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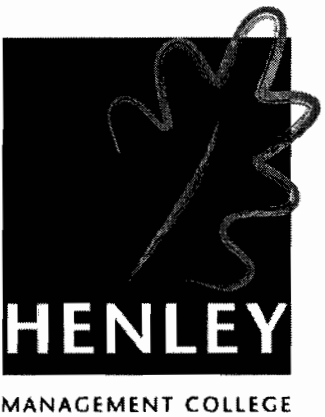

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Phillip Samouel is Professor of Business Economics at Kingston University, UK. His career has included successful endeavours in academia and the commercial world. His research interests focus on the Theory of the Firm and its inter-relationships with the business environment. Most recently he has been Dean of the Business Faculty.

Dr David Price, Director of Studies, Doctoral Programmes at Henley for Ten years was a Senior Scholar of Jesus College, Oxford. He was later a Research Fellow of the International Development Centre before being a Director of Studies at Newcastle University. Interests include innovation, research methodology and doctoral education.

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Dr Staffan Canbäck received his DBA from Henley Management College in 2002. He also holds an MBA from Harvard Business School and an MSc from the Royal Institute Technology. He is managing director of Canback Dangel LLC in Boston, and a former partner at McKinsey & Company and Monitor Company.

First Award

Bureaucratic Limits of Firm Size:

An Empirical Analysis Using Transaction Cost Economics

Staffan Canbäck

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Abstract:

The thesis tests Oliver Williamson's proposition that transaction cost economics can explain the limits of firm size. Williamson suggests that diseconomies of scale are manifested through four interrelated factors: atmospheric consequences due to specialisation, bureaucratic insularity, incentive limits of the employment relation and communication distortion due to bounded rationality. Furthermore, Williamson argues that diseconomies of scale are counteracted by economies of scale and can be moderated by adoption of the multidivisional organisation form and by high internal asset specificity. Combined, these influences tend to cancel out and thus there is not a strong, directly observable, relationship between a large firm's size and performance. A review of the relevant literature, including transaction cost economics, sociological studies of bureaucracy, information-processing perspectives on the firm, agency theory, and studies of incentives and motivation within firms, as well as empirical studies of trends in firm size and industry concentration, corroborates Williamson's theoretical framework and translates it into five hypotheses: (1) Bureaucratic failure, in the form of atmospheric consequences, bureaucratic insularity, incentive limits and communication distortion, increases with firm size; (2) Large firms exhibit economies of scale; (3) Diseconomies of scale from bureaucratic failure have a negative impact on firm performance; (4) Economies of scale increase the relative profitability of large firms over smaller firms; and (5) Diseconomies of scale are moderated by two transaction cost-related factors: organisation form and asset specificity.The hypotheses are tested by applying structural equation models to primary and secondary cross-sectional data from 784 large U.S. manufacturing firms. The statistical analyses confirm the hypotheses. Thus, diseconomies of scale influence the growth and profitability of firms negatively, while economies of scale and the moderating factors have positive influences. This implies that executives and directors of large firms should pay attention to bureaucratic failure. Managerial diseconomies of scale at the firm level is a topic seldom discussed and rarely studied. In fact, many observers doubt that diseconomies of scale exist. The purpose of the current research is to open up avenues of inquiry for this potentially important research topic.

Problem Definition

Diseconomies of scale are a neglected area of study. Observers from Knight ([1921] 1964) to Holmström and Tirole (1989) have pointed out that our understanding of bureaucratic failure is low. The neglect is to some extent due to a disbelief in the existence of diseconomies of scale (e.g., Florence 1933, 12; Bain 1968, 176). It is also due to a dearth of theoretical frameworks that can help inform our understanding of the nature of diseconomies of scale.

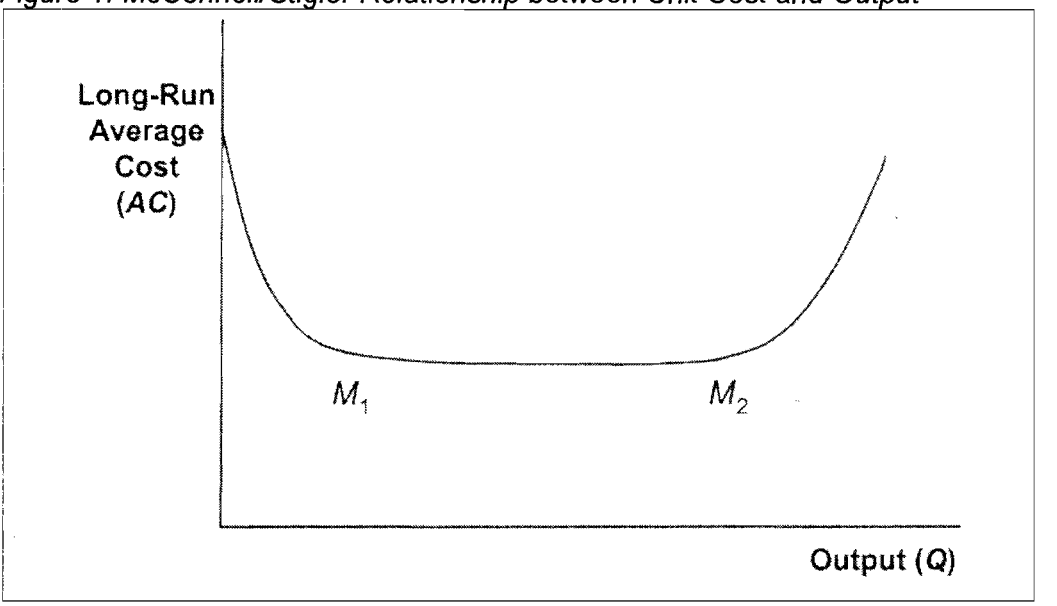
However, if diseconomies of scale did not exist, then we would presumably see much larger firms than we do today (Panzar 1989, 38). At the time of the research, no business organisation in the United States had more than one million employees or more than ten hierarchical levels. No firm has ever been able successfully to compete in multiple markets with a diverse product range for an extended period of time. Common sense tells us that there are limits to firm size. Common sense does not, however, prove the point. Unfortunately, scientific inquiry has not yet focused on finding such proof.

Cost curves are used in neoclassical theory to illustrate economies and diseconomies of scale . McConnell 's quantification (1945, 6) and Stigler 's illustration (1958, 59), reproduced in Figure 1, are typical.

If the curve above is correct, it is still unclear why the cost curve bends upwards at but empirical evidence suggests it does. The concentration in the U.S. manufacturing sector has changed little or has declined over much of the last century (e.g., Nutter 1951, Bain 1968, Mueller and Hamm 1974 and Scherer and Ross 1990). The size of large manufacturing firms has kept pace with the overall growth of the manufacturing part of the economy since the 1960s in value-added terms, but has declined in employment terms since 1979 and has declined relative to the total U.S. corporate sector and the global corporate sector (e.g., Bain 1968, Allen 1976, Adelman 1978, Bock 1978, Scherer and Ross 1990, Sutton 1990, Farrell 1998). This empirical evidence supports the notion that the cost curve bends upwards at some point.

Limits-of-firm-size is, nevertheless, not a major field of study. Given the relative slowdown in the growth of large firms over the last 30 years, understanding why market-based transactions are slowly winning over internally-based transactions matters more than ever.

Figure 1. McConnell/Stigler Relationship between Unit Cost and Output



Literature Review

Williamson (1975, 126-130) found that the limits of firm size are bureaucratic in origin and can be explained by transaction cost economics. He identified four main categories of diseconomies of scale:

Atmospheric consequences: According to Williamson (1975, 128-129), as firms expand there will be increased specialisation, but also less commitment on the part of employees. In such firms, the employees often have a hard time understanding the purpose of corporate activities, as well as the small contribution each of them makes to the whole. Thus, alienation is more likely to occur in large firms.

Bureaucratic insularity: Williamson (1975) argued that as firms increase in size, senior managers are less accountable to the lower ranks of the organisation (p. 127) and to shareholders (p. 142). They thus become insulated from reality and will, given opportunism, strive to maximise their personal benefits rather than overall corporate performance. According to Williamson, this problem is most acute in organisations with well-established procedures and rules and in which management is well-entrenched. As a consequence, large firms tend towards organisational slack.

Incentive limits of the employment relation: Williamson (1975, 129-130) argued that the structure of incentives large firms offer employees is limited by a number of factors. First, large bonus payments may threaten senior managers. Second, performance-related bonuses may encourage less-than-optimal employee behaviour in large firms. Therefore, large firms tend to base incentives on tenure and position rather than on merit. Such limitations may especially affect executive positions and product development functions, putting large firms at a disadvantage when compared with smaller enterprises in which employees are often given a direct stake in the success of the firm through bonuses, share participation, and stock options.

Communication distortion due to bounded rationality: Because a single manager has cognitive limits and cannot understand every aspect of a complex organisation, it is impossible to expand a firm without adding hierarchical layers. Information passed between layers inevitably becomes distorted. This reduces the ability of high-level executives to make decisions based on facts and negatively impacts their ability to strategise and respond directly to the market. Williamson (1967) found that even under static conditions there is a loss of control.

The nature of these diseconomies of scale is supported by the theoretical and empirical economics and sociology literature. Table 1 summarises the authorities (which are fully discussed in Chapter 3 of the complete thesis).

While the four categories relating to diseconomies of scale theoretically impose size limits on firms, three factors tend to offset diseconomies of scale: economies of scale, organisation form and degree of integration. All are central to transaction cost economics, and in order to test the validity of the diseconomies-of-scale argument, it is necessary to account for these factors.

Economies of scale: Transaction cost economics does not usually deal with economies of scale, which are more often associated with neoclassical production costs. However, Riordan and Williamson (1985) made an explicit attempt to reconcile neoclassical theory and transaction cost economics and showed, among other things, that economies of scale are evident in both production costs (p. 371) and transaction costs (p. 373), and that both can be kept internal to a firm if the asset specificity is positive. That is, economies of scale can be reaped by the individual firm and are not necessarily available to all participants in a market (pp. 367-369). This is at odds with much of the literature.

Table 1. Sources of Limits of Firm Size

Communication Distortion	Bureaucratic Insularity	Atmospheric Consequences	Incentive Limits
Arrow (1974): Specialisation leads to poor communication	Blau and Meyer (1987): Excessive rigidity	Arrow (1974): Rigidity to change	Axtell (1999) : Free-rider problem
Arrow (1983): Information loss in R&D	Brock (1987): Risk aversion	Blau and Meyer (1987): Excessive rigidity	Blau and Meyer (1987): Excessive rigidity
Barnard ([1938] 1968): Communication losses	Carroll and Hannan (2000): Firm age leads to insularity	Brown, Hamilton and Medoff (1990): Unexplained wage differential	Cooper (1964): R&D incentives
Cooper (1964): R&D coordination	Child (1973): Insularity	Child (1973): Insularity	Crozier (1964): Rigidity
Geanakoplos and Milgrom (1991): Information signal delays	Crozier (1964): Rigidity	Cooper (1964): R&D cost control	Olson (1982) : Absence of selective incentives
McAfee and McMillan (1995): Lower efficiency	Jensen (1986): Firms larger than optimum	Crozier (1964): Alienation	Peters (1992): Low productivity in R&D
Mookherjee and Reichelstein (2001): No control loss under certain restrictive conditions	Merton (1957): Rigidity	Kwoka (1980): Low job satisfaction in large firms	Rasmusen and Zenger (1990): Employment contracts
Simon ([1947] 1976): Processing bottlenecks	Monsen and Downs (1965): Different owner/manager objectives	Merton (1957): Rigidity	Schmookler (1972): Quality of R&D employees
	Olson (1982): Rigidity	Pugh et al. (1969): Insularity from reality	Silver and Auster (1969): Limits to entrepreneurship
	Pondy (1969): Increase in administration	Qian (1994): Monitoring costs/inadequate effort levels	Zenger (1989, 1994): Employment contract disincentives in R&D
	Pugh et al. (1969): Insularity from reality	Scherer (1976): Low job satisfaction in large firms	Williamson (1996): Weaker incentives in bureaucracies
	Schmookler (1972): Understanding market needs in R&D	Schmookler (1972): R&D cost consciousness; Climate for innovation	
	Stinchcombe (1965): Perpetuation of organisation form	Schumacher (1989): Low motivation	
	Williamson (1996): Bureaucratic rigidity		

Organisation form: Williamson (1975, 117) recognised that diseconomies of scale can be reduced by organising appropriately. Based on Chandler 's pioneering work (e.g., 1962) on the evolution of the American corporation, Williamson argued that the M-form organisation lowers internal transaction costs compared to the U-form organisation . It does so for a key reason: The M-form allows most senior executives to focus on high-level issues rather than day-to-day operational details, making the whole greater than the sum of its parts (p. 137). Thus, large firms organised according to the M-form should perform better than similar U-form firms.

Asset specificity: Williamson showed that asset specificity is the most important determinant of degree of integration (e.g., Riordan and Williamson 1985, 366). Asset specificity influences integration from a geographic reach, product breadth, and vertical depth point of view.

Geographic reach: Teece (1976) showed that multinational firms only exist because the combination of asset specificity and opportunism leads to moral hazard, which is difficult to contain in market transactions. Without, for example, human asset specificity, a firm could just as easily license its technology to a firm in another country, reaping the benefits of development. Tsokhas (1986) illustrated this in a case study of the Australian mining industry. Other studies have shown that market diversity reduces profitability (e.g., Bane and Neubauer 1981).

Product breadth: A number of studies of product breadth show that asset specificity plays a major role in explaining the success and failure of diversification. Rumelt (1974) found a strong correlation between profitability and human asset specificity—in this case the degree to which a firm draws on common core skills or resources (pp. 121-127).

