817	-	-	-	-	0.062	0.150
Observed P	0.175		0.175		0.175		0.174		0.174		0.174	
Predicted P	0.156		0.148		0.147		0.159		0.147		0.143	
Sample size	1740		1740		1740		1601		1601		1601	
Pseudo R2	0.098		0.122		0.126		0.088		0.125		0.140	

Skill shortages and firm performance

One of the unique features of the Business Longitudinal Database is that it contains information on firms' sales, investment and total wages derived directly from Tax Office records. This information was reported for all three waves of the data, which means we can estimate the possible consequences one or two years after the skill shortages were reported. We investigate the possible consequences of skill shortages by focusing on three main outcomes. First, we look at growth in sales. The question we ask is whether firms that report skill shortages grow slower or faster than comparable firms without skill shortages. Second, we look at the level of investment. The question we ask is whether firms that report skill shortages also show higher levels of investment expenditure. Third, we look at changes in the wages bill of firms. The question we ask is whether firms that report skill shortages have a larger increase in their total wages bill in the subsequent year than comparable firms without skill shortages. We find some clear and intuitively appealing results.

Table 25 suggests that, when skill shortages are estimated on their own, the firms that report skill shortages are firms that experience higher growth in sales. That is, skill shortages go with firm growth. Note the similarity of this result with the estimates on firm survival presented in tables 21 and 22. While we cannot support the proposition that skill shortages directly cause increased sales, it is clear that the proposition that shortages may result in *reduced* sales is not supported by the data. Note also that this is not the same as saying that skill shortages may reduce the potential level of sales, which is a proposition that we cannot test with these data. What remains is the proposition that skill shortages are one of the *results* of growth and, as such, we find that firms that grow are also firms that experience skill shortages. The data do not support a clear direct causal link between shortages and growth in sales. Instead, it appears that skill shortages are an indication of successful businesses with strong product demand, expanding in volume, or with production deepening in the use of technology and skilled labour.

This picture becomes clearer when we replace the variable for single-skill shortages with the multiple-causes variables (also shown in table 25). We find that firms with only one cause of skill shortages are making good progress with increasing sales, even after all size, competition and sector variables are included in the estimation. Given the weaknesses of the data, this is a very strong result. By contrast, firms with multiple skill shortages are not improving their position in the market.

The level of capital investment estimations in table 26 suggests that, where skilled labour is in short supply, we also find higher levels of capital expenditure, especially for moderately complex skill shortages. This could be for several reasons that our data cannot distinguish. It could be that firms respond to skill shortages (that is, the inability to find enough skilled people at the right price) by introducing a more capital-intensive production process, which would translate into higher levels of capital expenditure and the need for a smaller number of skilled workers. It could also be that firms are introducing new technologies which are dictated by developments in the product market and which need skills that are not present in the first instance, but which may be developed later. Both cases would show up in our estimations as a positive association between the level of capital investment and the level of skill shortages, with no clear way to distinguish between simple and complex skill shortages.

Finally, we examine the association between skill shortages and the changes in firms' wages bill over one year. Results from both the single skill shortage and the complexity-of-causes estimations (table 27) show that no association can be traced to the change in firms' total wages and salaries as reported to the Tax Office.

Table 25 Ordinary least squares (OLS) estimations of the change in total sales from 2004–05 to 2005–06

