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Keywords electricity distribution, ownership unbundling, New Zealand

JEL Classification L94

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OWNERSHIP UNBUNDLING IN ELECTRICITY DISTRIBUTION: EMPIRICAL EVIDENCE FROM NEW ZEALAND

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Abstract

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Section 1: Introduction

The 2007 proposals for the European energy market by the European Commission (referred to as "the Third Package") expresses a clear preference for ownership unbundling as the most effective way of separating energy transmission networks from other stages of the energy value chain.[1] The Commission regards this as necessary in order to promote infrastructure investment, fair network access and market transparency. The balance of costs and benefits from transmission ownership separation is however hotly debated (see for example Pollitt, 2008 and special issue of Intereconomics, 2007).

Although the current discussion at the European level focuses on transmission, it is possible that in future the Commission will consider ownership unbundling further down the value chain, at the distribution level as well. For the time being the Commission's viewpoint on this issue is clear:

> *"…the benefits from further unbundling at the distribution level are not overwhelmingly higher than costs. Due to the recent entry into force of the last liberalisation date in a number of Member States, it would seem to be disproportionate to go a step further in forcing unbundling in this activity."*[2]

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[1] The Commission has indicated that the setting up of an independent system operator is a possible alternative option (i.e. ownership unbundling of system operation and not transmission wires/pipes assets).

[2] European Commission (2007c), page 4.

Nevertheless in some countries or jurisdictions ownership unbundling at distribution level has already taken place. In the UK over the last ten years there has been significant voluntary ownership separation between distribution and commercial activities.[3] In Texas there has been voluntary unbundling between commercial activities and transmission and distribution.[4] The Netherlands recently passed a law requiring ownership separation of electricity and gas distribution networks from commercial activities by 1 January 2011.[5] Outside Europe, New Zealand forced ownership separation at the distribution level in 1998. The forced ownership separation of distribution networks in New Zealand and the resulting economic consequences have received little attention. An examination of the empirical evidence from New Zealand offers a unique opportunity to analyse the impact forced distribution ownership unbundling has.

New Zealand is particularly interesting because initially following the reform of the electricity sector in 1992, regulation was left to general competition policy. There was no explicit sector regulator, but a reliance of light-handed regulation with compulsory information disclosure. In 1998, when further reforms were deemed necessary following limited competition, the New Zealand Government introduced the forced separation at ownership level of distribution and commercial activities. Eventually, in 2001 more specific sector-focused regulation was introduced (the Electricity Commission began operating in 2003).

In this paper we use data from New Zealand to examine the economic consequences of ownership unbundling at the distribution level. As part of our analysis we will examine the one-off transaction costs incurred by integrated utilities, the structural effect on unit distribution costs, and the development of competition in the retail market. The analysis attempts to examine the main

[3] For a discussion see Davies & Waddams-Price (2007).
[4] Since the introduction of retail competition in Texas in 2002, two of the three largest incumbent utilities (CenterPoint and American Electric Power) have taken voluntary steps to fully divest their competitive activities from regulated transmission and distribution. For a discussion of competition in Texas see Abid & Zarnikau (2006).
[5] Ministry of Economics Affairs, the Netherlands (2007).

proposed benefits of ownership unbundling using a dataset from 1995 to 2007. As ownership unbundling was introduced in 1998, this dataset allows us to compare *pre* and *post* unbundling. The structure of this paper is as follows. In Section 2 we discuss the different degrees of unbundling and the theoretical arguments for ownership unbundling. In Section 3 we provide an overview of the empirical evidence on the impact of ownership unbundling. In Section 4 we discuss the New Zealand electricity market and the events leading up to, and following, the ownership unbundling in 1998. In Section 5 we present our testable hypotheses and a priori expectations. In Section 6 we discuss the data available. In Section 7 we report the results and finally in Section 8 we provide concluding remarks and policy implications.

Section 2: The theoretical and political arguments for distribution ownership unbundling

Many electricity markets around the world have been restructured (see Sioshansi and Pfaffenberger, 2006, for an overview). Common features have been the breaking-up of monopolies, privatisation of state-owned utilities, the introduction of wholesale electricity markets (and spot markets), freedom of choice for consumers of electricity, and the incentive regulation of networks. The sector has been made competitive where competition was deemed possible (generation and retail) and regulation has been introduced in those parts where natural monopolies prevented effective competition (transmission and distribution networks). The networks required a regulator to ensure non-discriminatory access for all parties at reasonable tariffs (as New Zealand demonstrates). In many instances the networks have remained part of the integrated utility. Various forms (and degrees of) unbundling are possible. The four most common forms of unbundling (in increasing intensity) are: (i) management unbundling, (ii) accounting unbundling, (iii) legal unbundling, and (iv) ownership unbundling.

The lightest form of unbundling is management unbundling. This form of unbundling entails setting up separate management for the operation of the network. This business unit can have

separate management accounts, but is not required to publish (audited) accounts. Accounting unbundling requires the network operator to publish separate (audited) accounts for the network operation business. These accounts are then open to the public and regulatory scrutiny. Legal unbundling requires the owner of the network to set up a separate legal entity that is responsible for the operation of the network assets. This legal entity has its own accounts, management, and Board of Directors. Ownership unbundling is the most extreme form of unbundling. Under ownership unbundling, a separate company owns and operates the network assets. This company is not allowed to have the same shareholders as the company that owns the generation and/retail activities (or the maximum amount of cross-shareholding is limited to a low level).

In the EU legal unbundling is required in all Member States for transmission and distribution of electricity from generation and retail. [6] Although many of the transmission networks are held by separate companies, the distribution networks on the other hand are predominantly still all part of integrated utilities.[7]

The literature on the impact of different forms of unbundling is reviewed in a transmission context in Pollitt (2008). Among the small number of relevant theoretical papers one by Bolle and Breitmoser (2006) suggests that legal unbundling is superior to ownership unbundling for utilities in general. The authors focus on allocative efficiency only. They suggest that the advantage of ownership unbundling is that the regulator reduces prices closer to costs, but the disadvantage is the introduction of double marginalisation (an inefficient transfer price) between the formerly integrated incumbent's separated businesses. The paper then suggests that it is very unlikely that the advantages of better regulation can outweigh the double marginalisation effect. However, this

[6] Directives nr. 96/92/EC and 98/30/EC. In the summer of 2003 two new Directives nr. 2003/54/EC and 2003/55/EC were agreed that altered the original Guidelines and were meant to be implemented before July 2004. Under these Directives all business customers should be free to choose their supplier from 1 July 2004 and all residential customers from 1 July 2007. It also requires legal unbundling for transmission by 1 July 2004 and by 1 July 2007 for distribution. It foresees regulated Third Party Access and requires each country to establish a regulator (Germany has been the exception in the EU – but has recently established a regulatory authority responsible for energy – BundesNetzagentur). In January 2007 the European Commission (2007c) announced plans that integrated energy companies should separate – at ownership level – their energy infrastructure (electricity and gas networks) from commercial activities (retail and generation/production of electricity and gas). We discuss this in more detail later in the paper.

[7] A few smaller integrated utilities have chosen for early ownership unbundling ahead of the legal requirement in the Netherlands.

paper is unrealistic. First, double marginalisation assumes a one-part price. This is not the case in network service pricing, where multipart pricing is practised and marginal prices often equal marginal cost. Second, the paper assumes that regulators only reduce prices and fail to induce actual productive efficiency savings as a result of tighter price regulation. Third, the paper ignores the impact of unbundling on competition, which can be expected to increase when businesses are ownership unbundled (as in Joskow and Tirole, 2000), further reducing costs and prices. Incorporating more realistic modelling to address these issues could reverse their conclusions.

Substantial analysis has been performed in the Netherlands in the run up to the requirement to unbundle both electricity and gas distribution networks from all commercial activities at ownership level by 1 January 2011.[8] There were several arguments for proposing the structural separation. According to the Government a separate network company would be easier to regulate because inter-company relationships would be removed. This would increase transparency and thus remove any possibilities for cross-subsidisation. In the Government's view, the increasing internationalisation of the energy market would lead Dutch companies to become part of larger European energy players. By separating the networks and keeping them in public ownership, competition could take place across these networks. The public shareholders of these integrated utilities would then be offered the possibility of privatising the commercial parts of the business and thereby decrease their exposure to the commercial activities (and raising revenue from asset sales). The discussions on the costs and benefits of ownership unbundling have been heated and protracted. The stakes in the unbundling discussion are thought to be large, as the networks represent a substantial part of the asset base and generate a stable cash flow that reduces the overall risk profile of the energy companies.[9]

[8] For an overview of the discussions and considerations see Baarsma *et al*. (2007) de Nooij & Baarsma (2007), CPB (2005), Arts & Elskamp (2007), and the Ministry of Economic Affairs website (www.minez.nl).
[9] Several of the larger utilities have announced consideration of legal steps against the Government in order to claim financial compensation.

Many arguments have been put forward both in favour and against ownership unbundling at the distribution level. Some of the arguments are politically motivated, such as the fear of losing control over part of the business to foreign owners or the fact that it is not required under European Directives. In turn some arguments are economically motivated, such as loss of synergies or scope economies. We have bundled the arguments for ownership unbundling under three headings: (i) Competition, (ii) Quality, and (iii) Costs. In our view all the substantive economic arguments put forth fall into one of these categories – although it is likely that some are interrelated.

Competition

Ownership unbundling is posited to have a positive effect on competition. The main arguments here are that ownership unbundling will prevent the possible abuse of a monopoly position on the network. This could occur by denying or restricting access to the network to competing retailers. Therefore, separating ownership of the network and commercial activities will remove the incentive for the network operator to discriminate. Possible cross-subsidisation of commercial activities using the stable cash flows from the network business will also no longer be possible if the two activities have different owners. Separating the network business from the commercial activities will also remove the financing advantage of commercial activities relative to non-integrated companies. It is likely that the riskier commercial activities will be able to benefit – in terms of financing costs – from being part of an integrated company with stable and predictable network income.[10] Finally, separating the two activities will remove the "holding discount" and should unlock value by increasing focus and therefore the competitive drive.[11] By separating the ownership of commercial and network activities the contestability of customers will increase and is likely to benefit competition. This increase in competition can also spur innovation in the sector.

[10] The removal of the inherent advantages of retailers that are part of an integrated business versus stand-alone retailers is often referred to as creating a "level playing field".
[11] The argument here is that the sum of the parts is greater than the whole (this argument may clearly be at variance with the previous one)

Ownership unbundling could also have negative effects on competition. One argument is that separation will lead to an acceleration in the consolidation amongst players and could lead to a new form of vertical integration where the separated retailers look for asset-backing. By asset-backing we mean that retailers will try to match their supply portfolio with a portfolio of equal generating capacity, thus reducing dependence (and associated risk) on wholesale electricity markets. This could then result in strong players with a both a retail and generation portfolio and causing *de facto* foreclosure to stand-alone retailers or generators. In situations where integration of generation and retail is already the norm, existing generation-retail companies might simply buy up the separated retailers in order to create more balanced portfolios with no increase (and possibly a decrease) in competition.

Quality

Ownership separation is also posited to have positive effects on the investment levels and subsequent quality of the network. By removing the aforementioned cross-subsidisation and cross-financing, more financial room is available for the network owner to invest. This increased investment potential is likely to have positive effects on quality.[12] Besides the increased financial room for investments, there may also be less strategic reason for restraining or reducing investments in the network once separated from commercial interests. Increasing capacity on the network for example could "invite" more competition, to the detriment of the commercial activities.

The counter argument here is that separation leads to a lower overall capital base, thus reducing the debt capacity of the company and reducing the ability of invest. It is likely however that the stable cash flows from the network should facilitate raising capital and or that mergers could occur between distribution network companies.

[12] It should be noted that given the high capital intensity of electricity distribution there is likely to be a substantial delay between new investments and noticeable impact on quality.

Costs

There are a number of arguments why ownership unbundling could have a positive impact on costs. The removal of cross-subsidies and cross-financing will have a structural influence on costs. The removal of the former will reduce costs by removing unfavourable cost allocation keys for example. The removal of the latter will result in a more favourable rating – there is less risk without the commercial activities – therefore reducing the financing costs. In the case of costs, the separation is also likely to increase focus and unlock latent value (the aforementioned holding discount).[13] From a regulatory perspective, the separation will increase transparency and therefore increase and facilitate regulatory scrutiny, this likely to have a downward impact on costs, in jurisdictions where regulators are effective.

On the other hand there are a number of possible negative effects on costs as a result of ownership unbundling. There are likely to be one-off transaction costs involved with the unbundling, such as advisory fees, new IT systems, and contract renegotiations due to the forced break-up. Separation will also remove potential synergies and economies of scope, such as sharing IT platforms and call centres. The reduction in financing costs for the network company will not necessarily offset the increase in financing costs for the commercial company – due to the non-linear relationship between risk and risk premia – leading to an overall increase in costs in the sector. Finally, the separation of the companies could lead to double marginalisation – again increasing the overall costs in the sector.

CPB (2005, 2006) and Nooij (de) & Baarsma (2007) have attempted to quantify the welfare consequences of the unbundling proposals in the Netherlands. CPB (2005, 2006) conclude that unbundling is welfare neutral, but becomes positive when positive effects for distributed generation

[13] One of the additional reasons for separating the companies and using the Holding discount argument in the Netherlands was to allow public shareholders, such as local or provincial authorities, to privatise the commercial activities and unlock value, whilst the monopoly network activities remained in public ownership.

are assumed or the possibility for (partial) privatisation is included. The authors note however, that it is very difficult to estimate the benefits or costs.

The Nooij (de) & Baarsma (2007) paper sets out a comprehensive cost-benefit framework and analyses each of the aforementioned arguments in detail. From their analysis they conclude that the main benefits of unbundling are greater efficiency in generation resulting from increased competition, and better-focused and therefore more efficient distribution companies. The main costs are the permanent higher cost of the unbundled organizations (the permanent reorganization cost). The net welfare consequences are negative in all but one case, which the authors consider unrealistic.

Section 3: The empirical evidence so far

Relatively little empirical analysis has been done to examine the specific welfare consequences of ownership unbundling at distribution level. Michaels (2006) reviews 12 papers on vertical integration in electric power and finds that 11 show benefits to vertical integration. Of these 11, eight test the separability of generation from either transmission alone, or a combination of distribution and transmission, while the remaining three examine vertical economies between generation and distribution. It also seems to be the case that analysis of US data also seems to show that vertically integrated utilities have lower distribution costs than non-integrated utilities: Kwoka & Pollitt (2007) and Nillesen & Pollitt (2008) find this for distribution wires business costs.

Davies & Waddams-Price (2007) examine whether co-ownership of a network and commercial activities in the UK confers advantages on the company by investigating whether local market shares are significantly higher. Davies & Waddams-Price examine the situation of a regulated monopoly distribution company, and an incumbent who retains some market power in the retail market. In this case there is concern about whether a vertically integrated company can influence

the effectiveness of the regulation and so "lever" its monopoly advantage to deliver (or protect) market power in the downstream market. The company has an incentive to transfer costs from the retail activity to the regulated network activity – thereby increasing costs for rivals and protecting the downstream market. In addition, the transfer of costs to the regulated business is likely to mean that these costs will not be "competed away" immediately. In the UK seven of the fourteen regional electricity companies have undergone voluntary ownership unbundling. Using a panel model of market shares they find that the reduction in market share of the incumbent is significantly slower for integrated companies than for separated companies. On average, in any one year, the market share of an integrated company has been more than 8 percent higher than for a separated company.

