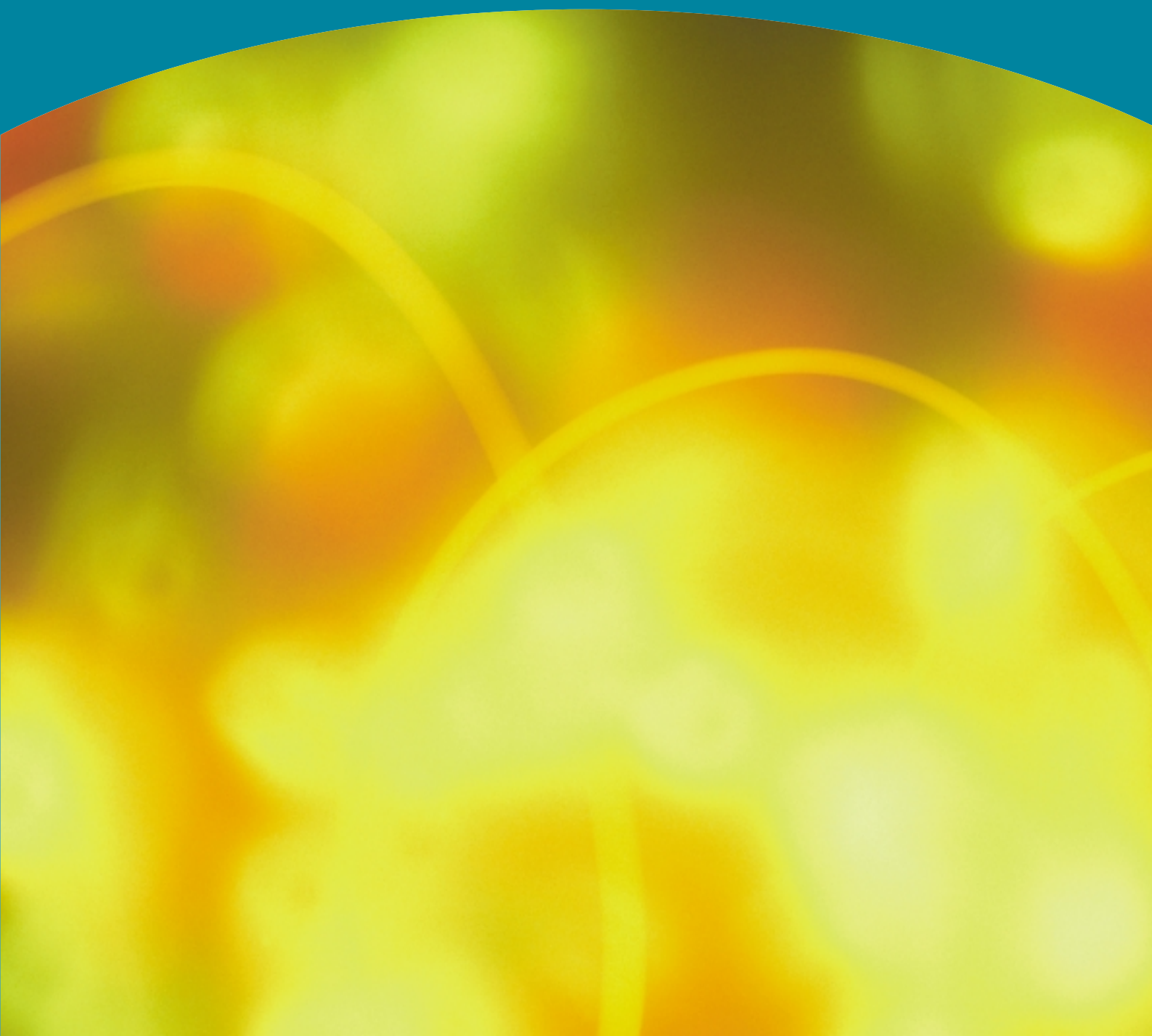# Employers Skill Survey:
Existing Survey Evidence and its use in the Analysis of Skill Deficiencies

EMPLOYERS SKILL SURVEY

Existing Survey Evidence and its use in the Analysis of Skill Deficiencies

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FOREWORD

The Secretary of State for Education and Employment established the Skills Task Force to assist him in developing a National Skills Agenda. An important part of this remit was to provide evidence on the nature, extent and pattern of skill needs and shortages and their likely future development. The research evidence assembled by the Task Force was summarised in *"Skills for all: Research Report from the National Skills Task Force"*, published in June 2000.

An important contribution to the evidence was made by a major programme of new research. This included two employer surveys, detailed case studies in seven different industries and a review of existing surveys. We are grateful to all those who participated in this research and so contributed to the work of the task force. This report provides more detailed information on one element of this research. Details of associated reports are listed in the rear of this publication.

It should be noted that the views expressed, and any recommendations made, within this report are those of the individual authors only. Publication does not necessarily mean that either the Skills Task Force or DfEE endorse the views expressed.

Contents

INTRODUCTION

In this paper we address four questions:

- What surveys of skill deficiencies are currently produced in the UK?

- How do respondents answer the questions in the surveys?

- What can we learn from basic written reports and analysis of the survey results?

- Do more sophisticated analytical methods alter our view of the value of the survey information?

In the paper's final section we draw some brief conclusions about how useful survey information is for the identification of skill deficiencies.

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GLOSSARY

This is a technical paper, and as such it inevitably includes some technical terms. Generally these are explained as they arise. However, some are widely used throughout the text and it may be helpful to explain their standard meanings here. Note that as part of our research we asked survey respondents about what they understood some of these terms to mean; the results were sometimes very different to the meanings given below.

Balance - A commonly-used way of presenting survey evidence, the balance is the difference between the weighted percentage of respondents replying 'more' or 'up' to a question minus the percentage relying 'less' or 'down'. This makes possible use of a single number, with either a positive or negative value, to represent the answer to any question. Balances are typically used where survey respondents are asked how an economic variable has changed or is expected to change over time. A positive value can be interpreted as a rise in the variable concerned, while a negative value represents a fall. However, even in those surveys where balances are widely reported, percentage results are often given for skills questions (e.g. the percentage of firms reporting a significant skills shortage).

Generic Skills - These are transferable skills which can be used across occupational groups. These consist partially of 'Key Skills' such as communication, numeracy, problem solving, team working, IT and improving one's own learning and performance. However, the term also applies to reasoning skills, work process management skills and personal values and attitudes such as motivation, discipline, judgement, leadership and initiative.

Vocational Skills - Specific 'technical' skills needed to work within an occupation or occupational group. Some vocational skills, such as foreign language ability, may be transferable across occupational groups.

Job Specific Skills - These are skills specific to a particular job or employer and are not entirely transferable within that occupation. These might include the ability to operate a specific piece of equipment or familiarity with the employer's specific working methodologies.

Skill Shortage - A situation where there is a genuine shortage in the accessible external labour market of the type of skill being sought, and which leads to a difficulty in recruitment. Not all recruitment difficulties are the result of skill shortages.

Skill Gap - This arises where a deficiency in the skills of existing employees or new recruits reduces business performance, rather than being manifested in a current recruitment difficulty.

Skill Deficiency - This term encompasses both skill shortages and skill gaps.

1. SUMMARY

- Many surveys are produced within the UK that address, or at least touch upon, issues to do with skill deficiencies. But the interpretation of these surveys is bedevilled by differences in methodology, terminology, and phraseology, and also by some of the inherent ambiguities in the subject, and by suspicions over how respondents understand the terminology of questions.

- For example, about 60 per cent of respondents in the CBI manufacturing survey thought that the question regarding whether or not skilled labour was likely to limit output over the next four months was concerned with difficulties in recruiting the right skilled labour, while 45 per cent saw it as reference to problems in relation to their current workforce.

- In the Skill Needs in Britain survey, a limited survey of respondents indicates that most felt their own knowledge of the skill needs, vacancies and training in their organisation was either excellent or very good. Opinions were split about whether the questions were easy to answer: just under half had thought the questions had been thought provoking. Eight out of the nine respondents were sure that they had only answered questions that they were well qualified to deal with.

- There was a general consensus that a skills gap is the difference between the skill levels of employees and what is required by the job, while all respondents defined a skill shortage as a lack of skilled people compared to what was needed. All respondents to the question said that a "suitably skilled person" was someone who had the right qualifications and experience for the job.

- Respondents were asked which actions they had taken in response to hard to fill vacancies. Most found it hard to remember their past actions.

- Such surveys and their more local counterparts are generally written up in a fairly descriptive way. While informative, that approach means that explanations for survey phenomenon can only be conjectured. For formal hypothesis testing, more rigorous methods are needed. An example is given in this paper, and despite anxieties over existing surveys and the ways in which respondents often miss the intended meaning of the survey design, it appears that some important and robust conclusions can be drawn.

- Our analysis suggests that, for both manufacturing and services, there are negative associations between skills shortages/recruitment difficulties and both output and employment.

- In the case of manufacturing, an increase of one percent in the number of respondents citing skills as a constraint on output is associated with an eventual fall in employment by about one per cent.

- In the case of services, an increase of one percent in the number of respondents citing recruitment difficulties is associated with an eventual fall in employment by something between 1/2 and 3/4 of a per cent.

- In both cases the feedback from lower employment to the skills shortages/recruitment difficulties means that the actual responses to the questions understates the true extent of the problem.

- That implies in turn that it is important that future research should focus on understanding how skill needs, and skill deficiencies, evolve over time. That requires the separation of cyclical and structural trends, but also a richer understanding of how employers respond to skill deficiencies.

2. THE MAIN SURVEYS

Many surveys are produced within the UK which address, or at least touch upon, issues to do with skill deficiencies. Many TECs have commissioned surveys of their local areas, and sectoral bodies including the NTOs have done the same for their sectors. There have also been surveys on labour market issues such as flexible employment or social inclusion, and some of these have addressed skills issues.

The interpretation of these surveys is bedevilled by differences in methodology, terminology, and phraseology, and also by some of the inherent ambiguities in the subject (the perennial problem is "what do we really mean by the expression 'skill'?"). Often two surveys that appear to be similar use markedly different wording, which makes comparisons difficult. As a result, those who seek to interpret the surveys can find it difficult to know what significance to attach to particular results.

Particularly problematic is the lack of decent time series for most skill surveys. Three notable exceptions are the Skill Needs in Great Britain (and since 1998 in Northern Ireland) survey and the more general business surveys conducted by the CBI and the British Chambers of Commerce. Between them, these three represent the fullest information available to date on the evolution through time of skill deficiencies, although the Skill Needs in Britain survey is currently being replaced by the much fuller Extent, Causes and Implications of Skills Deficiencies survey, and changes may occur at some point in the future with respect to the other surveys.

2.1 Skill Needs in Great Britain and Northern Ireland

This survey is intended to collect information about:

- the scale and pattern of employers' recruitment difficulties and the skill gaps perceived in existing staff

- employers' commitment to training, and

- employers' awareness of and participation in initiatives related to training and skills.

The survey has been carried out on behalf of the DfEE annually between 1990 and 1998 and covers medium and large sized employers in Great Britain (defined as those in establishments with 25 or more employees). It is intended to provide a snapshot of skill needs at the time of the survey. During the last survey, a parallel study was conducted for the first time amongst small, medium and large employers in Northern Ireland, although results for Great Britain are still given in the report in order to allow comparison with previous surveys.

Survey Method and Sample Design: Each annual survey consists of around 4,000 telephone interviews in Great Britain and, in 1998, of about 400 telephone interviews in Northern Ireland. All public and private business sectors, with the exception of Agriculture, Forestry & Fishing, are covered in the survey. The sampling methodology has changed over the years, but for Great Britain in 1998 it was designed to achieve a representative distribution across Government Office Region, industry sector and establishment size.

Reporting of Results: Results in the 1998 survey were grossed up to percentage data using population estimates derived from the Census of Employment (although again the method has changed since the survey began). Results are therefore representative of employers in the UK with 25 or more employees.

Questions: The survey contains a series of questions relevant to analysis of skill shortages and skill gaps. Not all employers are expected to answer all questions. For example, if the existence of hard to fill vacancies is indicated, the employer is asked to answer follow-up questions, but if not the interviewer moves in to the next section. Some examples of the questions asked in the survey are given below, using the precise wording adopted in the 1998 survey:

SNB1.2. Do you currently have any vacancies at this location which are proving hard-to-fill?
>   a) Yes;
>   b) No

SNB1.3. Which of the following reasons that I am going to read out are the causes of your hard-to-fill vacancies?
>   a) Not enough suitably skilled people;
>   b) Not enough people interested in doing this type of job;
>   c) Too much competition from other employers;
>   d) Company doesn't pay enough;
>   e) Lack of technical or practical skills;
>   f) Lack of basic ability to build upon;
>   g) Poor attitude, motivation, or personality;
>   h) Lack of the qualifications you demand;
>   i) Lack of the work experience you demand;
>   j) Inflexibility and unwillingness to accept change;
>   k) Other;
>   l) Don't Know

SNB2. I'd like you to tell me the specific occupations in which you currently have vacancies at this location that are proving hard-to-fill?

SNB4. Thinking back over the past twelve months, have you had any vacancies at this location that were hard-to-fill that do not exist now?
>   a) Yes;
>   b) No

SNB5. Which of these would you say is the more important reason for your not having had any hard-to-fill vacancies at this location over the last twelve months?
>   a) You have not been doing much recruitment;
>   b) You have not had any problems finding recruits

SNB7. Turning now to the overall skills needed at your location to keep it running effectively, would you say that the need for skills in your average employee was… ?
>   a) Decreasing;
>   b) Static;
>   c) Increasing

SNB8. Would you say that there is a significant gap between the type of skills that your current employees have now, and those they need to meet your current business objectives?
>   a) Yes;
>   b) No

SNB9. Which, if any, of these skills do you think are generally lacking in your existing employees?
- a) Technical or practical skills;
- b) Literacy skills;
- c) Numeracy skills;
- d) Management skills;
- e) Customer handling skills;
- f) General communication skills;
- g) Computer literacy or knowledge of information technology;
- h) Team working skills;
- i) Problem solving skills;
- j) Managing own development

2.2 The CBI Industrial Trends Survey

The CBI Industrial Trends Survey (ITS) was first introduced in 1958, and covers only manufacturing firms. Detailed cover includes: total UK manufacturing; small, medium and large companies; 12 broad industry groups[1]; and, 50 individual industries. Since 1972 it has been conducted on a quarterly basis (having been published three times a year between 1958 and 1971). The most recent survey was in January 2000.

