Loyalty taxes in retail electricity markets: not as they seem?

Working Paper 2005
May 2020

Bruce Mountain, Victoria University*
Kelly Burns, Victoria University

Abstract

A common view in retail electricity markets is that retailers discriminate based on consumers' loyalty: loyal consumers pay more. The premium is colloquially known as a "loyalty tax" or "loyalty premium". Reflecting this understanding Australia's governments, regulators and consumer advocates have encouraged consumers to switch electricity retailers. Using a sample of 47,114 household electricity bills we test whether consumers that had switched in the previous 12 months ("switchers") pay less than consumers who remained with their retailers ("remainers") in the previous 12 months. We find that the annual bills of switchers are expected to be AU$48 (4%) lower than remainers and that the median switcher could reduce their bills by 21% by selecting the cheapest offer. Classifying retailers into tiers however provides some nuance to the main conclusion: the third tier of retailers (the new entrants with market shares of less than 3%) impose higher loyalty taxes than the other two tiers (incumbents and mid-sized retailers). The middle tier of retailers impose the lowest loyalty tax, in fact for many consumers they may reward loyalty. These findings suggest the loyalty tax is (typically) smaller than widely considered, that it varies across tiers of retailers and that even engaged consumers typically do not select the lowest priced offers. This raises the question of whether switchers are motivated by other factors as well as lower bills or whether the main challenge is difficulties in search.

Keywords: Retail choice, search costs, loyalty tax, electricity

JEL: C21, D11, D12

DOI: 10.26196/5e8d23d218959

Declarations

Bruce Mountain and Amine Gassem are co-founders of a price comparison website, and the extraction and processing of bill data used in this study was performed using data extraction and pricing software used by that website.

Acknowledgements

We thank Amine Gassem without whose PDF parsing, website scraping and data science skills this research would not have been possible. We also acknowledge Stephanie Rizio's research assistance and thank Stephen Littlechild for rigorous scrutiny, ideas and much interesting discussion.

Funding

This research was supported by a multi-year funding grant from the Government of Victoria for the establishment of the Victorian Energy Policy Centre.

Conflicts of interest

None

* The corresponding author is: bruce.mountain@vu.edu.au

1. Introduction

The retail electricity market in the state of Victoria, Australia, was opened to competition in 2003, with all price controls withdrawn in 2009. Between 2009 and 2016 Victorian retail electricity prices rose by 84% in real terms (Australian Bureau of Statistics, 2017). Consequently, Victoria's retail electricity market has attracted substantial attention from economists and commentators (for example (Australian Competition and Consumer Commission, 2018; Ben-David, 2018; B. Mountain, 2015; Thwaites, Faulkner, & Mulder, 2017; Woods & Blowers, 2017).

A common belief in Australia is that electricity retailers discriminate on the basis of consumer loyalty. Consumers who are engaged in the market and switch to cheaper deals (the "switchers"), pay less than loyal consumers (the "remainers"). The premium paid by loyal consumers is often referred to as a "loyalty tax" or "loyalty premium" or alternatively the absence of a "loyalty discount" (see for instance (Australian Competition and Consumer Commission [ACCC], 2018b; Potter, 2016). Loyalty taxes have also been suggested in other consumer markets in Australia including insurance (Fels, 2019) and mortgages (Australian Competition and Consumer Commission [ACCC], 2018a).

The notional loyalty taxes in retail electricity markets is not unique to Australia. In its review, the Competition and Markets Authority reached similar conclusions about the retail electricity market in Great Britain (Competition and Markets Authority, 2016) and in other sectors (and electricity) in its response to Citizens Advice's super-complaint (Competition and Markets Authority, 2018).

The loyalty tax hypothesis in electricity retailing has typically followed an analysis of the range of prices that suppliers charge in the offers they make. However there has been no accepted definition of loyalty tax when the term has been used by regulators, governments or consumers groups in Australia. In its analysis of Australia's retail electricity markets, ACCC did not quantify the loyalty tax but pointed to its existence including through a review of internal documents from incumbent retailers that referred to strategies for communication with passive customers (for the case in point identified as 87% of its customers) aimed at minimising the chance that customers are prompted to inquire about better deals. Governments have however at times[1] taken a narrower view of loyalty taxes by estimating them with reference to the prices that a much smaller percentage of customers (around 10%) pay on "Standing Offers" (at the time of this research these Standing Offers were default unregulated offers and typically the highest prices in the market). Underlying the common understanding of the loyalty tax there is also a common belief that switchers can and do secure the highest available savings (in other words that they select the cheapest offers) when they switch. The inference is that the loyalty tax is essentially equal to the highest available savings.

We seek to understand loyalty taxes by examining what customers actually pay and how this compares to the range of offers that retailers make. We contribute to the literature through the development and application of robust multivariate econometric models drawing on a large sample of consumers' bills. Our sample also distinguishes remainers and recent switchers (unlike the earlier seminal study by Waddams Price and Wilson (2010) which analysed switchers only) enabling comparison of the outcomes for recent switchers and remainers. Further, our study considers all commonly available offers in the market in assessing the available savings for each consumer. Access to a large sample of bills, the effort required in data extraction from such a large sample and collection of all commonly available offers has meant that this type of research is rarely (if ever) found in the literature.

The paper is set out as follows: Section 2 reviews the relevant literature on search costs and loyalty taxes. Section 3 estimates loyalty taxes by comparing the outcomes for switchers and remainers. Section 4 extends the analysis by examining how loyalty taxes vary when analysing retailers into three tiers. The concluding section draws out the main points, policy implications and suggestion for further research.

[1] See for example https://www.minister.industry.gov.au/ministers/taylor/media-releases/lower-electricity-prices-and-getting-rid-loyalty-tax

2. Relevant literature

The theory of rational consumer behaviour and choice suggests that if consumers are acting rationally they will engage in the market and search for, and select, the best offer available to them. "Active" consumers are those that engage in the market and benefit from retailer competition in the form of lower prices, whereas "inactive" or "passive" customers are those that do not engage in the market and face relatively higher prices. In our study the active and passive customers, "switchers" and "remainers", are distinguished on the basis of whether or not they switched retailer in the previous 12 months.

Engaging in the market to assess the variety of competing offers takes time and effort. The more time and effort required, the higher the opportunity cost of switching retailer. The time and effort needed to acquire information to compare competing offers are referred to as "search costs". Customers that then switch to competing offers incur switching costs. These include direct costs such as the transaction costs involved in changing payment arrangements, paying termination or joining fees, or losing loyalty discounts. Switching costs also include indirect costs such as procedural switching costs (that is, the switching time and effort required).

Rational consumers might be expected to switch retailer if the private benefit of switching (i.e. the amount by which they reduce their bill) exceeds the search and switching costs they incur. Both search and switching costs can influence the motivations of consumers to engage in a market and there is a wide body of literature considering the effect of switching and search costs on market outcomes (Giulietti, Waterson, & Wildenbeest, 2014a; Honka, 2014; Waddams Price, Webster, & Zhu, 2013; Waddams Price & Wilson, 2010; Waddams Price & Zhu, 2013; Wilson, 2012).

One study, for instance, found that respondents would prefer to remain with their current provider than engage with the market, because the hassle of switching arising from the time needed to gather the necessary information and seek a new provider (Hogan & Murphy, 2015). Notwithstanding that the relative magnitude of search and switching costs varies across markets and jurisdictions, several studies suggest that search costs are larger than switching costs in the context of retail electricity markets (Giulietti et al., 2014a; Waddams Price et al., 2013). This is because searching generally requires more effort and time than switching (Wilson, 2012). In fact, anecdotal evidence suggests that in most cases switching electricity retailer in Victoria is relatively simple.

Search costs and switching costs can create market power in an otherwise competitive environment by constraining the ability or capacity of consumers to effectively change suppliers and thus resulting in market bifurcation between active and inactive consumers (Defeuilley, 2009; Waddams Price & Wilson, 2010). Essentially, search and switching costs help to increase the number of inactive consumers and provides market power to the incumbent retailer (Defeuilley, 2009).