The above mentioned papers indicate that there is no clear empirical evidence to support ownership unbundling. This is because on the one hand there is evidence of vertical economies of integration and on the other evidence that unbundling facilitates competition. However, what has not been studied is the effect of changing distribution ownership on costs and hence social welfare.

The lack of definitive econometric evidence on reform effects clearly illustrates the need for further work on this now that we have more experience of reform. However the problems of co-incidence with other reform steps and difficulties in modelling underlying resource costs will continue to be an issue.

Section 4: New Zealand reforms

In this section we provide an overview of the key developments in the New Zealand electricity market. For a full review we refer to Bertram (2006), Evans & Meade (2005) and the New Zealand Ministry of Economic Development (MED) for a chronology of the reforms.[14]

[14] Available at http://www.med.govt.nz/templates/MultipageDocumentTOC____6477.aspx.

New Zealand is a country comparable in size (in terms of square km) with e.g. Germany. However, the total population is only approximately 3.5 million. As the country consists of two main islands, the electricity sector is self-reliant and there is no cross-border electricity trading.

Total installed capacity in 2006 was somewhat less than 9 GW with annual production of about 42 TWh. Hydro, gas, coal and geothermal generation accounted for 55 percent, 22 percent, 12 percent, and 8 percent of the total electricity generation, respectively. Other fuel types including oil, biogas, waste heat, wood, and wind represented the remaining 3 percent. The reliance on hydro implies that (marginal) costs of generation will be low and depend on water inflow (rain and snow), and thus wholesale spot prices fluctuate strongly. Furthermore, the hydro lakes are located predominantly in steeply sloping river valleys, which mean that changes in rainfall conditions quickly have an impact on generation capacity.

Consumption – both domestic and industrial – is concentrated on the north-island (especially Auckland), while a substantial part of production is on the south-island. Moreover, due to the north-south division in consumption versus production and the small number of consumers, the transmission network is relatively large and transmission costs are relatively high.
In order to structure the developments in the New Zealand electricity market and the events that led up to the forced ownership unbundling of the distribution networks we have identified four phases. Phase I runs from 1987 to 1992, Phase II runs from 1992 to 1998, Phase III runs from 1998 to 2000, and finally Phase IV runs from 2000 until now.

Phase I: 1987 – 1992 Gearing-up for liberalisation

The State Supply of Electricity Act 1917, the Electric-power Boards Act 1918, and the Municipal Corporations Act 1920 largely determined the development of the electricity sector in New Zealand for the 20th century. These Acts gave the Government the sole right to acquire, construct, and

maintain generation assets, but not sell directly to consumers. It also set-up separate power districts, which allowed power boards or local authorities to supply electricity (known as Electricity Supply Authorities ESAs). The ESAs could not compete with each other but held area franchises authorising them to distribute and retail energy in their respective area.

The ESAs had secure monopoly franchises but their Boards were accountable to consumers via regular elections, which had the effect of maintaining continual pressure on management to maintain high standards of supply and seek only small profits.

In 1986 the Government announced its decision to reform the generation and transmission sectors of the electricity industry. The New Zealand Electricity Division (NZED) of the Ministry of Energy became the Electricity Corporation of New Zealand (ECNZ) in 1987. The Ministry of Energy retained the policy and regulatory activities. Following the creation of ECNZ, the company set up a subsidiary to act as the transmission system operator (TSO) of the high voltage transmission network (Transpower). The Government amended the Electricity Act 1968 to allow ESAs to generate electricity themselves and procure from other persons than the state.

In 1989, the Electricity Task Force (which consisted of Government departments, ECNZ and ESAs) issued several recommendations for the industry: (i) Separate ownership of generation and transmission, (ii) no large scale break-up of generation but further study of limited generation break-up and creation of wholesale market (subject to this, ECNZ to be privatised), (iii) transmission to be owned by club of generators and distributors, (iv) ESAs to be corporatised and privatised, (v) removal of statutory franchise areas and obligation to supply, and (vi) the development of a light-handed regulatory regime.

In 1991 the Establishment Board (set up with a brief to oversee the establishment of Transpower as a separate corporate entity from ECNZ) published a report in which it recommended ownership of

Transpower by a "club" of ESAs and generators. The Board also recommended a process for separation of Transpower from ECNZ (i.e. transmission unbundling). Following this, two important pieces of legislation were prepared: (i) the Electricity Act 1992, and (ii) the Energy Companies Act 1992.

Phase II: 1992 – 1998 Liberalising the market

From 1992 to 1995 significant reforms took place in the New Zealand electricity market. The Energy Companies Act 1992 provided for the corporatisation of the ESAs. Ownership of Boards became the subject of share ownership plans that were incorporated in establishment plans. Diverse ownership patterns resulted among the 44 ESAs of which: (i) 21 consumer trusts, (ii) 10 partial consumer trusts, (iii) 1 cooperative, (iv) 9 local council operated ESAs, and (v) 3 investor-owned.

The Electricity Act 1992 provided inter alia for: (i) **deregulation**: the removal of distributors' statutory monopolies and of the obligation to supply, (ii) **self-regulation**: ring-fencing of network business and mandatory information disclosure focusing, (iii) **provision for price controls**: implicit threat of regulation in Act, and (iv) **maintenance guarantee**: compulsory maintenance of line services until 2013 (20 years).

The Government set-up Transpower (the TSO) as a stand-alone state-owned company. The Electricity Market Company (subsequently renamed The Market Place Company) was set up, to support the electricity market framework for wholesale trading. The Electricity (Information Disclosure) Regulations 1994 came into force for the ring-fenced network companies. The regulations were designed with the aim of enabling customers and analysts to identify any excess profit component in network pricing. These regulations required public disclosure of: (i) separate audited financial statements for natural monopoly and potentially competitive businesses, (ii) prices and other main terms/conditions of contracts, (iii) financial performance measures, based on

standard asset values and with removal of any elements of double counting of asset related expenditure, (iv) efficiency and reliability performance measures, (v) costs and revenues by tariff category, and (vi) line charges.

In 1995 the Government announced the steps it would take in the lead up to the opening of the wholesale electricity market, *inter alia*: (i) ECNZ to be split into two competing companies (ECNZ and Contact Energy which commenced operations in 1996, with a market share of 22 percent of total electricity production), (ii) six small hydro plants owned by ECNZ to be sold, (iii) remaining assets of ECNZ and Contact Energy not to be sold, and (iv) special constraints on ECNZ to apply until its market share fell to 45 percent (including a cap on building new capacity, ring-fencing new capacity, and high level of firm capacity to be offered by tender for long-term contracts).

Between 1992 and 1998 a number of problems were identified with the market and discussions started taking place for ownership separation. **Competition**: switching rates were low and price levels did not decrease following liberalisation. In fact prices increased for residential consumers. **Generation**: there was a lack of competition in the generation market. There were only two players in the market: ECNZ and Contact Energy. **Technical**: there was no system to reconcile the distribution of electricity and no standard profiles to estimate the load share of individual customers. **Distribution price inflation and monopoly rents**: there were concerns that network operators were able to extract additional profits by re-valuing their network assets and justifying price increases of electricity distribution (see Bertram & Twaddle 2005).[15] **Economies of scale**: although the corporatisation of the ESAs had taken place, it was felt that economies of scale were to be gained if network operators merged and consolidated their activities. **Cross-subsidies**: there was concern that integrated companies could subsidise retail activities or inefficient generation

[15] There was pressure to increase prices so as to cover the increased need for investments. In order to allow prices to increase, the asset values of the companies were increased up to replacement costs. This was based on Baumol *et al*.'s (1982) contestability theory. That is to say, in the process of competing for the market, a natural monopoly would be unable to price above the limit at which a new entrant would be attracted.

schemes with profits from the monopoly networks. **Access**: the Government was concerned that integrated companies could restrict access to the networks.

According to Kalderimis (2000) there was a lack of evidence and proper analysis of: (i) monopoly rents, (ii) cross-subsidies, and (iii) access. Kalderimis (2000) argues that most of the advisors at the time highlighted the lack of competition in the generation market and lack of technology for competition in the retail market as substantial issues. Although most parties acknowledged the risk of monopoly rents for network companies, they argued that this risk would not subside if ownership unbundling took place. The fundamental problem here was a lack of proper regulation of network monopoly charges. The key regulatory instrument was the threat of price control, better disclosure of information, asset valuation rules[16], enhanced Commerce Act penalties, and funded information analysis, however this was clearly not credible.

Although the Government did adopt the recommendations above, it nevertheless maintained that an ownership split was necessary and consistent with the light-handed approach to regulation. The Electricity Industry Reform Act (EIR) was introduced in 1998. The EIR was enacted on 8 July 1998.

Phase III: 1998 – 2000 Structural reform

Under the Electricity Industry Reform (EIR) Act 1998 several important changes were made to the electricity sector: (i) corporate separation of lines and energy businesses was to be achieved by 1 April 1999 and full ownership separation no later than 31 December 2003, (ii) ECNZ was split into three competing state-owned generators (Genesis Power, Meridian Energy, and Mighty River Power), and (iii) The Electricity (Information Disclosure) Regulations 1999 came into force,

[16] The companies subverted this with asset revaluations, which masked rising rates of return (see Bertram & Twaddle, 2005).

replacing the 1994 version. In addition, the industry was forced to facilitate switching by restructuring the metering and reconciliation in the sector.

The EIR prohibited the same party being involved in both a network business and a company that sold or generated electricity. The EIR prohibited a greater than 10 percent overlap in ownership or control and prohibited any parties involved in one type of business holding in aggregate more than 20 percent of the control or ownership in the other type of business. Article 30 prohibited a party increasing their existing cross-involvements under Articles 17 and 18. Two options were given to the companies. **Early split**: If a party complied by 1 July 1999 then there would be a limited exemption from Article 30 until this date. This allowed non-community-owned supply companies to acquire new generation or retail assets. **Delayed split**: If a party complied by 1 January 2004 there would be no exemption from Article 30. The outcome of the EIR was that all the companies chose for the early separation option.[17]

Contact Energy, the ECNZ "babies", and the larger regional energy companies saw an opportunity to expand their business and pursued the acquisition of smaller retailers. The expansion to gain economies of scale was restricted to the corporate energy companies. The wholly community-owned players were legally barred from expanding their commercial activities (Article 46). Following the ownership split, the majority of electricity companies retained their distribution businesses and sold their retail customer base. Between July 1998 and April 1999 nearly all retail operations were sold. Generators expanded into retailing, new companies appeared on the scene.

Of the then 36 integrated businesses, 3 businesses (TrustPower, TransAlta and Central Electric) divested their electricity networks, and continued to operate as an electricity supply business. One business (Wairoa Power) sold all of its assets (its network plus minor generation), exiting the electricity industry altogether. Two businesses (King Country Energy and Waitomo Energy

[17] Top Energy initially decided to delay their unbundling but were acquired by Contact energy.

Services) swapped their electricity assets, with King Country becoming a pure supply business and Waitomo a pure network business. The remainder all elected to retain their electricity networks and sell their retail businesses, along with any generation they owned.

The reasons behind these decisions varied between the players. TrustPower, TransAlta and Central Electric all had significant investments in generation assets, and due to their size, had reasonably sized retail bases to add to through acquisition. Wairoa Power was a very small company operating in a difficult region and the owners did not see that the company's network business would remain viable in the medium term under future regulation. The company originally saw a future in generation, and proceeds from the sale of the network were to be applied towards the purchase (in consortium) of a government owned hydro generation scheme. However, the government delayed the sale of this scheme, which was eventually vested to one of the three new state-owned enterprises that arose from the split of ECNZ. Wairoa subsequently sold all of its assets, including generation, and distributed the proceeds to its shareholders. King Country Energy and Waitomo Energy (now the Lines Company) swapped assets in order to give each a larger scale in their chosen business activities.

The remaining businesses retained their network operations for a range of reasons including: (i) In general, the overwhelming value of the electricity network relative to supply assets (many had no generation assets), (ii) The lack of economies of scale and the perceived risk of electricity retailing in an evolving industry (and where in fact, most retail customers were eventually acquired by gentailers – see below), (iii) The few opportunities to acquire generation assets (as a natural hedge for retail activities), most of which were already owned by TrustPower, TransAlta or ECNZ, (iv) Stable cash flows for shareholders, (v) The primary skill base of the majority of employees, (vi) The match between local assets and local ownership, and (vii) Tangible versus intangible assets.

Powerco's reasons for selling their retail business are summarised in the 1998 Annual Report:

"The logical choice is to focus on our network operation. The barriers to success in electricity retailing are simply too high for a company our size to successfully hurdle so our strategic direction lies in viable joint ventures. Why? Because success in energy retailing will require a very large customer base and wholesale market shares in the region of 20-30%. Without these, retailing companies have little chance of buying electricity at the best price and selling it at reasonable margins while managing the risks associated with fluctuating prices. Margins are likely to be very thin, a situation not new to the industry."[18]

By September 1999 there were eleven retailers in total holding over 97 percent of the market. The 6 major generation/retail combinations (known in New Zealand as "Gentailers") accounted for approximately 50 percent of the total market.

By the end of 2000 there was only a single independent retailer (in addition to the six Gentailers). However, even this player was finally integrated into one of the generators.[19] Bertram (2006) notes that:

"Vertically-integrated generator retailers had a strong competitive advantage over stand-alone retail businesses because of their ability to hold physical hedges within each company whereas independent retailers had either to secure hedge contracts from generators on an extremely thin market, or face the exposure to the spot market."[20]

[18] Powerco 1998 Annual Report, pages 7-9.
[19] We discuss this in more detail later. See also Bertram (2006) page 218 for a discussion of what happened to this player.
[20] Bertram (2006), page 217-8.

In April 1999 the industry introduced a system called "deemed profiling". This allowed retailers to determine the cost of electricity sold to consumers based on average profiles of consumption (using statistical proxies), thus obviating the need to install expensive time-of-use meters. According to Evans & Meade (2005), the original industry's metering and reconciliation agreement (MARIA) imposed costs on new retailers that were higher than their current retail margins. Since the introduction of deemed profiling there has been an increase in competition in the retail market. In the first year of effective competition – following the deemed profiling – 4.8 percent of total customers switched supplier (MED 2000) and this rose significantly afterwards.

In 1999, only six weeks after the EIR had come into effect, the Government proposed to amend the Commerce Act and remove the implicit threat of price cap regulation introducing statutory price controls for all network operators, including Transpower. However, the companies challenged the Government's assumptions through the select committee process. The Bill was not passed into legislation and the industry committed itself to a twelve month price freeze to allow time for an investigation into the industry.

On 3 February 2000, the Government announced a Ministerial Inquiry to examine New Zealand's electricity industry. According to the Minister the "…overall objective with this Inquiry is to ensure that electricity is delivered in an efficient, reliable and environmentally sustainable manner to all consumers."[21] With respect to distribution and transmission, a Ministerial Inquiry was requested to examine: (i) whether changes are required to the regulatory regime for transmission and distribution to ensure efficient prices and service delivery, (ii) whether asset valuations and efficiency assessments should form part of the regulatory regime, (iii) whether the existing information disclosure regulations provide adequate and reliable information for assessing the performance of transmission and distribution companies, (iv) and whether the present incentives for ensuring system security in transmission and distribution are appropriate.

[21] MED (2000).