Survey Method and Sample Design: The most recent surveys cover 800-1,500 UK firms in all manufacturing sectors, and with no upper or lower limit on firm size. The survey is conducted by post. The results are weighted according to industrial sector, net output and employment size. The data can be disaggregated to the level of 50 industrial sectors, 11 regions and 4 size bands.

The below table summarises the survey respondents in July 1999 and July 1989 by employee size group. Although the proportion of respondents within each size group is not in itself representative, the survey results are weighted to take this into account.

Table 1: Summary of CBI ITS Survey Respondents

CBI ITS Issue:	Respondents split by employment size group:				Total Respondents (count)
	0 - 199	200 - 499	500 - 4,999	5,000 and over	
July 1989	57%	23%	18%	2%	1336
July 1999	70%	19%	10%	1%	895

Reporting of Results: Much of the survey concentrates on how variables have changed and how they are expected to change in future and past months. In contrast to the Skill Needs in Britain Survey, most of the questions put to each employer are not quantitative but are concerned with the existence and direction of recent and imminent trends. Such results are typically presented and analysed in the form of balances (see glossary). However, the questions most directly relevant to analysis of skill deficiencies are reported in the form of percentages.

1 The twelve broad industry groups are: food, drink and tobacco; chemicals; metal manufacture; mechanical engineering; electrical and instrument engineering; motor vehicles and other transport equipment; metal products; textiles; other manufacturing; paper, printing and publishing; and, all other manufacturing.

Questions: All firms in the survey are asked to answer question 14, which is most directly relevant to analysis of skill deficiencies, and question 16c, which relates to labour constraints more generally. Question 4, 6 and 8 are also worth noting since they can be used as a proxy for the economic cycle. These questions are as follows:

Question 14. What factors are likely to limit your output over the next four months.
Please tick the most important factor or factors?
      a) Orders or sales;
      b) Skilled labour;
      c) Other labour;
      d) Plant capacity;
      e) Credit or finance;
      f) Materials or components;
      g) Other

Question 16c. Which factors are likely to limit (wholly or partly) your capital expenditure authorisation over the next twelve months?
      a) Inadequate net return on proposed investment;
      b) Shortage of internal finance;
      c) Inability to raise external finance;
      d) Cost of finance;
      e) Uncertainty about demand;
      f) Shortage of labour including Managerial and Technical staff;
      g) Other (please specify);
      h) N/A

Question 4. Is your present level of output below capacity (i.e. are you working below a satisfactory full rate of operation?)
      a) Yes;
      b) No;
      c) N/A

ITS question 6. What has been the trend in the numbers employed over the past 4 months?
      a) Up;
      b) Same;
      c) Down;
      d) N/A

ITS question 8. What has been the trend in output over the past 4 months?
      a) Up;
      b) Same;
      c) Down;
      d) N/A

2.3 The British Chambers of Commerce Quarterly Economic Survey

The BCC survey covers both manufacturing and services firms, although results for each are given separately. The survey is quarterly and has been run since 1985, however, the results were neither representative of all UK regions nor weighted until 1989.

Survey Method and Sample Design: Each survey covers around 9,000 companies, roughly 40 per cent of which are manufacturing companies and the rest are in the services sector. This makes it the largest survey of its type in the UK, although the size of the sample has increased significantly over time (see Table 2). There is no fixed database of companies: the British Chamber of Commerce has 60 affiliated member chambers covering the UK, each of whom chooses how to poll its members. The survey is conducted via a postal questionnaire. The below table summarises the survey respondents in the second quarter of 1999 and 1989 by employee size group (however, only the total number of respondents was available for 1989). As is indicated in Table 2, the survey includes firms of all sizes, although the core sample is more representative of smaller firms than the CBI sample. Total responses have been weighted according to the actual distribution of companies by size within the UK to try to ensure representative results.

Table 2: Summary of BCC Survey Respondents

BCC Issue:	Respondents split by employment size group:				Total Respondents (count)
Manufacturing	0 - 19	20 - 199	200 - 499	500 and over	
2nd quarter 1989	n.a.	n.a.	n.a.	n.a.	1616
2nd quarter 1999	36%	53%	7%	4%	3534
Non-manufacturing	0 - 19	20 - 199	200 - 499	500 and over	
2nd quarter 1989	n.a.	n.a.	n.a.	n.a.	1653
2nd quarter 1999	57%	36%	4%	3%	5267

Reporting of Results: As with the ITS, many of the results are presented in balances. However, responses to the questions outlined below are all intended to present a snapshot view, and are in the form of percentages.

Questions: All firms in the survey are asked to answer the questions that are most relevant to analysis of skill deficiencies. Other questions are also worth noting since they can be used as a proxy for the economic cycle. These questions are as follows.

BCC7a. Have you attempted to recruit staff over the past 3 months?
　　　Yes/No

BCC7c. Did you experience any difficulties finding suitable staff?
　　　Yes/No

BCC7d. If yes, for which of the following categories?
    a) Skilled manual and technical;
    b) Professional and managerial;
    c) Clerical;
    d) Un and semi-skilled

BCC1. Excluding seasonal variation, domestic sales over the past 3 months are:
    Up / Down / Same

BCC 5. Over the past 3 months your workforce has:
    Increased / Remained Constant / Decreased

BCC10. Are you currently operating at:
    Full capacity / Below full capacity

The key point to be made here is that the kind of analysis that we have described can be suggestive of explanations for phenomenon but little more than that. The real need is for hypothesis testing, and that requires more formal techniques. We discuss some such techniques in the following section, in the context of the time series evidence from the CBI and the BCC that we described earlier.

2.4 Summary of the Main Surveys

Although many surveys are produced in the UK that address skill deficiencies, the interpretation of them is bedevilled by differences in methodology, terminology, phraseology and ambiguities in the subject. In addition, it is particularly difficult to find decent time-series for most skill surveys. Three notable exceptions to the latter problem are the Skill Needs in Great Britain (and since 1998 in Northern Ireland) survey and the more general business surveys conducted by the CBI and the British Chambers of Commerce.

The Skill Needs in Great Britain (and since 1998 in Northern Ireland) survey has been carried out on behalf of the DfEE annually between 1990 and 1998 and covers medium and large sized employers in Great Britain (defined as those in establishments with 25 or more employees). Results in the 1998 survey were grossed up to percentage data using population estimates derived from the Census of Employment (although the method has changed since the survey began). Results are therefore representative of employers in the UK with 25 or more employees.

The CBI Industrial Trends Survey (ITS) has been running for the longest period. It was first introduced in 1958, and covers only manufacturing firms. The sample tends to be more representative of larger employing firms. However, this is allowed for by weighting the results accordingly.

The BCC survey covers both manufacturing and services firms, although results for each are given separately. The survey has been run since 1985. Contrary to the CBI Industrial Trends Survey, the sample has tended to be biased toward smaller employing firms. However, since 1989, the results have been weighted to ensure they are representative of the UK.

3. EVIDENCE ON ANSWERING PRACTISES

To understand the results of these surveys it is helpful to know a little about how they are typically answered. As with much survey work, however, the evidence on this is disappointingly slim.

3.1 The Industrial Trends Survey

The skills question in the Industrial Trends survey asks respondents whether a shortage of skilled labour is likely to limit their output over the next four months. However, it is quite possible that the question could be interpreted as referring to internal skill gaps as well as or instead of skill shortages (commonly measured by external recruitment difficulties). Indeed, in principle Question 1b could be interpreted as a reference to a shortage of skilled labour at that location, within the company as a whole (if applicable), in the local economy, in the economy at large, or some combination of the four.

Answers to this question could therefore involve either implicit or explicit references to both (internal) skill gaps and (external) skill shortages by employers in the survey. (The same could be said for question 2f, but the use of the word "shortage" possibly places a greater emphasis on quantitative rather than qualitative difficulties, and it is unlikely that this question is answered with specific reference to *skilled* labour.)

To investigate this the CBI has carried out occasional research into answering practises.[2] In 1998 companies were asked to make an assessment of how they identify skilled labour as a constraint on output. Nearly 60 per cent of companies thought that skilled labour as a constraint on output reflected their difficulties in *recruiting* the right skilled labour while 45 per cent saw it as a problem in relation to their *current* workforce.[3] In other words, companies were slightly more likely to see the question as referring to skill shortages than skill gaps. The research also showed that most respondents understood "skilled labour" to refer to technical/managerial staff as well as to skilled production line or craft workers.

It is also worth noting what respondents understood by the reference in the question to the impact of skill shortages 'over the next four months'. The CBI's analysis suggests that just over half of respondents took this to mean 'the four months as a whole compared with the previous four months' while a fifth of companies defined the time as applying 'from the beginning to the end of the four-month period'. Around 10 per cent compared the four months as a whole with the same period a year ago, and sixteen per cent employed some combination of the three options. Such factors again have important potential consequences for statistical analysis, although the CBI report that the findings are broadly consistent over time, so at least the consistency of responses may not be seriously affected.

3.2 Skill Needs in Great Britain and Northern Ireland 1998

In Summer 1999, for the purposes of this paper, we contacted a number of past respondents to SNIB and found twenty who were prepared to carry out follow up telephone interviews on their answering practises.[4] We attempted to achieve a fairly wide spread of employers in the economy as a whole, although concentrating primarily on those who reported hard-to-fill vacancies or skill gaps. In total, 9 people were interviewed: 6 in manufacturing and 3 in services. The spread of responses is illustrated in Table 3.

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2 "How do Companies Respond to the CBI's Industrial Trend Survey?", Sudhir Junankar, CBI Economic Situation Report, January 1990; "40 Years on: How do Companies Respond to the CBI's Industrial Trend Survey?", Ranjiv Mann and Sudhir Junankar, CBI Economic Situation Report, November 1998.
3 It should be noted that respondents were allowed to select more than one answer in relation to this question, and hence, the proportion of respondents to select each answer can sum to more than 100 per cent.
4 We are grateful to IFF Research for enabling us to conduct this part of the research.

Table 3: Summary of Responses

Sector	No of Employees					
	25-49	50-99	100-199	200-499	500+	TOTAL
Manufacturing	2	1	-	1	2	6
Services	-	2	-	1	-	3
TOTAL	2	3	0	2	2	9

3.2.1 Overview of Responses

This exercise was never intended to be a piece of definitive research, and the sample was clearly small and not completely representative. However, some broad conclusions can probably be drawn:

The majority of respondents felt that their knowledge of the skill needs, vacancies and training in their organisation was either excellent or very good. Only two thought it average. When asked about the skill needs in the industry as a whole, knowledge was more likely to be rated as good or average, with only one respondent rating it poor. Knowledge of skilled labour in the labour market as a whole tended to be less highly rated again - four thought it poor or very poor and only two thought it good.

Table 4: Summary of Respondents' Rating of Knowledge of Skills, Vacancies & Training

BASE=9					
	Excellent/ Very Good	Good	Fair/ Average	Poor	Very Poor
Skill needs within organisation	4	3	2		
Current vacancies within organisation	6	3			
Training provision within organisation	5	2	2		
Skill needs within their industry	1	4	3	1	
Availability of skilled labour in labour market as a whole	2	3	3	1	1

When asked about the Skill Needs in Britain Survey questions, most respondents did not have clear memories of the questionnaire. Two thirds considered the questions thought provoking and just under half had thought the questions easy to answer. However, a third could not remember whether the questions got to the heart of their subjects. Eight out of the nine respondents were sure that they had only answered questions that they were well qualified to deal with.

Table 5: Summary of Responses on Skills need in Britain Questions

BASE=9			
	Agreed	Disagreed	Don't know/ can't remember
I found the questions easy to answer	4	4	1
I found the questions thought-provoking	6	1	2
I thought that the questions did not really get to the heart of the subject they were covering	2	4	3
I only answered questions which I felt well qualified to deal with	8	1	

All except one respondent felt able to give definitions of skill gaps and skill shortages, and these definitions were broadly similar. There was a general consensus that a skill gap was the difference between the skill levels of employees and what was required by job and the business with one respondent defining it as a skilled job that was not filled. Two respondents (both human resource specialists) specifically mentioned that a skill gap identified a training need. All respondents defined a skill shortage as a lack of skilled people compared to what is needed.

There was also a great deal of similarity between the definitions of a hard to fill vacancy. This mainly involved being unable to find people with the right qualifications, skills and/or experience needed for the job. Only one person could not define a hard to fill vacancy and one defined a hard to fill vacancy as one where people did not stay in the job very long. For those that were asked further about factors that caused hard to fill vacancies, all but one replied that other factors other than those mentioned had such a small influence as to be considered unimportant.

Similar definitions were also given for a suitably skilled person with all respondents to the question describing a suitably skilled person as someone who has the right qualifications and experience for the job. This definition had changed for half of those responding to this question and for different reasons. For one it was the result of employing a wider range of occupations and for the other it was a lowering of requirements in order to suit what was more readily available in the labour market.

Definitions of an interested person were also similar across respondents with most reporting that it was someone that was motivated to actually do the job for the rewards on offer. When respondents had mentioned a shortage of interested applicants, all had meant a shortage in the number of applicants for the job - they had not meant that the applicants had appeared to be unmotivated or unenthusiastic.

Respondents were asked which actions they had taken in response to hard to fill vacancies. Most found it hard to remember their past actions. When prompted, further answers were given in all but one case. When asked how the wording of the question affected their answer, the majority did not know how to respond. One could not say at all and 3 others felt it was probably because their initial answers were actions they normally take and the other factors were more unusual and so not remembered straight away. The reverse was the case for one respondent who mentioned the more unusual action first and had to be prompted for the more regular actions usually taken in recruitment.