	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Skill shortage	0.101	0.055	0.067	0.217	0.050	0.346	-	-	-	-	-	-
Number of skill shortage causes (Reference category: no skill shortage)												
One cause	-	-	-	-	-	-	0.175	0.010	0.142	0.039	0.132	0.051
Two causes	-	-	-	-	-	-	0.023	0.817	-0.007	0.944	-0.025	0.807
Three or more causes	-	-	-	-	-	-	0.083	0.339	0.045	0.605	0.019	0.830
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	0.069	0.193	0.084	0.117	-	-	0.068	0.199	0.084	0.119
20–199 employees	-	-	0.055	0.298	0.074	0.173	-	-	0.054	0.302	0.074	0.174
Market structure (Reference category: no competitors)												
One or two competitors	-	-	0.158	0.058	0.178	0.039	-	-	0.159	0.057	0.179	0.039
Three or more competitors	-	-	0.090	0.186	0.114	0.105	-	-	0.089	0.189	0.113	0.105
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	0.077	0.320	-	-	-	-	0.078	0.314
Mining	-	-	-	-	-0.006	0.968	-	-	-	-	-0.004	0.982
Construction	-	-	-	-	0.044	0.619	-	-	-	-	0.041	0.649
Wholesale trade	-	-	-	-	-0.081	0.358	-	-	-	-	-0.083	0.346
Retail trade	-	-	-	-	-0.040	0.624	-	-	-	-	-0.039	0.634
Accommodation, cafes and restaurants	-	-	-	-	-0.058	0.642	-	-	-	-	-0.063	0.618
Transport and storage	-	-	-	-	0.081	0.375	-	-	-	-	0.080	0.380
Communication services	-	-	-	-	0.175	0.074	-	-	-	-	0.178	0.069
Property and business services	-	-	-	-	-0.032	0.795	-	-	-	-	-0.032	0.794
Cultural and recreational services	-	-	-	-	-0.122	0.139	-	-	-	-	-0.122	0.143
Personal and other services	-	-	-	-	-0.030	0.799	-	-	-	-	-0.033	0.779
Regression constant	-0.068	0.009	-0.173	0.005	-0.203	0.024	-0.068	0.009	-0.172	0.005	-0.203	0.024
Sample size	1825		1825		1825		1825		1825		1825	
Pseudo R2	0.002		0.006		0.011		0.003		0.007		0.012	

Table 26 Ordinary least squares estimations of the level of firm investment (capital purchases) in 2005–06

	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Skill shortage	0.916	0.000	0.325	0.016	0.291	0.031	-	-	-	-	-	-
Number of skill shortage causes (Reference category: no skill shortage)												
One cause	-	-	-	-	-	-	0.783	0.000	0.154	0.402	0.154	0.398
Two causes	-	-	-	-	-	-	1.230	0.000	0.593	0.009	0.578	0.010
Three or more causes	-	-	-	-	-	-	0.748	0.002	0.264	0.276	0.160	0.497
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	0.997	0.000	1.065	0.000	-	-	1.002	0.000	1.073	0.000
20–199 employees	-	-	2.471	0.000	2.590	0.000	-	-	2.467	0.000	2.584	0.000
Market structure (Reference category: no competitors)												
One or two competitors	-	-	0.110	0.512	0.174	0.306	-	-	0.112	0.507	0.178	0.297
Three or more competitors	-	-	-0.080	0.517	0.018	0.888	-	-	-0.078	0.527	0.020	0.874
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	0.414	0.009	-	-	-	-	0.418	0.009
Mining	-	-	-	-	0.784	0.016	-	-	-	-	0.777	0.017
Construction	-	-	-	-	-0.060	0.800	-	-	-	-	-0.057	0.809
Wholesale trade	-	-	-	-	0.210	0.259	-	-	-	-	0.220	0.236
Retail trade	-	-	-	-	-0.516	0.010	-	-	-	-	-0.527	0.009
Accommodation, cafes and restaurants	-	-	-	-	-0.362	0.135	-	-	-	-	-0.343	0.159
Transport and storage	-	-	-	-	0.374	0.152	-	-	-	-	0.388	0.137
Communication services	-	-	-	-	0.176	0.451	-	-	-	-	0.171	0.463
Property and business services	-	-	-	-	-0.632	0.003	-	-	-	-	-0.629	0.003
Cultural and recreational services	-	-	-	-	-0.417	0.058	-	-	-	-	-0.423	0.055
Personal and other services	-	-	-	-	-0.277	0.183	-	-	-	-	-0.278	0.183
Regression constant	1.766	0.000	1.103	0.000	0.952	0.000	1.766	0.000	1.101	0.000	0.946	0.000
Sample size	1825		1825		1825		1825		1825		1825	
Pseudo R2	0.027		0.190		0.215		0.029		0.191		0.217	

Table 27 Ordinary least squares estimations of the change in wages and salaries from 2004–05 to 2005–06

