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Innovation and R&D investments by leveraged buyout companies in times of crisis

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Abstract

We study innovation and R&D investments made from 2008 to 2010 by UK companies that were the targets of leveraged buyout (LBO) in previous years. We find that overall, LBO companies do not exhibit lower innovation and R&D investments than non-LBO companies during the crisis, with other things being equal. However, innovation and R&D investments decline substantially in LBO companies that were financially constrained before the deal. We argue that in unfavorable market conditions, LBOs tend to exacerbate the issues related to investments in innovation in firms facing financial constraints.

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1. Introduction

In recent years there has been renewed interest in the economic consequences of leveraged buyout (LBO) transactions (Gurung and Lerner 2008). This added interest is amplified by the worldwide economic downturn that began in 2008, which represented a strategic game changer for most organizations. Resource constraints and unpredictable market conditions created significant challenges for growth through innovation and venturing activities. The aim of the present study is to answer the following question: How do LBOs affect companies' innovation and R&D investments in such unfavorable market conditions?

LBOs usually involve (1) the acquisition of a divested division or subsidiary or of a private family-owned firm by a newly created acquisition vehicle, (2) an increased leverage to facilitate the acquisition, (3) an increased concentration of equity held by managers to provide high-powered incentives, and (4) the active monitoring of strategic decisions and financial performances through board seat acquisitions and specific detailed reporting requirements. Critics of LBOs argue that high leverage prevents investment and increases the risk of bankruptcy. Supporters of LBOs note that investors create value by improving management incentives and by contributing with financial and operational expertise to their portfolio companies.

The literature suggests that LBOs have a positive impact on productivity and performance (Cumming *et al.* 2007, Wilson *et al.* 2012). However, evidence regarding the impact of LBOs on innovation and R&D is less conclusive. While the early studies found that companies cut their innovation and R&D investments after an LBO (Smith 1990), more recent studies show no decrease in innovation activities (Lerner *et al.* 2011). In addition, after the deal LBO target companies are more innovative than non-LBO companies with similar innovation expenditures (Le Nadant and Perdreau 2014).

More importantly, the literature has not studied thoughtfully the extent to which the effect of LBOs on innovation may vary across different phases of the economic cycle. As most studies focus on post-investment periods during which economic conditions were predominantly favorable (Ughetto 2010), we know little about the effect of LBOs on innovation in unfavorable market conditions.[1]

Specifically, in periods of economic recession LBOs could be particularly harmful for financially constrained target companies. The literature suggests that LBOs may exacerbate the financial constraints of their target firms (Bertoni *et al.* 2013, Tykvová and Borell 2012). Moreover, innovation and R&D investments should be expected to be more pro-cyclical in firms facing tighter credit constraints (Aghion *et al.* 2012). To this extent, the negative effect of LBOs should be particularly visible in firms that were financially constrained prior to the deal.

The economic crisis that began in 2008 provides us with a quasi-experimental setting to study the effect of LBOs on innovation and R&D investments during an economic downturn. We conduct our study on respondents to the United Kingdom Innovation Survey (UKIS). More specifically, we compare the post-crisis innovation and R&D investments of companies that were LBO targets between 2005 and 2007 with those of non-LBO companies while controlling for a series of pre-deal firm characteristics.

We find no evidence that, on average, LBO targets were particularly affected by the economic downturn, with other things being equal. However, we find that pre-crisis financial constraints are associated with significantly lower innovation and R&D investments in LBO

[1] LBOs may also present a distinct effect in periods of euphoric credit markets, during which the discipline involved in financial- and incentive-structuring might break down (Gaspar 2012).

targets. This result is consistent with the idea that LBOs exacerbate financial constraints, thus causing a drop in investments for those firms that were financially constrained prior the LBO.

The work is structured as follows. Section 2 describes the data set and discusses the empirical approach used. Section 3 presents the results. Section 4 presents the conclusions.

2. Data, variables, and empirical approach

2.1 Data

To build the sample of LBO companies, we retrieved from Capital IQ all the deals that (1) involved target companies incorporated in the UK, (2) are reported as being LBOs, (3) were announced between 01/01/2005 and 31/12/2007, (4) were either "closed" or "effective". We identified 2,426 transactions that comply with the above criteria.

Second, we identified all LBO companies that responded to four waves of the UKIS: CIS4 (period 2002/2004), CIS5 (period 2004/2006), CIS6 (period 2007/2008) and CIS7 (period 2008/2010). To preserve the anonymity of the UKIS entries, the identification of LBO respondents was conducted directly by the ONS Inter-Departmental Business Register (IDBR) team, based on company name and address from Capital IQ.

