

Measuring the Effects of Local Government Reform: A New Zealand Highway Maintenance Application

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Abstract

In 1989 several hundred New Zealand local government authorities were amalgamated into less than one hundred larger entities. The interest in this research is on determining pre- and post-amalgamation performance focusing on highway maintenance activities. Data Envelopment Analysis is used to measure performance, which is decomposed using Malmquist indexes into changes in efficiency and shifts in technology.

1 Introduction*

In 1984 the newly elected New Zealand Labour Government embarked upon an ambitious programme of change affecting all sectors and levels of the economy. Having initiated major reforms at central government levels, Labour turned its attention to local government reforms based upon similar ideologies to those underlying national reforms *viz* efficiency centred on market contestability, greater transparency and accountability, and institutional rearrangements to streamline and align local bodies to these notions. Perhaps the most visible manifestation of local government reform was the amalgamation in 1989 of over 230 authorities into 92 comprising 74 territorial local authorities (TLAs), 12 regional councils and 6 special purpose authorities.

The research question addressed in this paper encompasses two issues. First, did amalgamation improve scale efficiencies, and second did performance change between pre- and post-amalgamation to reflect policy changes in management processes and service provision? Accordingly, we attempt to answer (albeit partially) the challenge set by Bush [6]: “Vaunted economies of scale have proved to be a mirage, but no *ex post facto* review of any New Zealand urban amalgamation has ever been conducted.”

The study examines highway maintenance activities performed by NZ local authorities between 1982 to 1997. Highway maintenance expenditure is a major item of expenditure for TLAs, accounting for a national average of 20% of total local authority expenditure in 1994/95 [1]. The study used time series data comprising major highway maintenance outputs and inputs of all the NZ mainland¹ local authorities covering the period from 1982 to 1997. Details of the composition of the ‘new’ TLAs enabled the pre-amalgamation data to be consolidated as if the new structure had prevailed prior to 1989.

* A fuller version of this paper is available from the authors.

¹ The Chatham Islands have been excluded from the analyses in this study.

2 New Zealand Background

Two major strands appear to underpin the NZ reform process: economic efficiency and more effective governance. For the latter, transparency was embodied in increased accountability and the separation of policy from provision whilst endeavouring to improve the democratic process. “The pursuit of efficiency must not destroy the democratic nature of the processes which make up the system of government.”[12].

A particularly visible aspect of local government was the large number of organisations. “Fragmentation and enormous disparities in size and activities characterised the sector. In 1976 the average populations were 7660 (98 counties), 17100 (132 municipalities), 1000 (7 independent town districts) and 5280 (13 district communities), while 27 of the 109 communities had populations in excess of 1000. Such figures concealed the phalanx of minute Territorial Local Authorities - over 40 per cent of boroughs contained less than 5000 inhabitants and 15% of counties could not muster even 2000 populations.” [7]. The amalgamation in 1989 into 74 territorial local authorities resulted in average populations of 125,742 (15 cities) and 26,223 (59 districts).

3 International Studies

Elsewhere, similar arguments have been used to support amalgamation. Dente *et al.* [11] observed that reductions in the number of local government units have been associated with objectives of improving functional effectiveness, increasing responsiveness, improving the overall performance of the system and enlarging central control.

The ‘benefits’ outlined above can be associated with what Mouritzen [16] describes as *the Reform Theory*. This theory states that citizens’ satisfaction with public services will increase with increasing size.

In contrast, “*the Political Economy Theory* questions the emphasis of the reform theorists on economies of scale. While economies of scale may be present in some capital intensive programmes (like harbours, waste disposal, sewage) they are typically not present in labour intensive programmes. A closer relationship between representatives and their constituency makes for better information flows and consequently greater efficiency. This theory posits that citizens’ satisfaction will decrease with increasing size.

Both Boyne and Mouritzen found improved performance with increasing fragmentation. However, they emphasised that activities of a more capital intensive nature may be more amenable to better performance with less fragmentation. In this regard, Deller and Nelson [10] studied the efficiency of small townships to produce low-volume rural road services in three mid-western states in the USA. Scale effects ascertained through comparison of efficiencies under constant returns to scale with variable returns to scale, revealed that small towns were more likely to be scale inefficient than larger townships.

