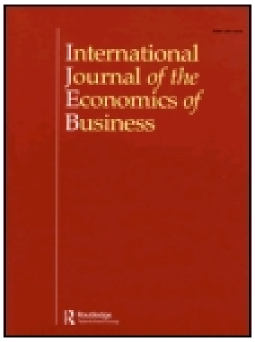

ISSN: 1357-1516 (Print) 1466-1829 (Online) Journal homepage: http://www.tandfonline.com/loi/cijb20

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To cite this article: Paul Stoneman & Otto Toivanen (2001) The Impact of Revised Recommended Accounting Practices on R&D Reporting by UK Firms, , 8:1, 123-136, DOI: 10.1080/13571510151075332

To link to this article: https://doi.org/10.1080/13571510151075332

Published online: 21 Jul 2010.

Int. J. of the Economics of Business, Vol. 8, No. 1, 2001, pp. 123–136

The Impact of Revised Recommended Accounting Practices on R&D Reporting by UK Firms

PAUL STONEMAN and OTTO TOIVANEN

ABSTRACT *The R&D reporting practices of UK quoted companies are analysed and the impact of the introduction of a revised Statement of Standard Accounting Practices in 1989, SSAP13 (Revised), recommending separate R&D disclosure for companies meeting certain size thresholds, explored. Using hazard rate models the preferred results indicate that the hazard of a firm reporting its R&D in its annual accounts shows positive time dependence and that large firms, by sales, are more likely to announce than small firms. It is also found that the introduction of SSAP13 impacted considerably upon the extent of reporting by all firms (whatever their size) with an anticipation effect in 1988, and large positive impacts in 1989 and 1990. Post-1989 those firms that exceeded the size thresholds embodied in the new standard also had a higher hazard of reporting their R&D.*

Key words: R&D; Accounting standards; Information disclosure.

JEL Classification: O32.

1. Introduction

In 1989 a revised Statement of Standard Accounting Practice (SSAP 13, Revised) was introduced in the UK that recommended that firms meeting certain size criteria should separately declare their R&D spend in their annual accounts. The main contribution of this paper[1] is to explore the impact of the introduction of this new standard upon the R&D reporting practices of UK firms quoted on the London Stock Exchange, in terms of both the time profile of firms' reactions to the introduction of the new standard and the quantitative impact of the new standard upon R&D reporting practices. Because empirical observation suggests that the

The research reported in this paper was funded by the ESRC as part of a project on Intellectual Property and Firm Value. We would like to thank Mark Longland of St Peters College, Oxford, for his efforts re data collection, and the Editor and two referees of this journal for comments on a previous version. As always standard caveats apply.
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International Journal of the Economics of Business
ISSN 1357-1516 print/ISSN 1466-1829 online
http://www.tandf.co.uk/journals
DOI: 10.1080/13571510110037609

decision to report R&D is irreversible, the main analytical contribution is a hazard rate model of first disclosure dates of R&D (and in applying this we also contribute to the literature on estimating left-censored duration models). Given that the efficient operation of markets will depend upon the quantity and quality of information that firms supply to market (particularly capital market) participants and also that the major source of the market's information on the firm is the firm's own published annual accounts, our analysis has direct relevance to the wider issue of the efficient operation of markets.

The literature on the voluntary disclosure of information is well summarised in Camfferman (1997). To the best of our knowledge however the impact of SSAP13 (Revised) has not been previously studied. Nixon (1996, 1997) explores disclosure of information upon R&D by UK companies but is primarily concerned with information beyond that required by SSAP13 and does not explore the impact of SSAP13 upon reporting as such. The main forerunners of the work reported here are US studies of accounting choice relating to the date at which firms complied with SFAS87 by Ali and Kumar (1994), SFAS52 by Ayres (1986) and SFAS8 by Salakta (1989). In each case, however, these studies consider compulsory changes with only limited (two to three years) time windows within which firms could choose the date of compliance. In our view the introduction of SSAP13 in the UK had a more voluntary character and our data also show a longer time profile of realised first disclosure dates.

2. SSAP13

For accounting periods beginning on or after 1 January 1989, the new Statement of Standard Accounting Practice (SSAP13) recommended that UK firms separately declare their R&D spend in their annual accounts if the firm is a public company and meets two of the three following criteria: the balance sheet total exceeds £39 m; turnover exceeds £80 m; average number of employees exceeds 2500. Although there had been an earlier version of SSAP13 in place prior to 1989 that specified good practice for the accounting treatment of R&D in company accounts it was only with this revised Statement in 1989 that separate declaration was recommended. In the two data samples used below, whether a firm reports R&D or not in time, t is defined by whether the data source (either *Extel Financial's 'Company Analysis'* or *Datastream*) reports the R&D spend of the firm.[2] It is worth noting for later purposes that a small number of companies do declare zero R&D.