In order to assess the impact of search costs on consumer choice and market outcomes, the magnitude of these costs must be understood and quantified. A common approach to measuring search costs is to assess the extent to which consumers are able to find the best offers when they search for them (Stahl, 1996; Waddams Price, 2018; Waddams Price & Wilson, 2010; Wilson, 2012). This can be measured as the difference between the price paid and the price that would have been paid had the consumer found the cheapest offer in the market.[2] Of course this assumes that consumers search for the lowest prices when they engage in the market. Waddams Price and Wilson (2010) use survey data of the UK electricity market and estimate that consumers that switch exclusively for price reasons appropriate less than half the monetary gains available (30-52%) from switching. Waddams Price and Wilson (2010) attribute this to the cumbersome search process and associated costs.

Complexity of choice is commonly cited in the literature to explain consumer inertia, particularly in retail electricity markets. For instance, Defeuilley (2009) focussed on the complexity of choice and suggests this explains why consumers don't switch retail electricity providers, even if there is an economic benefit in doing so. As a result, he argues that choice complexity translates into a persistent segmentation between active and inactive consumers (i.e. market bifurcation). Similarly, wealth and education are suggested as explanations for consumer inertia – see, for instance (Fels, 2019). Less affluent and less educated consumers may be disproportionally represented in the inactive customer group, because they are less able to engage effectively in a complex market and thus incur higher search costs. For instance, Hortaçsu, Madanizadeh and Puller (2015) analyse monthly Texan household-level data from 2002 to 2006 and find that neighbourhoods with lower income, lower education, and more senior citizens experienced higher search costs, although incumbent brand effects decline over time.

[2] This is sometimes also referred to as "money left on the table" or "MLT" see (Mountain & Rizio, 2019) and (Waddams Price & Wilson, 2010).

Waddams et al., 2013, 2016), the Competition and Markets Authority (2016) and the Office of Gas and Electricity Markets (2019)) find that consumers say they engage in the market mainly to reduce their bills. However, are there other factors besides price that are likely to affect consumers' choice including the value consumers may place on remaining with a brand they recognise, preference for quality-based attributes, uncertainty about relatively unknown retailers or concern that after switching, prices would quickly rise again and they wished to avoid the hassle of switching again? Studies that focused on non-price factors to explain the active consumers' (for example Giulietti et al. (2014b), Hortaçsu et al. (2015), Deller et al. (2017) and (The Office of Gas and Electricity Markets, 2019) identify factors such as product or retailer differentiation (such as branding), consumer preference (for instance, for a quality-based attribute), choice avoidance (either conscious or unconscious), uncertainty and cognitive limitations, and uncertainty about relatively unknown retailers. In Australia, Newgate Research (2017) suggest that consumers say price is the most important attribute when they search the market. Mountain and Rizio (2019) finds that Australian retailers' websites emphasise price more than other non-price attributes (such as simplicity, consumer service/reliability, ownership and environmental/sustainability characteristics)

Of some relevance to consumers' decisions in general and the relative importance of price and non-price factors in particular, the behavioural economics literature suggests that when faced with a complex task, bounded rationality, heuristics and consumer inattention might explain apparently irrational decisions (Cialdini, R B., Trost & R., 1998; Nicolson, Huebner, & Shipworth, 2017; Pollitt & Shaorshadze, 2013; Simon, 1986).

3. The estimation of loyalty taxes

3.1 Data

Our sample comprises 47,114 retail electricity bills of residential consumers in Victoria in their original electronic pdf format. These bills were voluntarily uploaded to the Victorian Government's price comparison website (https://compare.energy.vic.gov.au/) over the period from July 2018 to December 2018 (as an alternative to manual data entry into that website).[3] We source socio-economic data from the Australian Bureau of Statistics.

Our sample of 47, 114 household bills represents around 2 % of the 2.5 million households in Victoria. Table 1 compares the sample data to the population of household electricity consumers in Victoria in respect of tariff type, distributor, retailer, the proportion with rooftop PV production, the proportion with concession, the proportion that switched retailer in the past year.

Table 1. Comparison of sample and population (%)

		Sample	Population
Tariff type	Block or flat	83.00	86.79
	Time of use	15.33	13.15
	Flexible	1.67	0.05
Distributor	Ausnet Services	23.13	24.60
	Citipower	14.14	11.41
	Jemena	12.32	11.04
	Powercor	22.76	32.53
	United	27.64	20.41
Retailer	AGL	19.33	21.63
	Origin	15.49	17.00
	Energy Australia	14.24	16.52
	Simply Energy	11.56	9.54
	Red Energy	6.76	9.02
	Lumo	6.54	5.68
	Alinta	3.86	5.87
	Momentum Energy	4.62	3.42
	Powershop	3.24	2.30

[3] Consumers were encouraged to use the Government's price comparison site through the payment of AU$50 if they consulted the site, although they were not required to upload their bills in order to receive the payment. Consumers who had uploaded their bills agreed that the deidentified data in their bills could be used for research. Of the bills uploaded, 47,114 had the flexibility to choose their retailer and we were able to tell if consumers had switched to them in the last 12 months, or not.

	Dodo	2.62	1.60
	Click Energy and Amaysim	2.98	1.75
	Powerdirect	0.58	1.21
	Sumo	2.18	1.63
	Globird	3.48	0.96
	Tango	2.51	1.47
	First Energy	0.13	0.23
	Diamond	0.29	0.14
	Q Energy	0.03	0.03
Rooftop solar	Yes	14.64	13.95
Government concession	Yes	35	37
Switched retailer in previous 12 months	Yes	36	34.82

Notes: Source of population data: Carbon Market Economics (2017), Clean Energy Council (2018), Colmar Brunton Social Research (2018), AEMO (2019), (Essential Services Commission Victoria, 2019)

From the information in Table 1 we make the following observations:

- Mainly metropolitan distributors (Citipower, United and Jemena) are slightly over-represented in our sample than their mainly rural peers (Ausnet Services and Powercor). The metropolitan distributors have lower network charges, which is likely to be reflected in bills (and prices) that might therefore be expected to be a little lower in the sample than the population.
- The proportion of households with rooftop solar in the sample (15%) is very similar to the population (14%).
- The proportion of households that receive some form of government concession in our sample (35%) is similar to the population (37%).
- The proportion of consumers that switched retailer in the year before they uploaded their bills (36%) is slightly higher than the estimated switching rate of the population (35%)[4].

Table 2 compares the sample and population with respect to socio-economic deciles. It shows that compared to the population, the highest socio-economic deciles are over-represented in our sample (and conversely the lower socio-economic deciles are under-represented).

Table 2. Sample versus Population, by socio-economic decile (%)

Category	Sample	Population	Sample minus population
1	3.71	4.82	-1.10
2	4.57	6.27	-1.69
3	2.94	8.64	-5.70
4	6.61	9.70	-3.08
5	4.61	12.07	-7.46
6	12.80	12.80	0.00
7	11.61	13.65	-2.05
8	15.66	13.52	2.13
9	20.83	11.21	9.62
10	16.66	7.32	9.34
Total	100.00	100.00	

Source: Author calculations; Australian Bureau of Statistics (2011)

Ex ante we might have been concerned that the sample is biased to active customers because the Government's price comparison website was historically not widely known. Against this, the Government's payment to consumers to use their website might have drawn in additional consumers who may have been interested in the

[4] The Australian Energy Market Operator reported that 35% of all households switched retailer in 2018, however 14% of this 35% are counted as household moves (or new houses) so that the "net" switching rate (i.e. customers that switched from one retailer to another is 21%). Customers that select a retailer because they are moving into a new home or changing home are making an active choice of retailer and signing a new supply contract and for this reason and because we are not able to distinguish them other switchers, they are classified as "switchers". It might however be the case that they engage in the search for retailers with less enthusiasm as those customers that actually switch from one retailer to another. We do not know what proportion of the switches in our sample are new homes/household moves but have no reason to believe it will be significantly different to the proportion in the population.

payment (not necessarily only engaging in the retail market) although there was no extra payment for uploading bills. While the switching rate in the sample and population is comparable, the greater proportion of consumers supplied by Tier 3 retailers (the smallest new entrant retailers – these are discussed later) leads us to conclude that the sample in general but particularly the switchers may be skewed towards more engaged consumers than the population.

