Ownership, regulation, and financial disparity: the case of electricity distribution in Australia

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Abstract

Following electricity sector reforms in the late 1990s, prices charged by government-owned distributors in the south and eastern states of Australia more than doubled and the productivity of these government distributors declined. Econometric analysis associates much higher regulated revenues and regulated asset values with government-owned than investor-owned distributors. This disparity is not observed in other countries. Various commonly repeated explanations for higher distributor spending (stricter network planning standards, flawed regulatory rules, flawed appeal mechanisms, catch-up for historic underspending) do not seem to explain the disparity. This analysis suggests that owning governments perceive their cost of capital to be lower than that of their regulated private peers. The perceived premium encouraged government distributors to expand their asset base, and hence their prices and profits. The private-interest theory of regulation provides a plausible explanation for this.

Keywords: electricity distribution, independent regulation, ownership and regulation, regulatory capture

JEL: C51, D72, D78, G18, H21

1. Introduction

From the late 1990s, the electricity industry in the south and eastern states of Australia was restructured to separate those activities that could be opened to competition (the production and sale of electricity) from the transmission and distribution of electricity by network monopolies. State and later quasi-national regulators determined the monopolies' prices and revenues.

The Industry Commission's report (1991) justified reform on the basis that it would improve the distributors' capital productivity and that although electricity prices were then low by world standards, industry restructuring (including independent regulation of government monopolies) meant they were expected to become even lower. However, having once had amongst the lowest prices amongst member countries of the Organisation for Economic Cooperation and Development (OECD), household electricity prices in Australia are now amongst the highest. While several factors have contributed to this, increases in network charges are the main reason (Australian Competition and Consumer Commission 2018).

There is a disparity in the outcomes delivered by government and private distributors. Having started from a similar position in respect of prices and asset values at the time of the reform, over the course of successive regulatory controls, the regulated asset value and hence prices of the government distributors grew more quickly than those of the privatised

distributors. The disparity now evident between government-owned and investor-owned distributors in Australia is not evident in other countries.[1]).

This article responds to the questions raised in Mountain and Littlechild (2010), which found the costs and revenues of the government distributors in New South Wales (NSW) to be higher and increasing faster than the private distributors in Victoria or Great Britain. It suggested that regulatory framework and conduct and, in particular, the difference in ownership and its impact on regulation, appeared to be a large part of the explanation for the government/private disparity. That paper suggested further and more rigorous examination.

[1] For example, in New Zealand (Growitsch, Jamasb, and Wetzel 2012, Talosaga and Howell 2012, Nillesen and Pollitt 2011, Fillipini and Wetzel 2014) do not find a statistically significant difference in the prices charged by investor-owned and customer-owned distributors. In the United States, Kwoka (2005a, b) finds an immaterial difference in prices comparing investor-owned and non-investor owned (typically municipal or rural co-operative) distributors. More generally in the United States, a long tradition of comparison of public and private electricity utilities (see Stigler and Friedland, 1962; Peltzman, 1971; De Alessi, 1974; Atkinson and Halvorsen, 1986); Peters (1993) does not find large differences in various aspects between government-owned and investor-owned utilities.

This analysis seeks to provide a wider and more rigorous analysis of cost and price differentials, relating particularly to ownership. It examines more thoroughly other possible explanations and, among other things, includes more recent information and subsequent experience.

The study aims to contribute to the literature in two areas. First, a large and heterogeneous data panel of electricity distributors in five countries is developed and a mixed fixed-effects/random-effects model is used to establish a statistically significant association between ownership and the regulated asset values and prices charged by the Australian distributors, distinguishing those that are government owned from those that are privately owned. Second, the article contributes an empirical study relevant to the literature on the theories of regulation by evaluating the plausibility of explanations suggested by the public-interest and private-interest theories of regulation, in the case, not explicitly contemplated by the theories, that government owns the regulated entity.

The next section reviews the relevant literature. The third section provides context to the industry and its institutions. The fourth section presents analysis to establish a statistically significant association between Australian distributor ownership and their regulated asset values and prices. The fifth section critically examines explanations provided by governments, regulators and the industry for the outcomes examined in this article. This leads to discussion, conclusions, and policy implications. An appendix provides a quantitative

comparison of the outcomes delivered by the government-owned and privately-owned distributors.

2. Relevant literature

The theories of regulation and also finance theory with respect to the cost of capital to utilities are relevant to this study. Each is examined in turn.

Theories of regulation

The literature distinguishes two main theories of regulation: the public-interest theory of regulation and the private-interest theory of regulation (Crew and Kleindorfer, 2002; Den Hertog, 2010; Posner, 1974; Zerbe and Mc Curdy, 2000; Levine and Forrence, 1990; Priest, 1993; Laffont and Tirole, 1991). It is these two theories that we focus on.