Phase IV: 2000 The inquiry and subsequent changes

On 13 June 2000 the recommendations from the Ministerial Inquiry were published. The main recommendations for distribution were that the Commerce Commission should be responsible for the content and enforcement of the information disclosure regulations and analysis of line company performance and require recalculation of asset values and mandate future asset valuation methodologies. The Commerce Commission should be given responsibility for developing criteria and thresholds upon which price control should be imposed. The Commerce Commission should be empowered to impose price control (CPI-X) on individual distribution companies (and Transpower) for a maximum of five years. Distribution companies that are majority owned by trusts should be subject to the Local Government Official Information Act, the Public Finance Act and the Ombudsman Act. The Government's decisions on electricity sector reform were announced later in 2000 (the so called "Power Package“).

In 2001 the Electricity Industry Bill 2000 was enacted. The Bill amended four statutes (the Ministry of Energy Abolition Act 1989, the Commerce Act 1986, the Electricity Act 1992, and the Electricity Industry Reform Act 1998). The Commerce Amendment Act (No. 2) gave the Commerce Commission control over the price or revenue of electricity line businesses which breach thresholds set by the Commission. Furthermore it organised that the Commerce Commission would take over the administration of the electricity information disclosure regime including a review of the appropriate asset valuation methodology. In effect, from 2001 the changes to the Commerce Act introduced a sector-specific regulator. The regulatory thresholds defined by the Commerce Commission focus on price and quality. The aim is to induce line companies to reduce prices in real terms whilst maintaining certain quality standards (Commerce Commission, 2003). This is achieved by setting out price paths for regulatory periods following the common CPI-X form. The “target control” as set out in section 57E of the Commerce Act is to ensure that network companies: (i) are limited in their ability to extract excessive profits, (ii) face

strong incentives to improve efficiency and provide services at a quality that reflects consumer demands, and (iii) share the benefits of efficiency gains with consumers, including through lower prices. The Commission's first threshold period for distribution covered August 2001 to March 2004. For Transpower it was August 2001 to June 2004. A new price period (implemented in December 2003) covers the regulatory period of five years beginning on 1 April 2004 of 31 March 2009 for distribution. Transpower had a one year threshold from 1 July 2004 to 30 June 2005 and a new regime is now in place to cover the period to 30 June 2011.

The Electricity Amendment Act 2001 allowed the Government to establish an Electricity Governance Board, if negative reports are received on the Governance Board established by electricity sector (to co-ordinate competition in market) or if the industry was unable to establish a governance board. In addition, it enabled the Government to make regulations on a number of matters (requirement to provide domestic consumers with a low fixed charge tariff option, electricity governance, a complaints resolution system, hydro spill and hedge prices).
The EIR Amendment Act 2001 relaxed the rules on ownership of electricity generation by lines companies, including enabling unlimited ownership of renewable distributed generation by lines companies. The aim of the 2001 amendment was to facilitate the efficient use of distributed generation to support line function services and promote new renewables. Specifically, there were exceptions (i) to own distributed generation up to the higher of 5MW or 2 percent of lines' peak load, (ii) to own unlimited distributed generation from new renewable sources, and (iii) for selling the output of cross-owned generation. In the original EIR trading in financial instruments was prohibited. With the 2001 amendment there was an exception for up to 5MW or 2 percent of peak demand.

In 2003 the Government introduced a sector-specific regulator – the Electricity Commission. The Commission regulates the operation of the electricity industry and markets. It is not responsible

however, for tariff-setting in distribution or transmission – this is the responsibility of the Commerce Commission.

In 2004 further changes were made to the EIR. The EIR Amendment Act 2004 was aimed to promote increased security of supply and competition in the generation market. The key changes with respect to the 2001 amendment were: (i) Exception to own generation up to the higher of 50 MW or 20 percent of lines' peak load capacity limits and unlimited reserve energy, commissioned after 20 May 2003, and (ii) exception to own unlimited generation from new renewable sources.

According to the Ministry of Economic Development there has nevertheless been very little investment in generation by lines companies between 2004 and 2006. This has partly to do with hedging opportunities[22] and not having a retail portfolio to match. It may also be attributable to the small-scale of allowed generation.

In March 2005 and in May 2006 the Government published further consultation documents to review the current legislation – in particular the EIR (MED 2005, 2006). The purpose of the 2005 consultation was to open up a discussion on how lines companies' investment in generation can be facilitated (short of completely removing current ownership restrictions). Industry views were sought on a specific proposal to amend the legislation to allow lines companies to trade in hedge and spot energy markets up to the nominal capacity of their generating plant. As part of the consultation process, several other options have been suggested. Specifically, there were proposals aimed at further relaxation of some aspects of the EIR, with some suggesting that without a complete overhaul of the EIR effective participation of the lines businesses in the electricity generation market would not be possible.

[22] Lines companies cannot hedge the financial risks of selling energy at spot prices which may make potential generation projects costly. Lines companies are limited to selling their output either on the spot market, or to other parties able to manage variations in output from lines companies' generation (MED 2006).

The options discussed in the 2006 discussion paper included allowing lines companies to trade in electricity hedges and relaxing some arms-length separation rules for lines companies involved in generation. A draft Bill (EIR Amendment Bill 2007, see MED, 2007) has been developed based on the policy decisions made after consultations undertaken since 2005. In this draft Bill the Government has decided to amend the EIR. The purpose of this Bill is to implement three main policy changes.

The first is to make it easier for owners of lines businesses to facilitate the sale of generation they were permitted to own under the 2001 and 2004 amendments. The aim is to encourage the owners of lines businesses to invest in permitted generation, especially generation from new renewable energy sources. The important changes, inter alia, are: (i) allowing trading in financial hedges (to manage spot market risks), and (ii) allowing (within limits) to share staff and facilities between the network business and the generation activities.

The second main change is to limit the ownership separation requirements to those geographic areas where the network and generation/retail are co-located. The Government does state that:

> *"At the same time, existing ownership separation rules are retained where lines and supply are co-located. This is because co-owned, co-located lines and supply businesses have both the incentive and ability to lessen competition in retailing and local generation. Ownership separation removes this incentive and ability."*[23]

The third main change is to widen the definition of renewables to include all possible forms of renewable energy instead of the current definition which excludes hydro and geothermal generation using traditional technologies.

[23] MED 2007a, page 8.

In November 2007 The Government announced further proposed changes to the Commerce Act (MED 2007c). With respect to the regulation of the network businesses a number of important changes are proposed. First, a new "default/customised" price path regime will replace the current threshold regime. This form of regulation would provide the Commission with the ability to set sector wide control terms in a cost-effective way using comparative benchmarking. Second, an information disclosure regime for 100 per cent consumer trust-owned electricity lines businesses where there is a very high overlap (over 90 per cent) between customers and owners of the business, allowing them to be exempted from government price controls.

Section 5: Measuring the economic impact of ownership unbundling in New Zealand

In this section we discuss how the impact of ownership unbundling can be tested empirically and postulate a number of hypotheses we will test. Following section 2, we group our testable hypotheses by discussing in turn the impact of ownership unbundling on: (i) competition, (ii) quality of the networks, and (iii) one-off and structural costs.

In order to examine the economic impact we have formulated three broad hypotheses following the three categories above and defined some specific sub-hypotheses that are tested using our available dataset.

Hypothesis I: *As a result of ownership unbundling we expect competition to increase.*

One of the main reasons for ownership unbundling is to remove potential financial (e.g. cross-subsidies) and structural (e.g. access restrictions) barriers on the retail market thus increasing the contestability of the market. There is however no single measure for competition that we can analyse to see whether ownership unbundling has had this effect. Measuring competition directly is difficult and we need to rely on indicators of competition. These indicators capture signs of

competitive pressure that allow us to make a diagnosis of whether competition is taking place. Common indicators of competition are prices and the development of prices, the number of competitors in the market and their market shares, switching rates between competitors, market shares of incumbent players, and price-cost margins in the sector. In Table.1 we set out the tests and our *a priori* expectations to examine the impact of ownership unbundling on competition.

[here Table.1]

Hypothesis II*: As a result of ownership unbundling we expect the quality of networks to improve.*

We examine the impact of ownership unbundling on the quality of the networks. *A priori* it is expected that as a result of ownership unbundling the quality of the network to increase. The increase in quality should be the result of increased financial room for investment, assuming the commercial activities are cross-subsidised in an integrated company. However, quality could also deteriorate following ownership unbundling. An integrated company will have a strong incentive to maintain the quality of the network in order to minimise possible negative publicity resulting from e.g. outages. The customer is likely to view the network and the retail of electricity as one product. If outages occur this could reflect badly on the competing retail business and customers could switch to another supplier in the (false) hope that supply will be better then.[24] In the case where the network company no longer has any commercial interests it will have less incentive to maintain the quality of the network. In Table.2 we have defined a number of tests and our *a priori* expectations to examine the impact of ownership unbundling on quality.

[Here Table.2]

[24] Switching to another retailer in this case will not alter the quality of the network as the same network is still needed to transmit and distribute electricity to the customer.

Hypothesis III*: As a result of ownership unbundling we expect one-off transaction costs but subsequently lower unit costs.*

The final argument in favour of ownership unbundling is that it leads to, *inter alia*, an increase in focus within the network business and a reduction of possible cross subsidisation of commercial activities. These "cost" or "efficiency" effects should increase the overall efficiency of the network business. We are therefore interested to examine the costs of the network companies over time. We would expect to see a decrease in the average unit operational costs of network companies as a result of these efficiency gains. We would then also expect the price-cost margin for the network companies to remain the same (i.e. cost savings are passed through in tariff reductions) or to decrease as transparency (and therefore governance or regulatory oversight) increases.

At the same time it is likely that the integrated businesses will have to incur some one-off restructuring costs to comply with the ownership unbundling. In Table.3 we have defined a number of tests and our *a priori* expectations to examine the impact of ownership unbundling on costs.

[here Table.3]

Section 6: Data

We have collected data from various sources. The main sources are the New Zealand Ministry of Economic Development and the Electricity Information Disclosures that are published by the network companies. Unfortunately, not all the data is readily available. The Disclosures provide ample information for the network companies on quality indicators and costs. However, as there has been substantial consolidation amongst network operators it is not always possible to reconstruct the total sector over the full time period the Disclosures are available. The data on competition is scarcer. This is in part due to the commercial sensitivity of this data and the fact that

there was not a single body (until the Electricity Commission) collecting this data in standardised form over the years.

In Tables 4 and 5 we report the data that is used for the testing of Hypothesis I (competition). In Table.4 we report all non-price data (from 1994 to 2007), whereas in Table.5 we report the price data (from 1979 to 2007).

[Here Tables 4 and 5]

Using the Electricity Information Disclosures we have collected data on operational revenue, operational costs and quality indicators for 28 network companies. The data runs from 1995 to 2007.[25] There are data prior to 1995, however due to a major accounting change between 1994 and 1995 the data are less comparable. Table.6 summarises the data for the network companies. This data will be used in the testing of Hypothesis II and III (quality and cost).

[Here Table.6]

The operational costs exclude transmission charges (as these are passed-on) and depreciation charges (as these are non-cash and potentially influenced by the accounting policies of the network company). The cost data is deflated using a PPP index from the OECD. The units distributed are those supplied from the system, rather than those entering the system. The difference is referred to as network losses.

[25] The reporting year runs are not the same as calendar years. The reporting years run from to 31 March. For simplicity we use calendar year nomenclature.

In addition we have collected data on one-off restructuring costs using a selection of available Annual Reports from the bigger network operators. Table.7 summarises the available data on one-off restructuring costs. This data allows the testing of Hypothesis III (cost).

[Here Table.7]

Section 7: Results

Hypothesis I*: As a result of ownership unbundling we expect competition to increase.*

I.a. Price levels

Using the data from Table.5 we construct Figure.1 which shows the development of the electricity prices in New Zealand over time.

[Here Figure.1]

From Figure.1 shows that whereas commercial prices have fallen steadily over the time period, the prices for residential consumers have increased. The industrial price has been relatively stable over the same period. Overall this has lead to a stable average electricity price between 1979 and 2007. According to Evans & Meade (2005) the rebalancing from commercial prices to residential prices is a combination between the removal of cross-subsidies following the corporatisation of the ESAs and the introduction of competition where emphasis was on larger customers. With average national prices remaining relatively stable, there has been a shift in revenue source from commercial customers to residential customers. The average residential price pre-unbundling was NZ$ 14.14 cents, whereas post-unbundling it was NZ$ 18.60 cents. For commercial customers this is exactly the opposite, pre-unbundling it was NZ$ 18.99 cents whereas post-unbundling it was NZ$ 13.72 cents. The noticeable increase in residential prices was however part of the underlying motivation to introduce ownership unbundling in 1998.

The overall average price has remained relatively constant. In the period prior to ownership unbundling it was NZ$ 12.53 cents. In the period after ownership unbundling it was NZ$ 13.11 cents and therefore higher than prior to unbundling. The difference is not statistically significant (t-test 1.59) leading us to conclude that the average electricity price has not decreased following ownership unbundling in 1998 and could even have increased. Furthermore, the increase in residential prices looks to have been off-set entirely by the decrease in commercial prices.

Comparing electricity prices is difficult due to the importance of the wholesale electricity price. In New Zealand with an abundance of hydro power production it is even more difficult due to the high volatility of prices when there are hydro shortages. This can have substantial impact on prices. We come back to this point when we examine test I.f (price-cost margins).

I.b. Price variance

The variance of the electricity price provides an indicator on the variability of the electricity price. In markets where there is competition prices vary more widely than in those markets with limited or no competition. Therefore, if competition increased following the unbundling in 1998 we would expect electricity prices to have become more volatile. Our analysis shows that the variance of the national average electricity price prior to unbundling was 0.57, whereas following unbundling the variance was 1.46. This suggests that the electricity price has become more volatile following the 1998 reforms as was expected *a priori*.

I.c. Number of players and concentration

In Table.4 we report the number of retail companies over time and the concentration index (HHI and CR3). As noted earlier in this paper at the time of ownership unbundling rapid consolidation took place. In 1995 there were 43 retailers in New Zealand (all linked with networks). By 1998 there were 36 retailers. However between 1998 and 1999 – when ownership unbundling was

introduced – this number fell to 11 players. Currently there are only 9 players left in the market. At the time of unbundling nearly all the retail companies were acquired by the generators (becoming Gentailers); there are currently no independent retailing companies active. The HHI index shows an increase between 1998 from 715 to 1909 in 1999.[26] Subsequently, it has increased to above 2000. The usual threshold value applied by competition authorities is 1800. The concentration ratio of the three largest players (CR3) also shows a similar pattern. Following unbundling approximately 70 percent of the market is served by the three largest players.