3.2 Preliminary analysis

Preliminary analysis sought to compare outcomes for switchers and remainers. By examining the consumption history reported in each bill and reported consumption in previous years, it is possible to determine whether the consumer switched retailer in the previous 12 months. We define "switchers" as consumers that recently switched retailers (i.e. in the preceding 12 months) and "remainers" as consumers that remained with the same retailer for the preceding 12 months[5].

The steps in the preparation of the data are summarised as follows:

1. Extract and record bill information: MISwitcher extracted and processed the following information: address, postcode, usage, rooftop PV export (where applicable), rooftop PV feed-in rates, all relevant supply and fixed charges, the data needed to calculate effective discount rates, the amount of government concessions, distributor and retailer.
2. Calculate price paid for electricity: Determining the actual price that most customers pay requires careful calculation. This is because discounts apply to around 85% of all bills and the discounts, being expressed in a variety of ways, are complex and difficult to compare. Since discounts are an important component of most bills, properly accounting for them is essential in accurately pricing bills.
3. Annualise monthly bill data: The most common billing periods are 30 days or 90 days although many bills covered longer periods. Based on the actual billing period information, we annualise the data to estimate annual consumption, and solar export volumes (where applicable).[6]
4. Calculate the Annual Bill (AB_i): Using annualised consumption and supply price data, the Annual Bill amount for each customer is calculated. This calculation assumes that the prices in the bill remain the same for the year.
5. Identify competing offers: At the time of this study, there were 19 electricity retailers and 5 electricity distributors in Victoria. The Victorian Government's price comparison website lists all commonly available offers and they were included in the analysis of the offers available to each customer. In total there were around 1,300 competing offers in the five distribution zones that together cover Victoria. Eligible offers available to each consumer are restricted by their existing tariff type and distribution zone. This means that we restrict the comparison to offers of the same tariff structure as the customers' existing tariff. While customers can in theory choose different tariff structures, in practice this seldom occurs. Our restriction in the competing set of offers available to consumers therefore reflects how the market actually operates.

---

[5] We were able to do this for bills from all retailers in the market except from the retailer Powershop and so their customers' bills are excluded from our analysis.

[6] The possible error from annualising consumption based on the average consumption in each bill was measured using data on the half-hourly consumption of 1524 household meters in the Citipower and Powercor areas of distribution covering one year, and provided to us by these distributors through C4Net. Our test involved selecting 86 days (the median billing period), annualising consumption for each of the 1524 meters based on the average consumption in this 86 day period and then comparing that to the actual annual consumption. This was done 221 times (for each of the 1524 households) to cover the 221 different possible combinations of 86 continuous days from March 2018 to December 2018 (the period during which most of the 47114 bills were uploaded). The estimated annual consumption for each meter was then established by randomly selecting 10 of the 221 estimates and taking the average of these 10 estimates. This established a data series of estimates to compare to the actual annual consumption. The comparison was performed by regressing the estimated annual consumption for the 1524 households against the actual annual consumption. The coefficient of the estimate was 0.87 (and intercept of 322). The Multiple R-squared error of the regression was 96.7%, and the residuals were normally distributed. This procedure was repeated for billing periods of 30, 60, 90 and 120 days. Similar coefficients and multiple R-squared errors were produced. We conclude from this that our approach of estimating annual consumption from a single bill is unlikely to bias our analysis though of course it can not necessarily guarantee a high degree of accuracy in the estimation of the consumption in individual bills. Appendix A provides data on the number of bills classified by the month in which the mid-point of the billing period occurred, and also a histogram of the duration of the billing period of the bills in the sample.

6. Identify the lowest cost offer: Having identified the competing eligible offers and calculated the annual bill per competing offer, we rank these according to magnitude of bill and identify the lowest available to each consumer.
7. Calculate Available Saving (AS_i): The Available Saving is the difference between a consumer's estimated annual bill based on the prices in their contracts with their retailers (AB_i), and their estimated annual bill had they selected the commonly available offer with the cheapest rates at the date that we assessed this (ABC_i)[7]. If consumers have solar, the calculation considers the combination of their purchase and sales (for household solar export) prices. The calculation of Available Saving can be summarised mathematically as:

$$AS_i = AB_i - ABC_i \qquad [1]$$

where: AS_i = Available Saving for consumer *I* (AUD),
AB_i = Annual Bill for consumer *i*,
ABC_i = Annual Bill for customer *i* if customer *i* had been supplied on the cheapest available offer in the market on 31 August 2018.

We do not know the switchers' original retailers or what prices they paid before switching. Therefore we do not know how much they saved when they switched at some point in the previous 12 months.

Table 3 presents a summary of the preliminary comparison of switchers and remainers. It shows a notable difference in the Annual Bill and Available Saving for switchers and remainers. We estimate the average Annual Bill for switchers to be $1,298 compared to $1,434 for remainers. In other words, the remainers had average annual bills that were $136 higher than the switchers. At first sight this suggest a reasonable "loyalty tax". But a significant part of the difference in the Annual Bill for switchers and remainers is higher consumption (about 12% for remainers) which translates into average Annual Bills for remainers about 10% higher and average prices approximately the same.

We also observe the average Available Saving for switchers/remainers ($269/$357) expressed as a ratio of the Annual Bill is 21% for switchers and 25% for remainers.[8]

---

[7] The assessment date – 31 August 2019 – is the median end-date of the billing period of the bills in our sample. There may be a difference between Available Savings at the time that consumers switched and when we examined their bills and performed our calculations. Specifically, a consumer that found the best deal when they switched may find that within a year further savings can be made by switching again. This could be because retailers increased prices to their existing customers after they switched (very few offers have fixed prices) or because more attractive offers become available between the time the customer switched and the time we examined their bills. The latter case will not bias our results since the saving is available to both the switchers and remainers. But to the extent that retailers raised prices to customers that switched to them in the first 12 months after switching, our estimate of the loyalty tax will understate the benefit that switchers gained at the time they switched.

[8] The Victorian Government suggests that seven out of ten Victorians can save money on their energy bills by using the government's price comparison site and that typically, households can save $330 on energy bills annually (see https://compare.energy.vic.gov.au/top-tips-for-saving-money-on-energy-bills). This is a little below the average saving we estimate remainers could achieve if they found the cheapest publicly available.

Table 3. Preliminary comparison: switchers and remainers

		Switchers	Remainers
Number		16045	31069
Annual bill ($)	Min.	-5619	-8608
	1st Qu.	806	906
	Median	1094	1229
	Mean	1298	1434
	3rd Qu.	1551	1720
	Max	15697	14071
Annual consumption (kWh)	Min.	0	0
	1st Qu.	2244	2625
	Median	3629	4050
	Mean	4667	5033
	3rd Qu.	5852	6243
	Max	80074	86925
Prices (cents per kWh)	Min.	13	8
	1st Qu.	26	27
	Median	30	31
	Mean	32.6	32.8
	3rd Qu.	37	37
	Max	79	79
Available saving ($)	Min.	1	1
	1st Qu.	129	179
	Median	203	279
	Mean	269	357
	3rd Qu.	314	432
	Max	9535	5262
Available Saving divided by Annual Bill	Min.	0	0
	1st Qu.	0.13	0.17
	Median	0.2	0.24
	Mean	0.21	0.25
	3rd Qu.	0.26	0.3
	Max	52.3	45

Discounts can significantly impact bills and offers and a wide range of approaches have been applied. Discounts can apply to either the total bill or just to the consumption component of the bill. Sometimes they are applied before the receipt of solar export income and/or government concessions and in some cases after either or both. Some discounts are guaranteed while others are conditional on customers paying bills on time or for other reasons such as accepting direct debit. Most discounts are applied to the amounts in that bill but some discounts are based on the previous bill's consumption. Some bills (and offers) have more than one discount, some of which are conditional.