3. The Data

We have two data sets. The 'wide data set' encompasses a 1987–94 panel of 604 UK companies from 23 industries selected on the basis of data availability from an original sample of 890 quoted companies taken from *Extel Financial's Company Analysis*. For this sample we have data upon both reporting practices and also a number of firm characteristics that might relate to reporting behaviour. As far as we can tell there are no biases with regard to R&D reporting practices inherent in this sample and it thus gives an unbiased picture of the overall reporting pattern across UK quoted companies.

Although the first data set is rich, encompassing reporting behaviour and firm characteristics, it is limited in observations pre-SSAP13 in 1989 that complicate the task of estimating the effect of SSAP13. As we were unable for data reasons to take the wide sample back in time we also used a 'long data set' which encompasses a 1984–92 panel of 177 UK companies listed as reporting R&D in the 1992 DTI R&D Scoreboard (Company Reporting Ltd, 1992). This sample is not unbiased (it is biased towards firms reporting at the end of the sample period), and contains data only upon reporting dates. It does provide, however, a useful extra resource. All data are annual.

4. Hazard Rate Models

Of all the firms in our two data sets only one firm that starts to report its R&D fails to do so in the following years, and even this one starts to report again two years later. It thus seems to be the case that the decision to report is irreversible.[3] This suggests that the crucial aspect of understanding disclosure is to understand the determinants of the date at which the firm *first* discloses.[4] This leads us to use hazard rate models as the basis for the empirical analysis.

The hazard rate, $h_i(t)$, is defined as the probability that a firm i that has not disclosed its R&D spend previously will disclose (for the first time) in the time interval $\{t, t+\mathrm{d}t\}$, with the hazard rate determined by the hazard function. There are various specific forms for the hazard function that may be used (see for example Kalbfleisch and Prentice, 1978) of which two of the most common are the exponential and the Weibull. As the latter nests the former, we proceed using a Weibull hazard function and write (dropping any i subscripts) that

$$h(t) = \lambda p(\lambda t)^{p-1} \tag{1}$$

where p is the Weibull parameter, λ the baseline hazard (the hazard rate in time zero) and t is time measured from the beginning of the experiment. The advantage of the Weibull formulation is that it allows the possibility of time dependence in the hazard rate. If $p > 1$ then there is positive duration dependence. This would allow that over time the probability that a non-announcer will start to announce its R&D spend increases purely as a function of time. If $p = 1$ there is no such time dependence and the Weibull reduces to the exponential hazard.

Covariates may be introduced in to the analysis through two routes. First, one may allow that

$$\lambda = \exp(\beta X) \tag{2}$$

where X is a vector of explanatory variables and β is a coefficient vector. Second, less conventionally one may allow that

$$p = p_0 + p'Y \tag{3}$$

where Y is also a vector of explanatory variables and p' a coefficient vector. The first route introduces covariates in to the baseline hazard whereas the second route introduces covariates in to the Weibull parameter itself.

In estimating these hazard rate models, standard maximum likelihood techniques may be used. However, both our data sets are left and right censored, i.e. at the start of the data sample there are firms that already announce R&D and at the end of the sample period there are firms that still do not announce R&D. There are standard techniques for handling right-censored data. However in most applications of hazard rate models (and to the best of our knowledge all cases in Economics) the data tends to begin at the start date of the experiment and thus left censoring does not arise. To cope with the left censoring we have thus amended the standard right-censored likelihood function such that the log likelihood function that we maximise[5] is given by

$$\log L = \delta\log(1-\exp(-(\exp(\beta' X)T)^{p}) + (1-\delta)[\sigma(p\beta' X + \log(p) + (p-1)\log t) - (t\exp(\beta' X))^{p}] \quad (4)$$

where: δ takes the value 1 if the firm started to disclose before the start date of the sample and zero otherwise; σ takes the value 1 if the firm starts to disclose before the end date of the sample and zero otherwise; T is the length of the pre-sample period, i.e. the time from the start of the experiment to the first sample date; and t is time measured as T plus observed years.

This general hazard rate framework is applied below in two related exercises. In the first the covariates are restricted to simply time or time related variables and as such it is primarily the time profile of reporting that is analysed. In the second exercise the list of covariates is extended to include company characteristics to explore whether there is anything to be gained from a more behavioural approach to the analysis of disclosure.