Vertical depth: Asset specificity has repeatedly been shown to be the primary determinant of vertical integration . A number of empirical studies confirm this (e.g., Masten 1984; Masten, Meehan and Snyder 1989, 1991; Monteverde and Teece 1982; Joskow 1993; Klier 1993; Krickx 1988).

Again, the literature supports Williamson's theoretical argument, except for the reasoning regarding economies of scale (where the literature is inconclusive). Table 2 summarises the authorities (which are fully discussed in Chapter 3 of the complete thesis).

Table 2. Potential Moderators of Diseconomies of Scale

Economies of Scale	M-Form Organisation	Asset Specificity
Adams and Brock (1986), Peters (1992): Myth of economies of scale	Armour and Teece (1978): M-form increases ROE	Bane and Neubauer (1981): Market diversity reduces profitability
Bain (1968), Scherer and Ross (1990): Economies of scale exhausted at moderate firm size	Chandler (e.g., 1962), Chandler and Daems (1980): M-form alleviates coordination and control problems	Coase (1993c): No distinction between vertical and lateral integration
Masten (1982), North and Wallis (1994): Economies of scale not proprietary to individual firms	Fligstein (1985): Multi-product coordination favours M-form	Grossman and Hart (1986), Teece (e.g., 1976): TCE applies to lateral integration
Ijiri and Simon (1964), Lucas (1978), Nelson and Winter (1982), Rumelt and Wensley (1981), Simon and Bonini (1958): Stochastic growth processes, not economies of scale, explain firm size-distribution	Peters (1992): Decentralisation is critical to firm performance	Mahoney (1992), Holmström and Roberts (1998): Uncertainty and frequency not important
	Teece (1981): M-form firms are significantly better performers than U-form firms	Masten (1984), Masten et al. (1989, 1991), Monteverde and Teece (1982), Joskow (1993), Klier (1993), Krickx (1988): Asset specificity more important than uncertainty and frequency
		Rumelt (1974): Product diversity reduces asset specificity
		Teece (1976), Tsokhas (1986): Asset specificity influences geographic reach
		Walker and Weber (1984, 1987): Volume uncertainty is weak factor

Theoretical Framework and Research Hypotheses

The literature review discussed the theoretical and empirical studies that inform the current research. The findings are now translated into five hypotheses :

H1: Bureaucratic failure, in the form of atmospheric consequences, bureaucratic insularity, incentive limits and communication distortion, increases with firm size

H2: Large firms exhibit economies of scale

H3: Diseconomies of scale from bureaucratic failure have a negative impact on firm performance

H3a: Atmospheric consequences have a negative impact on the performance of large firms

H3b: Bureaucratic insularity has a negative impact on the performance of large firms

H3c: Incentive limits have a negative impact on the performance of large firms

H3d: Communication distortion has a negative impact on the performance of large firms

H4: Economies of scale increase the relative profitability of large firms over smaller firms

H5: Diseconomies of scale are moderated by two transaction cost-related factors: organisation form and asset specificity

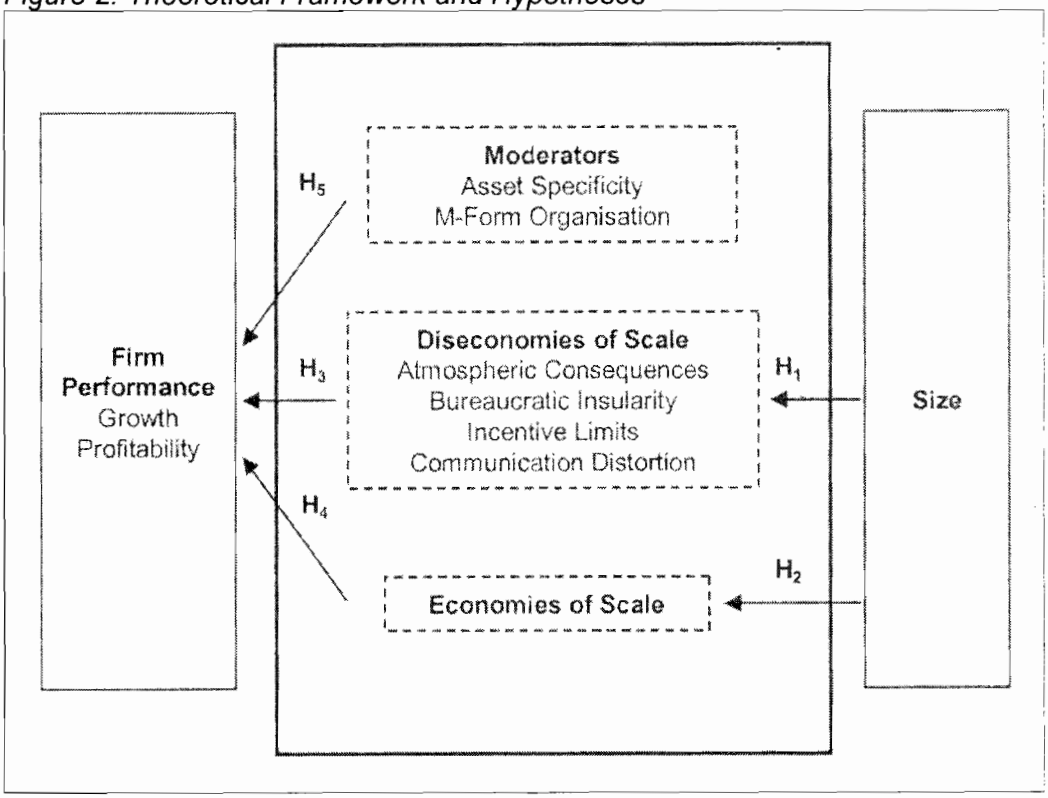
H5a: Large M-form firms perform better than large U-form firms

H5b: High internal asset specificity affects a firm's performance positively

Figure 2 summarises the hypotheses graphically in a theoretical framework. The expectation is that as the overall relationship between firm performance and size is deconstructed, insights into the true nature of managerial diseconomies of scale will be gained.

The question remains: are the hypothesised effects large enough materially to influence the performance of a large firm? Only an empirical analysis, in which the framework and hypotheses are operationalised, will answer this. The next two sections focus on this operationalisation and analysis.

Figure 2. Theoretical Framework and Hypotheses



Methodology

The research uses a positivist approach emphasising universal understanding in Runkel and McGrath 's terms (1972, 81-89). There are no studies of this general type on the particular issue of diseconomies of scale. However, generalised studies on, for example, the profit impact of an M-form organisation or the link between size, structure and complexity are widely quoted in the literature (e.g., Rumelt 1974; Ramanujam and Varadarajan 1989).

Among different multivariate techniques, structural equation modelling (SEM) was picked based on Hair et al. 's classification scheme for choosing among techniques (1998, 20-21) and a review of the pertinent literature on SEM (Bollen 1989, 1-9; Kelloway 1998, 2-3; Maruyama 1998, 20-24). SEM is the most appropriate technique when multiple relationships between dependent and independent variables are studied. Moreover, SEM is well suited for confirmatory analysis and allows for efficient hypothesis testing, especially of complex models. Finally, SEM allows for the use of latent, unobserved variables.

The analyses were cross-sectional. Data were collected for publicly traded manufacturing firms (SIC codes 10-39) with headquarters in the U.S. and with sales of more than $500 million. 1998 was the benchmark year. Primary and secondary data were derived from several sources, including company organisation charts, official filings such as 10-Ks and proxy statements, annual reports, biographies of executives, historical company documents, corporate web sites, articles in Business Week and Fortune, corporate, Compustat and academic research. Table 3 describes the most important variables used in the analyses.

The data was screened extensively for missing values, non-normality, non-linearity, heteroscedasticity, etc. Despite issues such as many missing values, non-normality of certain variables and some heteroscedasticity, the data was deemed more than sufficiently robust for the structural equation models.

Table 3. Overview of Variables Used in the Analyses

Name	Description	Metric	Sources	No. of Obs.	Trans-formation	K-S z
Employees	No. of employees	'000	Compustat	784	atan	1.28
Atmospheric Consequences	Unit labour cost defined as labour cost / employees	$'000	Compustat	146	sqrt	0.59
Leadership Tenure	Average years of employment with firm for officers	Years	10-Ks, proxy statements. annual reports, corporate web sites, executive biographies	163	none	0.85
Company Age	Years since founding of company	Years	10-Ks, proxy statements. annual reports, corporate web sites, historical sources	638	none	2.25
Incentive Limits	Research and development expense / Sales	%	Compustat	489	ln	0.76
Communication Distortion	No. of hierarchical levels	#	Annual reports, corporate web sites, 10-Ks, company organisation charts	386	ln	0.71
Economies of Scale	Defined as (fixed cost)^2 / sales	$M	Compustat	752	ln	0.82
Geographic Reach	% of sales derived outside the United States	%	Compustat, annual reports, 10-Ks	663	ln	3.37
Product Breadth	Defined as the diversification ratio (1 - Rumelt's specialisation ratio)	%	Compustat, annual reports, 10-Ks, corporate web sites	670	ln	5.24
Vertical Depth	2 = Very high; 1 = High; 0 = Average or low	Ordinal	10-Ks, annual reports, corporate web sites, Compustat	675	not meaningful	

Governance	Qualitative rankings	Index	Business Week, IRRC, Fortune	229	inv	0.64
Divisionalisation	2 = Divisionalised; 1 = Hybrid; 0 = Unitary	Ordinal	10-Ks, proxy statements, annual reports, corporate web sites	375	not meaningful	
Growth	5-year compound annual growth rate (1993-1998)	%	Compustat	756	atan	0.84
Profitability	Economic value added defined as return on equity less cost of equity	%	Compustat, Ibbotsen Associates (1999)	781	atan	0.57

Note: K-S = Kolmogorov-Smirnov

Results

Figure 3 shows a path diagram for the most important statistical analysis (sub-model b) in the thesis (the complete thesis contains 21 path diagrams). This analysis tests hypotheses 3, 4 and 5 (sub-model a tests hypotheses 1 and 2) and depicts the delicate balance between factors that reduce the limits of firm size and those that increase the limits. A positive regression weight increases the limits and a negative regression weight reduces the limits. In general, the diseconomies of scale have a stronger negative influence on growth than on profitability, while the positive influence of economies of scale, M-form organisation and high internal asset specificity is larger on profitability than on growth.

Table 4 reports the coefficients and the statistical significance of the analysis. The regression coefficients are of the hypothesised sign (except for the non-significant Communication Distortion → Growth) and most coefficients are significant at the 5% or better level.

The findings in this, and other analyses not reported here, are robust for a number of reasons. The data were screened and tested extensively. They were found to be well-behaved in most respects. The path diagrams confirm well with the underlying theory. The indicators appear to reflect the unobserved phenomena fairly well. Finally, the results were similar when random sub-samples were used.

Figure 3. Complete Sub-Model b

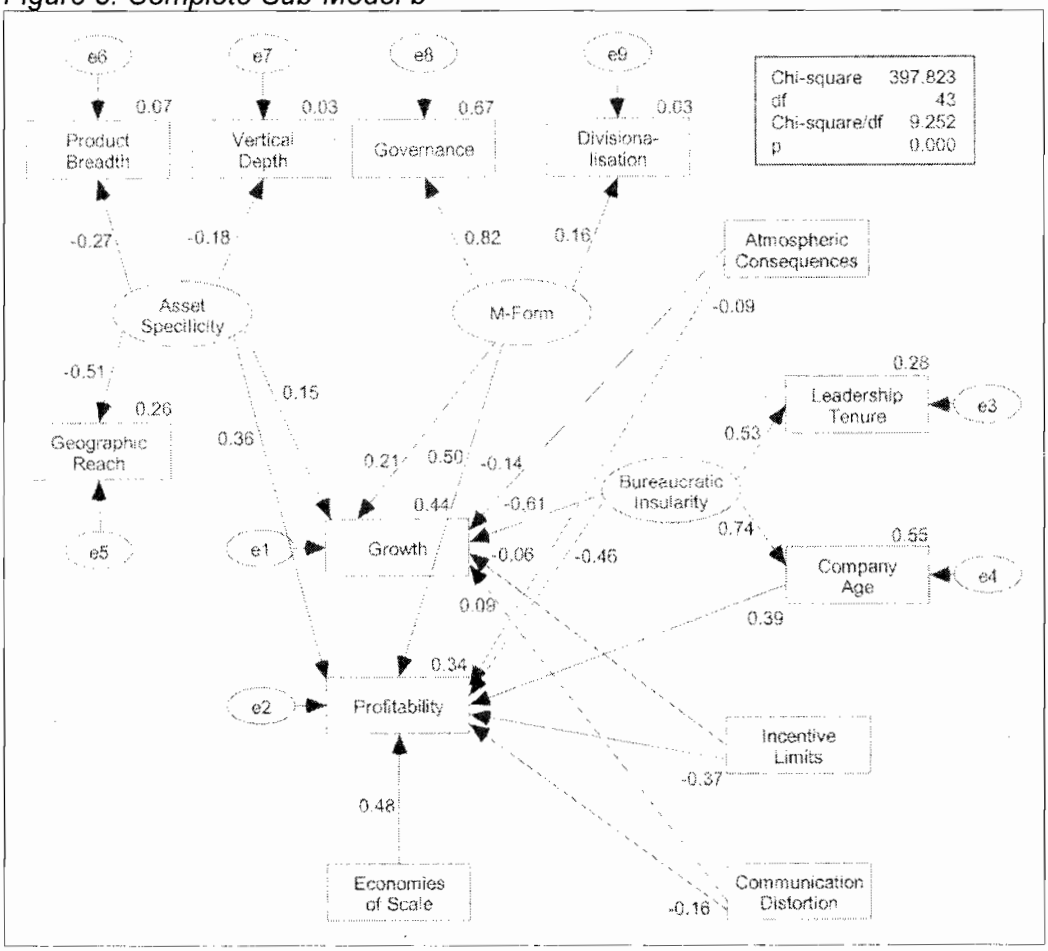


Table 4. Regression Weights for Complete Sub-Model b

	Std. Coeff.	Unstd. Coeff.	S.E.	C.R.
Atmospheric Consequences → Growth	-0.142	-0.057	0.041	-1.417***
Atmospheric Consequences → Profitability	-0.087	-0.049	0.066	-0.746***
Bureaucratic Insularity → Growth	-0.609	-0.120	0.036	-3.348***
Bureaucratic Insularity → Profitability	-0.465	-0.128	0.103	-1.244***
Bureaucratic Insularity → Leadership Tenure	0.531	0.263	0.050	5.244***
Bureaucratic Insularity → Company Age	0.740	1.000		
Company Age → Profitability	0.386	0.079	0.047	1.689†**
Incentive Limits → Growth	-0.059	-0.019	0.027	-0.706***
Incentive Limits → Profitability	-0.375	-0.170	0.063	-2.688***
Communication Distortion → Growth	0.092	0.333	0.312	1.067***
Communication Distortion → Profitability	-0.157	-0.793	0.833	-0.952***

