Productivity and Corporate Governance in Smaller Firms

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ABSTRACT. Our starting point was to argue that the entrepreneur is central to the organisation of production in smaller firms. We also contended that it was crucial to understand how differences in corporate governance structures affect productivity. This is particularly important given that many small firms have relatively unsophisticated and non-complex governance structures. Our results show positive, and significant, effects from the founding entrepreneur, the board of directors and the management team on productivity. We also find that the majority of smaller firms face increasing returns to scale. In total, our results cast serious doubts on the relevance of "black box" theories of production which exclude a role for the entrepreneur.

I. Introduction

> *With the development of a theory of the production function, the entrepreneurial function essentially disappeared from the theory of the firm.* (Neil B. Niman, 1991, p. 165)

The nature and role of the entrepreneur has been the subject of theoretical debate for over three hundred years. Despite this lengthy tradition, entrepreneurship has been a difficult concept to integrate into formal analysis (Penrose, 1959) given that it is so entwined with the individuals personality. There is, however, broad agreement that the entrepreneur is a special factor of production which cannot be replicated in the way that machinery or normal labour can (Reid, 1995, 1993). Thus she is a unique factor of production.

Many earlier studies have observed how ownership and control is so closely held in smaller, independently owned firms, and how this manifests itself in terms of the objectives that this type of firm pursues (Short, 1994; Gray, 1997; Cowling, 2000). What is clear is that the entrepreneur is in a unique, and extremely powerful, position within the firm. In this paper we proceed by explicitly identifying how the entrepreneur, and also governance structures, affect the efficiency of the firm. In doing so we adopt the traditional production function framework, but augment our analysis to allow for potential effects from the entrepreneur and other non-direct labour inputs such as the board of directors, shareholders and the management team.

Despite this obvious difference in governance between small and large firms, mainstream industrial economics has largely chosen to ignore the entrepreneur by assuming the inevitability of a divorce of ownership from control to the extent that "it is not even certain that the objectives of the owners of a company are of any relevance at all to the company's behaviour and performance" (Hay and Morris, 1991, p. 276). In a similar vein, Walrasian neoclassical theory excludes the entrepreneur by assumption (Short, 1994). On this we note that the three most fundamental theoretical tenets of neoclassicism are perfect competition, perfect knowledge of technology and perfect foresight. Each of which leaves no role for the entrepreneur as a marketer, innovator or as a bearer of uncertainty.

To summarise, the rest of this paper will provide evidence on how different governance structures affect productivity in smaller firms. One specific aim being to test whether in fact the entrepreneurial input does exhibit decreasing returns to scale as hypothesised by the earlier work of Reid (1993). In doing so we will also provide evidence on the responsiveness of output with respect to labour and capital in the entrepreneurial

Final version accepted on November 1, 2001

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Small Business Economics **20**: 335–344, 2003.

and non-entrepreneurial firm. In order to maintain a degree of consistency with the small firms production function estimation of Reid, a series of cross-sectional production functions are estimated. The results of which can also be evaluated in the light of the theoretical constructs put forward by Casson regarding the relative fixity of capital and labour in the entrepreneurially controlled firm. Further examination of the role of the management team is also provided in the light of the issues raised by Atkinson and Storey, in addition to an examination of the role of governance structures, including boards of directors, non-executives and shareholders.

II. The entrepreneur and corporate governance

In rejecting neoclassical theories, Casson (1996, p. 2) by reintegrating the entrepreneur into the theory of the firm argues that, "the firm is essentially an institutionalised extension of the personality of the entrepreneur". For the firm, a competitive advantage is gained as a result of the superior decision-making abilities of the entrepreneur, which are, at least partially, embodied in the firm's choice of organisational structure.

If the firm's environment is then subject to continuous shocks, which can be either permanent or transitory in nature, then a number of potential outcomes can be established. One example being that the entrepreneur, in her monitoring role, identifies what is perceived to be a persistent shock. There are two immediate responses that can be effected by the entrepreneur. The first is to create a new firm specifically to take advantage of such an opportunity, and the second is to reorder the firm's organisational structure to reflect the new environment. In both cases it is the founder entrepreneur who effects the change.