4 Research background and methodology

The research questions in the introduction address (i) scale economies pre-1989 and (ii) changes in efficiency before and after amalgamation. The first hypothesis is:

H1: Significant improvements in performance were obtained after the 1989 amalgamation.

Major reasons include increased professionalism attracted by a broader asset base and network size; economies of scale associated with the capital intensive nature of highways; more holistic views of network management through greater network size; economies of scope through combining road-related functions within a single authority (works, planning, traffic control and highway maintenance); and increased potential for improved information systems. Specific changes to local government processes are also expected to contribute to productivity gains: outsourcing, competitive price tendering, formation of business units and / or local authority trading enterprises, and increased accountability requirements embodying distinctions among outcomes, outputs and inputs as articulated by Ramanathan [17]. These form the basis for two sub-hypotheses:

H1a: For the period 1982 to 1989, scale efficiency would have been higher if local authorities had been amalgamated into a smaller number of larger entities.

H1b: Technical efficiencies will have improved between pre amalgamation TLAs (consolidated) and post amalgamation TLAs.

5 A linked structure performance pyramid framework

Informed by the balanced scorecard approach of Kaplan and Norton [14] and the performance pyramid of Cross and Lynch [9], the schematic model depicted Figure 1 has been developed as a general managerial framework for performance measurement [19] where each face of the pyramid reflects a different perspective: (i) customer, (ii) internal business, (iii) financial and (iv) innovation and learning perspectives. Measures are linked to CSFs and to underlying process or cost drivers as suggested by [4].

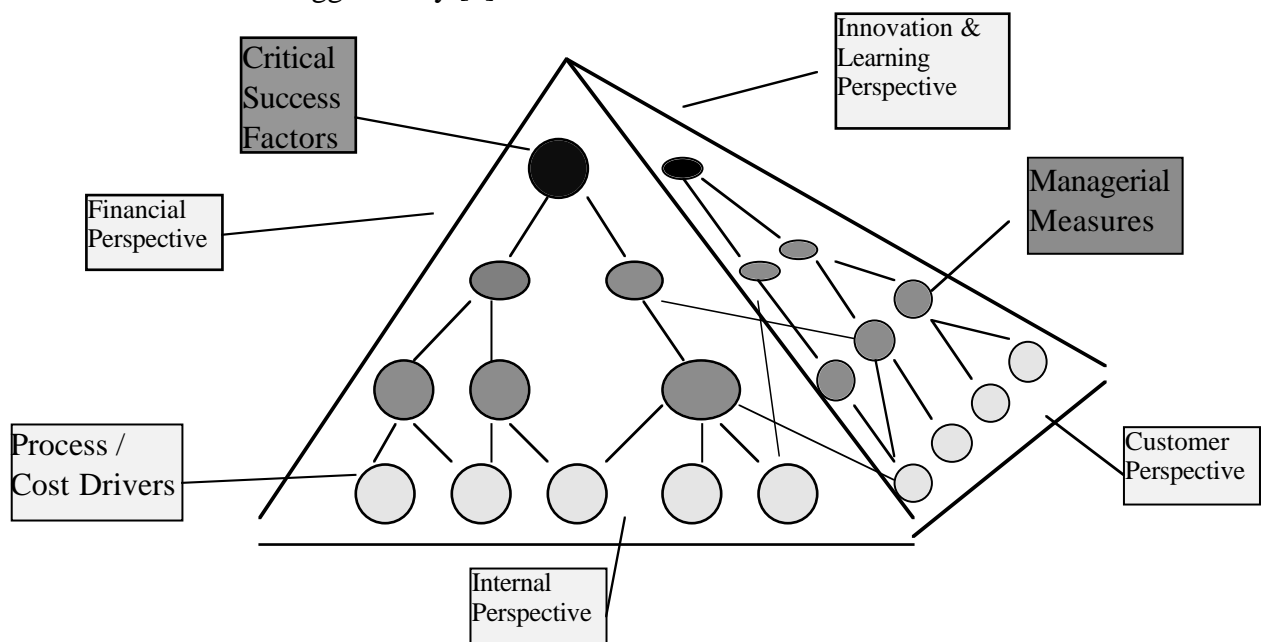


Figure 1. Fully integrated performance measurement system with the balanced scorecard, performance pyramid and linked measures

