Oxera

Tax-advantaged employee share schemes: analysis of productivity effects

Appendices to Report 1

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Appendix 1 Detailed description and comparison tables

A1.1 Detailed description and comparison tables

This appendix provides further details on employee share schemes and provides answers to question such as:

– Who can participate in the schemes?

– Are there any restrictions that may lead to individuals being excluded from the schemes?

– What are the tax and National Insurance savings accruing to employees and employers?

– How much exposure to risk do employees face from individual schemes?

– What is the maximum value of options/shares that can be given to employees under the schemes?

Table A1.1 Tax-advantaged employee share schemes

SAYE	APS	CSOP/DSOP
Employees are given an option that allows them to acquire shares in the company in 3, 5 or 7 years. Option can be granted with exercise discount of up to 20% on the market value of the shares at the time of grant. Employee enters into savings contract (eg, SAYE) over the same period as that of the option and makes monthly savings contributions from post-tax salary. At the end of savings period, employee receives a tax-free bonus payment set by the Treasury. An additional bonus follows if five years of savings are held for a further two years. Proceeds of savings and bonus may be used to exercise share options, which were granted at the start of the contract. Alternatively, the option can be allowed to lapse and employees can withdraw their savings including bonus. If participant leaves the savings contract prior to its specified duration (three or five years), a simple interest is paid on the savings. No interest is paid if savings are withdrawn prior to the first anniversary.	Participants receive shares that are held by a trustee in their name for three years. At the end of that time the employees can sell them if they wish. A popular arrangement is that employees are given shares in their employing company or its parent as a bonus. Under HM Revenue & Customs practice, employees may also contribute a percentage of basic gross salary towards the purchase of shares ('salary forgone') in order to receive free matching shares under the APS scheme. It is also possible for employees to purchase shares from their own resources—ie, after-tax salary ('contributory scheme'). Under an APS scheme shares are held in trust for a minimum of two years. After that time, the members may dispose of them but they may be subject to tax. Shares must be fully paid up, non-redeemable ordinary shares (quoted on the stock exchange, or in an unquoted company which is not controlled by another unquoted company).	The company grants eligible employees or full-time directors an option to purchase its shares in the future.
Historical developments: Introduced by the Finance Act 1980 and in its present form in the Income and Corporation Taxes Act 1988. The monthly savings limit of £250 has not changed since 1991. Since April 6th 1999, participants have the option to transfer shares bought via the scheme into tax-free individual savings accounts (ISAs). The transfer allows participants to avoid capital gains tax (CGT) to which gains would otherwise be subject.	**Historical developments**: Introduced by the 1978 Finance Act. APS has been replaced by Share Incentive Plans (SIP). No new APS schemes have been introduced since April 2001 but employers were able to award shares under existing schemes until the end of December 2002.	**Historical developments**: Introduced by the Finance Act 1984 and substantially amended by the Finance Act 1996. It is likely that these changes were intended to reduce the use of the tax exemptions to reduce tax liabilities. Schemes classified as tax-advantaged prior to May 1996 were known as discretionary share option schemes (DSOPs) or executive schemes. After this date, all schemes became CSOPs unless companies with schemes notified HM Revenue & Customs that they wished to have their scheme no longer approved.

Source: HM Revenue & Customs scheme booklets: IR16, IR96, IR97, and IR102; HM Treasury; and Oxera.

Table A1.2 Tax-advantaged employee share schemes: comparison of main features

Scheme	SAYE	APS	CSOP/DSOP
Coverage	All-employee scheme: must be made available to all employees and full-time directors.	All-employee scheme: must be made available to all employees and full-time directors.	Discretionary—directors and employees chosen by company.
Eligibility restrictions	All employees (including part-time workers but not directors) *must* be eligible if they have a tenure of 5+ years (eg, to exclude temporary or short-term employees), but often companies accept less. Everyone must participate on 'similar terms' either by receiving the same value of shares or the same percentage of salary or similar formula. The company is allowed to vary the amount on a sliding scale depending, for example, on length of service or level of pay. Participation in the scheme is not open to anyone who owns more than 25% of the ordinary share capital of the employer.	All employees (including part-time workers but not directors) *must* be made eligible if they have a tenure of +5 years, but companies may allow participation of employees with less than this. Everyone must participate on 'similar terms', either by receiving the same value of shares or the same percentage of salary or similar formula. The company is allowed to vary the amount on a sliding scale depending, for example, on length of service or level of pay.	Participants cannot own more than 25% (10% up to 10 July 2003) of the ordinary share capital of the company if it is a close company (ie, a company controlled by no more than 5 shareholders, which covers most private companies in the UK). CSOPs may include provisions, such as performance targets, and option holders may be required to fulfil these conditions prior to exercising options.
Tax breaks/savings for employees	Assuming that option exercise or withdrawal is undertaken within the terms of the option (ie, not earlier), generated income is not subject to income tax or National Insurance Contributions (NIC). Gains are subject to CGT when shares acquired with option are sold. The gains are subject to a taxpayer's annual exempt amount and taper relief.	After two years, shares can be disposed of but are subject to tax. Provided that participating employees hold the shares for the full term of three years, participants are not subject to tax (income tax or NICs) on the value of the shares. Any gains realised on disposal of the shares above the applicable exemption limit are subject to CGT. Participants can put shares worth up to £3,000 into a Personal Equity Plan, which invests only in shares of the same company. No income tax or capital gains liability arises.	Assuming that certain conditions are met, income tax relief applies to options that are exercised. In addition, no income tax and NICs are chargeable when an option is granted under a tax-advantaged CSOP. Gains are subject to CGT when shares acquired with option are sold.

Scheme	SAYE	APS	CSOP/DSOP
Tax breaks/savings for employers	Payroll savings in the form of relief from employers' NIC. In addition, the company may obtain a corporation tax deduction for the amount of option gains realised by its employees. The cost of setting up schemes classified as tax-advantaged after April 1st 1991can be deducted from company profits for corporation tax purposes.	The company has corporation tax relief on payments into the trust. Payments made into the trust for the acquisition of shares, made after April 5th 2002 will qualify for the relief.	The cost of setting up schemes classified as tax-advantaged after April 1st 1991 can be deducted from company profits for corporation tax purposes.
Employee exposure to risk	Low risk, since the savings in the SAYE account are not exposed to downside risk. The option holder can still gain even if the options are underwater after three, five or seven years (ie, a tax-free bonus). The lack of downside risk may make it a particularly attractive incentive for employees. There is a risk on the upside that it may not be worth exercising the option.	Under APS, participants bear the highest risk of the three schemes. The shares are held on behalf of employees for three years. There is therefore a potential downside risk that the reward received is small or negative because the company's share price can fall as well as rise. This can be due to either company-/sector-specific factors or general stock market trends. APS may be a less attractive incentive for employees than SAYE. Under APS, employees bear the risk of a potentially negative payoff, which can be driven by macroeconomic factors that are exogenous to company performance.	The risk under CSOP is likely to be somewhere between SAYE and APS. Employees do not have the guarantee of positive returns as under SAYE, but at the same time are not exposed to the downside risk under APS. Employees may make zero gains given that the options may go underwater. However, because options were awarded to them directly, employees do not stand to lose money as a result.
Maximum value	Payments under the savings contract must be made on a weekly or monthly basis from salary or wages. The monthly savings must be between £5 and £250. The minimum number of monthly contributions is 36. The maximum is 60.	The maximum value per tax year is £3,000, or 10% of annual earnings—whichever is greater—with a ceiling of £8,000 in any one year.	Since July 17th 1995, the maximum value of options from an individual company that a participant can hold under the scheme is £30,000. This value is based on the market value of the shares at the date of grant. Prior to this date aggregate option values in excess of £100,000 were possible.
In case of takeover	Companies *may* include a provision that allows option holders to exchange their options for options in the new controlling company. The new options must be exercisable in the same manner; they must be subject to the same rules, and the value and aggregate price of the new options must be equal to that of the old options.	Need to take into account any potential lead effects of incentives of takeover	Companies *may* include a provision that allows option holders to exchange their options for options in the new controlling company. The new options must be exercisable in the same manner; they must be subject to the same rules, and the value and aggregate price of the new options must be equal to that of the old options.

Source: HM Revenue & Customs scheme booklets: IR16, IR96, IR97, and IR102; HM Treasury; and Oxera.

A1.2 Theoretical considerations of financial participation schemes

There are several types of financial participation used by companies to help them achieve various objectives, such as improved employee performance or reduced employee turnover. However, two broad categories of financial participation can be distinguished.

– C*ash-based* profit sharing and employee rewards, which are paid from company profits more or less immediately. An element of the employee remuneration varies in these according to company performance, or on the performance of a group of employees, or individual employees. Performance criteria employed include profitability (ie, profit sharing) and other performance measures, such as manager assessment (merit pay or annual bonuses), productivity or cost savings (gain sharing), output (eg, piece rate contingent pay), sick absence or quality.

– *Equity-based* remuneration, such as stock holdings or employee share schemes, in which the financial gains are mainly made through long-term increases in company share values.

One of the differences between these two categories of financial participation is the timing of the remuneration. Financial rewards under share schemes take relatively longer to materialise than those awarded under profit-sharing arrangements.

A further difference relates to the directness of the link between company performance and employee remuneration. Several of the profit-sharing schemes are based on individual performance such as manager assessment and, under these, the remuneration is not directly linked to company performance. On the other hand, incentive plans that are explicitly based on company performance (eg, profit sharing per se or employee share option plans) provide this direct link. However, due to the longer time frame within which share schemes operate, they may provide relatively weaker incentives for improved performance if employees value short-term financial rewards more than medium and long-term rewards. It has been suggested that cash-based schemes may be most suited to incentivising employees in the short run, and that equity-based schemes may be better suited to developing long-term ties/loyalty with the firm (see Gregg and Machin 1988).

The theoretical literature provides some broad insights into the incentive implications for employees and the circumstances under which financial participation schemes are likely to be effective in improving company performance. Some of the main arguments are outlined below.

Employee and firm characteristics

Agency theory of the interaction between employees and firms suggests that the optimal amount of shared compensation is a function of the *characteristics of employees* and the *firm*. The less risk-averse the employees, the higher the level of optimal risk sharing between firm and employees, since the potential gains of a contract with variable remuneration linked to company performance are greater than those under a fixed-wage contract.

Moreover, the less effort-averse employees are, and the less disutility[1] they derive from work, the higher the optimal sharing rate, since employees' remuneration is a function of their effort. Consequently, employees are less likely to prefer fixed remuneration as their main source of income, and are willing to have remuneration systems based on sharing arrangements between employees and the firm.

[1] Disutility refers to the state or quality of being contrary to an individual's desires or well-being. Traditional models of labour supply assume that individuals derive utility from leisure and disutility from work.

Firm activity

Firms are more likely to implement shared-compensation schemes if the nature of the firm's activity implies that, when incentivised, employees can have a significant effect on output. However, employees' efforts are often more difficult to monitor closely and supervising their effort level can be resource-intensive. The moral hazard problem that arises between employees and management can be addressed through the use of financial participation schemes. Since the schemes link individual (or group) performance to reward, employee effort levels may be higher than they would be in the absence of financial participation schemes even without managerial supervision.

The free-rider problem

One criticism of profit-sharing schemes is that group incentives may be an inefficient way of motivating individuals. In particular, under a group performance profit-sharing scheme with N employees, the additional effort of an individual worker results in the award of a 1/N share of profits for that worker. The financial reward for an individual worker's extra effort decreases as the number of employees participating in the scheme increases. Consequently, employees may choose not to make additional effort, and instead free-ride on the contributions of other employees.

However, the free-rider argument has been criticised for not taking into account the interaction between employees—for example, the possibility of employees cooperating to maximise group productivity (see Fitzroy and Kraft 1987).

Firm size

There is also an issue as regards effects differing between small and large firms, where supervision may be more difficult in the latter. In a payment system relating to company performance, the theoretical effect could go either way. As shown above, the direct individual reward from high-level individual performance becomes more diluted as the work group grows, potentially leading to free-riding, suggesting that profit sharing could be more effective in small firms. However, the effect could also go the other way: in larger companies, the costs of a scheme are spread over a wider base (ie, lower cost per employee), and human resource managers may be more experienced in employee relations and thus better placed to coordinate profit sharing with other policies. Finally, company size may also be largely irrelevant: since the policy itself is of importance, as long as the pay–productivity link exists, the policy is effective (see, for example, Kruse 1993b, p. 28).

Appendix 2 Summary of UK literature review

Table A2.1 Summary of UK studies

Study author(s) and year	Sample of companies	Period of analysis	Data sources	Main econometric methodology	Main findings (related to financial participation)
Addison and Belfield (2001)	700–800 UK establishments	1998	WERS98	Ordered probit	No or limited evidence that financial participation has had a significantly positive impact on productivity: – SAYE has marginally significant impact on productivity levels, but insignificant impact on productivity increases. Executive share options have significantly negative impact on productivity levels (and negative but insignificant impact on productivity increases). Profit sharing and profit-related pay also do not significantly increase productivity
Bhargava (1994)	114 UK firms introducing profit sharing	1979–89	Company accounts data from Datastream Exstat	GMM (Arrellano–Bond)	Introduction of profit sharing has significant impact on profitability in short run (5%). Some persistence of profits in the longer run
Blanchflower and Oswald (1988)	Around 1,000 UK establishments responding to WIRS2	1984	WIRS2	Ordered probit	No impact of employee share ownership, profit sharing and value-added bonuses on profitability, as measured by management's own assessment of company performance. Also, no notable differences in terms of employment growth rates and the quality of industrial relations
Cable and Wilson (1989)	52 UK engineering firms	1978–82	Special interview survey carried out between 1982–84	GLS	Firms with profit sharing have 3–8% higher productivity than other firms
Conyon and Freeman (2004)	299 listed UK companies responding to Conyon–Read survey 1,600–1,800 UK establishments responding to WERS98	1995–98 for listed companies 1998 for WERS, and some analysis of 1990–98 longitudinal data	Conyon–Read 1999 survey of UK firms listed on LSE, matched with accounting data from Datastream WERS98	Fixed effects (for Cobb–Douglas production specification) OLS (for stock-return regression) Ordered probit (for WERS analysis of productivity impact)	Positive impact on productivity and financial performance, but differences across schemes and datasets: – For listed companies, APS and CSOP have positive impact on productivity, with increases of up to 18.9% and 12.2% respectively, whereas profit-related pay and SAYE have no effect. Companies with SAYE have higher stock returns – In WERS analysis, SAYE and profit-related pay have significant positive impact on productivity, and all schemes have positive effect on financial performance, with highest effect measured for SAYE and profit-related pay

Study author(s) and year	Sample of companies	Period of analysis	Data sources	Main econometric methodology	Main findings (related to financial participation)
Equity Incentives Ltd (2003)	25–30 UK quoted companies with a significant degree of employee share ownership	Since 1992	Employee Ownership Index (EOI)	n/a	EOI is shown to outperform FTS All-share index since 1992, suggesting that companies with employee share ownership may have above-average financial performance
Estrin et al (1996)	93 UK manufacturing companies	1988–91	Not specified	Log-linear Cobb–Douglas production function. Econometric technique not specified	Firms which use profit sharing have 6% higher than average levels of factor productivity (statistically significant effect)
Fernie and Metcalf (1995)	Between 842 and 918 establishments from the non-public sector were used in models with productivity as modelled outcome	1990	WIRS3	Ordered probit	Financial participation schemes, including profit sharing and employee share-ownership schemes, have a positive relationship with productivity levels or growth
Festing et al (1999)	2,398 companies from UK, France, Germany and Sweden used in profit-sharing regressions	1995	Cranfield Network on European Human Resource Management (Cranet-E), collected via postal survey	OLS (linear regression) for modeling outcomes and logistic regression for modelling determinants of financial participation	Positive and significant relationship between profitability and both employee share ownership and profit sharing
McNabb and Whitfield (1998)	Depending on specification, between 127 and 657. Sample restricted to companies operating in the trading sector that do not sell the majority of their output to other parts of the organisation	1990	WIRS3	Maximum likelihood univariate probit	Results indicate that financial participation should not be analysed independently of that of other types of employee participation schemes due to strong interaction effects. Financial participation and employment involvement schemes are very heterogeneous; employee share ownership and profit-related pay are substitutes rather than complements (negative interaction effects, establishments with both schemes do not have better-than-average financial performance, whereas those with one or the other do—they should therefore not be analysed under the same umbrella but rather as separate schemes)
Pendleton (1997)	591 UK manufacturing establishments	1990	WIRS3	Logistic regressions to determine the characteristics of firms adopting different forms of financial participation	Existence of SAYE and/or cash schemes explained mostly by industrial relations characteristics (eg, union presence). Establishments with schemes do not have significantly better financial performance