Segmenting our sample by discount band we find that the median annual undiscounted bill is more than 30% lower than the median annual discounted bill (Table 4). The segmentation of Available Saving by discount is even starker: the median Available Saving of consumers that receive no discount is lower than the median Available Saving of all discount segments (with the exception of consumers whose stated discount is greater than 41%). This suggests that the stated discount is often a poor indicator of a low after-discount price. The Victorian Government has recently introduced default regulated offers and retailers are now required to state the discounts in their offers with reference to the default offer. These changes are not reflected in our data, whose bills pre-date the most recent regulations.

Table 4. Annual Bill and Available Saving, by discount band

Discount range (%)	Number of bills	Median Annual Bill	Median Available Saving
No discount	4568	$1,181	$189
(0,5]	1278	$1,280	$402
(5,17]	6521	$1,217	$343
(17,27]	6081	$1,275	$352
(27,30]	7037	$1,205	$279
(30,33]	5371	$1,158	$251
(33,35]	4485	$1,094	$222
(35,41]	5394	$1,154	$196
(41,78]	5801	$1,108	$121

3.3 Empirical analysis of loyalty taxes

To isolate the effect of switching on Annual Bills and on Available Savings it is necessary to adjust for all the differences that might affect Annual Bills and Available Saving for switchers and remainers, including differences in consumption, tariff type, distributor, access to rooftop solar and government concessions. This section explains econometric models developed to isolate the impact of switching retailer on Annual Bill and Available Saving. In the selection of the dependent variables in the models we make the following observations:

1. In preliminary investigation, we found that the socio-economic decile of the post code where the consumer lives does not significantly influence AB or AS and so we exclude these deciles from the regressions.
2. In preliminary investigation we found some tariff types and some distributors are correlated and so we need to choose between them in our model. We chose tariff type. However our regression results, specifically the estimate of the impact of switching, are robust to model specifications that included distributors but not tariff type.[9]
3. We considered the correlation between discount (a continuous variable) and retailer (a discrete variable). We measure correlation between discount and the number of customers served by each retailer. The correlation, 0.42, is sufficiently small to justify including both discount and retailers in the regression.

Endogeneity attributable to simultaneity bias and omitted variable bias are common concerns with cross-sectional data (Oster, 2017). With respect to simultaneity bias, there are three continuous independent variables (annual solar export volumes, the level of discounts and usage) in our model. We reject simultaneity bias with respect to solar export volumes, discount rates and usage. This is because the level of Available Savings or the Annual Bill does not impact the amount of solar exported, the level of discount applied by the retailer or the amount of energy consumed. It might also be argued that there is simultaneity between Available Savings or Annual Bills and switchers. But consumers had already switched before they uploaded their bills. This leaves a possible concern of multicollinearity between switchers and usage, i.e. that switchers have substantially increased their consumption after having switched offers at some point in the previous 12 months. We reject this possibility based on empirical evidence that the short term price elasticity of electricity demand is low (Burke, 2017; Fan & Hyndman, 2011; Labandeira, Labeaga, & López-Otero, 2017).

This leaves omitted variable bias as a potential concern. As with any cross-sectional study we cannot dismiss the prospect that an unknown omitted variable may bias the results. Our model controls for supply-side factors that define the market (tariff type, distributor, inclusion or not of rooftop solar). On the demand-side, our characterisation is limited to post-code level socio-economic data and whether the household receives a government concession. A more complete demand-side characterisation (for example distinguishing consumers on the basis of income, wealth, gender, age, education, whether they switched because they moved home etc.) may allow a more sophisticated understanding of the effect of switching than our model is able to estimate.

The chosen models are estimated using OLS and are specified as follows:

[9] Model results are available from the authors on request.

$$AB_i = \alpha + \beta_1 Usage_i + \beta_2 Switch_i + \beta_3 Solar_i + +\beta_4 Discount_i + \beta_5 CLD_i + \beta_6 Concession_i + \sum_{j=2}^{18} \lambda_j Retailer_{i,j} + + \sum_{k=2}^{7} \omega_k Tariff_{i,k} + \varepsilon_i \quad [2]$$

$$AS_i = \alpha + \beta_1 Usage_i + \beta_2 Switch_i + \beta_3 Solar_i + +\beta_4 Discount_i + \beta_5 CLD_i + \beta_6 Concession_i + \sum_{j=2}^{18} \lambda_j Retailer_{i,j} + + \sum_{k=2}^{7} \omega_k Tariff_{i,k} + \varepsilon_i \quad [3]$$

where:

AB_i = Annual Bill for consumer i (AUD);
AS_i = Available Saving for consumer i (AUD);
Usage is annual consumption estimated by annualising the consumption in each bill (kWh);
Switch is a dummy variable (takes value of 1 if household has switched retailer in the previous 12 months, 0 otherwise);
Solar is annual exports from those households with rooftop solar estimated by annualising the exports (kWh);
Discount is the percentage discount applied to the bill;[10]
CLD is a dummy variable for households with controlled load[11] (takes value of 1 if the household has controlled load, 0 otherwise);
Concession is a dummy variable (takes value of 1 if household receives a government concession, 0 otherwise);
$Retailer_j$ is a dummy variable (takes a value of 1 if household uses retailer j, 0 otherwise);
$Tariff_k$ is a dummy variable (takes value of 1 if household is on tariff type l, 0 otherwise).[12]

We estimate the loyalty tax as the coefficient on the "switch" variable in Equation 2 or Equation 3. We expect the coefficient to be similar in both models since Equation 2 uncovers the effect of switching in reducing annual bills while Equation 3 estimates the effect of switching expressed as the difference between the annual bills and the cheapest offers.

To test the reliability of the models in estimating how much consumers reduce their bills (and their Available Savings) when they switch, we use standard t-tests to determine if the coefficient on the variable "switch" is statistically significant. The coefficient on the "switch" dummy measures whether, after adjusting for consumption and various other characteristics, consumers that remain with their retailers for more than 12 months, pay more (Equation 2) or leave more money on the table (Equation 3) than consumers that switched in the previous 12 months. The next section presents the results of these models.

Our estimate of the loyalty tax as the coefficient on the "switch" variable reflects constraints imposed by the available data. First, remaining with a retailer for at least 12 months is assumed to be loyal. Longer or shorter periods may be plausible. Secondly there may have been at least as many "intra-retailer" switches[13] as there were inter-retailer switchers and so a number of remainers may be no more loyal to their retailer than the inter-retailer switchers. If so, our measure may understate the loyalty tax that would be measured if we were able to segment the remainers between those who had switched to other offers from their existing retailer from those who had not done so. Thirdly consumers that relocated (or new homes) are assumed to be switchers (our data can't distinguish such switches from others). But many such consumers may not have attempted to find the best offers. Fourthly,

[10] Percentage discounts can be stated or applied. The discount can relate to usage or the total bill amount.

[11] Controlled load refers to separately metered and switched loads (generally electric hot water systems or slab or underfloor heating), often charged at a lower rate than the main load that operate during off-peak hours (e.g. overnight).

