Testing Regulatory Consistency[#]

Robert Breunig and Flavio M. Menezes, School of Economics Discussion Paper No. 380, November 2008, School of Economics, The University of Queensland. Australia.

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EPrint Type: Departmental Technical Report

Keywords: price regulation; consistency; Australia

Subjects:

ID Code: JEL Classification: L51

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[#] Breunig and Menezes acknowledge the financial support of the Australian Research Council (ARC Grants DP 0557885 and 0663768). We thank Fernando Camacho, Steven Hamilton, Tom Gole and participants at the 2008 Association for Public Economic Theory Conference for useful comments. We are thankful to Cardy Man for research assistance. The usual disclaimer applies.

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1. Introduction

Consistency is generally deemed to be a key principle of good regulation.[1] It is also often demanded by regulated businesses.[2] Although no general definition of regulatory consistency exists, it usually means a requirement for equitable treatment; different firms under identical conditions regulated by different regulators should expect to be treated in the same way.

An important issue, and the starting point of this paper, is that there does not seem to be a clear articulation of how one should measure consistency. The approach followed in legislation often seems to rely on ensuring that particular regulatory parameters are the same. For example, the weighted average cost of capital (WACC) parameters that will apply to all electricity distribution businesses across Australia for regulatory proposals submitted between 01 April 2009 and 01 April 2014 will be identical 'unless there is persuasive evidence provided in individual distribution proposals that justify a departure'[3] from the standard rate set by the regulator.

Without detailed knowledge of the regulatory process, an outside observer may be tempted to equate consistency of specific regulatory parameters such as the WACC with regulatory consistency. This focus could be rationalised by the view that the WACC is based on the firms' capital requirements, which can be objectively assessed. This view, however, can be misleading as it ignores the discretionary nature of the choice of the WACC and other regulatory parameters by the regulator.

Consider, for example, two identical firms that are assessed by different regulators. It is clear that the regulatory decisions should yield the same return on capital. Suppose

[1] See, for example, statements available at http://www.dfes.gov.uk/hegateway/uploads/principles_good_regulation.doc, http://www.finance.gov.au/obpr/proposal/coag-requirements.html, and http://www.oecd.org/dataoecd/38/13/40395187.pdf.

[2] See, for example, Energy Retailers Association of Australia (2003), Australian Logistics Council (2006), and National Insurance Brokers Association of Australia (2007).

[3] See, Australian Energy Regulator (2008), p. 5.

further that the WACC parameters are identical across the two decisions but there are two different methodologies for setting the regulated asset base. In this simple example, identical WACC parameters will result in inconsistent returns on capital. This example highlights that regulators typically set both the WACC and other regulated parameters simultaneously. This is different from the role that the WACC plays in unregulated markets where the value of assets is determined by the market. Therefore, using the WACC to measure regulatory consistency might be misleading.

Perhaps the focus on specific parameters such as the WACC is understandable; it is easier to compare the WACC across decisions than to compare more multi-dimensional criteria such as asset valuation methods. However, as the example above illustrates, focusing on the WACC as a measure of regulatory consistency may be misleading. This observation provides one motivation for this paper, namely, to provide an alternative measure of regulatory consistency which has the advantage of being one-dimensional but avoids the disadvantage of focusing on a single parameter such as the WACC.

We propose to measure consistency as the proportion of firms' revenue requirement claims disallowed by the regulator when determining the maximum revenue. This measure aggregates a wide variety of inputs into the regulatory process and also focuses on a concrete outcome which both the firm and the regulator care about. This measure also has the advantage of not requiring any detailed knowledge of how the regulatory decision was arrived at.

A second motivation for this paper is to propose an approach for testing regulatory consistency across jurisdictions and industries. We do not specify a model of the regulatory decision-making process, but take an econometric approach which allows for, but does not impose, systematic differences across time, industry, and regulator. We can then test whether in fact differences exist. We view our analysis as exploratory in nature and we apply our technique to a database that we assembled from publicly available information in Australia.

One important finding is that when we examine WACC parameters across decisions in six industries, we find almost no consistency across regulatory agencies in Australia, giving the impression of regulatory chaos. However, using the proportion of firms' cost claims disallowed by the regulator, we find a much greater degree of consistency. This finding of consistency in one dimension but not in another dimension should also be of interest to those developing more structural models of the regulatory process, as it indicates the kind of stylised facts which such models must be able to accommodate.

We also find systematically different treatment, for both measures, of publicly-owned and privately-owned firms after controlling for industry, regulator, and time. We find no political effects as measured by which party is in power in the regulator's jurisdiction. We find some evidence that consistency appears to have increased over time.

Our paper is similar in nature to Hagerman and Ratchford (1978) in that we also advance a fact-finding approach with the aim of informing the development of theory. It also fits with a recent, albeit small, literature that aims to explain the variability of regulatory outcomes. Examples include Lehman and Weisman (2000), Figueiredo, Jr. and Edwards (2007), and Edwards and Waverman (2006).

