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Evaluation of Enterprise Management Incentive scheme

Appendix C – Econometric analysis

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Enterprise Management Incentive: Assessment of effectiveness

Summary of findings

This analytical paper presents an assessment of the effectiveness of the Enterprise Management Incentive for beneficiary firms. The aim of the scheme is to enable SMEs with high growth potential to compete with larger firms for highly skilled employees in order to counter identified market failures in the financial and labour markets which could otherwise prevent the realisation of this growth potential.

Comparing those that adopted EMI between 2012 and 2014 to a control group (matched to have similar characteristics), we find the following impacts:

- Recruitment and retention: EMI appears to aid recruitment efforts (with increased employment numbers and decreased proportion of hard-to-fill vacancies). However, the scheme does not appear to have an effect on retention. This is in line with expectations outlined in the supporting market failure analysis. Information asymmetries are likely to be most acute in the case of the prospective employee, whereas those that have joined the firm will acquire information about its prospects (with additional incentives predicted to have a weaker effect).
- Innovation and investment: In addition to helping firms to grow in terms of employee numbers, there is also an indication that the EMI scheme has led onto increased equity investment for some adopters. This could be interpreted as a signal that the scheme has been at least partially successful in encouraging participation by firms with high growth potential. However, the scheme does not appear to have had a significant effect on R&D spending. One possible explanation for this finding is that EMI users are at a later stage of the growth cycle than perhaps anticipated in the business case, using equity investment to scale up their operations rather than to further the development of new product, process, or service offerings.
- Output and productivity growth: We do not find an effect on turnover, output or productivity growth. Again, this would potentially be explained if a share of EMI users are at the scale-up phase, recruiting larger numbers of workers but yet to substantial effects on revenues or efficiency. As such, the time frame for analysis (3 years) may be insufficient to assess the long term economic impacts of the scheme.

A. Introduction

This analytical paper presents an assessment of the effectiveness of the Enterprise Management Incentive. The scheme provides an implicit subsidy to SMEs by allowing them to offer tax efficient stock options to employees. The aim of the scheme is to enable SMEs with high growth potential to compete with larger firms for highly skilled employees in order to counter identified market failures in the financial and labour markets which could otherwise prevent the realisation of this growth potential. This paper assesses the effectiveness of the scheme on the economic performance of beneficiary firms.

B. Method

The findings presented in this analytical paper are based on a dataset of 703 respondents to the firm survey. The analysis compares the changes *over time* in outcomes between *a treatment group* (356 firms that adopted EMI in 2012/3 and 2013/14) and *a comparison group* (347 firms that adopted EMI in 2015/16).[1] The underlying assumption of this approach is that later adopters should be reasonably similar in their unobservable characteristics to early adopters, or at least more similar than any comparison group which could be drawn from the general business population, countering the likelihood of *selection bias* which would otherwise confront the research design.

We use a *difference-in-difference* approach, which allows us to estimate the impact of an intervention compared to what would have happened anyway. If we can reasonably assume that in the absence of the policy the outcomes of

[1] The study was originally conceived to compare those taking up the EMI programme in 2012/13 against those taking it up in 2015/16. We have had to adjust this design as the sample sizes available were too small to support the original design.

each group would have experienced the same trends (i.e. the *common trend assumption*), then the differences in trends over time (between 2012/13 and 2015/16) will represent the *causal impact* of the participation in EMI.

While it is not necessary for a robust difference-in-difference analysis that the two groups are exactly equivalent (the common trend assumption is sufficient), using a matching technique[2] to remove some observable differences in baseline characteristics between the treatment and control groups will strengthen the plausibility of this assumption.

The difference-in-difference model can be represented as follows:

$$[1] \quad \Delta y_{it} = \alpha + \beta X_{it-1} + \delta_1 \cdot EMI2012/13 + \delta_2 \cdot EMI2013/14 + u_{it}$$
$$\text{or } [2] \quad \Delta y_{it} = \alpha + \beta X_{it-1} + \delta \cdot EMI + u_{it}$$

Here, y represents the change in the outcome of interest between the baseline and 2016. Specifying the outcome in first differences means that the estimated treatment effect is robust to any unobserved but time invariant differences between firms. X is a vector of pre-treatment controls; the same set of variables used in the matching model. The treatment variable is EMI. EMI can be specified as a simple dummy variable (as in [2]) or can be defined to allow for differential effects between those that adopted EMI in 2012/13 and those that adopted in 2013/14 (as in [1]).