Bertram (2006) discusses the entry and exit of the only serious independent retailer – On Energy (owned by Canadian Trans Alta and sold in 1999 to NGC[27]). On Energy had more than 20 percent retail market share in 2000, but only 5 percent generation capacity. In the dry winter of June 2001 On Energy was unable to hedge its position and was exposed to the spot market where prices soared. NGC's Annual Report 2001 notes:

> "*Wholesale prices increased to up to four times their normal levels, placing a pronounced strain on NGC's cash flows, profitability and financing arrangements, and raising serious questions about the operation of the market itself. NGC decided to withdraw from electricity retailing and completed its exit on August 1, 2001 following the sale of its retail electricity customers to two Government-owned energy companies. NGC's withdrawal from that business closed off future retail exposure to the volatile wholesale electricity market and crystallized the resulting losses.*"[28]

The underlying reason for the exit of On Energy was a mismatch between its supply and generation portfolio. This suggests that the retail assets without asset-backing are substantially more exposed to wholesale prices than integrated Gentailers. It is also demonstrates that the separation of the

[26] HHI stands for the Herfindahl-Hirschman-index which is calculated by summing the squares of the market shares per company. The maximum value is therefore 10,000 (i.e. a single company with 100 percent market share).
[27] NGC is currently part of Vector.
[28] NGC Annual Report 2001, page 5; source: Bertram (2006).

commercial activities from the monopoly network in 1998 subsequently resulted in a reconfiguration where the commercial activities were integrated with generation assets. Bertram (2006) notes that "*The elimination of non-generator parties from the retail market spelt a halt to the process of competition for retail customers, which had briefly flourished in the 2 years following the 1998 separation of lines and energy retail activities*."[29]

I.d. Non-incumbent market shares in former franchise areas

Table.4 shows the market shares of non-incumbents in former franchise areas. This provides information on the market power of the traditional supplier in an area versus non-incumbent suppliers. Following ownership unbundling we expect that this percentage will increase as the contestability of the market is improved. Figure.2 shows the development of the non-incumbent market shares over time.

[here Figure.2]

Figure.2 shows a sharp increase following ownership unbundling 1998 from approximately 5 percent market share of non-incumbents to 26 percent in the subsequent years. The market share has stabilised since 2001. According to Bertram (2006) this was due to On Energy leaving the market.[30] It is not clear whether the increase in non-incumbent market shares can be solely attributed to ownership unbundling. As discussed previously the industry also introduced "deemed profiling", allowing customers to switch more easily at lower cost to the retailer. It is likely that this is also driving part of the increase between 1998 and 2000.

[29] Bertram (2006), *op. cit*., page 218.
[30] Bertram (2006), page 219.

I.e. Price-cost margins

We expect that following ownership unbundling the competitive impulse will reduce the retail margins available in the sector. That is to say, more competition will drive out any excess profits. Analysis by the MED (2004) suggests that the retail/wholesale margin increased between 1995 and 2000, but that the trend has since been broken (until 2003 their last year in the study). In a study by Hutton (2004)[31], reported in Evans & Meade (2005), the author finds that margins rose between 1997 and 2001, but declined between 2001 and 2003. Both studies note that measuring the margin is difficult due to volatile wholesale prices, different mixes of spot and contract prices in company portfolios, lag effects with long term contracts, and differing prices in various regions.

In Table.4 we report the wholesale electricity price from the New Zealand spot market. We assume that the total transmission and distribution revenues need to be earned back through the final electricity price (i.e. we are not correcting for the margins in distribution or transmission – see hypothesis III for a discussion of margins in distribution). Dividing the total revenue figures by the kWh throughput leads to an estimate of the total transport costs. Thus by subtracting the wholesale electricity price and the transport costs from the national average electricity price we get an estimate for the price-cost margin over time. We refer to this measure as "price-cost margin I". Given the difficulty with filtering out the wholesale electricity price or accounting for the large fluctuations we have also constructed an alternative price-cost margin metric. We assume that the average industrial prices will closely following the underlying long term cost electricity. Industrial buyers are likely to be active energy buyers as it forms a substantial part of their cost base. These large contracts are also attractive for retailers as the demand profile is usually flat and it offers substantial volumes (as opposed to smaller consumers like households). We can therefore assume that industrial prices are very competitive. By subtracting the industrial price – as a proxy for wholesale electricity prices – and the distribution costs from the national average price we can get another measure of the price-cost margin over time. We refer to this metric as "price-cost margin

[31] Reference from Evans & Meade (2005), original paper could not be located.

II". The advantage of this metric is its relative stability (see Figure.3), but it does not account for any possible remaining transmission costs that could be allocated to distribution or the margins that are made selling electricity to industrial consumers. However, it should be a close approximation assuming that the transmission costs are relatively stable and assuming that commercial margins for industrial consumers will also be relatively stable and constant. Figure.3 shows both measures expressed as percentages of the national average price over time.

[Here Figure.3]

From Figure.3 it can be seen that the price-cost margin I – using wholesale prices – shows more fluctuation that the price-cost margin II metric. If we focus on the price-cost margin II metric – where we use industrial prices as a proxy for production and transmission costs – we see negative margins between 1997 and 2001. Since 2001 margins have steadily increased. The period with negative margins fits with the evidence of competition flourishing post-unbundling (see non-incumbent market shares) but dying-off post-2001 when On Energy disappeared from the market.

In our analysis so far we have not accounted or corrected for changes in the underlying production costs of electricity. In New Zealand the marginal supply is provided by hydro power. As discussed in the introduction, the hydro lakes are located predominantly in steeply sloping river valleys, which mean that changes in rainfall conditions quickly have an impact on generation capacity and therefore on prices. In 2001 and 2003 for example, there were severe hydro shortages, which resulted in steep price increases (contributing to the bankruptcy of On Energy in 2001). The correlation between the share of hydro production and the wholesale electricity price is approximately -0.57, suggesting that in years with high hydro production the wholesale electricity price is lower. The correlation between the hydro share and the two margin metrics is weaker. In the case of price-cost margin I it is 0.10, suggesting no direct relationship. In the case of price-cost margin II it is -0.40, suggesting higher margins when hydro production is lower.

In order to examine the drivers of the price-cost margin in more detail we specify the following the relationship, using price-cost margin II.

$$\ln(PCII_t) = \beta_1 + \beta_2 \ln(hydro_t) + \beta_3 \ln(HHI_{gen,t}) + \beta_4 EIR_t + \varepsilon_t$$

In this specification the price-cost margin II is explained by the share of hydro production and the degree of concentration in generation. We include a dummy (EIR) to test whether ownership unbundling influenced the price-cost margin. This dummy takes on 0 between 1991 and 1998 and 1 between 1999 and 2007. In Table.8 we report the regression results.

[here Table.8]

Our simple regression shows that the share of hydro production has a negative impact on the price-cost margin. The coefficient is just not statistically significant at the 10 percent level (p-value 0.114). The HHI of generation has a positive influence on the margin is statistically significant at the 1 percent level. The coefficient suggests that a 1 percent increase in HHI will increase the margin by 0.18 percent. The EIR dummy is statistically significant at the 1 percent level and suggests that margins have experienced a one-off increase of almost 22 percent.

***Hypothesis I**: Summary of results*

In Table.9 we summarise the findings for hypothesis I.

[Here Table.9]

The impact of ownership unbundling on competition has been mixed in New Zealand. The national average electricity price has not decreased significantly since 1998, although the variance in prices has. Following ownership unbundling there has been a rapid consolidation amongst the retailers and a reconfiguration of the sector. From vertical integration between retail and distribution, there is now vertical integration between retail and production. With the introduction of deemed profiling and unbundling the market shares on non-incumbent players rose rapidly, but has levelled-off since 2001 following the exit of the only independent retailer, On Energy, from the market. The price-cost margins show a temporary drop between 1997 and 2001 – in line with the temporary increase in competition. However, since 2001 the degree of competition seems to have dropped and the overall margin in the sector has increased. From our simple regression analysis we even find that the margin has increased significantly following unbundling.

When ownership unbundling was proposed there were numerous reactions and estimates of the impact on competition. For example, the Board of Powerco Ltd. stated in their 1998 Annual Report:

"Separation also raises concerns about asset backing. With their networks gone, electricity retailers without generating facilities have no tangible assets, such as power lines, cables and transformers. These assets currently underpin strong credit ratings which are basic to business, including the ability to trade in the wholesale electricity market and borrow in the debt market at lower interest rates." [32]

The 1997 Annual Report of Southpower states:

[32] Powerco 1998 Annual Report, pages 7-9.

"*While mandatory divestment of a business without compensation seems a draconian government policy in this day and age, the Board is comfortable with its general objective to promote competition.*"[33]

Southpower goes on to state that:

"*The split of ECNZ into three generating companies able to enter retail trading with the advantage of major asset backing…and a national surplus of generating capacity equivalent to several years' demand growth, will create greater wholesale market competition than previously experienced.*"[34]

Orion is also positive. In their 1998 Annual Report they state that:

"*However it [competition] is gathering momentum, and given a little more time the reforms will not only work, but appear to the general public to work, and result in lower electricity prices to end-customers.*"[35]

However, not all parties were convinced that ownership unbundling would have positive effects. In their 1999 Annual Report, UnitedNetworks was critical:

"*It is fair to say the whole industry has been through an evolution that has created confusion for customers, employees, shareholders, and the public alike. The companies have incurred huge restructuring and reestablishment costs. The stated political expectation of immediate price reductions for all consumers was at best naïve and at worst misleading.*"[36]

[33] Southpower Annual Report 1997, page 13 (network later to become Orion and retail business sold to TransAlta).
[34] Soutpower Annual Report 1997, page 14.
[35] Orion Annual Report 1998, page 2.
[36] UnitedNetworks Annual Report 1999, page 11.

Murray and Stevenson (2004, p. 18) report to the Electricity Commission that "customer switching figures seem to have declined and stabilized over a period when prices have been rising" and that "price trends suggest electricity prices are probably higher on average than they would be in a workably competitive market".

***Hypothesis II**: As a result of ownership unbundling we expect the quality of networks to improve.*

II.a. Network losses

The loss ratio is an indicator of the technical and administrative quality of the network. Technically, transmitting electricity results in losses in the conductor (through heating). This type of electricity loss is called resistive loss and is a physical property of electricity transmission. Resistive losses on a network are difficult to influence in the short term. It is possible to reduce certain losses by using different technology. However, given the long life-cycle of distribution investments it is likely that a fixed loss percentage will remain regardless of ownership unbundling. Administratively, some electricity losses may occur as a result of the misallocation of electricity flows between different retailers and customers using the network. All the electrical flows across the network need to be allocated to the retailers using the network. This allocation is complex, certainly when there are many different retailers and customers can easily switch. Therefore, it is common that a certain percentage of electricity remains unaccounted for and cannot be allocated to a particular retailer. This is referred to as administrative losses.

From Figure.2 we know that the non-incumbent market share increased substantially following ownership unbundling and the introduction of deemed profiling. We would therefore expect that (administrative) losses show an increase between 1998 and 2000 due to the administrative burden associated with the increase in switching. However, *a priori* we expect this to be temporary and to fall back to normal levels once systems and procedures are in place. Figure.4 shows the weighted-average loss ratio over time.

[here figure.4]

In Figure.4 we see the weighted average loss ratio increase from 5.4 percent in 1999 to 5.8 percent in 2000 and then back down to 5.3 percent in 2001. This seems to fit our *a priori* hypothesis. The average loss ratio over the whole time period is 5.5 percent and remains relatively stable over time period. The average pre- and post-unbundling do not differ statistically (*t*-value 0.21).

II.b. Capacity utilisation

Capacity utilisation measures the extent to which the network company uses the available capacity. It measures the difference between the actual utilisation relative to the maximum possible utilisation of the network. The greater the capacity utilisation, the more efficient the network company is using its network to serve its customers. However, given the need to continuously meet supply and demand in electricity, it is also necessary to have some reserve margin in the capacity. The peak pattern in electricity consumption also means that average capacity utilisation figures for electricity networks may seem low. We expect that capacity utilisation will naturally increase over time as the electricity consumption per connection increases and the investments in networks are "lumpy". In the case of unbundling, we would expect that capacity utilisation increases following unbundling. Network companies will become more efficient and thus will exploit their network more than in the integrated situation. Figure.5 shows the weighted-average capacity utilisation over time.

[here Figure.5]

Figure.5 shows an increasing capacity utilisation over time. It seems that capacity utilisation decreases between 1997 and 1999 and then shows an upward trend. There is no statistical difference however between the average pre- and post-unbundling (*t*-value 1.54).

II.c.d.e. SAIDI, SAIFI and CAIDI

The most common quality measures for electricity networks are outages. This is directly noticed by customers. There are three outage indicators: (i) System Average Interruption Duration Index (SAIDI), (ii) System Average Interruption Frequency Index (SAIFI), and (iii) Customer Average Interruption Duration Index (CAIDI).

SAIDI is the most commonly used measure of outages. It measures the average annual number of minutes a retail customer is without service. It is calculated by dividing the sum of all customer interruption durations by the number of customers served. SAIFI measures the number of interruptions per year and is calculated by dividing the total number of interruptions by the number of customers served. Whereas SAIDI measures the minutes without power, SAIFI measures the number of times without power. CAIDI is calculated by dividing SAIDI by SAIFI and gives the average outage duration that any given customer would experience. It can therefore be viewed as a proxy for the average restoration time. *A priori*, we expect the quality of the networks to increase following ownership unbundling. Figures.6, 7, and 8 show the development of SAIDI, SAIFI and CAIDI over time respectively.

[here Figures.6,7,8]

SAIDI demonstrates a sharp decrease following ownership unbundling and a sharp increase in 2007. SAIFI shows a longer term downward trend, whereas CAIDI remains relatively stable with the exception of 2007, where there is also a similar sharp increase as with SAIDI. SAIDI increases from 134.3 minutes lost in 2006 to 195.0 minutes lost in 2007. SAIDI for Orion (with a 10 percent market share weighting) increases from 59 minutes in 2006 to 150 minutes in 2007. In Orion's 2007 Network Quality Report an extreme snow storm is cited as the reason behind the sharp

increase in SAIDI.[37] According to this report SAIDI for Orion without the snow storm would have been 45 minutes. Likewise Vector states in their 2007 Electricity Information Disclosure that "*the increase is mainly due to a Transpower outage on 12 June 2006 and other extreme events.*" (Vector Electricity Information Disclosure 2007, page 28). This is the same day as the extreme snow storm mentioned by Orion.

The weighted average SAIDI pre-unbundling was 191.4 minutes, whereas post-unbundling it was 136.2 and excluding 2007 128.9 minutes. The difference between the average SAIDI pre-unbundling and post-unbundling (including 2007) is statistically significant at the 1 percent level (*t*-value 3.88).[38]

The weighted average SAIFI pre-unbundling was 2.7, whereas post-unbundling it was 1.8.[39] The difference between average SAIFI pre-unbundling and post-unbundling is statistically significant, with a *t*-value of 7.72.

The weighted average CAIDI (average restoration time) pre unbundling was 71.8 minutes, whereas post unbundling it was 75.1, and excluding 2007 70.8 minutes. The difference between the average restoration time pre- and post-unbundling is not statistically different (t-value 0.47 with 2007 and 0.36 without 2007).

Based on the empirical evidence we can conclude that both SAIDI and SAIFI have been lower following unbundling in 1998. However, we cannot test whether there is a casual relationship between the two. That is to say, we cannot state that as a result of ownership unbundling quality has improved. We can only observe that quality has improved following unbundling.

[37] The report states: "The June 2006 snow storm was the worst weather event to affect the rural Canterbury electricity network in more than three decades, causing extensive damage to our network and cutting power supplies to thousands of rural residents" and "Canterbury has had big snow storms in the past, but what made the 2006 storm particularly severe was the type of snow that fell. It was a 'wet' snow – a heavy mixture that weighed down lines, poles and trees. As a result, we had widespread faults on our system which disconnected around 8,000 rural customers on the morning of Monday 12 June." page 6.
[38] Excluding 2007 increases the statistical significance substantially and the t-value becomes 6.80.
[39] Excluding 2007 does not alter the average substantially as SAIFI measures frequency rather than duration.