Study author(s) and year	Sample of companies	Period of analysis	Data sources	Main econometric methodology	Main findings (related to financial participation)
Pérotin and Robinson (1998)	Five different datasets for Britain, Germany, France and Italy. British data consists of four-year panel data of 93 manufacturing firms	1988–91	Not known	OLS (specification comparable across countries). Specification for Britain, France and Germany two stage least squares with profit sharing endogenous; fixed effects estimator for Italy	Using their most parsimonious functional specification which is comparable between countries, they find a productivity differential for their manufacturing firms with profit-sharing schemes in place in the order of 15–16% for Britain. In a specification that controls for the potential endogeneity of the regressors, which biases the above upwards, the positive productivity differential is somewhat lower (9%)
Pérotin and Robinson (2000)	1,135–37	1998	WERS98	Ordered probit	Firm policies that promote equality of opportunity of the workforce have a positive impact on performance; these policies improve the contribution of individual participation schemes (financial—eg, employee share and profit-sharing schemes—and non-financial) to higher labour productivity
Richardson and Nejad (1986)	41 large firms in the multiple stores sector	1978–84	Extel records for financial participation variables and Datastream for share prices	Standard statistical measures and inferences (mean, t-tests)	They found that there was a clear and statistically significant relationship between share-price movements and the operation of share-ownership schemes. In addition, they find that firms experienced a relatively faster increase in their share prices after they introduced financial participation schemes
Whadhwani and Wall (1990)	219 large (average number of employees >10,000) manufacturing companies, public accounts. After matching with other dataset, number of observations reduced to 101	1972–82	Datastream (EXSTAT). Although EXSTAT also contains information in the form of profit-sharing schemes, the dataset was matched with information carried out by Dr Richardson of LSE on profit sharing	OLS using instrumental variables estimation	Their findings from estimating the parameters of a production function concur with the view that profit sharing boosts productivity

Appendix 3 Descriptive analysis and summary statistics

This appendix presents additional summary statistics and is designed to complement the analysis in section 8 of the main report.

The dataset is very heterogeneous—ie, there is considerable variation across companies in terms of their characteristics. For example, the distribution of number of employees, amount of capital employed, turnover, and other characteristics, is skewed to the right—ie, the distribution has values that are bunched together below the mean, but has a long tail above the mean. As consequence it is more informative to focus on the median (when ordering the dataset, the median divides the distribution into half) rather than the mean. The mean represents a distorted picture of the 'true' average value since it is influenced by large observations, whereas the median is not sensitive to unusually large values.

A3.1 Companies with new schemes

Table A3.1 compares the number of companies that establish new schemes with the number of companies with existing schemes. A scheme is defined as new if it has been in operation for only up to one year. However, the figures should be regarded only as an approximation. For example, if company data at time t were missing in t – 1 but not in t – 2 (eg, due to a data entry error), the scheme would be erroneously classified as new.

Companies started offering most new APS in 1997/98 and 1998/99. The pattern is less clear for companies with new CSOPs, and appears to fluctuate around a mean of around 46. From 1996/97 to 1998/99, there appears to be a period with a relatively high number of new SAYE schemes. However, this did not result in a notable increase in the total number of companies offering schemes, suggesting that there were some companies that may have stopped offering the scheme.

Table A3.1 Companies with new schemes and all schemes

Year	New APS schemes	All APS schemes	New CSOP	All CSOP schemes	New SAYE	All SAYE schemes
1990/91	25	584	19	2,038	54	495
1991/92	14	579	66	2,051	72	506
1992/93	12	548	40	1,973	91	541
1993/94	17	549	39	2,061	80	589
1994/95	19	527	37	2,077	102	643
1995/96	9	484	51	1,934	93	666
1996/97	15	422	38	2,068	108	738
1997/98	28	428	47	2,124	112	775
1998/99	29	442	66	2,202	116	789
1999/2000	21	433	53	2,147	92	763
2000/01	23	413	39	2,105	65	539
2001/02	10	324	35	1,755	166	624
2002/03	9[1]	279	63	1,631	103	693
Mean	18	462	46	2,013	96	643

Note: [1] HM Revenue & Customs has not approved any new schemes since April 2001 but companies were permitted to continue awarding options under existing schemes until December 2002 (financial year ending 2003). The existence of new APS schemes in 2002/03 is likely to be due to data problems (eg, if data for a company at time t was missing in t – 1 but not in t – 2 due to a data entry error, the scheme would be erroneously classified as new).
Source: HM Revenue & Customs; and Oxera calculations.

A3.2 Companies with multiple schemes

As shown in Table A3.2, companies are most likely to have both a CSOP and a SAYE scheme. This is at least partly because, after 1993/94, more companies offered either CSOP or SAYE than APS, and few companies offered all three types of scheme simultaneously.

Table A3.2 Proportion of companies with multiple schemes and total number of schemes

Year	APS, CSOP and SAYE (%)	APS and CSOP (%)	APS and SAYE (%)	CSOP and SAYE (%)	SAYE	APS	CSOP	Total number of companies
1989/90	n/a	n/a	n/a	23	563	553	2,507	417
1990/91	5	11	5	19	495	584	2,038	871
1991/92	6	12	7	18	506	579	2,051	1,362
1992/93	6	13	7	19	541	548	1,973	1,816
1993/94	6	13	7	21	589	549	2,061	2,284
1994/95	7	12	7	23	643	527	2,077	2,785
1995/96	7	12	7	24	666	484	1,934	2,373
1996/97	7	12	8	27	738	422	2,068	2,350
1997/98	6	10	7	28	775	428	2,124	2,270
1998/99	5	9	6	27	789	442	2,202	2,361
1999/2000	5	9	6	25	763	433	2,147	2,377
2000/01	4	8	5	25	539	413	2,105	2,207
2001/02	3	7	4	18	624	324	1,755	2,337
2002/03	4	6	5	23	693	279	1,631	2,437

Source: HM Revenue & Customs; and Oxera calculations.

A3.3 Further descriptive statistics of employee participation

Employee participation is defined as the number of participants in a given year (ie, new and existing participants who are awarded additional shares under an existing scheme). The figures should therefore not be interpreted as the overall number of participants within a company. Although the adoption of this definition would be preferable, companies are only required to report to HM Revenue & Customs details of individual share awards, options grants, option exercises and taxable events that occurred during the tax year for their tax-advantaged schemes. To minimise the compliance burden on companies, they are not required to report total participants each year for the tax year or the scheme overall.

Table A3.3 shows the number of employees who purchased shares under APS over time. As expected, the number declined after financial year ending 2001. This decline is mainly is due to HM Revenue & Customs no longer approving new schemes after April 2001. Awards under existing APS schemes could be made until the end of December 2002 (ie, some companies would have their accounts classified as financial year ending 2003). An inspection of the data reveals that relatively few companies continued to award shares, since the median number of participants in 2003 is zero.

A median of zero means that less than 50% of companies continued to award schemes in financial year ending 2003. In 2003, 121 companies awarded schemes compared with 158 companies that did not. In contrast, 219 companies awarded schemes in 2002, whereas 105 companies did not.[2]

[2] Source: HM Revenue & Customs and Oxera calculations.

Table A3.3 Number of employees who purchased shares under APS

Year	Total	Mean	Median	Standard deviation
1989/90	844,558	1,527	76	9,644
1990/91	870,990	1,491	49	9,572
1991/92	723,980	1,250	15	9,452
1992/93	718,470	1,311	11	9,291
1993/94	690,281	1,257	17	8,181
1994/95	626,658	1,189	36	7,284
1995/96	718,023	1,484	48	7,719
1996/97	806,289	1,911	100	8,198
1997/98	918,891	2,147	121	10,212
1998/99	859,173	1,944	103	8,255
1999/2000	808,168	1,866	73	8,409
2000/01	819,725	1,985	56	9,227
2001/02	684,203	2,112	34	9,685
2002/03	313,913	1,125	0	7,762

Source: HM Revenue & Customs; and Oxera calculations.

Table A3.4 shows that the number of employees who were granted options under SAYE has broadly increased since 1989/89, particularly after 1995/96.

Table A3.4 Number of employees granted options under SAYE

Year	Total	Mean	Median	Standard deviation
1988/89	358,607	625	72	2,167
1989/90	451,076	801	80	3,011
1990/91	536,096	1,083	135	4,067
1991/92	470,606	930	108	3,473
1992/93	579,100	1,070	155	3,786
1993/94	470,457	799	96	3,201
1994/95	542,009	843	88	3,217
1995/96	599,300	900	106	3,193
1996/97	791,861	1,073	129	3,980
1997/98	1,136,432	1,466	132	7,675
1998/99	890,706	1,129	105	4,705
1999/2000	951,408	1,247	111	5,088
2000/01	972,254	1,804	198	6,784
2001/02	1,188,534	1,905	108	15,917
2002/03	807,986	1,166	63	5,156

Source: HM Revenue & Customs; and Oxera calculations.

As shown in Table A3.5, the number of employees granted options under CSOP has been broadly increasing since 1996/97. The reduction in 2001/02 may be due to the downturn in the market after 2000. The data for employees granted options in 1995/96 is incomplete in

the database provided by HM Revenue & Customs. The figures for 1995/96 are therefore considered to be not representative and are not included in the table (denoted by n/a).

In 1994/95 and 1997/98, the median value of zero employees reflects the fact that, across all companies, less than 50% awarded options under CSOP to any of their employees.

Table A3.5 Number of employees granted options under CSOP

Year	Total	Mean	Median	Standard deviation
1986/87	49,933	37	8	210
1987/88	76,932	42	7	239
1988/89	78,170	35	4	485
1989/90	99,687	40	3	368
1990/91	58,096	29	4	152
1991/92	70,134	34	2	269
1992/93	72,115	37	3	252
1993/94	61,771	30	3	162
1994/95	72,583	35	0	204
1995/96	n/a	n/a	n/a	n/a
1996/97	132,384	64	1	718
1997/98	96,642	46	0	1,643
1998/99	252,073	114	1	1,666
1999/2000	220,283	103	1	1,291
2000/01	359,201	171	3	2,304
2001/02	222,683	127	1	1,421
2002/03	444,425	272	1	7,062

Source: HM Revenue & Customs; and Oxera calculations.

A3.4 Employee gains from SAYE and CSOP

Tables A3.6 and A3.7 provide descriptive statistics of the aggregate annual gains and losses estimated using HM Revenue & Customs' database that employees participating in SAYE have realised over time. The largest aggregate gain occurred in 1997/98 during a period of strong stock market growth. The largest aggregate losses occurred in 2001/02 during the market downturn.

Note that, under SAYE, employees can allow their options lapse and instead collect their tax-advantaged savings including an interest payment. Employees are therefore highly unlikely to incur losses due to non-rational behaviour. Instead, losses, as Table A3.7 shows, can be attributed to the use of an *estimated* selling price instead of the *actual* selling price. The number of companies for which 'losses' are measured is highest in 1998/99, 1999/2000 and 2001/2002, with aggregate losses highest in 2001/2002.

Table A3.6 SAYE gains over time (£m)

Year	Total number of companies with SAYE	Number of companies with gains	Total gains	Mean	Median	Standard deviation
1988/89	574	492	231	0.5	0.00	2.0
1989/90	563	506	258	0.5	0.00	1.9
1990/91	495	458	527	1.2	0.02	11.8
1991/92	506	428	266	0.6	0.02	3.5
1992/93	541	494	397	0.8	0.01	4.6
1993/94	589	553	534	1.0	0.03	4.5
1994/95	643	594	411	0.7	0.01	2.8
1995/96	666	634	871	1.4	0.02	5.4
1996/97	738	683	1,040	1.5	0.01	8.7
1997/98	775	700	1,790	2.6	0.01	15.5
1998/99	789	652	1,240	1.9	0.01	14.3
1999/2000	763	615	1,560	2.5	0.02	13.8
2000/01	539	443	890	2.0	0.00	10.8
2001/02	624	503	804	1.6	0.04	8.4
2002/03	693	186	240	1.3	0.08	4.1

Note: Results for 1994/95, 1995/96 and 2002/03 should be interpreted with caution since, overall, less than 50% of companies have all data required to calculate the gains. In the remaining years, the data contains information on 90% or more of all companies. All figures are expressed in 2003 prices.
Source: HM Revenue & Customs, and Oxera calculations.

Table A3.7 SAYE 'losses' over time (£m)

Year	Total number of companies with SAYE	Number of companies with losses	Total losses	Mean	Median	Standard deviation
1988/89	574	81	–70	–0.9	–0.07	3.6
1989/90	563	57	–19	–0.3	–0.03	1.3
1990/91	495	37	–16	–0.4	–0.02	1.8
1991/92	506	56	–13	–0.2	–0.01	1.2
1992/93	541	26	–26	–1.0	–0.00	4.7
1993/94	589	15	–1	–0.1	–0.00	0.2
1994/95	643	32	–1	–0.1	–0.00	0.3
1995/96	666	14	–1	–0.1	–0.00	0.2
1996/97	738	37	–7	–0.2	–0.00	1.2
1997/98	775	52	–47	–0.9	–0.02	2.8
1998/99	789	137	–28	–0.2	–0.01	0.7
1999/2000	763	146	–15	–0.1	–0.02	0.3
2000/01	539	84	–28	–0.3	–0.03	1.1
2001/02	624	120	–119	–1.0	–0.05	6.0
2002/03	693	80	–67	–0.8	–0.02	3.9

Note: Results for 1994/95, 1995/96 and 2002/03 should be interpreted with caution since, overall, less than 50% of companies have all data required to calculate the gains. In the remaining years, the data contains information on 90% or more of all companies. All figures are expressed in 2003 prices.
Source: HM Revenue & Customs; and Oxera calculations.

Similarly, Tables A3.8 and A3.9 show the estimated gains and losses of CSOP participants. While, overall, sizeable aggregate gains were made, in less than 50% of companies, non-zero gains appear to have been made (ie, more than 50% of companies in any one year reported gains that were zero). The non-zero median in 2002/03 is due to missing information required to calculate the gains.

Of all years, during 1999/2000, 2000/01 and 2001/02 the greatest number of companies are estimated to have experienced losses. This could be due to non-rational behaviour (selling 'underwater'—ie, when the stock's current market price is below the grant price on the option) or because in calculating the gains, the estimated rather than the actual selling price of shares was used.

Table A3.8 CSOP gains over time (£m)

Year	Total number of companies with CSOP	Number of observations with gains	Total gains	Mean	Median	Standard deviation
1992/93	1,973	1,790	501	0.3	0.00	1.6
1993/94	2,061	1,846	721	0.4	0.00	1.4
1994/95	2,077	1,026	402	0.4	0.00	1.6
1995/96	1,934	745	720	1.0	0.00	3.2
1996/97	2,068	2,036	565	0.3	0.00	2.0
1997/98	2,124	2,060	819	0.4	0.00	4.5
1998/99	2,202	2,134	568	0.3	0.00	2.4
1999/2000	2,147	1,906	507	0.3	0.00	3.4
2000/01	2,105	1,868	247	0.1	0.00	1.5
2001/02	1,755	1,604	189	0.1	0.00	1.3
2002/03	1,631	325	64	0.2	0.01	1.0

Note: Results for 2002/03 should be interpreted with caution since, overall, less than 50% of companies have all the data required to calculate the gains. In the remaining years, the data contains information on 95% or more of all companies. All figures are expressed in 2003 prices.
Source: HM Revenue & Customs; Oxera calculations.