Figure 2 illustrates one of the perspectives in the application of the linked structure to highway management. Outputs employed in the study are rehabilitation, reseals and routine maintenance. Rehabilitation involves major reconstruction of the pavement structure and is generally expected to extend operating life up to twenty five years. Resealing is an overlay over the existing surface and on average is expected to occur two to three times over the life of the pavement. Routine maintenance encompasses a variety of ongoing activities throughout each year, such as pothole repairs, patching, drainage and landscaping. These actions are vital for safety, aesthetic reasons and to ensure that rehabilitation and reseal average costs do not rise excessively.

Rehabilitation and resealing are measured in kilometres, which directly capture the extent of these activities. As with housekeeping, routine maintenance encompasses a large number of mutually reinforcing tasks undertaken regularly. The interrelated nature, size and frequency of these tasks do not justify the regular collection and reporting of detailed measures. There is general agreement that dollar expenditure is the most appropriate all-encompassing measure of output for routine maintenance. Except for a small number of TLAs, outcome measures are not available before 1994 for the majority of authorities.

As maintenance activities are either contracted out or performed by ‘stand-alone’ business units, cost is an appropriate input.

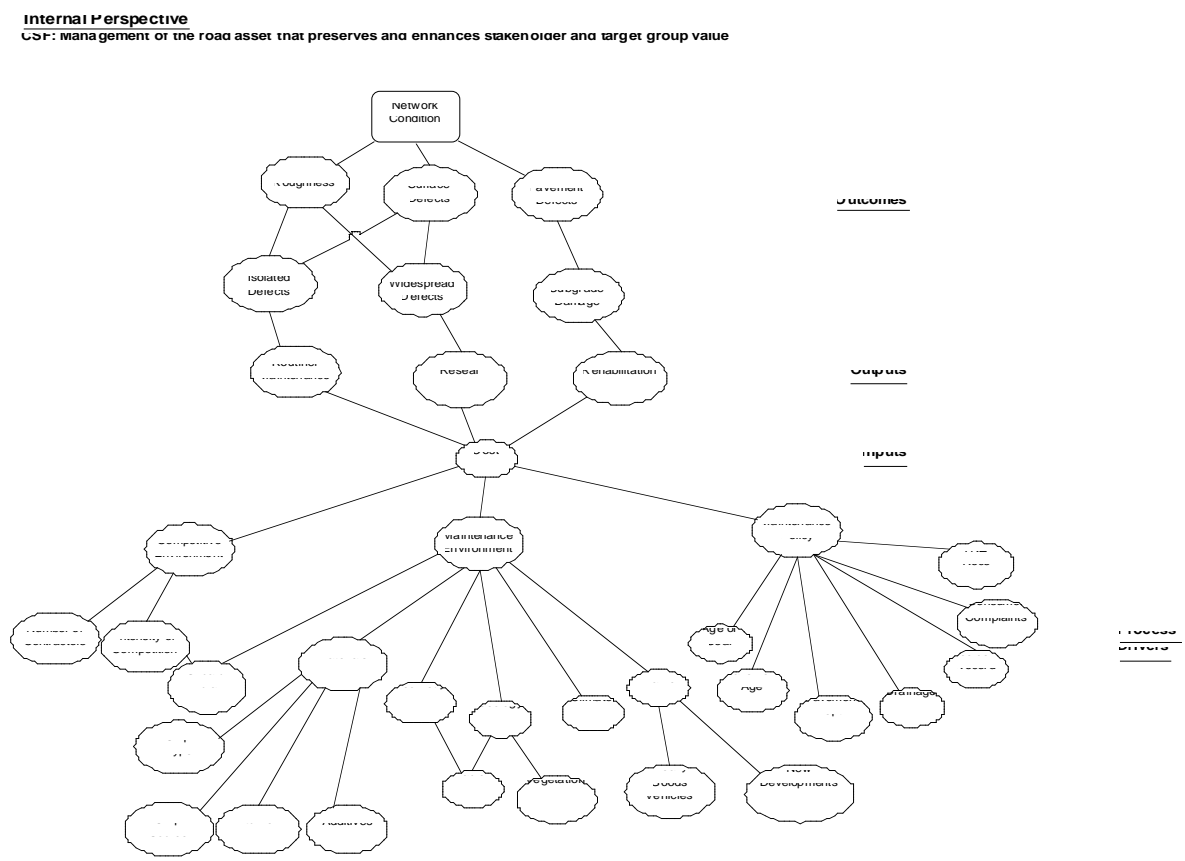


Figure 2. Internal Perspectives for Highway Management

The central government highway funding department, Transfund NZ, believe that quality has either remained the same or has improved since amalgamation. Considering that personnel

in this Department have been actively involved in monitoring TLA performance in highway maintenance since the early seventies, we regard their opinion as a good control.

Environmental factors identified in [18] are traffic, the ratio of urban to rural roads and geological and climatic factors. The latter two are assumed to remain unaffected by the changes over the period of the study and therefore have no impact on pre and post performance. Traffic volumes have steadily increased over this period.

All dollar amounts have been restated in 1997 ‘real terms’ using a construction cost index specifically devised for highway activities.

6 Results and summary