II.c.d.e. Quality variance

As a result of unbundling we do not only expect the quality of the networks to increase, but we also expect the quality to be more consistent. In other words, we expect fewer fluctuations in the quality. To examine whether the consistency has increased we measure the variance pre- and post-unbundling. We look at SAIDI, SAIFI and CAIDI only. In the case of SAIDI the variance has increased from 41.7 pre-unbundling to 752.8 post-unbundling. For SAIFI the variance has decreased from 0.058 pre-unbundling to 0.028 post-unbundling. CAIDI on the other hand also shows an increase in variance from 16.3 pre-unbundling to 181.5 post-unbundling.

It seems that the fluctuations in quality have increased following unbundling. However, there are only four data points pre-unbundling (1995-1998), which might influence the accuracy of the variance measure pre-unbundling.

***Hypothesis II**: Summary of results*

In Table.9 we summarise the findings for hypothesis II.

[here Table.9]

On balance it seems that quality has improved since ownership unbundling. The two main indicators of quality, SAIDI and SAIFI, are statistically significantly lower post-unbundling. This suggests that ownership unbundling has had positive effects on quality. However, we have not tested whether there is a casual relationship between the two. Furthermore, the results need to be treated with care as investments in distribution networks can take a long time to actually impact the underlying quality of the network. It is therefore possible that the time period over which we are measuring quality changes is too short to draw any definitive conclusions. Ideally, investment behaviour would need to be measured to assess the impact of ownership unbundling.

Hypothesis III*: As a result of ownership unbundling we expect one-off transaction costs but subsequently lower unit costs.*

III.a. One-off costs

We expect that as part of the structural separation between commercial and network activities companies will be faced with one-off restructuring costs. The 1999 annual reports of the larger ESAs reported substantial costs associated with the EIR. We have examined the annual reports of Powerco, Vector, and United Networks. All three companies report losses as a result of, *inter alia*, the forced sale of electricity contracts associated with the retail business. Some of these costs can be seen as transfers rather than real costs. However, in the absence of ownership unbundling these contracts would not have been transferred at prices below their value to their initial owners. In Table.7 it can be seen that the total cost incurred by Powerco, Vector, and United Networks in 1999 was NZ$ 102.8mln (1999 prices). Assuming that these three companies are representative for the total one-off restructuring costs incurred in the sector, we can scale up the costs according to their combined market share. This implies a total one-off cost to the sector of NZ$ 210.6 mln (1999 prices) or NZ$ 267.3 mln (2007 prices). This is equivalent to NZ$ 237 per customer (2007 prices).

III.b. Structural costs

A priori, we expect ownership unbundling to have a positive impact on the underlying cost structure of the network companies. Three effects could take place that we would want to examine. First, there may be a one-off reduction in the level of operational costs due to unbundling. Therefore, unbundling structurally influences the level of average costs at the time of unbundling but does not alter the path of average costs over time (i.e. there is a simple shift in the cost curve but the slopes before and after unbundling do not change). Second, unbundling could structurally change the development of unit costs over time – thus altering the path of average costs over time (i.e. the slope term changes after unbundling). Finally, it is possible that both effects take place. That is to say, at the time of unbundling there is a one-off downward correction in average costs

and the subsequent development of average costs over time is significantly different from the development of average costs before unbundling. We do not account for non-network cost effects in generation or retail.

Table.6 shows that the total operational cost increased at a compound annual rate of 2.8 percent, whilst the units distributed and customers grew at a compound annual rate of 5.7 percent and 5.1 percent respectively. As a result the operational costs per unit distributed and per customer decreased at a compound annual rate of 2.7 percent and 2.2 percent respectively.[40] In Figure.9 the development of unit costs over time is shown.

[Here Figure.4]

Figure.9 shows a sharp fall in unit costs between 1998 and 2001 by approximately 31 percent following the EIR. It seems that some extra operational costs were made in the run-up to the ownership unbundling in 1998 as the unit cost is higher than the previous two years (approximately 8 percent). The average price between 1995 and 1998 was NZ$ 0.021 and between 1999 and 2007 NZ$ 0.016 (a 24 percent reduction). This difference is statistically significant (*t*-value 4.97). *Prima facie* therefore it seems that ownership unbundling in 1998 was beneficial by driving down unit operational costs.

However, the decrease in average operational unit costs could also have been (partly) the result of (i) scale economies and consolidation, and (ii) general technological progress. There have recently been a number of sophisticated studies that have attempted to examine economies of scale in distribution. There have been studies on the economies of scale in Sweden (Hjalmarsson and Veiderpass, 1992), Norway (Salvanes and Tjotta, 1998), England and Wales (Burns and Weyman-

[40] As the growth in customer numbers is similar to the growth in units distributed, we will focus on the latter for the remainder of the analysis.

Jones, 1996), Switzerland (Filippini, 1996), Canada (Yatchew, 2000), and New Zealand (Giles and Wyatt, 1993). All these studies find evidence of scale economies in distribution. Interestingly, the New Zealand distribution system exhausts the economies at relatively modest scale, while others have more persistent economies.

In the New Zealand study Giles and Wyatt report that as far back as 1959 there were proposals for 26 network companies (down from the then 83 ESAs). Their empirical analysis using data from 60 ESAs from 1986/87 shows that there are economies of scale. Using a translog cost model they estimate an elasticity of cost with respect to output of 0.661, implying that a 1 percent increase in output at the firm level results in only a 0.66 percent increase in costs.

It is therefore likely that part of the efficiency improvement can be attributed to the rapid consolidation in the sector following ownership unbundling. In 1995 there were 43 network companies with an average size of 555 GWh distributed. By 2007 however were just 28 network companies left with an average size of 1,083 GWh distributed. The average size of the companies doubled in 12 years. Figure.10 shows the HHI index over time for the network companies.

[Here figure.10]

Figure.10 shows that the HHI increases from 670 in 1995 up to 1640 in 2007. The sharp decrease in unit costs following the ownership unbundling in 1998 seems to have occurred as the network sector consolidated.

We wish to examine the impact of ownership unbundling on unit operational costs but account for scale effects and technological progress. We therefore specify a cost function and use the panel dataset of 28 companies between 1995 and 2007 to examine the effect of the EIR. A standard cost function, following Kwoka (2005a, b), would take the following form:

$$C_D = C_D(Q_D, P_D, X_D)$$

Where C_D denotes distribution operational costs, Q_D denotes distribution output, P_D denotes factor prices, and X_D denotes exogenous factors that affect distribution costs. It is common to define output (Q_D) as the units distributed (U_D). However, distribution costs can also be a function of transformer capacity (T_D), customer numbers (N_D) and the size of the network (L_D). Given the likely correlation between the units distributed, number of customers, and transformer capacity, inclusion of any one of the variables will capture the impact of scale of distribution costs. The impact of customer numbers and network length can be combined as connection density to capture an often cited driver of distribution costs beyond the control of management (i.e. an exogenous factor). Connection density influences the cost structure in two ways. Greater customer numbers increase servicing and administrative costs, while larger territories with greater network length directly affect infrastructure costs. We therefore include connection density (D_D) into the cost function as an exogenous variable, defined as:

$$D_D = \frac{N_D}{L_D}$$

The quality of the network may also influence the underlying cost structure of the network business. Lower quality networks could result in higher operational costs. We include an additional variable $SAIDI_D$ to capture differences in underlying quality that could affect cost levels.[41] The consolidation of the sector from 43 to 28 ESAs is possibly an additional cost driver for distribution costs. Our dataset includes the companies present in 2007 (28 in total) and includes the data from the companies that were taken over or that merged over time. Thus, the increase in concentration is

[41] SAIDI stands for System Average Interruption Duration Index and measures the average annual number of minutes a retail customer is without electricity.
service

implicitly included in the data. Finally, we include two dummies. One trend dummy ($Trend_D$) to capture technological change over time and one unbundling dummy (EIR_D) to capture the introduction of ownership unbundling. This gives the following panel Cobb-Douglas cost specification:

$$\ln(C_{it}) = \beta_1 + \beta_2 \ln(U_{it}, T_{it}) + \beta_3 \ln(D_{it}) + \beta_4 \ln(SAIDI_{it}) + \beta_5 EIR_{it} + \beta_6 \ln(U_{it}, T_{it})^2 + \beta_7 \ln(D_{it})^2 + \beta_8 \ln(SAIDI_{it})^2 + \beta_9 EIR_{it}.\ln(U_{it}, T_{it}) + \beta_{10} EIR_{it}.\ln(D_{it}) + \beta_{11} EIR_{it}.\ln(SAIDI_{it}) + \beta_{12} Trend_{it}$$

Where *i* denotes the company and *t* denotes the year. The model includes multiplicative dummy variables to test whether the slope coefficients change as a result of ownership unbundling. We have further specified a quadratic cost function as opposed to a translog specification. Here we implicitly assume that there is only one output (U_D or T_D), rather than multiple outputs without substitution possibilities, and that the other factors are exogenous (X_D). Both the quadratic and translog cost functions have been used in the literature to estimate cost functions, where the two specifications make different assumptions about the homogeneity of input prices. We assume that factor prices are the same for all the companies in our sample (and therefore exclude them from our analysis) and are therefore less concerned with the quadratic or translog specification.

Panel data allows the regression analysis to cover both a spatial and temporal dimension. The spatial analysis examines the cross-sectional data, whereas the temporal examines the periodical data. In other words, panel data analysis allows a number of companies (in our case 28) to be followed over a number of years (in our case 13 years). This also implies that corrections may be necessary for the non-spherical disturbances that occur in cross-sectional and time-series regressions, heteroskedasticity and autocorrelation respectively.

The two most commonly applied panel data analytical models are fixed effects models and random effects models.[42] In the fixed effects models the intercepts between the cross-sectional units (in our case the companies) are assumed to differ. Thus, although the assumption is made that are no significant temporal effects, there are significant differences between the constant terms of the companies. This could be the case e.g. if the companies operate in different conditions. Because fixed effects estimators depend only on deviations from their group means, they are sometimes referred to as within-groups estimators (Davidson and MacKinnon, 1993). The main disadvantage of fixed effects models is that in the case of many cross-sectional units it may require a substantial amount of dummy variables in the specification – this dummy requirement reduces the available degrees of freedom and thus the statistical power of the model.

In the random effects models the model has a random constant term. In this case the assumption is made that there is no correlation between the unobserved company-specific random effects and the regressors. Using a random effects model is more powerful and parsimonious as it does not require additional dummies. However, if there is correlation between the unobserved company-specific effects and the regressors, the random effects model would be inconsistently estimated and the fixed effects model would be more suitable.

A priori, we assume that there are unobserved company-specific effects, such as other environmental variables (besides connection density), that could influence the underlying cost structure. We therefore specify the panel cost model with fixed effects and test whether a random effects model can be applied.

Table.11 reports the results from our panel data regression. The results we present follow a specification and model search. We observed a high degree of multicollinearity between the standard regressors and the dummy multiplicative regressors. Given our sample size we were

[42] See Greene (2003) for an overview of panel data analytical models.

forced to exclude these regressors. The quadratic regressors were found to be statistically insignificant and were dropped. Given the high degree of correlation between customers, output and transformer capacity, we chose to use transformer capacity.

[Here Table.11]

Table.11 reports four panel regressions. In the columns two and three of Table.11 we report both a fixed and random effects panel regression correcting for possible autocorrelation and heteroskedasticity using the cluster function to get robust standard errors. The results from the Mundlak test are reported. The Mundlak test is a statistical test between fixed and random effects model specifications.[43] The p-value for the Mundlak test is 0.350, meaning that we cannot distinguish between the fixed and random effects specifications. In this case the random effects model is preferred given the higher degree of statistical efficiency. However, given the fact that we are using time series data there is possibly some form of autoregression. To correct for this effect we specify the panel regression to account for first order autoregression (AR(1)). Columns four and five report these panel regression results. The rho measures the degree of autoregression in the dataset. The value is 0.506, suggesting some autoregression. For the two panels we again test whether we can use the random effects specification. The Mundlak test shows a p-value of 0.101, which is just not statistically significant at the 10 percent level. For the discussion of the results we focus on the random effects model corrected for autoregression (order 1) and those coefficients that are statistically significant.

The coefficient on transformer capacity is statistically significant at the 1 percent level and is less than one, suggesting there are economies of scale in the network business. In other words, a 1 percent increase in transformer capacity (to meet an output increase for example) results in a 0.82

[43] See Mundlak (1978); the Mundlak test is similar to the Hausman test between fixed and random effects.

percent increase in operational costs. This coefficient is higher than Giles & Wyatt (1993) find for 1987 (0.661).

The coefficient on SAIDI (quality) is also statistically significant at the 1 percent level. This suggests that a 1 percent increase in minutes lost due to outages will increase operational costs by 0.11 percent.

The dummy on ownership unbundling is statistically significant at the 1 percent level. This suggests that ownership unbundling had a negative (one-off) impact on unit operational costs. The effect of ownership unbundling is approximately a one-off saving of 17.2 percent.

The empirical evidence suggests that there has been a substantial drop in unit operational costs following unbundling. Our panel regression analysis shows that approximately 17 percentage points of the decrease can be attributed to the introduction of ownership unbundling. Unfortunately, our dataset does not allow us to test whether there has also been a structural change in the development of unit costs following unbundling.[44] Furthermore, there may have been a number of other factors that we are not accounting for contributing to the sharp decrease in average operational costs, such as the overall effect of liberalisation, the increased threat of regulation, and the "polishing" of the numbers for the transactions. We have not been able to correct for these effects. However, it does seem that ownership unbundling provided a strong impulse to realise substantial cost savings.

[44] For example, the Board of Powerco Ltd. stated in their 1998 Annual Report: *"We cannot take a positive view of the Government's decision to split our line business from our energy retailing and generating business... Some separation was always expected, but not the total split requiring separate Boards, staff and systems and limiting cross-ownership to 10%. Enforced separation means additional operating costs. We estimate the duplication required will come at a cost of NZ$2 million to NZ$3 million a year to Powerco and that cost will inevitably be borne by customers."*

III.c. Network price-cost margins

We expect that the price-cost margin for the network companies to either stay the same over time or to decrease. Therefore, the substantial operational cost savings reported in II.b would filter through into lower tariffs (and lower operational revenues). This would then result in similar margins over time. One of the arguments for ownership unbundling has also been the increased oversight and transparency for network companies. Thus, over time we could also expect price-cost margins to decrease following ownership unbundling.

Bertram & Twaddle (2005) examine the price-cost margins of the network companies. Their analysis shows that price-cost margins have increased from NZ$ 1.63 cents per kWh in 1995 to NZ$ 2.64 cents per kWh in 2002 (2002 prices). The increased margins were justified by asset revaluations according to Bertram & Twaddle. In Figure.11 we show the price-cost margin for network companies using our dataset. The price-cost margin is defined as the difference between the unit operational revenues and the unit operational costs as a percentage of unit operational revenues.

[Here Figure.11]

From Figure.11 we can see that the price-cost margin has steadily increased, but has stabilised since 2001 at approximately 62 percent. Bertram & Twaddle (2005) find similar mark-ups. This all suggests that even though there were substantial operational cost reductions, these reductions were not passed on to consumers in the form of lower tariffs. It is possible that some of the additional profits were passed to customers in the form of post-tax rebates (in the case of trust-owned network companies).

***Hypothesis III**: Summary of results*

In Table.12 we summarise the findings for hypothesis III.