Table A3.9 CSOP 'losses' over time (£m)

Year	Total number of companies with CSOP	Number of observations with losses	Total losses	Mean	Median	Standard deviation
1992/93	1,973	46	–4.2	–0.1	–0.01	0.2
1993/94	2,061	25	–5.7	–0.2	–0.01	1.0
1994/95	2,077	26	–0.4	–0.0	–0.00	0.0
1995/96	1,934	10	–23.7	–2.4	–0.08	4.9
1996/97	2,068	19	–0.7	–0.0	–0.02	0.1
1997/98	2,124	20	–2.8	–0.1	–0.02	0.4
1998/99	2,202	61	–14.5	–0.2	–0.02	0.6
1999/2000	2,147	192	–135.0	–0.7	–0.04	2.7
2000/01	2,105	174	–62.8	–0.4	–0.03	2.6
2001/02	1,755	151	–158.0	–1.0	–0.03	10.1
2002/03	1,631	15	–1.0	–0.1	–0.01	0.1

Note: Results for 2002/03 should be interpreted with caution since less than 50% of companies have all the data required to calculate the gains. In the remaining years, the data contains information on 95% or more of all companies. All figures are expressed in 2003 prices.
Source: HM Revenue & Customs; and Oxera calculations.

A3.5 Company size by scheme type

Tables A3.10 to A3.12 provide, for each scheme type, descriptive statistics of the number of employees for companies with and without share schemes. When measuring size in terms of turnover or amount of capital employed, the picture that emerges is similar as for employees—there is a clear indication that larger companies are more likely to have share schemes than smaller companies, both in terms of the mean and median. The significance of these size differences is supported by statistical tests (see Table A3.14).

It is notable that the size discrepancy is more significant for SAYE and APS share schemes than for CSOPs. This is to be expected since SAYE and APS are all-employee share schemes and, due to set-up and operating cost considerations, are therefore more suited to larger companies. At the aggregate level—ie, across all share schemes (as shown in Table 8.2), the size discrepancy is more in line with the position on CSOPs. This is due to a larger number of companies operating a CSOP than either an APS or SAYE scheme.

Table A3.10 Employee numbers in companies with and without share schemes: SAYE

	SAYE scheme			No scheme		
Year	**n**	**Mean**	**Median**	**n**	**Mean**	**Median**
1992/93	209	8,304	2,052	2,788	509	98
1993/94	519	9,463	2,163	8,683	458	79
1994/95	588	9,818	2,052	9,472	468	80
1995/96	604	9,294	1,939	10,490	493	81
1996/97	657	8,378	1,811	10,801	495	83
1997/98	674	8,516	1,677	11,561	519	87
1998/99	677	8,818	1,636	12,882	499	85
1999/2000	658	9,923	1,699	13,803	492	88
2000/01	479	12,448	1,806	14,233	572	90
2001/02	551	12,274	2,111	14,763	538	91
2002/03	444	12,204	2,091	13,039	502	87
Average	**551**	**9,886**	**1,883**	**2,788**	**509**	**98**

Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.11 Employee numbers in companies with and without share schemes: APS

	APS scheme			No scheme		
Year	**n**	**Mean**	**Median**	**n**	**Mean**	**Median**
1992/93	211	5,189	715	2,788	509	98
1993/94	436	6,480	948	8,683	458	79
1994/95	427	6,623	998	9,472	468	80
1995/96	408	6,761	953	10,490	493	81
1996/97	355	6,577	1,006	10,801	495	83
1997/98	355	7,076	912	11,561	519	87
1998/99	360	7,501	911	12,882	499	85
1999/2000	357	7,417	777	13,803	492	88
2000/01	337	7,871	739	14,233	572	90
2001/02	262	9,556	1,034	14,763	538	91
2002/03	120	14,041	1,917	13,039	502	87
Average	**330**	**7,305**	**929**	**2,788**	**509**	**98**

Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.12 Employee numbers in companies with and without share schemes: CSOP

	CSOP scheme			No scheme		
Year	**n**	**Mean**	**Median**	**n**	**Mean**	**Median**
1992/93	901	2,654	366	2,788	509	98
1993/94	1,732	3,941	441	8,683	458	79
1994/95	1,782	4,013	464	9,472	468	80
1995/96	1,660	4,210	520	10,490	493	81
1996/97	1,778	3,992	490	10,801	495	83
1997/98	1,797	3,890	446	11,561	519	87
1998/99	1,837	3,929	389	12,882	499	85
1999/2000	1,808	4,480	381	13,803	492	88
2000/01	1,740	4,488	340	14,233	572	90
2001/02	1,465	4,949	364	14,763	538	91
2002/03	889	6,991	700	13,039	502	87
Average	**1,581**	**4,257**	**439**	**2,788**	**509**	**98**

Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.13 summarises the results of undertaking two-sample t-tests of the hypothesis that the firm size (as measured by number of employees, turnover and capital) has the same mean within the two company groups (ie, those with share schemes and those without). The test results show that company size is statistically different for companies with share schemes than for those without. The t-tests where conducted for each year and the null hypothesis that mean company size is equal for companies with and without schemes is rejected for each year and scheme type.

Table A3.13 The statistical significance of the difference in firm size between those firms with a share scheme and those without (across all years)

	SAYE	APS	CSOP	All schemes
Employees: probability > |t|	0.000	0.000	0.000	0.000
Turnover: probability > |t|	0.000	0.000	0.000	0.000
Capital: probability > |t|	0.000	0.000	0.000	0.000

Source: HM Revenue & Customs; and Oxera calculations.

A3.6 Size of companies with multiple schemes

Companies may also operate more than one employee share scheme of any one type. Since the set-up costs for schemes are relatively high for smaller companies, larger companies are more likely to offer multiple schemes. This is confirmed when analysing the likelihood of companies operating multiple schemes.

Table A3.14 examines the number of employees over time for those companies with multiple SAYE share schemes—there is a clear indication that larger companies are more likely to have share schemes or multiple share schemes, with the largest companies having the highest number of schemes.

Table A3.14 Average number of employees by number of SAYE share schemes

Year	1 × SAYE	2 × SAYE	3 × SAYE	4 × SAYE
1992/93	6,319	28,927	n/a	n/a
1993/94	7,881	21,032	399	21,705
1994/95	7,598	21,791	n/a	25,317
1995/96	7,261	18,558	2,128	25,622
1996/97	7,005	14,847	4,466	26,175
1997/98	6,819	15,755	29,096	n/a
1998/99	7,844	13,736	8,356	49,209
1999/2000	8,428	16,642	42,087	72,749
2000/01	11,960	20,086	31,378	n/a
2001/02	10,471	20,939	36,371	64,562
2002/03	10,847	18,750	35,570	60,740
Average	**8,397**	**17,899**	**25,203**	**43,260**

Note: n/a indicates that no company operated the number of schemes given by column heading.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.15 examines the number of employees over time for those companies with multiple APS share schemes. Again, there is a clear indication that larger companies tend to have more schemes.

Table A3.15 Average number of employees by number of APS share schemes

Year	1 × APS	2 × APS	3 × APS	4 × APS
1992/93	4,940	9,988	n/a	n/a
1993/94	6,005	18,358	n/a	n/a
1994/95	6,014	18,493	n/a	25,317
1995/96	6,454	12,509	n/a	497
1996/97	6,726	3,725	n/a	626
1997/98	6,463	18,221	n/a	n/a
1998/99	6,576	27,569	n/a	n/a
1999/2000	6,749	17,110	n/a	72,474
2000/01	7,413	6,828	2,067	85,462
2001/02	8,916	17,088	58,720	n/a
2002/03	13,168	23,576	38,955	n/a
Average	**6,805**	**15,271**	**39,615**	**44,973**

Note: n/a indicates that no company operated the number of schemes given by column heading.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.16 examines the number of employees over time for those companies with multiple CSOP share schemes. Again, there is a clear indication that larger companies tend to have more schemes.

Table A3.16 Average number of employees by number of CSOP share schemes

Year	1 × CSOP	2 × CSOP	3 × CSOP	4 × CSOP
1992/93	2,298	8,229	1,186	n/a
1993/94	3,452	8,370	4,731	27,007
1994/95	3,105	8,589	20,668	843
1995/96	2,998	8,852	14,846	8,803
1996/97	2,787	7,930	10,595	11,718
1997/98	2,723	6,688	12,109	45,895
1998/99	2,775	6,253	17,336	2,749
1999/2000	2,920	7,988	13,337	41,290
2000/01	2,477	9,012	23,619	32,426
2001/02	2,658	10,563	19,884	35,469
2002/03	4,241	11,391	25,596	45,864
Average	**2,923**	**8,331**	**16,948**	**27,063**

Note: n/a indicates that no company operated the number of schemes given by column heading.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

A3.7 Company performance: partial productivities

As outlined in section 8.2.4, the fact that there are considerable differences in sample size of companies with and without schemes means that performance measures vary considerably across the panels. This is due to actual aggregate differences in performance, and also to data outliers that distort descriptive statistics in particular means. Since the sample size of the control group is significantly larger than that of companies with schemes, large variations in performance are more likely to occur in the larger dataset than the dataset of companies with schemes. As a consequence, to the extent that the actual or recorded (with measurement errors) performance measure in the larger dataset tends to be higher, performance measures, particularly those based on the mean, tend to be distorted.

It is therefore more insightful to focus on a smaller subset of companies, which share a characteristic that is common in both types of company (ie, those with schemes and those without). The comparisons in section 8.2.4 are therefore made only for the sample of listed companies.

Due to greater variability shown by the standard deviations, it is more meaningful to focus on median rather than mean productivity because this summary measure is less likely to be biased due to unusual observations or measurement error.

For completeness, Table A3.17 and A3.18 show the labour and capital productivity when calculated for the sample as a whole. As shown in A3.17, when comparing labour productivity for companies with and without schemes using the sample as the whole, the mean and median labour productivity are *lower* for the companies with schemes. However, as stated above, this is likely to be due to the greater amount of noise in the sample without schemes relative to the sample with schemes, with outlier observations likely to bias the results.

Table A3.17 Average annual labour productivity: all share schemes versus companies with no tax-advantaged share schemes (£'000s)

	Mean		Median		Standard deviation		Number of observations	
Year	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme
1992/93	237	617	115	100	596	12,440	2,788	1,009
1993/94	397	223	122	104	3,612	815	8,683	1,938
1994/95	419	217	125	106	3,357	587	9,472	2,007
1995/96	432	230	125	110	5,133	800	10,490	1,873
1996/97	376	390	128	107	2,945	6,347	10,801	1,988
1997/98	405	214	123	105	4,468	694	11,561	2,043
1998/99	428	234	118	106	4,684	1,062	12,882	2,090
1999/2000	483	335	120	106	5,993	4,498	13,803	2,073
2000/01	434	215	121	101	4,154	499	14,233	1,989
2001/02	437	218	124	105	3,734	599	14,763	1,706
2002/03	515	191	131	104	4,718	358	13,039	1,014

Note: Labour productivity is defined as real turnover:number of employees. The unit of measurement is annual turnover per worker.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Similarly, as shown in A3.18, when comparing capital productivity figures for companies with and without schemes using the sample as the whole, the mean and median capital productivity are *lower* for the companies with schemes. As above, this is likely due to the larger amount of noise in the sample without schemes compared with the sample with schemes.

Table A3.18 Average annual capital productivity: all share schemes versus companies with no tax-advantaged share schemes (£)

	Mean		Median		Standard deviation		Number of observations	
Year	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme
1992/93	38	21	6	4	464	368	2,788	1,009
1993/94	61	12	7	4	970	67	8,683	1,938
1994/95	58	12	8	4	594	71	9,472	2,007
1995/96	160	9	8	4	9,842	42	10,490	1,873
1996/97	57	10	8	4	486	26	10,801	1,988
1997/98	64	10	8	4	809	28	11,561	2,043
1998/99	70	13	7	3	1,998	86	12,882	2,090
1999/2000	170	12	7	3	10,229	48	13,803	2,073
2000/01	88	12	7	3	1,633	56	14,233	1,989
2001/02	90	12	8	3	1,209	45	14,763	1,706
2002/03	100	10	9	3	1,146	36	13,039	1,014

Note: Capital productivity is defined as real turnover:fixed assets. The unit of measurement is annual turnover per £ of capital employed.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Tables A3.19 and A3.20 compare labour and capital productivities by industry across all companies. The number of companies over which the statistics are calculated varies between the two tables since data availability for industry classification, and employee and capital data varies.

Table A3.19 Average labour productivity across all companies by industry: all share schemes versus companies with no tax-advantaged share schemes (average 1993/94–2001/02, £'000s per worker per year)

	Mean		Median		Standard deviation		Number of observations	
	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme
Mining and quarrying	933	802	187	159	2,207	1,739	827	334
Manufacturing	203	217	99	96	1,299	4,184	22,216	6,101
Electricity, gas and water supply	4,514	263	201	208	28,769	197	314	298
Construction	259	222	141	171	846	155	6,090	678
Wholesale and retail trade	719	277	236	147	5,249	699	18,271	2,405
Hotels and restaurants	62	81	38	46	109	243	1,758	360
Transport, storage and communication	397	181	136	121	2,195	318	4,976	726
Financial intermediation	1,005	778	115	114	11,597	12,272	4,439	946
Real estate, renting and business activities	376	244	110	98	3,046	615	19,719	4,326
Other community, social and personal service activities	264	152	100	94	1,034	230	3,863	639

Note: Labour productivity is defined as real turnover:number of employees.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.20 Average capital productivity across all companies by industry: all share schemes versus companies with no tax-advantaged share schemes (average 1993/94–2001/02, turnover per £ of capital employed)

	Mean		Median		Standard deviation		Number of observations	
Industry (SIC)	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme	No scheme	Scheme
Mining and quarrying	20	1	1	1	157	2	996	342
Manufacturing	26	6	5	3	362	32	23,720	6,163
Electricity, gas and water supply	7	1	<0.5	1	34	2	363	298
Construction	80	28	17	11	379	117	7,817	681
Wholesale and retail trade	214	14	14	6	9930	39	20,725	2,422
Hotels and restaurants	10	4	1	1	61	17	2,260	365
Transport, storage and communication	102	7	7	2	1235	17	5,739	738
Financial intermediation	295	40	9	6	4787	390	5,143	963
Real estate, renting and business activities	55	13	8	4	508	36	27,808	4,493
Other community, social and personal service activities	47	7	5	2	591	21	5,199	648

Note: Capital productivity is defined as real turnover:fixed assets.
Source: HM Revenue & Customs; FAME; and Oxera calculation.

A3.8 Scheme use by industry (SIC sub-category)

As highlighted in section 8.2.2, a useful extension of the analysis of share schemes by industry sector would be a more detailed examination of the adoption of schemes using a more disaggregated classification of SIC. This may provide additional insights particularly in those sectors where the use of schemes is most frequent, since it is possible that scheme adoption is concentrated among certain SIC sub-groups. However, an analysis of scheme use by disaggregated SIC is limited by the fact that, for most industries, there are no or only very few observations in each of the sub-categories. This section shows scheme usage by disaggregated SIC for those industries where scheme use is most widespread, namely manufacturing, wholesale and retail trade, financial intermediation, and real estate, renting and business activities.

Note that analysis shows that scheme usage being greater in certain industries than in others is mainly due to the overall number of firms within a sector relative to the number of firms in other sectors, rather than certain sectors being more likely to offer schemes than others (eg, due to differences in the characteristics of companies). For example, the publishing sub-sector has the third-largest number of companies without schemes in the manufacturing sector, the largest number of companies with schemes, and, overall, is the largest sub-sector

within manufacturing. A further characteristic that helps to explain the patterns of usage of share schemes is differences in average company size—eg, in terms of turnover or workforce, across sub-sectors.

Table A3.21 shows the sub-sectors within the manufacturing sector where most companies offer a tax-advantaged share scheme. The criterion for inclusion is that the sub-sector must have a minimum of 20 companies on average over the years 1993/94–2001/02.

Table A3.21 Scheme use by SIC sub-section: manufacturing

Industry (SIC sub-section)	% of total
Publishing	6
Manufacture of basis chemicals	5
Manufacture of pharmaceuticals, medicinal chemicals and botanical products	4
Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	4
Manufacture of beverages	4
Miscellaneous manufacturing not classified elsewhere	3
Manufacture of other food products	3
Manufacture of office machinery and computers	3
Printing and service activities related to printing	3
Number of companies (average 1993/04-2001/02)	**652**

Note: Only sectors with a minimum of 20 companies on average over the years 1993/94–2001/02 were included in the table.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.22 shows the sub-sectors within the real estate, renting and business activities sector where most companies offer a tax-advantaged share scheme. The criterion for inclusion is that the sub-sector must have a minimum of 20 companies on average over the years 1993/94–2001/02.