C. Descriptive statistics

The table that follows shows the average baseline values for a range of variables in the treated and untreated groups. Across most variables, the differences in characteristics are not large enough to be identified as statistically significant. However, some statistically significant differences are found. Specifically, R&D spend and level of equity investments are higher among treated firms than untreated firms:

- R&D spend: The average R&D spend in 2012/13 is £79,417 for the untreated firms and £217,635 for the treated firms. The proportion of firms that have no R&D spend is higher among untreated firms (55%) compared to treated firms (49%). In addition, those treated firms that do spend on R&D spend more than untreated firms that spend on R&D.
- Equity investment: Average level of external equity investment in 2012/13 (i.e. not including stock options awarded through EMI) is £467,437 for the untreated firms and £3,110,713 for the treated firms. The proportion that has secured equity investment is 28% among treated firms and 15% among untreated. Of those that have secured equity investment, the average amount is higher amongst the treated group.

Some differences are also observed in terms of turnover and profit (these are not identified as statistically significant – likely due to the large variation in this variable and the relatively small sample size):

- Turnover: Average turnover is higher among treated firms. The proportion with non-zero turnover is similar among treated (90%) and untreated (92%) firms. Of these, average turnover is higher among treated firms.
- Profit: Higher average profit is observed among untreated firms. This is partly because the proportion of loss-making firms is higher among treated firms (29% vs. 22%).

As a general caveat for the analysis, the combination of large variation (in variables such as profit, turnover, equity investment and R&D spend) and relatively small sample size means that the results from this analysis may not be very stable, in that a few firms with extreme values may drive the observed changes over time.

[2] The propensity score matching algorithm was implemented using a probit model, kernel matching and imposing common support. Care was taken not to overspecify the model given the modest sample size and the higher rates of missing values for certain variables.

Table 1: Descriptive statistics (2012/13) – treated vs. untreated firms

Variable (all values are baseline averages)	Untreated firms (adopted EMI in 2015/16)			Treated firms (adopted EMI between 2012/13 and 2013/14)			Sig. diff.[3]
	# obs.	**Mean**	**Std. Dev**	**# obs.**	**Mean**	**Std. Dev**	
Age of the firm (2012)	341	9.235	13.874	343	10.166	13.224	
% of firms with low sector/market risk	347	0.159	0.366	356	0.197	0.398	
% of firms with medium sector/market risk	347	0.493	0.501	356	0.472	0.500	
% of firms with high sector/market risk	347	0.331	0.471	356	0.320	0.467	
Recruitment and retention							
# employees	325	28.203	45.268	340	26.159	34.396	
HTF vacancies as % of employment	270	0.212	0.311	267	0.250	0.380	
# of staff leaving as % of employment	282	0.114	0.194	277	0.127	0.196	
Innovation and investment							
R&D spend (£)	286	79,417	203,635	299	217,635	636,606	***
Equity Investment (£)	299	467,437	3,085,118	302	3,110,713	22,000,000	**
Firm performance and productivity							
Turnover (£)	333	8,246,412	32,000,000	339	12,000,000	42,900,000	
Turnover per worker (£)	318	394,226	986,889	327	1,172,855	9,011,856	
Profit (£)	241	218,240	1,289,696	273	113,144	1,400,467	
Output per worker (£)	217	54,689	116,559	253	35,292	169,419	
Output (£)	220	1,701,142	5,172,124	258	1,665,866	5,187,435	

The next table shows a comparison of adopters in 2012/13 and adopters in 2013/14. Across most variables, the differences in characteristics are not large enough to be identified as statistically significant. Statistically significant differences are found in the cases of R&D spend and output with those that adopted EMI in 2012/13 having higher averages. Another large difference is observed in turnover but this is not identified as statistically significant, most likely due to the large variation in the variable combined with the relatively small sample.