Our approach is also similar in sprit to the fact-finding literature that aims at investigating whether regulatory outcomes vary with particular aspects of the regulatory regime such as whether regulators are appointed or elected. In this vein, Lehman and Weisman (2000) find that prices of telecommunication leases are higher in U.S. states with elected public utility commissioners. For retail telecommunications and electricity, prices in states with elected commissioners are found to be either lower (Besley and Coate, 2003) or not statistically significantly different (Primeaux and Mann, 1986) from prices in states with appointed commissioners. Using a richer database of regulatory decisions over time, Quast (2008) shows that the political affiliation of elected commissioners may be correlated with the lease (wholesale) prices that they set. Moreover, he shows that retail prices may vary with the political affiliation of appointed regulators.

This paper is organised as follows. In the next section we provide background on the regulatory environment in Australia for the industries we analyse. In section 3 we discuss our alternative measure of consistency and our empirical strategy. Section 4 describes the database that we assembled and our estimation results. In that section we address our main hypotheses, examine the effect of private ownership, and undertake robustness checking of our findings. Section 5 concludes.

2. The Institutional Framework

The institutional arrangements that prevailed since the deregulation of the network utility sectors saw regulatory responsibilities spread between state, territory and national regulators.[4] Even within industries, different segments of the supply chain were regulated by different regulators and at different jurisdictional levels. This practice resulted in divergent implementations of the underlying principles of price regulation. This divergence was a primary motivation for the regulatory reforms that established the Australian Energy Regulator, which will take over responsibility for the regulation of electricity distribution in most states from 2009 onwards.

The remainder of this section describes the different regulatory frameworks that applied for the industry sectors during the period covered in this study.

Electricity

Responsibility for electricity regulation in Australia was divided amongst state, territory and national regulators since the introduction of deregulation. As part of the deregulation process a National Electricity Market (NEM) was developed. This market comprises Queensland, New South Wales, Australian Capital Territory, Victoria and South Australia. Tasmania joined the NEM when the Basslink Interconnector was commissioned in April 2006. Jurisdictions in the NEM were required to regulate the

[4] Australia is a federal system with six states and two main self-governing territories, the Northern Territory and the Australian Capital Territory. Australia also has several minor overseas territories which do not figure in the analysis presented here. Governance in the states and territories is identical in relation to the regulatory issues presented here and we refer to both generically as 'states' in what follows.

electricity industry according to an industry access code developed under Part IIIA of the *Trade Practices Act* 1974: the National Electricity Code (NEC).

Price regulation under the NEC focused on an incentive-based mechanism that applied a CPI-X approach. The regulation of electricity transmission companies in NEM jurisdictions was conducted on a national basis by the Australian Competition and Consumer Commission (ACCC) whereas distribution companies were regulated via the relevant state-based regulator.

While the ACCC regulated electricity transmission under the NEC, there was sufficient scope within the NEC to allow the ACCC to interpret regulatory pricing components in different ways. The NEC also allowed state-based regulators to develop alternative pricing principles to those set out in the NEC. As a result, price regulation developed differently amongst state-based regulators. For example, while the NSW regulator applied a revenue cap regime, the Victorian regulator applied a price cap regime. In addition, other incentive-based mechanisms of the regime also varied. For instance, Victoria was the only jurisdiction to apply a service incentive scheme and an efficiency carryover mechanism.

For those jurisdictions that are outside the NEM, state-based regulation applied for both transmission and distribution although there is movement towards regulatory regimes similar to the NEM style of price control.

Finally, the ownership profile varies quite dramatically across states. While electricity distribution businesses in Victoria and South Australia are privately owned, public ownership is the norm across other states. This divergence of ownership profiles is also present in electricity transmission.

Gas

Gas industry regulation in Australia during the period covered by this study was developed under the National Third Party Access Regime for Natural Gas Pipelines (the

Gas Access Regime).[5] This regime applied to third party access to natural gas transmission and distribution pipelines. Unlike for electricity, the Gas Access Regime operated in each state and territory through the corresponding gas law.

The Gas Access Regime in Australia only applied to pipelines that were ‘covered’ under the regime. `Covered' pipeline operators were required to have an access arrangement in place. Transmission pipeline access arrangements were the responsibility of the ACCC (except in Western Australia), while distribution pipelines were the responsibility of state-based regulators. The ownership profile (i.e., public versus public ownership) of the gas distribution industry is similar to that of electricity although gas transmission is characterised entirely by private ownership.

