Victoria's Economic Bulletin

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Table of contents

Secretary's foreword

By David Martine

The Department of Treasury and Finance (DTF) provides robust and impartial advice to the Victorian Government about the State's economic, commercial, financial, budget and resource management. Our analysis supports decisions on the most effective ways government policy development and funding can be used to make Victoria a better place to live, now and into the future.

Victoria's economy is broadly equivalent to the size of a small OECD (Organisation for Economic Cooperation and Development) nation. Indeed, measured in terms of real gross domestic product in 2016, it would be ranked 26th among the 35 OECD member nations, about the size of Hungary and larger than the economies of Iceland, Finland, Luxembourg and New Zealand.[1] There are, however, relatively few economic research publications that focus on economic trends in Victoria. This research volume, *Victoria's Economic Bulletin*, is designed to provide one such contribution.

DTF has been investing in the Department's analytical and research capability. This volume provides a snapshot of some of the staff research being undertaken. By publishing it we hope to contribute to the broader public policy debate on important economic issues. We also hope to highlight important trends driving change in the Victorian economy. The articles in this volume are produced by authors to increase awareness about important economic and social trends.[2]

The first article examines trends in consumer engagement in the Victorian retail electricity sector and delves into the relationship between the annual switching rate and consumption patterns. The second measures the extent of intergenerational mobility in Victoria and compares relative economic mobility at the national level and between states. The third article reviews various methodologies for calculating discount rates that are used to evaluate the net costs and benefits of potential economic projects, and provides up-to-date estimates using each methodology. The final article estimates fiscal multipliers for Victoria and compares these multipliers for consumption and investment expenditure.

I hope the articles provide some insight into the research being undertaken and, perhaps more importantly, start a wider conversation on research into the Victorian economy.

David Martine
Secretary

[1] This is measured in real United States (US) dollars and in constant purchasing-power-parity (PPP) terms.
[2] They reflect the views of the authors and not necessarily those of the Department.

Money left on the table or rational inertia? Consumer engagement in Victoria's retail electricity sector

By Andrew O'Keefe and Darren Wong[1]

ABSTRACT

We examine consumer engagement in Victoria's retail electricity market using smart meter consumption data. Trends in the level of engagement are routinely assessed using the annual consumer switching rate, but this is principally driven by consumers changing address rather than consumers proactively seeking out better deals. After controlling for this, and other factors that can introduce upward biases, we find the level of consumer activity is typically around one-third to one-half of the annual switching rate and is positively correlated with annual electricity consumption. Despite meaningful increases in consumer engagement during the past two years, the level of long-term consumer disengagement from the retail electricity market is increasing with time. However, long-term disengaged consumers most at risk of paying higher than necessary prices for their electricity are more likely to be located in higher socio-economic postcodes, and have lower consumption, relative to more active electricity consumers.

Overview

Retail electricity markets have been the subject of intense scrutiny over the past few years after a succession of large increases in consumer prices. Major reports by the Australian Competition and Consumer Commission (ACCC 2018), an independent panel led by Professor John Thwaites in Victoria (2017), and others (Australian Energy Market Commission (AEMC) 2018; ESC 2017; Wood and Blowers 2017) have sought to understand the causes of these price rises, and the extent to which the competitive market is working in the best interests of consumers.

The consensus finding of these reports is that there are systemic problems in retail electricity markets causing many consumers to pay higher prices for their electricity than they need to.

The Thwaites-led review concluded, for example, that Victorian households are paying an average of 21 per cent per year more for their electricity than the cheapest offer available in the market. A prominent feature of each report is a discussion of the outcomes for consumers who choose not to regularly engage with the competitive market. These consumers are much more likely to be paying higher prices than consumers who regularly shop around and switch to the most competitively priced offers in the market (ACCC 2018). Our analysis explores the nature and extent of consumer engagement in Victoria's retail electricity market, and its consequences for consumer outcomes.

1 The authors would like to thank CitiPower and Powercor for providing the data used for the analysis, and James Brugler, David Hedley, Madeleine Tan, Annette van Rooyen and Mark Rodrigues for their comments. The views expressed in this paper are those of the authors and do not necessarily reflect the views of DTF.

The Victorian retail electricity market

Retail market competition was introduced in stages in Victoria following privatisation of the government-owned electricity assets during the 1990s. Small electricity consumers were not able to choose their retailer until 2002, and price controls remained in place for a further seven years as a consumer protection mechanism (AEMC 2017).

In 2009, the Victorian Government removed the remaining price controls on small consumers on the advice of the AEMC. The AEMC concluded at the time that competition was effective, and regulation of standing offer electricity prices was unnecessary as competitive pressures would protect consumers from retailers exercising market power (AEMC 2008).[2]

One of the key reasons why the AEMC determined competition was effective was that most energy consumers had actively participated in the retail market since contestability was introduced. In 2008, 60 per cent of Victorian consumers had chosen to move to a market offer, which was taken as strong evidence of consumer engagement, and more consumers were expected to sign up to a market offer as time progressed (AEMC 2008).

Following the removal of price controls, more consumers did indeed engage with the market at one time or another. By March 2018, 95.2 per cent of residential consumers had moved to a market offer (Essential Services Commission (ESC) 2018) and the annual rate of consumers switching between electricity retailers in Victoria was reported to be 26 per cent in 2016–17 (Australian Energy Regulatory (AER) 2017).

However, as the retail electricity market matured it became more difficult for consumers to navigate. Retailers' business strategies evolved to embody deliberately confusing marketing practices triggering a proliferation in the number and complexity of products, greater price dispersion and opaque discounting strategies. This has resulted in extensive price discrimination among different types of consumers. The AEMC (2018) has now concluded that retailers price discriminate based on how informed a customer is, rather than by systematically offering products that are best for a consumer's individual circumstances, suggesting the level of ongoing engagement is integral to consumer outcomes.

The state of the competitive market means that now, more than ever, consumers need to regularly evaluate their retail contract to ensure they are not paying higher prices than they need to. Consumers who shop around for the best prices can take advantage of the many competitively priced products available and a typical Victorian household would save $574 a year by switching from the median standing offer to the cheapest market offer (AEMC 2018). But this also illustrates that the cost of disengagement can be substantial relative to the average Victorian household's electricity bill of $1 457 a year (ACCC 2018).

Switching retailer as a measure of consumer engagement

As the retail market has evolved, the total number of consumers who have moved to a market offer has become a less relevant measure of consumer engagement and, accordingly, of whether the market is operating in the best interests of consumers. The proliferation of fixed discount periods and reversion of contracts to high prices, among other developments in contracting practices – see for example ESC (2017) – means that having switched to a market offer at some point in the past is no guarantee a consumer will be paying competitive prices now. In its place, the percentage of consumers who change retailer every year – the annual switching rate – is now used as the standard indicator of consumer engagement, supplemented by consumer surveys canvassing things such as intention to switch retailer, motivations for changing retailer and confidence engaging with the market (AEMC 2017; AER 2017).

A rational consumer will only switch retailer when the expected benefits from switching exceed the costs. Therefore, while the rate of consumer switching is positively correlated with the level of engagement, it is also dependent on other things such as the level of the transactions costs, the available savings in the market, businesses' customer retention strategies, and the value consumers attach to non-price features of a retailer such as customer service quality and green credentials (Flores and Waddams Price 2018; Waddams Price and Zhu 2016). The link between the switching rate and actual consumer engagement can be clouded by other factors that force consumers to consider changing retailers such as consumers moving homes.

Conventional retail market switching rates are aggregate measures that do not provide insight into the context within which switching decisions are made. In this paper, we use a novel panel data set to explore how context affects consumer decisions and report new indicators of consumer engagement. We find rates of active consumer engagement are typically around one-third to one-half of the switching rates reported using Australian Energy Market Operator (AEMO) data, but they have increased substantially over the past two years.

At the same time as some consumers are becoming more active, we find long-term consumer disengagement is increasing, with 31 per cent of consumers having remained with their retailer for at least five years – up from 25 per cent in January 2014. However, these disengaged consumers are more likely to have lower consumption levels and are more likely to be of higher socio-economic status, suggesting a large part of this disengagement can be explained by rational consumer inertia.

The remainder of this paper is organised as follows. Section 1 describes our novel data set, while Section 2 provides a breakdown of the annual switching rate and presents alternative indicators of consumer engagement. Section 3 summarises our findings.

[2] Retailers may offer consumers two types of contracts: a market retail contract and a standard retail contract. Standing offer terms and conditions must be approved by the Victorian ESC and contain mandatory consumer protections. Standing offer prices are no longer regulated but tend to be high prices from which retailers make discounted market offers. Market offers have their terms, conditions and prices set by the retailer.

1. Data

Electricity retailers purchase electricity from the wholesale market on behalf of their customers and deliver it via the network distribution businesses who own and operate the poles and wires. There are five network distribution businesses in Victoria, each operating a geographic monopoly in different parts of the state. Electricity consumption data are managed by the network distribution businesses who provide it to the electricity retailers who interface directly with electricity consumers.

We use smart meter data on electricity consumption and solar export from the CitiPower and Powercor distribution zones in Victoria. The CitiPower distribution zone comprises the inner and inner-northern suburbs of Melbourne, and in 2018 contained around 330 000 residential and business customers. The Powercor distribution zone is much larger, encompassing most of the western half of Victoria, including the outer western suburbs of Melbourne. It contained around 810 000 residential and business customers in 2018.

The smart meter consumption data are supplemented with information from distribution businesses' customer databases, which enable us to construct a monthly time series for each meter between January 2014 and June 2018, which includes:

- total electricity consumption from the grid during the month;
- total net export of rooftop solar generation to the grid during the month (if applicable);
- a deidentified consumer ID that tracks changes in customers at the meter, noting we are unable to follow consumers if they change address;
- the consumer's retailer, and when the consumer's retailer changed;
- the network tariff charged during the month; and
- the postcode of the meter.

The first observation for each consumer also includes the date they commenced their tenure with the retailer. This means while the sample period commences in January 2014, we know precisely how long each customer had been with their retailer at that point in time. For some loyal consumers, the date they became a customer of the retailer they were contracted to in January 2014 was as far back as 2002.

Most meters in a distribution zone are used for residential electricity consumption, which is the principal focus of our analysis.[3] Average annual residential consumption remained reasonably stable across the sample period at around 4 500 kWh and 5 100 kWh for consumers in the CitiPower and Powercor distribution zones, respectively, though consumption is highly variable across meters (Table 1). Eighty per cent of residential consumers used between 1 035 kWh and 7 915 kWh of electricity per year over the sample period in the CitiPower distribution zone, and 1 289 kWh and 9 265 kWh per year in the Powercor distribution zone.