[3] Using t-test. * 90% confidence level ** 95% confidence level *** 99% confidence level

Table 2: Descriptive statistics (2012/13) – 2012/13 EMI adopters vs. 2013/14 adopters

Variable (all values are baseline averages)	Adopted EMI in 2012/13			Adopted EMI in 2013/14			Sig. diff.
	# obs.	**Mean**	**Std. Dev**	**# obs.**	**Mean**	**Std. Dev**	
Age of the firm (2012)	162	10.907	14.102	181	9.503	12.387	
% of firms with low sector/market risk	168	0.185	0.389	188	0.207	0.407	
% of firms with medium sector/market risk	168	0.476	0.501	188	0.468	0.500	
% of firms with high sector/market risk	168	0.333	0.473	188	0.309	0.463	
Recruitment and retention							
# employees	159	28.918	35.324	181	23.735	33.470	
# of staff leaving as % of employment	130	0.130	0.215	147	0.124	0.179	
HTF vacancies as % of employment	121	0.257	0.375	146	0.243	0.385	
Innovation and investment							
R&D spend (£)	143	288,610	824,929	156	152,574	383,170	*
Equity Investment (£)	137	1,173,758	4,302,443	165	4,718,974	29,500,000	
Firm performance and productivity							
Turnover (£)	161	15,900,000	56,000,000	178	8,547,514	25,500,000	
Turnover per worker (£)	152	1,580,660	12,200,000	175	818,649	4,693,710	
Profit (£)	129	102,162	1,821,302	144	122,982	872,470	
Output per worker (£)	118	41,271	163,882	135	30,066	174,554	
Output (£)	121	2,371,376	7,269,697	137	1,042,750	1,840,111	*

D. Matching process

A propensity score matching algorithm is used to remove differences in a range of baseline characteristics, including R&D spending (log transformation[4]), turnover (log transformation), number of hard-to-fill vacancies as a proportion of total employment (log transformation), level of equity investment (log transformation), level of risk in product markets and age of the firm.

As shown in the table below, the matching process has achieved an overall reduction in the differences in baseline characteristics between groups. Matching has reduced the standardised bias[5] to below 5% for all variables used in the model (typically, a bias reduction below 3% or 5% is seen as sufficient[6]).

[4] Log transformations were used to improve efficiency of matching on variables that had a positively (i.e. towards the lower end) skewed distribution. 0.01 was added to variable values to avoid taking the log of 0 (which cannot be logged).

[5] The standardised bias indicates the distance in marginal distributions of the variables after matching, with a lower value indicating a closer match. It is the difference of sample means in the treated and matched control subsamples as a percentage of the square root of the average of sample variances in both groups.

[6] Caliendo, 2005. Available at: http://ftp.iza.org/dp1588.pdf

Table 3: Propensity score matching – reduction in bias

Variable (all values are baseline averages)	Treatment	Matched control	% bias (after matching)	% reduction in bias (after matching)
% of firms with medium sector/market risk	0.473	0.484	-2.2	74.8
% of firms with low sector/market risk	0.315	0.319	-0.7	50.1
Age of the firm	12.966	12.659	2.5	19.1
Log transformation of HTF vacancies as % of employment	-2.356	-2.291	-4.1	35.8
Log transformation of R&D spend (£)	5.301	5.231	0.9	92.1
Log transformation of Equity Investment (£)	1.573	1.387	2.3	94.0
Log transformation of Turnover (£)	13.742	13.751	-0.2	97.6

The imposition of the matching model results in a loss in sample size. Ultimately, just 203 of 356 treated firms are matched. This is mostly due to missing values in the proportion of hard-to-fill vacancies[7] (in particular because many firms were unable to report how many vacancies they had in the base year). The consequence is that any firms with a missing value for the proportion of hard-to-fill vacancies are excluded from the analysis. This could result in bias in the results if EMI adoption affects this type of firm differently to the rest.

E. Findings

The results are shown in the following table. Model 1 shows the coefficients associated with the treatment variables in equation [1], which allows for differential impacts between those that adopted EMI in 2012/13 and those that adopted EMI in 2013/14. The treatment variable in model 2 is whether the firm adopted EMI in either year (as shown in equation [2] earlier) so this should represent the overall effect.