5. The Time Profile of Disclosure

For the wide sample we define the date of first disclosure as the calendar year ending the accounting period in which reporting first occurred. For the long sample we define the first disclosure date as the calendar year beginning the accounting period in which reporting first occurred. The procedures are equivalent if the firm's accounting period ends on 31 December. These procedures, though different, produce a maximum measured rate of first disclosure at the same date (1989) in both samples.[6]

In the wide sample of firms, 10% of the firms were reporting at the sample start date of 1987 while 323 (53%) had not started to disclose by the sample end date of 1994. For the proportion of non-reporting firms at time $t-1$ beginning to report in time t (the average hazard rate), $H(t)$, and the (cumulative) proportion of the sample reporting in each of the sample years, $M(t)$ (rounded to the nearest integer), see Table 1.

For the long sample 12% of the companies were reporting at the sample start date of 1984, 6 (3%) had not reported by the end of 1991. The relevant data on reporting are as shown in Table 2.

Table 1. Proportion of firms reporting R&D: wide sample

Year	1987	1988	1989	1990	1991	1992	1993	1994
$M(t)$(%)	10	16	30	37	40	42	45	47
$H(t)$(%)		8	17	11	5	5	6	3

Table 2. Proportion of firms reporting R&D: long sample

Year	1984	1985	1986	1987	1988	1989	1990	1991
$M(t)$%	12	13	18	19	31	79	92	97
$H(t)$%		1	5	1	15	69	61	60

As these data show, the average hazard rate peaks in 1989 in both samples, whereas in the long sample the hazard rate stays high post-1990, in the wide sample it falls back to much more moderate levels. As we have pointed out, however, the long sample will provide a biased picture since only firms that declare their R&D by 1992 are included in this sample. In the long sample we also see that the average hazard rate starts to increase in 1988 (prior to the introduction of the revised SSAP13), which suggests that there may have been some anticipation of SSAP13. The long sample would also tend to suggest that the average hazard rate did not start increasing prior to 1988.

More formally, using the hazard function, we have explored the time profile of first announcements with only time-based variables included as covariates. As discussed above the Weibull model allows the baseline hazard potentially to be duration dependent, and thus if the resulting estimate of p is greater than unity, the model predicts that over time the probability of firms declaring R&D is increasing (independent of any other factors). In addition we have considered the inclusion of time dummies in both the baseline hazard and the Weibull parameter p to explore whether the baseline hazard or the Weibull parameter are changing over time. Of particular interest is whether time dummies that are close to the date when the revised SSAP13 was introduced impact significantly upon the hazard rate. If they do then the estimates would suggest that SSAP13 did impact upon decisions to announce R&D.

Using the long data set and after considerable experimentation we concluded that the best estimates were generated under the condition that the length of the pre-sample period T was 21 years[7] for all firms. Estimates were produced introducing time dummies that affect either the baseline hazard alone or both the baseline hazard and the Weibull parameter. The results are presented in Table 5. Our preferred results, on the basis of the log likelihood value, allow the baseline hazard to contain separate year dummies for the two years immediately prior to the introduction of SSAP13 ($T87$ and $T88$) and the two years when SSAP13 was first in place ($T89$ and $T90$) with the Weibull parameter allowed to vary as

$$p = p_0 + p_{88}T88 + p_{89}T89 + p_{90}T90 \tag{5}$$

where p_0, p_{88}, p_{89} and p_{90} are parameters. The results show that the $T87$ dummy is not significant but $T88$, $T89$ and $T90$ all carry positive and significant coefficients suggesting that the probability of a firm announcing R&D for the first time increased considerably around the time that SSAP13 was introduced. In addition we observe highly significant and positive estimates for p_0, p_{89} and p_{90}. The significant coefficients upon $T89$ and $T90$ in the expression for the Weibull parameter indicate again that the probability of a firm announcing R&D increased considerably around the time SSAP 13 was introduced. We were able to reject for this data set the hypothesis that the estimate for p_0 is significantly different from unity. This suggests that, for this sample (in the absence of the $T88$ and $T89$ effects), the pattern of disclosure was not duration dependent.