The public-interest theory of regulation is a "normative" theory of regulation (Ricketts 2006, p. 35; Newbery 2000, p. 136; Baldwin & Cave 1999, p. 10; Laffont & Tirole 1993, p. 19). Laffont and Tirole (1991) suggest that almost all of the theoretical work on the regulation of natural monopolies has embraced the public-interest paradigm. However, there are differing perspectives on what the theory holds. Posner (1974) describes the theory as more often assumed than articulated. As Hantke-Domas (2003, 166) suggests, “no author has claimed intellectual ascendancy over the public-interest theory…the public-interest theory does not have any known origin”. Den Hertog (2010) suggests that the mainstream economic literature is implicitly or

explicitly critical of the public interest theories of regulation and Priest (1993) suggests few scholars purport to defend public interest explanations of regulation. Scholars describe the theory in vague and philosophical terms. For example, Levine and Forrence (1990, 167) say the theory posits "political actors who act, sometimes perhaps mistakenly, to further a vision of the public good". Ricketts (2006, 37) describes the public-interest theory as consistent with "… regulators in the public interest tradition as acting as philosopher kings in an economy understood as a set of equations and in which the technical task is simply to control the values of a set of policy instruments so as bring about the best result".

In this analysis, I draw on the thrust of the public-interest theory, as a normative theory, in prescribing what regulators *should* do. By implication under the normative theory of regulation, regulators are assumed always to be seeking to act in the public interest, and so outcomes that do not serve the public interest are attributed to well-intended but unanticipated flaws in regulatory design or conduct. Joskow and Noll (1981, 36) suggest that as a positive theory of regulation, that is a theory to describe what actually occurs, the public-interest theory is obviously incorrect. They attribute this to two main factors: first, individuals have objectives that are affected by the actions of regulatory institutions, but are not yet accounted for in applied welfare economics; and second, political agents are economic actors, as are producers and consumers, and they respond to incentives created by political institutions and administrative processes. Hence, a rational regulator would be unlikely to seek to maximise conventional measures of economic welfare.

The economic theory of regulation is also referred to as the "private-interest theory" (Den Hertog, 2010), “the Chicago version of the modern development of public choice theory” (Tollison, 1989, 295), the “Chicago theory of government” (Noll, 1989, 48) or the “interest group theory of government” (Leight, 2012, 230). The economic theory of regulation, as an element of broader public choice theory, is often described as a positive theory of regulation. Whereas the public-interest theory does not have any known origin (Hantke-Domas, 2003), Leight, (2012, 214) suggests that public-choice theory has emerged as a "coherent, self-conscious intellectual movement with a significant complement of intellectual historians who chronicle its origins and growth". Peltzman (1989) suggests the most important element of the economic theory of regulation is its integration of the analysis of political behavior with the larger body of economic analysis. Politicians, like the rest of us, are presumed to be self-interested maximisers. This means that interest groups can influence the outcome of the regulatory process by providing financial or other support to politicians or regulators. (Leight ,2012, Peltzman, 1989, 1993, Posner, 1974) and others point to Stigler (1971) as the foundational article on the economic theory of regulation. Stigler provided a theoretical rationale for the capture of regulatory agencies by producer interests. By implication, the private-interest economic theory of regulation predicts the failure of regulation to serve the public interest as attributable to its capture by producer interests.

It is relevant to this study that the development of both the public-interest and private-interest theories of regulation have implicitly considered regulation as

a phenomenon that applies to privately owned entities. This study examines the somewhat unusual situation in which regulation has been applied to government-owned entities on the assumption, strictly applied, that they are privately owned.

Finance theory

A feature of the institutional arrangements in Australia is that after the reforms, the government-owned distributors have been regulated as if they were privately financed. Perhaps it was expected that the government distributors would respond to profit maximisation incentives in the same way as their investor-owned peers. While regulation of government-owned businesses by an entity distinct from the government is not unknown in other countries, in Australia an ownership-invariant approach has been rigorously applied in the design and conduct of regulation.

Finance theory (for example, Baumol et al., 1983; Evans, 1998; or Hathaway, 1997) suggests that the cost of capital should be invariant to ownership. Specifically, it advises that the appropriate estimate of the cost of a government's capital is a private owner's pre-tax cost of capital. While not contesting this advice on how governments *should* value their capital, in practice this does not seem to be how they have valued their capital; I suggest that this is the at the root of the explanation for the government-private distributor disparity.

3. Network regulation in Australia

This section presents background on the industry, describes its institutions and summarises the relevant outcomes. For the sake of brevity, the reference to “Australia” here refers to electricity distribution within the boundary of what is now known as the National Electricity Market (NEM) that encompasses the south and eastern states and territories of South Australia, Tasmania, Victoria, NSW, Queensland, and the Australian Capital Territory. Appendix A presents data on the outcomes (allowed expenditure, investment, and profits) of the Australian distributors over the study period.

3.1 Industry

Distributors transport electricity from high voltage substations to customers’ meters, and increasingly from distributed power sources behind the meter to other customers. In Australia distribution account for around 80% of the total regulated asset value of networks, with the higher voltage transmission companies accounting for the remaining 20%.