Within these two distribution zones there were 28 active retailers and, in both distribution zones, Origin Energy is the local retailer and retains a dominant market share (Figure 1).[4] The collective market share of the three Tier 1 retailers decreased from 67 per cent in January 2014 to 57 per cent in January 2018, although this is mostly attributable to Origin Energy losing customers rather than Energy Australia or AGL gaining customers, with the latter marginally increasing their market share over the sample period.[5] Tier 2 retailers increased their collective market share by 4 percentage points and Tier 3 retailers by six percentage points over the four years with Tango Energy, Amaysim/Click Energy and Sumo Energy among those retailers experiencing the most rapid growth in customer account numbers.

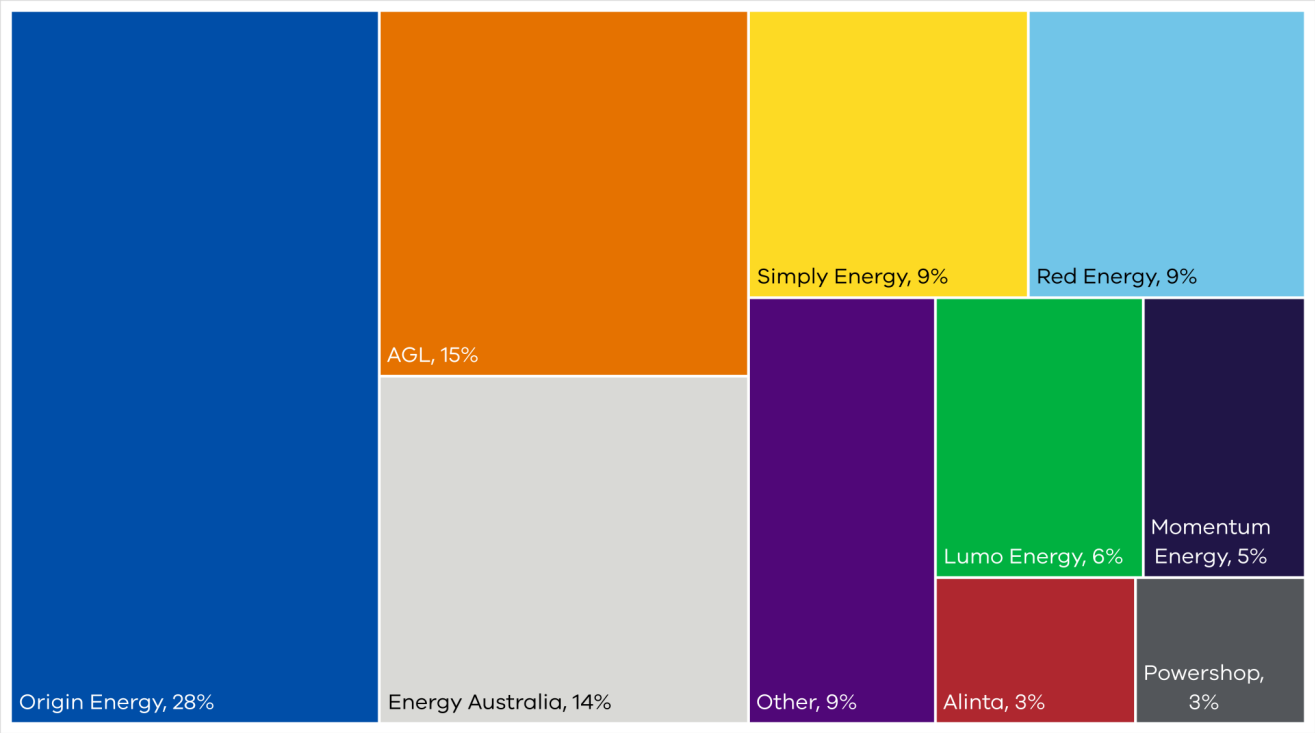
Table 1: Average annual consumption for residential consumers in the CitiPower and Powercor distribution zones, 2014 to 2017

		DISTRIBUTION ZONES			
		CITIPOWER		POWERCOR	
		KWH	COUNT	KWH	COUNT
Annual consumption (kWh)	2014	4 445	25 750	5 034	588 439
	2015	4 577	260 801	5 209	623 948
	2016	4 450	265 294	5 133	642 759
	2017	4 553	272 679	5 181	663 203

Note: Data are only presented for meters where a meter was active for the entire year.

[3] Residential consumption is defined here as a meter being on a residential class network tariff.
[4] Where there is no previous connection, the local area retailer cannot refuse to connect and supply electricity under its standing offer. This usually covers the connection for new houses or where a property is connected to the grid for the first time.
[5] Retailer tiers are defined as per the Thwaites Review.

Figure 1: Combined market shares of retailers in the CitiPower and Powercor distribution zones on 31 January 2018, all consumer classes



Note: Only retailers with more than 3 per cent market share are listed separately.

2. Interpreting the consumer switching rate in Victoria

The rate of consumer switching in retail electricity markets has long been used as an indicator of the robustness of retail competition both in Australia and internationally (Council of European Energy Regulators (CEER) 2017; Electricity Authority of New Zealand 2018; Littlechild 2018). High rates of consumer switching have been taken as a sign of healthy competition, as consumers who switched retailer were thought to be engaged and actively making decisions about their electricity contract.

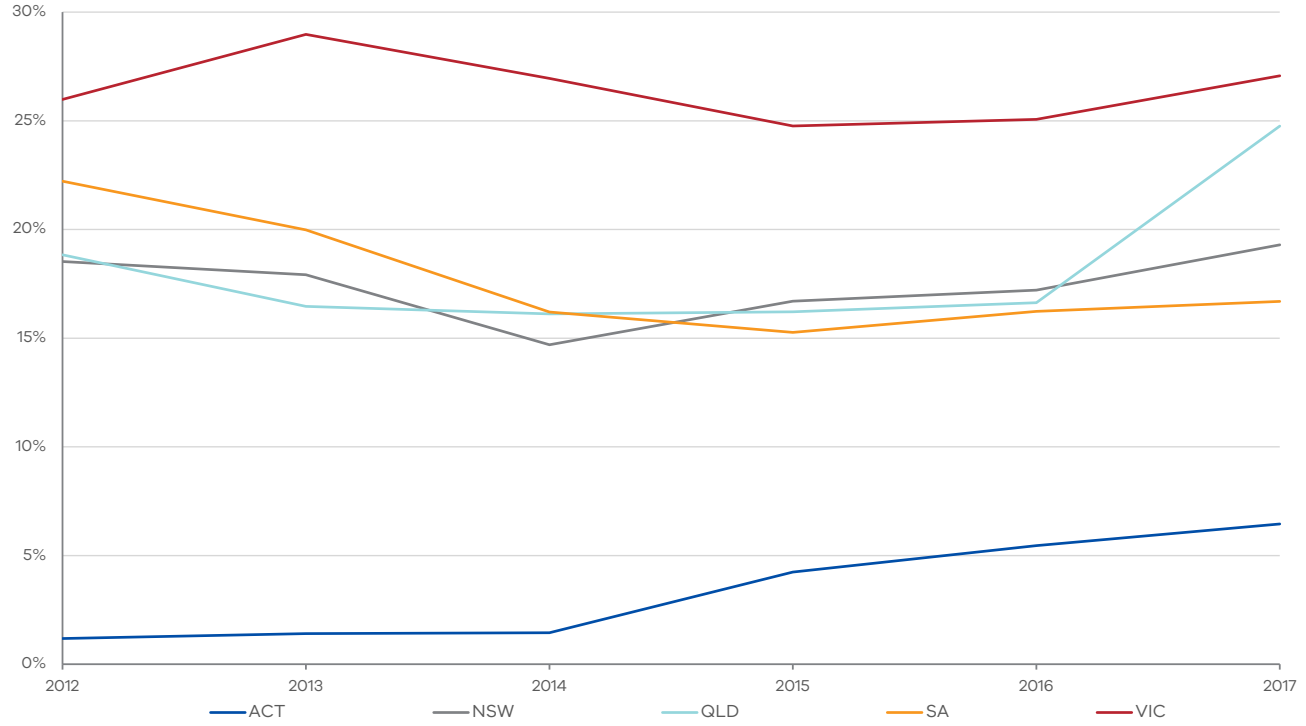
Victoria has historically had the highest reported rate of consumer switching in the National Electricity Market (NEM) (AER 2018), principally because Victoria has been at the forefront of liberalising retail electricity markets among jurisdictions in Australia. Since 2012, an average of 26 per cent of Victorian consumers are reported to change retailer in a year (Figure 2).

The headline rate of consumer switching is effectively a count of the number of times a retailer changes at a meter, plus the number of new accounts created (e.g. new meters are installed at a newly constructed home on greenfield or sub-divided land) as a percentage of the total number of meters in a jurisdiction (AEMO 2011).[6]

Headline consumer switching statistics therefore provide some information about the level of consumer engagement in the retail market, but the clarity of the signal is clouded by other factors as the data are recorded for each meter rather than for each consumer. Importantly, the statistics do not enable consideration of the effect of customer changes at a meter, or repeated switching by consumers, which can have a large bearing on the observed rates.

[6] Technically, this statistic represents transactions recorded in AEMO's database where either the financially responsible market participant or the local retailer changes at a meter. This includes all changes of retailer and all new meter installations.

Figure 2: Switching rates reported by the AEMC in its evaluation of retail competition across the NEM, 2012 to 2017



Source: AEMC (2018) based on AEMO data. Does not include instances where a customer remains with the same retailer but moves to a different contract offered by that retailer.

We explore three adjustments to the headline switching statistics to provide a clearer picture of changes in the level of consumer engagement over time. The adjustments account for:

- changes of consumer at the meter;
- instances of retailers winning back consumers after they have switched; and
- repeated switches by a consumer.

2.1 Changes of consumer at the meter

When the consumer changes at a meter, our data show the retailer also changes around 55 to 60 per cent of the time. These changes of retailer at the meter contribute to the switching statistics despite it being uncertain whether a change of retailer by the consumer has actually occurred. Where the retailer does not change when there is a change of consumer at the meter, this does not contribute to the switching statistics even though some of these occurrences will involve consumers switching retailer. These limitations are driven by statistical measurement at the meter, rather than for each consumer, and affect the accuracy of switching statistics when used as an indicator of consumer engagement.