Water

Water regulation in Australia is conducted on a state and territory basis with different jurisdictional arrangements applying across them. Water pricing decisions typically consider bulk water, storm water, and wastewater as well as general water supply services. Water price regulation is conducted under specific state-based water legislation with regulatory powers provided through the legislation specific to the regulator. The industry is characterised by complex arrangements involving ownership by local councils and states of the various segments of the industry. Most water businesses were affected by the drought and the imposition of severe water restrictions in many jurisdictions over the last five years.

Rail

We assembled regulatory decisions for access prices to rail infrastructure by two state regulators (Victoria and Queensland). These are the two states for which data was available from the Economic Regulator’s website.

The Essential Services Commission of Victoria’s objectives under the legislation are to ensure that users have fair and reasonable access to declared rail transport services, and to

[5] See, for example, Productivity Commission (2004).

ensure that users requiring access to declared rail transport services to provide passenger services have priority over users requiring such access to provide services other than passenger services. Tracks are owned by private firms in Victoria.

In contrast, the rail infrastructure in Queensland was owned by a single government-owned firm. The state regulator, the Queensland Competition Authority, has a legislated duty to assess and approve third party access undertakings to Queensland's intrastate rail network; arbitrate access disputes; enforce breaches of access obligations; and assess competitive neutrality.

3. Testing consistency

This section develops an approach to test the consistency of regulatory decisions across jurisdictions and industries, controlling for the effect of time, ownership, and political affiliation. The approach we take may be thought of as asking a broad question, "As an outsider, how can I tell if two regulatory decisions are consistent?" This question is obviously of interest to anyone who wishes to analyse whether regulatory reform has been successful in increasing consistency. Here we focus on two specific aspects of this broader question: what should I be testing and how should I be testing it?

Public debate often focuses on specific parameters such as the weighted average cost of capital (WACC). We propose an alternative to the WACC, which is the difference between a firm's revenue requirements measured in dollars (*Y*) and the maximum allowable revenue (*MAR)* as determined by the regulator.[6] We define the following unit-free variable:

$$(1)\ PDC = \frac{Y - MAR}{Y}$$

We refer to our variable as *PDC* (proportion of disallowed claims) for short. Note that in principle we have $0 < PDC < 1$ as in one extreme the regulator can set the maximum allowable revenue to exactly cover the firm's revenue requirement claims

[6] We proposed and used this measure in an earlier paper--see Breunig et al. (2006). That paper did not consider any information on political effects and used a pilot data set which was less than half the size of the dataset used in this paper.

making $PDC = 0$.[7] At the other extreme, the regulator sets the maximum allowable revenue to zero making $PDC = 1$.

Note that the interpretation of *PDC* is unlikely to be trivial. If one assumes truthful revelation of costs by firms, then *PDC* could be interpreted as a measure of a firm's deviation from the efficiency frontier; a higher *PDC* indicating a more inefficient firm. By the same token, if firms' behaviour across industries were the same so that they all exaggerated their forecasted future costs, then *PDC* can be interpreted as a measure of the toughness of the regulator, a higher *PDC* indicating a tougher regulator.

In order to test regulatory consistency we specify a simple model for the regulatory parameter (whether it be the WACC or *PDC*) that depends upon industry, regulator, and time. The model does not depend upon any knowledge of the underlying regulatory process. We also allow for the effect of private ownership and the political party in power in the jurisdiction of the regulator.

The model is

$$(2)\; z_{irt} = \alpha + RD_r'\beta + ID'_i\gamma + TD'_t\delta + \mathrm{Priv}_{irt}\theta + Labour_{irt}\lambda + \varepsilon_{irt}$$

where *z* is the variable of interest (WACC or *PDC*), subscripts *irt* indicate, respectively, the industry, regulator and time of the decision. *RD* are dummy variables indicating which regulator took the decision, *ID* are dummy variables representing the industry to which the decision applies, *TD* are dummy variables for the year in which the decision was taken, Priv is a dummy variable equal to one when the firm is privately owned (and zero otherwise) and Labour is a dummy variable equal to one when a Labour government is in power in the regulatory jurisdiction (and zero otherwise). α, β, γ, δ, θ and λ are (vectors of) parameters to be estimated while ε_{irt} is a random term.

[7] In practice it is possible to observe $PDC < 0$. This can be the result, for example, of the regulator allowing the firm to anticipate to period *t* certain expenses that would be incurred at a later date.

The model may be viewed as a three-way error component model. Our approach can also be viewed as a flexible, non-parametric model where we group the data into cells by time period, regulator and industry. We then calculate means for each cell, which we can use to make cross-cell comparisons. The regression framework allows us to easily conduct hypothesis tests for pairs and groups of cells while controlling for ownership and political effects.

Finally, we would remind the reader that our objective is not to explain the WACC values (nor the values of *PDC*) but rather to estimate a simple exploratory model that allows us to test differences across regulatory decisions in various dimensions.