From the late 1980s, the distribution sector was rationalised. In New South Wales 25 local government distributors were merged into four and finally three. In Queensland (QLD) seven were merged into three and then two. In Victoria (VIC) 11 municipal and one regional distributor were merged to form five distributors. Electricity retailing was unbundled from distribution starting in VIC and then SA. Other than in Tasmania (TAS) and in one part of QLD (where retailing is legally separated from distribution) retailers are completely separate from distributors.

There are now 13 distributors in the NEM, of which the five in Victoria were privatised in 1994 and the single distributor in South Australia in 2000. In other jurisdictions, until 2016 all distributors remained government owned. Two of the three in NSW have since been partially (51%) privatised. The distributor in the Australian Capital Territory is significantly smaller than the other distributors and so has not been included here. The remaining 12 distributors vary considerably. One of the three government-owned distributors in NSW (Essential Energy), one of the Queensland distributors (Ergon), two of the investor-owned distributors in Victoria (Powercor and Ausnet Services) and the investor-owned South Australian distributor (SA Power Networks) and the Tasmanian distributor serve a combination of cities, small towns, villages and sparsely populated rural areas. The remaining five distributors (of which two are government-owned and three are investor-owned) serve mainly populated metropolitan areas that are relatively dense.

3.2 Institutions

Electricity supply is a constitutional right of the jurisdictions (states and territories). After the industry was vertically separated and the distributors merged, state regulatory commissions oversaw the distributors in their states. Since 2004, pursuant to centralisation policies, quasi-federal institutions were created. Four institutions are now relevant to economic regulation: the Council of Australian Government's (COAG) Energy Council, the Australian Energy Markets Commission (AEMC), the Australian Energy Regulator (AER) and the

Australian Competition Tribunal (ACT). A fifth entity, the Energy Security Board has recently been created.

The COAG Energy Council represents state and territory energy ministers and is chaired by the Commonwealth Energy Minister. The Council provides policy leadership and is also responsible for the oversight of the AEMC, in some respects the AER, Australian Energy Market Operator and Energy Consumers Australia.

The AEMC was established by COAG. It is the statutory rule-maker and advisor to the COAG Energy Council. Its five members are appointed by COAG. The AEMC established and maintains the National Electricity Rules ("Rules"). The main features of regulation are specified in Rules: the duration of the regulatory control period; allowable methods for the calculation of the regulated cost of capital; the valuation and indexation of the regulatory asset base; depreciation methods; allowances for income taxes; arrangements for intra-period cost pass-throughs; and the regulatory process.

The AER is a three-person Commission funded by the Commonwealth Government who appoints one commissioner, with another appointed by state governments and whose Chair is jointly appointed by the Australian Competition and Consumer Commission (ACCC) and the states.

The AER implements the regulations established in the Rules. This entails setting quinquennial revenue or price controls that establish allowances for

operating expenditure, depreciation, a post-tax return on assets and expected income tax. The details of the AER's approach are described in nine guidelines. Another 13 documents explain the guidelines. The predecessor regulators to the AER, the state-based essential services commissions, applied a similar periodic regulatory review approach.

AER decisions were (until October 2017) subject to merits review by the Australian Competition Tribunal (ACT). Appeals to the ACT on some aspect of the AER's determinations were usual.

A particularly significant feature of the institutional arrangements is the idea that regulation should be applied in a way that does not discriminate on the basis of the ownership of the regulated entity. Specifically, this has meant that government distributors are assumed to be privately financed and they are awarded a cost of capital based on the pre-tax cost of capital of their investor-owned peers. The ownership invariant approach is prescribed in the Rules and follows the Competition Principles Agreement (CPA) signed the state and territory and Australian governments in 1994. While the CPA was intended to apply to government-owned businesses that sell in contestable markets, all the state governments chose also to apply it to the network monopolies they owned.

Australia's regulators have defended the approach of awarding government distributions a pre-tax cost of capital. For example, in 2011 a group of major Australian energy users petitioned the AEMC to change the Rules so that the

regulator's allowance for borrowing costs charged to energy users (for government-owned distributors) should more closely reflect their owning governments' actual borrowing costs (rather than the estimated private borrowing rates of BBB-rated debt). The AEMC rejected the application (see Australian Energy Markets Commission, 2012), on the basis that to have regard to the government's actual borrowing costs would underestimate the distributor's actual cost of capital and hence misallocate resources. In its rejection of the energy users' petition, the AEMC also argued that the governments' receipt of the income tax on their distributors' profits would not distort their investment decisions since the income tax was received by a different branch of the Government than that of their distributors' shareholding ministers.

The AER and state governments that owned their distributors supported the AEMC's rejection. By contrast, in line with the arguments in (Laffont and Tirole, 1993), the Productivity Commission, an independent advisor to the Commonwealth Government, recognised that distortions arose by awarding government distributors private funding rates. While it continued to support an approach that allowed government distributors to charge customers private financing costs, it did nonetheless suggest that further thought be given to an adjustment to returns to account for the fact that state governments would not collect income tax on the distributors within their jurisdiction if those distributors were privately owned (see Productivity Commission, 2013).