We only retained LBO companies for which we were able to obtain both pre- and post-LBO information from the relevant wave of the UKIS. For LBOs that occurred in 2005 and 2006 we used CIS4 for pre-LBO information and CIS6 for post-LBO information. For LBOs that occurred in 2007 we used CIS5 for pre-LBO and CIS7 for post-LBO information.

Third, we created a control sample of all non-LBO companies present in the same UKIS waves (CIS4 and CIS6 or CIS5 and CIS7). To limit the disproportion in the number of LBO and non-LBO companies, we randomly extracted 10 non-LBO respondents within the same 2-digit SIC code of each LBO respondent.

Finally, we eliminated from the control samples the companies that underwent an LBO after 1998, and we eliminated from the LBO sample all the secondary LBOs. Our final sample is composed of 88 LBO and 1,147 non-LBO companies.

2.2 Variables

The variables of interest in this study are two continuous dependent variables measuring a firm's innovation effort: the innovation expenditure as a percentage of turnover, and the R&D expenditure as a percentage of turnover. Total innovation expenditure includes both product (goods and services) and process innovation.

Our main independent variable is *LBO*: a dummy variable equal to 1 when the company is an LBO target, and 0 otherwise. In the analysis we control for a series of factors that are relevant, according to the literature, for innovation at the firm level. First, we control for the past R&D effort, which is typically found to be a significant predictor of current innovative activity (Crépon *et al.* 1998, Raymond *et al.* 2006). Specifically, we include in the regression the ratio between innovation investments and the number of employees and two dummies for the presence of innovation activities before the deal - one for non-technological innovation and one for technological innovation.

Second, a common finding is that size explains the propensity to innovate, but does not affect or then decrease the share in total turnover due to new or improved goods or services. In other words, large firms are more likely to innovate, but their innovation output increases less proportionately with total turnover (Mairesse and Mohnen 2010). *Size* is the lagged value of the number of employees (in logarithm).

Further, we included a measure of financial constraints. The literature argues that, due to asymmetric information, high uncertainty and intangibility innovation expenditure should be financed mainly by internal financial resources (Bertoni *et al.* 2010, Brown *et al.* 2009,

Carpenter and Petersen 2002, Hall 2002, Ughetto 2008). The reliance of R&D financing on internal financial resources implies that during an economic downturn R&D investments should decrease as well (at least for firms that have no substitute for internal capital). Several studies rely on surveys to identify financially constrained firms to overcome problems traditionally associated with the use of proxies (Crespi and Scellato 2010, Herrera and Minetti 2007, Ughetto 2009). We follow this approach and use a direct measure of financial constraints given by the firms themselves (Savignac 2008). In the UKIS, firms were asked if they had encountered obstacles that prevented them from leading or to undertaking innovative projects. In particular, two expressions of the existence of financing constraints are listed: availability of finance and cost of finance. Answers are coded from 0 (not a constraint) to 3 (high constraint). We built a dummy variable for each of the two dimensions, thus identifying companies exhibiting the two highest levels of constraints. We also built a dummy variable to identify companies for which both cost and availability of financing are high, which is equal to one when the two answers sum to 3 or more. As additional controls, we included firm age, presence of the firm on international markets, sector dummies, and a CIS wave dummy that identifies respondents to CIS5 and CIS7 against the omitted category of respondents to CIS4 and CIS6. We summarize the variables used in this study in Table 1.

Table 1. Definition of variables used in the empirical analysis

The table reports a definition of the variables used in the empirical analysis. Time *t* refers to the LBO year (2005-2007). Time *t+1* refers to information obtained from the closest CIS wave after the LBO (CIS6 for LBOs in 2005 and 2006; CIS7 for LBOs in 2007). Time *t-1* refers to information obtained from the closest CIS wave before the LBO (CIS4 for LBOs in 2005 and 2006; CIS5 for LBOs in 2007).