Signal clarity is also affected by the nature of the decision faced by consumers when they move to a new property, which is fundamentally different from when they proactively decide to change retailer after having been at a property for a period of time. In the latter case, consumers who decide to switch are commonly motivated by factors such as receiving a large bill that surprised or shocked them, direct marketing approaches from retailers using door-to-door salespeople or telemarketing offering high discounts relative to their existing contract, or general dissatisfaction with their current retailer (AEMC 2017).

Consumers moving address face a different type of decision. They are forced to choose a new retailer or accept high standard prices from the previous occupant's retailer under deemed arrangements (ESC 2018) in the absence of a relevant consumption history. In 2017, 44 per cent of residential consumers in our sample retained the same retailer as the previous occupant at the property immediately after moving in, though it is unclear how many of these instances reflect proactive consumer decisions and how many involve deemed contracts. Survey data collected for the ACCC indicates just one in six residential consumers switch retailer when moving to a new house (Colmar Brunton 2018).

Many consumers also use utility connection services, which affects their choice of retailer when changing address. These services help consumers select an electricity retailer and other utility providers when moving to a new house. However, utility connection services offer only a few of the range of retail electricity products available, and in some cases are owned by the retailers themselves. AGL, Snowy Hydro (Red Energy and Lumo Energy) and amaysim (Click Energy) all own utility connection services (AEMC 2018), and their market share of acquisitions of consumers moving house is universally higher than their general market share.

To provide the most accurate and consistent signal of consumer engagement, we focus on the consumer rather than the meter, and isolate only those instances of consumer switching that were not prompted by a change of address. While we are unable to follow consumers across different properties, intuitively, our approach may be thought of as targeting instances where consumers proactively decide to change retailer during their tenure at a property. This follows the approach taken by the ACCC to disaggregate consumers according to whether they switched retailer when changing address (ACCC 2018; Colmar Brunton 2018).

Depending on the distribution zone and rate of property turnover, consumers changing address can contribute as much as 22 percentage points to the reported annual switching rate. In our sample, the effect is more pronounced in the CitiPower distribution zone where property turnover is higher than in the Powercor distribution zone.

2.2 Consumer win-backs and repeated consumer switching

When a consumer switches retailer, it is common for them to recontract with their old retailer within a few months of having left (Figure 3). This mostly occurs because losing retailers regularly make aggressively priced counter-offers to consumers who have left to try and win them back, often at prices not generally available to all consumers (AEMC 2018).

Consumers who are won back by their old retailer switch retailer twice within a relatively short period of time. Here we use 90 days or less with the new retailer as the definition of a win-back.[7] In the Powercor distribution zone, for example, 6.7 per cent of customers who switched retailer recontracted with their old retailer within 90 days of having left, and 10.9 per cent eventually returned to their old retailer.

The contribution of win-backs to the switching rate is consequential. They inflate switching rates because consumers who are won back are counted twice, and the switch away and the win-back are attributed equal importance. However, a consumer who is won back is not necessarily any more engaged than one who is not. It could simply be, for example, that they were originally contracted with a Tier 1 retailer who is more likely to engage in successful win-back strategies (AEMC 2018). They therefore cause a systematic overestimation of the number of engaged consumers.

Win-back outcomes are correlated with the tier of retailer a consumer is switching from and to. Tier 1 retailers were much more likely to win back customers they had lost. Over our sample period, 14.3 per cent of the total number of residential switches to Tier 1 retailers not associated with a change of address were actually win-backs. This compares with just 2 per cent for Tier 3 retailers (Figure 4). The highest rate of win-backs for an individual retailer was more than 20 per cent of the total number of consumers they attracted over the 54 months.

Tier 3 retailers were much more likely to lose newly acquired customers to win-backs – 13.2 per cent of the total number of residential switches not associated with changes of address were consumers won back from Tier 3 retailers, equating to 46 per cent of all the win-backs observed in the data. One Tier 3 retailer had 19 per cent of its newly acquired customers won back by their previous retailer, equivalent to 32 per cent of all customers who left them. Just 20.6 per cent of all win-backs resulted in Tier 1 retailers losing consumers.

[7] These data do not include 'saves' where a customer cancels their switch to another retailer before it is completed, thereby maintaining supply from their existing retailer without being transferred in the distribution businesses' customer databases.

Figure 3: Consumer days with their new retailer before being won back by their previous retailer, Powercor distribution zone, January 2014 to June 2018

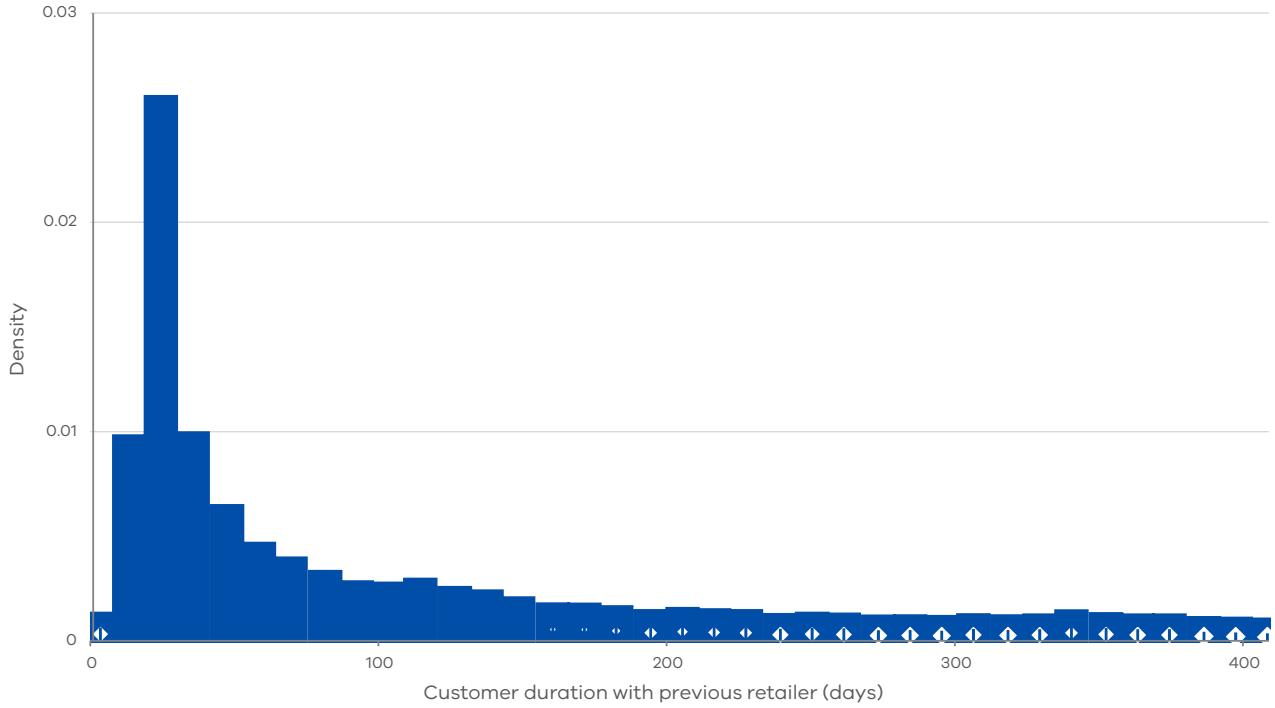
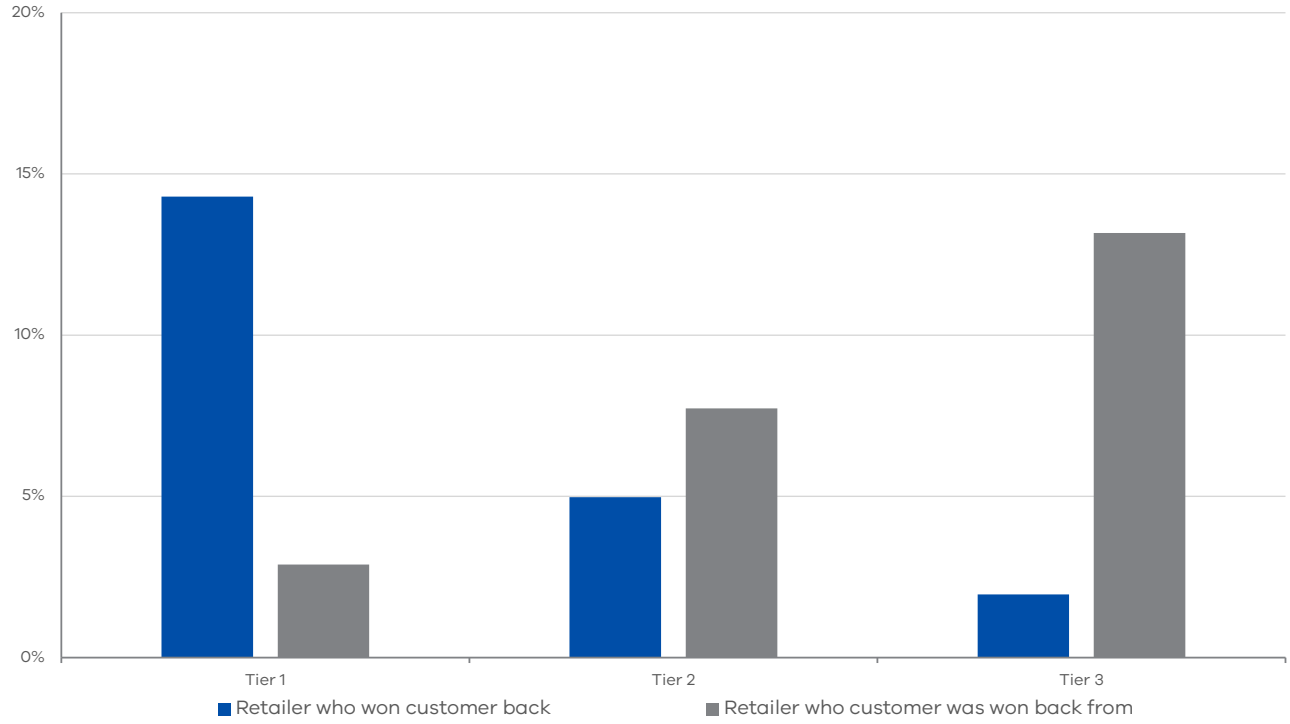