Table A3.22 Scheme use by SIC sub-section: real estate, renting and business activities

Industry (SIC sub-section)	% of total
Software consultancy and supply	22
Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings	17
Real estate activities with own property	12
Miscellaneous business activities not classified elsewhere	12
Other computer-related activities	6
Research and experimental development on natural sciences and engineering	6
Advertising	5
Architectural and engineering activities and related technical consultancy	4
Labour recruitment and provision of personnel	4
Number of companies (average 1993/04–2001/02)	**507**

Note: Only sectors with a minimum of 20 companies on average over the years 1993/94–2001/02 were included in the table.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.23 shows the sub-sectors within the wholesale and retail trade sector where most companies offer a tax-advantaged share scheme. The criterion for inclusion is that the sub-sector must have a minimum of 20 companies on average over the years 1993/94–2001/02.

Table A3.23 Scheme use by SIC sub-section: wholesale and retail trade

Industry (SIC sub-section)	% of total
Other retail sale of new goods in specialised stores	20
Wholesale of household goods	11
Wholesale of non-agricultural intermediate products, waste and scrap	11
Wholesale of machinery, equipment and supplies	10
Other wholesale	10
Wholesale of food, beverages and tobacco	8
Retail sale in non-specialised stores	8
Number of companies (average 1993/04–2001/02)	**254**

Note: Only sectors with a minimum of 20 companies on average over the years 1993/94–2001/02 were included in the table.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Table A3.24 shows the distribution of share schemes among all sub-sectors within the financial intermediation sector.

Table A3.24 Scheme use by SIC sub-section: financial intermediation

Industry (SIC sub-section)	% of total
Other financial intermediation	43
Insurance and pension funding, except compulsory social security	27
Monetary intermediation	14
Activities auxiliary to financial intermediation, except insurance and pension funding	12
Activities auxiliary to insurance and pension funding	5
Number of companies (average 1993/04–2001/02)	**156**

Note: Figures do not sum to 100 due to rounding.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Random effects model of likelihood of scheme take-up (listed companies only)
The table below shows the statistical output when modelling the likelihood of scheme adoption for listed companies only. Section 9 of the main report contains models for the sample of all companies.

```
Random-effects logistic regression              Number of obs      =     63315
Group variable (i): n_bvdid                     Number of groups   =     12537

------------------------------------------------------------------------------
      scheme |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lturnover |   1.218736   .0501509    24.30   0.000     1.120442     1.31703
returncapi~l |  -.0044109   .0030076    -1.47   0.142    -.0103057    .0014839
  labourprod |  -.3637527   .1156762    -3.14   0.002     -.590474   -.1370315
 capitalprod |  -.0441484   .0587381    -0.75   0.452    -.1592729    .0709761
        repo |  -.0018801   .0567353    -0.03   0.974    -.1130792     .109319
   changegdp |   6.559149   5.832494     1.12   0.261    -4.872328    17.99063
   agricult  |  -2.227109    .919923    -2.42   0.015    -4.030125   -.4240933
   construct |  -2.026266   .3520168    -5.76   0.000    -2.716206   -1.336325
   wholesale |   -.624828   .2791662    -2.24   0.025    -1.171984   -.0776723
   transport |  -1.763817   .3996618    -4.41   0.000     -2.54714   -.9804945
   finance   |     .36891   .3004336     1.23   0.219    -.2199291    .9577491
   health    |  -1.825505   1.136815    -1.61   0.108    -4.053621    .4026114
       _cons |   -9.73262   .8075292   -12.05   0.000    -11.31535   -8.149891
-------------+----------------------------------------------------------------
    /lnsig2u |   2.156976   .0785451                     2.003031    2.310922
-------------+----------------------------------------------------------------
     sigma_u |   2.940231   .1154704                     2.722404    3.175487
         rho |   .7243472    .015683                     .6925745    .7540025
------------------------------------------------------------------------------
```

Random effects model of likelihood of scheme take-up (all industries)
The table below shows the statistical output when modelling the likelihood of scheme adoption for all companies. Compared with the model above, this model includes control variables for all industries (including those which are not statistically significant), and financial intermediation is used as a reference group for estimating the industry effects (elsewhere in the main report, the omitted group is manufacturing).

```
Random-effects logistic regression              Number of obs      =     63315
Group variable (i): n_bvdid                     Number of groups   =     12537
------------------------------------------------------------------------------
      scheme |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lturnover |   .9522659   .0176951    53.82   0.000     .9175841    .9869477
  labourprod |  -.5543866   .0389497   -14.23   0.000    -.6307266   -.4780465
 capitalprod |  -.3729168   .0203169   -18.36   0.000    -.4127372   -.3330964
        repo |   .3462855   .0231344    14.97   0.000     .3009429    .3916281
   changegdp |   22.10187   2.210927    10.00   0.000     17.76854    26.43521
   agricult  |  -2.293643   .3365305    -6.82   0.000    -2.953231   -1.634056
   fishery   |  -23.17589   22809.48    -0.00   0.999    -44728.94    44682.59
   mining    |  -.7724249   .3270956    -2.36   0.018    -1.413521   -.1313293
   manuf     |  -.9907417   .1334637    -7.42   0.000    -1.252326   -.7291577
   electricity |  -.5996066   .3837767    -1.56   0.118    -1.351795     .152582
   construct |   -1.90647   .1806458   -10.55   0.000    -2.260529    -1.55241
   wholesal  |  -1.613953   .1431198   -11.28   0.000    -1.894463   -1.333444
   hotels    |  -1.975725   .2263582    -8.73   0.000    -2.419379   -1.532071
   transport |  -2.145508   .1889432   -11.36   0.000     -2.51583   -1.775186
  otherbus   |  -.2395447   .1355342    -1.77   0.077    -.5051868    .0260974
  publicadmin|   -25.0511   25421.25    -0.00   0.999     -49849.8    49799.69
  edu        |  -.8207474   .4583051    -1.79   0.073    -1.719009    .0775141
  health     |   -1.69989   .3326457    -5.11   0.000    -2.351864   -1.047916
  othercom   |  -1.077263   .1853479    -5.81   0.000    -1.440538   -.7139874
       _cons |    -11.039    .299181   -36.90   0.000    -11.62538   -10.45262
-------------+----------------------------------------------------------------
    /lnsig2u |   1.884035   .0184162                      1.84794     1.92013
-------------+----------------------------------------------------------------
     sigma_u |   2.565151   .0236201                     2.519272    2.611866
         rho |   .6666756   .0040924                     .6586069    .6746477
------------------------------------------------------------------------------
Likelihood-ratio test of rho=0: chibar2(01) =  1.9e+04 Prob >= chibar2 = 0.000
```

Appendix 4 Correlation analysis and plots of the variables

Table A4.1 Correlation matrix

	rturnover	scheme	employees	rcapital	rgdp	repo	listed
rturnover	1						
scheme	0.1171	1					
employees	0.5831	0.1646	1				
rcapital	0.6077	0.084	0.3789	1			
rgdp	0.0121	–0.0303	0.0204	0.0211	1		
repo	–0.0116	0.0045	–0.0215	–0.0136	–0.6208	1	
listed	0.0986	0.3082	0.1582	0.0758	0.1475	–0.1307	1

Source: HM Revenue & Customs; FAME; and Oxera calculations.

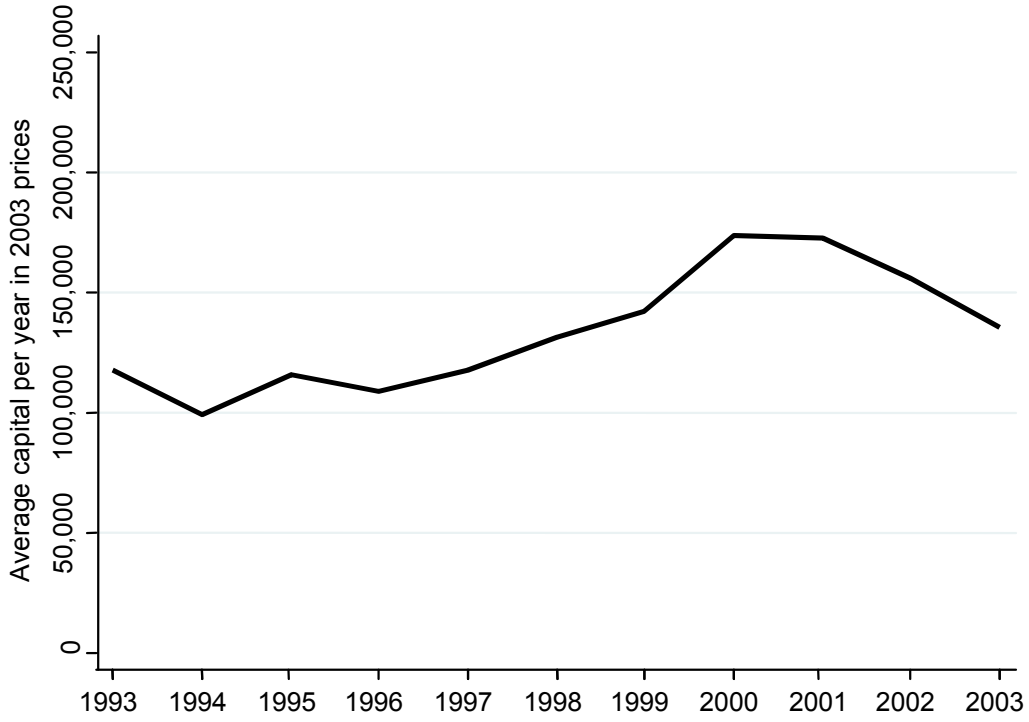
Table A4.2 Summary means and standard deviations of variables

Variable	Observations	Mean	Standard deviation
rturnover	122,477	127,302.50	1,231,668.00
scheme	142,245	0.14	0.35
employees	110,130	1,101.25	7,127.55
rcapital	142,245	137,767.70	2,417,801.00
rgdp	142,245	234,062.50	19,412.47
repo	142,245	5.84	1.00
listed	67,174	0.18	0.38
industry1	138,680	0.01	0.09
industry2	138,680	0.00	0.03
industry3	138,680	0.01	0.11
industry4	138,680	0.24	0.43
industry5	138,680	0.00	0.07
industry6	138,680	0.07	0.26
industry7	138,680	0.19	0.39
industry8	138,680	0.02	0.14
industry9	138,680	0.05	0.22
industry10	138,680	0.06	0.23
industry11	138,680	0.28	0.45
industry12	138,680	0.00	0.02
industry13	138,680	0.00	0.07
industry14	138,680	0.01	0.10
industry15	138,680	0.05	0.22
industry16	138,680	0.00	0.02
industry17	138,680	0.00	0.01
CSOP indicator	142,245	0.12	0.33
SAYE indicator	142,245	0.04	0.20
APS indicator	142,245	0.03	0.16

Note: Minimum and maximum values cannot be reported due to confidentiality restrictions.
Source: HM Revenue & Customs; FAME; and Oxera calculations.

Figure A4.1 shows the increasing trend in average capital (fixed assets) over the time period of the analysis.

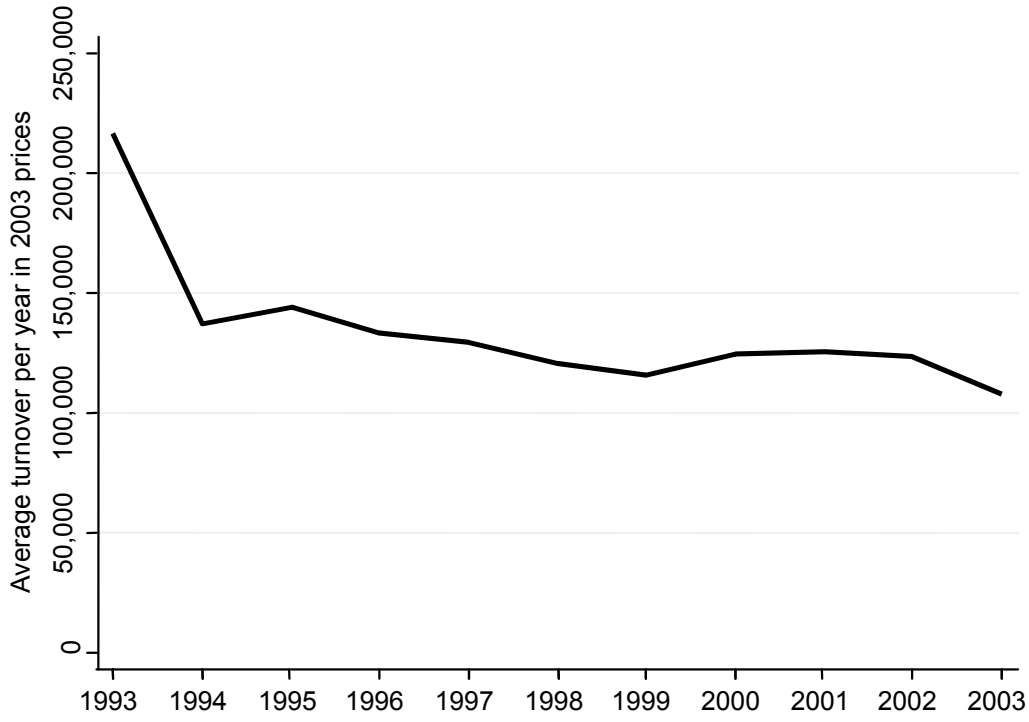
Figure A4.1 Average capital (fixed assets) per year, 2003 prices



Source: HM Revenue & Customs; FAME; and Oxera calculations.

As shown in Figure A4.2 although there may appear to be a negative trend in average turnover per year, the first and last years hold very little data and as such may be classed as outliers leaving a broadly flat trend.

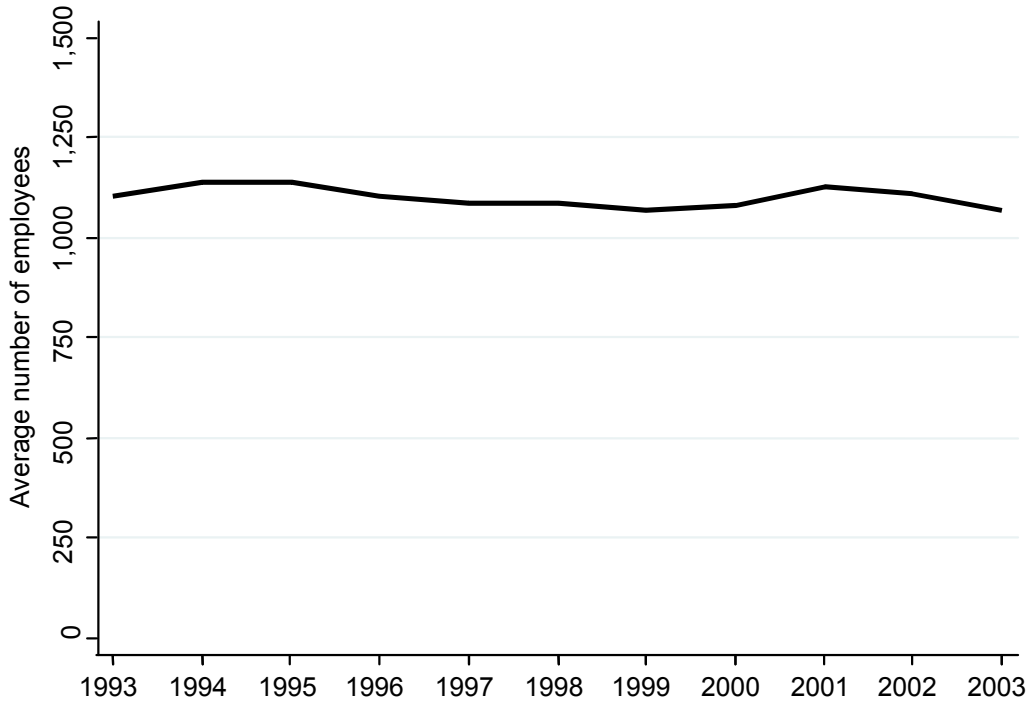
Figure A4.2 Average turnover per year, 2003 prices



Source: HM Revenue & Customs; FAME; and Oxera calculations.