[here Table.12]

Our results show that there have been substantial one-off restructuring costs that have been incurred by the companies as a result of ownership unbundling. At the same time there have been significant reductions in unit operational costs that can be attributed to the ownership separation. However, the reduction in unit operational costs have resulted in a similar decrease in unit operational revenues, suggesting that margins in the network sector have increased rather than remained stable or even decreased following unbundling (as they might have done had regulation of distribution charges been tighter).

Section 8: Conclusions and policy recommendations

In 1998 New Zealand decided to force ownership unbundling between the commercial activities and the monopoly network activities. This structural remedy was deemed necessary by the government to increase competition in the electricity market. The vertical integration between commercial activities (such as retailing) and the networks could lead to unwanted cross-subsidisation, access discrimination, and blunted incentives to realise efficiencies and promote innovation.

We defined three main hypotheses to test the effects of ownership unbundling on (i) competition, (ii) the quality of the network, and (iii) the costs of the network companies.

Our analysis shows that competition has only partially and temporarily benefitted from ownership unbundling. The temporary increase in competition resulted in some pressure on margins and an increase in market shares for non-incumbent players. At the same time following unbundling all the retail companies were acquired by the incumbent generators leading to a new form of vertical integration. The only independent retailer, On Energy, was forced to exit the market in 2001 due to exposure to the wholesale power markets. Since 2001 competition has stagnated and margins have started to increase. Our analysis shows that part of the increase in margins can be attributed to ownership unbundling. New Zealand average prices have not changed pre- and post-unbundling – although the limited effect of greater wholesale price volatility on average prices may demonstrate some more price stability for consumers. The question remains whether the removal of vertical integration between retail and network outweighed the anti-competitive effects of the subsequent vertical integration between retail and generation. Bertram (2006, page 216) notes that *"The anti-competitive effect of vertical integration of generation with retail had not been foreseen at the time of the 1998 separation of retail from distribution networks*". Overall we conclude that competition has not benefitted from ownership unbundling to the degree that was predicted at the time. In total two out the five tests were positive.

The quality of the networks has improved substantially over time period of our dataset. It seems that ownership unbundling has been beneficial and has resulted in better performance. The network loss statistics show an increase during the brief increase in competition, suggesting increased switching and subsequent reconciliation issues. Overall we conclude that quality has improved since ownership unbundling. In total two out the six tests were positive – although these related to SAIDI and SAIFI which are the most common measures of quality. A longer time period is required to draw any definitive conclusions on quality as there are substantial time lags between investments and quality improvement.

Our analysis of network costs show that there have been substantial one-off transaction costs associated with ownership unbundling. The operational costs have decreased significantly as a result of unbundling. Our analysis suggests a 17 percent decrease in unit operational costs can be attributed to unbundling. However, the decrease in costs has not resulted in a similar decrease in tariffs. Price-cost margins for the network companies has increased rather than remained stable or decreased. This suggests the cost reductions have resulted in larger profits rather than lower tariffs. Overall we conclude that ownership unbundling has produced one-off costs but can reduce operational costs substantially. However, in New Zealand this has not resulted in any consumer welfare through lower tariffs. In total two out the three tests were positive.

The empirical evidence we have presented does not provide a complete picture from which we can judge the success of ownership unbundling. Ideally the effects of ownership unbundling on the underlying behaviour and cost structure of the generators and retailers would need to be included. However, the empirical evidence from New Zealand does offer some useful policy recommendations for distribution ownership unbundling.

First, structural remedies may have unforeseen and irreversible consequences. In New Zealand one form of vertical integration (retail-distribution) was swapped for another form of vertical integration (retail-generation). The possible vertical foreclosure effects of retail and generation combinations may in fact be worse than allowing retail companies to be integrated with network companies. The evidence from New Zealand demonstrates that pure stand-alone retail companies – without any asset-backing – are unlikely to survive in competitive electricity markets given the volatility of wholesale markets. Therefore, any unbundling legislation should take into account the fact that retail businesses will seek the stabilising effect of generation assets. The fact that the separation requirements in New Zealand are currently being relaxed underpins this conclusion.

Second, the evidence from New Zealand shows that competition only temporarily increased until with rapid consolidation a new market structure with gentailers was created. Ownership unbundling

may therefore only have temporary effects, rather than being a structural solution to ineffective competition. The evidence from New Zealand suggests that things like (i) being able to switch at low cost, and (ii) a liquid and open wholesale market may be far more effective in allowing competitors to enter the market.

Third, the empirical evidence from New Zealand suggests that there are substantial one-off restructuring costs to be taken into account. However, our econometric analysis also shows that ownership unbundling can have a significant impact on unit operational costs. This suggests that there are possible benefits from unbundling network companies from commercial activities from a pure cost perspective. However, the example of New Zealand also demonstrates that cost reductions need not necessarily result in tariff reductions. Therefore, ownership unbundling with the associated increase in transparency and possible oversight will not necessarily result in benefits for customers through lower tariffs. In the case of New Zealand a strong sector-specific regulator could have avoided this margin increase. Thus, the regulatory structure in the sector should be taken into account when considering ownership unbundling.

New Zealand has experimented with light-handed regulation and relied strongly on industry structure – in part explaining the introduction of ownership unbundling instead of a conventional independent regulatory agency. The fact that following ownership unbundling a sector-specific regulator has been introduced and the separation requirements are being relaxed suggest that the separation has not generated the results initially hoped for. Our empirical evidence does not provide a clear positive or negative conclusion. On the positive side the ownership unbundling in New Zealand led to substantial cost reductions and increases in quality of service. On the negative side overall competition was reduced and prices rose.

Transferring the lessons from New Zealand should be done with care and consideration. Ownership unbundling is not the “silver bullet” with which to achieve a competitive energy markets. This

suggests that policy makers should take care when proposing structural remedies to solve market malfunctioning. The question remains whether a strict regulator enforcing a proven regulatory regime could have achieved more than the current results demonstrate.

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Table.1 Hypothesis I and sub-tests

Hypothesis I: Competition		Indicator measures:	Following ownership unbundling we expect this indicator to:
I.a.	Price levels	The electricity price for the total sector. As a result of increased competition we would expect, *ceteris paribus*, that prices decrease.	*Decrease as competition increases*
I.b.	Price variance	The variance of electricity prices in the sector. As a result of more competition we would expect, *ceteris paribus*, the variance to increase	*Increase as competition increases*
I.c.	Number of players and concentration	The number of players operating in a market. More players and less concentration is an indication of more competition and more customer choice.	*Increase as competition increases*
I.d.	Non-incumbent market shares in former franchise area	The market shares of non-incumbent players in former franchise areas provides an indication of the movement of customers and the success of "new entrants".	*Increase as competition increases*
I.e.	Price-cost margins	The price-cost margin measures the available profits in the sector. In a competitive market margins will decrease to competitive levels.	*Decrease as competition increases*

Table.2 Hypothesis II and sub-tests

Hypothesis II: Quality		Indicator measures:	Following ownership unbundling we expect this indicator to:
II.a.	Network losses	The loss ratio is a measure of the technical and administrative losses of the network. Lower losses suggest a more efficient network.	*Initially increase (following one-off unbundling administrative burden) then decrease*
II.b.	Capacity utilisation	Capacity utilisation measures the degree to which the network is being used at full capacity. A certain minimum spare capacity (reserve margin) is always required.	*Could decrease because network is run more optimally, or could increase as more investment in (spare) capacity is possible*
II.c.	SAIDI	System Average Interruption Duration Index (SAIDI) measures the average annual number of minutes a retail customer is without service.	*Decrease*
II.d.	SAIFI	System Average Interruption Frequency Index (SAIDI) measures the number of interruptions per year.	*Decrease*
II.e.	CAIDI	Customer Average Interruption Duration Index (CAIDI) is calculated by dividing SAIDI by SAIFI and gives the average outage duration that any given customer would experience. It can therefore be viewed as a proxy for the average restoration time	*Decrease*
II.f.	Quality variance	The variance in the quality delivered is likely to vary over time. The stability in delivered quality can therefore be seen as a measure of quality consistency	*Decrease*

Table.3 Hypothesis III and sub-tests

Hypothesis III: Costs		Indicator measures:	Following ownership unbundling we expect this indicator to:
III.a.	One-off costs	There will be substantial one-off transaction costs associated with ownership unbundling.	*One-off costs*
III.b.	Structural costs	Unit operational costs for the distribution companies measures the efficiency of operations over time. There can be both a one-off drop in operational costs and a structurally different rate of change of unit costs	*One-off decrease in operational costs and more rapid unit cost reduction over time following unbundling*
III.c.	Price-cost margins	The price-cost margin in distribution measures the available profits for the network companies. In a more transparent market margins will decrease to competitive levels.	*Decrease in price-cost margin for the sector following ownership unbundling*

Table 4. Overview of Competition data (excluding price data)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of retail companies (#)					43	40	38	36	11	11	10	10	9	9	9	9	9
Number of major generators (#)				2	2	2	3	3	5	5	5	5	5	5	5	5	
HHI retail (#)					614	641	698	715	1,909	2,121	2,018	1,956	1,975	2,044	2,039	2,041	2,039
HHI generation (#)	92,136	92,136	92,136	92,136	88,626	85,280	54,000	47,660	22,660	22,660	21,980	22,460	22,979	22,723	22,999	22,613	22,613
CR3 retail (%)					36.4%	36.9%	37.6%	37.9%	68.0%	71.0%	67.3%	67.0%	67.1%	70.3%	70.9%	71.4%	71.8%
CR3 generation (%)									68.0%	68.0%	68.0%	70.0%	74.2%	74.9%	76.0%	76.3%	
Annual average non-incumbent market share (%)				2.9%	3.9%	4.1%	3.7%	5.9%	10.7%	20.6%	28.9%	29.1%	30.9%	30.9%	26.8%	28.5%	27.8%
Transmission revenue (2007 NZ$ cents per kWh)	2.53	2.54	2.46	2.10	2.07	2.08	1.98	1.89	1.84	1.66	1.38	1.49	1.34	1.33	1.41	1.34	1.37
Distribution revenue (2007 NZ$ cents per kWh)	3.82	3.91	4.22	3.95	3.91	3.94	4.17	4.44	4.43	4.21	3.93	4.28	4.10	4.19	4.10	4.15	4.14
Wholesale price (2007 NZ$ cents per kWh)				4.56	4.55	4.40	4.53	3.56	3.52	3.45	7.93	3.97	8.24	3.54	7.39	7.84	5.16
Share of hydro production (%)	69.5%	65.6%	69.9%	75.4%	77.5%	72.4%	64.2%	68.7%	62.6%	63.7%	58.3%	62.9%	58.8%	64.7%	55.4%	55.1%	54.9%

Sources:

Number of retail companies and market shares estimated using various Annual Reports and Retail Registry Statistics, The Electricity Commission (2008).

Number of generators and market shares estimated using Energy Data Files, MED. 1991-1993 estimated as same as 1994; 2007 estimated as same as 2006.

Non-incumbent market share data based on Stratagen in Betram (2006) for 1994-2004 and ICP statistics from the Electricity Commission for 2005-7. For 2007 only first four months available.

Transmission based on Transpower data.

Distribution based on Electricity Information Disclosures.

Wholesale power prices 1994-1996 from the MED (2000) and for 1997-2007 based on average Mco data.

Share of hydro based on Energy Data Files.

Table 5. Overview of Competition price data

	Residential (2007 NZ$ cents per kWh)	Commercial (2007 NZ$ cents per kWh)	Industrial (2007 NZ$ cents per kWh)	National average (2007 NZ$ cents per kWh)	Price-cost margin I (2007 NZ$ cents per kWh)	Price-cost margin II (2007 NZ$ cents per kWh)	Price-cost margin I (% of nat. ave.)	Price-cost margin II (% nat. ave.)
1979	14.69	27.32	9.72	14.70				
1980	14.49	24.50	9.29	14.05				
1981	13.76	22.43	8.81	13.18				
1982	13.33	21.40	8.68	12.86				
1983	12.80	20.89	8.31	12.43				
1984	12.33	20.20	7.86	11.81				
1985	12.51	20.23	7.98	11.92				
1986	13.20	20.20	8.80	12.60				
1987	13.41	20.23	8.82	12.73				
1988	13.91	19.79	8.85	12.84				
1989	13.64	19.04	8.28	12.38				
1990	13.13	18.07	7.89	11.88				
1991	13.61	17.29	8.01	11.97		0.13		1.1%
1992	14.11	16.97	8.11	12.02		0.00		0.0%
1993	14.61	16.15	7.92	11.96		-0.18		-1.5%
1994	15.15	15.57	7.66	11.80	1.19	0.19	10.1%	1.6%
1995	15.33	15.78	7.98	12.02	1.49	0.13	12.4%	1.1%
1996	15.93	15.62	8.00	12.15	1.72	0.20	14.2%	1.7%
1997	16.65	14.34	8.92	12.68	2.01	-0.40	15.8%	-3.2%
1998	16.17	13.70	9.16	12.56	2.66	-1.04	21.2%	-8.3%
1999	16.29	13.74	8.13	12.22	2.43	-0.35	19.9%	-2.9%
2000	15.86	12.90	7.68	11.54	2.23	-0.34	19.3%	-3.0%
2001	16.50	12.38	7.60	11.61	-1.63	0.08	-14.1%	0.7%
2002	17.34	12.89	8.09	12.35	2.60	-0.02	21.1%	-0.2%
2003	18.30	14.21	9.06	13.31	-0.37	0.15	-2.8%	1.1%
2004	19.81	14.46	8.77	13.72	4.67	0.77	34.0%	5.6%
2005	20.37	14.59	9.52	14.36	1.46	0.74	10.2%	5.2%
2006	20.99	14.01	9.50	14.21	0.88	0.56	6.2%	3.9%
2007	21.97	14.26	9.31	14.67	4.00	1.22	27.3%	8.3%

Source: Ministry of Economic Development, Energy Data File.
National average prices are calculated as residential (including taxes), commercial and industrial prices (excluding taxes) weighted by consumption.
Price-cost margin I calculated by subtracting transmission, distribution and wholesale price from national average.
Price-cost margin II calculated by subtracting the industrial price from the national average.

Table 6 see end of document.