[12] In Victoria there are 42 different tariff structures that can be classified into 7 tariff type categories. All have daily charges (cents per day). In addition: "Flat" tariffs have a single consumption rate (i.e. cents per kWh charge); "Flexible" tariffs have three time-variant rates (i.e. rates that vary by time of day and for weekdays and weekends); "Seasonal-Flexible" have three time variant rates some of which differ across two seasons; "Multi-flat" has two or more rates that apply for blocks of consumption which can be measured daily, monthly or in some cases three monthly; "Time-of-Use" (also known as TOU) have two time-variant rates in weekdays; "multi-TOU" combine two time-variant rates with block structures for the peak rates; and "Multi-flexible" combine three time-variant rates with block rates for the peak periods. "Flat" tariff is the reference tariff structure in the regression.

[13] For example in a survey of 400 consumers Newgate Research (2017) suggested that more consumers switched plans offered by their existing retailer than switched retailers in 2016. In Britain, the Office of Gas and Electricity Markets has been tracking this for several years (see https://www.ofgem.gov.uk/data-portal/all-charts?page=4) and finds slightly higher intra-retailer switches by tariff than switches to different retailers.

we examine the market up to 12 months after switches occurred, not at the time of the switch. For some consumers this might mean that our estimate could overstate the loyalty tax measured at the date they switched (because their prices may have risen between the date of the switch and when we measured it) or, less likely, could understate the loyalty tax (because their prices may have declined since they switched). Evidently there are arguments that our measure understates taxes on loyalty tax and other arguments that it overstates it. There is a plausible range of different definitions of loyalty, but we find it difficult to imagine that the estimate of loyalty taxes will differ greatly over this range. Furthermore, these considerations affect mainly the estimate of the loyalty tax but less so the estimate of the projected Available Saving.

Table 5 presents the estimation results for Equations (2) and (3). The coefficient on the "Switch" dummy ($48.21 in Equations (2) and $48.99 in Equation (3)) show the projected impact on Annual Bills and Available Savings (over the next 12 months) of consumers' decision to switch retailers in the previous 12 months. As expected, the value of the coefficient (and the Robust Standard Error) in both models is similar. The coefficients are stable and statistically significant (at 1% level of significance) in both models. Model diagnostics indicate each model provides a reasonable fit of the data (for Available Saving) and a good fit (for Annual Bills) and each model generates stationary residuals. We therefore conclude our models and estimates are robust.

Table 5. Annual Bill and Available Saving OLS estimation results (Equations 2 and 3)[14]

Variable	Eq.2 (Annual Bill)	Eq.3 (Available Saving)
Intercept	666.2(3.89)***	375(3.7)***
Usage	0.21(0)***	0.05(0)***
Switch	-48.21(2.36)***	-48.99(2.24)***
Solar	0.11(0)***	0.01(0)***
Discount	-7.43(0.11)***	-8.6(0.1)***
CLD	-141.08(4.03)***	-25.11(3.83)***
Concession	2.54(7.63)	-13.04(7.24)
Retailer B (Tier 1)	27.31(3.71)***	39.27(3.53)***
Retailer C (Tier 2)	-170(4.87)***	-160.86(4.63)***
Retailer D (Tier 1)	-49(3.54)***	-24.68(3.36)***
Retailer E (Tier 2)	-228.18(5.5)***	-193.29(5.22)***
Retailer F (Tier 2)	-69.37(3.92)***	-57.37(3.73)***
Retailer G (Tier 2)	-449.71(6.47)***	-473.56(6.15)***
Retailer H (Tier 3)	-286.28(12.61)***	-287.88(57.45)***
Retailer I (Tier 3)	124.39(7.43)***	147.27(7.05)***
Retailer J (Tier 3)	-290.9(6.56)***	-213.46(6.23)***
Retailer K (Tier 2)	-398.55(6.69)***	-329.9(6.35)***
Retailer L (Tier 3)	-119.73(20.77)***	-80.61(19.73)***
Retailer M (Tier 3)	-18.49(6.82)	-5.32(6.48)
Retailer N (Tier 3)	244.7(28.22)***	324.57(26.81)***
Retailer O (Tier 3)	-44.8(13.76)***	-91.91(13.07)***
Retailer P (Tier 3)	-241.96(60.54)***	-279.82(57.5)***
Retailer Q (Tier 3)	166.99(7.66)***	233.96(7.27)***
Retailer R (Tier 3)	-544.79(7.56)**	-582.83(7.18)***
Tariff_type: Flexible	-46.42(5.19)***	-149.1(8.5)***
Tariff_type: Multi-flat	111.46(37.88)	2.19(2.79)
Tariff_type: Multi-flexible	-29.78(1.05)***	-212.9(27)***
Tariff_type: Multi-TOU	95.39(9.78)***	-61.65(9.26)***
Tariff_type: Seasonal-Flexible	-109.21(60.48)	-228.97(57.45)
Tariff_type: TOU	52.82(3.29)***	-69.46(3.13)***

[14] The retailers' identities are anonymised to preserve commercial confidentiality.

Adjusted R^2	0.929	0.522
N	47114	47114

Notes: Standard errors are in parenthesis. The critical values for the ADF test are -3.43, -2.86 and -2.57 at the 1, 5 and 10 percent level of significance, respectively. ***, ** and * indicates statistical significance at the 1, 5 and 10 level, respectively.

Other notable findings include:

1. As expected, the volume of electricity bought and (in the case of consumers with rooftop solar the volume of electricity sold) are both statistically significant determinants of Annual Bills and Available Saving. Controlling for all other factors, Annual Bills increase at the rate of 21 cents per kWh consumed, and Available Savings increase at the rate of 5 cents per kWh consumed. Annual Bills decline at the rate of 11 cents per kWh fed back into the grid from households with rooftop solar (matching the regulated minimum feed-in rate) and Available Savings decline at the rate of 1 cent per kWh of their rooftop solar feed-in.
2. Government concession is not a statistically significant factor affecting either Annual Bills or Available Savings.
3. Consumers with more complex tariff structures (i.e. those with a greater number of different consumption rates and particularly with rates that apply at different times of the day or week) have lower Annual Bills and Available Savings (we discuss this in more detail later).
4. Retailer is a statistically significant explanatory factor for Available Savings and Annual Bills in almost all cases except two retailers that had very few consumers in our sample.

While we cannot know how much switchers might have saved when they switched at some point in the previous 12 months, this analysis suggests that consumers that switched are projected to be only a little better off (about $48 of 4% of their Annual Bills) than consumers that had remained with their retailer in the last 12 months. Relative to previous expectations this is small and inconsistent with the widely shared concern by regulators, policy makers, customer groups and the industry itself, that loyalty is severely penalised. Finding the cheapest offer in any market is perhaps a generally unattainable expectation and perhaps not even generally sought. Nevertheless, if instead the Available Saving is estimated using the second or third cheapest offer (rather than the cheapest offer), the median Available Saving reduces by $8 and $26 respectively. This suggests that even engaged consumers have typically not chosen close to the cheapest offers available.

4. Analysis of loyalty taxes by tier

The analysis to this point has produced a point estimate of the loyalty tax. Here we extend the analysis by sorting retailers into three categories based on a combination of market share and history. Tier-based classifications are common in Australia. Our Tier 1 retailers are AGL, Energy Australia and Origin Energy. These retailers sold electricity to households when the market was first opened to competition 2003, and currently have an aggregate 56% share of the market. Tier 2 is all retailers with a minimum of 3% and a maximum of 10% market share (Alinta, Momentum, Simply, Red and Lumo). Tier 3 retailers are those with less than 3% market share (Click, Amaysim, Globird, Tango, Sumo, Powerdirect, Diamond, Dodo and QEnergy). In this classification, multiple brands operated by the same retailer (PowerDirect and AGL, Click and Amaysim, Red and Lumo) are counted as separate retailers since they are marketed independently.

4.1 Preliminary analysis by tier

Table 6 below shows the market share of the retailers in these three tiers firstly for the population as a whole, then for our full sample and then distinguishing switchers and remainers.