Two standard DEA models were used to calculate technical efficiency scores for each TLA: Charnes *et al.* [8] constant returns to scale (CRS) and Banker *et al.* [2] variable returns to scale (VRS). Scale efficiency (ratio of CRS to VRS efficiencies) can be used to determine how close an observed DMU is to the most productive scale size [3]. Where DMUs are close to the most productive scale size, scale efficiency is close to unity.

The analysis uses two sets of data pertaining to pre-amalgamation TLAs in 1987, 1988 and 1989. The first set contains the original local authorities’ outputs and inputs (e.g. 231 TLAs in 1987 with non-zero activities) and efficiencies are computed under constant returns to scale (CRS) and variable returns to scale (VRS) for both input and output orientations. Mean scale efficiencies for the first set are provided in Table 1 in the row labelled “Old”. For an input orientation, mean scale efficiency is 88.6% in 1987, 92% in 1998 and 96% in 1989. This indicates that mean scale efficiencies were improving as the number of authorities declined marginally from 231 to 226.

Scale Efficiency Results

	1987			1988			1989		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
<u>Input Orientation</u>									
Old	231	88.6%	10.7%	227	92.0%	8.9%	226	96.0%	5.6%
New	73	96.2%	6.4%	73	96.2%	5.8%	73	97.5%	4.4%
<u>Output Orientation</u>									
Old	231	87.1%	11.3%	227	92.0%	8.9%	226	96.0%	6.1%
New	73	95.3%	7.1%	73	94.9%	7.1%	73	96.5%	6.3%
<u>Input Orientation</u>									
T-test		< 1%			< 1%			< 5%	
Mann-Whitney U		< 1%			< 1%			< 1%	
<u>Output Orientation</u>									
T-test		< 1%			< 1%			n.s.	
Mann-Whitney U		< 1%			< 1%			< 1%	

Table 1. Scale efficiencies for Pre-Amalgamation TLAs

The process is repeated for the second set comprising the consolidated outputs and inputs for 73 TLAs. These results appear in the row labelled “New”. For an input orientation, scale

efficiencies were 96.2% in 1987 and 1988, increasing to 97.5% in 1989. Differences between the two sets were evaluated using a t-test and the Mann-Whitney U test. Significant (at the level of 1%) differences between scale efficiencies for the two sets were evident for 1987 and 1988 under both tests, with weaker results in 1989 for the t-test but significant for the Mann-Whitney U test.

This lends support to H1a and indicates that in the case of highway maintenance activities, economies of scale were obtainable prior to 1989.