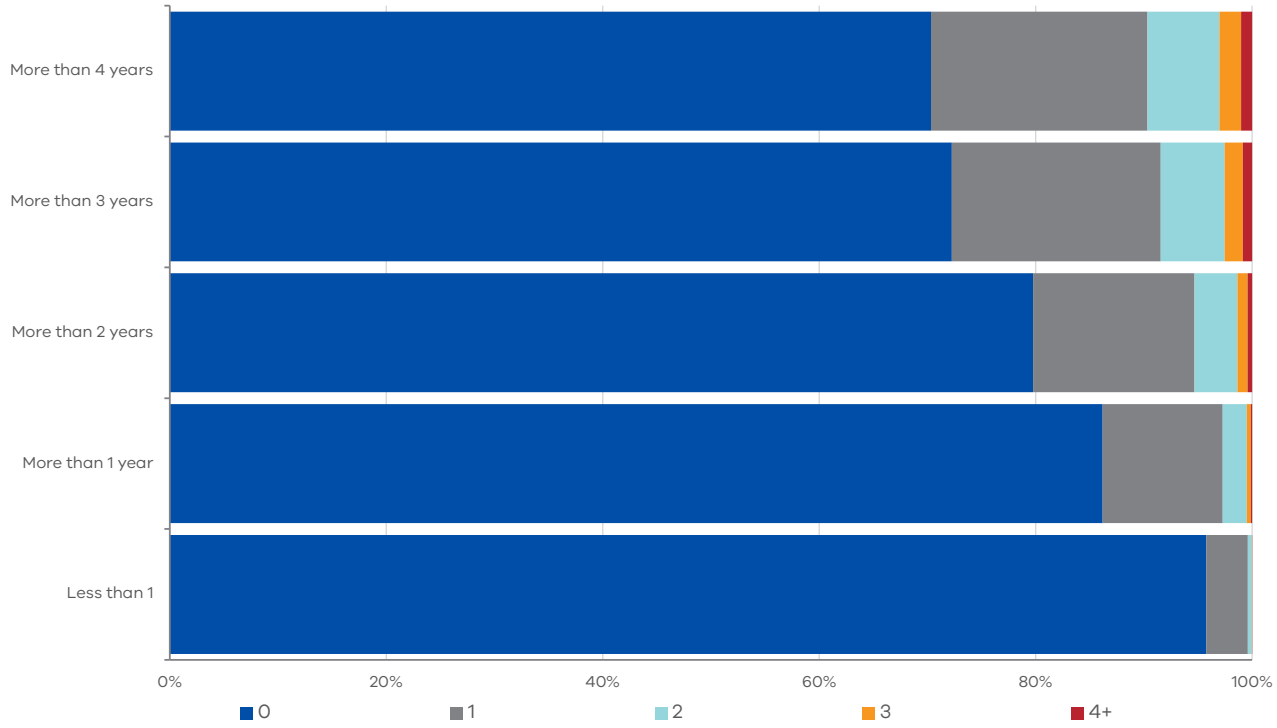
Figure 4: Proportion of consumer switches involving win-backs, by retailer tier, excluding switches associated with a change of customer at the address, January 2014 to June 2018



Our final adjustment to the switching rate relates to those consumers who are highly engaged with the retail electricity market and switch multiple times per year, presumably to maintain the most competitive rates available. Like win-backs, instances of consumers switching more than once per year are separately counted in the AEMO data, leading to an upward bias in the interpretation of AEMO switching statistics as a measure of consumer engagement.

The data for both distribution zones show that some consumers have switched more than 10 times over four and a half years, but the proportion of these types of consumers is very small. Only 4.8 per cent of all consumers in the Powercor distribution zone switched retailer more than once during the entire sample period, whereas 82.8 per cent of consumers didn't switch retailer at all.

Figure 5: Switching frequencies of residential consumers by tenure at address, Powercor distribution zone, January 2014 to June 2018



2.3 Indicators of consumer engagement

Consumers moving address, win-backs and other repeated switching cause an overestimation of the number of consumers engaged in the retail electricity market. We report an alternative binary indicator based on the number of consumers who have changed retailer at least once during a calendar year but have not changed address – the number of active consumers. This allows us to remove double-counting associated with repeated consumer switching, and the effects of consumers changing address and new meters being installed, to get a clearer signal of consumer engagement over time. While we are unable to identify when a consumer changes contract while remaining with the same retailer, this measure provides a more accurate snapshot of the level of engagement in the retail market relative to the annual switching rate. The number of active customers in each distribution zone each year as a percentage of the total meters installed for solar and non-solar residential consumers is reported in Table 2.

Table 2: Annual switching rates and the percentage of active consumers in the Powercor and CitiPower distribution zones, residential solar and non-solar consumers, January 2014 to June 2018

		CUSTOMER CLASSES			
		RESIDENTIAL NON-SOLAR		RESIDENTIAL SOLAR	
		POWERCOR	CITIPOWER	POWERCOR	CITIPOWER
Switching rate	2014	23.4%	26.8%	13.8%	13.7%
	2015	23.3%	28.7%	15.0%	13.5%
	2016	23.6%	27.7%	16.5%	13.8%
	2017	25.9%	28.4%	20.7%	13.5%
	2018	27.3%	28.6%	23.2%	14.5%
Percentage of active consumers	2014	8.1%	6.1%	8.0%	8.0%
	2015	7.0%	5.7%	8.4%	8.1%
	2016	7.3%	6.2%	8.8%	7.6%
	2017	8.5%	6.9%	11.0%	7.2%
	2018	11.3%	7.9%	14.7%	8.9%

Notes: Percentage switching rate is defined as the total number of switches in the year divided by the total number of relevant customer accounts. The 2018 switching rate is annualised based on data from the first six months of the year.

The percentage of active consumers is typically between one-third and one-half of the active switching rate. It has increased substantially across all customer classes between 2014 and 2018, but particularly for residential consumers in the Powercor distribution zone where average consumption is higher than in the CitiPower distribution zone. The relatively low levels of consumer activity in 2014 may be explained in part by the removal of the carbon tax on 31 June 2014, leading to a general reduction in electricity prices. Since then, average retail electricity prices in Victoria, as measured by the Australian Bureau of Statistics (ABS 2018), have increased by 25 per cent and, as would be expected, we see commensurate increases in the level of consumer activity across all customer classes.

Consumers' level of activity is correlated with annual consumption and smart meter data enable the percentage of active consumers to be disaggregated by different levels of annual consumption. We report results for high, medium and low household consumption using thresholds of 3 000 kWh and 5 500 kWh per annum to delineate the three consumption categories. The consumption thresholds broadly align with the AER's reference pricing methodology thresholds for one-person households, two-to-three-person households, and four-or-more-person households in Victoria (AER 2017).[8]

[8] The AER's methodology also depends on climatic zone, reticulated gas connection, heating types, and presence of a swimming pool. We refer here to Climatic zone 6, without swimming pool, which is the most representative for our sample.

Table 3: Percentage of active consumers in the Powercor and CitiPower distribution zones by level of annual consumption, residential solar and non-solar consumers, January 2014 to June 2018

		CUSTOMER CLASSES			
		RESIDENTIAL NON-SOLAR		RESIDENTIAL SOLAR	
		POWERCOR	CITIPOWER	POWERCOR	CITIPOWER
Low consumption <3 000 kWh p.a.	2014	7.4%	6.3%	7.0%	7.9%
	2015	6.5%	6.0%	7.6%	8.6%
	2016	7.0%	6.5%	8.8%	7.2%
	2017	8.4%	7.3%	10.7%	6.8%
	2018	10.1%	7.1%	12.9%	7.2%
Medium consumption 3 000 to 5 500 kWh p.a.	2014	9.0%	7.3%	8.4%	8.3%
	2015	7.8%	6.8%	8.6%	9.2%
	2016	8.0%	6.9%	9.3%	7.8%
	2017	9.1%	7.6%	11.4%	7.4%
	2018	11.5%	8.6%	14.9%	9.5%
High consumption >5 500 kWh p.a.	2014	10.5%	7.9%	9.7%	9.8%
	2015	8.6%	7.1%	9.9%	7.6%
	2016	8.5%	7.1%	9.5%	9.1%
	2017	9.8%	8.3%	12.2%	8.8%
	2018	13.0%	9.8%	17.4%	10.8%

Notes: Percentage switching rate is defined as the total number of active customers in the year divided by the total number of relevant customer accounts. The 2018 switching rate is annualised based on data from the first six months of the year. Only meters active for the compete year were included in the analysis.

As expected, the measured levels of consumer activity increase, on average, with higher annual consumption levels – and likely higher average electricity bills. The number of non-solar active consumers in the high consumption category, for example, was 2.9 percentage points higher in 2018 than the low consumption category in the Powercor distribution zone, and 2.7 percentage points higher in the CitiPower distribution zone. However, the percentage point increase in active consumers between 2014 and 2018 was not consistent among the different consumption categories and distribution zones.

2.4 Trends in consumer disengagement

To provide a more complete picture of consumer behaviour in the retail electricity market, we examine trends in consumer disengagement. Persistent disengagement from the market increases the likelihood consumers will be paying higher prices, and both the ACCC Inquiry and the Thwaites Review made numerous recommendations to deliver better outcomes for this sub-group of consumers.