Figure A4.3 shows the average number of employees per year. There have been no significant changes in the number of employees per year over the sample period.

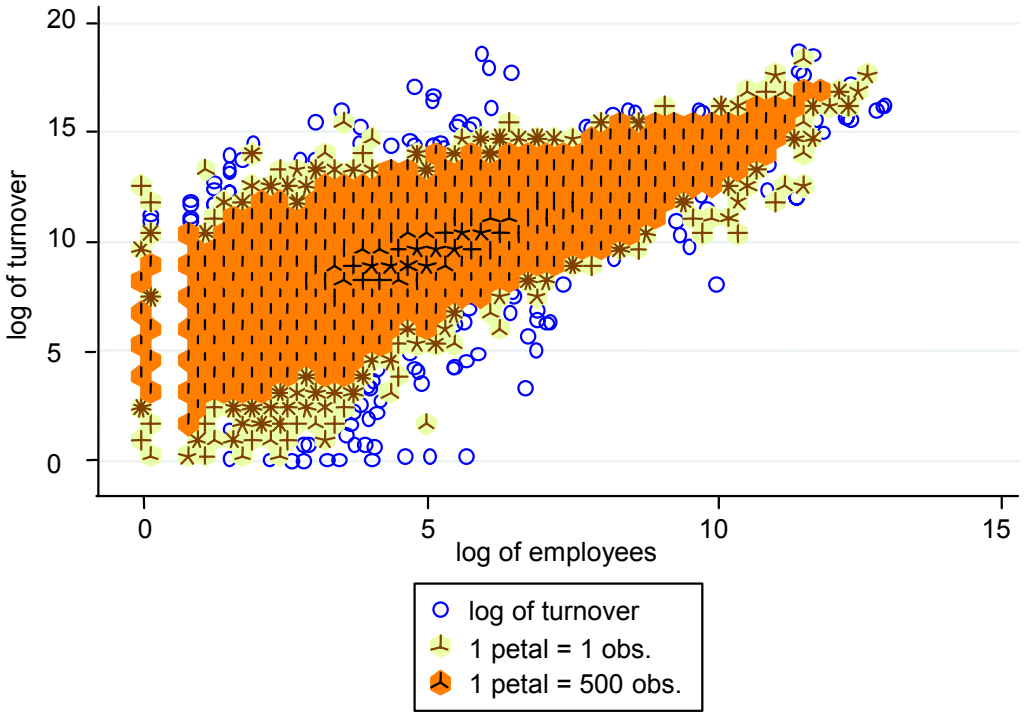
Figure A4.3 Average number of employees per year



Source: HM Revenue & Customs; FAME; and Oxera calculations.

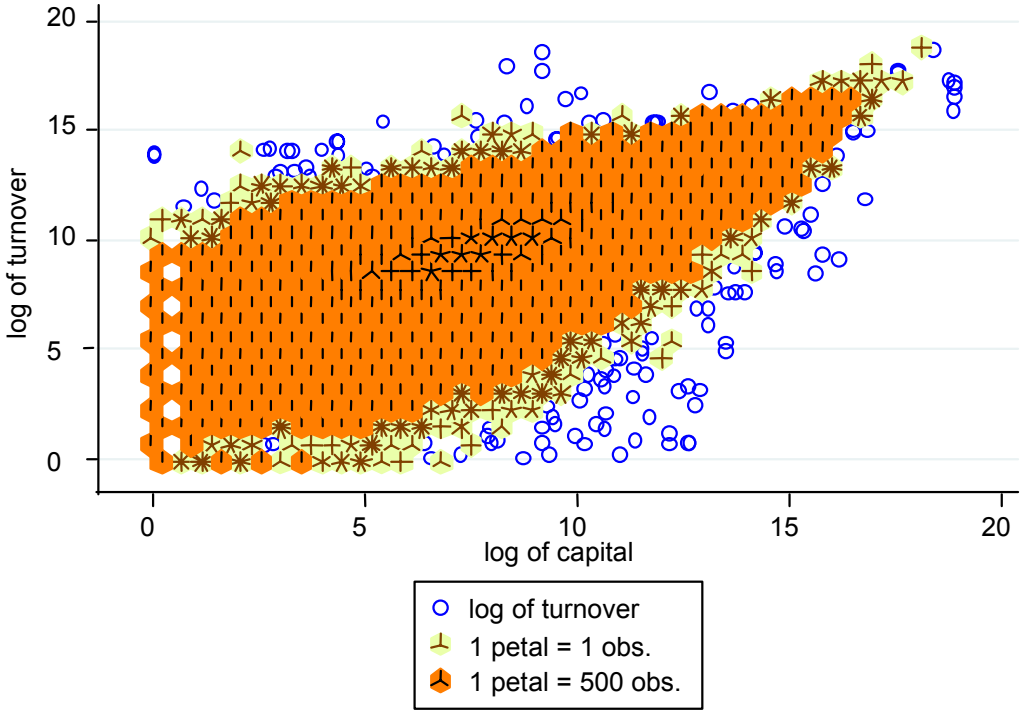
Figures A4.4 and A4.5 show the relationships within the Cobb Douglas production function. When turnover and capital or labour is converted to natural logarithms the linear relationship between turnover and capital and labour clear to see. These are the relationships, which are modelled in section 10. The graphs also demonstrate that majority of the data is in the centre of the distribution with a few very large companies at towards the higher end of the distribution.

Figure A4.4 log of turnover and log of employees



Source: HM Revenue & Customs; FAME; and Oxera calculations.

Figure A4.5 log of turnover and log of capital



Source: HM Revenue & Customs; FAME; and Oxera calculations.

Appendix 5 Technical econometric details

A5.1 Panel data estimation

In the general case, assume that the standard *levels* equation to be estimated has the following form:

$$y_{it} = \beta x_{it} + \psi z_i + \alpha_i + u_{it} \quad \text{(Equation A5.1)}$$

where:

- y_{it} is the dependent variable, which varies both over time t and across firms i;
- x_{it} is an explanatory variable, which varies both over time t and across firms i;
- z_i is a time-invariant variable, which varies only across firms i;
- α_i are unobservable effects, specific to firm i; and
- u_{it} is a random error term.

In *fixed-effects* models, the unobservable effects, α_i, are assumed to be in the form of a jump in the intercept β_1 for each firm. This jump varies by firm, but is constant over time. Within-group (WG) estimation may be used to estimate fixed-effects models. This eliminates the unobservable fixed effects α_i through subtracting the time series mean from each y_{it} and x_{it} observation. In addition, any other time-invariant variables, z_i, which are not captured in the effects α_i will also drop out of Equation A5.1, if it is assumed that the influence of these variables is constant over time. The WG transformation is shown in Equation A5.2.

$$(y_{it} - y_{i.}) = \beta(x_{it} - x_{i.}) + (u_{it} - u_{i.}) \quad \text{(Equation A5.2)}$$

Differencing also eliminates the α_i, if they are assumed to be fixed effects. In the two time period case (T = 2), differencing mimics the WG estimator. The differencing transformation is shown in Equation A5.3.

$$(y_{it} - y_{it-1}) = \beta(x_{it} - x_{it-1}) + (u_{it} - u_{it-1}) \quad \text{(Equation A5.3)}$$

Random-effects models assume that the unobservable effects, α_i, are in the form of a jump around the error term, u_i, rather than in the intercept. Again, the size of the effect varies by firm, but is constant over time. Generalised least squares (GLS) may be used to estimate random-effects models. This involves transforming the y_{it} and x_{it} variables by subtracting a portion θ of their time-series means from each variable. This is shown in Equation A5.4. Thus the estimator uses information both across and within firms (over time) and between firms (across the cross-section). In practice, a two-step approach is used. The first step involves estimating θ, and the second involves estimating the transformed equation. This is known as feasible generalised least squares (FGLS).

$$(y_{it} - \theta y_{i.}) = \beta(x_{it} - \theta x_{i.}) + (1 - \theta)\psi z_i + (u_{it} - \theta u_{i.}) \quad \text{(Equation A5.4)}$$

However, because random-effects models assume that the effects are in the form of a systematic jump in the error term, they rely on the assumption that the effects, α_i, are uncorrelated with the explanatory variables x_{it}. If this is not the case, the coefficient estimates obtained will be inefficient and inconsistent (the coefficient estimates may be biased, even in large samples). In practice, it is possible to test for this using a Hausman test.

It is also possible to test for whether pooled ordinary least squares (OLS) delivers similar coefficient estimates to a random-effects model, via the Breusch–Pagan test. The null

hypothesis under this test is that FGLS is equivalent to pooled OLS, which can be rejected if the Breusch–Pagan test statistic is high.

In the random-effects modelling, an estimate of θ can also be reported, which reveals how close the FGLS estimate of the β coefficients are to the estimates that would be obtained using fixed effects or pooled OLS. θ will lie between zero and 1; a θ of 1 indicates that the coefficient estimates derived are close to those that would be derived under fixed effects, and a θ of zero indicates that the coefficient estimates derived are close to those that would be derived under pooled OLS.

Diagnostic testing

There are some assumptions regarding the behaviour of the error term on which the OLS estimation is based. When these assumptions break down, the results of the modelling can be invalidated. Diagnostic testing helps to ascertain whether these assumptions have broken down.

The tests are applied for the following potential problems:

- *heteroscedasticity*—OLS assumes that the variance of the error term, u_i, is constant. If this is not the case, heteroscedasticity is said to exist, which may be tested using the 'Cook Weisberg' (CW) test; and
- *incorrect functional form*—OLS assumes that the true relationship is that specified in the regression model estimated (eg, a 'linear' or a 'log' relationship). If this is not the case, the functional form has been 'mis-specified', which may be tested using a 'Ramsey RESET' test.

If these problems occur, the error term, u_i, will not be 'well behaved'. In turn, this makes interpreting the results from the regressions estimated problematic.

Heteroscedasticity occurs when the classic assumption of a *constant error variance* across observations does not hold. In particular, problems for statistical inference based on least-squares estimates tend to arise when this error variance is a function of the values of the explanatory variables. Although this should not affect the expected values of the coefficient estimates, it would invalidate the standard errors associated with these coefficients. Consequently, heteroscedasticity would hamper the assessment of whether particular variables were statistically significant. Tests for heteroscedasticity tend to consider whether the error variance (estimated by the squared residuals) is a function of the explanatory variables and their squares.

Regression models also make an assumption that the dependent variable is related to the explanatory variables in the particular way chosen by the researcher—eg, linear or log-linear. However, the true relationship might be more complex.

The Ramsey RESET test of functional form is a very general test and considers whether adding non-linearities into the model adds explanatory power to a significant extent.

Data handling

In order to ensure high-quality data analysis, summary statistics have been produced for each of the potential variables in the modelling (see Appendix 4), and both cross-sectional and time-series graphs produced to check for outlying observations and data entry errors. Observations identified as outliers are investigated to understand why they are significantly different from the majority of the data, and whether this is an error or due to a unique factor that can be controlled for by a firm-specific effect.

Correlations and correlograms of the data have been examined to ensure that economic relationships are intuitive and help inform the modelling process.

When conducting the regression modelling, outlier analysis is used to identify which observations do not fit the data. These observations are then examined to assess whether there are individual problems or if the outliers are systematic and a different specification is required. The outlier analysis is described below.

Outlier analysis
Four tests are employed to examine whether particular observations are outliers:

- DFBETA examines the influence of each observation on the coefficient estimates included in the model, and, relating to this, 'leverage', which examines the influence of each observation on the estimated relationship;
- DFITS summarises information on leverage versus the residual-squared plot into a single statistic;
- Cook's Distance (a function of DFITS); and
- Welsh's Distance (also a function of DFITS).

For each test, the summary statistic obtained is compared with a critical value. The observation might be deemed statistically to be an outlier if, in the test concerned, its summary statistic exceeds this critical value.

A5.2 Arellano and Bond estimators

There are some potential biases with dynamic panel data, as noted by Arellano and Bond. The simple dynamic panel data model is:

$$y_{i,t} = \delta y_{i,t-1} + x_{i,t} + u_{i,t} \qquad \text{(Equation A5.5)}$$

and the residual is composed of a firm-specific effect and a white noise random error term:

$$u_{i,t} = \upsilon_i + v_{i,t} \qquad \text{(Equation A5.6)}$$

Since $y_{i,t}$ is a function of μ_i, the introduction of the lagged dependent variable means that $y_{i,t-1}$ is also a function of μ_i. In a dynamic specification with $y_{i,t-1}$ on the right-hand side, there is a problem in that the error term is correlated with one of the regressors. This can lead to bias in the estimation.

Arellano and Bond proposed a solution whereby modelling in differences allows the use of lags of the dependent variable as valid instruments.

The Arellano Bond estimator was used during this research. However, this requires running a difference model with lags on datasets containing an average of only six time period observations per company. This left very few degrees of freedom in terms of *T* and the models estimated did not appear robust because the estimated elasticities to employees, capital and GDP were either incorrectly signed or of a unintuitive magnitude.

A dataset with a longer time series may be required to allow estimation without this potential bias.

Appendix 6 Sensitivity to excluding 1993 and 2003

The models below replicate those presented in Tables 10.1 and 10.2, but with the time series shortened to 1994–2002.

Table A6.1 Static production function models (1994–2002)

Model	1	2	3	4	5
	lturnover	lturnover	lturnover	lturnover	lturnover
lemployees	0.765	0.765	0.765	0.764	0.764
	(243.06)**	(241.94)**	(243.06)**	(242.64)**	(242.86)**
lcapital	0.077	0.076	0.076	0.077	0.076
	(34.43)**	(33.88)**	(34.33)**	(34.35)**	(34.33)**
lgdp	0.451	0.454	0.448	0.454	0.448
	(20.02)**	(20.02)**	(19.86)**	(20.11)**	(19.87)**
repo	–0.017	–0.016	–0.017	–0.017	–0.017
	(9.59)**	(9.41)**	(9.57)**	(9.56)**	(9.59)**
scheme	0.082				
	(12.55)**				
sind1		–0.18			
		(2.21)*			
sind2		0			
		(.)			
sind3		0.216			
		(4.18)**			
sind4		0.072			
		(6.02)**			
sind5		0.224			
		(3.74)**			
sind6		0.02			
		–0.56			
sind7		0.037			
		(2.14)*			
sind8		0.115			
		(2.66)**			
sind9		0.154			
		(4.59)**			
sind10		0.114			
		(4.48)**			
sind11		0.069			
		(5.75)**			
sind12		0			

Model	1	2	3	4	5
		(.)			
sind13		0.233			
		(2.11)*			
sind14		0.107			
		–1.47			
sind15		0.19			
		(6.35)**			
sind16		0			
		(.)			
sind17		0			
		(.)			
slisted			0.132		
			(9.56)**		
snonlisted			0.068		
			(9.18)**		
aps_indicator				0.046	
				(3.04)**	
csop_indicator				0.069	
				(10.21)**	
saye_indicator				0.05	
				(4.58)**	
app_scheme					0.031
					(3.08)**
unapp_scheme					0.085
					(6.44)**
Constant	–0.063	–0.089	–0.022	–0.091	–0.02
	–0.22	–0.31	–0.08	–0.33	–0.07
Observations	103,117	101,479	103,117	103,117	103,117
Number of companies	16,844	16,294	16,844	16,844	16,844

Notes: Absolute value of t statistics in parentheses. * significant at 5%; ** significant at 1%.
Source: Oxera analysis.