Table 6. Market share classified by tier

	Population	Full sample	Remainers in sample	Switchers in sample
Tier 1	56.5%	50.5%	54.9%	42.1%
Tier 2	34.3%	34.3%	35.5%	31.9%
Tier 3	9.2%	15.2%	9.6%	26.0%

Table 6 shows that the full sample is roughly comparable to the population though the sample has about a 6 percentage point greater share of consumers supplied by Tier 3 (T3) retailers offset by 6 percentage point fewer consumers supplied by Tier 1 (T1) retailers. The tier shares of the remainers (about 2/3rds of the sample) is close to that of the population. However, there is a big disparity in the tier shares of the switchers in the sample (relative to the population) with the greatest disparities between the proportions of T3 and T1 retailers. Relative to their market share in the populations, the switchers in our sample were twice as likely to switch to T3 retailers as T1 retailers but only slightly more likely to switch to T2 retailers as T1 retailers.

Analysis of the median annual bills for consumers supplied by retailers in each of the three tiers is shown in Table 7 below.

Table 7. Tier analysis of median Annual Bills

	All customers	**Remainers**	**Switchers**	**Difference (remainers – switchers)**
Median bill	$1181	$1229	$1094	$135
Median Tier 1	$1226	$1271	$1120	$152
Median Tier 2	$1133	$1162	$1087	$75
Median Tier 3	$1153	$1280	$1073	$207
T2 relative to T1	-$93	-$109	-$33	
T3 relative to T1	-$27	+$9	-$47	

This table shows that for all three tiers the median bill of switchers is lower than the median bill of the remainers – by $152 for T1 but even higher ($207) for T3 and significantly lower ($75) for T2. The difference in the annual bills of remainers and switcher is of course affected by differences in consumption (as discussed earlier the typical remainer uses 366 kWh more than the typical switcher) but nevertheless the differences amongst tiers is remarkable. From this preliminary analysis an observation is that T3 retailers might be expected to offer the lowest prices to switchers but T2 certainly and even T1 possibly, may be cheaper for remainers. Is it possible that this reflects significantly different pricing policies as between typical T2 and T3 retailers? Specifically, does it suggest that T3 retailers tend to offer the lowest prices to new customers, but then subsequently raise their prices to then-existing customers, more rapidly than do the T2 retailers?[15] If so, this suggests that T3 retailers are imposing a "loyalty tax" whereas T2 retailers, by comparison, are not. Or they are perhaps doing so to a significantly greater extent, or more quickly than T2 retailers or, conversely, that T2 retailers are rewarding customer loyalty. From this perspective, it now seems possible that the smallest new entrants (as a cohort although not necessarily for each member of the cohort) levy a higher loyalty tax than the former incumbents (T1).

Table 7 has potentially provided information of which we were hitherto unaware, of differences between tiers of retailers and the implications of this for consumers and for definition of the loyalty tax. However, since many factors affect the measurement of the loyalty tax (consumption, tariff type, concession, solar and so on) it is not clear how much weight should be placed on the results in Table 7. So, the next step is to take account of those other factors through an empirical analysis by tier that focuses on the differences between the tiers after adjusting for other factors. Will that remove or reduce those differences?

4.2 Empirical analysis by tier

We use dummy variables for the three tiers of retailers to determine how the annual bill varies for consumers supplied by each retailer classified by tiers (ABT_i). Equations (4) to (6) specify these regressions, with independent variables defined as above and $Tier_j$ is a dummy variable (takes a value of 1 if the household's retailer is a member of $Tier_j$, 0 otherwise).

$$ABT_i = \alpha + \beta_1 Usage_i + \beta_2 Switch_i + \beta_3 Solar_i + +\beta_4 Discount_i + \beta_5 CLD_i + \beta_6 Concession_i + \sum_{j=2}^{3} \lambda_j Tier_{i,j} + +\sum_{k=2}^{7} \omega_k Tariff_{i,k} + \varepsilon_i \qquad [4]$$

for $i \in all\ consumers.$

$$ABT_i = \alpha + \beta_1 Usage_i + \beta_2 Solar_i + +\beta_3 Discount_i + \beta_4 CLD_i + \beta_5 Concession_i + \sum_{j=2}^{3} \lambda_j Tier_{i,j} + +\sum_{k=2}^{7} \omega_k Tariff_{i,k} + \varepsilon_i$$

[15] This is colloquially known as "bait and switch" pricing (i.e. "bait" consumers with cheap offers but then later "switch" them onto more expensive offers). See for example https://www.esc.vic.gov.au/media-centre/regulator-puts-end-bait-and-switch-energy-deals

$$\text{for } i \in all\ switchers. \qquad [5]$$

$$ABT_i = \alpha + \beta_1 Usage_i + \beta_2 Solar_i + +\beta_3 Discount_i + \beta_4 CLD_i + \beta_5 Concession_i + \sum_{j=2}^{3} \lambda_j Tier_{i,j} + + \sum_{k=2}^{7} \omega_k Tariff_{i,k} + \varepsilon_i \qquad [6]$$

for $i \in all\ remainers$.

The results of the regressions in equations 4, 5 and 6 are set out in Table 8. This shows the three datasets produce similar coefficients and levels of statistical significance on the main characteristic variables (usage, solar, controlled load and most tariff types). However, access to a government concession is a statistically significant explanation for lower bills in the analysis of the full dataset and for remainers, but not for switchers.

Table 8. Annual Bill OLS estimation results by tier for all bills, switchers and remainers (equations 4, 5 and 6 respectively)

	All bills (equation 4)		Switchers (equation 5)		Remainers (equation 6)	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
(Intercept)	535.22***	3.32	451.24***	5.42	545.91***	4.05
Switch	-71.9***	2.52				
Usage	0.2***	0	0.2***	0	0.21***	0
Solar	-0.11***	0	-0.12***	0	-0.11***	0
CLD	-147.85***	4.4	-133.06***	7.03	-159.17***	5.54
Tier 2	-142.73***	2.86	-78.28***	5.2	-169.23***	3.41
Tier 3	-73.81***	3.29	-101.79***	4.78	-25.07***	4.5
Discount	-2.21***	0.09	-1.03***	0.13	-3.16***	0.11
Tariff_type: Flexible	-35.51***	9.75	-29.91***	5.42	-41.73***	12.1
Tariff_type: Multi-flat	77.15***	2.9	73.49***	4.6	81.1***	3.66
Tariff_type: Multi-flexible	-135.33***	30.78	-20.05	61.41	-169.7	35.36
Tariff_type: Multi-TOU	68.08***	9.99	102***	16.77	32.84**	12.26
Tariff_type: Seasonal-Flexible	-50.76	66.47	84.4	167.48	-84.94	72.46
Tariff_type: TOU	40.19***	3.59	51.37***	6.37	36.63***	4.3
Concession	-57.44***	8.1	-0.08	12.98	-106.15***	10.19
Adjusted R-squared	0.914		0.921		0.912	

The main variables of interest in this study are the coefficients for the tiers, which are extracted from Table 8 and summarised in Table 9. The regression coefficients for T2 and T3 are expressed with reference to T1 so the regression cannot establish how annual bills change for customers that switched to or remained with T1 retailers.

Table 9. Difference in Annual Bill by retailer in full sample and in sample of switchers and sample of remainers

	All	Remainers	Switchers
Tier 2 relative to Tier 1	-$142.73	-$169.23	-$78.28
Tier 3 relative to Tier 1	-$73.81	-$25.07	-$101.79

Table 9 shows that across the full sample, consumers supplied by T2 retailers are projected to pay $142 per year less than consumers supplied by T1 retailers, while consumers supplied by T3 retailers are projected to pay $73 per year less than those supplied by T1 retailers. In other words, considering the full sample, consumers supplied by T1 retailers typically have the highest bills (after adjusting for the variables in the regression) while consumers supplied by T2 retailers have the lowest bills and those supplied by T3 retailers are about mid-way between T1 and T2.