Panel A: Malmquist Components from 1987 to 1997
Efficiency Changes for Annual Pair Comparisons

	<u>87-88</u>	<u>88-89</u>	<u>89-93</u>	<u>93-94</u>	<u>94-95</u>	<u>95-96</u>	<u>96-97</u>
Min	83%	71%	72%	49%	47%	88%	77%
1st Quartile	97%	95%	93%	77%	92%	106%	96%
Median	102%	100%	99%	83%	97%	113%	102%
3rd Quartile	109%	105%	106%	93%	103%	122%	109%
Max	169%	123%	140%	123%	127%	256%	165%
Mean	105%	101%	100%	85%	97%	118%	104%

Technical Changes for Annual Pair Comparisons

	<u>87-88</u>	<u>88-89</u>	<u>89-93</u>	<u>93-94</u>	<u>94-95</u>	<u>95-96</u>	<u>96-97</u>
Min	83%	97%	89%	103%	94%	42%	86%
1st Quartile	94%	98%	98%	116%	101%	88%	94%
Median	98%	99%	99%	125%	102%	91%	95%
3rd Quartile	100%	101%	100%	135%	102%	95%	96%
Max	102%	106%	103%	252%	118%	101%	105%
Mean	96%	100%	99%	132%	102%	90%	95%

Panel B: Malmquist Components Comparing 1988 with 1994 and 1996

<u>1988 and 1994 Comparisons</u>			
	<u>Efficiency</u>	<u>Technical Change</u>	<u>Malmquist Index</u>
Min	48%	102%	59%
1st Quartile	76%	116%	99%
Median	86%	125%	107%
3rd Quartile	95%	141%	117%
Max	121%	251%	304%
Mean	85%	132%	111%

<u>1988 and 1996 Comparisons</u>			
	<u>Efficiency</u>	<u>Technical Change</u>	<u>Malmquist Index</u>
Min	62%	104%	75%
1st Quartile	85%	109%	94%
Median	96%	111%	106%
3rd Quartile	103%	115%	116%
Max	127%	130%	164%
Mean	94%	113%	106%

Table 2: Efficiency and Technical Change Using Annual Pair Comparisons 1987 to 1997

Table 2 sets out summary results using a Malmquist [15] index under constant returns to scale, following the model set out in [13]. Essentially, the Malmquist index decomposes performance into changes due to efficiency and changes due to shifts in technology (or technical change). There is a significant improvement in 1994 persisting into 1995. Our intuition is that this reflects the impact of policy changes such as contracting out and competitive pricing policies. 1996 and 1997 reveal some slippage in these gains but a sustainable improvement

appears to have been achieved. The efficiency changes reveal that although the 'game' has improved, individual 'players' struggled with efficiency in 1994 as efficiencies fell overall. Post 1994 years reveal steady improvement as the bulk of TLAs appear to catch up with the shift in technology. To test this latter observation, panel B reports comparisons using 1988 as the base year with 1994 and 1996. The shift in technology is evident across all TLAs in both years. Notwithstanding, efficiency was generally lower in 1994 for over 75% of TLAs. In 1996 about half of the TLAs had almost caught up with their efficiency, with a 6% overall improvement in performance for half of the TLAs when efficiency and technical change are combined.

In summary, the higher scale efficiencies for consolidated TLAs reveal the existence of economies of scale prior to 1989, which supports the amalgamation reforms in 1989. Furthermore, sustainable improvements in performance have been identified that must be strongly influenced by policy changes effected during and after amalgamation.

These changes have lifted the frontier of technology and although many authorities appear to have initially slipped behind the outward shift, subsequent improvements in efficiency have restored overall efficiency relative to the frontier. These results support both hypotheses.

Several caveats must be made. First, this study has addressed only highway maintenance which, although a major activity, is not the sole activity of local authorities. For instance, costs of amalgamation are not included in this study. Second, pre-amalgamation TLAs were consolidated using a breakdown by area as opposed to road network; this information was not available. Third, although general price effects were reduced by the use of a national cost index, local market conditions may differ.

This is an exploratory study. Future research includes improving the analyses by separating TLAs into cities and districts. An obvious avenue is the search for the range containing the optimal most 'productive scale size' for local authorities, bearing in mind the single focus on highway maintenance. This is a fruitful avenue given that the New Zealand Government is presently considering proposals to devolve the management of local and state highways to a small number of regional organisations. This would remove responsibility for these functions from local authorities and inevitably prompt calls for further defragmentation.

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