For the purpose of this investigation, this is an extremely important feature, with the founder entrepreneur being so closely, in a cultural and economic sense, identified with the firm in its' early life-cycle stages. The reasoning being that as the firm becomes older, and evolves in terms of its procedural routinisation, then this implies a much greater division of labour. This aspect can manifest itself in simple numerical terms, as an alienation of the original, founding entrepreneur or the entrepreneurial ethos which drove the firm on from inception.

Furthermore, the entrepreneurial drive and opportunism that carries the firm in the early stages of its' life-cycle may be subject to decreasing returns to scale (or indeed variable returns to scale) as the firm grows and evolves over time. This can, in part, be attributed to the limited information-processing abilities of human decision-makers (Simon, 1957). That is to say that as the firm expands over time monitoring of performance becomes more difficult and costly, and in the case of incomplete contracting can lead to ex ante opportunism.

Fama and Jensen (1983a) link style of decision management and control to the complexity of the organisation. Here it is efficient for entrepreneurs to combine ownership and control in small, non-complex organisations where information is concentrated. By contrast, in complex organisations where information is diffuse, they predict that the efficient form of organisation is one in which decision control is separated from decision management.

As such, it might be relatively easy to envisage an increasing disassociation between the founding entrepreneur and the firm, at least in its day-to-day operations. The evolution of organisational structure and control can now be seen in terms of a set of simple decision rules which are laid down by the entrepreneur and applied by salaried managers, who then organise factor inputs, primarily labour (on the assumption that capital stock is relatively fixed in the short-run).

As to the division of labour, the findings of Atkinson and Storey (1994) suggest a positive association between identifiable managerial functions and size of firm. However, their results also show that the delegation threshold is much lower than suggested by small business definitions that require a unification of the owner-manager position. In fact the delegation threshold for the majority of firms appears to begin once the firm passes the micro-business stage (defined as less than 10 employees). On this basis they suggest several areas which merit further investigation. Firstly, the role of the founder in developing the management team; secondly, the functional composition of that team; and thirdly, the specific qualities, competencies and responsibilities of

non-owner managers. This result notwithstanding, perhaps the most important finding of this study in the context of the present one was that founder entrepreneurs were far more likely to recognise the need for additional managerial capacity in their own area of expertise than outside it. This, in practical terms, meant that founding entrepreneurs, who typically possessed more general management skills, would in a relatively short period of time from inception begin to hire other general managers. Only at much larger size levels did the majority of firms begin to employ specialist managers, for example finance managers or personnel managers. For non-founder controlled firms, which are arguably more likely to be controlled by a more experienced, formally trained manager,[1] it might be more likely that the management team consists of a greater proportion of formally identifiable functional experts.

On the nature of production itself, and keeping to the simple two factor case (capital and labour), how is this discussion then tied in with the entrepreneur, the firms choice of organisational structure and input combination? Regarding capital inputs, it has been argued that smaller, unquoted firms might face credit constraints in the market for capital (see Stiglitz and Weiss, 1981; Blinder, 1987; for theoretical rationales, Berger and Udell, 1990; Buck, Friedman and Dunkleberg, 1991 for empirical evidence). A consequence of which might be the adoption of labour intensive production techniques. As such any additions to capital stock should, theoretically, have a large and positive effect upon output. That is to say that for the credit constrained firm the marginal productivity of an extra unit of capital will be greater than the corresponding marginal productivity of an additional unit of labour. Yet, if the credit constraint is binding, at least in the short to medium term, then any increased demand for the firm's output will have to be met with an increased demand for labour units.

By allowing for high transaction costs in the labour market, firms which have successfully recruited high quality workers might then also be expected to retain them, even in the presence of adverse external shocks. It is for this reason that Casson (p. 23) argues that firms are discouraged from "adjusting the composition of their labour force in response to shocks, and [that this] encourages them to adjust their use of other factors (notably capital) instead." This is borne out by evidence from Cowling (2000) which identified providing employees with secure jobs as a key objective of the firm. Thus managers and employees become a fixed factor of production and to a large extent capital becomes the variable factor. This implies that employment in smaller firms is variable only in an upward direction, although Casson applies this only to managerial and skilled labour. To a certain extent this is counterintuitive, given accepted wisdom that it is the flexibility of small firms that allows them to react so quickly to fill new markets and identify niches in established markets or conversely to downsize rapidly in the face of adverse economic conditions.