Table A6.2 Dynamic production function models (1994–2002)

Model	1	2	3	4
	lturnover	lturnover	lturnover	lturnover
lturnover_1	0.367	0.369	0.369	0.368
	(116.89)**	(116.98)**	(117.01)**	(118.12)**
lemployees	0.679	0.678	0.678	0.678
	(175.67)**	(174.19)**	(174.29)**	(175.67)**
lemployees_1	–0.227	–0.228	–0.228	–0.224
	(50.89)**	(50.88)**	(50.89)**	(51.63)**
lcapital	0.049	0.048	0.048	0.053
	(20.11)**	(19.68)**	(19.72)**	(25.99)**
lcapital_1	0.006	0.006	0.006	
	(2.54)*	(2.55)*	(2.54)*	
lgdp	1.062	1.063	1.069	
	(7.93)**	(7.90)**	(7.95)**	
lgdp_1	–0.999	–0.996	–1.003	
	(7.54)**	(7.48)**	(7.54)**	
scheme	–0.011			
	–1.23			
aps_indicator		0.006		
		–0.44		
csop_indicator		0.01		
		–1.65		
saye_indicator		0.026		
		(2.82)**		
slisted			0.031	
			(2.61)**	
snonlisted			0.012	
			–1.89	
app_scheme				–0.012
				–1.32
unapp_scheme				0.045
				(3.86)**
unapp_scheme_1				0.004
				–0.52
Constant	2.778	2.727	2.736	3.586
	(12.98)**	(12.70)**	(12.75)**	(153.53)**
Observations	83,602	82,550	82,550	8,602
Number of companies	14,960	14,601	14,601	14,960

Source: Oxera analysis.