4. Data and results

The data were obtained by searching the websites of all Australian utility regulators for their pricing determinations. Therefore, the data are limited to those decisions where the regulator has provided the information on both the proposal and the determination on the Internet.[8] There are 115 decisions, all of which were made since 1998, for which we were able to find the required information to construct *PDC* as described in equation (1) above. Decisions cover three to nine years, with five years being both the average and the most common decision length. Most regulatory decisions report several different WACC values; we use the `vanilla' WACC.[9]

Of the 115 decisions in our data base, there are 70 regulatory decisions for which we have information on both *PDC* and the `vanilla' WACC. Since one objective of the paper is to compare the degree of consistency which we find when we use different measures of consistency, we focus on this sub-set of 70 decisions for which we can compare the two measures. As a robustness check, we also estimate equation (2) using the full sample of

[8] In most cases, the business's proposed revenue requirement and the regulator's maximum allowable revenue determination were found in the regulator’s final decision report for that business or industry. In some instances, the business's proposed revenue requirements were not available in the final decision. When this was the case, the business’s initial submission was used to obtain the data. WACC parameters were not available for all decisions.

[9] This is the WACC value prior to adjustments for taxes and imputation credits.

115 regulatory decisions – but we can only do this for *PDC* (See section 4.3 below.). We describe the data in section 4.1 and present our main estimation results in section 4.2.

4.1 Descriptive statistics

Tables 1 to 3 summarise the basic information about the 70 decisions used in estimating equation (2) for both WACC and *PDC*. Each decision comprises several years and the tables also provide information about the 277 annual observations which make up these 70 decisions. Appendix tables A1 to A3 provide information about the full sample of 115 decisions.[10]

Table 1 provides the number of observations and decisions for each of the six industries for which we have data by the nine regulators covered in our database. The ACCC is the national regulator, and as described in section 2 above, regulated only electricity and gas transmission during the period covered by our sample. Note that half of the decisions in our database relate to the water industry and that average values for both the WACC and *PDC* are lowest for that industry. We discuss the robustness of our results to the predominance of the water industry in section 4.3 below.

[10] The full database is available at http://www.uq.edu.au/economics/staff/flavio_menezes/Regulation_database_with_ownershipv2.xls.

Table 1
Number of observations (decisions), average *PDC* (*in italics*) and
average vanilla WACC value (in ALGERIAN) by regulator and industry.

					Regulator					
Industry	ACCC	Vic	NSW	QLD	WA	SA	ACT	TAS	NT	**Total**
Electricity Transmission	29 (4) *.107* .085									**29 (4)** ***.107*** **.085**
Electricity Distribution		25 (5) *.165* .059	20 (4) *.089* .067	10 (2) *.115* .085				3 (1) *.094* .081	4 (1) *-.055* .097	**62 (13)** ***.112*** **.070**
Gas Distribution			9 (2) *.116* .068	10 (2) *.026* .087	5 (1) *.082* .062	5 (1) *.103* .061	6 (1) *.081* .096			**35 (7)** ***.079*** **.076**
Gas Transmission	5 (1) *.141* .088				11 (2) *.063* .068					**16 (3)** ***.089*** **.075**
Water		65 (24) *.014* .052	20 (7) *.087* .062					27 (6) *.246* .064		**112 (37)** ***.065*** **.056**
Rail		3 (1) *.377* .066		20(5) *.043* .084						**23 (6)** ***.099*** **.081**
Total	**34 (5)** ***.114*** **.086**	**93 (30)** ***.051*** **.054**	**49 (13)** ***.092*** **.065**	**40 (9)** ***.055*** **.085**	**16 (3)** ***.069*** **.066**	**5 (1)** ***.103*** **.061**	**6 (1)** ***.081*** **.096**	**30 (7)** ***.224*** **.066**	**(4) 1** ***-.055*** **.097**	**277 (70)** ***.082*** **.065**

Tables 2 and 3 describe the decisions relating to privately-owned firms and those relating to publicly-owned firms. From Table 2, we see that all decisions in the water industry relate to publicly-owned firms. In all other industries, we have a mix of privately and publicly-owned firms in the data. Table 3 provides average values for both the WACC and *PDC* by regulator, split by ownership status of the firm. We see a very small difference in average WACC across publicly and privately-owned firms, but *PDC* is twice as large, on average, for privately-owned firms than for publicly-owned firms. Of course, these are average values before we control for any systematic differences across industry or regulator.