Economies of Scale → Profitability	0.483	0.176	0.079	2.232***
Asset Specificity → Growth	0.149	1.000		
Asset Specificity → Profitability	0.365	3.431	2.213	1.550***
Asset Specificity → Geographic Reach	-0.507	-1.487	0.675	-2.201***
Asset Specificity → Product Breadth	-0.268	-0.880	0.421	-2.091***
Asset Specificity → Vertical Depth	-0.179	-1.510	0.806	-1.872†**
M-Form → Growth	0.213	0.168	0.117	1.427***
M-Form → Profitability	0.498	0.548	0.409	1.339***
M-Form → Governance	0.819	1.000		
M-Form ? Divisionalisation	0.163	0.270	0.169	1.596***
† p<10%, * p<5%, ** p<1%, *** p<0.1% (two-tailed)				

The practical significance of the statistical analyses is that both sub-model b (and sub-model a) validate Williamson's theoretical framework. Both the main analyses and the supporting analyses that tested particular aspects of the theory are in line with the theoretical predictions.

Table 5 summarises the literature findings and the full set of statistical analyses. All hypotheses (except H3d which was inconclusive) were confirmed at better than 5% significance and each statistical model had an overall fit which was acceptable or better. Combined with the findings from the literature, this implies that firms have to balance a number of countervailing forces to reach a performance optimum. For example, it is unlikely that geographic or product expansion alone will improve corporate performance. Only when the expansion is done in conjunction with other adjustments, aimed at reducing the diseconomies of scale or capturing the benefits of M-form organisation, is it likely that performance will improve.

Table 5. Summary of Findings

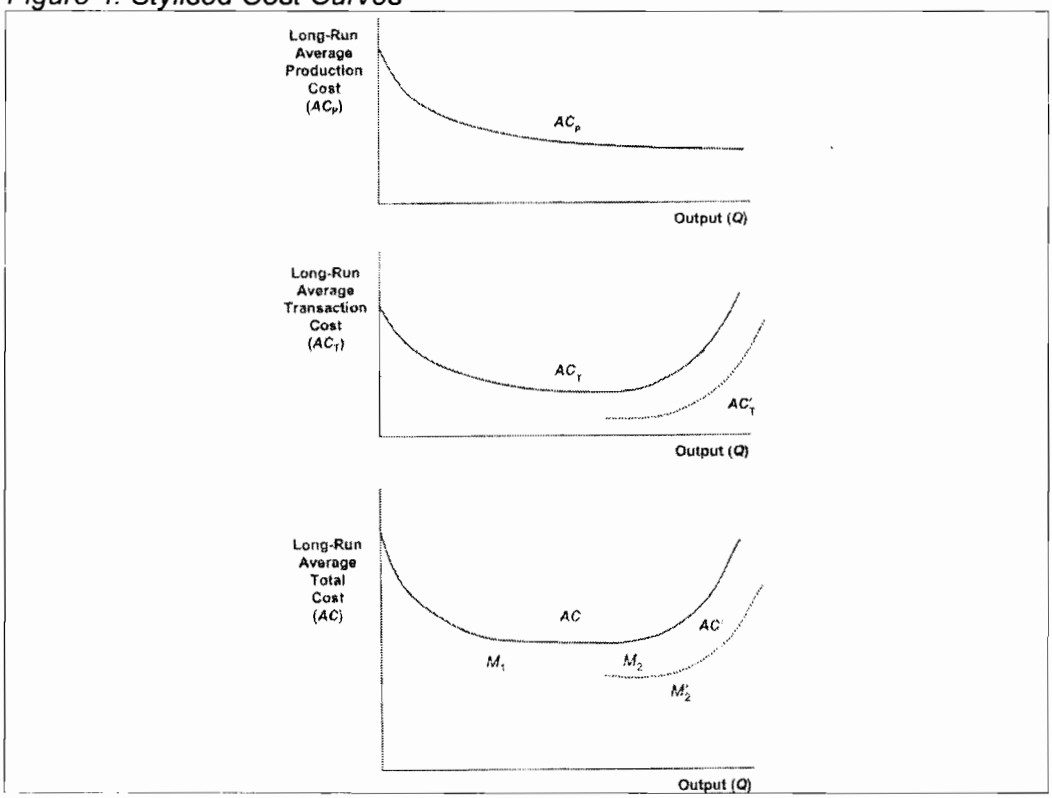
Hypothesis	Literature Finding	Statistical Finding	
		Result	**Significance**
H_1: Bureaucratic failure, in the form of atmospheric consequences, bureaucratic insularity, incentive limits and communication distortion, increases with firm size	Confirmed	Confirmed	p<1%
H_2: Large firms exhibit economies of scale	Confirmed	Confirmed	p<0.1%
H_3: Diseconomies of scale from bureaucratic failure have a negative impact on firm performance	Confirmed	Confirmed	see H_{3a} - H_{3d}
H_{3a}: Atmospheric consequences have a negative impact on the performance of large firms	Confirmed	Confirmed	p<10%
H_{3b}: Bureaucratic insularity has a negative impact on the performance of large firms	Confirmed	Confirmed	p<0.1%
H_{3c}: Incentive limits have a negative impact on the performance of large firms	Confirmed	Confirmed	p<0.1%
H_{3d}: Communication distortion has a negative impact on the performance of large firms	Confirmed	Inconclusive	p=21.2%

H_4: Economies of scale increase the relative profitability of large firms over smaller firms	Inconclusive	Confirmed	p<10%
H_5: Diseconomies of scale are moderated by two transaction cost-related factors: organisation form and asset specificity	Confirmed	Confirmed	see H_{5a} - H_{5b}
H_{5a}: Large M-form firms perform better than large U-form firms	Confirmed	Confirmed	p<10%
H_{5b}: High internal asset specificity affects a firm's performance positively	Confirmed	Confirmed	p<1%

Interpretation and Discussion

As was shown in Table 5, the theoretical framework is supported by both the literature and the statistical findings. It is now possible to interpret the findings by returning to the neoclassical cost curves . First, the cost curve shown in Figure 1 is modified to reflect the characteristics of diseconomies of scale, economies of scale and the moderating factors. Second, a similar curve is constructed for firm growth. Third, these two curves are combined to show the overall impact of these two factors on firm performance.

Figure 4. Stylised Cost Curves



Average cost. To begin with, the elongated U-shaped average total cost curve used in neoclassical theory can be split into two parts: the average production cost curve and the average transaction cost curve. The modified cost curves are depicted in a stylised fashion in Figure 4. The top graph shows a curve for average production cost consistent with the findings in the current research.

The middle graph in Figure 4 shows the average transaction cost curve. The middle graph also shows a shifted and slightly tilted average transaction cost curve. The curve reflects the positive contribution from the moderating factors and is supported by the literature and by the statistical analysis. This analysis indicates that the shift can be quite large. Finally, the bottom graph in Figure 4 shows the average total cost curve (AC), with a shifted curve for the moderators ($AC = AC_P + AC_T; AC' = AC_P + AC'_T$). The curve resembles the neoclassical curve in Figure 1.

Growth: The underlying logic of the cost curves can also be applied to firm growth. Figure 5 shows the same set of graphs as above for the relationship between firm growth and output. The top graph illustrates the relationship between growth and output, under the hypothetical assumption that firms only have neoclassical production costs. The middle graph in Figure 5 portrays the growth curve resulting from bureaucratic, transaction cost-based, failure.

The bottom graph in Figure 5 convolutes the production- and transaction-cost contributions to growth into overall growth (G). The graph shows that the growth capacity of firms is steadily declining as a function of output, but it can be moderated

Finally, it is instructive to combine the cost and growth curves to see how they jointly contribute to a firm's performance (Figure 6). Other factors also contribute to firm performance and the graph shows the partial contribution to performance. By convoluting the average total cost (AC) and growth (G) curves, the partial performance curve Y results.

Figure 5. Stylised Growth Curves

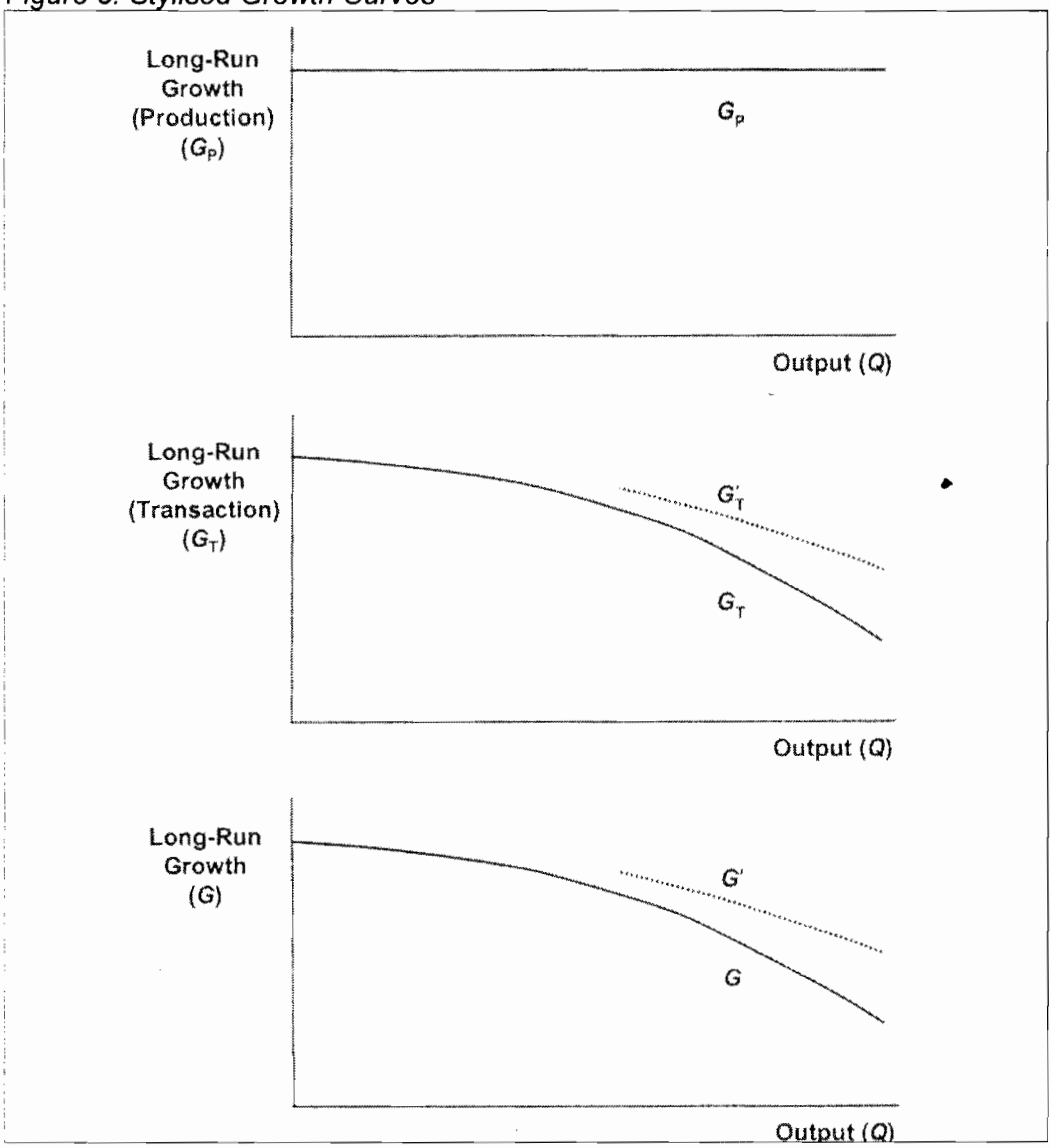
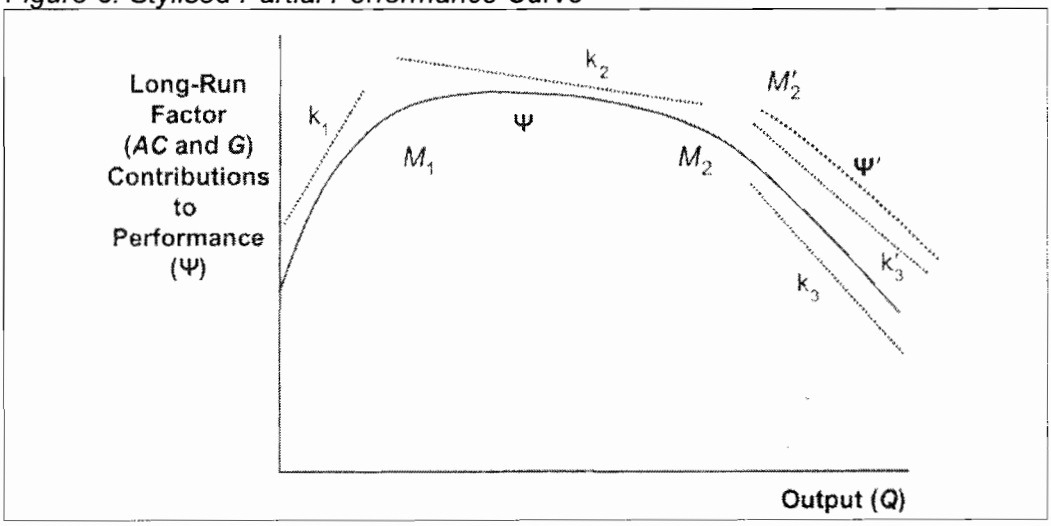


Figure 6. Stylised Partial Performance Curve



The set of curves discussed above agree well with neoclassical theory (e.g., Panzar 1989) and transaction cost economics (e.g., Williamson 1975), individually. The curves also agree with the joined perspectives on production and transaction costs expressed by, for example, Riordan and Williamson (1985) and Wallis and North (1986).