	Model 1A		Model 2A		Model 3A		Model 1B		Model 2B		Model 3B	
	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Skill shortage	0.037	0.531	-0.007	0.901	0.003	0.958	-	-	-	-	-	-
Number of skill shortage causes (Reference category: no skill shortage)												
One cause	-	-	-	-	-	-	0.077	0.426	0.033	0.735	0.048	0.635
Two causes	-	-	-	-	-	-	-0.072	0.457	-0.110	0.260	-0.094	0.343
Three or more causes	-	-	-	-	-	-	0.104	0.201	0.050	0.529	0.049	0.537
Business size (Reference category: fewer than 5 employees)												
5–19 employees	-	-	0.129	0.024	0.138	0.019	-	-	0.126	0.028	0.135	0.022
20–199 employees	-	-	0.057	0.388	0.056	0.423	-	-	0.060	0.371	0.059	0.406
Market structure (Reference category: no competitors)												
One or two competitors	-	-	0.193	0.040	0.178	0.062	-	-	0.193	0.040	0.177	0.062
Three or more competitors	-	-	0.182	0.028	0.167	0.041	-	-	0.182	0.028	0.166	0.041
Industry (Reference category: manufacturing)												
Agriculture, forestry and fishing	-	-	-	-	-0.067	0.355	-	-	-	-	-0.067	0.350
Mining	-	-	-	-	-0.050	0.801	-	-	-	-	-0.047	0.816
Construction	-	-	-	-	0.043	0.698	-	-	-	-	0.041	0.710
Wholesale trade	-	-	-	-	0.110	0.118	-	-	-	-	0.105	0.132
Retail trade	-	-	-	-	-0.119	0.120	-	-	-	-	-0.114	0.142
Accommodation, cafes and restaurants	-	-	-	-	-0.150	0.207	-	-	-	-	-0.156	0.192
Transport and storage	-	-	-	-	0.051	0.591	-	-	-	-	0.045	0.637
Communication services	-	-	-	-	0.239	0.010	-	-	-	-	0.241	0.009
Property and business services	-	-	-	-	-0.102	0.506	-	-	-	-	-0.103	0.502
Cultural and recreational services	-	-	-	-	-0.142	0.177	-	-	-	-	-0.141	0.181
Personal and other services	-	-	-	-	-0.133	0.225	-	-	-	-	-0.132	0.231
Regression constant	-0.083	0.002	-0.282	0.000	-0.247	0.004	-0.083	0.002	-0.281	0.000	-0.245	0.004
Sample size	1548		1548		1548		1548		1548		1548	
Pseudo R2	0.000		0.011		0.022		0.002		0.013		0.024	

Conclusion

This report set out to investigate the causes of, responses to and consequences of skill shortages in the Australian economy. It used a new ABS dataset, the Business Longitudinal Database, which provides nationally representative information on Australian firms employing up to 200 employees for the years 2004—05 to 2006—07. The analysis was undertaken within an economic framework that involved the detailed statistical description of the information from the Business Longitudinal Database and the econometric analysis of the complex relationships surrounding the causes of skill shortages, employers' responses to them and some of their economic consequences. The econometric analyses utilised various types of multivariate regression, depending on the questions asked and the data capabilities and constraints. The report provided extensive descriptive information for the Business Longitudinal Database dataset, as this is a new resource that covers topics rarely covered by nationally representative data collections. As with all datasets, it is important that their limitations come to the fore in order to avoid over-interpretation. This report used the Business Longitudinal Database with a critical eye, in particular by investigating non-response patterns and explaining the limiting way that skill shortages have been measured and coded, but also with attention to the dataset's unique strengths, especially regarding complexity and the measures of firm performance.

The report built on some of the unique strengths of the Business Longitudinal Database data, in two major ways. First, it built on the diversity of information on both the causes of and responses to skill shortages which are reported by individual firms. This constitutes a great strength of the data at hand and has provided the report with the ability to investigate issues of complexity of skill shortages that proved to be empirically important and which have yielded valuable new insights about the workings of skill shortages in the Australian economy. Second, the report built on the unique information relating to economic outcomes in the Business Longitudinal Database, as represented by Tax Office records of business sales, capital expenditure and labour costs. These measures were combined with the cause and response evidence to examine some of the microeconomic consequences of skill shortages.