Our data show that 31 per cent of consumers have remained with their retailer for at least five years – up from 25 per cent in January 2014. However, such long-term disengagement from the market is most detrimental for consumers only when they are paying much higher-than-necessary prices for their electricity. The AEMC (2018) provided some general guidance on the average prices paid by residential consumers with different retailer durations. Using confidential data supplied by retailers, it found:

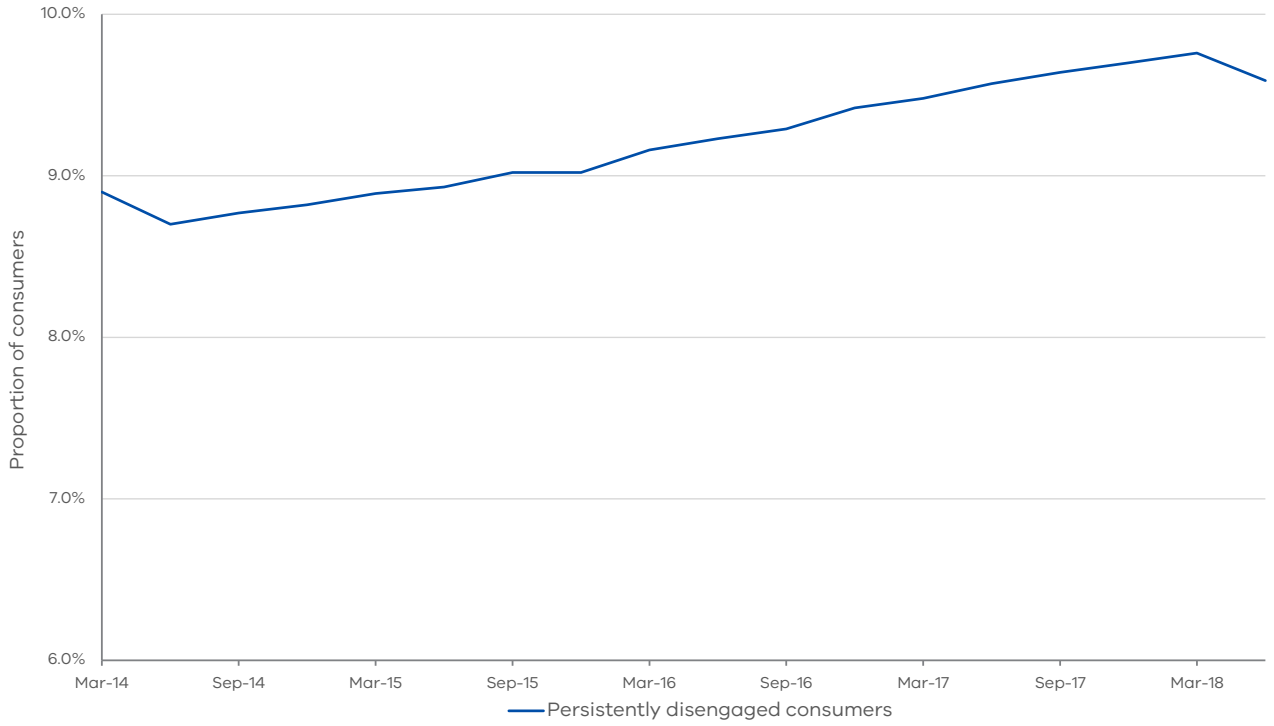
- the proportion of customers of Tier 1 retailers on 'higher discounts' decreases over time, and stabilises at around 20 to 40 per cent after three to four years;

- 22 per cent of the customers of Tier 1 retailers are on zero discount contracts, suggesting a significant proportion of their customer base is disengaged; and
- the customers of Tier 2 or 3 retailers are more likely to receive the same discount level, regardless of how long they have been with the retailer.[9]

While discounts are an imperfect measure of the competitiveness of retail contracts, these findings suggest, on average, consumers who have remained long-term with a Tier 1 retailer are the most likely group to be paying higher than necessary electricity prices.

We report the percentage of consumers who have remained with a Tier 1 retailer for more than five years, who we refer to as 'at-risk, disengaged consumers'. The five-year threshold aligns with survey data collected for the AEMC as part of its consumer survey work investigating long-term trends in consumer disengagement (Newgate Research 2017) and is consistent with the discounting findings noted above. Figure 6 illustrates the proportion of these at-risk, disengaged consumers has increased with time and, in absolute terms, has increased by around 47 000 consumers over the four and a half years.

Figure 6: Percentage of residential consumers who have remained with a Tier 1 retailer for more than five years, CitiPower and Powercor distribution zones combined, March 2014 to June 2018



To understand why the numbers of at-risk, long-term disengaged consumers have increased over a period of rising electricity prices, we consider their consumption and socio-economic characteristics and contrast these with the consumption and socio-economic characteristics of more active consumers. The price competitiveness of a retail contract tends to persist over a few years (ESC 2017), so for comparative purposes we define an engaged consumer as one who has made an active switch within the past two years.

Consistent with the findings on consumption in the previous section on engaged consumers, at-risk, disengaged consumers are over-represented in the low-consumption category and under-represented in the high-consumption category. Figure 7 illustrates the proportion of at-risk, disengaged consumers in the high-consumption category is around two percentage points (or 20 per cent) lower than in the low-consumption category. This is not surprising as the potential savings – or implied costs – for low consumption households resulting from remaining disengaged from the retail market and paying higher than necessary prices are smaller than those available for high-consumption households, and are therefore less likely to outweigh the costs, or perceived costs, of engaging with the market.

The consumption effect is reinforced by socio-economic factors. Socio-economic attributes of consumers are likely to have an impact on consumer engagement as the opportunity costs imposed by search and switching costs would differ between consumers. Socioeconomically disadvantaged consumers are more likely to be cost sensitive, while socioeconomically advantaged consumers might be relatively indifferent to high electricity bills.

[9] The AEMC report only distinguishes between the Big 3 retailers and Tier 2 retailers, which encompass Tier 3 retailers according to the Thwaites Review definitions.

Figure 7: Engaged and at-risk disengaged consumers by consumption category, CitiPower and Powercor distribution zones, March 2014 to June 2018

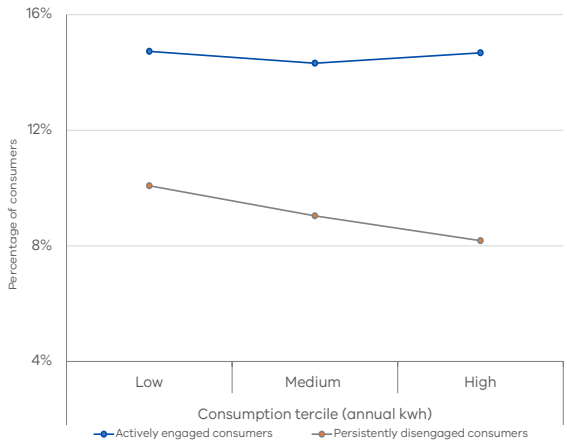
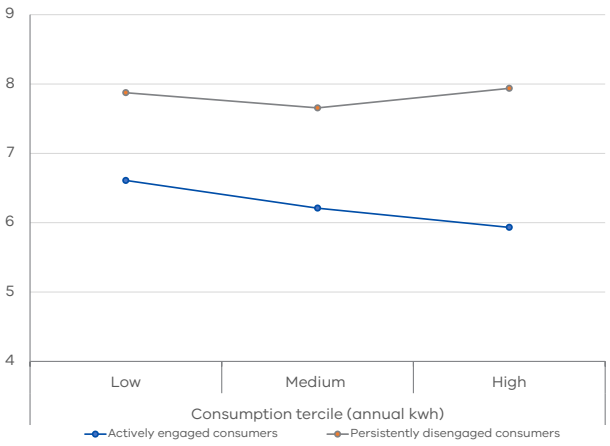


Figure 8: Engaged and at-risk disengaged consumers by consumption category and average postcode SEIFA score, CitiPower and Powercor distribution zones, March 2014 to June 2018



While individual-level demographic data on each consumer were not available, the average socio-economic scores for their postcodes were assigned to each consumer, allowing an approximation of the impact of socio-economic attributes on consumer behaviour. We employ the Socio-Economic Indexes for Areas (SEIFA) of relative socio-economic advantage and disadvantage to capture the combined effect of a range of socio-economic factors. This measure was developed by the ABS to rank areas in Australia according to relative socio-economic advantage and disadvantage, with a higher relative score indicating greater advantage.

Figure 8 shows for all consumption categories, at-risk, disengaged consumers were, on average, located in postcodes with a significantly higher SEIFA score than engaged consumers. This suggests those consumers most at risk of having high electricity prices due to persistent disengagement are both more likely to have low consumption, and more likely to be socio-economically advantaged.

Our analysis of consumer disengagement is dependent on the reported pricing strategies employed by different retailer tiers. These features of the market are not static. Should, as expected, the regulatory improvements underway deliver tangible benefits for consumers, then we should expect retailers' pricing strategies to respond and our analytical approach would need to change. Supplementary analysis with more detailed data on consumer prices would provide a more complete picture of the policy implications of consumer disengagement.

3. Conclusion

Numerous recent reports have established the retail electricity market in Victoria is not functioning in the best interests of consumers. It has evolved to advantage those consumers who shop around for a better deal and penalise those who do not. In this environment, understanding how and why consumers engage with the market is important to inform the development of policy interventions that seek to address the many problems present in the market today.

Our analysis using a binary annual indicator of consumer activity has demonstrated the level of consumer engagement in Victorian electricity markets is likely to be materially less than that suggested by headline switching rates. Much of the switching behaviour reported using AEMO-derived data is attributable to consumers moving house, win-backs and other repeated switching by consumers, rather than consumers taking an active interest in their electricity contract and proactively switching retailer to find a better deal. While our data could be improved by being able to follow consumers over time, and understand when they change contract without changing retailer, the survey evidence from the ACCC and the AEMC (ACCC 2018; Colmar Brunton 2018; Newgate Research 2017) on consumer behaviour when moving house suggests the true rate of consumer engagement is more closely approximated by our analysis of active consumers than annual switching rates.

Consumer activity may be explained at an aggregate level by electricity prices and consumption. As would be expected, the measured levels of consumer activity increase, on average, when prices increase. We also observe that individuals with higher consumption – and likely higher average electricity bills – are more likely to actively participate in the market.

Patterns of consumer disengagement from the market may similarly be explained at an aggregate level by consumption and socio-economic status. Consumer disengagement from the market has been increasing since 2014, as measured by the proportion of consumers who have remained with their retailer for more than five years. However, the disengaged consumers most likely to be at-risk of paying higher than necessary prices are more likely to have low consumption and are more likely to live in higher socio-economic postcodes, suggesting a large part of this disengagement can be explained by rational consumer inertia.

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A measurement of intergenerational mobility in Australia

By Trung Dang and Jason Tian[1]

ABSRACT

We follow the methodological approaches of Leigh (2007) and Mendolia and Siminski (2016a) to derive intergenerational earnings elasticities for fathers and sons in Australia and Victoria, using Household, Income and Labour Dynamics in Australia (HILDA) survey data from 2001 to 2016. Our adjusted pooled estimate suggests intergenerational mobility in Australia is similar to other high-income countries, and higher than countries such as the United Kingdom (UK) and the United States (US). Our adjusted pooled estimate suggests Victoria is considerably more economically mobile across generations than New South Wales, Queensland and Australia as a whole.

Overview

Intergenerational mobility refers to the extent to which the relative economic outcomes of an individual differ from the relative economic outcomes of their parents. The Organisation for Economic Co-operation and Development (OECD) has argued higher intergenerational mobility supports economic growth by better matching individuals with jobs that best suit their skills, talent and productivity, regardless of their socioeconomic background (OECD 2018). Further, the potential negative effects of income inequality can be mitigated or amplified across generations by greater or less mobility between generations. In a highly mobile society, with little association between the relative position of children and their parents, income inequality will be less persistent across families and generations, compared with a society with little to no mobility across generations.