The conceptual curves depicted in Figures no xref 4 to 6 can also be used to show the shape of the data in the sample of 784 firms. This was done with three analyses which replicated the cost (AC), growth (G) and partial performance (Y) curves. Figures no xref 7 to 9 show the resulting graphs, which are surprisingly similar to the conceptual curves. It should be remembered though, that the scatterplots presented are somewhat simplistic. They use the sample data as is and no attempt was made to include control variables or to make other corrections.

First, Figure 7 reports the results for the cost curve (AC), which plots average total cost against output. A quadratic regression line has been added to show the underlying trend in the data. The data conforms well to the conceptual AC curve in Figure 4.

Second, growth data was plotted against output (Figure 8). Again, the curve has the predicted shape and the quadratic regression line is similar to the conceptual G curve in Figure 5. The plot points are quite scattered though, and firms seem to have considerable leeway to deviate from the growth rate prescribed by their size.

Figure 7. Cost Curve for Current Sample

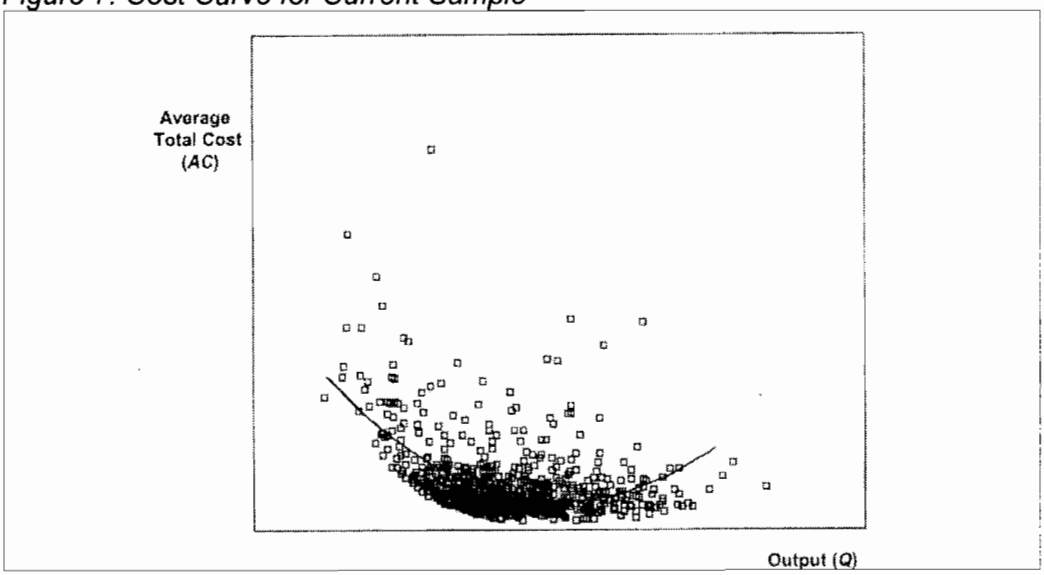
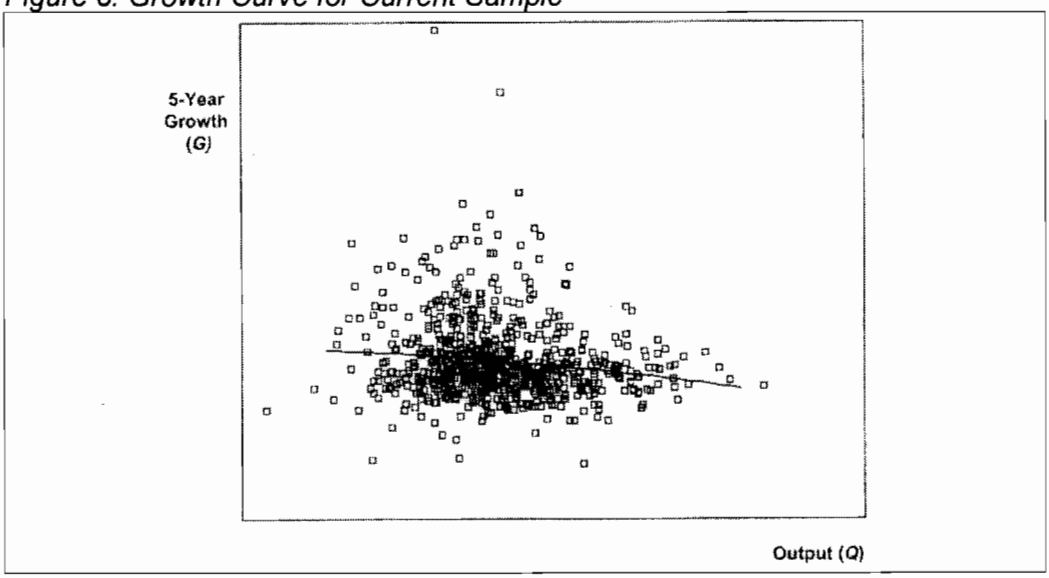
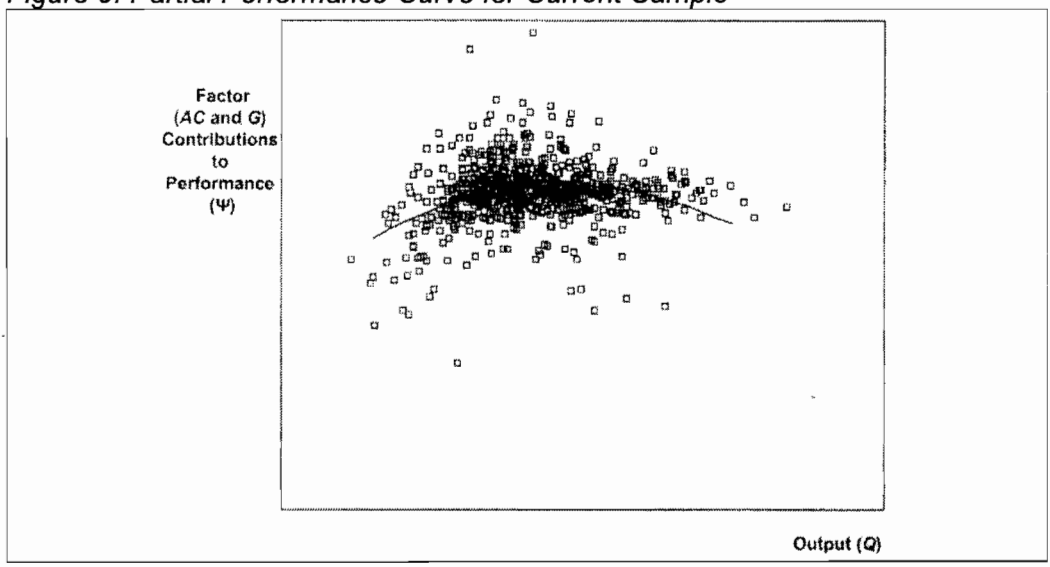


Figure 8. Growth Curve for Current Sample



Third, the joint contribution to firm performance by the two factors is shown in Figure 9. The performance curve (Y) is not unlike the conceptual curve shown in Figure 6. There is significant variation around the trend line, but overall the data conforms to the theoretical and empirical predictions.

Figure 9. Partial Performance Curve for Current Sample



Conclusion

There are a number of real-life implications of the research. First, strategy and structure appear to be intimately linked. Executives at large corporations have to grapple with real trade-offs when they consider expansion. Certain growth strategies are easier to execute than others, and the choice of organisation has major implications for which strategies make sense. Indeed, structure does not necessarily follow strategy; strategy and structure inform each other continuously and forever.

Second, much of the rationale for mergers and acquisitions seems to be weak, at best. Proponents of mergers typically argue that the resulting larger entity after a merger will realise economies of scale, benefiting customers and shareholders; in addition, they claim that growth will be accelerated through the introduction of new products and services that were previously too expensive to develop. But the analysis here shows that although some economies of scale may be realised, they are likely to be offset by diseconomies of scale. Furthermore, there is no evidence that larger, merged entities innovate more and grow faster. Instead, the opposite appears to be true: innovation and growth declines, on average.

Third, boards of directors may want to emphasise the importance of executive renewal and the elimination of rigid processes to stimulate growth. Maximising the

quality of governance, which is part of the board's fiduciary duties, appears to be an important lever for addressing these issues.

Fourth, firms that strive for high internal asset specificity appear to be better off than those that expand reach, breadth, or depth. This does not imply that single-product or single-geography strategies are optimal (because this reduces growth in the long run), but it does imply that any expansion strategy should strive for high asset specificity and that some firms are best off reducing their scope of activities.

Finally, in a world in which companies increasingly try to sell solutions rather than basic products and services, incentive limits have become real and problematic. In businesses that involve team selling or large product-development efforts, attention should be paid to creating well-functioning incentive schemes for employees. The superior productivity of research and development in small firms, in which incentives are tailored to individual performance, demonstrates why effective incentive schemes matter.

From a research perspective, the current work indicates a number of opportunities for further study. For example, the statistical analyses indicate yet another way to put Gibrat's law of proportional effects (1931, 74-81) into doubt. The dissertation also suggests four areas for further research. (1) Proving the existence of diseconomies of scale by studying a more narrowly defined problem such as focusing on an industry rather than a whole economic sector; (2) Expanding the analysis across geography and time; (3) Finding better ways to operationalise unobserved diseconomies of scale; and (4) Replicating the current research with better statistical approaches and a larger sample, with a particular eye towards industry effects.

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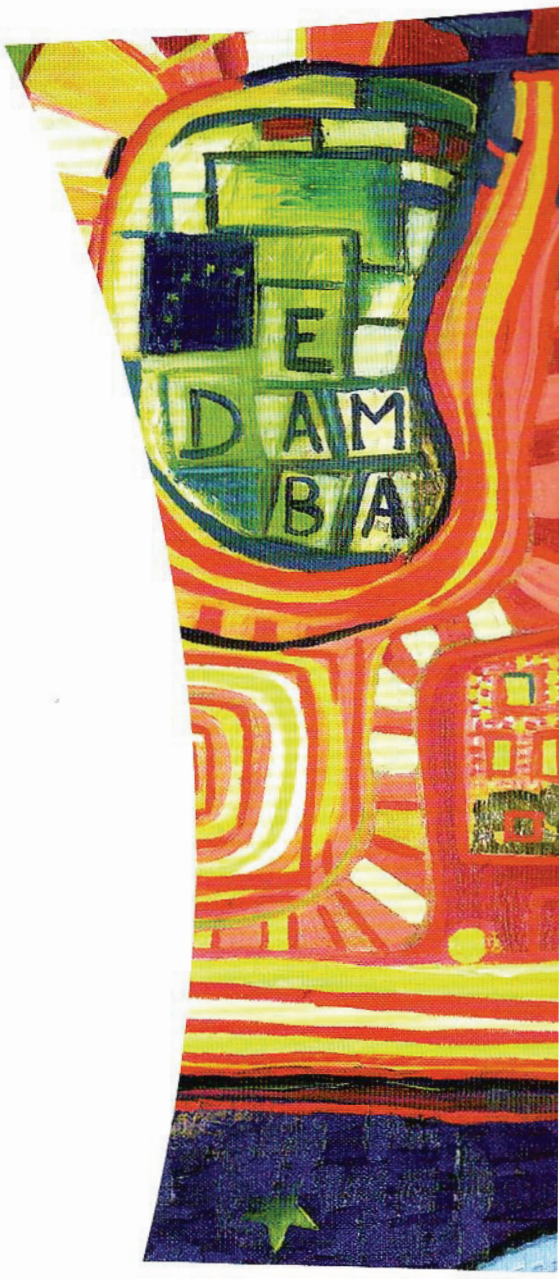

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BUREAUCRATIC LIMITS OF FIRM SIZE
Empirical Analysis Using Transaction Cost Economics

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Abstract

The thesis tests Oliver Williamson's proposition that transaction cost economics can explain the limits of firm size. Williamson suggests that diseconomies of scale are manifested through four interrelated factors: atmospheric consequences due to specialisation, bureaucratic insularity, incentive limits of the employment relation and communication distortion due to bounded rationality. Furthermore, Williamson argues that diseconomies of scale are counteracted by economies of scale and can be moderated by adoption of the multidivisional organisation form and by high internal asset specificity. Combined, these influences tend to cancel out and thus there is not a strong, directly observable, relationship between a large firm's size and performance. A review of the relevant literature, including transaction cost economics, sociological studies of bureaucracy, information-processing perspectives on the firm, agency theory, and studies of incentives and motivation within firms, as well as empirical studies of trends in firm size and industry concentration, corroborates Williamson's theoretical framework and translates it into five hypotheses: (1) Bureaucratic failure, in the form of atmospheric consequences, bureaucratic insularity, incentive limits and communication distortion, increases with firm size; (2) Large firms exhibit economies of scale; (3) Diseconomies of scale from bureaucratic failure have a negative impact on firm performance; (4) Economies of scale increase the relative profitability of large firms over smaller firms; and (5) Diseconomies of scale are moderated by two transaction cost-related factors: organisation form and asset specificity. The hypotheses are tested by applying structural equation models to primary and secondary cross-sectional data from 784 large US manufacturing firms. The statistical analyses confirm the hypotheses. Thus, diseconomies of scale influence the growth and profitability of firms negatively, while economies of scale and the moderating factors have positive influences. This implies that executives and directors of large firms should pay attention to bureaucratic failure.