Table 2
Number of observations (decisions) by industry split by publicly/privately owned firm

	Industry						
Ownership	Electricity Transmission	Electricity Distribution	Gas Distribution	Gas Transmission	Water	Rail	**Total**
Public	14 (2)	37 (8)	9 (2)	5 (1)	112 (37)	20 (5)	**197 (55)**
Private	15 (2)	25 (5)	26 (5)	11 (2)	0	3 (1)	**80 (15)**
Total	**29 (4)**	**62 (13)**	**35 (7)**	**16 (3)**	**112 (37)**	**23 (6)**	**277 (70)**

Table 3
Number of observations (decisions), average value of *PDC* (in *italics*) and 'vanilla' WACC (in ALGERIAN) by regulator and public/private ownership

	Regulator									
Ownership	ACCC	Vic	NSW	QLD	WA	SA	ACT	TAS	NT	**Total**
Public	19 (3) *.070* .088	65 (24) *.014* .052	44 (12) *.094* .064	35 (8) *.057* .085				30 (7) *.224* .066	4 (1) *-.055* .097	**197 (55)** ***.066*** **.064**
Private	15 (2) *.179* .083	28 (6) *.201* .060	5 (1) *.075* .070	5 (1) *.042* .087	16 (3) *.069* .066	5 (1) *.103* .061	6 (1) *.081* .096			**80 (15)** ***.138*** **.069**
Total	**34 (5)** ***.114*** **.086**	**93 (30)** ***.051*** **.054**	**49 (13)** ***.092*** **.065**	**40 (9)** ***.055*** **.085**	**16 (3)** ***.069*** **.066**	**5 (1)** ***.103*** **.061**	**6 (1)** ***.081*** ***.096***	**30 (7)** ***.224*** **.066**	**4 (1)** ***-.055*** **.097**	**277 (70)** ***.082*** **.065**

The only jurisdictions within which there is any variation in political party in power during the time period of our data are South Australia, Victoria, and the Australian Capital Territory. Given this lack of variation, the political variable is statistically insignificant in the regression models of the next sub-section.

4.2 Regression results

Table 4 presents the estimated coefficients from the model of equation (2) using the WACC parameter as the dependent variable. Table 5 presents the estimated coefficients using the average *PDC* across all years of the decision as the dependent variable.[11] For both measures, we find significant differences across the decisions for privately and publicly-owned firms in keeping with the descriptive statistics of Table 3 even after

[11] For each decision in our data set, we observe one value of the WACC parameter. Thus equation (2) is estimated at the level of the decision. However, regulators' decisions regarding firms' allowable cost claims are spread across multiple years (usually five) so the equation for *PDC* can be estimated either at the level of the decision or at the level of the annual value of *PDC*. In the latter case, one would want to allow for correlation in ε_{irt} as the disallowed cost claims of a firm over different years within the same decision are clearly related. For comparability across measures, we have presented results at the decision level. A model estimated using individual yearly observations with correction for clustering produces substantively similar results.

controlling for industry, regulator, and time effects. Time dummies are included in the regressions but are not presented since they are not of particular interest.

Table 4
Estimated model coefficients
Dependent variable: 'vanilla' Weighted Average Cost of Capital

	coefficient estimate (standard error)
Industry (water is reference category)	
Electricity Transmission	.0082** (.0032)
Electricity Distribution	.0056* (.0008)
Gas Transmission	.013** (.0023)
Gas Distribution	.0071** (.0013)
Rail	.0072** (.0012)
Regulator (ACCC is reference category)	
Victoria	-.023** (.0028)
New South Wales	-.014** (.0027)
Queensland	.0031 (.0027)
Western Australia	-.022** (.0021)
South Australia	-.022** (.0031)
Australian Capital Territory	.012** (.0031)
Tasmania	-.0046 (.0037)
Northern Territory	.011** (.0037)
Ownership (publicly owned is reference category)	
Privately owned	.0015* (.0009)

Regression includes time dummies
** Significant at 5% level
* Significant at 10% level

Table 5
Estimated model coefficients
Dependent variable: PDC

	coefficient estimate (standard error)
Industry (water is reference category)	
Electricity Transmission	-.083 (.128)
Electricity Distribution	.090** (.039)
Gas Transmission	-.054 (.097)
Gas Distribution	-.036 (.054)
Rail	.105** (.049)
Regulator (ACCC is reference category)	
Victoria	-.145 (.116)
New South Wales	-.071 (.113)
Queensland	-.182 (.111)
Western Australia	-.128 (.089)
South Australia	-.158 (.127)
Australian Capital Territory	-.056 (.139)
Tasmania	-.140 (.130)
Northern Territory	-.289 (.130)
Ownership (publicly owned is reference category)	
Privately owned	.102** (.035)

Regression includes time dummies
** Significant at 5% level
* Significant at 10% level

We are primarily interested in the coefficient estimates from Tables 4 and 5 to address the question that we pose in this paper: do we arrive at different conclusions regarding regulatory consistency if we use a parameter such as the WACC or if we use the revenue requirement of the business compared to the revenue determination of the regulator?