Appendix 7 Statistical output from econometric models

```
. ************************
. * General Static model *
. ************************
.

Fixed-effects (within) regression               Number of obs      =    103117
Group variable (i): company                     Number of groups   =     16844

R-sq:  within  = 0.5343                         Obs per group: min =         1
       between = 0.6772                                        avg =       6.1
       overall = 0.6775                                        max =        10

                                                F(5,86268)         =  19793.47
corr(u_i, Xb)  = 0.0020                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      scheme |   .0819362   .0065313    12.55   0.000     .0691348    .0947376
  lemployees |   .7646949   .0031461   243.06   0.000     .7585286    .7708613
    lcapital |   .0767165   .0022281    34.43   0.000     .0723495    .0810835
        lgdp |   .4514141    .022547    20.02   0.000     .4072222    .4956059
        repo |  -.0166707   .0017392    -9.59   0.000    -.0200794   -.0132619
       _cons |  -.0630155   .2810549    -0.22   0.823    -.6138807    .4878497
-------------+----------------------------------------------------------------
     sigma_u |  1.1461794
     sigma_e |  .40679766
         rho |  .88812667   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(16843, 86268) =    37.47        Prob > F = 0.0000

. *Effects by Industry

Fixed-effects (within) regression               Number of obs      =    101479
```

```
Group variable (i): company                     Number of groups   =     16294

R-sq:  within  = 0.5354                         Obs per group: min =         1
       between = 0.6734                                        avg =       6.2
       overall = 0.6753                                        max =        10

                                                F(17,85168)        =   5773.15
corr(u_i, Xb)  = -0.0044                        Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lemployees |   .7654661   .0031638   241.94   0.000     .7592651    .7716672
    lcapital |   .0759759   .0022424    33.88   0.000     .0715807    .0803711
        lgdp |   .4539317   .0226709    20.02   0.000     .4094969    .4983665
        repo |  -.0164942   .0017528    -9.41   0.000    -.0199297   -.0130587
       sind1 |  -.1795305   .0812463    -2.21   0.027    -.3387727   -.0202884
       sind2 |  (dropped)
       sind3 |   .2160455   .0516433     4.18   0.000     .1148251    .3172659
       sind4 |   .0718411   .0119388     6.02   0.000     .0484412     .095241
       sind5 |   .2236767   .0598533     3.74   0.000     .1063647    .3409887
       sind6 |   .0195339   .0350796     0.56   0.578    -.0492218    .0882896
       sind7 |   .0373101   .0174326     2.14   0.032     .0031423    .0714779
       sind8 |   .1154808   .0433771     2.66   0.008     .0304621    .2004996
       sind9 |    .154132   .0335671     4.59   0.000     .0883409    .2199232
      sind10 |    .113999   .0254688     4.48   0.000     .0640804    .1639177
      sind11 |   .0690904   .0120167     5.75   0.000     .0455377    .0926432
      sind12 |  (dropped)
      sind13 |   .2332533   .1104924     2.11   0.035     .0166892    .4498175
      sind14 |   .1065506   .0724123     1.47   0.141     -.035377    .2484781
      sind15 |   .1902445   .0299518     6.35   0.000     .1315392    .2489497
      sind16 |  (dropped)
      sind17 |  (dropped)
       _cons |  -.0887289   .2826206    -0.31   0.754     -.642663    .4652053
-------------+----------------------------------------------------------------
     sigma_u |  1.1433605
     sigma_e |  .40675107
         rho |  .88765925   (fraction of variance due to u_i)
```

```
------------------------------------------------------------------------------
F test that all u_i=0:     F(16293, 85168) =    37.45        Prob > F = 0.0000

. *Effects by listing

Fixed-effects (within) regression               Number of obs      =    103117
Group variable (i): company                     Number of groups   =     16844

R-sq:  within  = 0.5344                         Obs per group: min =         1
       between = 0.6771                                        avg =       6.1
       overall = 0.6774                                        max =        10

                                                F(6,86267)         =  16500.43
corr(u_i, Xb)  = -0.0006                        Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lemployees |   .7646418   .0031459   243.06   0.000     .7584759    .7708076
    lcapital |   .0764986   .0022285    34.33   0.000     .0721308    .0808664
        lgdp |     .44809   .0225593    19.86   0.000     .4038739    .4923061
        repo |  -.0166413    .001739    -9.57   0.000    -.0200498   -.0132329
     slisted |   .1320597   .0138161     9.56   0.000     .1049804    .1591391
  snonlisted |   .0677546   .0073835     9.18   0.000     .0532829    .0822262
       _cons |  -.0219336    .281206    -0.08   0.938     -.573095    .5292278
-------------+----------------------------------------------------------------
     sigma_u |  1.1462679
     sigma_e |  .40676006
         rho |  .88816037   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(16843, 86267) =    37.48        Prob > F = 0.0000


. *Effects by scheme
Fixed-effects (within) regression               Number of obs      =    103117
Group variable (i): company                     Number of groups   =     16844

R-sq:  within  = 0.5343                         Obs per group: min =         1
```

```
       between = 0.6775                                        avg =       6.1
       overall = 0.6778                                        max =        10

                                                     F(7,86266)         =  14137.60
corr(u_i, Xb)  = 0.0003                              Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lemployees |   .7642658   .0031497   242.64   0.000     .7580924    .7704393
    lcapital |   .0765762    .002229    34.35   0.000     .0722074     .080945
        lgdp |   .4539107   .0225695    20.11   0.000     .4096747    .4981466
        repo |  -.0166309   .0017392    -9.56   0.000    -.0200398   -.0132221
aps_indica~r |     .04571   .0150374     3.04   0.002     .0162368    .0751833
csop_indic~r |   .0685896   .0067191    10.21   0.000     .0554202     .081759
saye_indic~r |   .0503605   .0109945     4.58   0.000     .0288114    .0719095
       _cons |  -.0914378   .2813349    -0.33   0.745    -.6428518    .4599762
-------------+----------------------------------------------------------------
     sigma_u |  1.1457228
     sigma_e |   .4068044
         rho |  .88804416   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(16843, 86266) =    37.25        Prob > F = 0.0000


. *Effect of unapproved scheme Also

Fixed-effects (within) regression               Number of obs      =    103117
Group variable (i): company                     Number of groups   =     16844

R-sq:  within  = 0.5345                         Obs per group: min =         1
       between = 0.6773                                        avg =       6.1
       overall = 0.6777                                        max =        10

                                                     F(6,86267)         =  16509.21
corr(u_i, Xb)  = -0.0001                             Prob > F           =    0.0000

------------------------------------------------------------------------------
```

```
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  app_scheme |   .0314042   .0102067     3.08   0.002     .0113991    .0514092
unapp_scheme |   .1165846   .0084599    13.78   0.000     .1000032     .133166
  lemployees |   .7641492   .0031465   242.86   0.000     .7579821    .7703164
    lcapital |   .0764853   .0022278    34.33   0.000     .0721188    .0808519
        lgdp |   .4481037   .0225475    19.87   0.000     .4039107    .4922966
        repo |  -.0166666   .0017387    -9.59   0.000    -.0200745   -.0132586
       _cons |   -.019861   .2810688    -0.07   0.944    -.5707535    .5310314
-------------+----------------------------------------------------------------
     sigma_u |  1.1460114
     sigma_e |  .40670222
         rho |  .88814416   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(16843, 86267) =    37.44        Prob > F = 0.0000
. *************
. * Dynamics *
. *************
. *General Dynamic model

Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6188                         Obs per group: min =         1
       between = 0.8813                                        avg =       5.6
       overall = 0.8677                                        max =         9

                                                F(11,68631)        =  10127.15
corr(u_i, Xb)  = 0.2652                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3663421   .0031449   116.49   0.000     .3601782    .3725061
      scheme |   .0159539   .0057282     2.79   0.005     .0047266    .0271812
    scheme_1 |   .0036616   .0056608     0.65   0.518    -.0074337    .0147569
  lemployees |    .679395   .0038661   175.73   0.000     .6718175    .6869725
lemployees_1 |  -.2280965   .0044686   -51.04   0.000    -.2368549   -.2193381
```

```
    lcapital |    .050109   .0024477    20.47   0.000     .0453115    .0549065
  lcapital_1 |   .0058107   .0025161     2.31   0.021     .0008791    .0107422
        lgdp |   .4362553   .1948154     2.24   0.025     .0544174    .8180932
      lgdp_1 |  -.4878207   .1849426    -2.64   0.008     -.850308   -.1253334
        repo |  -.0119654   .0021354    -5.60   0.000    -.0161509     -.00778
      repo_1 |   -.006052   .0016556    -3.66   0.000    -.0092969    -.002807
       _cons |    4.32297   .2995472    14.43   0.000     3.735858    4.910082
-------------+----------------------------------------------------------------
     sigma_u |  .68688913
     sigma_e |  .30494484
         rho |  .83535759   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68631) =     4.53        Prob > F = 0.0000

. *and by industry

Fixed-effects (within) regression               Number of obs      =     82550
Group variable (i): company                     Number of groups   =     14601

R-sq:  within  = 0.6202                         Obs per group: min =         1
       between = 0.8807                                        avg =       5.7
       overall = 0.8673                                        max =         9

                                                F(35,67914)        =   3169.02
corr(u_i, Xb)  = 0.2638                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3683476    .003157   116.68   0.000     .3621598    .3745353
  lemployees |   .6781365   .0038883   174.40   0.000     .6705155    .6857576
lemployees_1 |   -.228873   .0044907   -50.97   0.000    -.2376748   -.2200712
    lcapital |   .0495519   .0024598    20.14   0.000     .0447307    .0543731
  lcapital_1 |   .0060511   .0025271     2.39   0.017      .001098    .0110042
        lgdp |   .4585256   .1956281     2.34   0.019     .0750948    .8419564
      lgdp_1 |  -.5041466   .1856816    -2.72   0.007    -.8680824   -.1402108
        repo |  -.0117336   .0021456    -5.47   0.000     -.015939   -.0075282
      repo_1 |  -.0059999   .0016663    -3.60   0.000    -.0092658   -.0027339
```

```
       sind1 |  -.0944531   .0667443    -1.42   0.157    -.2252719    .0363658
       sind2 |  (dropped)
       sind3 |   .0605138   .0466202     1.30   0.194    -.0308617    .1518892
       sind4 |   .0300679   .0104334     2.88   0.004     .0096184    .0505174
       sind5 |   .1005799   .0559918     1.80   0.072     -.009164    .2103238
       sind6 |  -.0516605   .0298756    -1.73   0.084    -.1102166    .0068956
       sind7 |  -.0154721   .0149255    -1.04   0.300    -.0447261    .0137819
       sind8 |    .060815   .0368489     1.65   0.099    -.0114088    .1330389
       sind9 |   .0135462   .0313968     0.43   0.666    -.0479914    .0750838
      sind10 |   .0126859   .0222567     0.57   0.569    -.0309373     .056309
      sind11 |   .0148829   .0106526     1.40   0.162    -.0059963     .035762
      sind12 |  (dropped)
      sind13 |   .0526656   .0924726     0.57   0.569    -.1285805    .2339117
      sind14 |    .073898   .0630414     1.17   0.241     -.049663     .197459
      sind15 |    .039271   .0261234     1.50   0.133    -.0119307    .0904728
      sind16 |  (dropped)
      sind17 |  (dropped)
     sind1_1 |  -.1923024   .0670118    -2.87   0.004    -.3236454   -.0609595
     sind2_1 |  (dropped)
     sind3_1 |  -.0729764    .044206    -1.65   0.099    -.1596201    .0136672
     sind4_1 |    .002627   .0102628     0.26   0.798    -.0174882    .0227421
     sind5_1 |   .1080471   .0559404     1.93   0.053    -.0015961    .2176902
     sind6_1 |   -.033097   .0292432    -1.13   0.258    -.0904137    .0242197
     sind7_1 |    .001345   .0147815     0.09   0.927    -.0276267    .0303167
     sind8_1 |   .0485329   .0379186     1.28   0.201    -.0257876    .1228534
     sind9_1 |  -.0883011   .0287038    -3.08   0.002    -.1445604   -.0320417
    sind10_1 |   .0684134     .02215     3.09   0.002     .0249995    .1118273
    sind11_1 |   .0101681   .0106411     0.96   0.339    -.0106884    .0310247
    sind12_1 |  (dropped)
    sind13_1 |   .0031523   .0926584     0.03   0.973     -.178458    .1847627
    sind14_1 |  -.0861655   .0706808    -1.22   0.223    -.2246999    .0523688
    sind15_1 |   .0170079   .0257972     0.66   0.510    -.0335545    .0675703
    sind16_1 |  (dropped)
    sind17_1 |  (dropped)
       _cons |   4.241889   .3010524    14.09   0.000     3.651826    4.831951
-------------+----------------------------------------------------------------
     sigma_u |  .68404103
     sigma_e |  .30464344
```

```
         rho |   .83448483   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14600, 67914) =     4.52        Prob > F = 0.0000

. *Specific Dynamic model
Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6184                         Obs per group: min =         1
       between = 0.8814                                        avg =       5.6
       overall = 0.8679                                        max =         9

                                                F(8,68634)         =  13904.22
corr(u_i, Xb)  = 0.2667                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3668214   .0031429   116.71   0.000     .3606613    .3729815
      scheme |    .015907   .0056605     2.81   0.005     .0048124    .0270015
  lemployees |   .6789435   .0038674   175.56   0.000     .6713634    .6865235
lemployees_1 |  -.2277763   .0044682   -50.98   0.000    -.2365339   -.2190187
    lcapital |   .0490184   .0024449    20.05   0.000     .0442264    .0538104
  lcapital_1 |   .0064335   .0025151     2.56   0.011     .0015039     .011363
        lgdp |   1.060948   .1339071     7.92   0.000       .79849    1.323406
      lgdp_1 |  -.9946028   .1324595    -7.51   0.000    -1.254223   -.7349823
       _cons |   2.744081    .214025    12.82   0.000     2.324592     3.16357
-------------+----------------------------------------------------------------
     sigma_u |  .68664378
     sigma_e |  .30508205
         rho |  .83513546   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68634) =     4.53        Prob > F = 0.0000

. *Specific Dynamic model by scheme type

Fixed-effects (within) regression               Number of obs      =     82550
Group variable (i): company                     Number of groups   =     14601
```

```
R-sq:  within  = 0.6195                         Obs per group: min =         1
       between = 0.8813                                        avg =       5.7
       overall = 0.8680                                        max =         9

                                                F(10,67939)       =  11062.44
corr(u_i, Xb)  = 0.2643                         Prob > F          =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3690594    .003155   116.98   0.000     .3628757    .3752431
aps_indica~r |   .0056249   .0128492     0.44   0.662    -.0195596    .0308093
csop_indic~r |   .0095498    .005803     1.65   0.100     -.001824    .0209236
saye_indic~r |   .0258007   .0091581     2.82   0.005     .0078509    .0437505
  lemployees |   .6775187   .0038896   174.19   0.000      .669895    .6851424
lemployees_1 |  -.2284538   .0044902   -50.88   0.000    -.2372545   -.2196531
    lcapital |   .0483783   .0024576    19.68   0.000     .0435614    .0531953
  lcapital_1 |   .0064337   .0025258     2.55   0.011     .0014831    .0113842
        lgdp |   1.063106   .1345379     7.90   0.000     .7994122      1.3268
      lgdp_1 |  -.9957864   .1330929    -7.48   0.000    -1.256648   -.7349244
       _cons |   2.726924   .2147734    12.70   0.000     2.305968    3.147879
-------------+----------------------------------------------------------------
     sigma_u |  .68253979
     sigma_e |  .30487053
         rho |  .83367046   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14600, 67939) =     4.46        Prob > F = 0.0000

. *Specific Dynamic model by listing

Fixed-effects (within) regression               Number of obs      =     82550
Group variable (i): company                     Number of groups   =     14601

R-sq:  within  = 0.6195                         Obs per group: min =         1
       between = 0.8812                                        avg =       5.7
       overall = 0.8679                                        max =         9
```

```
                                                F(9,67940)        =  12291.17
corr(u_i, Xb)  = 0.2640                         Prob > F          =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3691213   .0031545   117.01   0.000     .3629385    .3753041
     slisted |   .0313205   .0119915     2.61   0.009     .0078172    .0548238
  snonlisted |   .0121829   .0064616     1.89   0.059    -.0004819    .0248477
  lemployees |   .6777385   .0038887   174.29   0.000     .6701167    .6853602
lemployees_1 |  -.2284815     .00449   -50.89   0.000    -.2372818   -.2196812
    lcapital |    .048458   .0024572    19.72   0.000     .0436418    .0532742
  lcapital_1 |   .0064056    .002526     2.54   0.011     .0014546    .0113565
        lgdp |   1.069416   .1345001     7.95   0.000     .8057961    1.333036
      lgdp_1 |  -1.003058   .1330551    -7.54   0.000    -1.263846   -.7422703
       _cons |    2.73628   .2146277    12.75   0.000      2.31561     3.15695
-------------+----------------------------------------------------------------
     sigma_u |  .68271724
     sigma_e |  .30487298
         rho |  .83374032   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14600, 67940) =     4.46        Prob > F = 0.0000

. *Test for unapproved schemes

Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6185                         Obs per group: min =         1
       between = 0.8813                                        avg =       5.6
       overall = 0.8678                                        max =         9

                                                F(11,68631)       =  10115.44
corr(u_i, Xb)  = 0.2645                         Prob > F          =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
 lturnover_1 |   .3666354    .003145   116.58   0.000     .3604712    .3727996
  app_scheme |  -.0107961   .0088909    -1.21   0.225    -.0282222    .0066301
app_scheme_1 |    .001311   .0087657     0.15   0.881    -.0158698    .0184918
unapp_scheme |   .0332858   .0074829     4.45   0.000     .0186193    .0479522
unapp_sche~1 |   .0041081    .007415     0.55   0.580    -.0104254    .0186415
  lemployees |   .6788108   .0038672   175.53   0.000     .6712311    .6863906
lemployees_1 |  -.2279748   .0044697   -51.00   0.000    -.2367354   -.2192141
    lcapital |   .0489468   .0024448    20.02   0.000     .0441551    .0537385
  lcapital_1 |   .0063531   .0025155     2.53   0.012     .0014227    .0112836
        lgdp |   1.062346   .1339123     7.93   0.000     .7998782    1.324814
      lgdp_1 |   -.997017   .1324661    -7.53   0.000     -1.25665   -.7373837
       _cons |   2.759437   .2141229    12.89   0.000     2.339756    3.179118
-------------+----------------------------------------------------------------
     sigma_u |   .6865927
     sigma_e |  .30505401
         rho |  .83514028   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68631) =     4.52        Prob > F = 0.0000

. *Specific model controlling for unapproved schemes

Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6181                         Obs per group: min =         1
       between = 0.8815                                        avg =       5.6
       overall = 0.8680                                        max =         9

                                                F(7,68635)         =  15867.97
corr(u_i, Xb)  = 0.2603                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3683918   .0031188   118.12   0.000     .3622789    .3745047
  app_scheme |  -.0117039   .0088446    -1.32   0.186    -.0290392    .0056314
unapp_scheme |   .0328877   .0074836     4.39   0.000       .01822    .0475555
unapp_sche~1 |   .0038859   .0074155     0.52   0.600    -.0106486    .0184203
```

```
  lemployees |   .6782068   .0038607   175.67   0.000     .6706399    .6857737
lemployees_1 |  -.2241179   .0043409   -51.63   0.000     -.232626   -.2156098
    lcapital |   .0525003   .0020199    25.99   0.000     .0485412    .0564594
       _cons |    3.58603   .0233571   153.53   0.000      3.54025     3.63181
-------------+----------------------------------------------------------------
     sigma_u |  .68508819
     sigma_e |  .30521525
         rho |  .83438935   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68635) =     4.54        Prob > F = 0.0000


. *Specific Dynamic model by Industry

. xtreg lturnover lturnover_1 lemployees lemployees_1 lcapital lcapital_1 lgdp lgdp_1 repo
repo_1 sind4 sind1_1 sind5_1 sind9_1 sind10_1, fe


Fixed-effects (within) regression               Number of obs      =     82550
Group variable (i): company                     Number of groups   =     14601

R-sq:  within  = 0.6201                         Obs per group: min =         1
       between = 0.8812                                        avg =       5.7
       overall = 0.8679                                        max =         9

                                                F(14,67935)        =   7919.53
corr(u_i, Xb)  = 0.2636                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3687589   .0031536   116.93   0.000     .3625779      .37494
  lemployees |   .6781676   .0038862   174.51   0.000     .6705507    .6857845
lemployees_1 |  -.2284781   .0044865   -50.93   0.000    -.2372717   -.2196846
    lcapital |   .0496447   .0024592    20.19   0.000     .0448246    .0544648
  lcapital_1 |   .0059583    .002526     2.36   0.018     .0010073    .0109093
        lgdp |   .4534983   .1955665     2.32   0.020     .0701881    .8368085
      lgdp_1 |  -.5002969    .185622    -2.70   0.007    -.8641159   -.1364779
        repo |  -.0117637   .0021448    -5.48   0.000    -.0159676   -.0075598
      repo_1 |  -.0060444   .0016661    -3.63   0.000    -.0093099   -.0027789
       sind4 |   .0304299   .0102236     2.98   0.003     .0103916    .0504681
     sind1_1 |  -.2091225   .0659633    -3.17   0.002    -.3384105   -.0798345
```

```
     sind5_1 |   .1495595   .0508836     2.94   0.003     .0498278    .2492912
     sind9_1 |  -.0865061   .0282912    -3.06   0.002    -.1419569   -.0310554
    sind10_1 |   .0699978   .0219271     3.19   0.001     .0270207    .1129749
       _cons |   4.252244   .3009287    14.13   0.000     3.662424    4.842064
-------------+----------------------------------------------------------------
     sigma_u |  .68262403
     sigma_e |  .30466163
         rho |  .83389467   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14600, 67935) =     4.54        Prob > F = 0.0000


. *Specific Dynamic model by turnover band
. summ rturnover, detail

                          rturnover
-------------------------------------------------------------
      Percentiles      Smallest
 1%     12.76271              1
 5%     80.59632              1
10%     327.5762              1       Obs              122477
25%     3375.589              1       Sum of Wgt.      122477

50%     11249.92                      Mean           127302.5
                        Largest       Std. Dev.       1231668
75%     36267.17       1.25e+08
90%     135825.6       1.28e+08       Variance       1.52e+12
95%     355788.7       1.30e+08       Skewness       60.25773
99%      2116181       1.40e+08       Kurtosis       5471.494

*Specific dynamic model for turnover Q1
Fixed-effects (within) regression               Number of obs      =      9796
Group variable (i): company                     Number of groups   =      3502

R-sq:  within  = 0.2266                         Obs per group: min =         1
       between = 0.4601                                        avg =       2.8
       overall = 0.4664                                        max =         9
```

```
                                                F(8,6286)           =    230.19
corr(u_i, Xb)  = 0.1437                         Prob > F            =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .1395917   .0097951    14.25   0.000     .1203899    .1587935
      scheme |   .0144078   .0270315     0.53   0.594    -.0385832    .0673988
  lemployees |   .4778037   .0184358    25.92   0.000     .4416633    .5139441
lemployees_1 |  -.0463581   .0156096    -2.97   0.003    -.0769583   -.0157579
    lcapital |   .0620297    .008903     6.97   0.000     .0445767    .0794827
  lcapital_1 |   .0345732    .009062     3.82   0.000     .0168087    .0523377
        lgdp |   .2310342   .6248508     0.37   0.712    -.9938868    1.455955
      lgdp_1 |  -.0649642   .6173386    -0.11   0.916    -1.275159     1.14523
       _cons |   2.178554   1.220394     1.79   0.074    -.2138352    4.570943
-------------+----------------------------------------------------------------
     sigma_u |  .91727002
     sigma_e |  .44242735
         rho |  .81126506   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3501, 6286) =     4.22          Prob > F = 0.0000

*Specific dynamic model for turnover Q2

Fixed-effects (within) regression               Number of obs      =     22547
Group variable (i): company                     Number of groups   =      6168

R-sq:  within  = 0.3528                         Obs per group: min =         1
       between = 0.1829                                        avg =       3.7
       overall = 0.1907                                        max =         9

                                                F(8,16371)          =   1115.56
corr(u_i, Xb)  = -0.5092                        Prob > F            =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .1852485   .0046276    40.03   0.000     .1761779    .1943192
```

```
      scheme |   .0087184   .0073124     1.19   0.233    -.0056147    .0230515
  lemployees |   .3415679   .0064615    52.86   0.000     .3289028    .3542331
lemployees_1 |   -.092235    .005807   -15.88   0.000    -.1036173   -.0808526
    lcapital |   .0353201   .0030049    11.75   0.000     .0294302    .0412099
  lcapital_1 |    .004376   .0030589     1.43   0.153    -.0016197    .0103717
        lgdp |   .6467018   .1497598     4.32   0.000     .3531562    .9402474
      lgdp_1 |  -.3385866   .1491499    -2.27   0.023    -.6309366   -.0462366
       _cons |   2.066389   .2659097     7.77   0.000     1.545178    2.587601
-------------+----------------------------------------------------------------
     sigma_u |   .3331027
     sigma_e |  .16939911
         rho |  .79451953   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(6167, 16371) =     4.89         Prob > F = 0.0000

*Specific dynamic model for turnover Q3

Fixed-effects (within) regression               Number of obs      =     25156
Group variable (i): company                     Number of groups   =      6273

R-sq:  within  = 0.4173                         Obs per group: min =         1
       between = 0.1766                                        avg =       4.0
       overall = 0.1843                                        max =         9

                                                F(8,18875)         =   1689.76
corr(u_i, Xb)  = -0.6228                        Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .2089798   .0042947    48.66   0.000     .2005618    .2173978
      scheme |   .0113214   .0059258     1.91   0.056    -.0002938    .0229366
  lemployees |   .3571471   .0058655    60.89   0.000     .3456502     .368644
lemployees_1 |  -.1003847   .0054547   -18.40   0.000    -.1110765    -.089693
    lcapital |   .0428142   .0028631    14.95   0.000     .0372023    .0484261
  lcapital_1 |   .0034526   .0029315     1.18   0.239    -.0022933    .0091985
        lgdp |    .656427   .1306686     5.02   0.000     .4003048    .9125492
      lgdp_1 |  -.3776335   .1294602    -2.92   0.004    -.6313871   -.1238799
```

```
       _cons |   2.785836   .2264137    12.30   0.000     2.342045    3.229627
-------------+----------------------------------------------------------------
     sigma_u |  .36663692
     sigma_e |  .15760077
         rho |   .8440418   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(6272, 18875) =     5.26         Prob > F = 0.0000

*Specific dynamic model for turnover Q4

Fixed-effects (within) regression               Number of obs      =     26103
Group variable (i): company                     Number of groups   =      5118

R-sq:  within  = 0.6024                         Obs per group: min =         1
       between = 0.7758                                        avg =       5.1
       overall = 0.7970                                        max =         9

                                                F(8,20977)         =   3973.05
corr(u_i, Xb)  = 0.1117                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3666301   .0049381    74.25   0.000      .356951    .3763091
      scheme |   .0207724   .0067324     3.09   0.002     .0075765    .0339684
  lemployees |   .4442826    .005892    75.40   0.000     .4327338    .4558315
lemployees_1 |  -.1451234   .0063484   -22.86   0.000    -.1575668   -.1326801
    lcapital |   .0819583     .00361    22.70   0.000     .0748823    .0890343
  lcapital_1 |   .0039949   .0036351     1.10   0.272    -.0031301      .01112
        lgdp |   .8002709   .1648133     4.86   0.000     .4772241    1.123318
      lgdp_1 |   -.780877   .1624924    -4.81   0.000    -1.099375   -.4623793
       _cons |   4.424404   .2712386    16.31   0.000     3.892755    4.956053
-------------+----------------------------------------------------------------
     sigma_u |  .53944241
     sigma_e |   .2078767
         rho |  .87070221   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(5117, 20977) =     6.15         Prob > F = 0.0000
```

```
. *Structural Breaks <=2000 & >2000

Fixed-effects (within) regression               Number of obs      =     54185
Group variable (i): company                     Number of groups   =     12297

R-sq:  within  = 0.5845                         Obs per group: min =         1
       between = 0.8550                                        avg =       4.4
       overall = 0.8429                                        max =         7

                                                F(8,41880)         =   7364.82
corr(u_i, Xb)  = 0.1794                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .2965627   .0042415    69.92   0.000     .2882492    .3048762
      scheme |   .0096288   .0067301     1.43   0.153    -.0035624      .02282
  lemployees |   .6930861   .0046684   148.46   0.000      .683936    .7022362
lemployees_1 |    -.18807   .0057176   -32.89   0.000    -.1992767   -.1768634
    lcapital |   .0427113   .0032275    13.23   0.000     .0363853    .0490372
  lcapital_1 |   .0297201   .0034012     8.74   0.000     .0230536    .0363866
        lgdp |   1.055984   .1675731     6.30   0.000     .7275372    1.384431
      lgdp_1 |  -1.100863   .1661019    -6.63   0.000    -1.426426      -.7753
       _cons |   4.407764   .3333934    13.22   0.000     3.754306    5.061222
-------------+----------------------------------------------------------------
     sigma_u |  .72799313
     sigma_e |  .29164834
         rho |  .86170045   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(12296, 41880) =     4.07        Prob > F = 0.0000

Fixed-effects (within) regression               Number of obs      =     29417
Group variable (i): company                     Number of groups   =     12243

R-sq:  within  = 0.2965                         Obs per group: min =         1
       between = 0.7204                                        avg =       2.4
       overall = 0.7154                                        max =         3
```

```
                                                F(8,17166)        =     904.54
corr(u_i, Xb)  = 0.2532                         Prob > F          =     0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .0693614   .0064279    10.79   0.000     .0567621    .0819606
      scheme |   .0137419   .0132398     1.04   0.299    -.0122095    .0396932
  lemployees |    .602287   .0087943    68.49   0.000     .5850492    .6195248
lemployees_1 |   .0043353   .0092906     0.47   0.641    -.0138753    .0225458
    lcapital |   .0499881   .0047754    10.47   0.000     .0406279    .0593484
  lcapital_1 |   .0088479   .0048034     1.84   0.065    -.0005672     .018263
        lgdp |  -1.012467   .8236236    -1.23   0.219    -2.626853    .6019196
      lgdp_1 |   2.422572   1.200597     2.02   0.044     .0692788    4.775864
       _cons |   -11.7836   4.765356    -2.47   0.013    -21.12418   -2.443017
-------------+----------------------------------------------------------------
     sigma_u |  1.0336359
     sigma_e |  .26203864
         rho |  .93961286   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(12242, 17166) =     4.38        Prob > F = 0.0000

. *Specific Dynamic Model by all combinations of scheme type

. *aps & csop
Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6184                         Obs per group: min =         1
       between = 0.8815                                        avg =       5.6
       overall = 0.8680                                        max =         9

                                                F(9,68633)        =  12360.14
corr(u_i, Xb)  = 0.2666                         Prob > F          =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
 lturnover_1 |   .3669084    .003142   116.78   0.000     .3607502    .3730667
aps_csop_i~r |  -.0211374   .0150475    -1.40   0.160    -.0506303    .0083556
saye_indic~r |   .0285323   .0090548     3.15   0.002     .0107849    .0462797
  lemployees |   .6789826   .0038675   175.56   0.000     .6714024    .6865628
lemployees_1 |  -.2275351   .0044666   -50.94   0.000    -.2362896   -.2187806
    lcapital |   .0489516   .0024452    20.02   0.000     .0441591    .0537442
  lcapital_1 |   .0063791    .002515     2.54   0.011     .0014496    .0113085
        lgdp |    1.05079    .133945     7.84   0.000     .7882575    1.313322
      lgdp_1 |  -.9874488   .1324917    -7.45   0.000    -1.247132   -.7277653
       _cons |   2.781742   .2141546    12.99   0.000     2.361999    3.201484
-------------+----------------------------------------------------------------
     sigma_u |  .68634703
     sigma_e |  .30507652
         rho |  .83502139   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68633) =     4.53        Prob > F = 0.0000

. *aps & saye

Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6184                         Obs per group: min =         1
       between = 0.8815                                        avg =       5.6
       overall = 0.8679                                        max =         9

                                                F(9,68633)         =  12357.99
corr(u_i, Xb)  = 0.2672                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3669359   .0031427   116.76   0.000     .3607762    .3730956
aps_saye_i~r |  -.0020818   .0184832    -0.11   0.910    -.0383088    .0341452
csop_indic~r |   .0114138   .0057194     2.00   0.046     .0002039    .0226238
  lemployees |   .6790168   .0038683   175.53   0.000      .671435    .6865987
lemployees_1 |  -.2276806   .0044685   -50.95   0.000    -.2364389   -.2189223
    lcapital |   .0490765   .0024448    20.07   0.000     .0442847    .0538683
```

```
  lcapital_1 |   .0064336   .0025152     2.56   0.011     .0015038    .0113634
        lgdp |   1.061475   .1339121     7.93   0.000     .7990077    1.323943
      lgdp_1 |  -.9956123   .1324683    -7.52   0.000     -1.25525   -.7359746
       _cons |   2.748673   .2142457    12.83   0.000     2.328752    3.168594
-------------+----------------------------------------------------------------
     sigma_u |  .68655448
     sigma_e |  .30509297
         rho |  .83508979   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68633) =     4.53        Prob > F = 0.0000

. *csop & saye

Fixed-effects (within) regression               Number of obs      =     83602
Group variable (i): company                     Number of groups   =     14960

R-sq:  within  = 0.6184                         Obs per group: min =         1
       between = 0.8816                                        avg =       5.6
       overall = 0.8680                                        max =         9

                                                F(9,68633)         =  12359.59
corr(u_i, Xb)  = 0.2662                         Prob > F           =    0.0000

------------------------------------------------------------------------------
   lturnover |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lturnover_1 |   .3668833   .0031421   116.76   0.000     .3607248    .3730418
aps_indica~r |   .0055012   .0127413     0.43   0.666    -.0194717    .0304742
csop_saye_~r |    .028291   .0093336     3.03   0.002     .0099972    .0465848
  lemployees |   .6788758   .0038678   175.52   0.000     .6712949    .6864566
lemployees_1 |  -.2275883   .0044666   -50.95   0.000    -.2363428   -.2188338
    lcapital |   .0489856    .002445    20.03   0.000     .0441934    .0537778
  lcapital_1 |   .0064121   .0025151     2.55   0.011     .0014826    .0113416
        lgdp |   1.053623   .1339444     7.87   0.000     .7910922    1.316154
      lgdp_1 |  -.9879156   .1324968    -7.46   0.000    -1.247609   -.7282221
       _cons |   2.752652   .2141065    12.86   0.000     2.333003      3.1723
-------------+----------------------------------------------------------------
     sigma_u |  .68622412
```

```
     sigma_e |  .30508069
         rho |  .83496827   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(14959, 68633) =     4.53        Prob > F = 0.0000
```