Problem Definition

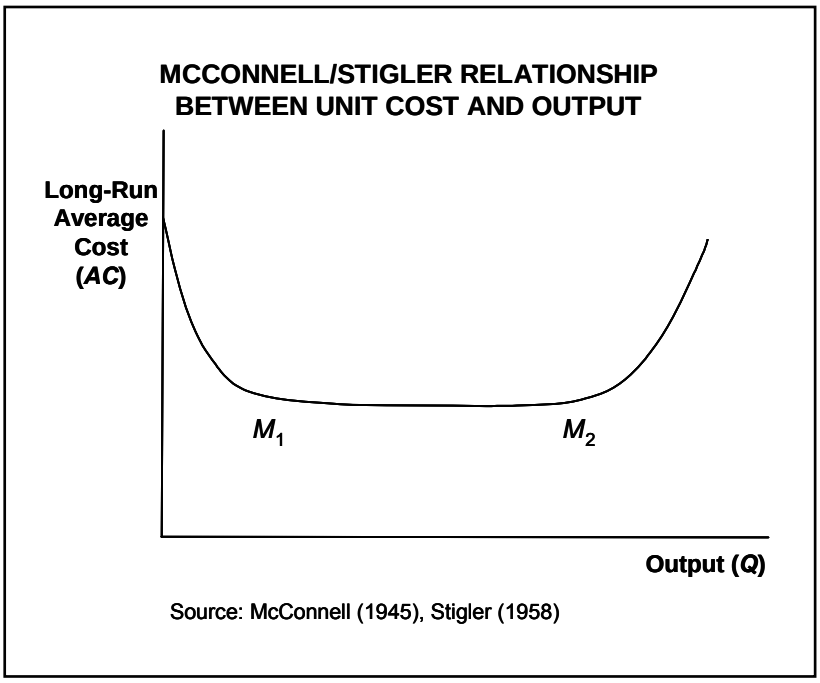
Diseconomies of scale are a neglected area of study. Observers from Knight ([1921] 1964) to Holmström and Tirole (1989) have pointed out that our understanding of bureaucratic failure is low. The neglect is to some extent due to a disbelief in the existence of diseconomies of scale (e.g., Florence 1933, 12; Bain 1968, 176). It is also due to a dearth of theoretical frameworks that can help inform our understanding of the nature of diseconomies of scale.

This is a summary of Dr Canbäck's doctoral thesis (2002), which can be downloaded at http://canback.com/henley.htm. The thesis won first prize in the EDAMBA (*European Doctoral Programmes Association in Management and Business Administration*) competition for best European doctoral thesis in 2002.

However, if diseconomies of scale did not exist, then we would presumably see much larger firms than we do today (Panzar 1989, 38). At the time of the research, no business organisation in the United States had more than one million employees or more than ten hierarchical levels. No firm has ever been able successfully to compete in multiple markets with a diverse product range for an extended period of time. Common sense tells us that there are limits to firm size. Common sense does not, however, prove the point. Unfortunately, scientific inquiry has not yet focused on finding such proof.

Cost curves are used in neoclassical theory to illustrate economies and diseconomies of scale (e.g., Marshall [1920] 1997, 278–292; Scherer and Ross 1990, 101). McConnell's quantification (1945, 6) and Stigler's illustration (1958, 59), reproduced in Figure 1, are typical.

Figure 1. McConnell/Stigler Relationship between Unit Cost and Output



If the curve above is correct, it is still unclear why the cost curve bends upwards at M_2, but empirical evidence suggests it does. The concentration in the US manufacturing sector has changed little or has declined over much of the last century (e.g., Nutter 1951; Bain 1968; Mueller and Hamm 1974; Scherer and Ross 1990). The size of large manufacturing firms has kept pace with the overall growth of the manufacturing part of the economy since the 1960s in value-added terms, but has declined in employment terms since 1979 and has declined relative to the total US corporate sector and the global corporate sector (e.g., Bain 1968; Allen 1976; Adelman 1978; Bock 1978; Scherer and Ross 1990; Sutton 1997; Farrell 1998) . This empirical evidence supports the notion that the cost curve bends upwards at some point.

Limits-of-firm-size is, nevertheless, not a major field of study (Coase 1993a, 228). Given the relative slowdown in the growth of large firms over the last 30 years, understanding why market-based transactions are slowly winning over internally-based transactions matters more than ever.

Literature Review

Williamson (1975, 126–130) found that the limits of firm size are bureaucratic in origin and can be explained by transaction cost economics. He identified four main categories of diseconomies of scale:

Atmospheric consequences: According to Williamson (1975, 128–129), as firms expand there will be increased specialisation, but also less commitment on the part of employees. In such firms, the employees often have a hard time understanding the purpose of corporate activities, as well as the small contribution each of them makes to the whole. Thus, alienation is more likely to occur in large firms.

Bureaucratic insularity: Williamson (1975) argued that as firms increase in size, senior managers are less accountable to the lower ranks of the organisation (p. 127) and to shareholders (p. 142). They thus become insulated from reality and will, given opportunism, strive to maximise their personal benefits rather than overall corporate performance. According to Williamson, this problem is most acute in organisations with well-established procedures and rules and in which management is well-entrenched. As a consequence, large firms tend towards organisational slack.

Incentive limits of the employment relation: Williamson (1975, 129–130) argued that the structure of incentives large firms offer employees is limited by a number of factors. First, large bonus payments may threaten senior managers. Second, performance-related bonuses may encourage less-than-optimal employee behaviour in large firms. Therefore, large firms tend to base incentives on tenure and position rather than on merit. Such limitations may especially affect executive positions and product development functions, putting large firms at a disadvantage when compared with smaller enterprises in which employees are often given a direct stake in the success of the firm through bonuses, share participation, and stock options.

Communication distortion due to bounded rationality: Because a single manager has cognitive limits and cannot understand every aspect of a complex organisation, it is impossible to expand a firm without adding hierarchical layers. Information passed between layers inevitably becomes distorted. This reduces the ability of high-level executives to make decisions based on facts and negatively impacts their ability to strategise and respond directly to the market. Williamson (1967) found that even under static conditions there is a loss of control.

The nature of these diseconomies of scale is supported by the theoretical and empirical economics and sociology literature. Table 1 summarises the authorities, which are fully discussed in Chapter 3 of Canbäck (2002).

Table 1. Sources of Limits of Firm Size

SOURCES OF LIMITS OF FIRM SIZE			
Atmospheric Consequences	**Bureaucratic Insularity**	**Incentive Limits**	**Communication Distortion**
Arrow (1974): Rigidity to change Blau and Meyer (1987): Excessive rigidity Brown, Hamilton and Medoff (1990): Unexplained wage differential Child (1973): Insularity Cooper (1964): R&D cost control Crozier (1964): Alienation Kwoka (1980): Low job satisfaction in large firms Merton (1957): Rigidity Pugh et al. (1969): Insularity from reality Qian (1994): Monitoring costs/inadequate effort levels Scherer (1976): Low job satisfaction in large firms Schmookler (1972): R&D cost consciousness; Climate for innovation Schumacher (1989): Low motivation	Blau and Meyer (1987): Excessive rigidity Brock (1987): Risk aversion Carroll and Hannan (2000): Firm age leads to insularity Child (1973): Insularity Crozier (1964): Rigidity Jensen (1986): Firms larger than optimum Merton (1957): Rigidity Monsen and Downs (1965): Different owner/manager objectives Olson (1982): Rigidity Pondy (1969): Increase in administration Pugh et al. (1969): Insularity from reality Schmookler (1972): Understanding market needs in R&D Stinchcombe (1965): Perpetuation of organisation form Williamson (1996): Bureaucratic rigidity	Axtell (1999): Free-rider problem Blau and Meyer (1987): Excessive rigidity Cooper (1964): R&D incentives Crozier (1964): Rigidity Olson (1982):Absence of selective incentives Peters (1992): Low productivity in R&D Rasmusen and Zenger (1990): Employment contracts Schmookler (1972): Quality of R&D employees Silver and Auster (1969): Limits to entrepreneurship Williamson (1996): Weaker incentives in bureaucracies Zenger (1989, 1994): Employment contract disincentives in R&D	Arrow (1974): Specialisation leads to poor communication Arrow (1983): Information loss in R&D Barnard ([1938] 1968): Communication losses Cooper (1964): R&D coordination Geanakoplos and Milgrom (1991): Information signal delays McAfee and McMillan (1995): Lower efficiency Mookherjee and Reichelstein (2001): No control loss under certain restrictive conditions Simon ([1947] 1976): Processing bottlenecks

While the four categories relating to diseconomies of scale theoretically impose size limits on firms, three factors tend to offset diseconomies of scale: economies of scale, organisation form and degree of integration. All are central to transaction cost economics, and in order to test the validity of the diseconomies-of-scale argument, it is necessary to account for these factors.

Economies of scale: Transaction cost economics does not usually deal with economies of scale, which are more often associated with neoclassical production costs. However, Riordan and Williamson (1985) made an explicit attempt to reconcile neoclassical theory and transaction cost economics and showed, among other things, that economies of scale are evident in both production costs (p. 371)

and transaction costs (p. 373), and that both can be kept internal to a firm if the asset specificity is positive. That is, economies of scale can be reaped by the individual firm and are not necessarily available to all participants in a market (pp. 367–369). This is at odds with much of the literature.

Organisation form: Williamson (1975, 117) recognised that diseconomies of scale can be reduced by organising appropriately. Based on Chandler's pioneering work (e.g., 1962) on the evolution of the American corporation, Williamson argued that the M-form organisation lowers internal transaction costs compared to the U-form organisation. It does so for a key reason: The M-form allows most senior executives to focus on high-level issues rather than day-to-day operational details, making the whole greater than the sum of its parts (p. 137). Thus, large firms organised according to the M-form should perform better than similar U-form firms.

Asset specificity: Williamson showed that asset specificity is the most important determinant of degree of integration (e.g., Riordan and Williamson 1985, 366). Asset specificity influences integration from a geographic reach, product breadth, and vertical depth point of view.

Geographic reach: Teece (1976) showed that multinational firms only exist because the combination of asset specificity and opportunism leads to moral hazard, which is difficult to contain in market transactions. Without, for example, human asset specificity, a firm could just as easily license its technology to a firm in another country, reaping the benefits of development. Tsokhas (1986) illustrated this in a case study of the Australian mining industry. Other studies have shown that market diversity reduces profitability (e.g., Bane and Neubauer 1981).

Product breadth: A number of studies of product breadth show that asset specificity plays a major role in explaining the success and failure of diversification. Rumelt (1974) found a strong correlation between profitability and human asset specificity—in this case the degree to which a firm draws on common core skills or resources (pp. 121–127).

Vertical depth: Asset specificity has repeatedly been shown to be the primary determinant of vertical integration. A number of empirical studies confirm this (e.g., Masten 1984; Masten, Meehan and Snyder 1989, 1991; Monteverde and Teece 1982; Joskow 1993; Klier 1993; Krickx 1988).

Again, the literature supports Williamson's theoretical argument, except for the reasoning regarding economies of scale (where the literature is inconclusive). Table 2 summarises the authorities, which are fully discussed in Chapter 3 of Canbäck (2002).