Table 7. One-off restructuring costs due to EIR Act 1998

	Cost NZ$ mln.	Market share	Reason
Powerco	10.0	5.6%	*Loss on disposal of generation assets.*
Vector	50.8	17.7%	*Loss on sale of electricity contracts associated with retail business.*
United Networks	42.0	25.6%	*Restructuring costs and loss on sale of electricity contract.*
Total	102.8	48.8%	
Estimated sector cost (1999 NZ$ mln.)		210.6	

Figure 1. Electricity prices over time

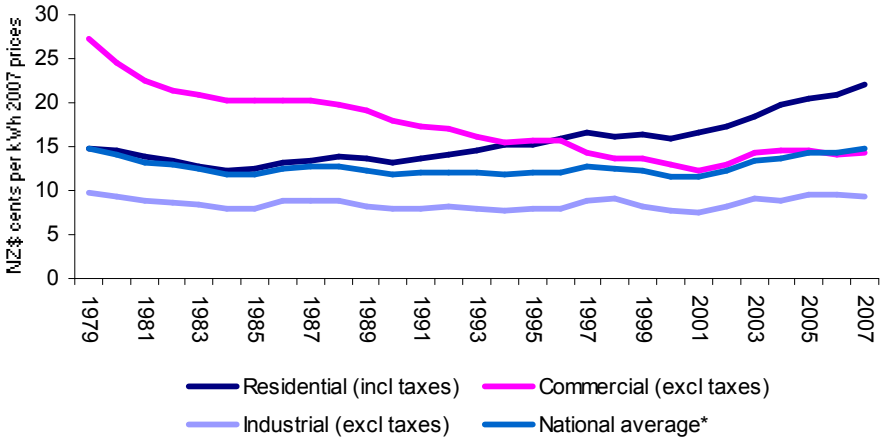

Figure 2. Non-incumbent market share in former franchise areas

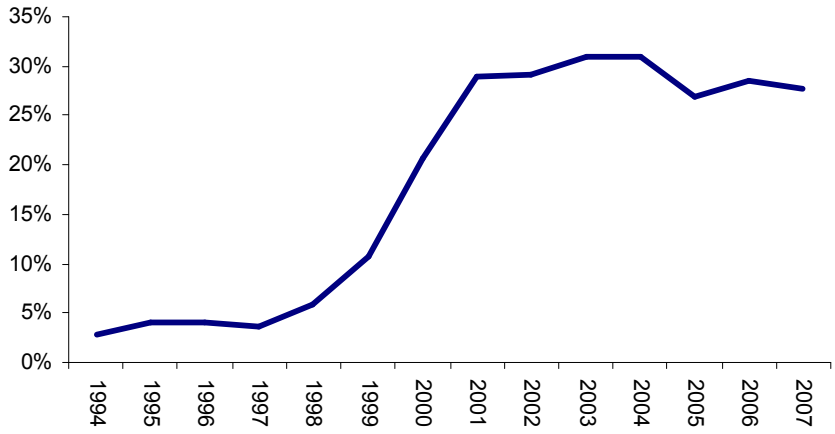

Figure 3. Price cost margins over time

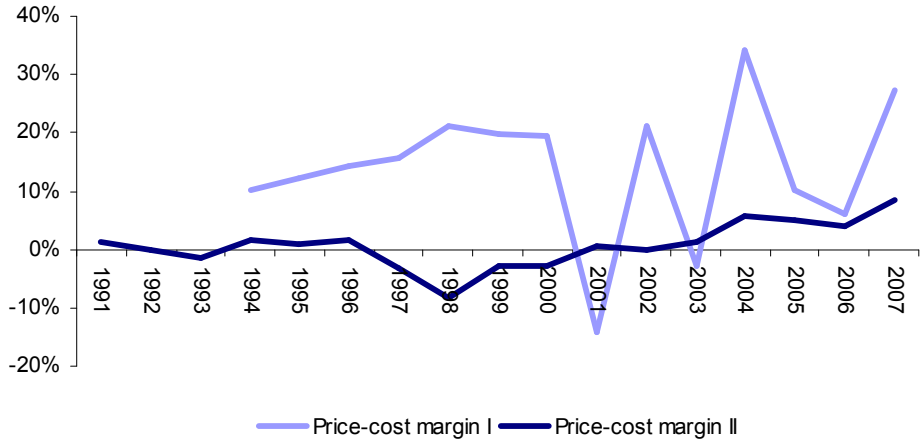

Table.8 regression results margin

	Coefficient
Hydro share	-0.275
	(-0.162)
HHI gen	0.178***
	(0.0573)
EIR	0.218***
	(0.0704)
Constant	0.186
	(0.666)
Observations	17
R-squared	0.54

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
* Note the margins have been scaled up by 10 to ensure all values are positive.

Table.9 Hypothesis I and sub-tests outcome

Hypothesis I: Competition		Indicator measures:	Following ownership unbundling we expect this indicator to…	Empirical evidence suggests…	Criteria achieved?
I.a.	Price levels	The electricity price for the total sector. As a result of increased competition we would expect, *ceteris paribus*, that prices decrease.	*Decrease as competition increases*	*No statistically significant change in national average electricity prices*	*N*
I.b.	Price variance	The variance of electricity prices in the sector. As a result of more competition we would expect, *ceteris paribus*, the variance to increase	*Increase as competition increases*	*Variance in national electricity price has increased following unbundling*	*Y*
I.c.	Number of players and concentration	The number of players operating in a market. More players and less concentration is an indication of more competition and more customer choice.	*Increase as competition increases*	*Number of players has decreased dramatically following unbundling. No retailer active without asset-backing of generation capacity*	*N*
I.d.	Non-incumbent market shares in former franchise area	The market shares of non-incumbent players in former franchise areas provides an indication of the movement of customers and the success of "new entrants".	*Increase as competition increases*	*Market share increased substantially following unbundling although it has stabilised since 2001. Not clear whether increase is fully attributable to unbundling or to introduction of deemed profiling*	*Y*
I.e.	Price-cost margins	The price-cost margin measures the available profits in the sector. In a competitive market margins will decrease to competitive levels.	*Decrease as competition increases*	*Price cost margins look to have temporarily decreased with ownership unbundling and have since recovered. This supports anecdotal evidence of initial intense competition and subsequent reduction in competition*	*N*

Figure.4 kWh-distributed weighted average loss ratio over time

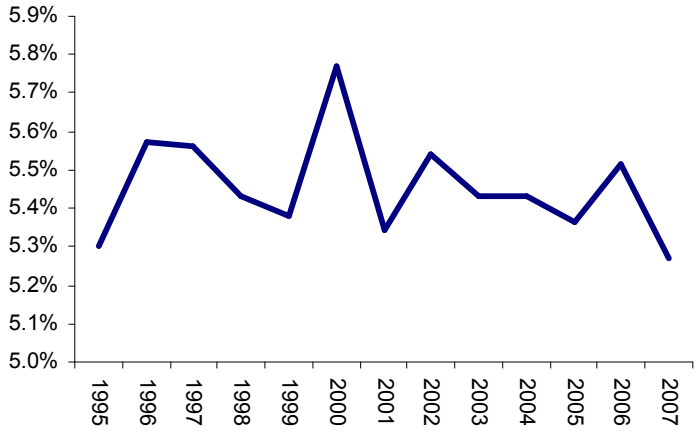

Figure.5 kWh-distributed weighted average capacity utilisation over time

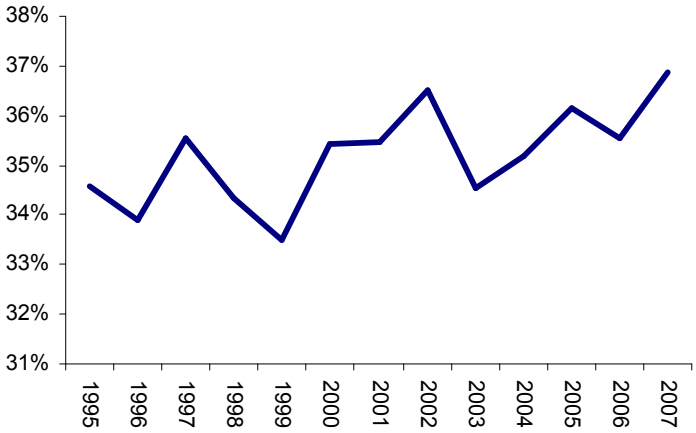

Figure.6 kWh-distributed weighted average SAIDI over time

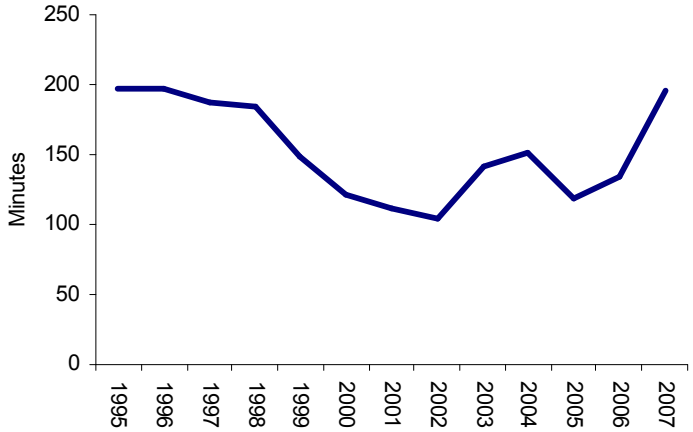

Figure.7 kWh-distributed weighted average SAIFI over time

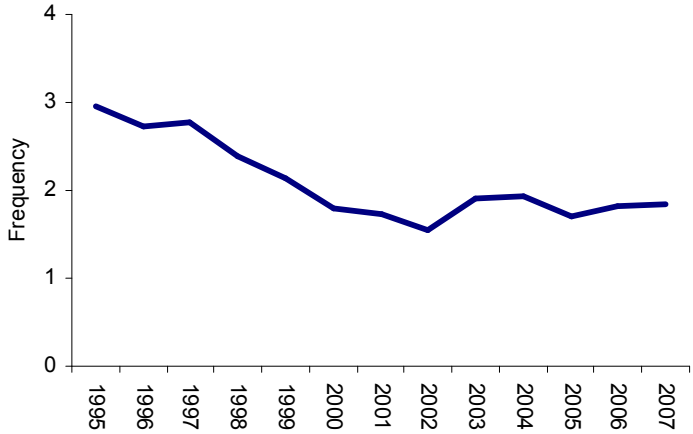

Figure.8 kWh-distibuted weighted average CAIDI over time

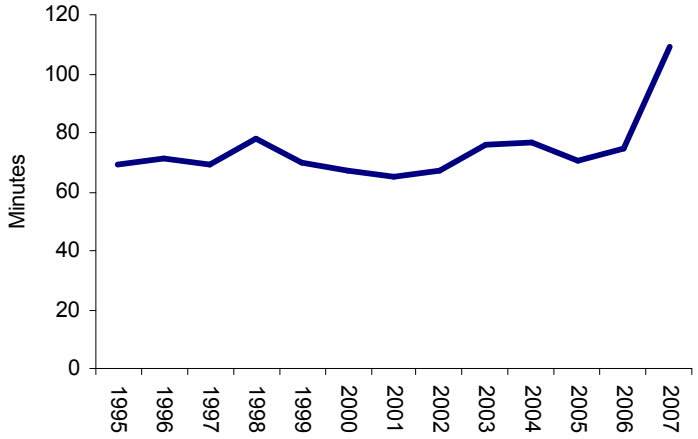

Table.10 Hypothesis II and sub tests outcome

Hypothesis II: Quality		Indicator measures:	Following ownership unbundling we expect this indicator to:	Empirical evidence suggests…	Criteria achieved?
II.a.	Network losses	The loss ratio is a measure of the technical and administrative losses of the network. Lower losses suggest a more efficient network.	*Initially increase (following one-off unbundling administrative burden) then decrease*	*Initial increase then reversion back to pre-unbundling average*	*N*
II.b.	Capacity utilisation	Capacity utilisation measures the degree to which the network is being used at full capacity. A certain minimum spare capacity (reserve margin) is always required.	*Could decrease because network is run more optimally, or could increase as more investment in (spare) capacity is possible*	*Capacity utilisation does not differ statistically pre- and post-unbundling*	*N*
II.c.	SAIDI	System Average Interruption Duration Index (SAIDI) measures the average annual number of minutes a retail customer is without service.	*Decrease*	*Average SAIDI is statistically significantly lower post-unbundling*	*Y*
II.d.	SAIFI	System Average Interruption Frequency Index (SAIDI) measures the number of interruptions per year.	*Decrease*	*Average SAIFI is statistically significantly lower post-unbundling*	*Y*
II.e.	CAIDI	Customer Average Interruption Duration Index (CAIDI) is calculated by dividing SAIDI by SAIFI and gives the average outage duration that any given customer would experience. It can therefore be viewed as a proxy for the average restoration time	*Decrease*	*Average CAIDI is not statistically significantly lower post-unbundling*	*N*
II.f.	Quality variance	The variance in the quality delivered is likely to vary over time. The stability in delivered quality can therefore be seen as a measure of quality consistency	*Decrease*	*Variance has increased post-bundling. However, this could be due to data limitations*	*N*

Figure 9: Operational costs (NZ$) per kWh over time (2007 prices)

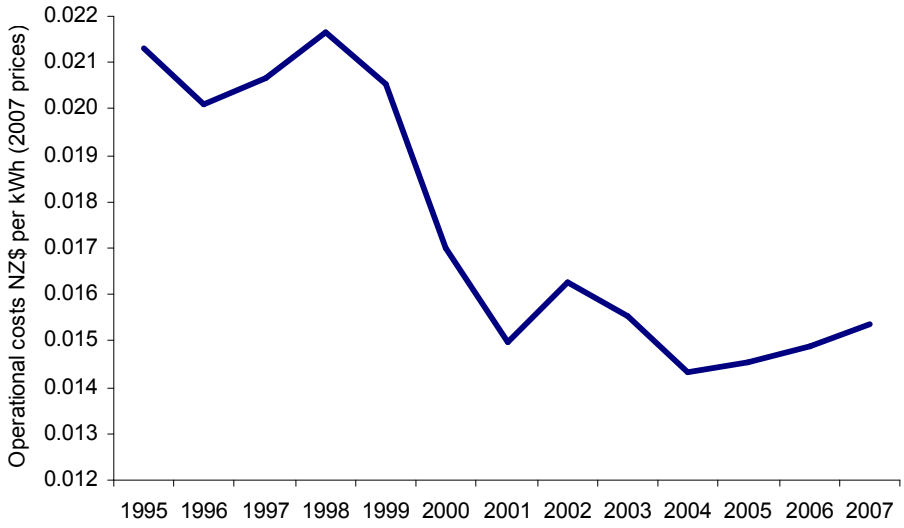

Figure 10. HHI index over time network companies

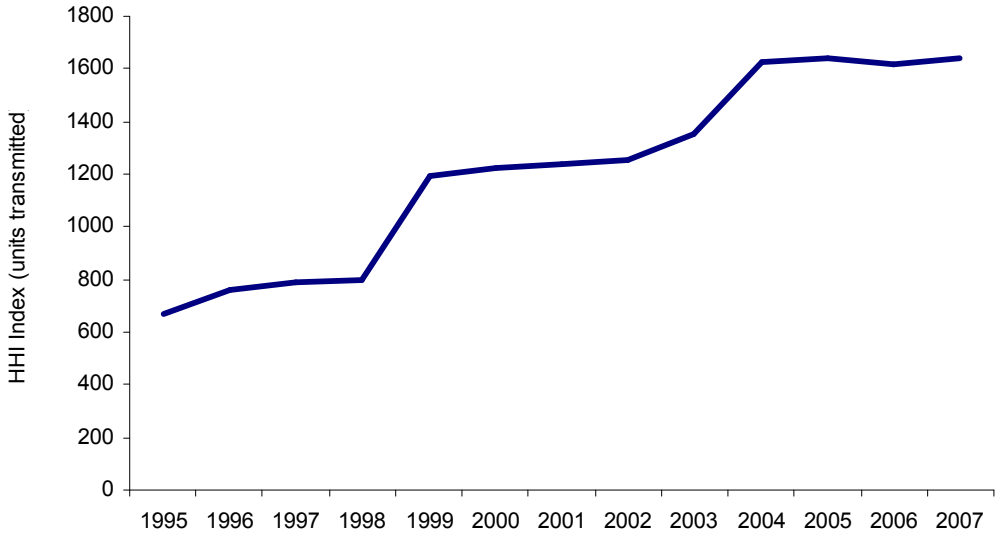

Table.11 Panel regression results

Coefficient	FE (cluster)	RE (cluster)	FE AR(1)	RE AR(1)
Connection density	-0.3610	-0.1250	-0.1920	0.0134
	(0.358)	(0.160)	(0.248)	(0.0944)
Transformer capacity	0.804***	0.864***	0.701***	0.816***
	(0.0887)	(0.0620)	(0.159)	(0.0536)
SAIDI	0.0752	0.0856	0.103***	0.105***
	(0.0609)	(0.0576)	(0.0351)	(0.033)
Trend	-0.0088	-0.0110	0.0014	-0.0080
	(0.00856)	(0.00748)	(0.0111)	(0.00844)
EIR dummy	-0.180*	-0.169*	-0.168***	-0.172***
	(0.0992)	(0.102)	(0.0588)	(0.0591)
Constant	5.153***	4.253***	5.104***	4.097***
	(0.782)	(0.519)	(0.517)	(0.380)
Observations	364	364	336	364
Number of companies	28	28	28	28
rho			0.506	0.506
p -value mundlak test		0.350		0.101