For the wide data set T is again set to 21. Results were produced (see Table 5) introducing time dummies affecting either the baseline hazard only (which results we do not present) or both the baseline hazard and the Weibull parameter. Again in terms of log likelihoods the latter results are to be preferred. The pattern of results for this wide data set is very similar to that found for the long data set. The coefficients on $T88$, $T89$ and $T90$ are positive and significant, with the coefficients p_0, p_{89} and p_{90} also positive and significant. Although the coefficient estimates relating to the time dummies for this sample are quite different from those found in the long sample, the story being told is very similar, i.e. that the hazard rate increased considerably around the introduction of SSAP13 in 1989. However, these results do differ from those for the long sample in two significant ways. First, there is a significant negative coefficient on the T_{93} dummy introduced in to the baseline hazard and, second, the estimate of p_0 is significantly greater than unity. The former result we find (see below) is overturned when a more complete model is estimated. The latter result suggests that there is positive duration dependency in the hazard rate. Thus as time proceeds the number of firms reporting R&D will increase purely by the effect of time (quite independent of any effects relating to SSAP13).

The results from the two samples are thus similar, but different in significant ways. These differences may partly arise from the two samples covering different time periods, but because the long sample is biased towards announcing firms whereas this is not the case for the wide sample, we tend to prefer the picture presented by the wide sample, i.e. the hazard of first announcing R&D spend shows a positive duration dependence allied with increases in both the baseline hazard and the Weibull parameter p around 1989 when the revised SSAP13 was introduced.

6. Modelling Disclosure

In the previous section we explored the time profile of R&D disclosure. In this section we consider more formally those factors that might be expected to affect the firm's decision to disclose, construct a richer model than previously considered and then estimate that model using the wide data set. The analysis is based upon the hypothesis that the decision of the firm to declare its R&D in its annual accounts is voluntary. In the absence of any legal or professional standards requiring firms to declare their R&D in the annual accounts, as in the UK prior to SSAP13 in 1989, the company's decision whether or not to disclose R&D spend can only be considered voluntary. With the introduction of SSAP13 in 1989 there was a change in the institutional environment whereby recommended accounting practices required the inclusion of R&D spend in the annual accounts for those firms that met the size criteria. A Statement of Standard Accounting Practice does not have the force of law and, thus, whether R&D is disclosed is still 'voluntary' in the UK to some degree for such firms; however, qualified accountants are expected to observe accounting standards, and thus the extent to which disclosure is voluntary, is really a matter of debate. Although in our wide sample between 1987 and 1994 the proportion of firms reporting R&D increased from 10 to 47%, it is clear from the data that not all firms complied with the new accounting standard immediately (and moreover many firms below the size thresholds also disclosed). There did therefore seem to be some degree of voluntariness (at least for some time and for some firms) in the disclosure decision even after 1989. This suggests that it is still appropriate to consider the disclosure decision as voluntary after SSAP13 in 1989 but there was in fact a much lesser degree of voluntariness than prior to SSAP13.

Theoretical approaches to modelling voluntary disclosure decisions (see, e.g. Verrechia, 1983; Dye, 1986; Wagenhofer, 1990) suggest that three main factors will impinge upon the disclosure decision: (i) disclosure costs – the costs of collecting, preparing and disseminating information relating to R&D, written as $C_i(t)$ for firm i in time t (ii) proprietary costs – the (expected) impact of disclosing R&D information on the firm's prospects through, for example, rivals' strategic reactions, written as $P_i(t)$ and (iii) the impact of disclosure of R&D on the valuation of the firm by the financial market. Defining $B_i(t)$ as the firm's expectation of the market's valuation of its disclosed R&D spend, we specify that the (expected) net annual benefit to firm i from the disclosure of R&D in time t, $N_i(t)$ is given by (6).

$$N(t)_i = F(C_i(t), B_i(t), P_i(t)) \tag{6}$$

where $F_1 < 0$, $F_2 > 0$ and $F_3 < 0$.[8]

For value-maximising firms the probability of disclosure in time t will be positively related to $N_i(t)$. Assuming (i) that the decision to disclose is irreversible, (ii) that the benefit flow from disclosure is independent of the first disclosure date and (iii) that firms have myopic expectations with respect to future annual net benefits from disclosure, then following the procedure in Karshenas and Stoneman (1993) for generating a hazard function, one may write that, where disclosure is voluntary,

$$h_i(t) = \mathcal{J}(C_i(t), B_i(t), P_i(t)) \tag{7}$$

and as such $C_i(t)$, $B_i(t)$, $P_i(t)$ should be considered as covariates in the hazard function.