Table 2. Potential Moderators of Diseconomies of Scale

POTENTIAL MODERATORS OF DISECONOMIES OF SCALE		
Economies of Scale	**M-Form Organisation**	**Asset Specificity**
Adams and Brock (1986), Peters (1992): Myth of economies of scale Bain (1968), Scherer and Ross (1990): Economies of scale exhausted at moderate firm size Masten (1982), North and Wallis (1994): Economies of scale not proprietary to individual firms Ijiri and Simon (1964), Lucas (1978), Nelson and Winter (1982), Rumelt and Wensley (1981), Simon and Bonini (1958): Stochastic growth processes, not economies of scale, explain firm size-distribution	Armour and Teece (1978): M-form increases ROE Chandler (e.g., 1962), Chandler and Daems (1980): M-form alleviates coordination and control problems Fligstein (1985): Multi-product coordination favours M-form Peters (1992): Decentralisation is critical to firm performance Teece (1981): M-form firms are significantly better performers than U-form firms	Bane and Neubauer (1981): Market diversity reduces profitability Coase (1993b): No distinction between vertical and lateral integration Grossman and Hart (1986), Teece (e.g., 1976): TCE applies to lateral integration Mahoney (1992), Holmström and Roberts (1998): Uncertainty and frequency not important Masten (1984), Masten et al. (1989, 1991), Monteverde and Teece (1982), Joskow (1993), Klier (1993), Krickx (1988): Asset specificity more important than uncertainty and frequency Rumelt (1974): Product diversity reduces asset specificity Teece (1976), Tsokhas (1986): Asset specificity influences geographic reach Walker and Weber (1984, 1987): Volume uncertainty is weak factor

Theoretical Framework and Research Hypotheses

The literature review discussed the theoretical and empirical studies that inform the current research. The findings are now translated into five hypotheses:

H_1: Bureaucratic failure, in the form of atmospheric consequences, bureaucratic insularity, incentive limits and communication distortion, increases with firm size

H_2: Large firms exhibit economies of scale

H_3: Diseconomies of scale from bureaucratic failure have a negative impact on firm performance

H_{3a}: Atmospheric consequences have a negative impact on the performance of large firms

H_{3b}: Bureaucratic insularity has a negative impact on the performance of large firms

H_{3c}: Incentive limits have a negative impact on the performance of large firms

H_{3d}: Communication distortion has a negative impact on the performance of large firms

H_4: Economies of scale increase the relative profitability of large firms over smaller firms

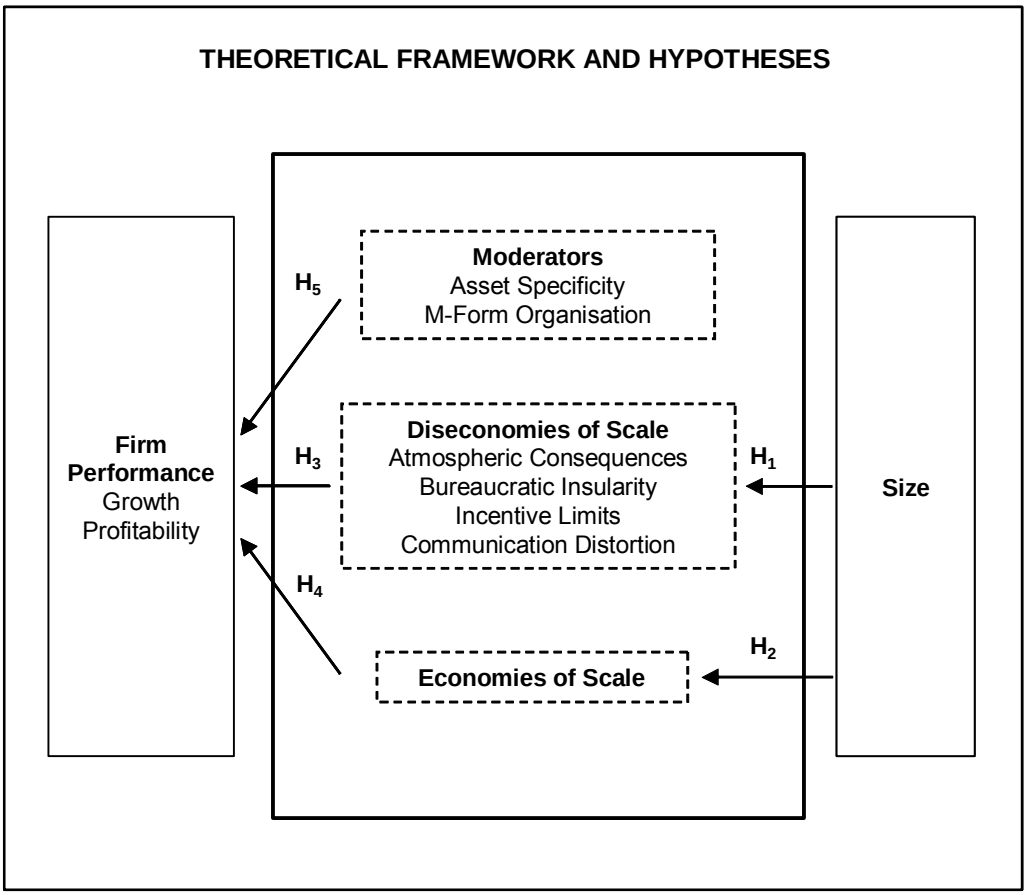
H_5: Diseconomies of scale are moderated by two transaction cost-related factors: organisation form and asset specificity

H_{5a}: Large M-form firms perform better than large U-form firms

H_{5b}: High internal asset specificity affects a firm's performance positively

Figure 2 summarises the hypotheses graphically in a theoretical framework. The expectation is that as the overall relationship between firm performance and size is deconstructed, insights into the true nature of managerial diseconomies of scale will be gained.

Figure 2. Theoretical Framework and Hypotheses



The question remains: are the hypothesised effects large enough materially to influence the performance of a large firm? Only an empirical analysis, in which the framework and hypotheses are operationalised, will answer this. The next two sections focus on this operationalisation and analysis.

Methodology

The research uses a positivist approach emphasising universal understanding in Runkel and McGrath's terms (1972, 81–89). There are no studies of this general type on the particular issue of diseconomies of scale. However, generalised studies on, for example, the profit impact of an M-form organisation or the link between size, structure and complexity are widely quoted in the literature (e.g., Rumelt 1974; Ramanujam and Varadarajan 1989).

Among different multivariate techniques, structural equation modelling (SEM) was picked based on Hair et al.'s classification scheme for choosing among techniques (1998, 20–21) and a review of the pertinent literature on SEM (Bollen 1989, 1–9; Kelloway 1998, 2–3; Maruyama 1998, 20–24). SEM is the most appropriate technique when multiple relationships between dependent and independent variables are studied. Moreover, SEM is well suited for confirmatory analysis and

allows for efficient hypothesis testing, especially of complex models. Finally, SEM allows for the use of latent, unobserved variables.

The analyses were cross-sectional. Data were collected for publicly traded manufacturing firms (SIC codes 10–39) with headquarters in the US and with sales of more than $500 million. 1998 was the benchmark year. Primary and secondary data were derived from several sources, including company organisation charts, official filings such as 10-Ks and proxy statements, annual reports, biographies of executives, historical company documents, corporate web sites, articles in *Business Week* and *Fortune*, corporate watchdogs, Compustat and academic research. Table 3 describes the most important variables used in the analyses.

Table 3. Overview of Variables Used in the Analyses

OVERVIEW OF VARIABLES USED IN THE ANALYSES						
Name	**Description**	**Metric**	**Sources**	**No. of Obs.**	**Trans-formation**	**K-S *z***
Employees	No. of employees	‘000	Compustat	784	atan	1.28
Atmospheric Consequences	Unit labour cost defined as labour cost/employees	$‘000	Compustat	146	sqrt	0.59
Leadership Tenure	Average years of employment with firm for officers	Years	10-Ks, proxy statements. annual reports, corporate web sites, executive biographies	163	none	0.85
Company Age	Years since founding of company	Years	10-Ks, proxy statements. annual reports, corporate web sites, historical sources	638	none	2.25
Incentive Limits	Research and development expense/Sales	%	Compustat	489	ln	0.76
Communication Distortion	No. of hierarchical levels	#	Annual reports, corporate web sites, 10-Ks, company organisation charts	386	ln	0.71
Economies of Scale	Defined as (fixed cost)^2/sales	$M	Compustat	752	ln	0.82
Geographic Reach	% of sales derived outside the United States	%	Compustat, annual reports, 10-Ks	663	ln	3.37
Product Breadth	Defined as the diversification ratio (1 − Rumelt’s specialisation ratio)	%	Compustat, annual reports, 10-Ks, corporate web sites	670	ln	5.24
Vertical Depth	2 = Very high; 1 = High; 0 = Average or low	Ordinal	10-Ks, annual reports, corporate web sites, Compustat	675	not meaningful	

Governance	Qualitative rankings	Index	*Business Week*, IRRC, *Fortune*	229	inv	0.64
Divisionalisation	2 = Divisionalised; 1 = Hybrid; 0 = Unitary	Ordinal	10-Ks, proxy statements, annual reports, corporate web sites	375	not meaningful	
Growth	5-year compound annual growth rate (1993–1998)	%	Compustat	756	atan	0.84
Profitability	Economic value added defined as return on equity less cost of equity	%	Compustat, Ibbotsen Associates (1999)	781	atan	0.57
Note: K-S = Kolmogorov-Smirnov						

The data was screened extensively for missing values, non-normality, non-linearity, heteroscedasticity, etc. Despite issues such as many missing values, non-normality of certain variables and some heteroscedasticity, the data was deemed more than sufficiently robust for the structural equation models.

Results

Figure 3 shows a path diagram for the most important statistical analysis (sub-model *b*) in the thesis (the complete thesis contains 21 path diagrams). This analysis tests hypotheses 3, 4 and 5 (sub-model *a* tests hypotheses 1 and 2) and depicts the delicate balance between factors that reduce the limits of firm size and those that increase the limits. A positive regression weight increases the limits and a negative regression weight reduces the limits. In general, the diseconomies of scale have a stronger negative influence on growth than on profitability, while the positive influence of economies of scale, M-form organisation and high internal asset specificity is larger on profitability than on growth.

Figure 3. Complete Sub-Model b

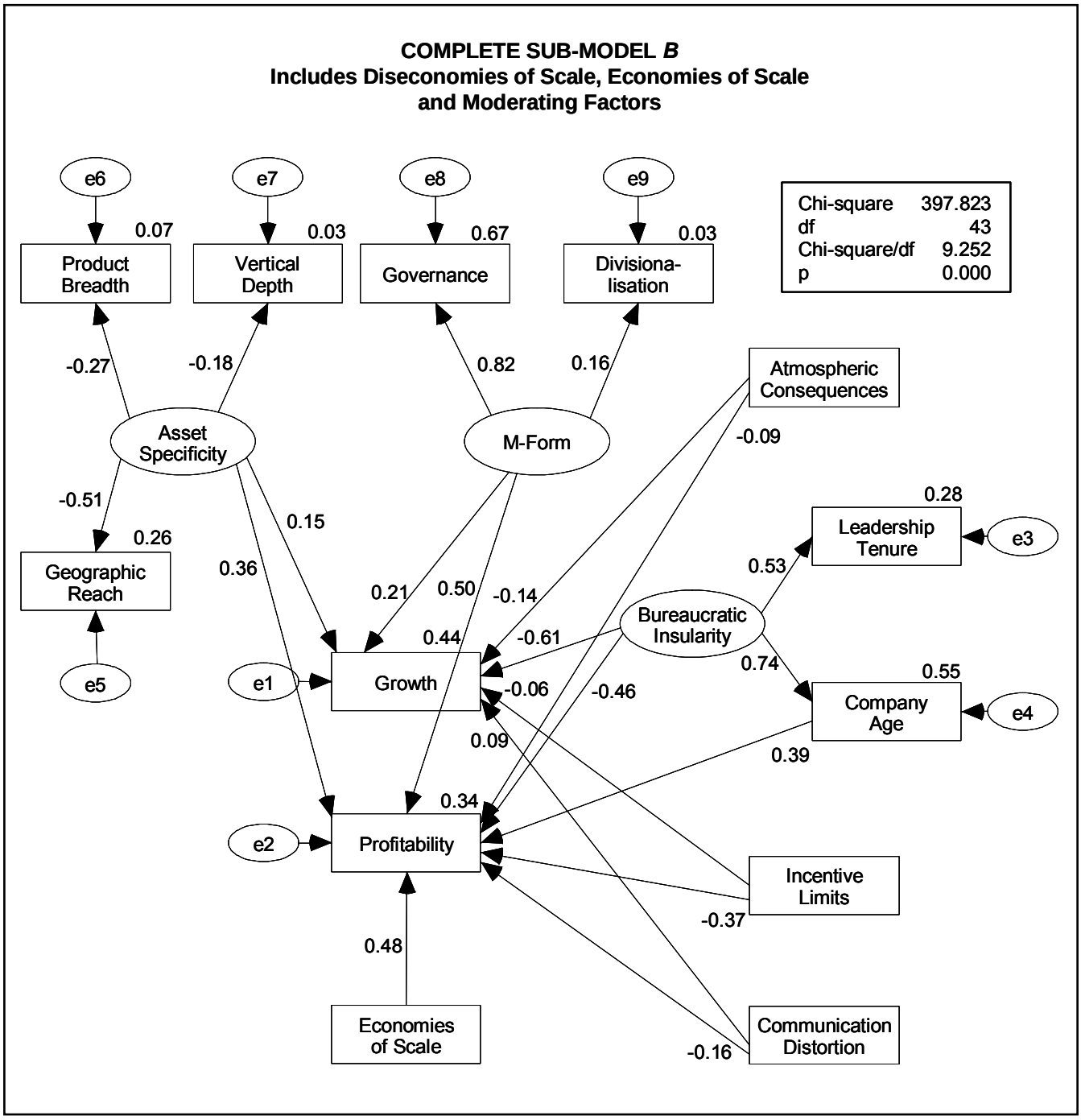


Table 4 reports the coefficients and the statistical significance of the analysis. The regression coefficients are of the hypothesised sign (except for the non-significant **Communication Distortion → Growth**) and most coefficients are significant at the 5% or better level.

Table 4. Regression Weights for Complete Sub-Model b

REGRESSION WEIGHTS FOR COMPLETE SUB-MODEL *B*				
	Std. Coeff.	**Unstd. Coeff.**	**SE**	**CR**
Atmospheric Consequences → Growth	−0.142	−0.057	0.041	−1.417
Atmospheric Consequences → Profitability	−0.087	−0.049	0.066	−0.746
Bureaucratic Insularity → Growth	−0.609	−0.120	0.036	−3.348***
Bureaucratic Insularity → Profitability	−0.465	−0.128	0.103	−1.244
Bureaucratic Insularity → Leadership Tenure	0.531	0.263	0.050	5.244***
Bureaucratic Insularity → Company Age	0.740	1.000		
Company Age → Profitability	0.386	0.079	0.047	1.689†
Incentive Limits → Growth	−0.059	−0.019	0.027	−0.706
Incentive Limits → Profitability	−0.375	−0.170	0.063	−2.688**
Communication Distortion → Growth	0.092	0.333	0.312	1.067
Communication Distortion → Profitability	−0.157	−0.793	0.833	−0.952
Economies of Scale → Profitability	0.483	0.176	0.079	2.232*
Asset Specificity → Growth	0.149	1.000		
Asset Specificity → Profitability	0.365	3.431	2.213	1.550
Asset Specificity → Geographic Reach	−0.507	−1.487	0.675	−2.201*
Asset Specificity → Product Breadth	−0.268	−0.880	0.421	−2.091*
Asset Specificity → Vertical Depth	−0.179	−1.510	0.806	−1.872†
M-Form → Growth	0.213	0.168	0.117	1.427
M-Form → Profitability	0.498	0.548	0.409	1.339
M-Form → Governance	0.819	1.000		
M-Form → Divisionalisation	0.163	0.270	0.169	1.596
† p<10%, * p<5%, ** p<1%, *** p<0.1% (two-tailed)				

The findings in this, and other analyses not reported here, are robust for a number of reasons. The data were screened and tested extensively. They were found to be well-behaved in most respects. The path diagrams confirm well with the underlying theory. The indicators appear to reflect the unobserved phenomena fairly well. Finally, the results were similar when random sub-samples were used.