The distributors in Victoria and South Australia were privatised in the mid-1990s (Victoria) and 2001 (South Australia). The rest have remained government owned until 2016 when NSW sold a 51% share in two of its three distributors to private investors. In all cases, the government-owned distributors were corporatised and became liable for income tax on their profits which the owning state governments (rather than the Commonwealth) collected pursuant to constitutional constraints on Commonwealth from taxing state government-owned entities.

4. Econometric analysis

While government distributors spent more and grew their assets more quickly than private distributors it is possible that factors such as technology selection (underground cable versus overhead line), network density or distributor size might explain the disparity. To assess this, an econometric study sought to determine whether ownership could explain the regulated revenues and regulated assets of government-owned and private distributors in Australia. In this analysis, I established a data panel that included distributors in Norway, New Zealand, Great Britain, and Ontario, covering a wide range of different distributors that varied as to size, customer numbers, the proportion of network above or below ground, peak demands and energy supplied. The data panel covered 225 distributors over the period from 2002 to 2013. The Norwegian distributors are (local) government owned, all but one of the Ontario distributors is (local) government owned, the British distributors are all privately owned and around half the New Zealand distributors are owned by

customers (through trusts in which customers are beneficial owners), with the other half owned by investors.

Two models with regulated revenues and regulated asset values as the dependent variables were selected. These were chosen since these are the two key variables that the regulators determine. Regulated annual revenue is the sum of the regulators' determination of allowances for operating expenditure, depreciation of the capital stock, the cost of finance and expected income tax. The regulated asset value is the regulators' assessment of the value of the capital stock. Country dummy variables control for different approaches to asset valuation (depreciated replacement cost versus depreciated historic cost), depreciation and other unknown factors that could explain country-level differences amongst the distributors.

In the regressions, the selection of possible independent variables included customer numbers, the volume of electricity distributed, peak demands, customer type, reliability standards, network length, network design and technology selection, typology, geology, climate, environmental and planning restrictions[2]. Drawing on Neuberg (1977) and considering the approaches adopted in the efficiency measurement and economies of scale literature (see in particular, Economic Insights, 2014; Nillesen and Pollitt 2011; Burns and Weyman-Jones, 1996; Kuosmanen, Saastamoinen, and Sipiläinen, 2013; Edvardsen and Førsund, 2003; Kwoka 2005a, 2005b; Kinnunen, 2005; Farsi

[2] The detailed examination of these competing explanatory factors is contained in my Ph.D. thesis.

and Filippini, 2009; Giles and Wyatt, 1993; Salvanes and Tjotta, 1998; and Yatchew, 2000), and considering the available data, the potential dependent variables was narrowed down to the number of customers served numbers, network throughput (energy delivered), peak demand, network length, and proportion of the distribution grid that is underground.

Analysis of the correlation between these potential variables, analysis of their correlation with the dependent variables, and observations from the literature suggested the selection of customer numbers and network density.

In the selection of the functional form of the regression both Cobb-Douglas and Translog functional forms were considered and following (Nillesen and Pollitt 2011), the Cobb-Douglas model was preferred. For completeness, a Translog model was also estimated. Both models are common in the literature. Equations 1 and 2 specify the regressions.

Equation 1. Regulated asset value regression

$$\ln(Regulated\ Asset\ Value_{i,t}) = \beta_0 + \beta_1 . \ln(customer\ numbers_{i,t}) + \beta_2 . \ln(network\ density_{i,t})$$

$$+ \beta_3 . \text{Australia government owned distributors}_{i,} + \beta_4 . \text{Australia privately owned distributors}_{i,}$$

+ + +

Equation 2. Regulated revenue regression

$$\ln(Regulated\ Revenue_{i,t}) = \beta_0 + \beta_1 . \ln(customer\ numbers_{i,t}) + \beta_2 . \ln(network\ density_{i,t})$$

$$+ \beta_3 . \text{Australia government owned distributors}_{i,} + \beta_4 . \text{Australia privately owned distributors}_{i,}$$

$$+ \beta_6 . \text{Great Britain distributors}_{i,} + \beta_7 . \text{Ontario distributors}_{i.} + \beta_8 . \text{Norway distributors}_{i,} + \beta_9 . \overline{\ln(customer\ numbers_{.})} + \beta_{10} . \overline{\ln(network\ density_{.})} + u_{i.t}$$

where are the regression coefficients, *i* denotes the distributor and *t* denotes the year, the error term with individual effects and the remainder random disturbances following a stationary autoregressive order one process i.e. = + with .

A fixed effects estimation to reduce omitted variable bias was preferred but rejected because the time-invariant country dummy variables would be eliminated in a fixed-effects estimation. Instead, a random-effects model with the inclusion of Mundlak Means following Mundlak (1978) was chosen. This allowed the relaxation of the assumption that the unobserved heterogeneity of the distributors is uncorrelated with the observed explanatory variables. A model that includes Mundlak Means might be described as a mixed fixed-effects/random-effects model, where the effects are allowed to be correlated with the time-varying regressors but are uncorrelated with the time-invariant regressors.