Table 6: Actions taken to fill hard to fill Vacancies

BASE=9		
	Initial answers	Prompted answers
Increasing salary to make job more attractive	2	1
Training existing workforce to fill the vacancy	2	2
Seeking to obtain staff from other firms (head-hunting)	1	2
Advertising / Advertising more widely	5	1
Changing internal structures and practises	1	1
Using recruitment agencies	4	1
Just carrying on looking	2	3

The question on how to define an average employee was not initially understood by about half of respondents and most required further prompting. One respondent could not define an average employee, as there was too much variety in their organisation and one used the whole workforce as a proxy for the average. The rest however, had similar ideas as to what constituted an average employee. This was the main occupation or the "workers" or "rank and file" rather than management. Only one respondent mentioned age. This was the same across manufacturing and service sector firms, with the exception of one of the latter where the average employee was defined in more abstract terms such as by the degree of their commitment.

For those respondents asked whether the economic cycle had been taken into account when reporting a rise in skill needs last year, the response was mixed. Both manufacturing firms with more than 500 employees had been referring to the increase in skill needs as a result of the changes in technology and products in their organisation. Another manufacturing firm (25-49 employees) also cited technology as the driver of increasing skill needs. Three respondents had just been reporting what they had been experiencing at the time and had not taken the economic cycle into account.

Tables 5 and 6 summarise the responses to questions regarding respondents' personal knowledge of skills in their organisation, industry and labour market as a whole; their views on the Skill Needs in Britain Survey itself, and the respondents' response to hard to fill vacancies.

4. BASIC SURVEY INTERPRETATION

The value of survey evidence depends as much on the way in which the results are interpreted as on the way in which respondents reply. There is a fairly standard approach to interpretation, used with differing degrees of skill, in analysing surveys throughout the UK. In this section we provide an example of such an approach, looking at the analysis that Business Strategies provided to Hertfordshire TEC of its 1998 skills survey. Many other examples could have been chosen: this one illustrates the value but also the inherent limitations of what is inevitably a fairly basic approach to data interpretation.

4.1 The Hertfordshire TEC Skills Survey

This was a telephone survey of 1,000 training managers in Hertfordshire. It was conducted in August and September of 1998. The survey results were weighted using firm size according to the number of employees by SIC Broad Industry groups in Hertfordshire - thus ensuring the results were representative of the Hertfordshire economy. The distribution of the respondent firms by size according to the number of employees is provided in Table 7 below.

Table 7: Distribution of Respondents by the Number of Employees

Employee Size Group								
	1-4	5-10	11-24	25-49	50-99	100-199	200-499	500+	Count
Unweighted	9.8%	31.0%	15.8%	11.8%	13.6%	8.8%	6.6%	2.6%	1000

Employment had been rising strongly in Hertfordshire and the survey showed 30 per cent of employers reporting an increase in their workforce over the last 12 months, with 17 per cent reporting a decrease. Employment levels had been constant for 53 per cent of firms.

Employers were also optimistic about future employment. Thirty-six per cent expected an expansion in their workforce over the next 12 months while only 3 per cent of respondents expected their workforce to shrink. Fifty-six per cent expected their workforce to remain the same size and 5 per cent did not know.

4.2 Recruitment Difficulties

Those employers that were currently recruiting or who had recently recruited[5] were asked whether they had experienced recruitment difficulties over the past twelve months. On average, 24 per cent of firms reported that they had experienced recruitment difficulties.

The survey results showed that firms who had increased employment over the past year were more likely than average to have experienced recruitment difficulties. That raises the question of whether skills deficiencies (not, of course, the same as recruitment difficulties, but certainly linked to them) are likely to be positively or negatively correlated to a rise in output. The researchers commented that the results were largely what they would have expected, although they also noted that recruitment difficulties were more common in firms whose employment decreased over the past than in those whose employment had remained stable. This was offered as a more surprising result, and was interpreted as possibly reflecting the different types of occupations required by these firms. The kind of deeper statistical analysis described later in this paper can offer a more exhaustive analysis of the underlying issues.

The survey results also suggested that when firms with decreasing employment recruit to replace workers who leave, they might be searching for someone with a greater skill requirement than the lost worker, so that the new recruit can do more than one job within the firm. Only one new one may replace two lost workers, and such new multi-skilled workers may be harder to find. This is an interesting proposition and raises questions about the measurement of skill deficiencies. However, the survey evidence itself probably cannot resolve such arguments. (The suggestion was also made that it may be harder to attract people to work in an industry where employment is declining and where pay levels may not be as high as those in an expanding industry.)

Table 8: Have you had Recruitment difficulties in the last 12 months?

% FIRMS				
Employment over Last 12 months				
	Average	**Increased**	**Decreased**	**Stayed the Same**
YES	24	34	27	18
NO	76	65	73	83

Looking at the experience of firms according to their future employment intentions, the researchers commented that the proportion that reported experiencing recruitment difficulties was higher amongst those expecting employment levels to change over the next twelve months (whether increase or decrease) than those expecting employment levels to remain the same.

5 The survey questions on recruitment difficulties applied to 35 per cent of the 1000 respondents.

Table 9: Have you had Recruitment difficulties in the last 12 months?

	% FIRMS			
	Employment over Next 12 months			
	Increase	**Decrease**	**Stay the Same**	**Don't Know**
YES	31	31	20	20
NO	68	69	80	80

If we look at recruitment difficulties experienced by firms in the manufacturing and non-manufacturing sectors we see little difference between the sectors. The researchers commented that for both manufacturing and non-manufacturing firms, above average proportions of firms with increasing employment reported recruitment difficulties. Average proportions of firms with decreasing employment cited recruitment difficulties and below average proportions with stable employment had cited recruitment difficulties. However, with only the survey information to go on, it is hard to know how much weight to apply to these interpretations.

Table 10: Have you had Recruitment difficulties in the last 12 months?

	% FIRMS					
	MANUFACTURING			**NON MANUFACTURING**		
	Employment over Past 12 months			**Employment over Past 12 months**		
	Increase	**Decrease**	**Stay the Same**	**Increase**	**Decrease**	**Stay the Same**
YES	35	24	17	34	27	18
NO	65	76	83	65	73	83

Looking at the experience of firms according to their future employment intentions, more differences were apparent between sectors. The researchers noted that small sample sizes in some categories mean care must be taken with these results, but the results were nevertheless quoted. However, in both sectors recruitment difficulties were more common in firms who expected to increase or to decrease employment over the following year, and this point was identified to the client.

Table 11: Have you had Recruitment difficulties in the last 12 months?

	% FIRMS							
	MANUFACTURING				**NON MANUFACTURING**			
	Employment over Next 12 months				**Employment over Next 12 months**			
	Increase	**Decrease**	**Stay the Same**	**Don't Know**	**Increase**	**Decrease**	**Stay the Same**	**Don't Know**
YES	42	50	10	22	30	30	21	20
NO	59	50	90	78	69	70	79	80

4.3 Reasons for Recruitment Difficulties

A shortage of labour rather than a shortage of skills was the most commonly cited cause of recruitment difficulties. When asked to cite the one main reason for recruitment difficulties, a quarter of respondents cited an overall lack of applicants as causing recruitment difficulties compared to 15 per cent citing a lack of applicants with the right skills and 7 per cent reporting a lack of applicants with the right qualifications.

The researchers remarked that the most popular reason for recruitment difficulties was the same across all firms i.e. an overall lack of applicants. This was less of a problem for firms who had decreased employment levels, where being unable to pay enough was equally as important a reason as a lack of applicants for recruitment difficulties.

Although firms who had experienced increases or decreases in employment were more likely to have experienced recruitment difficulties, they were not more likely to have cited the cause of these recruitment difficulties as a lack of skills. There was no explicit investigation of the possibility that apparent evidence on skill deficiencies in fact tells us nothing more than we would gain by looking at a simple cyclical indicator. However, firms who had decreased employment were more likely to report that it was applicants' lack of qualifications that caused recruitment difficulties - a striking result but one which is not easy to interpret without evidence on, for example, wages or product strategy.

Table 12: The Main Reason for Recruitment Difficulties

% FIRMS				
	Employment over Last 12 months			
	Average	**Increased**	**Decreased**	**Stayed the Same**
Overall lack of applicants	25	26	20	26
Lack of applicants with skills needed by company	14	15	15	14
Lack of applicants with right attitude	12	12	11	13
Lack of applicants with right work experience	9	10	7	9
Lack of applicants with right qualifications	7	6	16	4
Competition from other employers	4	6	3	2
Pay too low	13	9	20	12
Unsociable hours/shift work	5	5	3	6
Other	11	12	5	13

Differences between manufacturing and non-manufacturing firms were evident from the survey results. Manufacturing firms, whether employment had increased, decreased or remained stable, were more likely than non-manufacturing firms to have cited that applicants lacking either the correct skills or qualifications had caused recruitment difficulties. In all cases the most commonly cited cause was on overall lack of applicants.

Similar proportions of firms who expected to increase employment or keep their workforce stable reported the main cause of recruitment difficulties to be a lack of applicants. However, more than average firms whereby employment was to increase in the future cited recruitment difficulties as a result of skill shortages. Skill shortages and a lack of qualifications were particular problems for firms who did not know how their employment levels would change (5 per cent of the sample). This is suggestive of a situation in which poor market information and skill shortages go together, but it is difficult to say much more than that.

The reasons for recruitment difficulties differed most for firms who expected to decrease employment in the future (although it must be noted that these firms only represented 3 per cent of the sample). Pay was perceived to have been the main cause, while a lack of applicants was much less of a problem than for other firms. However, the researchers noted that the proportion citing a lack of skilled applicants was well below average.

Table 13: Reasons for Recruitment Difficulties

	% FIRMS				
	Employment over Last 12 months				
	Average	**Increased**	**Decreased**	**Stayed the Same**	**Don't Know**
Overall lack of applicants	25	24	15	27	19
Lack of applicants with skills needed by company	14	17	8	10	28
Lack of applicants with right attitude	12	12	12	13	4
Lack of applicants with right work experience	9	10	-	9	9
Lack of applicants with right qualifications	7	8	1	6	13
Competition from other employers	4	4	12	2	11
Pay too low	13	9	25	15	13
Unsociable hours/shift work	5	3	12	7	-
Other	11	13	15	10	2

Manufacturing firms were also more likely to have said that recruitment difficulties had been caused by a lack of applicants with the right skills or qualifications than non-manufacturing firms, whether the firms in question were expecting to increase, decrease or keep employment stable.

4.4 Skill Gaps

Firms were asked whether there was a gap between the skills of their staff and the requirements of the job. On average, 16 per cent of firms reported a skill gap.

Firms who had decreased or increased employment were more likely than average to report a skill gap. Those firms with increasing employment were the most likely to have reported a skill gap (21 per cent) followed by just under a fifth of firms where employment had decreased. Only 12 per cent of firms with stable employment levels reported any skill gap in their workforce. This was interpreted

by the researchers as possible evidence that expanding or contracting firms may be placing greater demands on their employees (as a result of these changes) compared to those who are remaining stable in employment terms. This is an important hypothesis but not something which can easily be investigated further.

Table 14: Is there a Skill Gap?

% FIRMS			
Employment over Last 12 months			
	Average	**Increased**	**Decreased**	**Stayed the Same**
---	---	---	---	---
YES	16	21	19	12
NO	84	79	81	87

Examining skills gaps by firms' future employment intentions, the proportions reporting a skill gap were higher than average in those companies who expected to change employment levels. The researchers noted that this was particularly the case for those firms expecting to decrease their employment in the future, where 29 per cent reported a skill gap in their workforce (see Table 12 below). Skill gaps were least prevalent in firms who expected their workforce to remain stable or did not know. These results support the above hypothesis that expanding or contracting firms may be placing greater demands on their employees.

Table 15: Is there a Skill Gap?

% FIRMS			
Employment over Next 12 months			
	Increase	**Decrease**	**Stay the Same**	**Don't Know**
---	---	---	---	---
YES	21	29	12	12
NO	79	71	88	88

Overall, firms with increasing employment were most likely to have reported skill gaps, and firms with stable employment were least likely. When comparing manufacturing and non-manufacturing firms, non-manufacturing firms were the most likely to have reported skill gaps. Indeed, of all firms surveyed, non-manufacturing firms with changing (increasing or decreasing) employment were the most likely to have reported a skill gap. Only a small proportion of manufacturing firms with decreasing or stable employment reported a skill gap.

Table 16: Is there a Skill Gap?

% FIRMS						
	MANUFACTURING			NON MANUFACTURING		
	Employment over Past 12 months			Employment over Past 12 months		
	Increase	Decrease	Stay the Same	Increase	Decrease	Stay the Same
YES	16	7	6	22	20	12
NO	85	92	94	78	80	86

Key to tables 15 and 16:

Skills: Percentage of firms reporting skilled labour as a constraint on output over the next 4 months (ITS question 14b)

Employment: Balance of firms reporting an increase in employment over the past 4 months (ITS Q6)

Output: Balance of firms reporting an increase in output over the past 4 months (ITS Q8).

Capacity: Percentage of firms working below full capacity (ITS Q4).

Investment: Balance of firms expecting to increase capital spending on plant and machinery in the next 12 months (ITS Q3b).

A balance is the percentage reporting an increase less the percentage reporting a decrease.
The full texts of the survey questions are given in the annex.

Looking at the experience of non-manufacturing and manufacturing firms according to their future employment intentions, more differences were apparent, but the researchers advised that small sample sizes in some categories meant that care must be taken with these results.

Table 17: Is there a Skill Gap?

% FIRMS								
	MANUFACTURING				NON MANUFACTURING			
	Employment over Next 12 months				Employment over Next 12 months			
	Increase	Decrease	Stay the Same	Don't Know	Increase	Decrease	Stay the Same	Don't Know
YES	13	33	6	-	22	29	12	13
NO	88	67	93	100	78	71	87	87

4.5 Conclusions

The key point to be made here is that the kind of analysis that we have described can be suggestive of explanations for phenomenon but little more than that. The real need is for hypothesis testing, and that requires more formal techniques. We discuss some such techniques in the following section, in the context of the time series evidence from the CBI and the BCC that we described earlier.

5. STATISTICAL ANALYSIS & ESTIMATION

The approach outlined in Section 4 was largely descriptive with some interpretation based on knowledge of the subject matter. However, survey results can also be subject to more formal analysis, and we consider here whether or not that is useful.