Now consider how the situation changes depending on whether customers remained or switched retailer in the last year. For those customers who remained with their existing retailer, the picture is similar for those customers who remained with their T2 retailer (projected to pay $169 less than those customers who remained with their T1 retailer). Again, T1 consumers have the highest bills (among remaining customers) and T2 the lowest, but this time customers of T3 retailers are projected to pay only a little less than customers of T1 retailers. Recall in the preliminary analysis in Table 7, the median T3 remainer's bill is actually a little higher than the median T1 remainer's bill.

For those customers who switched retailer in the last year however, the situation is somewhat different. Again those customers that switched to T2 and T3 retailers are both projected to pay significantly less than those who switch to T1 retailers (by $78 and $101 respectively). However, for these more active customers, those who switch to T3 retailers are projected to pay less than those who switch to T2 retailers. In other words, consumers who switched to T1 retailers have the highest bills but this time those who switched to T3 retailers have the lowest bills. While directionally consistent with the analysis in Table 7, the econometric analysis suggests that the differences between the tiers is actually greater than Table 7 suggests.

This raises an interesting question. How is it that customers switching to T3 retailers are projected to save about $101-78=$23 compared to those who switch to T2 retailers, but that those customers that remain with T3 retailers are projected to pay about $169-25 = $144 more than those that remain with T2 retailers? Evidently the T3 retailers impose a much higher loyalty tax than the T2 retailers. It should be noted however that while the statistical significance and small standard error of the coefficients on T1 and T2 suggest clear distinctions by tier, Table 5 shows significant variations in the coefficient of the retailers in T2 and those in T3 (although relatively small differences in the coefficient for retailers in T1). For example, compare the large difference between the coefficient on T3 retailer "R" (-544) with that of retailer "N" (+244), albeit that differences in the approach to discounts (identified separately in the regression) might account for some part of the gap. Smaller differences are evident amongst the T2 retailers (between -449 and -69) and even smaller amongst T1 (between 27 and -49) noting again that in both cases differences in discounts might account for some part of the gap. The finding of large tier level differences in loyalty tax is therefore not necessarily true for all retailers in each tier, particularly for T2 and T3 retailers.

5. Conclusions

We analyse 47,114 household electricity bills and calculate annual bills and available savings if consumers switch to the cheapest offer available to them. We then construct an econometric model to assess the extent to which consumers that switched retailer in the previous 12 months, pay lower prices than consumers who remained loyal to their retailer for at least the last 12 months. This presents a clear result: the typical switcher reduced its bill by 4% ($48) but on average switchers could have reduced their bills by 21% ($269) more if they found the cheapest deals. In other words, the "loyalty tax" as often defined is lower than commonly believed, and switching retailers is less effective than believed in reducing bills.

However, the subsequent analysis of bills across three tiers of retailer suggests the picture is a little more nuanced. Across all three tiers, switchers paid less than remainers but the gap differed quite markedly. For switchers in the year after they switched, the Tier 3 (T3) retailers (those with less than 3% market share and typically that do not own generators) were on average the cheapest, by about $100 compared to T1 retailers, whereas T2 retailers (those with between 3% and 10% of the market and also that often also own generators) were about $78 cheaper. However, for remainers, the situation was reversed: T2 retailers were substantially cheaper than T1 retailers (by about $169) whereas Tier 3 retailers were only $25 cheaper than T1. While the evidence is not entirely conclusive it suggests that T1 were indeed imposing a loyalty tax but that T3 were (in aggregate) imposing a higher one, and that T2, on the contrary, could be said to be rewarding loyalty. Note, however, that there is considerable disparity between the pricing practices of different retailers, especially in Tier 3.

The findings in this paper raise the important policy question: if government wishes to increase the benefits to consumers from the competitive retail electricity market, what should it focus on? If the typical saving made by switchers is as low as $48 a year, is there really a "loyalty tax" problem, and is it really the best use of regulatory and customer responses to keep promoting more active customer engagement? At the same time, however, does the evidence of average available savings, even for recent switchers, of $269 per annum (21% of the median bill) suggest that switchers have other considerations in mind – such as reputation and reliability – as well as price, in which case should regulators and price comparison providers aim to provide more information and/or reassurance on such issues? Or does the low achieved saving compared to the much greater savings apparently available suggest that the problem is one of high search costs, perhaps as a result of misleading discounts, inadequacies in price comparison services and the difficulty of anticipating how retailers are likely to change their prices after customers have switched to them? If so, policy and regulation might focus on reducing search costs – for example, by clarifying discounts, improving price comparison services and providing more information on how particular retailers have changed their prices after consumers have switched to them.

Further cross-sectional study can usefully measure changes, including in response to recent policy developments. Longitudinal data can more precisely measure how loyalty taxes change in absolute terms and as a proportion of the available savings. Finally, collecting data to establish causal relationships in switching (both intra and inter-retailer) would be a valuable extension of this research.

Appendix A. Histogram of length of billing period and month of mid-date of billing period for all bills in the sample.

Table A1. Histogram of length of billing period

Duration bin (days)	Number of bills
(0,30]	10598
(30,40]	11378
(40,50]	442
(50,60]	468
(60,70]	638
(70,80]	295
(80,90]	14179
(90,100]	11653
>100	286

Table A2. Month of mid-date of billing period for all bills in the sample

Month of mid-date of billing period	Number of bills
1/12/17	27
1/1/18	142
1/2/18	195
1/3/18	1046
1/4/18	2734
1/5/18	4130
1/6/18	7110
1/7/18	8691
1/8/18	6663
1/9/18	5192
1/10/18	4209
1/11/18	2830
1/12/18	1948
1/1/19	1403
1/2/19	669
1/3/19	125

References

AEMO. (2019). *National Electricity Market Monthly Retail Transfer Statistics*.

Australian Bureau of Statistics. (2011). *Socio-Economic Indexes for Areas (SEIFA)*. Canberra. https://doi.org/Cat. No. 2033.0.55.001

Australian Bureau of Statistics. (2017). *6401.0 Consumer Price Index. TABLE 9. CPI: Group, Sub-group and Expenditure Class, Index Numbers by Capital City*. Canberra: c=AU; o=Commonwealth of Australia; ou=Australian Bureau of Statistics.

Australian Competition and Consumer Commission. (2018). *Restoring electricity affordability and Australia's competitive advantage*. Canberra. Retrieved from https://www.accc.gov.au/system/files/Retail Electricity Pricing Inquiry—Final Report June 2018_0.pdf

Australian Competition and Consumer Commission [ACCC]. (2018a). *Residential mortgage price inquiry - Final report*. Melbourne. Retrieved from https://www.accc.gov.au/publications/residential-mortgage-price-inquiry-final-report

Australian Competition and Consumer Commission [ACCC]. (2018b). Restoring electricity affordability and Australia's competitive advantage, (June). https://doi.org/10.1080/09654310420002127 40

Australian Energy Markets Commission. (2018). *Retail Energy Competition Review*. Sydney. Retrieved from www.aemc.gov.au

Ben-david, R. (2018). *Competition , Neo-paternalism and the Nonsumer uprising*. Melbourne. Retrieved from https://www.esc.vic.gov.au/sites/default/files/documents/competition-neo-paternalism-and-the-nonsumer-uprising-paper.pdf

Burke, P. (2017). *The price elasticity of electricity demand in the United States: A three-dimensional analysis. CAMA Working Paper 50*. Retrieved from https://ssrn.com/abstract=3016911

Carbon Market Economics (CME). (2017). *The retail electricity market for households and small businesses in Victoria, Analysis of Offers and Bills, Prepared for the Victorian Department of Environment, Water, Land, and Planning*. Melbourne.