Considering the calculation of regulated assets and regulated revenues autocorrelation in the error term was expected and confirmed in Wooldridge-Drucker tests (Wooldridge 2002). The chosen estimator to take account of this first order autocorrelation, is a generalised least-squares estimator for random effects, following (Bhargava, Franzini, and Narendranathan, 1982; Baltagi and Wu, 1999; and (Wooldridge 2002).

Tests for interactions between the dummy variables and the preferred explanatory and output characteristic variables confirmed that the dummy variables are not interacting with the other (continuous) explanatory variables, and hence dummy variable interaction terms are excluded from the preferred models

Table 1 presents the revenue estimation including the statistically significant Mundlak Means (denoted as the variable name plus “mm” at the end of the name). Tests showed that the value of the coefficients on the Australian dummies (and their statistical significance) is not meaningfully affected by the inclusion of all Mundlak Means rather than just the statistically significant Mundlak Means.

Table 1. Revenue estimation with statistically significant (p<0.05) Mundlak Means included

Only Mundlak Means statistically significant at p<0.05 included				
Customer numbers >	[illegible] >200,000	[illegible] >100,000	[illegible] >25,000	[illegible] >
Year	2004-2013	2004-2013	2004-2013	2004-2013
VARIABLES	LnRevenue	LnRevenue	LnRevenue	LnRevenue
LnCustNum	2.082***	1.029***	1.008***	1.070***
	(1.529 to 2.636)	(0.943 to 1.115)	(0.967 to 1.049)	(0.971 to 1.170)
LnDensity	-0.194***	-0.205***	-0.255***	-0.197***
	(-0.281 to -0.106)	(-0.285 to -0.125)	(-0.313 to -0.198)	(-0.301 to -0.0920)
LnCustNummm	-1.117***			-0.162***
	(-1.684 to -0.549)			(-0.264 to -0.0603)
LnDensitymm				-0.125**
				(-0.240 to -0.00963)
AusGovernment	0.546***	0.311***	0.253***	0.435***
	(0.160 to 0.933)	(0.0771 to 0.546)	(0.0675 to 0.439)	(0.242 to 0.627)
AusPrivate	0.256	0.0473	0.00955	0.188**
	(-0.114 to 0.626)	(-0.156 to 0.250)	(-0.158 to 0.177)	(0.00932 to 0.368)
NZIOU	-0.231	-0.192*	-0.261***	-0.335***
	(-0.691 to 0.228)	(-0.400 to 0.0168)	(-0.440 to 0.0822)	(-0.478 to 0.192)
NZCustomer	-	-	-0.426***	-0.551***
			(-0.559 to -0.294)	(-0.656 to -0.447)
GB	0.398**	0.138*	0.0530	0.0381
	(0.0295 to 0.767)	(-0.0247 to 0.301)	(-0.0336 to 0.140)	(-0.0450 to 0.121)
Ontario	-0.356*	-0.623***	-0.616***	-0.290***
	(-0.736 to 0.0241)	(-0.874 to -0.372)	(-0.788 to -0.444)	(-0.446 to -0.134)
o.Norway	-	-	-	-
Constant	0.417	-0.137	0.342	1.682***
	(-1.326 to 2.160)	(-1.214 to 0.941)	(-0.133 to 0.817)	(1.485 to 1.878)
Observations	320	423	825	2,079
Number of DNO	34	47	96	225
R2-Overall	0.891	0.952	0.982	0.986
R2-Within	0.309	0.203	0.265	0.288
R2-Between	0.930	0.973	0.989	0.987
Var explained by ui	0.657	0.587	0.567	0.711
Autocorrelation Coefficient	0.667	0.557	0.585	0.602
Confidence Interval in parentheses				
***p<0.01, **p<0.05, *p<0.1				

The columns in the table present the model results for the specified number of distributors in the panel (the first row shows the criterion for the number of customers to determine which distributors are included). The coefficient on the dummy variable for government distributors in Australia ("AusGovernment") is positive and statistically significant ($p<0.01$ in all cases except for the dataset of distributors with greater than 25,000 customers in which case significance is $p<0.05$). By comparison, the coefficient on private distributors ("AusPrivate") is not significant except for the dataset that includes

all distributors. For New Zealand, the coefficients for investor-owned distributors (“NZIOU”) and customer-owned distributors (“NZCustomer") are negative and statistically significant ($p<0.01$). Comparing the coefficients on these two dummies, it is clear that customer-owned distributors are associated with lower regulated revenues than the investor-owned distributors.

Sensitivity to the selection of different time periods ranging from 2002-2013 to 2006-2013 found that the value of the coefficients and the statistical significance of the main variables is barely changed. Table 2 shows the results for the estimation of regulated asset value. In this case both government and private dummies for the Australian distributors are statistically significant.

Table 2. Regulated asset value estimation with statistically significant ($p<0.05$) Mundlak Means included

Since the model regresses against the natural log of regulated asset values, the difference in the exponent of these variables expresses the relative impact of ownership on regulated revenues. By calculation, government ownership is associated with regulated asset values that are 46% higher for the model of distributors with more than 25,000 customers, rising to a maximum of 57% for the model of distributors with more than 200,000 customers. As for the

revenue regressions, testing showed that these results are robust to time period and the inclusion of all Mundlak Means.