The main finding of this report is that skill shortages are a complex labour market phenomenon and that they give rise to complex responses by firms. Complexity, especially of the causes of skill shortages, has been a recurring theme in the empirical analysis and proves to be an essential element in understanding how skill shortages work and how they are linked to economic outcomes. The causes of skill shortages are very diverse. The dominant cause is a lack of specialist knowledge, but future-demand uncertainties, slow recruitment processes and high market wages are also involved. Lack of availability of adequate training is not reported to be a major cause of skill shortages. We find that the causes vary by firm size and they are often influenced by the degree of competition facing the firm in the product market. Some industries are more susceptible to complex skill shortages (those with multiple causes), including agriculture and construction. For other industries, including wholesale trade, retail trade, and property and business services, the incidence is low.

Responses to skill shortages are also complex. Most businesses are addressing their skill shortages through better utilisation of their core workers (for example, longer hours, better pay and conditions and internal training), while some employ peripheral strategies (for example, outsourcing and short-term contracts). A small but significant proportion of firms reduce output. The complexity of responses also proves to be empirically relevant. The interaction between complexity of causes and responses was shown to matter, with some responses being more sensitive to multiple causes than others. The argument we make, based on the empirical estimations, is that some responses (for example, longer hours) are utilised where there are simple causes of skill shortages, while others (for example, reduced output) are only activated when multiple causes are encountered. Building this

argument further is our evidence about the persistence of skill shortages, which indicates that single-cause skill shortages are more likely to resolve quickly than complex skill shortages.

The report examined several longer-run economic consequences that may be related to skill shortages. These were the survival probability of the firm, the change in the volume of sales, the level of capital expenditure and the change in the wages bill of the firm, all in the three-year period of investigation afforded by the data. Although data from the Business Longitudinal Database do not lend themselves to a causal interpretation of the relationships we have examined, they do enable a much clearer picture of the statistical behaviour of skill shortages to emerge once all the components of the analysis are combined.

The main thrust of our results is that skill shortages matter, although their relationship to firm performance differs by the complexity of the skill shortage. In brief, single-cause skill shortages are associated with favourable or improving firm performance on most measures used. Complex or multiple-cause skill shortages, by contrast, are not shown to have a discernible effect on performance when compared with firms without skill shortages. Looking at each of the firm performance measures separately, we find that firm survival is positively associated with skill shortages, but only when shortages are simple in form. We cannot trace conclusive performance differences between the firms with simple and those with more complex types of skill shortages. Further, the estimated differences between complex skill shortages and no skill shortages are inconclusive, indicating that the performance of firms with complex skill shortages does not differ in a statistically significant way from firms with no skill shortages (the reference category in all estimations).

The comparison between firms facing simpler skill shortages and firms not facing any skill shortages yields statistically significant and intuitively appealing results. Instead of being a problem, simpler skill shortages appear to be a marker of success. The firms that report the simpler skill shortages are expanding in size above average, they are investing more than average, they are not paying above average wages, and they may have a higher probability of survival. In conclusion, these simpler skill shortages are associated with the positive attributes we expect successful firms to exhibit. This is not to say that simpler skill shortages have no economic costs. Indeed, some of the responses to them almost certainly imply higher labour costs. However, whatever the price of success is for the firms facing simpler skill shortages, it is lower and of shorter duration and persistence than the high costs that are borne by less successful firms in the economy.

Our data do not allow us to determine whether the (lack of an) empirical relationship between complex skill shortages and firm performance is because of the small cell sizes used for making comparisons, or because there is no empirical relationship to be traced. However, the presence of several estimates with low, but not completely negligible, statistical significance leads us to favour the possibility that there may be a negative relationship between complex skill shortages and firm performance. This possibility is consistent with our finding that only firms with very complex skill shortages respond by reducing outputs or production. We do not know whether this response means that firms have reduced their output in absolute terms, or that they believe potentially higher output has been foregone because of skill shortages. However, there is some tension in our results between, on the one hand, the finding that complex skill shortages appear to lead to reduced output, and, on the other hand, the lack of clear evidence about the effects of these complex skill shortages on firm performance, measured by sales and investment. Resolving this tension will be a useful direction for further research, once additional data from the fourth and fifth waves of the Business Longitudinal Database become available and more refined estimation results are appraised.