Appendix 8 Data envelopment analysis

Data envelopment analysis (DEA) is an analytical technique that is generally used to undertake efficiency comparisons between units (companies, hospitals, bank branches etc) while taking into account multiple inputs, outputs and exogenous factors. However, it can also be used to assess the impact of different policies, or, in the case of this study, the impact of having, or not having, share schemes.

Before explaining how to assess the impact of having share schemes, the general underlying assumptions and the DEA approach is explained.

A8.1 DEA in a general setting

In order to undertake comparisons between units or companies, DEA, unlike the econometric approach, does not assume any particular functional relationship between inputs and outputs (in this study, a log linear functional form was assumed for the econometric modelling). Instead, DEA compares the input and output levels between companies and linear combinations of different companies. Figure A8.1 illustrates the construction of the DEA frontier in two dimensions for a case with one input and one output, under input minimisation. By joining all the companies together, the possible input–output combinations are constructed (ie, the assumption of the DEA is that 50% of one company plus 50% of another company could represent the input–output combination of a hypothetical company).

These linear combinations are known as virtual companies. Thus, for example, in Figure A8.1, point Z represents a virtual company made up of a linear combination of company C and company D (in this case, around 75% of D plus 25% of C). This virtual company is intended to represent the possible inputs and outputs of a company that could, in theory, exist. By examining all possible linear combinations of companies, the area ABCDEFGHIJ is constructed as representing all the possibilities.

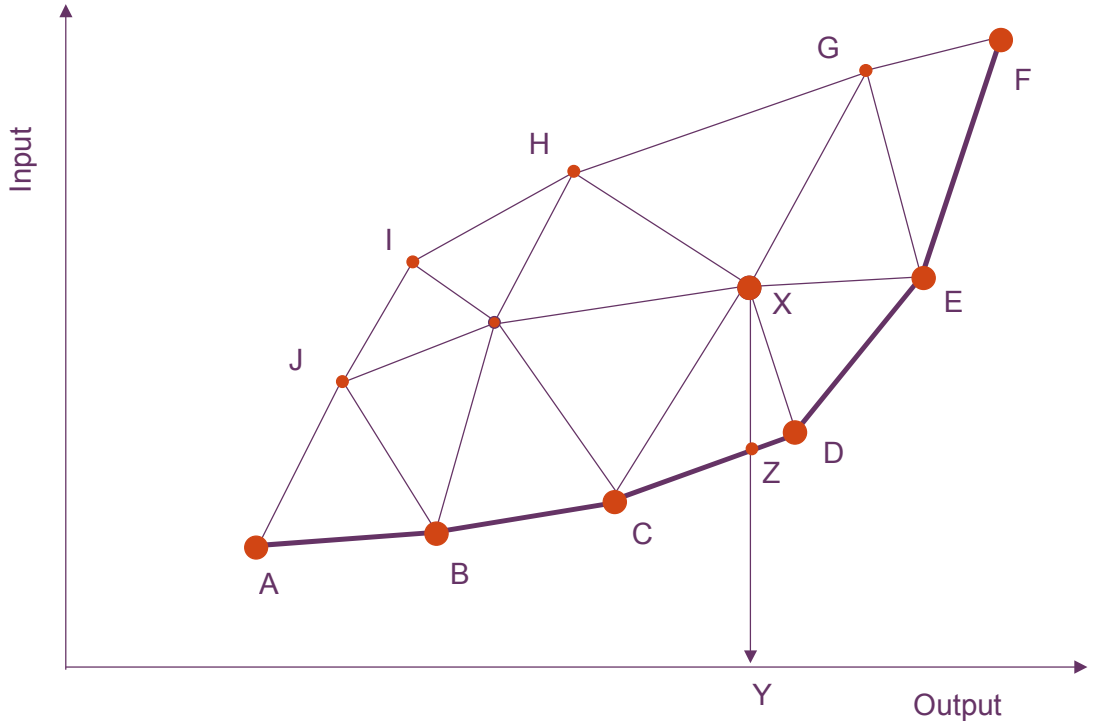
In the econometric framework all the observations are summarised by a line of best fit, which explains the relationship between inputs and outputs and represents the average position through all the observations—ie, for a given output level the econometric line of best fit represent what cost level would be expected on average. In DEA an average function is not constructed, instead the constructed reference for comparison is a frontier—ie, for a given output level the DEA frontier represent what cost level would be expected for the best performing company. (DEA is generally used for efficiency comparisons and the comparisons are undertaken with reference to the efficiency frontier).

The efficiency of each actual company can then be calculated by comparing it to this possibility set. Thus, if a virtual company is better than the company being assessed because it achieves the same output with less input (or it achieves more output with the same input), the original company is judged to be inefficient. DEA then selects the efficient observations and constructs a frontier from them.

Under input minimisation, the frontier is then determined by the set of hypothetical and actual companies that represent the lowest cost for any given output level—as illustrated in Figure A8.1 this is given by ABCDEF. In the illustration below, since company X lies above the frontier, it is judged to be inefficient. Its efficiency is given by a measure of how far it is from this frontier (ie, from virtual company, Z) at its given output level—ie, the ratio of the distance Y:Z to Y:X.

This illustration is useful in this simple two-dimensional example, but cannot be applied in higher dimensions. The normal method for evaluating the efficiency of a company is by using the linear programming formulation of DEA.

Figure A8.1 Illustration of DEA under input minimisation



A8.2 Assessing the impact of share schemes using DEA

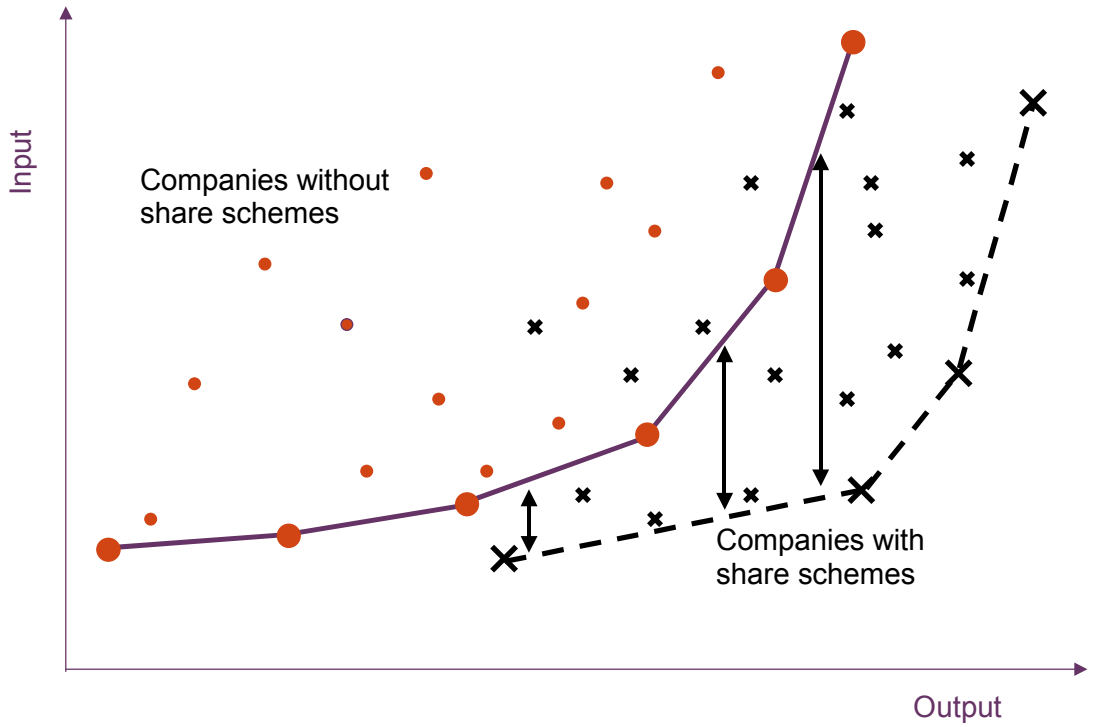
The general DEA approach discussed above can be extended to consider the impact of differences in policy, such as the impact of tax-advantaged share schemes.

In this case, DEA is undertaken separately on two sub-samples of the dataset—those that have a share scheme and those that do not. Figure A8.2 is used to illustrate this approach—again, the illustration is in two dimensions. Although, in practice, additional inputs, outputs, company characteristics and exogenous factors would also be taken into account by including them in the DEA model, but the model then becomes multi-dimensional and thus not practical to illustrate.

By using two sub-samples, the analysis results in two estimated frontiers—a frontier for those companies with share schemes and a frontier for those without.

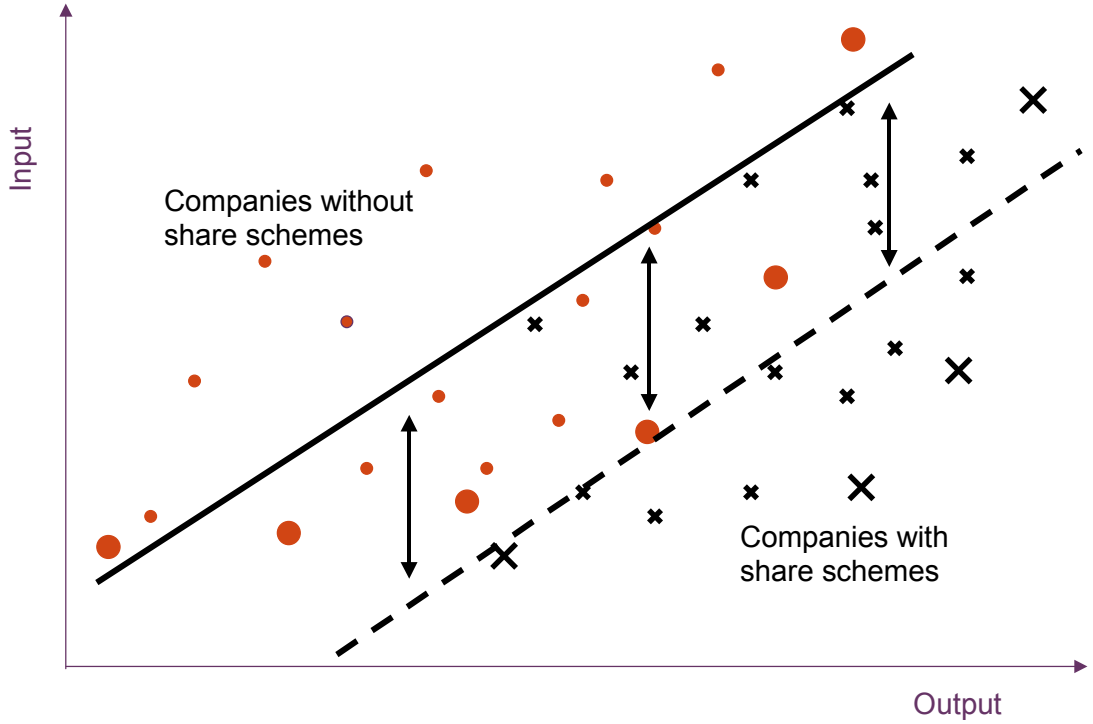
Figure A8.2 illustrates this approach: the crosses denote companies with share schemes, while the dots denote companies without share schemes. In the illustration, those companies with share schemes tend to have higher output levels. The impact of having a share scheme can then be estimated as the distance between the two frontiers. Moreover, the impact can be estimated for different firm characteristics. For example, in Figure A8.2, the impact is shown as being greater for larger companies than for smaller companies.

Figure A8.2 Illustration of the use of DEA to assess the impact of policy (under input minimisation)



By way of comparison the econometric approach is illustrated below in Figure A8.3. The econometric model fits a line of best fit that best explains the data. A dummy variable (which takes the value of 0 for those companies with a share scheme and 1 for those companies without a share scheme) is used to differentiate between companies. This is equivalent to a parallel shift in the line of best fit. Thus, the solid line represents the average relationship between the input and output for the companies represented by a dot, while the dashed line represents the average relationship between the input and the output for the companies represented by a cross. Again, the distance between these two lines then represents the impact of having a share scheme. A noticeable difference between the two approaches is that the econometric approach represents the impact as being the same for all company types (in this formulation), whereas the DEA model estimates different impacts depending on the size of the company.

Figure A8.3 Illustration of the use of econometrics to assess the impact of policy



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