Estimation using Translog rather than Cobb-Douglas cost functions produced similar results as to the magnitude and statistical significance of the Australian dummy variables. I also tested sensitivity to the selection of different explanatory variables including the combination of customer numbers and share of underground cable and found the conclusions are robust to this. In all models, Wald (Chi Square) tests rejected the null hypothesis ($p<0.01$) that the coefficient on the investor-owned and non-investor owned distributor dummy variables in Australia was the same.

In summary, the main finding of this study is that in Australia, government ownership of distributors is a statistically significant ($p<0.01$) explanation of regulated revenues and regulated assets in almost all cases. Comparing the central estimate of the coefficient on the Australian government dummy versus the Australian private dummy variable shows that for the preferred model, government ownership in Australia is associated with regulated revenues that are 26% higher and regulated assets that are 46% higher leaving all other factors the same. This finding is not meaningfully affected by the size of the distributors included in the models or the time periods for the study. It is also not affected by the model selection (Translog rather than Cobb-Douglas models) or the inclusion or exclusion of statistically insignificant Mundlak Means.

As with all models, it is possible that unspecified environmental factors and policy objectives might explain the difference between government and private distributors; however a review of their public statements and submissions finds that neither the government distributors, nor their owning governments, nor the regulators have suggested that such factors exist.

5. Possible explanations

Distributors, regulators, government departments and industry associations attributed distributors' higher spending and consequential increases in regulated revenues and asset values to various factors. These included rising peak demand, a need to catch-up for previous under-investment, a changing investment environment, flawed regulatory rules, excessively strict network planning standards and flaws in the arrangements for the review of the merits of the regulator's decisions. Can these explain relatively higher expenditure by the government than private distributors?

Higher expected demands

Expectations of higher peak demand (and consequently network augmentation to meet those higher demands) were typically a major factor in distributors' proposed regulated revenue claims. Review of the distributors' proposals finds that the government distributors forecast higher demand

growth and more expenditure to meet the forecast higher demand than the private distributors. The distributors' demand projections were typically accepted without variation by the state regulators and then the AER. In the event, peak demand grew more slowly than expected and for all distributors has declined since 2009 per connection and for most distributors also in absolute terms. In this sense demand forecast error is an explanation. However, the error was asymmetric: the government distributors consistently forecast higher demand growth rates than private distributors.

Historic expenditure catch-up

With respect to the claim that spending was justified to catch up for previous under-spending, government and industry association reports that preceded the industry reform (see London Economics Limited, 1993; 1994, 1994b; and Pierce, Price, and Rose, 1995) pointed to excess capital in electricity distribution as a justification, in part, for industry reform. Topp and Kulys (2012) show a slight improvement in Total Factor Productivity in the decade before the reforms took effect and that this was approximately comparable in all states. Yet in their regulatory proposals after the reforms, the government distributors proposed, and the regulators largely accepted, higher spending on the basis of the need to "catch up" for historic underspending. While it might be plausible to suggest that lower capital expenditure in the decade before the reforms took effect might be expected to be followed by higher expenditure to catch up, the historic spending pattern does not support the argument for

relatively higher “catch up” expenditure for the government-owned relative to the investor-owned distributors.

Changes in the investment environment

The AER suggested that changes in the environment for investment helped to explain why *“consumers are paying more than they should to maintain a reliable and secure power system*” (Australian Energy Regulator 2011, 4) For example in the pre-reform era the emphasis in influential inquiries - see (Hilmer, Rayner, and Taperell 1993) and (Industry Commission 1991) - was on raising the productivity of the economy through greater efficiency and in the case of the electricity industry, by raising capital productivity. This priority seemed to change after the reforms took effect. For example, the Productivity Commission suggested that regulators should err in favour of too much rather than too little expenditure by the regulated networks (Productivity Commission 2001). Not long after, a ministerial report (see Ministerial Council on Energy, 2003) which presaged the creation of the AER and AEMC, justified two separate agencies rather than one contrary to the advice they had received (see Parer et al., 2002), on the basis that this would improve the climate for investment and enhance regulatory certainty. It seems reasonable to suggest that changes in the investment environment had affected regulators’ willingness to allow greater capital expenditure but again this cannot explain why government distributors were allowed more than privately owned distributors.

Regulatory rules

In the course of the development of the first Rules that the newly created AER was required to implement from 2009, the AEMC said that the Rules would "improve the environment for investment by increasing regulatory clarity and certainty…" (Australian Energy Markets Commission 2006). At the time, the AER argued against these rules on the basis that they would undermine their ability to determine efficient expenditure allowances. After its first decisions under those Rules, in 2011 the AER proposed that they be changed on the basis that they had "inappropriately favour(ed) network service providers" (Australian Energy Regulator 2011, 4). In response, the AEMC changed aspects of the rules although the AEMC also pointed to the importance of the AER's effectiveness in applying the Rules and to the "corporate governance" of the distributors (Australian Energy Markets Commission 2012b, 7). While the contribution of perceived or actual flaws in the Rules in explaining higher expenditure is arguable, these flaws cannot explain the disparity between government and private distributor spending.