Statistically significant impacts[8] (marked with asterisks) are observed for the following outcomes:

- Hard-to-fill vacancies as a proportion of employment: Model 2 suggests that EMI adoption has had the effect of reducing the proportion of hard-to-fill vacancies. Both groups experienced a reduction in the proportion of hard-to-fill vacancies since the baseline, but this reduction was even greater among firms that adopted EMI in either 2012/13 or 2013/14 (a reduction of 10 percentage points from 26% to 16%) compared to the matched control group (a reduction of 4 percentage points from 22% to 18%). This could support the idea that EMI aids recruitment efforts and that this impact grows with the amount of time the firm has participated in the EMI scheme.
- Number of employees: According to Model 2, the impact of EMI adoption on the number of employees is positive. This approximates to a 26% increase or the equivalent of increasing from 24 employees to 30. Model 1 suggests a larger impact of adoption of EMI in 2013/14 than in 2012/13.
- Equity investment: Model 2 suggests that EMI adoption has had a large positive impact on the level of equity investment. The impact approximates to a 198% increase or the equivalent of increasing average levels of external equity investment from £2.2m to £6.6m.[9] Model 1 suggests that the impact of adoption of EMI in 2013/14 was larger than the impact of adoption in 2012/13.

[7] Omitting this variable from the matching model leads to a drop in the match quality while the number of matched firms only rises to 245 due to other missing values (e.g. in R&D, turnover).

[8] * 90% confidence level ** 95% confidence level *** 99% confidence level

The associated standard errors have not been adjusted to account for the fact that the propensity scores are estimated.

[9] Note that with some very large equity investment amounts present in the data, the overall trend can be driven by a few firms with extreme values.

Table 4: Findings – estimated impact of EMI

	Treatment variable (model 1)		**Treatment variable (model 2)**
Change in outcome	Adopted EMI in 2012/13	Adopted EMI in 2013/4	Adopted EMI in either 2012/13 or 201/14
Recruitment and retention			
Log transformation of # employees	0.178	0.328**	0.263*
# of staff leaving as % of employment	-0.009	0.008	0.001
HTF vacancies as % of employment	-0.076**	-0.046	-0.059**
Innovation and investment			
Log R&D spend (£)	-1.026	0.138	-0.362
Log Equity Investment (£)	1.560	2.298**	1.979**
Firm performance and productivity			
Log transformation of Turnover (£)	0.795	0.254	0.491
Log transformation of Turnover per worker (£)	0.732	0.054	0.350
Profit (£)[10]	-263,887	-458,567	-194,726
Output (£)	632,103	-208,626	162,089
Output per worker (£)	37,653	-18,348	6,351

Although a range of different outcomes are examined (including change in turnover, R&D spend, profit, output and staff retention,), no other statistically significant results are found. The estimates are too small to be distinguished from zero effect.

The findings can be summarised as follows:

- Recruitment and retention: EMI appears to aid recruitment efforts (with increased employment numbers and decreased proportion of hard-to-fill vacancies). However, the scheme does not appear to have an effect on retention. This is in line with expectations outlined in the supporting market failure analysis. Information asymmetries are likely to be most acute in the case of the prospective employee, whereas those that have joined the firm will acquire information about its prospects (with additional incentives predicted to have a weaker effect).

- Innovation and investment: In addition to helping firms to grow in terms of employee numbers, there is also an indication that the EMI scheme has led onto increased equity investment for some adopters. This could be interpreted as a signal that the scheme has been at least partially successful in encouraging participation by firms with high growth potential. However, the scheme does not appear to have had a significant effect on R&D spending. One possible explanation for this finding is that EMI users are at a later stage of the growth cycle than perhaps anticipated in the business case, using equity investment to scale up their operations rather than to further the development of new product, process, or service offerings.

- Output and productivity growth: We do not find an effect on turnover, output or productivity growth. Again, this would potentially be explained if a share of EMI users are at the scale-up phase, recruiting larger numbers of workers but yet to substantial effects on revenues or efficiency. As such, the time frame for analysis (3 years) may be insufficient to assess the long term economic impacts of the scheme.

[10] Profit and output outcomes were not log transformed due to the presence of negative values. Output was calculated as the sum of wage spending and profits, and negative output occurred where losses exceeded wage spending. This pattern would be expected in many R&D intensive but pre-revenue businesses that use their equity capital to develop new technologies.

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