As a first step, Section 5.1 takes an initial look at data from the CBI's Industrial Trends Survey to see what can be gleaned from simple manipulations of the data. We are particularly interested in considering the possibility that the survey evidence on skills really tells us nothing about skills as such, and simply repeats what we already know from other questions, namely that the manufacturing sector tends to follow a cyclical pattern. In other words, are reported skill shortages simply something that goes up when output or employment is increasing and vice-versa or are the surveys telling us something more than that?

Sections 5.2 and 5.3 then take this forward in a more formal manner, initially using bi-variate causality tests, and then using the technique of vector autoregressive regressions (VAR) to see if anything can be said about the *causes and implications of skill deficiencies.* These are techniques for dealing with complex interactions between times series data. The analysis in this paper implies that VAR methods in particular may be a useful way to analyse survey results.

5.1 Cyclicality & Structural Change

The main CBI survey evidence relating to skills shortages/skills gaps (question 14(b)) enquires about whether or not skills shortages/skills gaps are anticipated to limit future output. That is, question 14(b) states "What factors are likely to limit your output over the next four months? … b) skilled labour".

Our initial interest is to see to what extent the CBI survey results simply vary with the state of the economic cycle and to what extent have changes in the level of response been structural.

Inspection of Figs. 1 to 3 suggests that the responses to the skills constraint question do vary with the economic cycle. Figure 1 shows the movement in the series on skills as a constraint on future output and (for comparison) the results for question 16c(f) about general labour shortage capital constraining expenditure authorisations. The data are compared with the results of question 4, which shows the proportion of firms operating below full capacity and is generally used as a proxy for the manufacturing cycle.[6] The data cover the past thirty-eight years (eighteen years for the question about general labour shortage capital constraining expenditure authorisations, 16c(f)).

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6 However, here too there is some room for ambiguity. The CBI has twice asked respondents whether, in defining full capacity, they measured current output solely against physical capacity or whether other factors were considered. In 1998 sixty five per cent had physical capacity in mind (up from 55 per cent in 1989) while 35 per cent (45 per cent) also considered other factors (mainly utilisation of labour). This may have important implications for our statistical analysis: that is, the extent of the relationship between skill shortages and capacity, as estimated through the analysis of survey results, will depend on respondents' perceived definition of 'capacity'.

Figure 1. CBI ITS: Percentage Answering Yes to:

— Skills constraint — Labour shortage constraining capital expenditure — Below capacity working
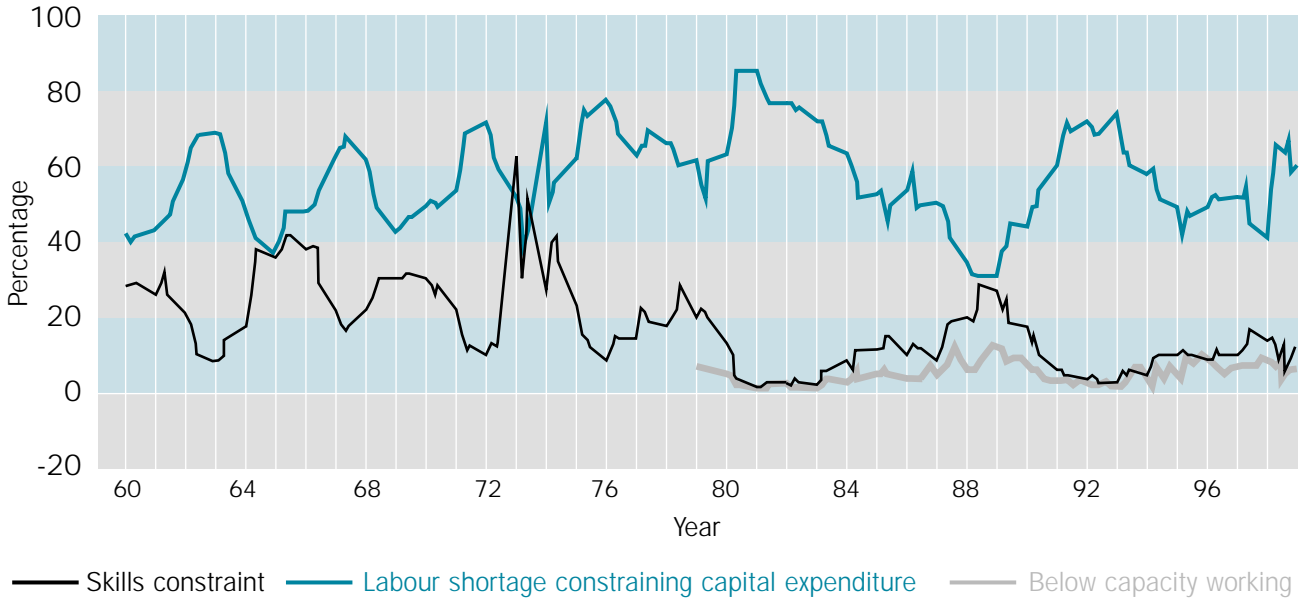
Figure 1 shows the extent of the relationship between the series over time. Put simply, skills constraints and labour shortages go up when the economic cycle is on an upswing and fall back again when it is on a downswing.

Figure 2 shows an even closer correlation between the skills constraint question and another survey result that can be taken to be a measure of the state of the cycle - that is, the balance of respondents saying that there had been an upward trend in the number employed over the past four months (question 6). (Interestingly, the degree of correlation between those respondents citing skills constraints and those *expecting* an increase in employment is much the same as for those *reporting* an increase in employment.)

Figure 2. CBI ITS: Percentage Answering Yes to:

Skills Constraint %   Emp Balance %

— Skills constraint — Employment (balance)
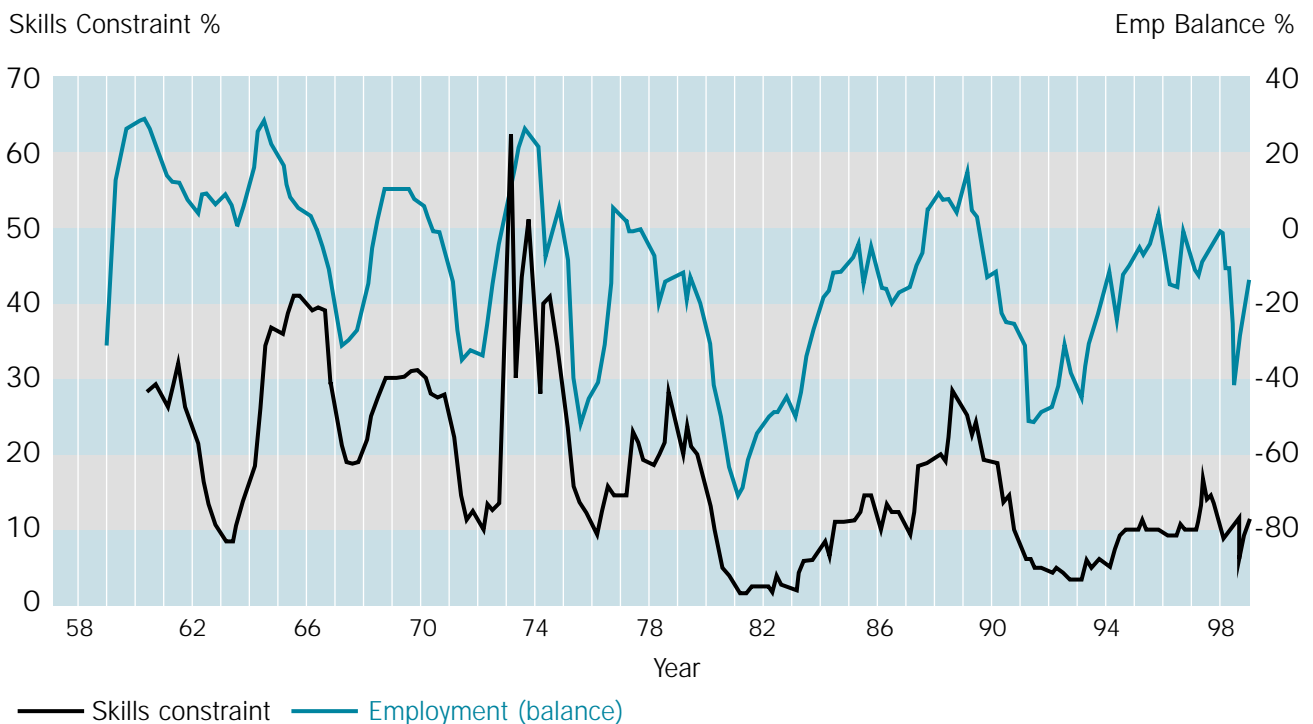
Figure 3 below depicts the correlation between actual year on year change in manufacturing employment and output and the balance of respondents saying that there had been an upward trend in the number employed over the past four months (question 6), evidencing the suitability of the latter as a measure of the state of the cycle.

Figure 3. Measures of the State of the Economic Cycle

CBI ITS: Employment Balance %   Actual Output and Employment YoY %

—— Manufacturing Output (Actual)   —— CBI ITS: Employment Balance   —— Manufcturing Employment (Actual)
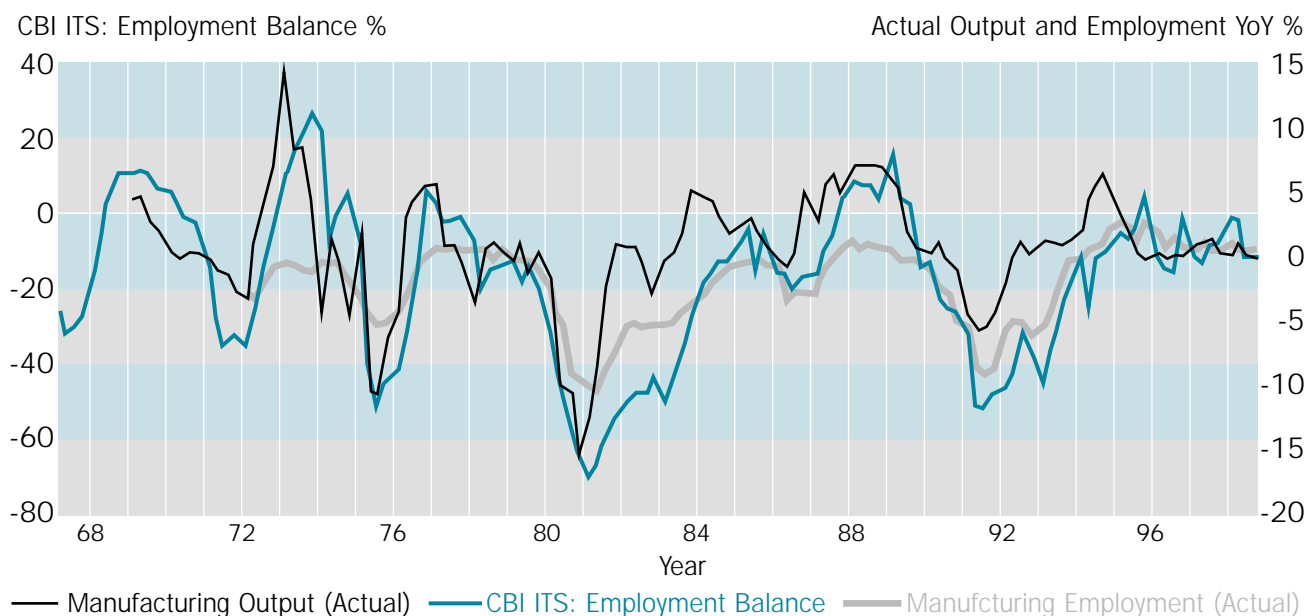
Casual inspection of Figures 1 to 3 suggests that reported skills constraints do vary with the economic cycle. We now proceed to investigate this more formally. If we accept the question on employment change as a proxy for the cycle, an easy way to extract the cycle is to regress the skills constraint question on the responses to the employment change question (we have actually included the current and lagged values of the employment change question as the skills constraint question is correlated with both of them). The fitted values will then be an approximation of the cyclical element, and the residuals will be an indicator of the structural changes in the responses to the skills constraints question. The results of this exercise are shown in Figures 4 and 5 below.

Figure 4. CBI ITS: Skilled Labour as a constraint on Output

—— Actual   —— Fitted
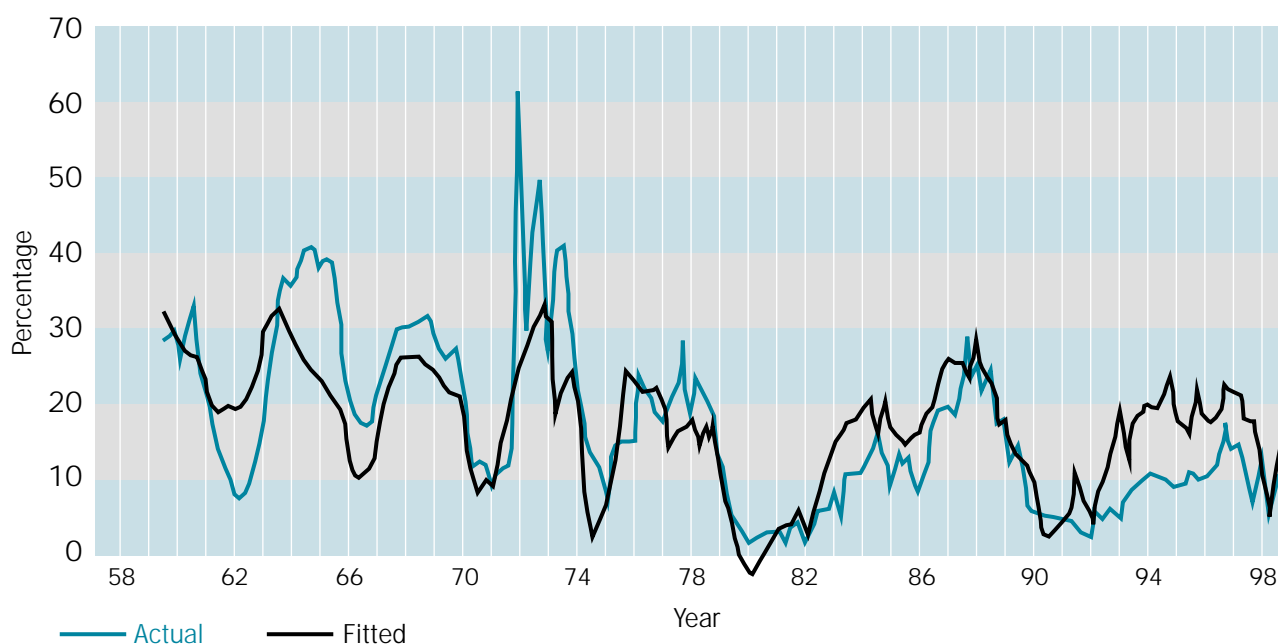
Figure 5 shows the actual residuals from the regression and a smoothed version of the series[7], which makes the long-run trends easier to identify.