Network planning standards

With regard to excessively strict planning standards, state governments in NSW and Queensland tightened their distribution network planning standards in 2005. This explains some part of the higher expenditure that their distributors proposed and that the state regulators and then later the AER approved. In 2012, the governments of NSW and Queensland relaxed the

planning standards again. Higher expenditure followed stricter planning standards but the rationale for those stricter standards is not clear. Although governments justified the higher standards on the need to improve quality of supply, data on the frequency and duration of network outages do not support the contention that the networks' quality of supply was inadequate. Indeed, the quality of supply was not meaningfully different after the higher expenditure, and the governments subsequently relaxed the standards.

Regulatory appeals

With regard to the appeal of regulatory decisions to the Australian Competition Tribunal (ACT), both government and private distributors have applied to the ACT to review aspects of AER determinations. The ACT, which had typically accepted the distributors' applications, has had a significant impact on regulated revenues of all distributors, not just the government distributors (Yarrow, Egan, and Tamblyn 2012).

Summary

All of these factors appear to have inappropriately favoured the distribution industry as a whole, and thus may help explain why network capital expenditure increased after the industry's reform. But none of these seem to explain the financial disparities between government and private distributors.

6. Discussion

This analysis finds that government ownership of distributors is associated with regulated assets and regulated revenues that are 46% and 26% respectively, higher than privately owned distributors in Australia. Network characteristics, size, and density cannot explain the difference in the regulated revenues or regulated assets of the government and private distributors. Similarly, explanations provided by the industry, regulators, and governments, while somewhat helpful in contributing to the context, do not seem to explain the disparity.

My working hypothesis is that the owning governments perceived their actual cost of capital to be well below the level that the regulators had determined in setting allowed returns. This encouraged government owners to encourage their managers to expand their regulated asset bases in order to increase financial returns.

The gap between allowed rates of return and actual financing costs can be seen for example in the allowances for debt funding. In the period from 2009 to 2014, for example, the AER determined a cost of debt to be recovered in regulated charges that exceeded the actual cost of debt for the three distributors in NSW as reported in their financial statements, by between 280 and 430 basis points (the range being attributable to different distributors for different years in this period). Over the five-year regulatory control period, this difference meant that the distributors received $2.5 billion more revenue than

needed to recover their actual borrowing costs. In addition, over the same period from 2009 to 2014, the NSW Government collected $2.7bn in taxes on the profits of its distributors and from fees on its loans to its distributors. The State Government would have not received the income taxes if the industry was privately owned (since the taxes would then have been paid to the Commonwealth Government).

Through the allowances for borrowing costs and incomes taxes, over the five years from 2009 to 2014, the NSW government distributors therefore collected $5.2bn more than they would have if the regulator set debt allowances based on their actual costs and not allowed them to recover income taxes that they would not have collected if the industry was privately owned. The same picture is evident for the government-owned distributors in Tasmania and Queensland.

The state budgets show the importance of state government funding of its distributors. The 2012-13 NSW budget showed total liabilities in June 2013 of $88 billion, of which borrowings comprised $30 billion. The annual financial reports of the three NSW distributors showed aggregate borrowing (from the NSW State Treasury) of $16.15 billion. In other words, the distributors' borrowing in the 2013 financial year accounted for more than half of all NSW Government borrowing. In the same year, total Queensland Government borrowing was $42.2 billion, of which the electricity distributors accounted for $11 billion. In that year, the largest item of capital spending in the Queensland Government's budget, after spending on roads by the Department of

Transport and Main Roads, was for capital spending by its electricity distributors.

In addition to the incentive to expand the asset base to increase profits, following Mountain and Littlechild (2010), I suggest the gap between the allowed and perceived cost of capital also encouraged owning governments to limit the extent of regulatory power in order to protect those profits. This is evident, for example, in the following:

(a) the bifurcation of regulation between two agencies rather than one which, as noted, was justified by state ministers on the basis that this would promote higher spending;

(b) the NSW and Queensland governments' tightening of network planning standards (a decision they did not allow regulators to make), which resulted in higher expenditures by the distributors they owned, but in the absence of a plausible quality of supply problem;

(c) transitional arrangements (when the regulation of distributors was transferred to the AER) that set a higher cost of equity than the AER had determined for other distributors.

My hypothesis leans heavily on the assumption that owning governments perceived the gap in financing allowances and responded to it as they might be expected to. Further research would be valuable to understand whether owning governments anticipated this at the time of the reform, or whether after having discovered how profitable distribution could be, they were

motivated to defend the arrangements. While financial returns might be expected to be of great interest to owning governments, it would be valuable also to explore the extent to which other possible objectives, such as employment and a desire to improve the quality of service, can contribute to the explanation of the disparity. Further, it would be worthwhile to investigate to what extent can outcomes be attributed to the explicit constraints that the governments placed on the regulatory bodies in comparison to the tacit regard for government thinking that may have influenced what the actions of the regulators (and the government distributors).