As income inequality has increased in many countries over the past 30 years (International Monetary Fund (IMF) 2017), understanding how intergenerational mobility has evolved is of increasing priority. A number of studies have demonstrated that a positive and significant association exists between intergenerational mobility and income inequality (Björklund and Jäntti 1997, Solon 2004, Aaronson and Mazumder 2008, Andrews and Leigh 2009).

Economists typically estimate the degree of intergenerational mobility by studying the association between incomes across generations. A standard methodology in this literature is to regress earnings of males onto the earnings of their fathers at a particular point in the lifecycle (see Corak 2013a; Leigh 2007; and Mendolia and Siminsky 2016a).[2] These regressions provide estimates of the intergenerational earnings elasticities (IGE).

[1] The views expressed in this paper are those of the author and do not necessarily reflect the views of DTF.

[2] Corak (2013a) argues that it is simpler to estimate the intergenerational mobility of fathers and sons than corresponding regressions for mothers and daughters due to the changing nature of women's participation in the labour market over time. Further, Corak states that studies of fathers and sons are more prevalent in the literature and so permit a broader cross-section of results for comparison purposes.

The IGE describes the association between a percentage change in sons' income with respect to a percentage change in fathers' income. An IGE of zero indicates there is no statistical association between fathers' incomes and that of their sons, or alternatively, that there is a large degree of mobility between generations. An IGE of one indicates that a 1 per cent increase in a given father's income is associated with a 1 per cent increase in their son's income, or that there is a one-for-one association in the expected rank of a son in the income distribution and that of his father.

In this paper, we estimate the IGE for fathers and sons in Australia using data from the HILDA survey. In doing so we directly follow the methodological approaches of Leigh (2007) and Mendolia and Siminski (2016a). We extend these previous results in three main ways. Firstly, we use the latest data and construct a pooled estimate of the IGE that covers all 16 years of data in HILDA (2001–2016). Secondly, we estimate the IGE for each year in the survey to examine whether there have been meaningful trends in IGE over time. Finally, we provide estimates of the IGE at the sub-national level, namely for Victoria and other large states in the survey.

We estimate an IGE of 0.40 for Australia, based on a pooled regression with time fixed effects and applying a scaling factor to our initial estimate to account for several biases explained later in this paper. Our single-year IGE estimates do not suggest any meaningful improvement or worsening of mobility over the 16-year period within Australia. Our adjusted IGE of 0.24 for Victoria suggests intergenerational mobility is higher than the comparably large states of New South Wales and Queensland, and greater than Australia.

Taken together, our evidence supports Mendolia and Siminksi (2016a) in finding Australia has an IGE comparable with other high-income countries such as New Zealand, Canada and Japan. Australia has considerably more mobility than some highly developed countries, such as the UK and the US but slightly less mobility than certain European countries such as Norway, Denmark and Sweden. The relative position of Australia across the spectrum of developed nations may reflect differences in the penetration of tax and transfer systems across countries, although further work needs to be done to test this hypothesis.

The structure of this article is as follows. Section 1 provides a review of the literature on the measurement of intergenerational mobility. Section 2 describes how we use occupation and income data from the HILDA survey. Section 3 explains the methodology to estimate the IGE. Section 4 describes and provides a discussion of the results, and Section 5 offers a conclusion.

1. Literature review

Intergenerational elasticities have been estimated for many countries. These include Canada (Corak and Heisz 1999), France (Lefranc and Trannoy 2005), Sweden (Björklund and Jäntti 1997), Singapore (Ng 2007) and the UK (Dearden, Machin and Reed 1997), with the range of results showing differing levels of intergenerational mobility across countries. However, as per Solon (2002), cross-country comparisons are complicated by differences in data availability and methodological approaches in estimating IGEs.

Only a few studies have explored intergenerational mobility in the Australian context. Leigh (2007) is the first paper to measure earnings mobility in Australia using imputed fathers' incomes and sons' incomes from HILDA. He finds the IGE between fathers and sons in Australia is 0.184 using only the 2004 HILDA data. He also estimates elasticities for a single year in each decade dating back to the 1960s using other survey sources. These results do not display any statistically significant trend. Finally, applying the same methodology to US father–son income data, Leigh estimates an elasticity of 0.325, suggesting the US is not as economically mobile across generations as Australia is. Mendolia and Siminski (2016a) replicate Leigh's work with the use of additional data from updated survey years in HILDA. They derive intergenerational elasticities that were higher than Leigh's estimates. Their preferred estimate of 0.35 is considerably higher, and they argue their estimate is likely to be less affected by sampling variation than Leigh's (2007).

While most studies have attempted to measure intergenerational mobility using father and son income data, there is a growing number of studies that are extending these measures to other groups or sub-samples such as females, migrants and households (Chetty et al. 2014; Chadwick and Solon 2002; Dustmann, Frattini and Preston 2013). In Australia, Fairbrother and Mahadevan (2016) found differences between father–son and father–daughter elasticities (0.2 and 0.08, respectively). They attributed this to children following the parent of the same sex into the same role with similar pay when they enter the workforce, labour market inequalities between sexes, and different human capital profiles between sexes.

Understanding the mechanisms by which income and social status is transferred between generations is an additional area of interest, particularly for policymakers. Education, for example, is generally thought to be one of the key mechanisms through which family background affects an individual's earnings (Blanden, Gregg and Macmillan 2007). Higher-earning parents have a greater capacity to invest more in their children's education, improving their human capital, productivity and, in turn, their wages (Wilkie 2007).

Consequently, it is expected these children are more likely to occupy a similar income position as their parents. Several studies demonstrate educational attainment has a sizeable impact (Checchi 1997), explaining between 24 per cent and 39 per cent of the overall family background effect on children's earnings in Australia and the UK, respectively (Blanden, Gregg, and Macmillan 2007; Mendolia and Siminski 2016a).

Although significant, education is only one of many factors that account for the effect of family background on children's earnings. Mendolia and Siminski (2016b) use a generalised approach to mediation analysis to address potentially biased estimates of the effects of education produced in some other studies. They include in their analysis several family background characteristics, such as parental background, and cognitive and non-cognitive skills of the child, with results showing these other factors have a stronger bearing on earnings than the role of education. Household structure and dynamics can also influence the persistence of income across generations. Broader measures of income – not just individual earnings – may be more appropriate to account for spousal selection, household size and the number of children (Murray et al. 2017).

2. Data

Our analysis draws on data from the HILDA survey, a panel study of Australian households that began in 2001. This survey collects information about various aspects of Australian households including income, employment, family relationships and personal wellbeing. Survey data from HILDA are organised in waves, each of which represent one year of data. We used 16 waves of available data to derive a pooled IGE, as well as single-year estimates for each wave.

We express employment income data for fathers and sons in terms of hourly wages. These are derived for each individual by dividing their weekly gross wages or salary by the usual number of hours worked in their main job.

Several adjustments are made to the sample before proceeding with the estimation procedure. We restrict the sample to fathers and sons, primarily because of potential issues around the pattern of female participation in the labour market and as the majority of the literature focuses on the father–son relationship. This also aids in comparing intergenerational mobility across countries.

We further restrict our sample to sons aged between 25 and 54, as individuals in this age range are considered to have earnings that are most likely to reflect their lifetime earnings.

Data on fathers whose incomes are reported as non-positive or missing are excluded, including fathers who were reported to be unemployed at the time their son was asked to recall their employment. We note excluding unemployed fathers can potentially bias our IGE estimates; however, as the HILDA survey does not provide unemployment data for fathers in an appropriate form for the purposes of our analysis, they have been deemed out of scope. Our approach is consistent with Leigh (2007) and Mendolia and Siminski (2016a) in this regard.

Some studies have been able to obtain direct observations of individuals' incomes to derive estimates. For example, Chetty et al. (2014) are able to access administrative tax records of millions of US citizens to study intergenerational mobility for a cohort of children born between 1980 and 1982. Murray et al. (2017) follow a similar approach, in terms of sample construction and variable definitions, but instead use data from the HILDA survey. Since our study draws only on survey-based data, it is unable to observe the true income of the father at the relevant point in the son's lifecycle. As a result, we follow Leigh (2007) and use an imputation method for deriving income values for fathers, based on the son's reported occupation of his father.[3] Specifically, these responses are generated from a question in the HILDA survey that asks the individual whether his father was in paid employment when the individual was 14 years old, and if so, the occupation held by his father.

We use the confidential releases of the HILDA survey because of the more detailed occupational information provided about the fathers, which are based on 4-digit level occupations defined under the Australian and New Zealand Standard Classification of Occupations (ANZSCO). Both imputed earnings and current earnings are calculated in hourly earnings.

HILDA applies sampling weights to each respondent in the survey to ensure the sample size in the survey is representative of the broader population. Descriptive statistics for variables of interest are set out in Table 1.

Table 1: Descriptive statistics

VARIABLE	MEAN	STANDARD DEVIATION
Son's age (Vic)	38.91	8.54
Son's age (Aus)	39.04	8.55
Son's hourly earnings (Vic)	31.28	21.49
Son's hourly earnings (Aus)	31.05	20.61
Father's predicted hourly earnings (Vic)	28.91	10.13
Father's predicted hourly earnings (Aus)	27.56	8.96

Note: Statistics based on an average over 16 waves of the HILDA dataset.

[3] For examples of imputation methods, see: Aaronson and Mazumder (2008), Leigh (2007), Dunn (2003), Björklund and Jäntti (1997).

3. Methodology

As per Corak (2013a), the IGE is typically obtained from an ordinary least squares (OLS) regression of adult sons' income onto fathers' income. This involves estimating a regression of the earnings of adult sons onto the earnings of their fathers at a point in the son's lifecycle. The model can be specified as:

$$lnY_{i,t}^{son} = \beta_0 + \beta_1 lnY_{i,t-1}^{father} + \varepsilon_{i,t} \quad (1)$$

where:

- $Y_{i,t}^{son}$ denotes son's income during the survey year t;
- $Y_{i,t-1}^{father}$ denotes father's income measured at a point in time in the childhood of the son; and
- $\varepsilon_{i,t}$ represents all the other influences on son's earnings that are not correlated with father's income (Corak, 2013a).