What is evident is that the vast majority of empirical work relating to the organisation of production, and the respective contributions of labour and capital to the output of firms, has focused very explicitly upon the large firm (see for example, Wadwhani and Wall, 1990; Nickell et al., 1992; Gregg et al., 1993; Nickell, 1996). The one notable exception to this is Reid who estimated a small, entrepreneurial firms production function using various specifications from a sample of young firms in Scotland (see Reid, 1995, 1993). Thus the value added of this paper is to provide new empirical evidence on productivity and its determination in small firms.

III. Data and methodology

In this section we briefly present the basic sample statistics of relevance to our estimation and discussion of the production relationship in smaller firms. Initially, however, we discuss the source of our data. The original data was collected from a randomly stratified sample of U.K., independent, unquoted companies carried out in 1995. In total 427 responses were received from 1,000 questionnaires after multiple recall. The survey information was supplemented by the collection of historical accounts information over a two year period following the survey.

The first point of note is that the average firm is small, having around thirty-five employees of whom five are managers. Governance structures are closely held with the typical board having

TABLE I
Sample statistics for governance, capital and output

Variable	Mean	Std. deviation
Normal labour	29.96	63.39
Managers	4.60	5.57
Directors	2.93	1.49
Shareholders	5.32	12.66
% Boards with non-execs	20.05	40.08
% Founder controlled	42.19	49.44
% Directors shares	86.92	24.69
% Multiple directorships	44.06	49.70
Fixed assets (£000s)	1,175.96	7,499.70
Value added (£000s)	1,131.57	4,611.04

three directors who hold an absolute majority of shares. Share ownership is also concentrated with only five shareholders. There is a surprisingly high proportion of portfolio business owners and in 42% of firms the founding entrepreneur is still there. In terms of fixed assets, we note that the average is in the region of £1.2m. Value added, on average, is slightly less at £1.1m.

In our estimation, a Cobb-Douglas production function was utilised. This was expressed in log-linear form and then estimated by OLS. The basic function can be expressed thus;

$$Y_i = AL_i^{\alpha}K_i^{1-\alpha}, \tag{1}$$

where, Y = output, L = quantity of labour and K = quantity of capital. The A and α are parameters. One important property of this Cobb-Douglas production function is that it assumes that the marginal rate of substitution between labour and capital is 1.

An alternative production function which does not require this assumption is the CES. The CES is essentially a non-linear model and can be represented thus;

$$Y_i = \gamma[\delta K_i^{-\rho} + (1-\delta)L_i^{-\rho}]^{-\upsilon/\rho}e^{\varepsilon i}, \tag{2}$$

where $\gamma > 0$, $1 > \delta > 0$, $\upsilon > 0$, $\rho > -1$.

The four parameters of the function, γ, δ, υ, ρ, represent efficiency, distribution, returns to scale and substitution. For our purposes here it is an important feature of the CES function that if the ρ parameter equates to zero (i.e. is found to be insignificant empirically) which implies an elasticity of substitution of 1 (derived from the formula $1/1-\rho$) then the CES function reduces to the original Cobb-Douglas specification. Others have argued that for short-run estimates of the production relationship the validity of CES models is also questionable.

The actual model to be estimated in the Cobb-Douglas case is defined thus;

$$\log Y_i = \log A + \alpha \log \text{Capital} + \beta \log \text{Labour} + e_i, \tag{3}$$

and in the CES case;

$$\log Y_i = \log \alpha - \upsilon/\rho \log [\delta \text{Capital}_i^{-\rho} + (1-\delta)\text{Labour}_i^{-\rho}] + \varepsilon_i, \tag{4}$$

Tests

The first issue to be addressed is whether the CES or Cobb-Douglas is the appropriate functional form for estimation. The key point of interest here is the ρ parameter. Remember if ρ is found to be statistically insignificant (i.e. $\rho = 0$) then we can reject the CES form in favour of Cobb-Douglas. In this the probability that $\rho = 0$ cannot be rejected on conventional significance grounds. This finding generates an elasticity of substitution of 1 that suggests that Cobb-Douglas is a more appropriate functional form than CES.