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Appendix 1: Descriptions of main estimation variables

Variable name and description	Coding
Incidence of skill shortages	
'Did this business have skill shortages during the year ended 30 June 2005?' (Definition: A skill shortage occurs when there is an insufficient supply of appropriately qualified workers available or willing to work under existing market conditions.)	0 = No 1 = Yes Missing = Not answered
Causes of skill shortage	
'Were this business's skill shortages due to any of the following factors?' (Tick all that apply)	
(a) Specialist knowledge required	0 = No 1 = Yes
(b) Geographic location of business	0 = No 1 = Yes
(c) Wages or salary costs too high for business	0 = No 1 = Yes
(d) Lack of availability of adequate training	0 = No 1 = Yes
(e) Unsure of long-term demand for products or service	0 = No 1 = Yes
(f) Recruitment too slow	0 = No 1 = Yes
(g) Other (please specify)	0 = No 1 = Yes
Number of skill shortage causes reported	0 = No skill shortage 1 = One cause 2 = Two causes 3 = Three or more causes
Responses to skill shortages	
'How did this business address skill shortages during the year ended 30 June 2005?' (Tick all that apply)	
(a) More use of external training of staff	0 = No 1 = Yes
(b) More use of on-the-job or internal training of staff	0 = No 1 = Yes
(c) Existing workforce worked longer hours (e.g. overtime, weekend work)	0 = No 1 = Yes
(d) Subcontracted or outsourced work to other businesses	0 = No 1 = Yes
(e) Employed staff on short-term contract basis	0 = No 1 = Yes
(f) Wages, salaries and/or conditions increased (e.g. bonus payments)	0 = No 1 = Yes
(g) Reduced outputs or production	0 = No 1 = Yes
(h) Other (please specify)	0 = No 1 = Yes
Number of responses to skill shortage reported	0 = No skill shortage 1 = One response 2 = Two response 3 = Three or more responses

Variable name and description	Coding
Consequences of skill shortages	
Business had ceased operation under its original ABN either after one year (by 30 June 2006) or after two years (by 30 June 2007) (treated as business death)	0 = No 1 = Yes
A 'lack of skilled persons within the business' was nominated as 'significantly hampering this business' either during 2005–06 or 2006–07 (treated as skill shortage persistence)	0 = No 1 = Yes
Change in total sales (as reported on business activity statements) from 2004–05 to 2005–06	Difference between the natural logarithm of total sales in these two years
Level of capital purchases (as reported on business activity statements) in 2005–06 (treated as firm investment)	Natural logarithm of capital purchases (in $000s) in this year
Change in total wage and salary payments (as reported on business activity statements) from 2004–05 to 2005–06	Difference between the natural logarithm of total wages and salary payments in these two years

Appendix 2: The skill shortages question: is non-response in the data random?

Table 1 showed that, of the total 2732 firms sampled in the Business Longitudinal Database, 469 did not provide any information about skill shortages. These firms comprise 17.2% of the unweighted sample. Table 2 showed that, after the data are weighted, this proportion remains largely unchanged at 17.7%. There is little analysis that can be carried out for firms with missing skill shortages information. The main question is whether there is a discernible, systematic relationship between missing information on skill shortages and the remaining information in the data. If we find that there is such a relationship, we must accommodate this finding by introducing a selection model in order to correct any possible selection bias.

Modelling selection always places new demands on the data, as the success of the estimation depends on finding information that pertains to the selection stage (that is, factors associated with whether a firm answered the question on skill shortages or not), but not the main stage of the estimation (that is, factors that are not associated with whether a firm reported a skill shortage). There is no guarantee that appropriate 'identifying variables' will be found. Hence, even where systematic selection is present, careful judgment is required to decide if and how it can be modelled explicitly. By contrast, if we find that there is no systematic relationship, we can assume that the selection stage is independent of the main stage and estimate the main stage on its own, without being concerned about selection bias.

The first step in deciding whether to model selection or not is to estimate the association between the observed data and a new variable, which takes the value of 1 if the response is missing and 0 if it is not missing. This estimation informs us about whether answering the skills shortage question or not is a random occurrence. The main statistic to observe in this case is the overall explanatory power of the estimation.