Figure 5. CBI ITS: Skilled Constraint - Residual
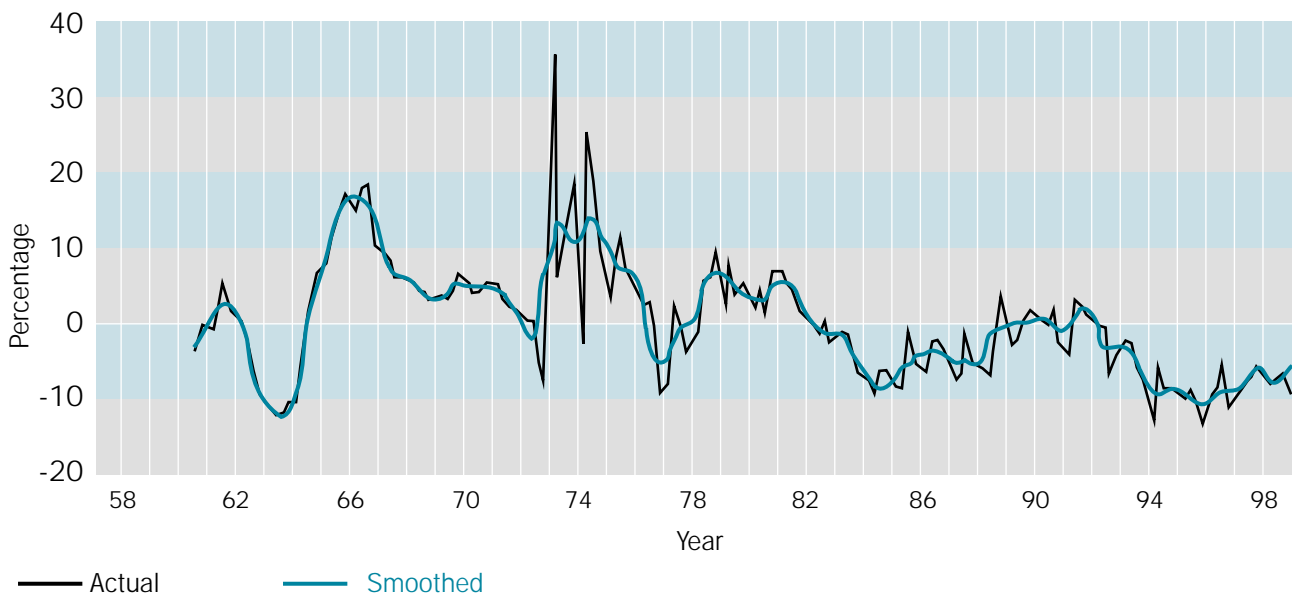
A number of features are apparent from Figures 4 and 5:

• There was a big upsurge in reported skills constraints, relative to the cycle, in the mid-sixties. This is the period associated with an increased number of labour disputes and the end of the "golden era" of post-war UK growth.

• The unparalleled effect of the Barber Boom (in 1972/73) is apparent in both Figure 4 and Figure 5 (and indeed, Figures 1 and 2). There has been nothing like the skills constraints apparent then since.

• Figure 4 indicates that since the mid-sixties there has been a trend decline in the proportion of respondents citing a shortage of skilled labour as a constraint on output. This decline may have flattened off since the mid-eighties, but it is too early to say for sure.

• The variation of the skills constraint series appears to have lessened over time. We can see from Figure 4 that the skills constraints series was more volatile than the employment change series until around 1980, and less volatile thereafter.

• From Figure 1, and from statistical tests, we can also see that labour shortages as a constraint on capital expenditure are much less cyclical than skills constraints.

This analysis shows that although there is an obvious positive relationship between reported skills constraints and the economic cycle (proxied here by the reported changes in employment), there are still interesting variations in reported skills constraints once we have extracted the cycle. There is still a suspicion from Figure 5, however, that even the residuals from the equation are displaying a similar pattern to the general economic cycle. This implies that the relationship between respondents citing availability of skilled labour as a constraint on output and the economic cycle is non-linear. Specifically, in this case, not only is there a positive relationship between skills as a constraint and

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7 The smoothed version of the residual series was constructed using a Henderson 9-point moving average.

employment growth but skills constraints show up as being particularly severe when employment is growing very rapidly and vice-versa.

If this is the whole story, with skills shortages being caused by the economic cycle and the survey results telling us little about the impact of skills shortages on the rest of the economy, then skills play a very secondary part. However, we cannot yet conclude that skills constraints are simple a reflection of the economic cycle as the link between skills and the cycle may be more complex than that - indeed, the CBI question is seeking evidence of a *negative* relationship between skills shortages and output and, by implication, employment.

Figure 6. Correlation of Kills constraints with Employment & Output
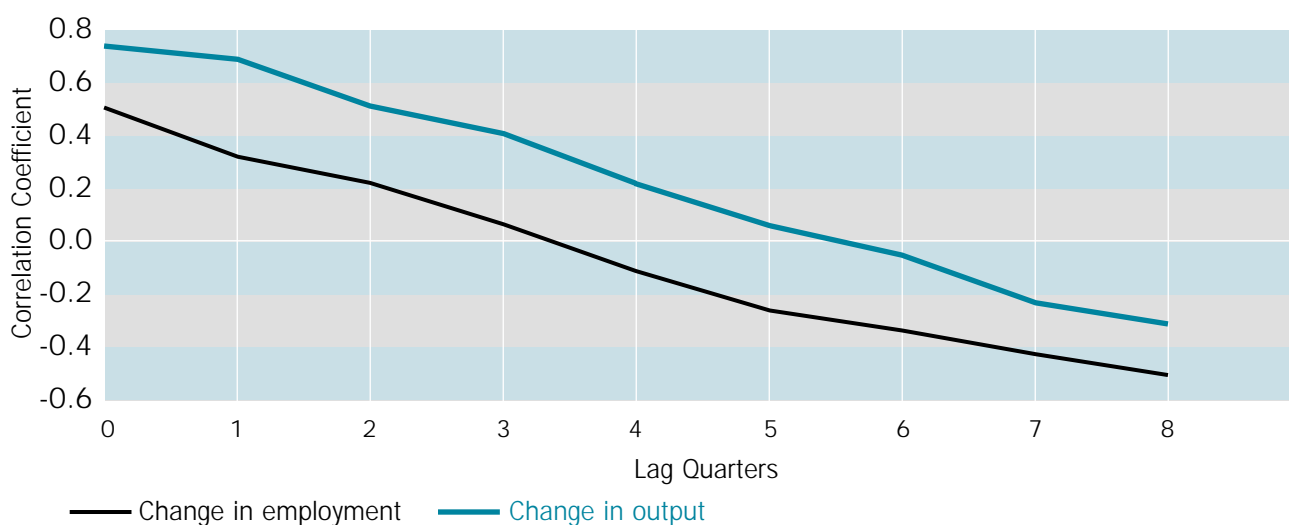
How does the evidence in Figures 1 to 5 fit in with the expectation of a negative relationship? The answer lies in the relationship over time. Figure 6 shows the correlation between reported changes in both employment and output from the survey and lagged values of the responses to the skills constraints question. From this we can postulate that, while the series move together over time (that is, the immediate relationship is *positive*) the *negative* relationship is captured by looking at the relationship between current and lagged values of the series'. That is, the negative relationship seems to exist as a cause-and-effect type relationship. For example, the simple correlation coefficient between the reported change in employment and the proportion of respondents citing skills shortages as a constraint on output *at the same point in time* is 0.694. A quarter earlier the correlation is lower, and two quarters earlier the correlation is lower still - and so on, until the correlation with the responses to the skills constraint question *six quarters* earlier is actually negative. While it can be seen that the relationship between the responses to the skills constraint question and changing output is not as strong as the relationship with changing employment, it does go negative sooner.

We have to be careful with this kind of analysis, since all we might be picking up are cycles that are out of step with one another, rather than a causal relationship. Nonetheless, we appear to be moving towards a type of "stop-go" model in which a number of the survey variables are linked over time, with skills deficiencies playing a part in generating the cycle where increases in employment are followed by decreases and subsequently by increases, and so on. The diagram below illustrates the idea, and the following sections examine the idea more rigorously.
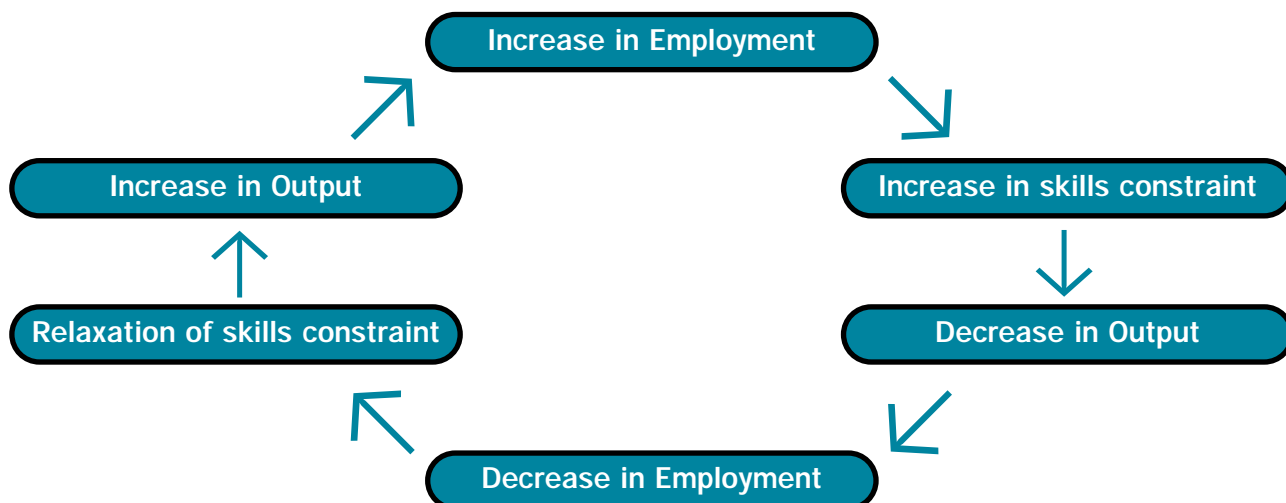
Furthermore, a study by Nickell and Nicolitsas[8], 1999, investigates the existence of any connection between the availability of human capital and the rates of accumulation of physical capital (fixed capital investment) or knowledge capital (R&D expenditure). The outcome of this study suggested a negative relationship existed[9] between a shortage of skilled labour and subsequent investments and R&D expenditure - thus raising the idea that investment in human capital and physical/knowledge capital are strategic complements. Using this idea, an increase in the skills constraints would lead to a subsequent fall in investment and consequently output as hypothesised in the diagram above.

It must be stressed that there are other impacts of skill shortages on output. For instance, Haskel and Martin[10], 1993, using a panel of 81 3-digit industries over 1980 - 1986, merged with industry skill shortage information from the CBI Industrial Trends Survey, investigated the hypothesis that skilled labour shortages reduce productivity. The results concluded that, with all else held constant, the increase in skill shortages over the mid-80s significantly reduced productivity growth. Shortages of unskilled workers, however, were found to have no significant effect. Two arguments were used to provide support for the hypothesis, these ran as follows: firstly, shortages increase the cost of hiring skilled labour leading firms to substitute toward cheaper, less productive unskilled labour; and secondly, shortages may put workers in a position of stronger bargaining power in which an easier pace of work can be demanded.

There may be supply-side reactions that could act to negate the cycle depicted in the diagram above. For example, an increase in output could lead to an increase in firms' training provision in the anticipation of future needs. This would break the circle. The results presented below, however, are consistent with any supply-side being insufficient to fully break out the circle. There is also a role for an exogenous supply-side input. If training provision increases there will be a decrease in skills as a constraint on output, and subsequent increases in output and employment. This is consistent with the findings reported below. It is also consistent with Nickell and Nicolitsas[11] who argue that an increase in human capital (in the form of an increase in the provision of training) will lead to an increase in investment and output.

8 Nickell, S. and Nicolitsas, D. (1999), Human capital, investment and innovation: what are the connections?, R. Barrell, G. Mason, M. O'Mahony (eds.), Productivity, Innovation and Economic Performance, Cambridge: Cambridge University Press.
9 The results of the study suggested that a 10 percentage point increase in the number of firms reporting skilled labour shortages in the manufacturing industry (in this case) will lead to a sustained 10 per cent reduction in its fixed capital investment and an unsustained 4 per cent reduction in R&D expenditure.
10 Haskel, J. and Martin, C. (1993), Do skill shortages reduce productivity? Theory and evidence from the United Kingdom. Economic Journal, 103 (March), 386 - 394, Blackwell Publishers, Cambridge.
11 Nickell, S. and Nicolitsas, D. (1999), Human capital, investment and innovation: what are the connections?, R. Barrell, G. Mason, M. O'Mahony (eds.), Productivity, Innovation and Economic Performance, Cambridge: Cambridge University Press.

5.2 Granger Causality

We will now use more formal statistical techniques to investigate whether there is any evidence of the kind of dynamic feedback loops suggested in the previous section.