Variables	Definition
INNEXP(t+1)	Logarithm of 1% plus the ratio between total innovation expenditure and turnover, measured in *t+1*.
RDEXP(t+1)	Logarithm of 1% plus the ratio between R&D expenditure and turnover, measured in *t+1*.
LBO(t)	Dummy variable that is equal to 1 if the firm is an LBO target in period *t*.
R&D EFFORT(t-1)	Total innovation expenditure divided by the number of employees, measured in *t-1*.
TECHNOLOGICAL(t-1)	Dummy variable that is equal to 1 if the firm is innovation active in product, process or ongoing or abandoned activities (technological innovation), measured in *t-1*.
NON-TECHNOLOGICAL(t-1)	Dummy variable that is equal to 1 if the firm has introduced a marketing or organization innovation, measured in *t-1*.
SIZE(t-1)	Logarithm of the number of employees, measured in *t-1*.
COSTFIN(t-1)	Dummy equal to 1 when respondent indicated cost of finance as a high or very high constraint to innovation activities in time *t-1*.
AVAILFIN(t-1)	Dummy equal to 1 when respondent indicated availability of finance as a high or very high constraint to innovation activities in time *t-1*.
HIGHFIN CONSTRAINTS(t-1)	Dummy variable that is equal to 1 if the answers about the importance of cost and availability of finance (each on an ordinal scale between 0 and 3) add to 3 or more.
INTERNATIONAL(t-1)	Dummy variable that is equal to 1 if the firm sells goods and/or services in international markets, measured in *t-1*.
AGE(t-1)	Age of firm, in years (source: Business Structure Database).
LBO RELATIVE(t)	Instrumental variable that is equal to the number of LBOs divided by the total number of respondents in the relevant CIS, computed for each NUTS2 area.

Descriptive statistics are presented in Table 2. LBO targets do not face higher financial constraints before the deal in comparison with non-LBO companies. Of the LBO targets, 48% report high financial constraints before the deal. The percentage is slightly lower (43%) for non-LBO companies, but the difference is not statistically significant.

Table 2. Descriptive statistics for LBO targets and non-LBO companies

The table reports the descriptive statistics of the variables used in the analyses. The number of observations is: N=1,235 for the whole sample, N=88 for LBO=1, and N=1,147 observations for LBO=0, except for variable INNEXP where observations are N=1,224, N=87 and N=1,137, respectively.

Variable	All sample	LBO=1	LBO=0
INNEXP(t+1)	-6.034	-6.165	-6.0241
RDEXP(t+1)	-6.688	-6.729	-6.6850
R&D EFFORT(t-1)	0.7526	1.5532	0.6912
TECHNOLOGICAL(t-1)	0.6866	0.7727	0.6800
NON-TECHNOLOGICAL(t-1)	0.4113	0.4659	0.4071
SIZE(t-1)	5.075	6.2150	4.9878
AVAIL FIN(t-1)	0.6915	0.8750	0.6774
COST FIN(t-1)	0.7976	0.9318	0.7873
HIGHFIN CONSTRAINTS(t-1)	0.4388	0.4886	0.4350
INTERNATIONAL(t-1)	0.3344	0.4204	0.3278
AGE(t-1)	23.20	23.86	23.15

2.3 Empirical approach

In a first step, we estimate two-stage treatment effect regressions where innovation and R&D investments are the dependent variables and LBO is the treatment variable. The LBO variable is instrumented by a variable capturing relative intensity of LBOs in the region where the company operates (LBO relative). We build this instrumental variable for each period and NUTS2 region as the ratio between the number of LBOs and the total number of UKIS respondents.[2]

To compare the effect of pre-crisis financial constraints on innovation and R&D investments during the crisis for LBO and non-LBO companies, we estimate, using OLS, a model on the two subsamples of LBO and non-LBO companies. To maintain a sufficient number of degrees of freedom in the regression, we only retain variables that are significant in the main regression and use the combined dummy about the cost and availability of financing to capture financial constraints.

3. Results

We report in Table 3 the results of the two-stage regression. As expected, innovation and R&D investments are higher the smaller the size and the higher the previous R&D effort of the target firm. The LBO dummy is negative but not significant, indicating that we cannot reject the hypothesis that LBO targets have, on average and other things being equal, the same innovation and R&D investments of non-LBO companies in times of crisis.[3]

[2] An additional problem common to all studies based on surveys is survivorship bias. In this study, we compare two groups of respondents, both of which are subject to survivorship. In this case, a bias could arise from systematic differences in survivorship rates between LBO and non-LBO companies. The literature finds no such systematic difference in survivorship (Tykvová and Borell 2012), which suggests that this bias should not be a major concern in our study.

[3] As a robustness check, we also use a two-stage least square instrumental variable regression where LBO was instrumented by LBO relative. Results (not presented here) are consistent with those presented herein.

Table 3. Treatment effect regressions on innovation and R&D investments

The table reports the results of the treatment effect regression on innovation and R&D investments. Standard errors are reported in brackets. ***: significant at the 1% confidence level; **: significant at the 5% level; *: significant at the 10% level. LBO relative is the instrument used in the first-step estimation.