Table 6
Hypothesis tests of consistency of the `vanilla' WACC across regulator

			Regulator					
Industry	Vic	NSW	QLD	WA	SA	ACT	TAS	NT
ACCC	.00**	.00**	.26	.00**	.00**	.00**	.23	.00**
Vic		.00**	.00**	.62	.75	.00**	.00**	.00**
NSW			.00**	.00**	.00**	.00**	.00**	.00**
QLD				.00**	.00**	.00**	.01**	.00**
WA					.88	.00**	.00**	.00**
SA						.00**	.00**	.00**
ACT							.00*	.71
TAS								.00**
p-value for test of joint equality between Victoria, South Australia and Western Australia: .87								

Table 6 provides the results of pairwise hypothesis tests across all regulators using the regression results from table 4 (the regression model of equation (2) using WACC as the dependent variable). The null hypothesis in each test is that the two regulators behave similarly. The values in the table are the p-values associated with this hypothesis test. A p-value greater than .1 means that we fail to reject the null hypothesis at the 10 per cent level.

Strikingly, we find many significantly different coefficients and no patterns of consistency across state or national based regulators which correspond to any market groupings. In particular, the NEM members (except neighbours South Australia and Victoria) appear to behave differently from one another in a statistically significant way. We can conclude that South Australia, Victoria, and Western Australia (as reported in the last row of Table 6) can be grouped together but it is difficult to find any economic justification for this grouping.

Table 7 provides the results of pairwise hypothesis tests across all regulators using the results from table 5 (the model of equation (2) using our proposed measure, *PDC*). The null hypothesis in each test is again that the two regulators behave similarly.

Table 7
Hypothesis tests of consistency of *PDC* across regulator

				Regulator				
Industry	Vic	NSW	QLD	WA	SA	ACT	TAS	NT
ACCC	.22	.53	.11	.16	.22	.69	.29	.03**
Vic		.01**	.41	.83	.87	.33	.95	.06*
NSW			.01**	.47	.26	.86	.37	.01**
QLD				.51	.77	.20	.58	.16
WA					.75	.48	.91	.14
SA						.33	.87	.22
ACT							.50	.06*
TAS								.11
p-value for test of joint equality between Australian Capital Territory, Queensland, South Australia, and Victoria: 0.60								

The Northern Territory appears to behave quite differently than the other states. While this may perhaps not be surprising given the very low population density and very high proportion of remote communities, one should probably not infer too much from these results as this coefficient is identified by only one decision! Dropping it from the model has no effect on the other results.

We find a large degree of consistency amongst the state-based regulators, in contrast to the impression of regulatory chaos that one gets looking at the WACC results. We fail to reject that the Australian Capital Territory, Queensland, South Australia, and Victoria behave consistently with one another. The p-value of this test is .6, as reported in the last row of Table 7. This is exactly the type of consistency that one might expect to find given the joint participation of these four states in the National Electricity Market (NEM) described above in section 2. We do find that the fifth member of the NEM, New South Wales, behaves significantly differently than both Victoria and Queensland, although not differently than the Australian Capital Territory and South Australia.

In the robustness checking of section 4.3, below, we explore this divergence of New South Wales from its Victorian and Queenslander neighbours and conclude that it may be driven by the predominance of water industry decisions in the sub-sample for which we have both a measure of *PDC* and of the WACC. From Table 1, we see that the average *PDC* in water decisions is six times larger in New South Wales than in Victoria and this drives the significant difference in the coefficients relating to these two states that we see in Table 5.

Overall, we find a large degree of homogeneity amongst the state regulators and the ACCC. We fail to reject the similarity of any grouping of the ACCC with the state regulators provided the grouping excludes New South Wales and the Northern Territory. Tables 8 and 9 present the results of the hypothesis tests for consistency across industry for the WACC and *PDC*. For our measure of relative revenue requirement, we find broad consistency across electricity transmission, gas transmission, gas distribution and water (Table 9). Rail and electricity distribution cannot be grouped with the other industries.

Table 8
Hypothesis tests of WACC consistency across industry

		Industry			
Ownership	Electricity Distribution	Gas Distribution	Gas Transmission	Rail	Water
Electricity Transmission	.38	.68	.01**	.74	.00**
Electricity Distribution		.15	.00**	.11	.00**
Gas Distribution			.00**	.92	.00**
Gas Transmission				.01**	.00**
Rail					.00**
p-value for test of joint equality of Electricity Distribution, Electricity Transmission, Gas Distribution, and Rail: .33					

Table 9
Hypothesis tests of *PDC* consistency across industry

		Industry			
Ownership	Electricity Distribution	Gas Distribution	Gas Transmission	Rail	Water
Electricity Transmission	.15	.67	.72	.13	.52
Electricity Distribution		.01**	.13	.72	.02**
Gas Distribution			.81	.00**	.52
Gas Transmission				.09*	.58
Rail					.04**
p-value for test of joint equality of Electricity Transmission, Gas Transmission, Gas Distribution, and Water: .90					

Table 8 presents the analogous tests for industry consistency for the regression model of equation (2) using the WACC parameter as the dependent variable. Although the patterns are slightly different, we find a roughly similar degree of consistency across industries when we examine the WACC parameter. In particular, we find that the different WACC values which have been used by regulators across Electricity Distribution, Electricity Transmission, Gas Distribution, and Rail are not statistically different from one another. For the WACC parameter, it is water and gas transmission that look quite different from the other industries.