Simms-Granger causality tests are statistical tests of the possibility of a causal link running from one variable (one survey question) to another. More precisely, they are tests of whether or not changes to one variable pre-date changes to another. The possible outcomes are that A causes B[12], that B causes A, that there is joint causality (i.e. A causes B and B causes A) or that there is no causality. Thus we can consider the following questions:

1. Are skills shortages a result of other developments in the economy? and/or

2. Are there identifiable consequences of skills shortages?

Granger causality should be distinguished from contemporaneous correlation (which is what is apparent to the eye in the charts), which just says that variables move the same way at the same time. If we can find that skills shortages 'Granger cause' other variables then it will offer us a pointer to the economic consequences of those skills deficiencies. If, on the other hand, other variables 'Granger cause' the skills shortages series without any feedback, the implication will be that we are merely picking up recruitment difficulties associated with different stages of the economic cycle.

As we have previously observed, the relationship between the various survey questions appears to have changed over time so we have run the tests twice; once for a longer sample and once for a shorter sample. Test results using the estimation period 1974 to 1999 are given in Table 15, and in Table 16 for the estimation period 1984 to 1999. The latter sample has been chosen taking into consideration the changes in the UK economy since the mid-eighties (i.e. no 3 day week and labour market reforms).

The interpretation of the tables is as follows. If the quoted test statistic is greater than the critical value of the F statistic (shown at the bottom of the tables), then there is evidence of Granger causality.

Table 15: Granger Causality Tests Statistics Using CBI data 1974-1999:2

		Caused Variable				
		Skills	Employment	Output	Capacity	Investment
Causal Variables	Skills	-	17.07	8.64	12.25	5.47
	Employment	2.42	-	3.06	1.70	0.41
	Output	7.27	20.70	-	23.52	12.23
	Capacity	0.96	8.13	3.84	-	1.52
	Investment	8.62	18.31	6.00	3.69	-
Critical value F(1%)4,98 = 3.57						

Source: Business Strategies, 1999

12 The usual statistical terminology is that A Granger causes B.

Table 16: Granger Causality Tests Statistics Using CBI data 1984-1999:2

		Caused Variable				
		Skills	**Employment**	**Output**	**Capacity**	**Investment**
Causal Variables	Skills	-	8.81	3.45	3.24	1.44
	Employment	1.95	-	0.85	0.92	1.60
	Output	4.28	11.95	-	4.91	1.61
	Capacity	1.72	4.66	2.90	-	0.68
	Investment	5.02	9.42	5.78	6.62	-
Critical value F(1%)4,58 = 3.81						

Source: Business Strategies, 1999

The results shown on Table 15 indicate that, for the wider (1974-1999) sample there is evidence that changes in skills shortages pre-date (or, Granger cause) changes in each of the other variables. In the case of output and investment there is also evidence of feedback. That is, for example, skills shortages have possible implications for future output and investment, which have possible implications for future skills shortages.

The implication of Table 15 is (as one would intuitively expect) perceived skill shortages may prevent employers from increasing employment by as much as they would like. Surprisingly, there is no evidence of *as significant* an impact on output. What may be going on here is that there are more complex links and lags than we have allowed for. That is, lower employment could lead to lower capacity, which in turn, could impact on output.

Another possible reason for the above results is provided in the ECISD case studies.[13] Here they find that rather than allowing skills problems, such as recruitment difficulties, to constrain capacity, they were 'overcome' in other ways. For instance, where possible, staff are required to work over-time. This especially applies at a managerial level where overtime is typically unpaid. At lower levels, agency workers are sometimes brought in, and when applicable, outsourcing is sometimes used to overcome skills shortages. Strategic responses to solving skill shortages were also cited. Responses include being more targeted in recruitment efforts and providing on-going professional development and training for existing staff.

If we look at Table 16 there is a very different picture. In the case of output and investment there is evidence that each 'granger causes' skills with no direct feedback. On its own, this could imply that we are merely picking up skills shortages, associated with the stage in the economic cycle. However, there is also 'strong' evidence of Granger causality from skills to employment, with no feedback. Given that the UK economy since the mid-eighties has been rather different from that in the seventies, we believe that the results in Table 16 are more useful in addressing our current concerns.

In terms of our original questions the answers from this avenue of analysis are that:

1. Skills shortages do not simply reflect recruitment difficulties associated with the stage of the cycle.

2. Reported skill shortages may show negative impact on employment, which, in turn impacts on lower capacity, lower output and lower reported skills shortages.

13 A summary of these case studies will be available in the forthcoming report: Hogarth, T., The Extent, Causes and Implications of Skill Deficiencies, Case Study Synthesis Report, Institute for Employment Research, University of Warwick.

5.3 The Vector Auto-Regressive Model

To further investigate whether there are more complex links and lags than we have allowed for, a VAR (Vector Auto-regression) model has been developed. VAR models have proven to be a popular means for analysing the dynamic and causal interrelationships between different time series.[14] The model also allows us to quantify the extent of these relationships.

This type of model aims to capture potential links such as those described in the flow chart above, but without imposing prior views on the relationship between variables. These models also have the advantage of encompassing the formulation of expectations, and the potential link between expectations of future values of a variable, rather than the current value of the variable itself, and other variables.

In a VAR model, all variables in the economic system are treated as endogenous in the estimated equations. Lags of each variable are included into each equation to capture the inter-temporal correlation between variables. The more lags we have, the more parameters there are in the system.

For instance, a system with 3 equations and a lag length of 2 quarters would be written as:

$y1t = \alpha11\ y1,t\text{-}1 + \alpha12y1,t\text{-}2 + \beta11y2,\ t\text{-}1 + \beta12y2,\ t\text{-}2 + \delta11y3,\ t\text{-}1 + \delta12y3,\ t\text{-}2 + \varepsilon1,t$

$y2t = \beta21\ y2,t\text{-}1 + \beta22y2,t\text{-}2 + \alpha21y1,\ t\text{-}1 + \alpha22y1,\ t\text{-}2 + \delta21y3,\ t\text{-}1 + \delta22y3,\ t\text{-}2 + \varepsilon2,t$

$y3t = \delta31\ y3,t\text{-}1 + \delta32y3,t\text{-}2 + \alpha31y2,\ t\text{-}1 + \alpha32y3,\ t\text{-}2 + \beta31y2,\ t\text{-}1 + \beta32y2,\ t\text{-}2 + \varepsilon3,t$

where yw,t stands for variable for w ($w=1, ..., 3$) at time t.

There are various procedures available to assist in the determination of the most appropriate lag length, such as Akaike's Information Criterion, Schwartz Bayesian Criterion and the Adjusted Likelihood Ratio Test. Both Akaike's Information Criterion and Schwartz Bayesian Criterion prompted us to select a lag length of eight quarters.

The choice of an eight-quarter lag structure leads us to one of the practical problems faced when estimating VAR models. If the lag length is set too low, some of the intertemporal correlation between the variables may not be captured, leading to serially correlated disturbances and thus, invalid hypothesis-testing procedures. However, if the lag length is set too high, we may end up with too many parameters to estimate given the sample size, or at the very least, can lead to a set of inferences with large standard errors.

Fortunately, this problem of "overparamaterisation" can be overcome using the Bayesian vector auto-regression (BVAR) approach.[15] The BVAR is an extension of the VAR model that enables the incorporation of any additional knowledge we have about the parameters beyond that contained in the sample. This is achieved by assigning some prior distribution on the estimated coefficients, the addition of more information into the model generally leading to more stable estimates. For this reason we have estimated our system of equations using a BVAR model.

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13 A summary of these case studies will be available in the forthcoming report: Hogarth, T., The Extent, Causes and Implications of Skill Deficiencies, Case Study Synthesis Report, Institute for Employment Research, University of Warwick.

14 C.A. Sims, "Macroeconomics and Reality", Econometrica, vol. 48, 1980, pp. 1-48.

15 For more information on Bayesian methods see:

Berger, James O., (1985), Statistical Decision Theory and Bayesian Analysis, (2nd edition), New York: Springer;

Bernado, J.M. and A.F.M. Smith, (1994), Bayesian Theory, New York: Wiley;

Poirier, Dale J., (1995), Intermediate Statistics and Econometrics: A Comparative Approach. Cambridge: MIT Press.

We incorporated into our model the likelihood that as the length of time between two variables increases, so decreases the likelihood that movements in the variable in the earlier period will impact on the other variable today. To achieve this, we constrained the coefficient estimates such that the likelihood of the coefficient being equal to zero was increasing in the lag length of the associated variable.

We constructed a BVAR model using data from the CBI's Industrial Trends Survey for the period 1984 to 1998. (We argued above that more recent data are more relevant because of distortions in the earlier period arising from the three-day week, and because of the potential impact of labour market reforms on the latter period). The model includes the survey questions on changes in employment, changes in output, changes in investment, below capacity working and skilled labour as a constraint on output.

Once the equations are estimated we can test the impact of skills as a constraint by adding a residual to the skills as a constraint equation which would result in the predicted value (all else being equal) being a fixed amount (one in this case) higher than it would otherwise have been. We then solve the full model to find the impact on the other variables and the feedback to the skills as a constraint question. This feedback will change the value of the skills as a constraint variable beyond the residual of one that we originally imposed. This is the equivalent of asking, "what is the impact of a tightening of skills constraints?"

The results (expressed in terms of differences from the base) are shown in Figures 7 to 9. Figure 7 shows that after a short period where both employment and output changes are higher than base, the differences go sharply negative. Similarly, Figure 8 shows that investment is down, and below capacity working is up.

Figure 7. CBI ITS: Impact of an Increase of 1% in Respondents Citing Skills Deficiencies as a Constraint (Estimation Period: 1984 - 1998)
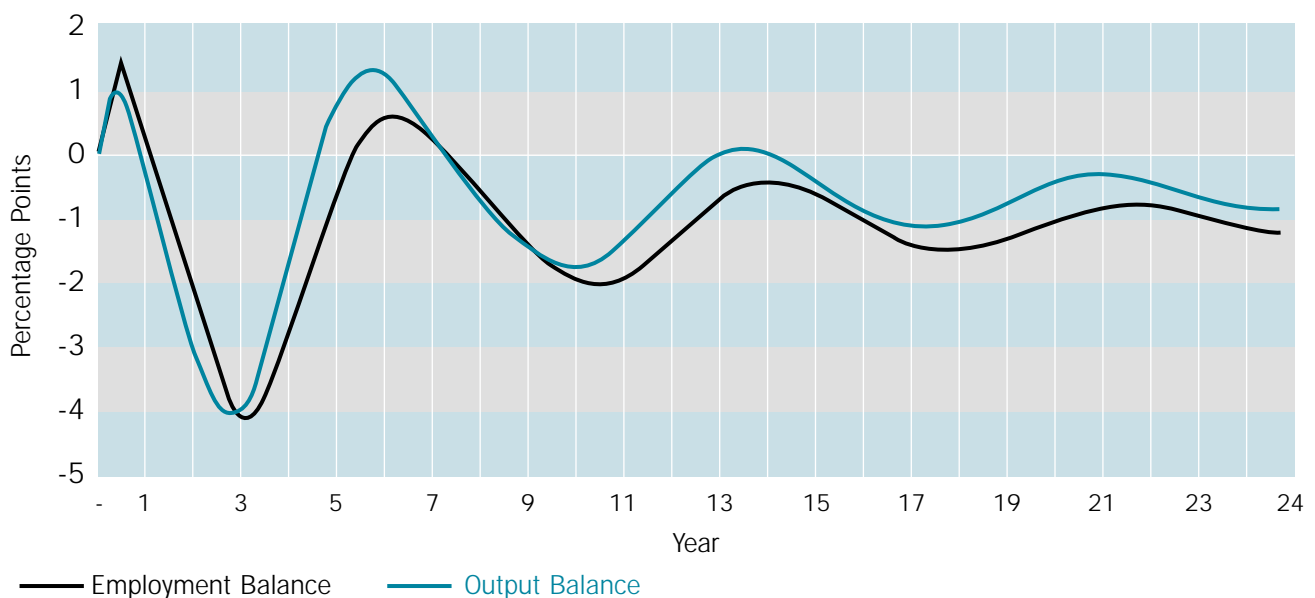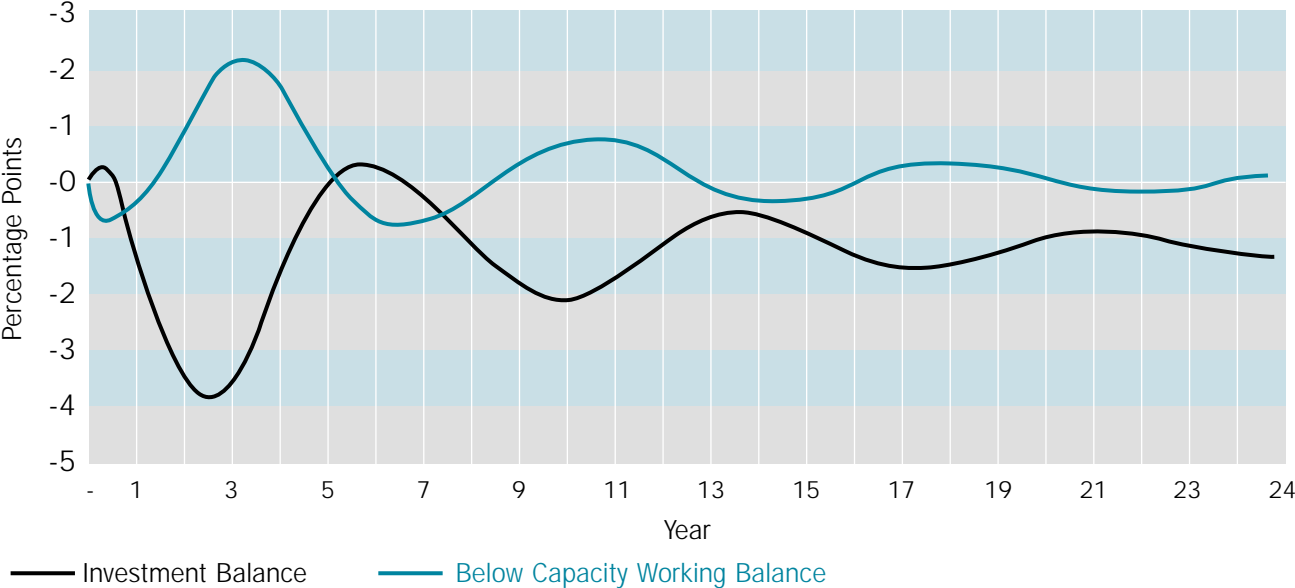
Figure 8. CBI ITS: Impact of an Increase of 1% in Respondents Citing Skills Deficiences as a Constraint (Estimation Period: 1984 - 1998)

Although the results shown in Figure 7 eventually settle down at about one below base after around twelve years, we should be wary about attaching too much weight to small changes so far out because we cannot be sure of their statistical significance. Because of this we focus our attention on the first six years, which is the time by which the re-bound has occurred. This means that after an initial increase in the balance of respondents citing skills deficiencies as a constraint, the impact is sharply negative until it returns to something not too far from zero after about six years. Similar results can be seen for investment and firms working below full capacity (Figure 8).