A further test of the appropriate functional form of the production function can be estimated if we apply a Taylor series expansion to the original CES function by expanding log Y around $\rho = 0$. This generates an estimating equation of the form;

$$\log Y_i = \log \gamma + \upsilon\delta \log K_i + \upsilon(1-\delta)\log L_i - 1/2\rho\upsilon\delta(1-\upsilon)[\log K_i - \log L_i]^2 + \varepsilon_i, \tag{5}$$

From this equation it can be seen that the first part relates to the Cobb-Douglas function and the second part allows for ρ to be non-zero. This second part can be ignored if $\rho = 0$ in which case we can reject the CES function in favour of the Cobb-Douglas function.

From Equation (5) an unrestricted linear form can be derived which can be estimated by OLS. The actual equation to be estimated is thus;

$$\log Y_i = \beta_1 + \beta_2 \log K_i + \beta_3 \log L_i + \beta_4 [\log K_i - \log L_i]^2 + \varepsilon_i, \tag{6}$$

Here if the estimate of β_4 is not found to be significant (i.e. $\beta_4 = 0$) once again we can reject the CES specification in favour of Cobb-Douglas.

TABLE II
Cobb-Douglas and CES estimates for value added

Cobb-Douglas		CES	
Dependent variable	Value added	Dependent variable	Value added
Parameter	Coefficient (*T* stat)	Parameter	Coefficient (*T* stat)
A (constant)	9.44 (73.15)	γ	9.55 (59.79)
α (capital)	0.14 (4.55)	υ	–0.98 (–25.30)
β (labour)	1.95 (21.54)	ρ	–0.12 (–0.87)
		δ	0.09 (1.83)
F stat	497.07	*F* stat	215.79

* The figures in parentheses are *T*-statistics.

To establish the validity of the finding that we cannot reject the possibility that $\rho = 0$, which is central to our choice of functional form, further regressions were estimated using Equation (6). They were estimated using value added as previously. The results of the unrestricted linear form derived in Equation (6) are presented below.

Thus the final coefficient, which corresponds to β_4 in Equation (6) and the final group of terms in Equation (5) was not found to be significantly different from zero at the 5% level of significance.

The OLS estimates of the β parameters obtained from estimating Equation (6) can then be used to calculate the parameters of Equation (5). The calculations are shown below;

$$\text{Value added} \quad \delta = \frac{\beta_2}{\beta_2 + \beta_3} \quad 0.02/2.10 = 0.01$$

which implies that the distributional shares between capital and labour for value added is 0.01 for capital and 0.99 for labour.

The returns to scale parameter, υ, can be calculated thus;

$$\text{Value added} \quad \upsilon = \beta_2 + \beta_3 \quad \upsilon = 2.10$$

TABLE III
Unrestricted OLS estimates of Equation 6

Output measure	Value added
Constant	9.66 (54.80)
log *K*	0.02 (0.21)
log *L*	2.08 (17.59)
$(\log K - \log L)^2$	0.02 (1.78)
F stat	320.85

which implies strongly increasing returns to scale. In Nickell et al.'s estimation, for example, the equivalent coefficients for value added are 0.062 and 0.52 for labour and capital respectively.

The substitution parameter, ρ, can be calculated thus;

$$\rho = \frac{-2\beta_4(\beta_2 + \beta_3)}{\beta_2\beta_3}$$

In this case, where ρ was found not to be statistically different from zero, the marginal rate of substitution which is calculated as $1/(1 - \rho)$ is exactly equal to 1. If we allow for ρ to be non-zero (at the 10% level) then the marginal rate of substitution is calculated as 1/1.04 = 0.96 in the value added case.