The parameter of interest β_1 is the IGE and can be interpreted as the predicted percentage change in a son's earnings from a percentage change in his father's earnings. This elasticity could take on a positive or negative value – a positive value indicates an increase in a father's income is associated with higher income for his son, while a negative value means a higher father's income is associated with a lower son's income. The constant term captures average changes in incomes across generations.

Ideally, the IGE would be estimated using actual earnings data for both sons and fathers over their working lives. However, as the HILDA survey does not report fathers' earnings, we follow Leigh (2007) and Mendolia and Siminski (2016a) and estimate the IGE over two steps.

The first step involves imputing fathers' earnings data. We impute each father's earnings using the son's reported occupation of his father when the son was 14 years of age. A benefit of this imputation method is that although estimated values of fathers' earnings are not as precise, respondents should more easily be able to recall information based on occupation relative to income. We use the confidential version of the HILDA data releases, which provide occupational information at the finer four-digit level classifications defined under ANZSCO.

Fathers' earnings are imputed with the following equation:

$$lnY_{i,t}^{male} = \theta_0 + \theta_1' Occ_i^{male} + \gamma_1 Age_{i,t}^{male} + \gamma_2 (Age_{i,t}^{male})^2 + u_{i,t} \quad (2)$$

where

- lnY_i^{male} denotes log earnings of males in the survey;
- Occ_i^{father} denotes a vector of occupation dummy variables for fathers (i.e. that take a value of one in a single element of the vector for each occupation category); and
- Age_i^{male} is the age of the male i in year t.

Each father's imputed earnings are then derived by mapping the parameters from Equation (2) to the reported occupation of the father by the son, fixing the age at 40 – as per Leigh (2007) and Mendolia and Siminski (2016a). Imputed father's income is essentially the fitted value from Equation (2) using each father's occupation and the parameters estimated across the entire sample of males.

An obvious limitation with this imputation method to estimate fathers' earnings is that occupation and wage structures are likely to be different between generations. For example, a son working in the same occupation as his father could earn exactly the same nominal income, even though it is likely relative wages across industries have changed across generations. It may be possible to obtain better estimates of relative wages in the past using historical labour market data – for example, from the Australian Bureau of Statistics (ABS). We leave this for possible future research. Further, this method abstracts from the possibility of fathers changing occupations, as well as excluding observations in which the father's income cannot be estimated based on their reported occupation and the misreporting of occupations.

Age and squared age are included to control for variation in sons' earnings attributable to the stage of the lifecycle observed. For example, individuals entering their 30s are likely to continue to experience an increase in their incomes, in contrast with individuals in their 50s who are more likely to experience declining incomes. As such, to remove 'lifecycle' income bias, we estimate fathers' earnings by fixing fathers' age variables at 40 – an approximate age considered to be fairly reflective of an individual's permanent lifetime earnings.

The second step involves estimating the IGE by using sons' earnings and our imputed fathers' earnings, using the following the equation:

$$lnY_{i,t}^{son} = \mu_t + \beta_1 \hat{Y}_{i,t}^{father} + \gamma_1 Age_{i,t}^{son} + \gamma_2 (Age_{i,t}^{son})^2 + \varepsilon_{i,t} \quad (3)$$

where definitions are as per equations (1) and (2) other than the inclusion of μ_t, denoting year fixed effects. These fixed effects are included to account for economy-wide shocks that impact earnings across all occupations in a given year. As per Equation (1), β_1 is the estimate of the intergenerational elasticity.[4] We estimate Equation (3) using the pooled sample across all waves of HILDA, and we also estimate the IGE for each year in the survey (waves 2001–2016) using ordinary least squares regression. These estimates using individual waves obviously do not contain year fixed effects but otherwise are identical to (3). We also estimate Equation (3) for Victoria, New South Wales and Queensland.[5] Standard errors are adjusted for clustering around fathers' occupations in both cases.

[4] The fact we use imputed father's earnings in Equation (3) rather than actual earnings, while standard in the literature, implies usual OLS standard errors need to be adjusted to account for this source of random variation in the right-hand side variables. The unadjusted standard errors are likely to be too low and further investigation of the importance of this issue is left for future work.

[5] We do not estimate the IGE for smaller states due to potential issues with sample size.

Raw estimates are then adjusted for two reasons. Firstly, the adjustment addresses downward bias in IGE estimates caused by measurement error related to the imputation of fathers' earnings. The reasons for the bias is that we do not observe true earnings of fathers, just an estimate that is subject to sampling variation. This introduces classical measurement error into our estimation of (3). Furthermore, because imputed earnings for fathers are based on current income data, they are subject to temporary economic shocks and lifecycle bias that do not reflect the individuals' permanent earnings (Corak 2006).

Secondly, the adjustment allows us to a make valid comparison of the IGE with IGE estimates of other countries published in Corak (2013b). We apply the same scaling method used in Siminski and Mendolia (2016a) and detailed in the appendix of Corak (2006) to rescale our estimates.

The scaling factor is based on a ratio of the US IGE benchmark and a US-derived estimate using the same method to derive the Australian estimate. The adjustment can be expressed as follows:

$$\widehat{IGE}_{Aus} = \beta_{AUS} \frac{IGE_{US\ benchmark}}{\beta_{US}} \qquad (4)$$

We use Grawe's (2004) estimate of 0.473 as the US elasticity benchmark and Mendolia and Siminski's (2016a) estimate of 0.306 as the US-derived estimate. Our raw elasticity estimates are therefore scaled up by 1.55.

4. Results and discussion

Our estimates of the intergenerational earnings elasticities using the regression of the form in Equation (3) across all waves, are presented in Table 2. Column 2 contains the raw intergenerational elasticity estimates for Australia, Victoria and two comparable large states with associated standard errors adjusted for clustering within fathers' occupations. Australia's raw estimate of 0.26 suggests a 10 per cent increase in father's hourly wages is associated with a 2.6 per cent increase in son's hourly wages. Our Australian IGE estimate is slightly higher than that of Leigh (2007) and Mendolia and Siminski (2016a), of 0.18 and 0.23, respectively.

We estimate a raw IGE for Victoria of 0.16, which is also statistically significant. Our estimate of Victoria's IGE would suggest its population is, on average, more intergenerationally mobile than the two similarly large states of New South Wales (0.32) and Queensland (0.24) and more mobile than Australia as a whole.

As noted previously, imputing fathers' incomes will likely lead to downward bias in the estimates, thereby overstating the degree of intergenerational mobility. To address this source of bias caused by measurement error, we use the approach by Corak (2006) and the relevant elasticity estimate from Mendolia and Siminski (2016a) to scale the raw estimates.

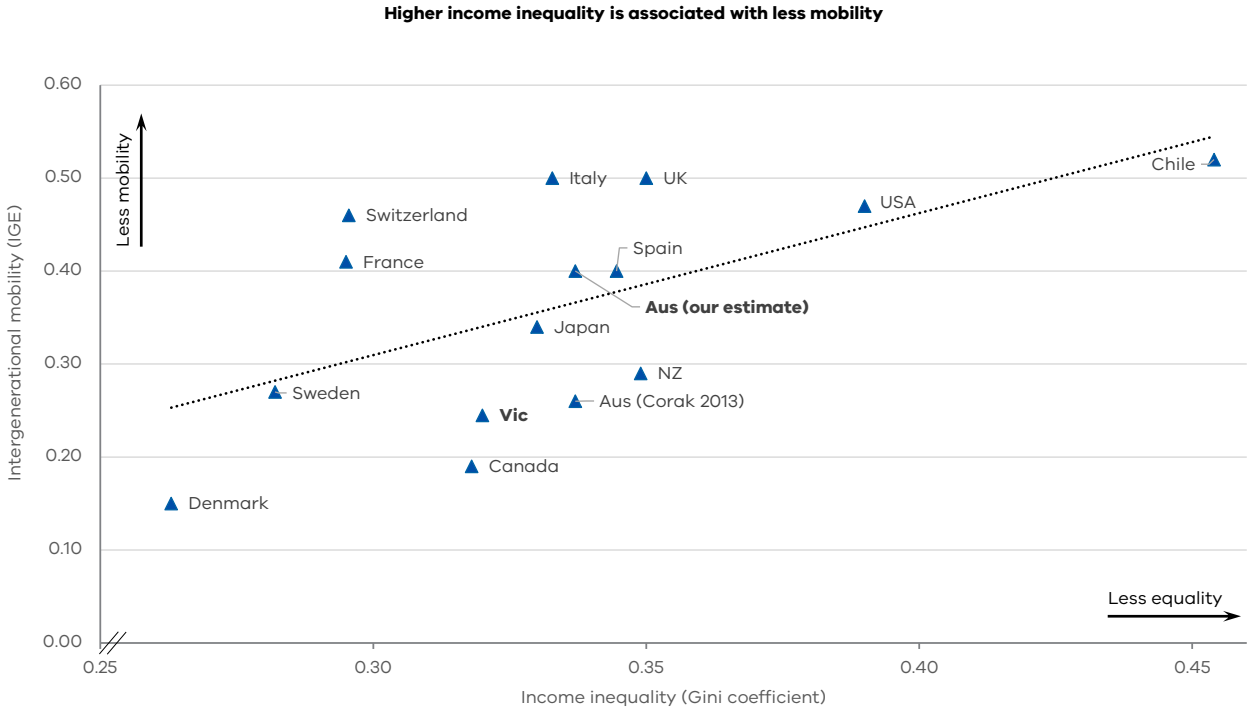
Column 3 contains the adjusted IGEs after applying the scaling factor. Our adjusted estimate of 0.40 for Australia is slightly higher than that of Mendolia and Siminski's (2016a) estimate of 0.35. In comparison to other OECD countries, our adjusted estimate suggests Australia's intergenerational mobility ranks somewhere in the middle of this group. These IGEs can be depicted along the vertical axis in 'The Great Gatsby Curve' (Figure 1), a chart that also maps out Gini coefficients for each country along the horizontal axis. There is a noticeable positive relationship between these two measures, which suggests lower intergenerational mobility is associated with higher income inequality.

Table 2: Summary of intergenerational earnings elasticities (pooled)

JURISDICTION	IGE	IGE (ADJUSTED)	LOWER CI	UPPER CI	SAMPLE SIZE
Australia	0.26*** (0.01)	0.40***(0.05)	0.30	0.50	37 308
Victoria	0.16*** (0.02)	0.24***(0.05)	0.15	0.34	9 325
New South Wales	0.32*** (0.02)	0.49***(0.06)	0.36	0.61	11 078
Queensland	0.24*** (0.02)	0.38***(0.05)	0.27	0.48	7 861

Notes: Clustered standard errors in parentheses. *** Statistically significant at the 1% level. Confidence intervals are calculated at the 95 per cent level.