Figure 9. CBI ITS: Impact of an increase of 1% in respondents Citing Recruitment Difficulties (Estimation Period: 1984 - 1998)
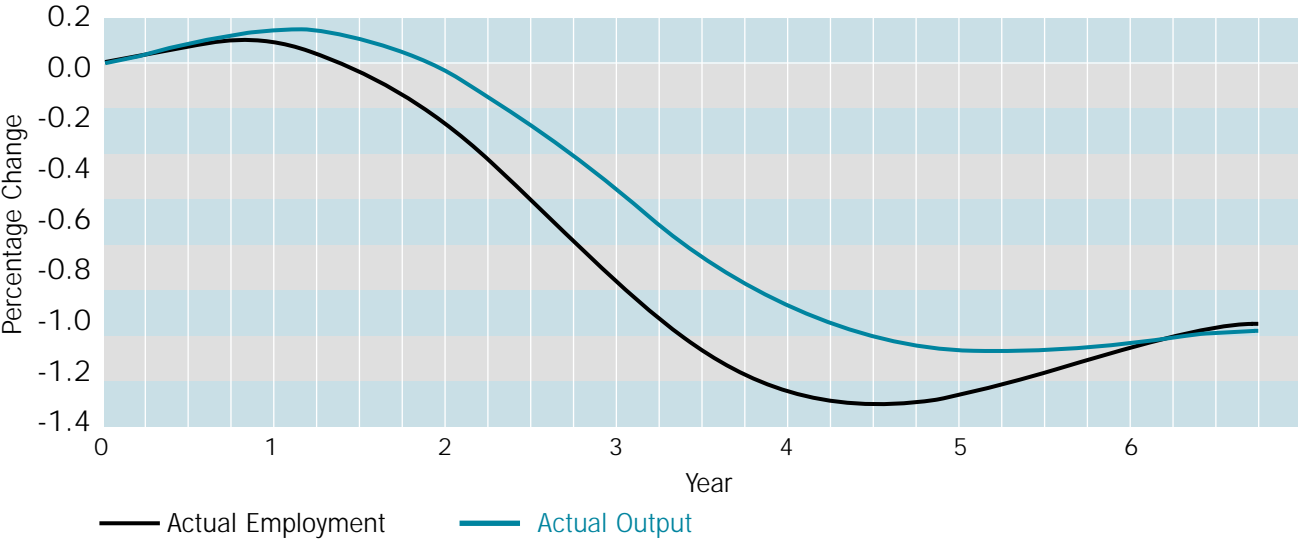
Recalling that the questions on output and employment refer to changes (as opposed to levels) in output and employment, we can estimate historical relationships between manufacturing output and employment growth and the CBI balances[16], and use these to infer the impact of *skills as a constraint* on actual output and employment. Focusing our attention on the first six years, the results of this are shown in Figure 9.

From Figure 9 we can see that an increase of one per cent in the number of respondents citing a shortage of skilled labour as a constraint on output is associated with a fall in both output and employment of about one per cent. This is strong statistical evidence that shortages of skilled labour do matter, and that their existence keeps both output and employment below what they might otherwise be.

Figure 10 shows the results for the *skills as a constraint* question itself. Initially this is one point above base (this is the residual that we have added). It then falls quite steeply to be $^1/_2$ a point below base. In other words, for a time, the responses to the *skills as a constraint* question itself do not show the full extent of the problem. The initial constraint is associated with a fall in employment, which in turn, is associated with a reduction the perceived problem as skills as a constraint on output. This is the process that we hypothesised in the flow chart.

Figure 10. CBI ITS: Impact of an Increase of 1% in Respondents Citing Recruitment Difficulties (Estimation Period: 1984 - 1998)

——— Skilled Labour as a Constraint on Output
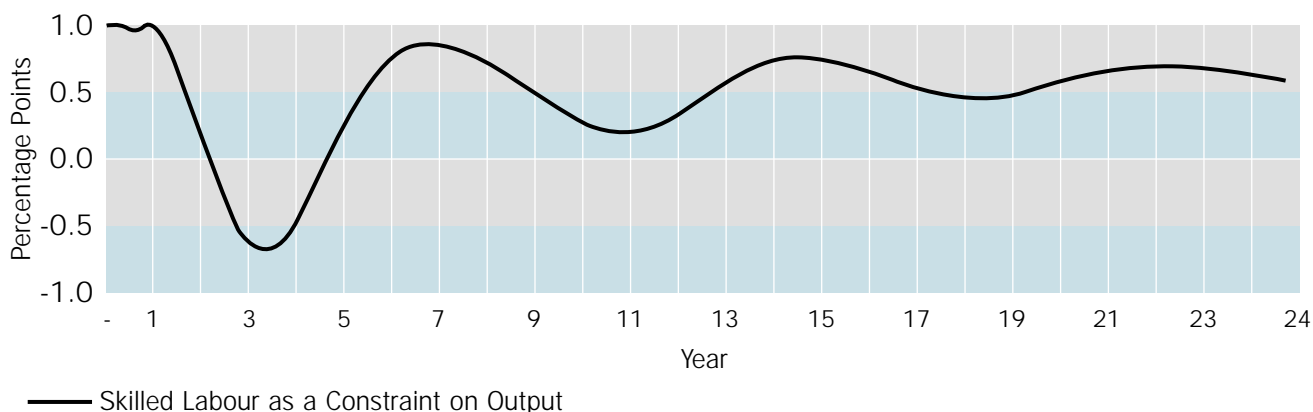
Although the model tells us that exogenous changes to *skills as a constraint* have a big impact on output and employment we need to be careful in interpreting past changes in the survey results. In particular, given the fall off in the importance of skills as a constraint since the seventies, we might be tempted to think that this had a positive impact on employment and output. One interpretation the model gives us, however, is that an exogenous, negative shock to output and/or employment are associated with an easing of the skills constraint. The current low levels of response to the skills constraint question may therefore not be an indication of the improvement of the workings of the labour market, but a result of the decline of UK manufacturing industry. So, although, *skills as a constraint* are important (as we have demonstrated), we need to be aware that other factors have been at work in determining the current levels of manufacturing output and employment.

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16 We have estimated our own equations for the link between the CBI balances for reported changes in output and employment and official estimates of manufacturing output and employment but the methodology closely follows that in Robson, P. and Sentence, A (1997) Interpreting the CBI Industrial Trends Survey, London Business School Centre for Economic Forecasting Discussion Paper DP31-97 and in Blake, N. and Robson, P. (1998) Are the official estimates of productivity growth giving the MPC misleading signals? Economic Outlook 22, 4.

So far we have confined the analysis to data on manufacturing, chiefly because of the availability of a lengthy time series. As outlined in section 2.3, we also have data from the British Chambers of Commerce (BCC) survey on recruitment difficulties in services, although the series only begins in 1989. We have used this to fit a similar model to that constructed with CBI data. The chief difference is that because of the shorter-time period we have only used four lags. The results summarised in Figures 11 to 13 are surprisingly similar to those for manufacturing.

Figure 11. BCC: Impact of an increase of 1% in Respondents Citing Recruitment Difficulties (Estimation Period: 1989q1 - 1999q2)
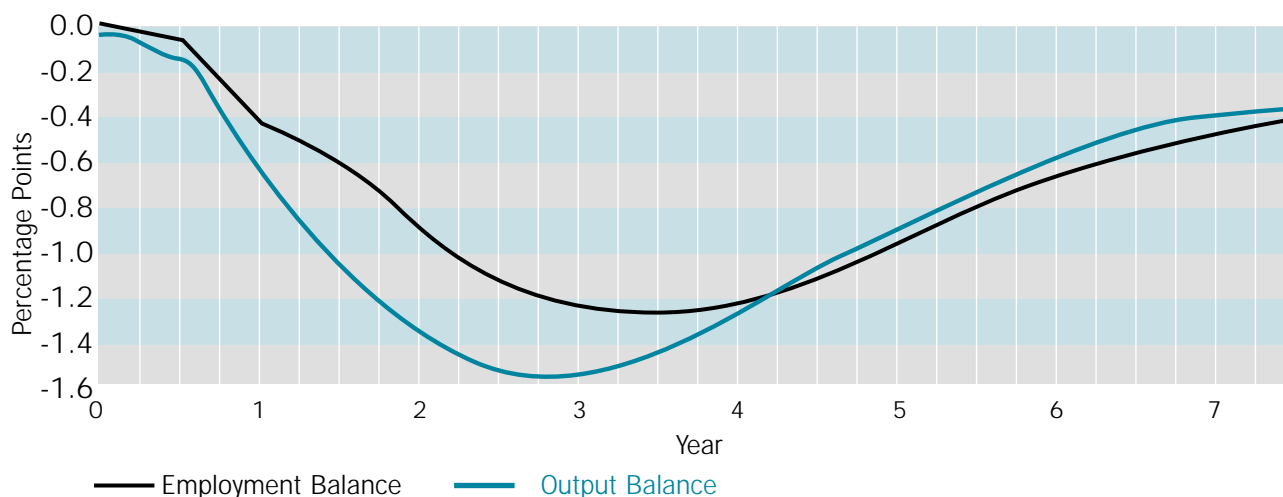
To get some idea of the actual impact on employment we have related changes in employment in services[17] to the BCC survey data. The results are shown in Figure 12. Once again, we have strong evidence of a negative relationship between recruitment difficulties and future employment.

Figure 12. BCC: Impact of an increase of 1% in Respondents Citing Recruitment Difficulties (Estimation Period: 1989q1 - 1999q2)
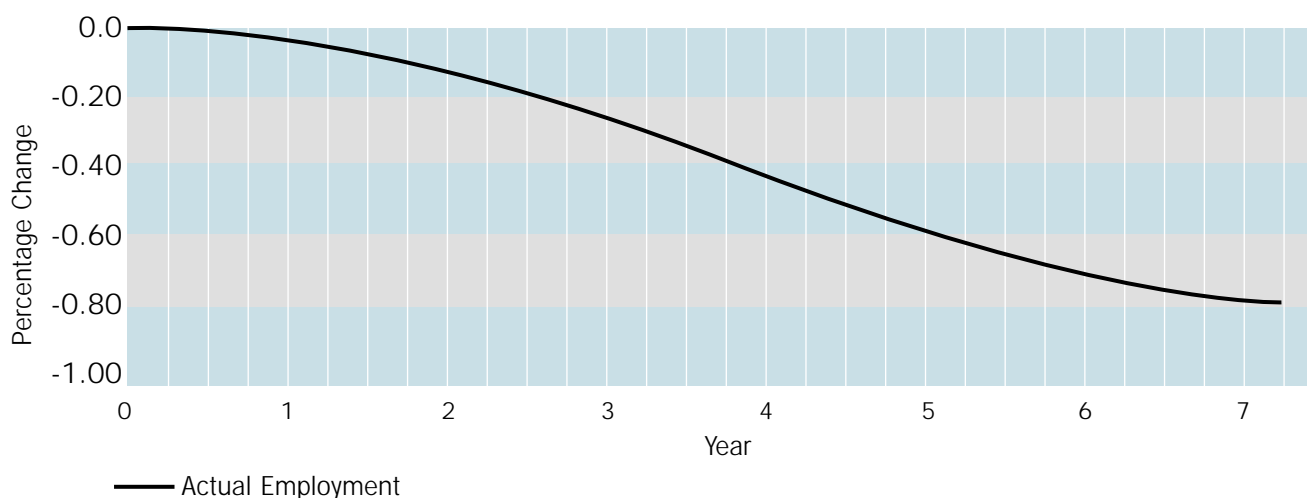
17 Including distribution, hotels and catering; transport and communications; and financial and business services.

Figure 13 demonstrates that the *recruitment question* itself responds similarly. The responses to the recruitment difficulties question under-state the problem as past recruitment difficulties reduced employment and hence relaxed the recruitment difficulties.

Figure 13. BCC: Impact of an increase of 1% in Respondents Citing Recruitment Difficulties (Estimation Period: 1989q1 - 1999q2)
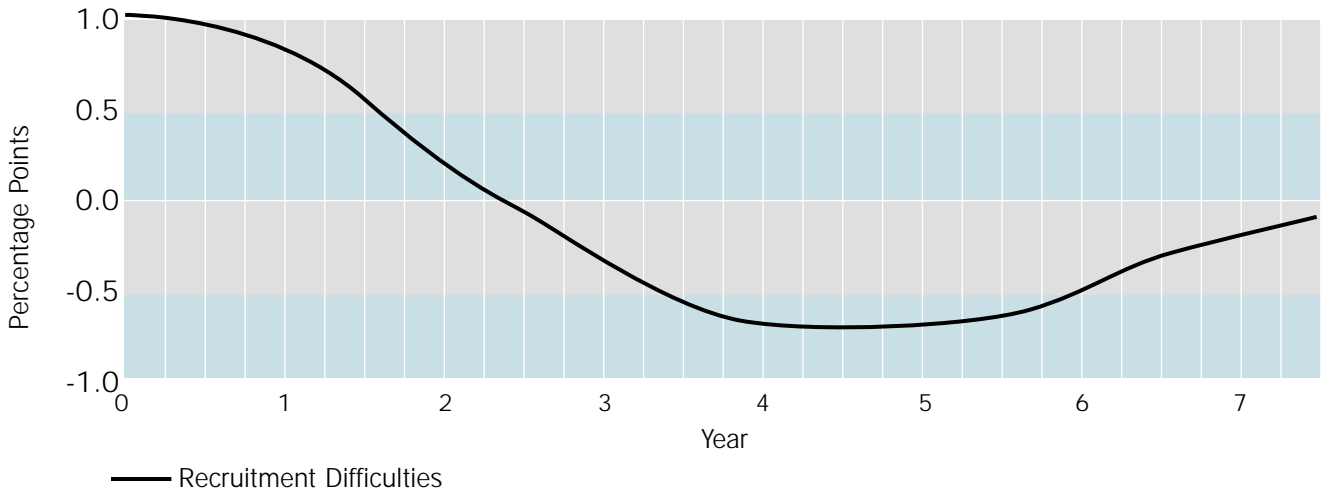
To properly compare the results obtained using the CBI ITS survey results with those obtained using the BCC survey results, the former model has been re-run using the shorter time period (that is, from 1989) with the lag length reduced to four. Figure 14 below demonstrates the impact on employment and investment of a 1% increase in respondents citing skills deficiencies as a constraint. Figure 15 demonstrates the impact of the same change on investment and the proportion of firms working below capacity. These results are very similar to those obtained using the longer time series, although less of the cyclical effect is captured in the estimation.