4.3 Robustness Checking

Our hypothesis tests are based upon the premise that a failure to find statistically significant differences is evidence of regulatory consistency. But it could also be that our failure to find statistically significant differences is simply a function of small sample sizes and large standard errors. This is a concern mostly for the estimates of table 5 using our measure of relative costs allowed by the regulator, *PDC*. We find many significant differences using the WACC values, as reported in tables 4 and 6.

Fortunately, the sample of data for which we were able to find information about firms' cost claims and regulators' decisions is much larger than the sub-sample used in tables 1 through 9 (where we needed consistent information to compare *PDC* and WACC). Our full dataset for the *PDC* variable contains 498 yearly observations on 115 regulatory decisions. Descriptive statistics are provided in Appendix Tables A1 to A3.

In Tables 10 and 11 we present the results of the hypothesis tests for regulatory consistency across regulators and industries based upon equation (2) estimated across all 115 decisions. These hypothesis tests are based upon a sample size which is 50% larger than that upon which tables 7 and 9 are based, giving us more confidence in the consistency tests.

In addition to the larger sample size, this group of 115 decisions is spread more evenly across industries and less concentrated in decisions relating to water (only 25 per cent of the decisions in the larger data set relate to water), which is a drawback of our smaller dataset that we flagged above. For all of these reasons, the results we present here are our "preferred" results for the *PDC* variable.

Table 10 presents the results of the hypothesis tests across regulators while Table 11 presents the hypothesis tests across industries.[12] The basic results presented above are confirmed and, in several senses, strengthened. We find very strong consistency across the five states which participate in the National Electricity Market (NEM), with the p-value of the test of pooling these five states equal to .34. We also find that Western Australia and Queensland, which have similar characteristics, are quite similar. Only Tasmania now stands out as being very different from the other states.

Table 10
Hypothesis tests of consistency across regulator

			Regulator					
Industry	Vic	NSW	QLD	WA	SA	ACT	TAS	NT
ACCC	.04**	.02**	.15	.06*	.12	.09*	.00**	.74
Vic		.18	.25	.28	.82	.74	.00**	.14
NSW			.06*	.13	.50	.33	.00**	.07*
QLD				.71	.67	.60	.00**	.35
WA					.50	.46	.00**	.58
SA						.99	.01**	.29
ACT							.00**	.23
TAS								.00**
p-value for test of joint equality of ACT, Vic, NSW, SA, and Qld: .34								

Looking at Table 11, we find consistency across industry of a type that we expect. The two transmission industries--gas and electricity--are quite similar as are the gas and electricity distribution industries. We find that rail can also be easily grouped with the two distribution industries while water behaves quite dissimilarly to the others.

[12] Full regression results are available from the authors. Results presented here are based upon the regression using the average observation of *PDC* over the full decision period as the dependent variable. Regressions estimated using the multiple yearly observations for each decision, with appropriate correction of the standard errors for clustering, result in very similar hypothesis tests.

Table 11
Hypothesis tests of consistency across industry

		Industry			
Ownership	Electricity Distribution	Gas Distribution	Gas Transmission	Rail	Water
Electricity Transmission	.02**	.01**	.41	.10	.01**
Electricity Distribution		.53	.03**	.33	.06*
Gas Distribution			.01**	.17	.29
Gas Transmission				.15	.01**
Rail					.05**
p-value for test of joint equality of Gas Distribution, Electricity Distribution and Rail: .37					

Finally, we note that the other results discussed above are unchanged in the larger data set. Regulators still appear to be `tougher' when the decision relates to a privately-owned firm than to a publicly owned firm and the difference is statistically significant. Also, the dummy variable for which political party is in power in the regulatory jurisdiction remains insignificant.

4.4 Has consistency increased over time?

In an earlier paper (Breunig et al. 2006), we looked at regulatory consistency in Australia over the time period 1997 - 2005 using a data base which was about half as large as the one used in this paper. We considered a smaller subset of industries, only had limited information on firm ownership, had no information on political affiliation, and only looked at one measure of consistency. Using *PDC*, we found consistency among the states in south-eastern Australia. In this paper with a longer sample and larger data set, we find increased consistency particularly in the fact that Queensland looks more similar to the south-eastern states in the latter part of the period. This might be interpreted as an increase in the amount of regulatory consistency over time.