	Model 1 INNEXP(t+1)	Model 2 RDEXP(t+1)
LBO(t)	-2.3530 (2.1097)	-.1960 (1.4650)
SIZE(t-1)	-.0826*** (.0288)	-.0772*** (.0213)
RDEFFORT(t-1)	.0142*** (.0039)	.0169*** (.0029)
TECHNOLOGICAL(t-1)	.1739* (.0910)	-.0085 (.0667)
NON TECHNOLOGICAL(t-1)	.0571 (.0855)	.0845 (.0628)
AVAILFIN(t-1)	-.0377 (.0681)	-.0474 (.0498)
COSTFIN(t-1)	.0495 (.0629)	.0374 (.0461)
INTERNATIONAL(t-1)	.2903*** (.0898)	.3225*** (.0667)
AGE(t-1)	-.0026 (.0040)	-.0048 (.0029)
Constant	-5.9549*** (.3744)	-6.8193*** (.2765)
SIC dummies	YES	YES
CIS dummy	YES	YES
Observations	1224	1235
Wald Chi2 (34)	318.55	450.11
Prob>chi2	.0000	.0000
LBO relative(t) (first stage)	.0875** (.0404)	.0877** (.0404)

We report the split sample regressions in Table 4. For the sub-sample of LBO targets, we find that financial constraints before the deal are negatively related to the level of innovation and R&D investments after the deal. In contrast, we find no impact for the sub-sample of non-LBO companies. This result indicates that LBO companies reduce their innovation and R&D investments more when they were significantly financially constrained before the deal. Hence, LBOs tend to amplify the acuteness of issues related to investments in innovation due to financial constraints.

4. Conclusions

In this study we investigate how LBOs influence innovation in unfavorable market conditions. We exploit the economic crisis that began in 2008 as a source of negative shock in economic conditions. Our results do not allow us to reject the hypothesis that on average there is a significant difference between the innovation and R&D investments of LBO companies and those of non-LBO companies. However, for LBO targets that were financially constrained before the deal the LBO had a negative impact on both innovation and R&D investments. Our results suggest that in unfavorable market conditions LBOs tend to exacerbate the financial constraints, thus limiting innovation activity for companies that were financially constrained prior to the deal.

Table 4. Impact of financial constraint on innovation and R&D investments

The table reports the results of the split-sample regression on innovation and R&D investments. Standard errors are reported in brackets. ***: significant at the 1% confidence level; **: significant at the 5% level; *: significant at the 10% level.

	Model 1 INNEXP(t+1)		Model 2 RDEXP(t+1)	
	LBO=0	LBO=1	LBO=0	LBO=1
SIZE(t-1)	-.0784**	-.0780	-.0624***	-.1024
	(.0309)	(.1093)	(.0224)	(.0964)
RD EFFORT(t-1)	0.0139***	-0.0989	0.0162***	-0.1325**
	(.0042)	(.0795)	(.0030)	(.0704)
INTERNATIONAL(t-1)	0.3191***	0.4899	0.2944***	0.9438***
	(.0949)	(.3168)	(.0687)	(.2704)
HIGHFIN	0.1307	-0.6778**	0.0360	-0.6789***
CONSTRAINT(t-1)	(.0822)	(.2807)	(.0595)	(.2467)
AGE(t-1)	-0.0019	-0.0012	-0.0053	-0.0026
	(.0042)	(.0139)	(.0030)	(.0123)
Constant	-5.984***	-7.020***	-6.846***	-7.3284***
	(.3852)	(.9567)	(.2799)	(.8421)
SECTOR dummies	YES	YES	YES	YES
CIS dummy	YES	YES	YES	YES
Observations	1,137	87	1,147	88
F	9.22	2.32	12.78	3.26
Prob>F	.0000	.0036	.0000	.0001
Adj R-Squared	.1783	.2932	.2356	.4123

This work contributes not only to the academic research but also to the recent policy discussion on private equity and LBOs. Policy makers fear that LBOs may have adverse effects on long-term investments by their portfolio companies, in particular during downturns. The present study provides some insights by showing that while, in general, no difference is observed in innovation and R&D investments between LBO and non-LBO companies, if we focus on those target companies that were financially fragile before the deal, we detect a substantial reduction in their innovation activity during the crisis.

This study has limitations that we aim to overcome in future work. First, it would be interesting to complement our analysis of innovation and R&D expenses with one on the output of innovation. In a future study, we will explore how LBOs affect different types of innovation outputs distinguishing between product, process, marketing and organizational innovations. Second, our study is based on a single country, and it will be interesting to analyze the extent to which our results depend on the specific institutional setting of the UK by replicating the analysis in other countries.

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