Figure 14. CBI ITS: Impact of an increase of 1% in Respondents Citing Skills Deficiences as a Constraint (Estimation Period: 1989q1 - 1999q2)
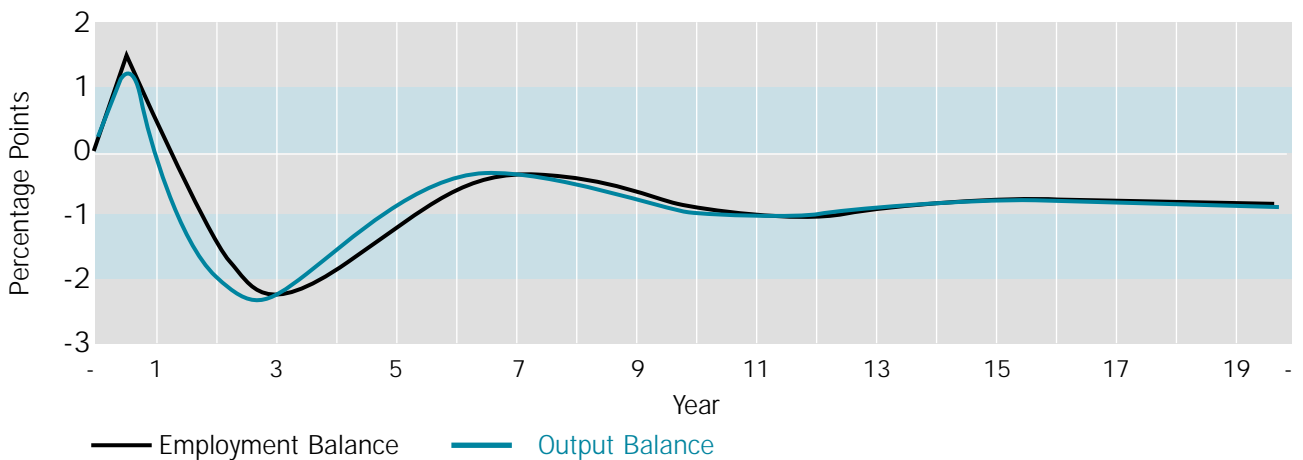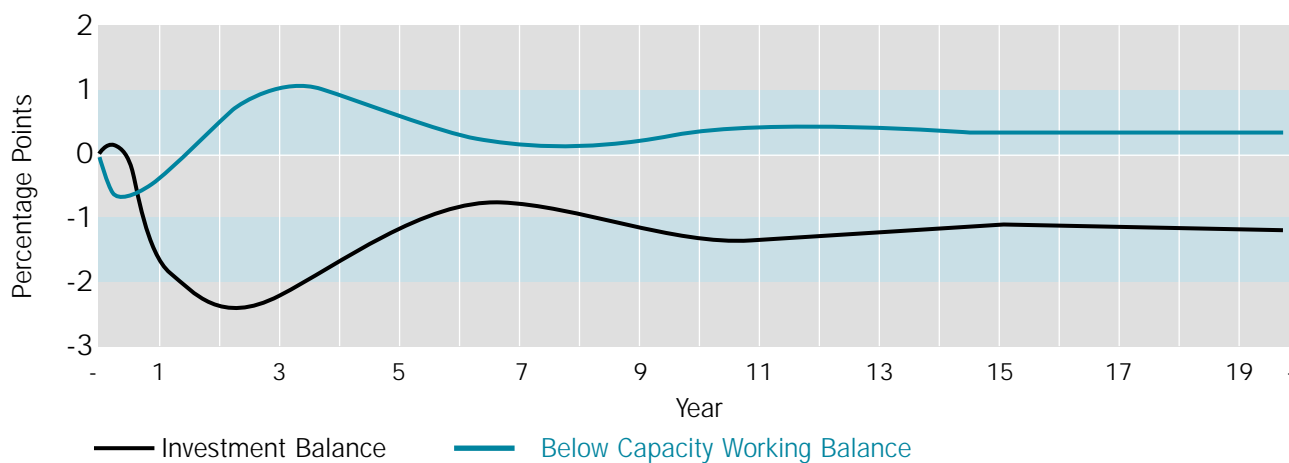
Figure 15. CBI ITS: Impact of an increase of 1% in Respondents Citing Skills Deficiences as a Constraint (Estimation Period: 1989q1 - 1999q2)

These results (using the BCC Survey and the CBI survey over a limited time period) confirm that the hypothesis about the impact of *skills as a constraint* on other economic variables that we originally tested using CBI data for 1984-1998 holds for services as well as for manufacturing. It also shows that the results for manufacturing are not overturned by shortening the estimation period.

6. IMPLICATIONS

The overarching question addressed by Section 5 is whether the reporting of *skills as a constraint* is simply a product of the stage of the economic cycle or does it have broader implications for the other economic variables such as output and employment? It begins by showing that casual inspection of the survey data and simple regression analysis do indeed suggest that the *skills as a constraint* responses vary with the economic cycle. However, this does not in itself prove that the former is simply a product of the latter or that skills constraints does not have implications for other variables. There is evidence (Figure 6) that skills constraints have a negative impact on output and employment when account is taken of possible time lags.

A simple model is hypothesised in which skills shortages, employment, output and other variables are all closely linked together over time. Granger causality tests lend some support to the hypothesis by showing that skills constraints are not simple a product of the economic cycle but have a negative impact on employment, output and capacity. A BVAR model is developed to estimate the impact of skills constraints. This shows that an increase of one per cent in the number of respondents citing a shortage of skilled labour as a constraint on output is associated with a fall in both output and employment of about one per cent. For services, an increase of one percent in the number of respondents citing recruitment difficulties is associated with an eventual decline in employment by something between $^{1}/_{2}$ and $^{3}/_{4}$ of a per cent.

That analysis suggests that, despite anxieties over the limitations of existing surveys and the ways in which respondents often miss the intended meaning of the survey design, some important and robust conclusions can be drawn. The results for both manufacturing and services show strong links between all of the variables, and a strong negative link between skills shortages/recruitment difficulties and both output and employment.

In both cases, the feedback from lower employment to the skills shortages/recruitment difficulties means that the actual response to the questions understates the true extent of the problem. That in turn implies that it is important that future research should focus on understanding how skill needs, and skill deficiencies, evolve over time. That requires the separation of cyclical and structural trends, but it also requires a richer understanding of how employers respond to skill deficiencies.

ANNEX
CURRENT SURVEY QUESTIONS

Skill Needs in Great Britain and Northern Ireland 1998

Questions on current vacancies:

SNB1. How many vacancies, if any, do you have at the moment at this location?
(If none, ask no more questions on current vacancies).

SNB1.1. I'd like you to tell me the specific occupations in which you currently have vacancies at this location. Please tell me them in their order of importance to you?

SNB1.2. Do you currently have any vacancies at this location which are proving hard-to-fill?
        a) Yes (ask Q1.3);
        b) No (ask no more questions on current vacancies)

SNB1.3. Which of the following reasons that I am going to read out are the causes of your hard-to-fill vacancies? (If only one is indicated, then go to Q2)
        a) Not enough suitably skilled people;
        b) Not enough people interested in doing this type of job;
        c) Too much competition from other employers;
        d) Company doesn't pay enough;
        e) Lack of technical or practical skills;
        f) Lack of basic ability to build upon;
        g) Poor attitude, motivation, or personality;
        h) Lack of the qualifications you demand;
        i) Lack of the work experience you demand;
        j) Inflexibility and unwillingness to accept change;
        k) Other;
        l) Don't Know

SNB1.4. And what is the main cause of your hard-to fill vacancies? (Read out all mentioned in Q1.3)

SNB2. I'd like you to tell me the specific occupations in which you currently have vacancies at this location that are proving hard-to-fill? (Refer to list at Q1.1)

SNB2.1. And how many actual vacancies do you have for... Read out all hard-to-fill vacancies mentioned in Q2.

SNB2.2. Overall, are the hard-to fill vacancies causing you...?
        a) Loss of business or orders to competitors;
        b) Loss of quality in the service given to customers;
        c) Significant restrictions to business development activities;
        d) Increased running costs due to use of overtime, subcontracting or temporary staff;
        e) Above average recruitment costs through advertising, use of recruitment agencies etc.;
        f) Loss of efficiency or increased wastage;
        g) None of these

SNB2.3. What actions are you taking at the moment to try and fill your hard-to-fill vacancies?

SNB2.4. How many people do you currently employ as... Read out first then subsequent vacancies from Q2.

SNB3. Did any of these current hard-to-fill vacancies that you have just been talking to me about exist twelve months ago
    a) Yes;
    b) No

Questions on past vacancies:

SNB4. Thinking back over the past twelve months, have you had any vacancies at this location that were hard-to-fill that do not exist now?
    a) Yes (Answer no more questions on past vacancies);
    b) No (And no vacancies at Q1 or Q1.2 - ask Q5; And yes at Q1.2 - answer no more questions
       on past vacancies)

If there have been no hard-to-fill vacancies over the past twelve months answer no more questions on past vacancies.

SNB5. Which of these would you say is the more important reason for your not having had any hard-to-fill vacancies at this location over the last twelve months?
    a) You have not been doing much recruitment (Answer no more questions on past vacancies);
    b) You have not had any problems finding recruits (Ask Q6)

SNB6. For which of these reasons do you feel you have not had any problems finding recruits over the past twelve months?

Questions on skills gaps:

SNB7. Turning now to the overall skills needed at your location to keep it running effectively, would you say that the need for skills in your average employee was...?
    a) Decreasing (Go to Q8);
    b) Static (Go to Q8);
    c) Increasing

SNB7.1. What are the main factors causing this increase?

SNB8. Would you say that there is a significant gap between the type of skills that your current employees have now, and those they need to meet your current business objectives?
    a) Yes;
    b) No (Go to Q10)

SNB8.1. In which occupations do you feel the skills gap is greatest?

SNB9. Which if any, of these skills do you think are generally lacking in your existing employees?
    a) Technical or practical skills;
    b) Literacy skills;
    c) Numeracy skills;
    d) Management skills;
    e) Customer handling skills;
    f) General communication skills; Computer literacy or knowledge of information technology;

g) Team working skills;

h) Problem solving skills;

i) Managing own development

SNB10. May I just check, are any of your current employees aged between ?

a) 16-17;

b) 18-19;

c) 20-24;

d) Don't know (If no to a, b, and c ask no more questions on skill gaps).

SNB10.1. Would you say there is a significant gap between the type of skills your 16 to 24 year old employees have now and those that they need to meet your current business objectives?

a) Yes;

b) No (Ask no more questions on skill gaps)

SNB10.2. Which, if any, of these skills do you feel need improving among your 16 to 24 year old employees?

SNB10.3. Thinking about (type of skill selected at 10.2) would you say that the skills gap is especially significant for 16 to 17 year olds?

The CBI Quarterly Industrial Trends Survey

ITS question 3b. Do you expect to authorise more or less capital expenditure in the next 12 months than you authorised in the last 12 months
on plant and machinery:

a) More;

b) Same;

c) Less;

d) N/A

ITS question 4. Is your present level of output below capacity (i.e. are you working below a satisfactory full rate of operation?)

a) Up;

b) No;

c) N/A

ITS question 6. Excluding seasonal variation, what has been the trend over the past four months with regard to the numbers employed:

a) Up;

b) Same;

c) Down;

d) N/A

ITS question 8. Excluding seasonal variation, what has been the trend over the past four months with regard to the volume of output:

a) Up;

b) Same;

c) Down;

d) N/A

ITS question 14. What factors are likely to limit your output over the next four months. Please tick the most important factor or factors? (For each of a-g the percentage all firms is reported)

      a) Orders or sales;

      b) Skilled labour;

      c) Other labour;

      d) Plant capacity;

      e) Credit or finance;

      f) Materials or components;

      g) Other

ITS question 16c. Which factors are likely to limit (wholly or partly) your capital expenditure authorisation over the next twelve months? (For each of a-h the percentage all firms is reported)

      a) Inadequate net return on proposed investment;

      b) Shortage of internal finance;

      c) Inability to raise external finance;

      d) Cost of finance;

      e) Uncertainty about demand;

      f) Shortage of labour including Managerial and Technical staff;

      g) Other (please specify);

      h) N/A

The British Chambers of Commerce Quarterly Economic Survey

BCC1. Have you attempted to recruit staff over the past 3 months? (Per cent of all firms)

BCC2. If yes, were they for: (For each of a and b, the percentage of those firms who answered yes to Q1 is reported)

      a) Part-time jobs / Full-time jobs?;

      b) Temporary jobs / Permanent Jobs?

BCC3. Did you experience any difficulties finding suitable staff? (Per cent of all firms).

BCC4. If yes, for which of the following categories? (For each of a-d, the percentage of those firms who answered yes to Q1 is reported)

      a) Skilled manual and technical;

      b) Professional and managerial;

      c) Clerical;

      d) Unskilled and semi-skilled

BCC5. Excluding seasonal variation, domestic sales (domestic orders) over the past 3 months are:

      Up / Same / Down

BCC6. Over the past 3 months, which changes have you made in your investmentplans:

      a) For plant and machinery: Revised upwards / Revised Downward / No change

BCC7. Are you currently operating at:

      Full Capacity / Below Full Capacity

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