To characterise the introduction of SSAP13 in 1989 in this framework we argue firstly that, for firms that met the size thresholds, one might view SSAP13 as an important shift in what constitutes good accounting practice, and thus firms that previously would not have voluntarily disclosed their R&D spend may now feel more pressured to do so. Secondly, for all firms, including those not meeting the size threshold requirements of SSAP13, the new standard could represent a change in what represents 'good corporate citizenship' and as such firms that previously would not have voluntarily disclosed their R&D spend may again feel more pressured to do so. Finally, one might argue that the new standard considerably changed what was expected of firms by markets. If SSAP13 changed perceptions of what 'good firms do' this may impact upon the capital market's perceptions of what information to expect to receive and by changing its attitude to non-reporting firms also further encourage reporting, i.e. in terms of the model one may consider that SSAP13 would have impacted upon at least the role played by $B_i(t)$ in the hazard function (and perhaps by more for those firms meeting the size requirements of the standard than those below those thresholds).

To operationalise the framework as represented by equation (7) above requires that the variables included on the RHS of equation (7) above can be measured and also that the introduction of SSAP13 in 1989 can be adequately represented.

However, the three variables $C_i(t)$, $B_i(t)$ and $P_i(t)$ are inherently unobservable. It is thus necessary for empirical purposes to use proxy indicators. In particular we have used the following proxy variables. (i) Firm size – on the grounds that the market's valuation of the firm's R&D spend, and thus $B_i(t)$, should be related to the expected profit gain from that R&D and this in turn will be positively related to the sales or output of the firm. It may also be the case (a) that there are greater political pressures on large firms to act in a socially responsible way (see Watts and Zimmerman, 1978) and thus declare their R&D and (b) that large firms may face less competitive pressures and thus face lower proprietary costs, $P_i(t)$. Although large firms may have higher disclosure costs, $C_i(t)$, overall we expect in total for firm size to impact positively on the disclosure hazard. (ii) Capital intensity of the firm – on the grounds that (a) capital intensity may act as an entry barrier and thus mean lower proprietary costs and (b) that more capital intensive firms may be better able to appropriate the benefits of R&D and thus the impact of R&D announcement on $B_i(t)$ will be greater. We measure capital intensity by the ratio of staff costs to sales expecting a negative coefficient. (iii) The debt equity ratio for the firm – on the grounds that the firm needs to fund complementary inputs (e.g. marketing expenditures) to exploit fully its R&D and such funding will be more difficult when the debt equity ratio is high, tending to generate lower $B_i(t)$ for firms with high debt equity ratios. (iv) The proportion of firms in the same industry already reporting R&D[9] on the grounds that the more firms that are declaring the more suspicious markets might be of non-disclosure and thus the greater will be the value of $B_i(t)$. The four proxy variables[10] thus identified are introduced as covariates in to the expression for the baseline hazard. Finally, we allow for trend effects, on the grounds that there has been increasing public and government pressure in the UK for companies to be open re their innovative behaviour, by estimating a Weibull hazard function in which the hazard rate is potentially duration dependent.

To model the effect of SSAP13 a number of time dummies are introduced in to the specification as per the analysis of the time profile of announcements. In particular time dummies were introduced for each of the years for which SSAP13 was in place ($T89-T93$) into the baseline hazard and also in to the expression for the Weibull parameter p. In addition a $T88$ dummy was introduced to allow for possible anticipation of the new accounting standard.[11] In addition a further dummy (MUST) was introduced, that takes the value of 1 post-1989 if the firm met the SSAP13 criteria and zero otherwise. The significance of this dummy should clarify whether there were differential impacts of SSAP13 between those firms meeting the size criteria and other firms.[12]

It may be noted that we have not included the R&D spend itself as an explanatory variable in the hazard function. The reasons are: (i) that the value of the R&D spend is not known prior to announcement; and (ii) in our view, it is the market's view of the potential return to R&D that matters rather than the level of the spend itself, and the other variables that we include capture these potential returns. To explore this further we have calculated for each year in the wide data set the R&D sales ratio for existing and new announcers. If the spend on R&D were to be a determinant of announcement then we would expect significant differences between these spends. In fact the data indicate (Table 3) that the R&D sales ratios of new announcers are neither consistently higher nor lower than of existing announcers and for each year the mean R&D sales ratio of new announcers is always within two standard deviations of that of existing announcers. The omission of the level of R&D is thus unlikely to be a significant issue.