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure.11 Network price-cost margins over time

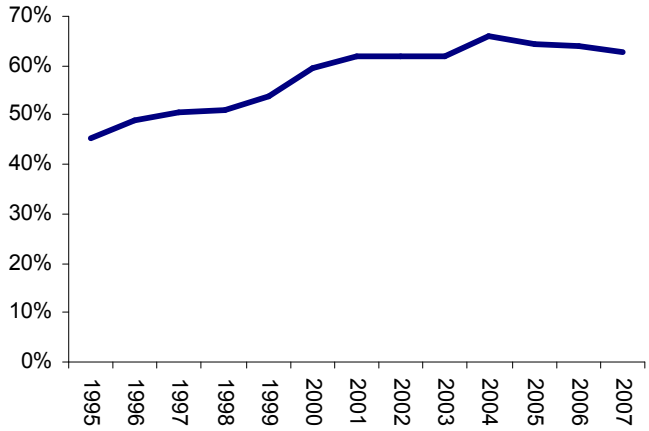

Table.12 Hypothesis III and sub-tests outcomes

Hypothesis III: Costs		Indicator measures:	Following ownership unbundling we expect this indicator to:	Empirical evidence suggests…	Criteria achieved?
III.a.	One-off costs	There will be substantial one-off transaction costs associated with ownership unbundling.	*One-off costs*	*Substantial one-off restructuring costs*	*Y*
III.b.	Structural costs	Unit operational costs for the distribution companies measures the efficiency of operations over time. There can be both a one-off drop in operational costs and a structurally different rate of change of unit costs	*One-off decrease in operational costs and more rapid unit cost reduction over time following unbundling*	*Statistically significant one-off decrease in unit operational costs of approximately 17 percent*	*Y*
III.c.	Price-cost margins	The price-cost margin in distribution measures the available profits for the network companies. In a more transparent market margins will decrease to competitive levels.	*Decrease in price-cost margin for distribution following ownership unbundling*	*Price-cost margins have increased over the time period suggesting tariffs have not been adjusted to account for decrease in unit operational costs*	*N*

Table 6. Overview of operational and quality statistics for the Big Three and Sector Total

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*CAGR*
"The Big Three"														
Vector														
Total operating cost NZ$ mln. (2007 prices)	56.1	62.4	66.1	89.2	126.6	82.8	49.7	69.4	120.0	124.4	126.6	142.1	144.8	*8.2%*
Total operating revenue NZ$ mln. (2007 prices)	168.9	181.3	188.5	216.7	228.5	186.2	194.1	215.2	305.8	416.1	426.9	440.9	464.4	*8.8%*
Electricity distributed (GWh)	4,053	4,454	4,367	4,432	4,364	4,424	4,765	4,885	7,463	9,774	10,243	10,289	10,696	*8.4%*
Customers ('000 #)	243	244	247	251	255	260	266	274	467	644	651	660	672	*8.8%*
Operating cost per kWh (NZ$ 2007 prices)	0.0138	0.0140	0.0151	0.0201	0.0290	0.0187	0.0104	0.0142	0.0161	0.0127	0.0124	0.0138	0.0135	*-0.2%*
Operating cost per customer (NZ$ 2007 prices)	0.2310	0.2560	0.2681	0.3551	0.4965	0.3190	0.1870	0.2532	0.2567	0.1932	0.1944	0.2153	0.2155	*-0.6%*
Network length (km)	8,531	8,582	8,630	8,813	9,014	8,711	8,446	8,579	17,657	27,641	27,732	27,926	28,118	*10.5%*
Transformer capacity (MVA)	2,536	2,835	2,613	2,657	2,275	2,277	2,240	2,349	3,685	4,843	4,930	5,047	5,121	*6.0%*
Loss ratio (%)	4.0%	4.5%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.6%	4.7%	4.7%	4.9%	4.7%	*1.5%*
Capacity utilisation (%)	29.6%	30.0%	36.0%	35.2%	35.5%	39.1%	40.9%	41.8%	35.9%	40.4%	42.3%	41.4%	43.8%	*3.3%*
SAIDI (minutes)	122	116	108	153	81	57	49	51	79	103	82	117	115	*-0.5%*
SAIFI (#)	1.64	1.90	1.83	1.72	1.19	1.01	0.99	0.80	1.30	1.43	1.14	1.50	1.41	*-1.3%*
CAIDI (minutes)	74.5	60.9	58.8	89.1	68.2	56.6	49.9	64.0	61.1	72.3	71.9	78.2	81.3	*0.7%*
Orion														
Total operating cost NZ$ mln. (2007 prices)	50.2	50.4	50.8	48.1	31.0	28.7	36.3	36.4	36.2	40.3	47.1	44.7	41.6	*-1.6%*
Total operating revenue NZ$ mln. (2007 prices)	89.4	97.9	103.9	111.0	119.7	118.1	119.1	115.9	120.2	120.2	116.3	121.4	124.6	*2.8%*
Electricity distributed (GWh)	2,416	2,507	2,530	2,582	2,560	2,601	2,683	2,759	2,914	2,929	3,037	3,098	3,126	*2.2%*
Customers ('000 #)	150	153	155	157	159	163	168	169	172	174	178	181	183	*1.7%*
Operating cost per kWh (NZ$ 2007 prices)	0.0208	0.0201	0.0201	0.0186	0.0121	0.0110	0.0135	0.0132	0.0124	0.0137	0.0155	0.0144	0.0133	*-3.6%*
Operating cost per customer (NZ$ 2007 prices)	0.3336	0.3306	0.3282	0.3063	0.1953	0.1763	0.2164	0.2151	0.2109	0.2308	0.2649	0.2476	0.2270	*-3.2%*
Network length (km)	10,448	10,881	10,988	11,274	11,478	11,521	11,371	11,641	12,083	13,028	13,304	13,748	14,188	*2.6%*
Transformer capacity (MVA)	1,498	1,559	1,603	1,640	1,686	1,505	1,488	1,495	1,526	1,559	1,589	1,615	1,650	*0.8%*
Loss ratio (%)	4.7%	4.8%	5.5%	4.7%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	*0.3%*
Capacity utilisation	36.1%	34.2%	33.9%	32.3%	30.7%	36.0%	35.3%	37.8%	39.5%	36.1%	36.3%	36.8%	38.1%	*0.5%*
SAIDI (minutes)	102	77	113	82	67	52	62	38	96	42	52	59	150	*3.3%*
SAIFI (#)	1.40	0.96	1.34	1.01	0.84	0.83	0.60	0.60	0.92	0.62	0.74	0.74	0.68	*-5.9%*
CAIDI (minutes)	72.4	79.8	84.4	80.8	79.8	61.9	104.0	63.3	104.3	68.4	69.9	80.1	220.7	*9.7%*
Powerco														
Total operating cost NZ$ mln. (2007 prices)	23.5	20.5	17.5	19.6	19.6	21.0	28.1	30.2	40.2	57.3	67.0	65.3	69.9	*9.5%*
Total operating revenue NZ$ mln. (2007 prices)	42.5	39.7	45.3	64.7	66.6	74.8	63.8	114.8	149.7	198.6	201.2	212.2	206.2	*14.1%*
Electricity distributed (GWh)	837	865	849	1,019	1,377	1,257	1,941	1,955	2,734	3,796	4,052	4,201	4,106	*14.2%*
Customers ('000 #)	73	72	72	84	104					296	299	304	306	*12.7%*

						107	157	157	217					
Operating cost per kWh (NZ$ 2007 prices)	0.0281	0.0237	0.0206	0.0193	0.0142	0.0167	0.0145	0.0154	0.0147	0.0151	0.0165	0.0155	0.0170	*-4.1%*
Operating cost per customer (NZ$ 2007 prices)	0.3235	0.2832	0.2443	0.2327	0.1874	0.1967	0.1788	0.1917	0.1855	0.1934	0.2244	0.2144	0.2284	*-2.9%*
Network length (km)	3,846	7,361	7,344	8,655	11,137	10,859	15,313	15,960	19,559	24,940	26,812	27,089	27,255	*17.7%*
Transformer capacity (MVA)	265	630	568	640	832	831	1,320	1,312	1,816	2,581	2,642	2,691	2,714	*21.4%*
Loss ratio (%)	6.2%	6.5%	6.0%	6.2%	6.8%	6.8%	6.8%	5.9%	6.6%	6.8%	5.6%	6.4%	7.4%	*1.5%*
Capacity utilisation	30.4%	29.0%	31.2%	30.5%	29.8%	29.8%	28.2%	28.4%	25.7%	26.8%	27.5%	25.2%	27.8%	*-0.8%*
SAIDI (minutes)	275	142	170	141	125	102	84	130	282	327	196	214	184	*-3.3%*
SAIFI (#)	3.62	2.11	2.29	2.08	2.12	1.83	1.58	2.25	3.18	3.37	2.76	2.58	2.45	*-3.2%*
CAIDI (minutes)	75.9	67.2	74.0	68.0	58.7	55.8	53.4	57.8	88.5	96.8	71.2	82.8	75.1	*-0.1%*
"The rest"														
Total operating cost NZ$ mln. (2007 prices)	203.0	195.5	205.5	210.2	177.7	172.0	178.0	184.8	178.6	178.7	184.0	189.8	209.2	*0.3%*
Total operating revenue NZ$ mln. (2007 prices)	309.9	326.2	347.7	359.5	352.0	374.3	389.0	399.2	413.5	436.0	451.2	456.7	459.8	*3.3%*
Electricity distributed (GWh)	8,326	8,539	8,695	8,917	8,991	9,619	10,106	10,127	11,033	11,470	11,837	12,088	12,389	*3.4%*
Customers ('000 #)	591	599	601	606	611	653	665	673	699	736	748	759	768	*2.2%*
Operating cost per kWh (NZ$ 2007 prices)	0.0244	0.0229	0.0236	0.0236	0.0198	0.0179	0.0176	0.0183	0.0162	0.0156	0.0155	0.0157	0.0169	*-3.0%*
Operating cost per customer (NZ$ 2007 prices)	0.3432	0.3262	0.3420	0.3468	0.2908	0.2632	0.2675	0.2745	0.2553	0.2427	0.2461	0.2500	0.2726	*-1.9%*
Network length (km)	67,672	68,016	68,186	69,451	70,092	75,566	76,001	76,742	79,475	84,094	84,425	85,448	85,566	*2.0%*
Transformer capacity (MVA)	4,914	5,114	5,182	5,284	5,298	5,653	5,806	5,953	6,244	6,612	6,826	7,039	7,276	*3.3%*
Loss ratio (%)	6.0%	6.3%	6.2%	6.0%	5.7%	6.5%	5.6%	6.2%	5.9%	5.7%	6.0%	5.9%	5.1%	*-1.4%*
Capacity utilisation	37.0%	36.3%	36.2%	35.0%	33.9%	34.3%	34.4%	35.1%	34.5%	33.3%	33.8%	33.8%	33.7%	*-0.8%*
SAIDI (minutes)	253	280	249	236	207	173	160	143	159	163	140	141	279	*0.8%*
SAIFI (#)	4.00	3.73	3.69	3.15	2.99	2.40	2.41	2.03	2.28	2.22	2.07	2.08	2.32	*-4.4%*
CAIDI (minutes)	65.0	73.9	69.7	72.3	69.3	74.3	64.6	70.9	74.8	76.2	69.8	67.7	116.7	*5.0%*
Total sector														
Total operating cost NZ$ mln. (2007 prices)	332.8	328.8	339.9	367.1	354.9	304.4	292.1	320.8	374.9	400.7	424.7	441.9	465.5	*2.8%*
Total operating revenue NZ$ mln. (2007 prices)	610.7	645.0	685.4	751.9	766.8	753.4	766.0	845.1	989.2	1,170.8	1,195.6	1,231.2	1,255.1	*6.2%*
Electricity distributed (GWh)	15,631	16,364	16,441	16,951	17,293	17,900	19,496	19,726	24,145	27,969	29,170	29,676	30,317	*5.7%*
Customers ('000 #)	1,057	1,068	1,074	1,099	1,129	1,182	1,256	1,274	1,555	1,851	1,875	1,905	1,929	*5.1%*
Operating cost per kWh (NZ$ 2007 prices)	0.0213	0.0201	0.0207	0.0217	0.0205	0.0170	0.0150	0.0163	0.0155	0.0143	0.0146	0.0149	0.0154	*-2.7%*
Operating cost per customer (NZ$ 2007 prices)	0.3147	0.3079	0.3165	0.3342	0.3143	0.2575	0.2326	0.2518	0.2411	0.2165	0.2265	0.2320	0.2414	*-2.2%*
Network length (km)	90,497	94,840	95,148	98,193	101,721	106,657	111,131	112,922	128,774	149,703	152,273	154,211	155,128	*4.6%*
Transformer capacity (MVA)	9,212	10,138	9,967	10,221	10,090	10,266	10,854	11,110	13,272	15,595	15,987	16,392	16,762	*5.1%*
Loss ratio (%)	5.3%	5.6%	5.6%	5.4%	5.4%	5.8%	5.3%	5.5%	5.4%	5.4%	5.4%	5.5%	5.3%	*0.0%*
Capacity utilisation	34.6%	33.9%	35.5%	34.4%	33.5%	35.4%	35.5%	36.5%	34.5%	35.2%	36.2%	35.5%	36.9%	*0.5%*
SAIDI (minutes)	197	197	187	185	148	122	112	104	141	152	118	134	195	*-0.1%*
SAIFI (#)	2.97	2.72	2.76	2.39						1.93				*-3.9%*

					2.15	1.79	1.73	1.55	1.91		1.70	1.81	1.85		
CAIDI (minutes)	69.2	70.9	69.3	77.7	69.8	66.8	65.3	66.8	75.7	76.8	70.7	74.8	109.3	*3.9%*	

Operational costs excludes transmission and depreciation charges.
Operational revenues are defined as Net Line Revenue + Loss Rental Rebates - Transpower Charges.
Electricity distributed is electricity supplied from the system.
Vector 1998 operational costs excludes NZ$110.8mln. in extraordinary costs associated with CBD crisis.
For loss ratio, capacity utilisation, SAIDI, SAIFI and CAIDI totals weighted using kWh transmitted.
SAIDI: System Average Interruption Duration Index - minutes per connected customer.
SAIFI: System Average Interruption Frequency Index - interruptions per connected customer.
CAIDI: Customer Average Interruption Duration Index - minutes per customer interrupted.