IV. Results

Having established the appropriate functional form for our estimation, we now turn our focus of attention to the task at hand, that of quantifying the effects of corporate governance on the firm. We present the results of a series of augmented production functions that allow for differences in the relative contributions of labour types, alternative governance structures and importantly the entrepreneur. We proceed using a Cobb-Douglas functional form and begin with a base line two-factor equation which serves as a reference point for our subsequent augmented production functions. The methodology we adopt across all equations is a robust regression procedure. This provides a means of eliminating heteroscedasticity in our estimation by performing an initial

screening to eliminate gross outliers prior to calculating starting values, and subsequently performs Huber iterations and biweight iterations. The full regressions are reported in Table V in the appendix. We denote the normal and managerial labour inputs by subscripts N and L respectively.

We begin by estimating the most basic form of production function using a two variable, capital and labour, approach with value added as our dependent variable. The reported estimates for Equation (1), which uses total employment as the labour input measure, shows that the elasticity of output with respect to labour is very much higher than that for capital. The labour coefficient of 1.95 implies that firms are more likely to face labour constraints than capital constraints. The sum of the coefficients, α and β, on labour and capital are clearly in excess of unity, which implies substantial and increasing returns to scale. One interpretation is that many firms in the sample need to grow in order to reach an equilibrium size at which all available economies of scale are exhausted. In theory at least we can assume that many firms may be operating below the minimum efficient scale of production.

In Equation (2) we substitute our total employment measure of labour input for a non-managerial labour input. This we call "normal" labour. The intuition being that we can then seek to identify and draw out how the various different types of labour contribute to the output of firms. This is a particularly important avenue of investigation in a smaller firm context given the substantial likelihood that they will be operating with an incomplete management team. Distinguishing between labour types also allows us to shed more light on the relative returns to increasing the number of workers and/or managers.

From Equation (2) we note that substantial, increasing returns to scale are still achievable, although the sum of the capital and labour coefficients declines from 2.09 in Equation (1) to 1.64 here. In Equation (3) we include all labour inputs but distinguish between normal and managerial labour. An important feature of the data is that the coefficient on capital remains the same as in our base equation. The combined labour coefficients are in the region of 0.3 higher.

The key result, given our earlier evidence relating to incomplete management teams, is that the elasticity of output with respect to managerial labour is only marginally less than that for normal labour (1.04 to 1.22 respectively). This suggests that many of these firms could expand employment of all types of worker and gain from substantial returns to scale. It also implies that efficiency could be increased by better organising the existing, normal, workforce.

If we allow for industry effects (Equation (4)), in the vast majority of sectors there are identifiable and significant effects. In terms of magnitude, non-metals manufacture, other manufacturing and transport & communications all have relatively large, and positive effects compared to our base category of other services. By contrast in agriculture we observe a large and negative industry effect. On balance the evidence strongly suggests that industry does have an important role to play in determining the production relationship in smaller firms.

We now turn our attention to the role of the founding entrepreneur. We begin by explicitly questioning whether the individual who began with a kernel of an idea, and actually made it reality and stuck with the firm through its early life-cycle stages has any significant part to play in the productive process. This is of crucial importance for Reid and others who view the entrepreneur as the ultimate scarce resource. In the words of Reid (1993, p. 66) she is "the fixed factor that cannot be made variable, even in the long-run, and it is this which ultimately gives rise to decreasing returns".

In fact the results (Equation (5)) show that founding entrepreneurs have a positive and significant role to play in the production process. This result, although in terms of magnitude is less important than industry effects, is evidence that founding entrepreneurs do matter. This contrasts with mainstream economics that has excluded the entrepreneur from the theoretical development of production functions. It also suggests that the relative strengths of entrepreneurs in their dual roles as outward looking opportunists and firm organisers are not so clearly biased in favour of the opportunistic role as many small business writers would have us believe. Implicitly our results suggest that a transfer of ownership away

from the founding entrepreneur has the effect of depressing output, holding all else constant.