5. Conclusion and discussion

In this paper, we have proposed a simple approach to testing for regulatory consistency that makes no assumption about the underlying regulatory process. Estimating a simple regression model where regulatory parameters are described (statistically) as a function of industry, time, and regulator allows us to test consistency in various dimensions and permits controlling for other variables such as private ownership or political effects in a simple way.

We argue against basing consistency tests solely on parameters such as the weighted average cost of capital (WACC) and instead argue for using the proportion of firms' cost claims which are disallowed by the regulator. We primarily make the case for this preference on theoretical grounds. Similar WACC parameters across regulatory decisions are neither sufficient nor necessary for consistent regulatory outcomes. Furthermore, it seems reasonable that consistency measures should be based on outcomes rather than on inputs. The WACC parameter is just one input amongst many whereas the proportion of firms' cost claims which are disallowed by the regulator is an outcome which is determined by a variety of parameters, including the WACC.

In our exploration of regulatory consistency in Australia we find a large degree of consistency among the state-based regulators who make up the National Electricity Market in eastern Australia when we use our measure of the proportion of firms' cost claims which are disallowed by the regulator. This consistency across state-based regulators in eastern Australia accords with our prior beliefs and there is some evidence that it is increasing over time. If we look at the WACC parameter, we find what appears to be regulatory chaos. It is important to note, however, that inconsistency in inputs is quite compatible with consistency in outputs.

Irrespective of our prior beliefs, our empirical results cannot be interpreted as favoring our measure *PDC* over the WACC as a measure of regulatory consistency simply because we do not know the underlying `true' degree of consistency. That the two measures give fairly different results may be taken as evidence that consistency is best thought of as a multi-dimensional concept and that one would want to look at more than one measure of consistency.

Given that regulatory reform has often cited consistency as an objective, this paper provides a framework which can be used to test whether consistency is increasing or decreasing over time. Such testing should not depend upon a detailed knowledge of the internal processes of the regulator and this has motivated us in our approach.

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APPENDIX

Table A1
Number of observations (decisions) and average value of *PDC* (*in italics*)
by regulator and industry (extended sample of 115 decisions)

	Regulator									
Industry	ACCC	Vic	NSW	QLD	WA	SA	ACT	TAS	NT	**Total**
Electricity Transmission	83(13) *.162*									**83(13)** ***.162***
Electricity Distribution		50(10) *.158*	30(6) *.110*	10(2) *.115*			10(2) *.093*	3(1) *.094*	4(1) *-.055*	**107(22)** ***.125***
Gas Distribution		30(6) *.115*	23(5) *.114*	22(4) *.060*	10(2) *.068*	9(2) *.122*	10(2) *.122*			**104(21)** ***.100***
Gas Transmission	35(7) *.135*				21(4) *.244*					**56(11)** ***.176***
Water		65(24) *.011*	33(12) *.053*					27(6) *.256*		**125(42)** ***.075***
Rail		3(1) *.377*		20(5) *.043*						**23(6)** ***.087***
Total	**118(20)** ***.154***	**148(41)** ***.089***	**86(23)** ***.089***	**52(11)** ***.064***	**31(6)** ***.187***	**9(2)** ***.122***	**20(4)** ***.107***	**30(7)** ***.240***	**4(1)** ***-.055***	**498(115)** ***.117***

Table A2
Number of observations (decisions) by industry split by publicly/privately owned firm
(extended sample of 115 decisions)

	Industry						
Ownership	Electricity Transmission	Electricity Distribution	Gas Distribution	Gas Transmission	Water	Rail	**Total**
Public	46 (8)	52 (11)	35 (7)	10 (2)	125(42)	20 (5)	**288 (75)**
Private	37 (5)	55 (11)	69 (14)	46 (9)	0	3 (1)	**210 (40)**
Total	**83(13)**	**107(22)**	**104(21)**	**56(11)**	**125(42)**	**23(6)**	**498(115)**

Table A3
Number of observations (decisions) and average value of *PDC* (*in italics*)
by regulator split by publicly/privately owned firm
(extended sample of 115 decisions)

	Regulator									
Ownership	ACCC	Vic	NSW	QLD	WA	SA	ACT	TAS	NT	**Total**
Public	56 (10) *.089*	80 (27) *.027*	72 (20) *.089*	41 (9) *.051*	0	0	5(1) *.090*	30(7) *.240*	4(1) *-.055*	**288 (75)** ***.080***
Private	62 (10) *.214*	68 (14) *.162*	14 (3) *.089*	11 (2) *.113*	31(6) *.187*	9(2) *.122*	15(3) *.113*	0	0	**210 (40)** ***.168***
Total	**118(20)** ***.154***	**148(41)** ***.089***	**86(23)** ***.089***	**52(11)** ***.064***	**31(6)** ***.187***	**9(2)** ***.122***	**20(4)** ***.107***	**30(7)** ***.240***	**4(1)** ***-.055***	**498(115)** ***.117***