Cialdini, R B., Trost, M., & R. (1998). *Social influence: Social norms, conformity and compliance. The Handbook of social psychology*. (D. T. Gilbert, S. T. Fiske, & G. Lindzey, Eds.). McGraw-Hill. Retrieved from https://psycnet.apa.org/record/1998-07091-021

Clean Energy Council. (2018). Number of Australian homes with rooftop solar tops 2 million...and counting | Clean Energy Council. Retrieved July 24, 2019, from https://www.cleanenergycouncil.org.au/news/number-of-australian-homes-with-rooftop-solar-tops-2-million-and-counting

Colmar Brunton Social Research. (2018). *Australian Competition and Consumer Commission: Consumer Outcomes in the National Retail Electricity Market - Final Report*. Melbourne. Retrieved from https://www.accc.gov.au/system/files/Appendix 12 - Colmar Brunton - Consumer Outcomes in the National Retail ....pdf

Competition and Markets Authority. (2016). *Energy Market Investigation*. London. Retrieved from https://assets.publishing.service.gov.uk/media/5773de34e5274a0da3000113/final-report-energy-market-investigation.pdf

Competition and Markets Authority. (2018). *Tackling the loyalty premium: Response to a super-complaint made by Citizens Advice on 28 September 2018*. London. Retrieved from https://assets.publishing.service.gov.uk/media/5c194665e5274a4685bfbafa/response_to_super_complaint_pdf.pdf

Defeuilley, C. (2009). Retail competition in electricity markets. *Energy Policy*, *37*(2), 377–386. https://doi.org/10.1016/j.enpol.2008.07.025

Deller, D., Giulietti, M., Loomes, G., Price, C. W., Moniche Bermejo, A., & Jeon, J. Y. (2017). Switching Energy Suppliers: It's Not All about the Money. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3024534

Essential Services Commission Victoria. (2019). *Victoria Energy Market Report*. Melbourne. Retrieved from https://www.esc.vic.gov.au/sites/default/files/documents/VEMR annual report 2018-19_Final_20191205.pdf

Fan, S., & Hyndman, R. J. (2011). The price elasticity of electricity demand in South Australia. *Energy Policy*, *39*(6), 3709–3719. https://doi.org/10.1016/j.enpol.2011.03.080

Fels, A. (2019, July). Simple fixes could help save Australian consumers from up to $3.6 billion in 'loyalty taxes''.' *The Conversation*. Retrieved from https://theconversation.com/simple-fixes-could-help-save-australian-consumers-from-up-to-3-6-billion-in-loyalty-taxes-119978

Giulietti, M., Waterson, M., & Wildenbeest, M. (2014a). Estimation of Search Frictions in the British Electricity Market. *The Journal of Industrial Economics*, *62*(4), 555–590. https://doi.org/10.1111/joie.12062

Giulietti, M., Waterson, M., & Wildenbeest, M. (2014b). Estimation of Search Frictions in the British

Electricity Market. *The Journal of Industrial Economics*, *62*(4), 555–590. https://doi.org/10.1111/joie.12062
Hogan, S., & Murphy, T. (2015). *Breaking up is hard to do: How behavioural factors affect consumer decision to stay in business relationships*.
Honka, E. (2014). Quantifying search and switching costs in the US auto insurance industry. *The RAND Journal of Economics*, *45*(4), 847–884. https://doi.org/10.1111/1756-2171.12073
Hortaçsu, A., Madanizadeh, S., & Puller, S. (2015). Power to Choose: An Analysis of Consumer Behaviour in the Texas Retail Electricity Market. *American Economic Journal: Economic Policy*, *9*(4), 192–226. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Power+to+Choose+:+An+Analysis+of+Consumer+Behavior+in+the+Texas+Retail+Electricity+Market#0%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Power+to+Choose:+An+Analysis+of+Cons
Labandeira, X., Labeaga, J. M., & López-Otero, X. (2017). A meta-analysis on the price elasticity of energy demand. *Energy Policy*, *102*, 549–568. https://doi.org/10.1016/j.enpol.2017.01.002
Mountain, B. (2015). *A critique of the Victorian Retail Electricity Market: A report for the Brotherhood of St Laurence*. Melbourne. Retrieved from http://cmeaustralia.com.au/wp-content/uploads/2013/09/150601-FINAL-bosl-victorian-retail-market-report.pdf
Mountain, B., & Rizio, S. (2019). *Do Victoria's households leave less money on the table when they switch electricity retailers?* (No. Working Paper 1909). Melbourne. Retrieved from https://docs.wixstatic.com/ugd/cb01c4_8babedb580d44ca080fefea8b2ae8b0b.pdf
Newgate Research. (2017). Consumer Research for the Australian Energy Market Commission'S 2017 Retail Competition Review, (April). Retrieved from https://www.aemc.gov.au/sites/default/files/content/62080e52-06d1-4526-8c92-3eadec24876f/Newgate-Research-AEMC-2017-Retail-Competition-Review-Consumer-Research-Report-F.pdf
Nicolson, M., Huebner, G., & Shipworth, D. (2017). Are consumers willing to switch to smart time of use electricity tariffs? The importance of loss-aversion and electric vehicle ownership. *Energy Research and Social Science*, *23*(2017), 82–96. https://doi.org/10.1016/j.erss.2016.12.001
Oster, E. (2017). Unobservable Selection and Coefficient Stability: Theory and Evidence. *Journal of Business & Economic Statistics*. https://doi.org/10.1080/07350015.2016.1227711
Pollitt, M. G., & Shaorshadze, I. (2013). The Role of Behavioural Economics in Energy and Climate Policy (pp. 523–546). Edward Elgar Publishing. Retrieved from https://www.elgaronline.com/view/9780857933683.00035.xml
Potter, B. (2016). Big Power neglects best customers, AGL boss says. *Australian Financial Review*. Retrieved from https://www.afr.com/politics/big-power-neglects-best-customers-agl-boss-says-20160823-gqzbgu
Simon, H. A. (1986). Rationality in Psychology and Economics. *The Journal of Business*, *59*(4), 209–225.
Stahl, D. O. (1996). Oligopolistic pricing with heterogeneous consumer search. *International Journal of Industrial Organization*, *14*(2), 243–268. https://doi.org/10.1016/0167-7187(94)00474-9
The Office of Gas and Electricity Markets. (2019). *Insights from Ofgem's consumer engagement trials: What works in increasing engagement in energy tariff choices?* London.
Thwaites, J., Faulkner, P., & Mulder, T. (2017). *Independent Review Into The Electricity and Gas Retail Market in Australia*. Retrieved from https://engage.vic.gov.au/application/files/7415/0267/4425/Retail_Energy_Review_-_Final_Report.pdf
Waddams Price, C. (2018). Back to the Future? Regulating Residential Energy Markets. *International Journal of the Economics of Business*, *25*(1), 147–155. https://doi.org/10.1080/13571516.2017.1402469
Waddams Price, C., Webster, C., & Zhu, M. (2013). Searching and Switching: Empirical estimates of consumer behaviour in regulated markets. *Centre for Competition Policy, Working Paper*, 11–13.
Waddams Price, C., & Wilson, C. M. (2010). Do consumers switch to the best supplier? *Oxford Economic Papers*, *62*(4), 647–668. https://doi.org/10.1093/oep/gpq006
Waddams Price, C., & Zhu, M. (2013). Pricing in the UK retail energy market , 2005 - 2013. *CCP Working Paper 13-12*. Retrieved from http://competitionpolicy.ac.uk/documents/107435/107587/13-12+Waddams+and+Zhu+(Final).pdf/6d49a6ed-b489-4603-a19e-890f6a098acc
Wilson, C. M. (2012). Market frictions: A unified model of search costs and switching costs. *European Economic Review*, *56*(6), 1070–1086. https://doi.org/10.1016/J.EUROECOREV.2012.05.007
Woods, T., & Blowers, D. (2017). *PriceShock: Is the retail electricity market failing consumers?* Melbourne. Retrieved from https://grattan.edu.au/wp-content/uploads/2017/03/Price-shock-is-the-retail-market-failing-consumers.pdf