The practical significance of the statistical analyses is that both sub-model *b* (and sub-model *a*) validate Williamson's theoretical framework. Both the main analyses and the supporting analyses that tested particular aspects of the theory are in line with the theoretical predictions.

Table 5 summarises the literature findings and the full set of statistical analyses. All hypotheses (except $\mathbf{H_{3d}}$ which was inconclusive) were confirmed at better than 5% significance and each statistical model had an overall fit which was acceptable or better. Combined with the findings from the literature, this implies that firms have to balance a number of countervailing forces to reach a performance optimum. For example, it is unlikely that geographic or product expansion alone will improve corporate performance. Only when the expansion is done in conjunction with other adjustments, aimed at reducing the diseconomies of scale or capturing the benefits of M-form organisation, is it likely that performance will improve.

Table 5.Summary of Findings

SUMMARY OF FINDINGS			
Hypothesis	**Literature Finding**	**Statistical Finding**	
		Result	**Significance**
H_1: Bureaucratic failure, in the form of atmospheric consequences, bureaucratic insularity, incentive limits and communication distortion, increases with firm size	Confirmed	Confirmed	p<1%
H_2: Large firms exhibit economies of scale	Confirmed	Confirmed	p<0.1%
H_3: Diseconomies of scale from bureaucratic failure have a negative impact on firm performance	Confirmed	Confirmed	see **H_{3a}** – **H_{3d}**
H_{3a}: Atmospheric consequences have a negative impact on the performance of large firms	Confirmed	Confirmed	p<10%
H_{3b}: Bureaucratic insularity has a negative impact on the performance of large firms	Confirmed	Confirmed	p<0.1%
H_{3c}: Incentive limits have a negative impact on the performance of large firms	Confirmed	Confirmed	p<0.1%
H_{3d}: Communication distortion has a negative impact on the performance of large firms	Confirmed	Inconclusive	p=21.2%
H_4: Economies of scale increase the relative profitability of large firms over smaller firms	Inconclusive	Confirmed	p<1%
H_5: Diseconomies of scale are moderated by two transaction cost-related factors: organisation form and asset specificity	Confirmed	Confirmed	see **H_{5a}** – **H_{5b}**
H_{5a}: Large M-form firms perform better than large U-form firms	Confirmed	Confirmed	p<10%
H_{5b}: High internal asset specificity affects a firm's performance positively	Confirmed	Confirmed	p<1%

Interpretation and Discussion

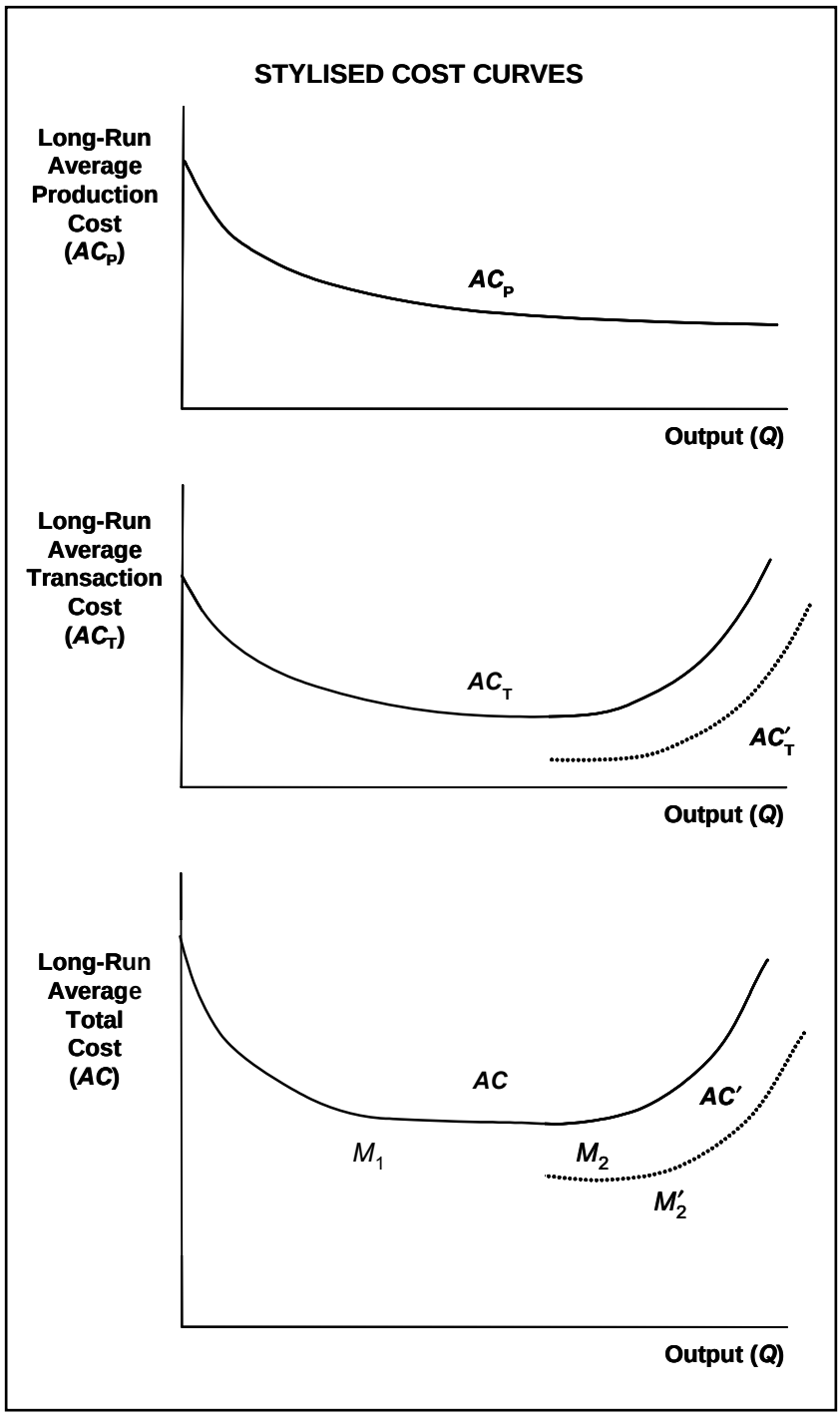
As was shown in Table 5, the theoretical framework is supported by both the literature and the statistical findings. It is now possible to interpret the findings by returning to the neoclassical cost curves. First, the cost curve shown in Figure 1 is modified to reflect the characteristics of diseconomies of scale, economies of scale and the moderating factors. Second, a similar curve is constructed for firm growth. Third, these two curves are combined to show the overall impact of these two factors on firm performance.

Average cost. To begin with, the elongated U-shaped average total cost curve used in neoclassical theory can be split into two parts: the average production cost curve and the average transaction cost curve. The modified cost curves are depicted in a stylised fashion in Figure 4. The top graph shows a curve for average production cost (AC_P) consistent with the findings in the current research.

The middle graph in Figure 4 shows the average transaction cost curve (AC_T). The middle graph also shows a shifted and slightly tilted average transaction cost curve (AC'_T). The curve reflects the positive contribution from the moderating factors. AC'_T is supported by the literature and by the statistical analysis. This analysis indicates that the shift can be quite large.

Finally, the bottom graph in Figure 4 shows the average total cost curve (*AC*), with a shifted curve AC' for the moderators ($AC = AC_P + AC_T$; $AC' = AC_P + AC'_T$). The curve resembles the neoclassical curve in Figure 1.

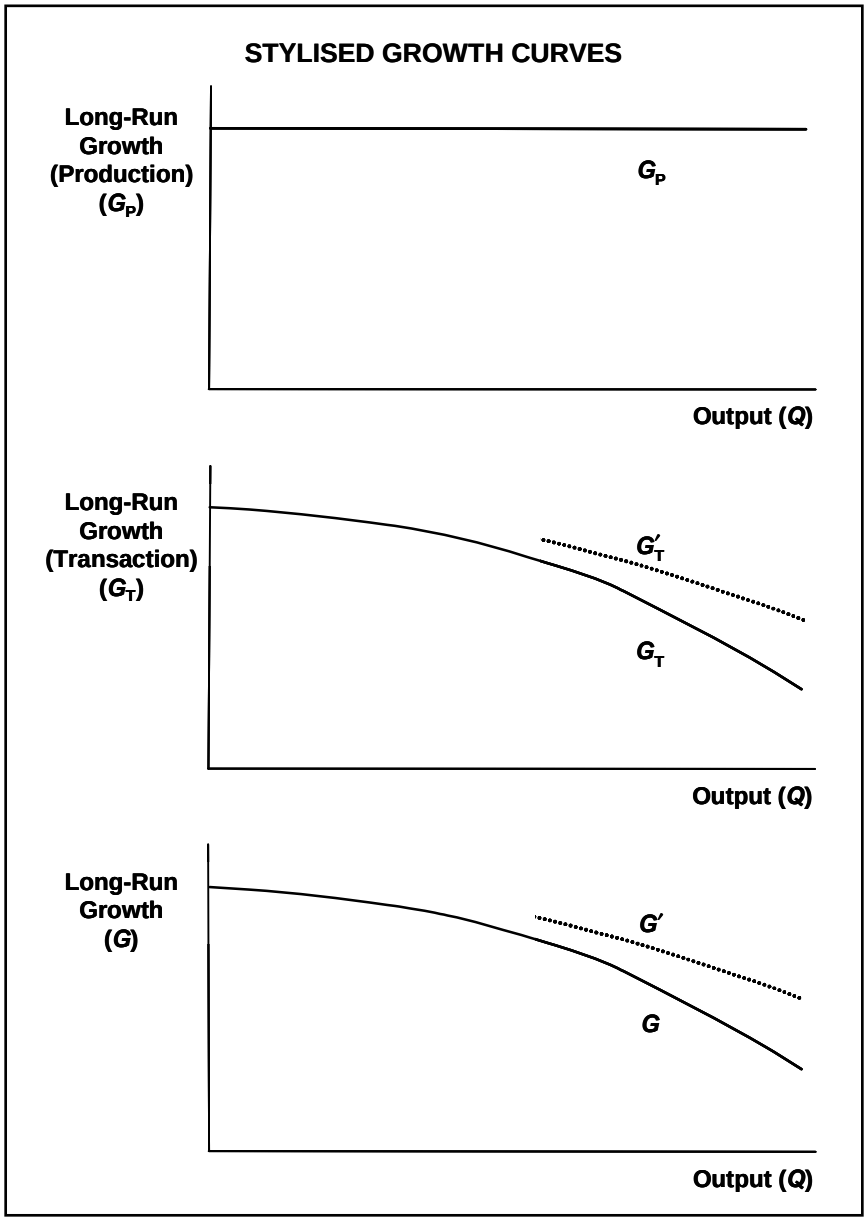
Figure 4. Stylised Cost Curves



Growth. The underlying logic of the cost curves can also be applied to firm growth. Figure 5 shows the same set of graphs as above for the relationship between firm growth and output. The top graph illustrates the relationship between growth and output, under the hypothetical assumption that firms only have neoclassical

production costs (G_P). The middle graph in Figure 5 portrays the growth curve resulting from bureaucratic, transaction cost-based, failure (G_T). The bottom graph in Figure 5 convolutes the production- and transaction-cost contributions to growth into overall growth (G). The graph shows that the growth capacity of firms is steadily declining as a function of output, but it can be moderated (G').

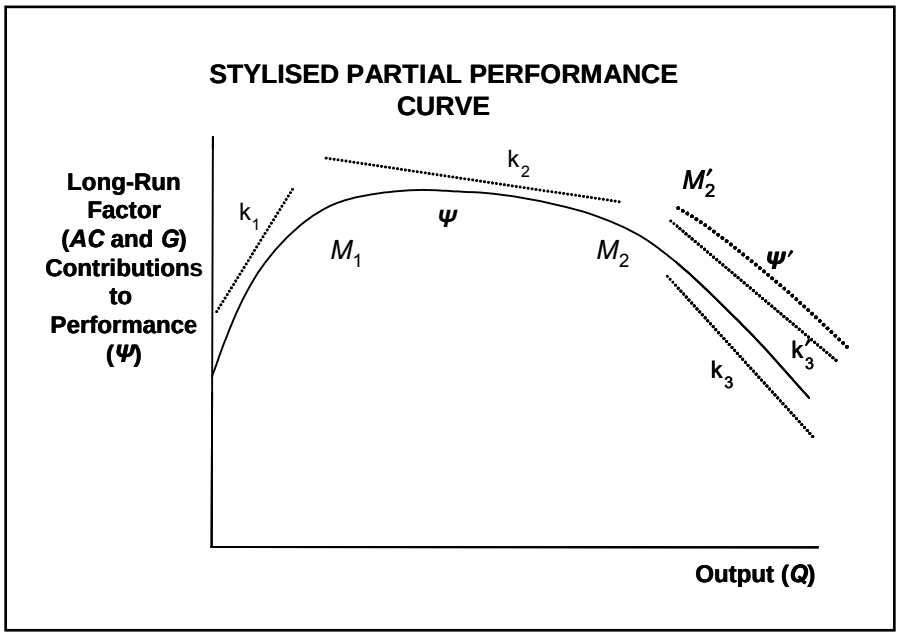
Figure 5. Stylised Growth Curves



Performance. Finally, it is instructive to combine the cost and growth curves to see how they jointly contribute to a firm's performance (Figure 6). Other factors also contribute to firm performance and the graph shows the partial contribution to

performance.[1] By convoluting the average total cost (*AC*) and growth (*G*) curves, the partial performance curve Ψ results.