The appropriate estimation method is the probit model and the appropriate statistic for the overall model fit is the Pseudo R-squared statistic, which is an estimate of the proportion of the variation of the explained variable (that is, the 0/1 response variable) that can be explained by all explanatory variables taken together. In order to examine the possibility that the answers may be different by sample size, table A.1 presents five estimations: one for the full sample and one for each of four categories of sample size (zero employees; 1—4 employees; 5—19 employees; and 20—199 employees).

Table A.1 shows that the Pseudo R-squared statistics range between 1.8 and 4.8%, which suggests that the explanatory variables in the right-hand side cannot explain more than 5% of whether the skill shortage question has been answered or not. The very low explanatory value of these estimations, combined with the lack of obvious identifying variables in the data, support a decision not to model selection.

Table A.1 Probit estimations of the probability of not answering the skill shortage question

	All businesses in sample		Non-employer		1–4 persons employed		5–19 persons employed		20–199 persons employed	
	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|	dF/dx	P>|z|
Derived Size Benchmark employment (Reference category: 20–199 persons)										
Non-employer	0.084	0.003	-	-	-	-	-	-	-	-
1–4 persons	0.032	0.126	-	-	-	-	-	-	-	-
15–19 persons	-0.017	0.425	-	-	-	-	-	-	-	-
Industry (Reference category: manufacturing)										
Agriculture, forestry and fishing	-0.047	0.038	-0.034	0.528	-0.085	0.038	-0.012	0.782	-0.055	0.206
Mining	0.009	0.803	0.016	0.838	-0.048	0.418	0.014	0.838	0.123	0.215
Construction	-0.027	0.425	-0.146	0.120	-0.097	0.077	0.044	0.506	0.058	0.369
Wholesale trade	0.005	0.840	0.016	0.802	-0.007	0.879	0.065	0.236	-0.053	0.273
Retail trade	-0.039	0.202	-0.086	0.222	0.033	0.590	-0.048	0.416	-0.067	0.241
Accommodation, cafes and restaurants	-0.008	0.793	0.054	0.562	-0.013	0.805	0.029	0.629	-0.090	0.102
Transport and storage	-0.040	0.216	-0.083	0.287	-0.020	0.737	0.011	0.862	-0.051	0.367
Communication services	0.020	0.564	0.009	0.909	-0.038	0.501	0.073	0.307	0.148	0.102
Property and business services	-0.041	0.195	-0.001	0.991	-0.051	0.374	-0.015	0.810	-0.074	0.182
Cultural and recreational services	-0.020	0.564	-0.143	0.146	0.000	1.000	0.033	0.619	-0.033	0.563
Personal and other services	-0.064	0.044	-0.145	0.083	-0.109	0.037	0.009	0.881	-0.024	0.687
Type of legal organisation (Reference category: registered company)										
Sole proprietor	0.031	0.211	-0.055	0.240	0.080	0.052	0.142	0.038	0.052	0.584
Partnership	-0.075	0.000	-0.170	0.000	-0.090	0.011	0.008	0.860	-0.073	0.159
Trusts, other unincorporated entity	-0.023	0.270		*	-0.024	0.531	-0.015	0.636	-0.015	0.662
Observed P	0.172		0.235		0.180		0.130		0.147	
Predicted P	0.165		0.222		0.169		0.126		0.138	
Sample size	2732		571		835		699		625	
Pseudo R2	0.029		0.048		0.038		0.018		0.042	

Note: * Insufficient number of observations precluded estimation.

Appendix 3: Sample sizes and statistical significance

Small cell sizes are a limitation in the econometric analysis of the Business Longitudinal Database. Table 1 showed that, of the 2732 firms that were sampled, 469 did not respond. The potential problems introduced through non-random response are examined in appendix 2. Of the remaining 2263 firms, 438 reported skill shortages, which is a sufficiently large number for relatively simple econometric analyses without worrying about sample size. When the analysis begins to examine the different causes and responses of skill shortages, however, individual cell sizes become small very quickly.