Table 3. R&D/sales ratios, existing and new announcers

Year	Existing		New	
	Mean	s.d.	Mean	s.d.
1988	0.021	0.031	0.014	0.018
1989	0.016	0.019	0.014	0.018
1990	0.017	0.020	0.020	0.024
1991	0.024	0.078	0.011	0.013
1992	0.021	0.032	0.016	0.023
1993	0.055	0.330	0.044	0.107
1994	0.093	0.518	0.513	1.402
All	0.051	0.386	0.048	0.305

A related issue concerns whether firms that have zero R&D expenditure will have different reporting behaviour to firms undertaking R&D. A referee has suggested that the main reason why firms do not report their R&D is because they do not do any R&D. We find this to be an unacceptable argument. Many firms when first disclosing their R&D report substantial expenditures. We do not accept that these firms have suddenly jumped from zero R&D to high levels of R&D overnight. In addition we cannot accept that the time pattern of reporting shown in the previous section reflects an increase in the number of UK firms doing R&D. Such an increase, mainly occurring around 1989, is not within the bounds of credulity. In our view the increased number of firms declaring their R&D spend does not reflect an increased number of firms doing R&D but an increase in the number of firms reporting R&D. This view is reinforced by three arguments: (i) there are firms in our sample who report zero R&D; (ii) the SSAP13 requirements do not treat firms that do zero R&D differently from any other firms; and (iii) there is no reason to believe that the market's approach to valuing firms with zero R&D differs from its approach to firms with positive R&D. We thus proceed on the basis that the reporting behaviour of firms that undertake zero R&D is no different from that of firms with positive levels of R&D.

In Table 4 definitions of appropriate variables and sample statistics are provided. One might note the mean value of the MUST dummy indicates that a significant proportion of the firms in the sample did not meet the SSAP13 thresholds. Of the numerous results generated through various experiments we present our preferred estimate of the hazard function for the new model in Table 5. These results are directly comparable with the hazard function estimates incorporating only time-based covariates. The first point to note is that the inclusion of the extra firm characteristics variables slightly improves the log likelihood relative to the inclusion of only time-based covariates but by only a small amount. The inclusion of the characteristics variables thus does not much improve the explanatory power of the regressions. However, with the extended model the coefficient on the dummy $T93$ is no longer negative and significant suggesting that the new function better represents the time profile of the hazard rate. Moreover p_{88} is now significant suggesting that the anticipation effect impacts not only on the baseline hazard but also on the Weibull parameter. The other coefficient estimates replicated from the simpler time-based model are little changed by the inclusion of the firm

Table 4. Variable definitions and sample statistics, wide data set

LABEL, definition	Mean (standard deviation)
SALES, sales of firm *i*, £10,000m	0.0288 (0.1226)
DEBTEQ, debt equity ratio of firm *i*	0.217 (0.193)
TFASAL, tangible fixed assets to sales ratio of firm *i*	0.460 (0.796)
MUST, dummy indicating whether firm *i* post-1989 meets SSAP13 size criteria	0.102 (0.302)
INREPR, proportion of reporting firms in the industry to which firm *i* belongs	0.174 (0.181)

Note: 3288 observations over the period 1987–94. All data from *Extel Financial's 'Company Analysis'*.

characteristic variables. The suggestion is that the unsatisfactory parts of the estimates using only time-based covariates are removed by the inclusion of the firm characteristics variables although this inclusion does not much affect the explanatory power of the model. This leads us to consider the new estimates as an improvement relative to the previous estimates.

The new estimates indicate:

(i) Positive and significant coefficients on *T*89 and *T*90 and positive and significant estimates of p_{89} and p_{90} which are consistent with the hazard rate for all firms being increased (considerably) in 1989 and 1990 by the introduction of SSAP13 in 1989.
(ii) A positive and significant coefficient on *T*88 and a positive and significant estimate of p_{88}, which are consistent with anticipation of SSAP13 leading to an increase in the hazard rate for all firms in 1988.
(iii) A positive and significant coefficient on MUST indicating that post-1989, those firms meeting the SSAP13 size criteria threshold were more likely to announce their R&D than other firms.

Jointly these results indicate that SSAP13 began to impact upon reporting behaviour from 1988 but, apart from the effect of the MUST variable, the impact of SSAP13 on announcements was exhausted by the end of 1990. However post-1990 those firms meeting the size criteria still have a higher baseline hazard and thus the effect of SSAP13, through the MUST variable, continues in to the future.

(iv) Of the firm characteristics variables other than MUST, only firm size (SALES) has a significant impact on the hazard rate. Larger firms are thus more likely to announce their R&D spend. No support was found to suggest that the debt equity ratio, capital intensity, or the number of other firms in the industry already reporting had a significant impact upon reporting behaviour.
(v) The estimate of p_0 at 3.260 is significantly greater than unity. There is thus positive duration dependence in the baseline hazard. As time proceeds therefore there is an increasing probability than non-announcers will begin to announce.