Figure 6. Stylised Partial Performance Curve



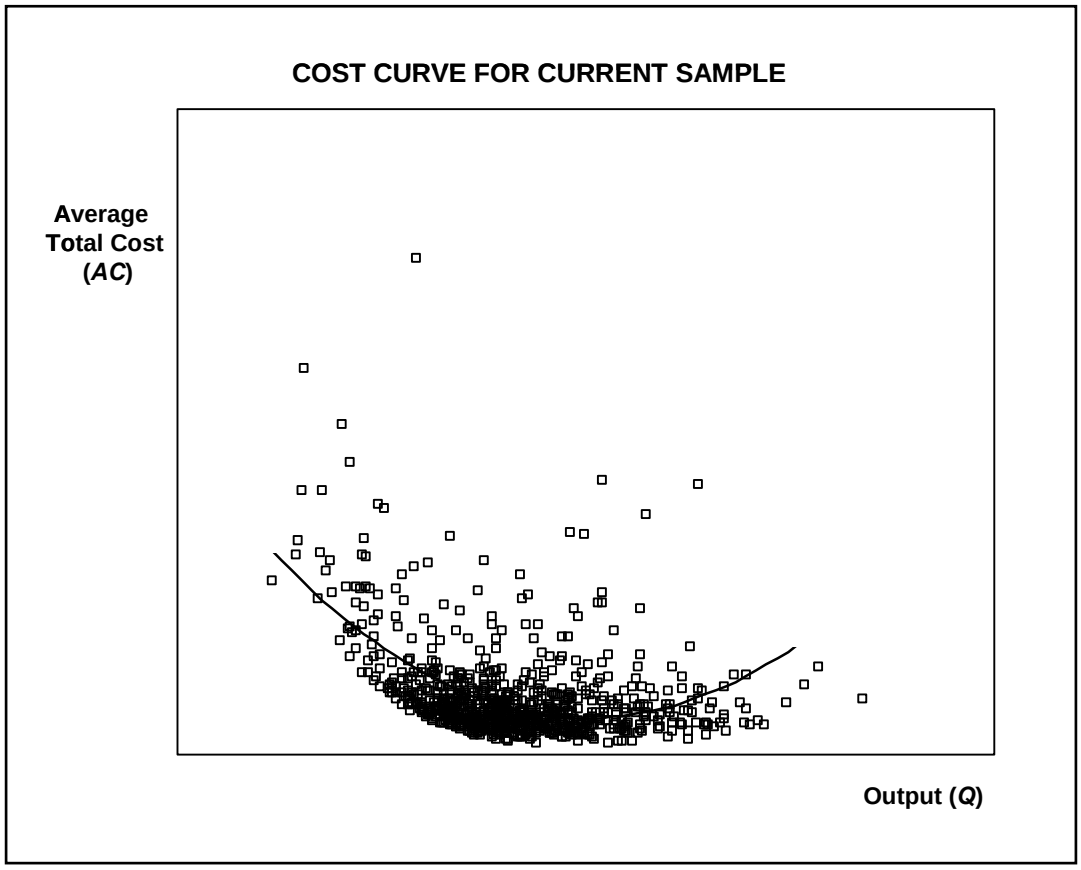
The set of curves discussed above agree well with neoclassical theory (e.g., Panzar 1989) and transaction cost economics (e.g., Williamson 1975), individually. The curves also agree with the joined perspectives on production and transaction costs expressed by, for example, Riordan and Williamson (1985) and Wallis and North (1986).

The conceptual curves depicted in Figures 4 to 6 can also be used to show the shape of the data in the sample of 784 firms. This was done with three analyses which replicated the cost (*AC*), growth (*G*) and partial performance (Ψ) curves. Figures 7 to 9 show the resulting graphs, which are surprisingly similar to the conceptual curves. It should be remembered though, that the scatterplots presented are somewhat simplistic. They use the sample data as is and no attempt was made to include control variables or to make other corrections.

First, Figure 7 reports the results for the cost curve (*AC*), which plots average total cost against output. A quadratic regression line has been added to show the underlying trend in the data. The data conforms well to the conceptual *AC* curve in Figure 4.

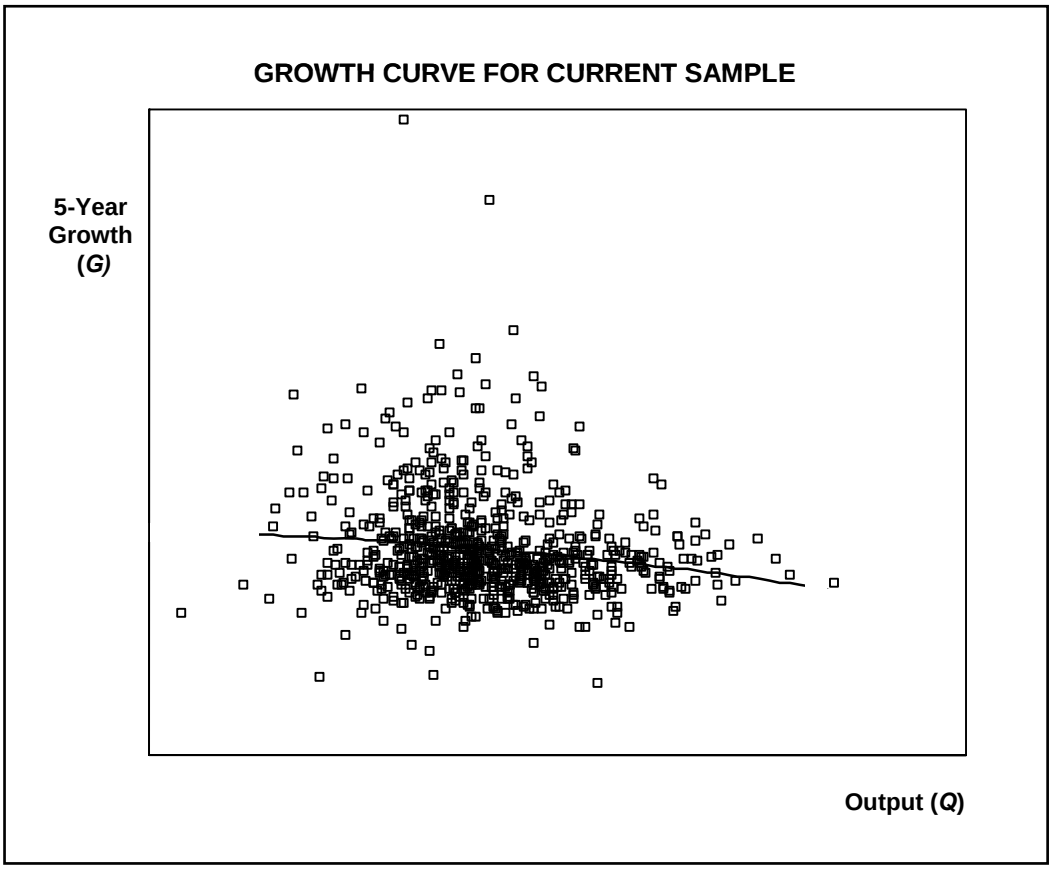
[1] Total performance (Ψ_{TOT}) is a function of, profitability(π), growth(G), risk(β) and other factors (ε): $\Psi_{TOT} = f(\pi, G, \beta, \varepsilon) = f(TR - TC, G, \beta, \varepsilon) = f(TR - AC \cdot Q, G, \beta, \varepsilon)$.

Figure 7. Cost Curve for Current Sample



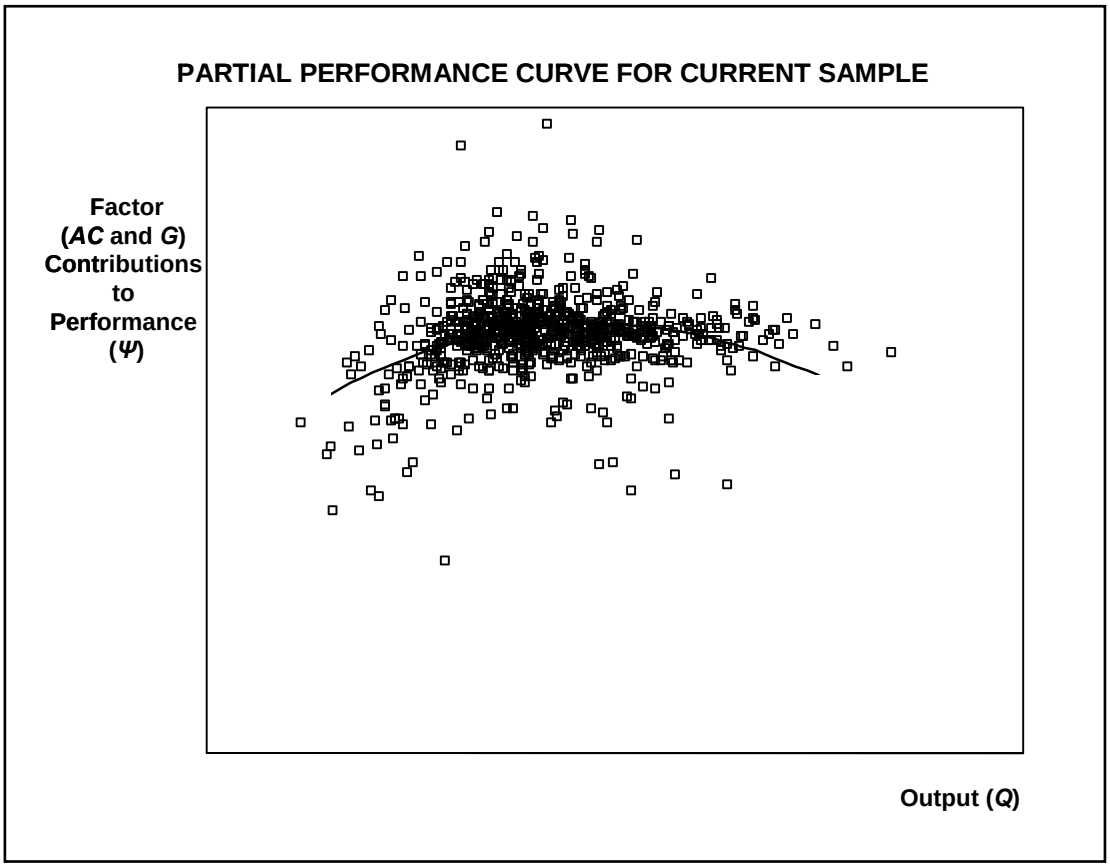
Second, growth data was plotted against output (Figure 8). Again, the curve has the predicted shape and the quadratic regression line is similar to the conceptual *G* curve in Figure 5. The plot points are quite scattered though, and firms seem to have considerable leeway to deviate from the growth rate prescribed by their size.

Figure 8. Growth Curve for Current Sample



Third, the joint contribution to firm performance by the two factors is shown in Figure 9. The performance curve (Ψ) is not unlike the conceptual curve shown in Figure 6. There is significant variation around the trend line, but overall the data conforms to the theoretical and empirical predictions.

Figure 9. Partial Performance Curve for Current Sample



Conclusion

There are a number of real-life implications of the research. First, strategy and structure appear to be intimately linked. Executives at large corporations have to grapple with real trade-offs when they consider expansion. Certain growth strategies are easier to execute than others, and the choice of organisation has major implications for which strategies make sense. Indeed, structure does not necessarily follow strategy; strategy and structure inform each other continuously and forever.

Second, much of the rationale for mergers and acquisitions seems to be weak, at best. Proponents of mergers typically argue that the resulting larger entity after a merger will realise economies of scale, benefiting customers and shareholders; in addition, they claim that growth will be accelerated through the introduction of new products and services that were previously too expensive to develop. But the analysis here shows that although some economies of scale may be realised, they are likely to be offset by diseconomies of scale. Furthermore, there is no evidence that larger, merged entities innovate more and grow faster. Instead, the opposite appears to be true: innovation and growth declines, on average.

Third, boards of directors may want to emphasise the importance of executive renewal and the elimination of rigid processes to stimulate growth. Maximising the

quality of governance, which is part of the board's fiduciary duties, appears to be an important lever for addressing these issues.

Fourth, firms that strive for high internal asset specificity appear to be better off than those that expand reach, breadth, or depth. This does not imply that single-product or single-geography strategies are optimal (because this reduces growth in the long run), but it does imply that any expansion strategy should strive for high asset specificity and that some firms are best off reducing their scope of activities.

Finally, in a world in which companies increasingly try to sell solutions rather than basic products and services, incentive limits have become real and problematic. In businesses that involve team selling or large product-development efforts, attention should be paid to creating well-functioning incentive schemes for employees. The superior productivity of research and development in small firms, in which incentives are tailored to individual performance, demonstrates why effective incentive schemes matter.

From a research perspective, the current work indicates a number of opportunities for further study. For example, the statistical analyses indicate yet another way to put Gibrat's law of proportional effects (1931, 74–81) into doubt. The thesis also suggests four areas for further research. (1) Proving the existence of diseconomies of scale by studying a more narrowly defined problem such as focusing on an industry rather than a whole economic sector; (2) Expanding the analysis across geography and time; (3) Finding better ways to operationalise unobserved diseconomies of scale; and (4) Replicating the current research with better statistical approaches and a larger sample, with a particular eye towards industry effects.

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