Finally, which of the two main theories of regulation provide a more plausible explanation of these outcomes? The public-interest theory would explain the outcomes as attributable to well-intentioned institutions that, with the benefit of hindsight, are seen to have made mistakes. In this case, it would suggest that apparent flaws in appeal mechanisms, poorly designed regulatory rules, demand forecast errors and excessively strict network planning standards resulted in what turned out to be unexpectedly higher expenditure and profits. But this does not explain why those mistakes were so much bigger for government than private distributors. To the extent that public-interest theorists argue that governments respond to regulatory incentives in the same way as private owners would, then the observed outcomes must be attributed to owning governments having failed to understand that finance theory suggests their cost of capital is the same as a private owners' pre-tax rate. Perhaps this is so, but the conclusion would nonetheless be that the public-interest theory of regulation failed to predict the outcomes. This case supports

Joskow and Noll (1981), that as a theory to describe what actually occurs, the public-interest theory is incorrect.

In contrast, the private-interest theory of regulation predicts that the supply of regulation will be shaped by the regulated entity's demand for it. While allowing government firms to recover private investor funding costs might be consistent with finance theory, the private-interest theory would predict that regulators would dismiss the evidence that governments perceived their funding costs to be below those of private investors.

While the private-interest theory implicitly assumes the regulation of investor-owned firms, this study suggests that the theory's predictions are valid, perhaps particularly so when governments as owners of the regulated entity create the demand for regulation.

7. Conclusions and policy implications

This analysis suggests that compensating government distributors' financing costs at a rate substantially above their actual financing costs, encouraged inefficient expansion of the regulated asset base to deliver higher profits. Consistent with this, the evidence also suggests that extraordinary profits encouraged government owners to attempt to limit the extent of regulatory power in order to protect those profits.

While finance theory suggests that governments (and regulators) should value a government's cost of capital at private investors' pre-tax rate, the hypothesis in this paper suggests that in Australia they do not. If so, the evidence that state governments perceive the cost of their capital as quite different from the apparent prescriptions of finance theory is important in the design and conduct of economic regulation.

Various solutions are possible. Privatisation would align industry ownership with the existing regulatory form. Alternatively, the merits of returning to government department oversight of the distributors that the government owns, should be explored. This may restore political accountability for prices and hence discipline the trade-off between higher profits and the consequent political detriment of higher prices. Both of these solutions present political disadvantages, but there is evidence that the first has actually worked successfully in Australia.

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Appendix A Outcomes

Figure 1, based on the on regulators' expenditure allowances, shows the total expenditure per connection that the regulators allow the distributors to charge to their customers, in the three regulatory periods (RP) for the government distributors in NSW and QLD and the private distributors in SA and VIC[3]. It shows that in all cases over the three periods, allowed expenditure, per connection, increased but the increase was much larger for the government distributors in NSW and QLD than in SA and VIC.

[3] With slight variation of the dates of the regulatory periods amongst the states, RP1 is from 2000 to 2004, RP2 is from 2005 to 2009 and RP3 is from 2010 to 2014.

Figure 1. Total expenditure allowances in three regulatory periods

Despite much higher expenditure allowances determined by the regulators, the government distributors also substantially overspent these allowances in the first two regulatory periods, while the private distributors typically underspent particularly in the first and second regulatory periods.

Analysis of the distributors' expenditure over the period from 2006 to 2013 covering most of RP2 and RP3 finds that the government distributors spent most on substations while the private distributors spent most on poles and wires. In all cases, however, network length per connection declined as all networks became more dense over the period.

Drawing on information in the Regulatory Information Notices published by the Australian Energy Regulator, Figure 2 contrasts the change in substation capacity, compared to the change in peak demand, both per connection between 2006 and 2013[4]. It shows that all distributors expanded substation capacity substantially more than demand, per connection, but more so for the government distributors (the first six from the left in the chart).

Figure 2. Change in substation capacity and peak demand per connection from 2006 to 2013

[4] These dates are chosen because the data allowing this analysis is only available from 2006.

The difference particularly in capital expenditure between government and private distributors resulted in higher growth in the regulated asset value and consequently the regulated revenues of the government relative to the private distributors. This in turn resulted in higher pecuniary gains for the government distributors relative to the private distributors[5]. A comparison of the owning governments' pecuniary benefits and the regulated asset values and regulated revenues of their distributors, per connection, is shown in Figure 3. The chart shows that pecuniary benefits more than doubled per connection over a period that both regulated revenues and regulated asset values per connection increased by around 70%.

Figure 3. Pecuniary benefit, regulated assets per connection and regulated revenue per connection for government distributors

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[5] The pecuniary gains for the private distributors are their after-tax profits, while the pecuniary gains for the government distributors include their after-tax profits, the income taxes and the debt guarantee fees charged by the state government for the loan they made to their distributors.

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