The reason is that all questions on the causes of and responses to skill shortages were only asked of the 438 firms that reported at least one skill shortage. For example, 'specialist knowledge required' was reported as a cause of skill shortages by 286 firms, a number comfortably large for analysis. By contrast, only 104 firms indicated that their 'geographic location' was a cause of skill shortages, a number that may be too small for multivariate analysis. Similarly, with reference to complexity in the causes of skill shortages, there are only 121 firms in the sample that indicated more than two causes for their skill shortage. Combining this small number with the rest of the variables (for example, firm size and market structure) for the purposes of multivariate regression means that some very small data cells will be involved in the estimations.

There are several implications. First, we should be careful not to estimate models with too many variables in them. To accommodate this concern, we have in all our analyses presented different model specifications, beginning with the most parsimonious and never getting too complex. Second, we should be prepared to encounter several estimates with low levels of statistical significance, indicated by low t-ratios, high P-values and wide confidence intervals. The Business Longitudinal Database data will not allow us to determine whether (a) there is a 'real' empirical relationship that we simply cannot detect because of small cell sizes, or (b) there is no such relationship and we would not obtain statistically significant estimates even if we had larger cell sizes. Third, and following from the previous point, we should interpret our measures of statistical significance (t-ratios or P-values) according to the sample size at hand. It is much harder to estimate precisely an empirical relationship using a small sample than when using a large sample. Accordingly, we should be thinking differently of a P-value of 0.10 for an estimate derived from a sample with 100 000 observations, and the same P-value of 0.10 derived from the Business Longitudinal Database sample, where all the variation concerning the skill shortages information is based on just over 400 observations. It is with this thinking in mind that, in the interpretation of the estimation results, some estimates with P-values around the 0.10 level are discussed and the cut-off point for statistical significance at 0.10 is not adhered to as stringently as we would have done with a large-sample estimation.

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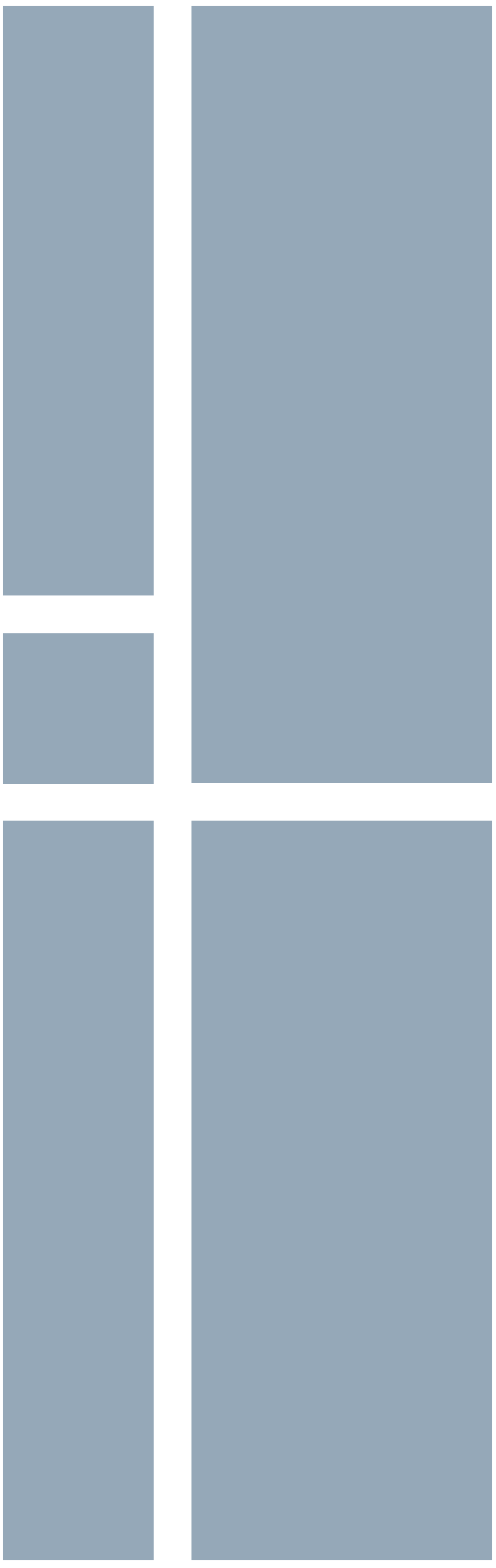

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