Next we consider whether widening share ownership and expanding board size have any material input to the firm which manifests itself in either increased output and/or efficiency. Although those more familiar with the large firm literature might consider this a strange proposition to test, the fact remains that in smaller, independently owned firms the dispersion of share ownership is low and highly concentrated in family groupings. Further, boards of directors are also small and tend to hold a huge majority of total shares. The low incidence of non-executives, outsiders, is a particularly interesting feature of even relatively large small firms. Here we implicitly question whether there are gains from opening up ownership and control to outsiders which can be captured through the measurement of production. Were this found to be the case then this would offer at least a modicum of support for the more traditional models of firm growth and the increasing dispersion of ownership and control.

In fact the results show that shareholding dispersion does not affect production in a significant and identifiable manner (Equation (6)). However, board size does act in a significant and positive manner on output (Equation (7)). In fact the coefficient on board size is more substantial than that for managers. Further, the addition of an outsider in the form of a non-executive director on the board also was found to increase output (Equation (8)). Interestingly, the non-executive effect is of equal magnitude to the entrepreneurial effect.

Thus we have identified a set of interesting results concerning the linkage between corporate governance and production in smaller firms. What sets our results clearly apart from the large firm literature is that all levels of individual within the firm, from the founding entrepreneur, through the board of directors and the management team right down to the normal worker, play a key role in the productive process. Turning the results around, we also note that many of our firms would gain, often substantially, from increasing board size, hiring more managers and normal workers and also by inviting outsiders onto their boards.

We now consider, in the light of our results, how firms might compensate for the loss of the founding entrepreneur. This is of critical importance to many small firms who struggle to successfully transfer control away from the founder. From Equation (8), our most inclusive model, we can calculate how firms might adjust their governance structures to maintain output at existing levels if the founder goes. Thus our basic question is by how much could the management team or board of directors be expanded to approximate this loss of the founder?

For the average firm in our sample there appear to be three alternatives. Firstly, the management team could be expanded from four to six. Secondly, the board could effectively double in size from three to six directors. Thirdly, the board could enlist the support of a non-executive director (NED). Clearly there are a number of intermediate combinations which might equally compensate for this loss. For example, one additional manager and one addition to the board. What is clear is that the founding entrepreneur is indeed a unique individual whose unique arrangement of skills is not easily replicated by more functional personnel.

An issue for us is the distributional shares between capital and labour. Here the relative share of the total product accruing to capital and labour is derived. This is even more important given that we have separated out our labour function to include normal labour, managerial labour, and the contribution of the board of directors (remember number of shareholders was not significant). The implied distributional shares are presented in Table IV below. The reported shares for each input can be interpreted as the partial elasticity of output with respect to each input.

Several interesting features of the data are apparent. Firstly, the share of capital is relatively small but only diminishes marginally as we augment the basic production function to take account of other labour components that may influence the smaller firm. This feature is also apparent for normal labour, which only decreases with the addition of the board of directors. Where the most significant distributional shifts occur is between the management team and the board of directors. Here we find that managers have a relatively high and constant distributional share prior to the inclusion of the board of directors.

TABLE IV
Distributional shares for capital and type of labour

Equation	(3)	(4)	(5)	(6)	(7)	(8)
Capital	0.06	0.05	0.05	0.05	0.03	0.04
N Labour	0.51	0.49	0.50	0.50	0.42	0.44
Managers	0.43	0.46	0.45	0.45	0.28	0.30
Board	n.a	n.a	n.a	na.	0.27	0.22
Added regressors	Base line	Industry dummies	Founder	Shareholders	Board	NED

However, once we allow for the board we find that the distributional shares for management declines substantially, to such an extent that it is nearly matched by that of the board. This confirms our earlier evidence concerning the crucial role that boards of directors can play in smaller firms. It also implies that the labour component of small firms is far more crucial to their efficiency than the capital component.

V. Conclusion

Our starting point was to argue that the entrepreneur is central to the organisation of production in smaller firms. We also hypothesised that it is the uniqueness of the founding entrepreneur which allows smaller firms to exhibit the degree of dynamism which is often lacking in larger firms, particularly those with widely distributed shareholdings and a divorce of ownership from effective control.

Our contention was also that the labour input in smaller firms is much more than that section of the workforce engaged in physical production. To us the board of directors and management team can have a critical input to the organisation of production in a very real and tangible way, not least by enhancing the stock of human capital available to the firm.