Overall the results indicate that even in the absence of SSAP13 the probability that a firm would declare its R&D spend was and would have been increasing with time,

Table 5. Hazard function estimates

	Long data set		Wide data set	
	(1)	(2)	(3)	(4)
Constant	−4.158*** (0.216)	−4.951*** (0.337)	−4.108*** (0.164)	−4.108*** (0.160)
*T*87	−0.639 (0.399)	−0.487 (0.462)		
*T*88	−1.076 (0.683)	2.432*** (0.463)	0.912*** (0.165)	0.913*** (0.161)
*T*89	0.356 (0.296)	2.530*** (0.337)	0.882*** (0.165)	0.882*** (0.161)
*T*90	1.439*** (0.297)	2.459*** (0.337)	0.834*** (0.165)	0.832*** (0.161)
*T*91			−0.153 (0.095)	−0.134 (0.096)
*T*92			−0.170 (0.095)	−0.143 (0.097)
*T*93			−0.248** (0.086)	−0.133 (0.095)
p_0	1.074*** (0.298)	0.867*** (0.083)	3.263*** (0.594)	3.260*** (0.581)
p_{88}		13.765 (29.826)	146.62 (95.89)	146.62** (69.45)
p_{89}		52.389*** (16.819)	254.91*** (8.55)	254.91*** (10.03)
p_{90}		66.357*** (9.789)	133.18*** (3.63)	133.18*** (4.09)
MUST				0.005** (0.002)
SALES				0.012*** (0.003)
TFSAL				0.0005 (0.007)
DEBTEQ				−0.004 (0.003)
INREPR				0.005 (0.441)
log *L*	−665.0	−318.5	−907.1	−891.6
Observations	1107	1107	3288	3288

Notes: ***Significant at 1%, ** significant at 5%. Standard errors in parentheses.

with larger firms (by sales) more likely to declare their R&D. In 1988 there was an SSAP13 anticipation effect that increased the hazard rate for all firms (not just those meeting the SSAP13 size thresholds). After the introduction of SSAP13 in 1989, the hazard rate was increased further in 1989 and 1990 for all firms, but the hazard for those firms meeting the SSAP13 size criteria was even greater. From 1991 onwards the hazard rate continued to increase through duration dependence with large firms and those meeting the SSAP13 size criteria having higher hazards, but apart from the latter effect, no further major impacts of SSAP13 were apparent.

Using the estimated coefficients in column 4 of Table 5 we have calculated the predicted number of firms who would have been announcers by 1994 in the absence of SSAP13 by allowing the Weibull parameter to equal p_0 and the baseline hazard λ to equal $\exp(-4.108 + 0.012 \times \text{mean SALES})$. We calculate that this would have meant a total of 82 announcers in 1984 compared to the actual number of 281. This increase of 199 represents four times the number of reporting firms at the start of the sample period and 33% of the total sample size. The quantitative impact of SSAP13 is thus seen to be considerable.

Finally we return to the issue of firms that do not undertake R&D. In our estimates we have allowed that all firms may potentially report their R&D spend even if that R&D is zero. It has been suggested to us, instead, that if firms do not do R&D then they will not report (zero) R&D. Although we do not believe that this is so we cannot prove it for we (obviously) do not know the R&D of non-reporting firms. However one may argue that if firms do not report because they do not do R&D, then for the wide sample any firm not reporting R&D at the end sample date is not doing R&D and thus will never report it. The 'no R&D–no reporting' argument would thus imply that it would be appropriate to estimate the hazard function without right censoring. This is what we have done. We find that the time dummies generally obtain coefficients that are smaller in absolute value and the 1991 time dummy carries a negative and significant coefficient. The constant of the Weibull parameter is significantly higher (approximately twice the value when using the whole sample). This was to be expected, as the average probability of announcing before or during the observation period is now by definition 100%, almost twice that of the whole sample. The coefficients on the time dummies in the Weibull parameter are essentially unchanged. The largest impact is on firm characteristics: with the exception of INDREPR, which carries a negative and significant coefficient, none carries a precisely estimated coefficient. In our view, these results (qualitatively at least) verify that our reported results on the impact of SSAP13 on the announcement probability are not the result of including non-R&D-performing firms in the sample.

7. Conclusions

In this paper, we have explored the R&D-reporting practices of UK quoted companies and in particular the impact of the introduction of a revised Statement of Standard Accounting Practice (SSAP13 Revised) in 1989 which recommended that firms meeting certain size criteria should separately declare their R&D spend in their annual accounts. Using two data samples it was illustrated that around 1989 the hazard of a firm first disclosing its R&D spend increased considerably. Further analysis introducing firm characteristics as determinants of reporting behaviour and using time dummies to represent the effects of SSAP13, showed: positive duration dependence in the baseline hazard rate (perhaps reflecting increasing governmental and public pressures for firms to declare information on their innovative behaviour); a greater baseline hazard for large than small firms (perhaps reflecting differences by firm size in the benefits of disclosure and in proprietary, data collection and dissemination costs); a significant positive anticipation effect of SSAP13 in 1988; and further significant positive impacts of SSAP13 in 1989 and 1990. Post-1990, the only continuing effect of SSAP13 arose as firms grew beyond the threshold criteria specified by the standard. It is calculated that, by 1994, SSAP13 increased the number of reporting firms by a factor of four.

These results indicate that in the absence of SSAP13 the number of firms declaring their R&D spend would have increased but only slowly. SSAP13 quickly generated a much larger number of reporting firms. Notably, SSAP13 impacted not only upon those firms that met the threshold criteria specified but also impacted upon the reporting practices of other firms. SSAP13 might thus be seen as establishing a new standard of good behaviour for all firms. Even so, by the end of the sample period still only half of the firms in our wide sample report their R&D spends.

The better is the information supplied to markets, the more efficient may those markets become. SSAP13 may thus be seen to have made a positive contribution to market efficiency. Given that Statements of Standard Accounting Practice do not have the force of law, our finding suggest that non-legal intervention of this kind may be an effective means of improving market efficiency.

Notes

1. This paper is a shortened version of material that can be found more fully described and discussed (especially theory and data issues) in Toivanen and Stoneman (1998).
2. A referee has pointed out that with such accounting standards it is the case that 'significant departures found to be necessary are adequately disclosed and explained in the financial statements'. Thus, in principle under SSAP13, a company not declaring its R&D spend for accounting periods beginning after 1 January 1989 should explain in the accounts why it is not. We have not collected any information on whether companies provided explanations for non-disclosure (nor any actual reasons provided).
3. A possible theoretical rationale for this is that information withdrawn is always seen by markets as unfavourable.
4. In principle the firm faces two related decisions, how much R&D to undertake and whether to disclose the R&D spend. This paper is concerned only with the second of these and any feedback from the disclosure decision on to the spending decision is outside the scope of the paper.
5. The maximisation was done using the LIMDEP 7.0 maximisation command that employs the D/F/P algorithm with a convergence criterion of 10E−4.
6. Different companies will have different reporting dates throughout the year. Except when the accounting period is from 1 January to 31 December, accounting years will also tend to cross calendar years. Thus a company report in April 1993 will cover the period from 1 April 1992 to 31 March 1993. As the dating procedure used in this paper is by calendar years the problem is whether such a company should be defined as first reporting in 1992 or 1993. The different procedures used for the two data sets are equally valid. In fact what it would be best to measure would be the date at which the decision was made to declare R&D for the first time, which may be at the beginning (or even earlier) or end of the accounting period. This date is however unobservable. As the most emphasised results in this paper refer to the wide sample, for our conclusions the year of first disclosure should be read as the calendar year in which the accounting year of first disclosure ended.
7. We undertook a number of experiments estimating hazard functions across which T was allowed to vary from 5 to 110. Apart from estimates based on very high values of T causing us to reject such values, the impact of this variation on the value of the estimated log likelihood was minimal. We also estimated a model where T was one of the parameters. This approach led however to very imprecise estimates of all parameters and was therefore abandoned.
8. Although Wagenhofer (1990) illustrates the existence of a partial disclosure equilibrium in which $F_3 > 0$.
9. This variable was entered with a one period lag to avoid endogeneity problems.
10. We also experimented with other proxies, but as these were unsuccessful empirically, we do not report upon them here.
11. The use of time dummies to model SSAP 13 effects may be criticised on the grounds that such dummies could pick up many other effects. However given that we have a time varying baseline hazard and our covariates are also time varying this would only be so if there were other events that paralleled the SSAP13 changes. We know of no such events.
12. Although there is some similarity between the SALES and MUST variables, they do measure different things. SALES is a continuous variable whereas MUST is a one/zero variable measuring whether the firm meets at least two of the three threshold criteria, of which total SALES is only one. Thus, for example, by including SALES as well as MUST we can explore whether amongst firms that do not meet the criteria, larger firms have a higher hazard rate. Also by including MUST as well as SALES we may observe whether after taking account of the effect of SALES on the hazard rate there is still an SSAP13 effect.

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