In terms of what our results show, there are a number of key results, most of which support our *a priori* expectations. Most importantly, we find a positive and significant entrepreneurial effect. However, this effect is dissipated as firms grow large. This is consistent with decreasing returns to entrepreneurship as firms expand beyond the (fixed) capabilities of the entrepreneur.

We also find evidence that governance does matter. For example, board size was found to increase productivity, as was the introduction of non-executive. The results show that all members of the firm, from the entrepreneur, to the board and management team, and all the way down to the production workers have a positive and crucial role to play. The only caveat is that a widening of share ownership was not found to be an important determinant of productivity. On balance, therefore, it is the labour component that is more important to productivity and efficiency than capital for this type of firm. This aspect has potentially important public policy implications.

On the nature of returns to scale, we note that, for the most part, firms face increasing returns to scale. The largest returns can be generated by increasing the size of the board, and by expanding the management team. This too has important implications for control averse entrepreneurs who are particularly reluctant to relinquish control over the firm and its strategic orientation.

Perhaps our most important finding is that the founding entrepreneur is indeed a unique individual whose input to the firm is not easily replicated by others. In particular her role is at its most crucial when firms are seeking to grow from the extremely small level at which most firms begin life, and many firms end life or remain at *ad infinitum*. These sorts of results cast an element of doubt on the relevance of "black box" theories of production which exclude the entrepreneurial input from the formal analysis of the firm.

Acknowledgements

The author would particularly like to thank Martin Conyon (Wharton), Gavin Reid (St. Andrews), Mark Casson (Reading), Dennis Leech (Warwick), Graham Beaver (Nottingham), Rob Watson (Glasgow) and David Storey (Warwick) for

TABLE V
Production function estimates: Dependent variable = log Value added

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
	β	*t*-stat	β	*t*-stat	β	*t*-stat	β	*t*-stat	β	*t*-stat	β	*t*-stat	β	*t*-stat	β	*t*-stat	β	*t*-stat
Constant	9044	73.51	10.09	70.04	9.92	67.41	10.10	50.36	9.99	48.25	10.00	47.09	9.86	46.97	10.30	25.13	10.21	25.68
K	0.14	4.55	0.18	5.25	0.15	4.46	0.012	3.76	0.13	4.02	0.13	3.67	0.11	3.21	0.11	3.15	0.11	3.26
L	1.95	21.54																
Normal *L*			1.47	17.73	1.22	12.87	1.24	14.20	1.25	14.35	1.27	14.27	1.29	15.04	1.25	14.12	1.25	14.00
Managerial *L*					1.04	4.90	1.14	5.88	1.13	5.85	1.14	5.77	0.85	4.18	0.92	4.38	0.93	4.41
Founder									0.15	1.99	0.14	1.76	0.19	2.47	0.19	2.43	0.19	2.46
Shareholders											0.007	0.13	–0.02	–0.42	–0.01	–0.13	–0.01	–0.09
Board Size													0.80	3.76	0.75	3.34	0.67	2.93
Board Shares															–0.22	–1.35	–0.19	1.16
Non-execs																	0.15	1.53
Industry	No		No		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
R^2	0.61		0.54		0.58		0.56		0.56		0.56		0.57		0.60		0.60	
F-stat	497.07		350.33		248.68		87.68		81.92		72.78		72.93		64.1		60.9	
N obs	415		390		390		390		390		376		376		366		366	

Notes: NL = production workers; ML = managers; Founder = entrepreneur; Shareholders = number of shareholders; Board size = number of directors; Board share = proportion of the total equity held by the board of directors; Non-exec = 1 if board contains a non-executive director; industry = 10 one digit SIC (1980) industry dummy variables.

extended comments on earlier drafts of this paper. In addition I would also like to thank seminar participants at the Centre for Small and Medium Sized Enterprises, Warwick Business School and a referee.

Note

[1] Note that only 30% of private firms in the UK are passed on to the next generation of the founders family, although of these some 87% retained a family CEO. Source: Westhead,P, Cowling, M (1998).

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