Figure 1: The Great Gatsby Curve: The association between income inequality and intergenerational mobility across countries



Sources: Intergenerational earnings elasticities obtained from Corak (2013b), Gini coefficients obtained from OECD Income Distribution Database, Australian and Victorian Gini coefficients obtained from ABS 6523.0.

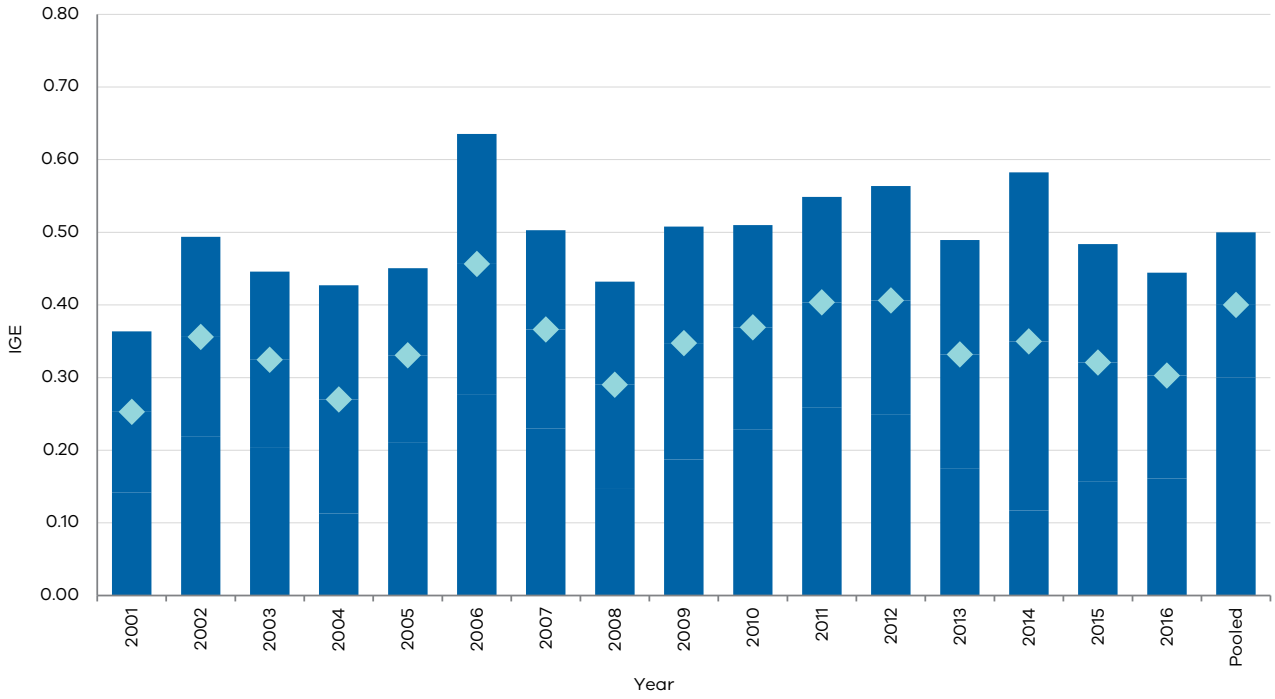
Figure 1 indicates Australia has comparable levels of intergenerational mobility and income inequality to other developed countries. With respect to intergenerational mobility, Australia has very similar levels to Japan, Spain and France. Intergenerational mobility in Victoria is similar to New Zealand, Sweden and Canada.

As discussed above, we estimate IGEs for every year of the HILDA dataset up until the latest available wave to examine whether there has been a meaningful trend in mobility over time.[6] These estimates, which have been scaled to account for downward bias, along with their associated 95 per cent confidence intervals, are set out in Figure 2. The estimate at the furthest right-hand side of the chart is our pooled estimate, which as expected has a narrower confidence interval. While the IGE estimates from year to year are all statistically significant, a clear trend in intergenerational mobility has not emerged in Australia over this period.[7]

[6] Ideally, we would use repeated cross-sections of the population of fathers and sons at identical points in the lifecycle but at different years to more accurately study whether mobility has trended over time. However, as HILDA is a longitudinal study of the same individuals, the majority of individuals are observed across multiple waves of the survey. This implies we are also estimating trends in mobility over the sons' lifecycle as well as trends in intergenerational mobility over time in Figure 2.

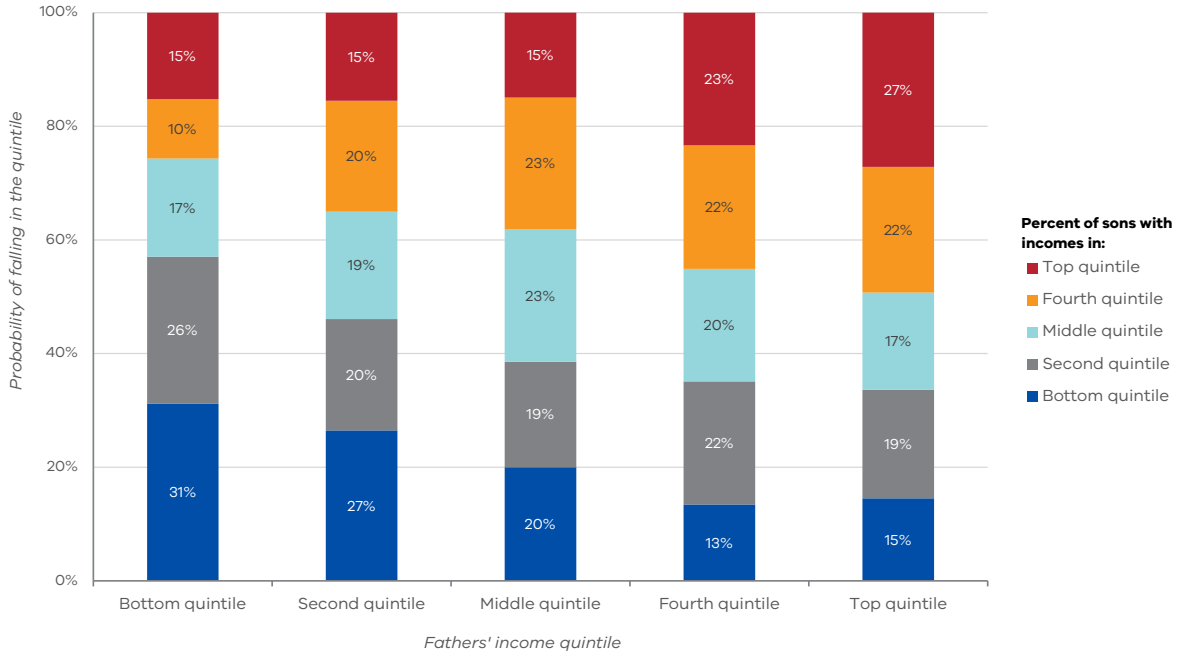
[7] IGEs for each wave were also estimated for Victoria over the period with no obvious trend in mobility emerging. The range of estimates across years was much larger than for the national cohort and we find the year-specific elasticities are only statistically significant for some years of the sample. Victorian IGE estimates range from -0.007 to 0.59.

Figure 2: Intergenerational earnings elasticities with associated 95 per cent confidence intervals, Australia (HILDA waves 2001–2016)



While the IGE provides a useful summary measure of intergenerational mobility for an entire sample, it may not reveal the potentially important non-linearities that exist between intergenerational mobility and income levels. For example, intergenerational mobility may be significantly higher or lower for a son born to a father in the bottom-income group and relative to a son born to a father in the middle or top-income group. To investigate the existence of these non-linearities, we calculate transition matrices for father and son relative incomes. As per Corak and Heisz (1999), a transition matrix in this context relates the position in the income distribution of the child to the position in the income distribution of the parent at the time the child was being raised. For each quintile in the distribution of fathers' income, we estimate what fraction of corresponding sons are contained in each of the five quintiles for sons' income. Elements along the diagonal of this matrix represent the probability that a son occupies the same quintile as their father did and therefore are representative of the degree of 'stickiness' in each quintile. Figure 3 contains the transition matrix pooled across all waves of the HILDA data.

Figure 3: Distribution of sons' incomes across imputed fathers' incomes, by income quintile, Victoria



There appears to be a degree of 'stickiness' at both ends of the father–son income distribution. In Victoria, sons born into the bottom-income quintile have a 31 per cent probability of remaining in the same quintile. Likewise, sons born to top-income quintile fathers have a 27 per cent probability of occupying the same position in the distribution. Those born into the middle-income group have, for the most part, an even chance of occupying different points of the distribution, although upward mobility to the top income group is the lowest (which also applies to the two bottom-income groups).

Comparing our transition matrix for Australian fathers and sons to the matrices presented in Corak and Heisz (1999), we find sons born into the top or bottom income groups within the US or UK are expected to have a higher probability of remaining in the same income group as adults. However, comparing this to the Canadian matrix in the paper, we find the probabilities of ending in any income group more evenly spread out across the income distribution, in line with our results. We note the periods covered in Corak and Heisz (1999) differ from those of our study and that this complicates our cross-country comparisons of the transition matrices.

5. Conclusion

This paper provides a measurement of intergenerational mobility in Australia by estimating the intergenerational earnings elasticity. We use all waves of HILDA data and estimate an adjusted pooled estimate of 0.40. This is broadly consistent with the estimate of 0.35 in Mendolia and Siminski (2016a), whose methodological approach we follow. Our IGE estimates indicate intergenerational mobility in Australia is relatively typical for advanced OECD countries, but there has not been an obvious trend upwards or downwards in mobility over time. IGE estimates for Victoria, New South Wales and Queensland show intergenerational mobility in Victoria is higher than the two comparably large states and Australia as a whole. While we do not investigate the factors and mechanisms leading to these differences, these results can provide a useful starting point for further research. This could include examining mobility for certain groups, such as the unemployed or using broader measures of income and wealth to provide a more comprehensive picture of intergenerational mobility.

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Review of discount rates used in economic evaluations

By Rohan Fernandez[1]

ABSTRACT

This paper reviews three principal methodologies used to calculate discount rates internationally and develops up-to-date estimates of the discount rate using each methodology. Over the past decade, interest rates have hit historic lows and several overseas jurisdictions have reduced their discount rates. This has led some academics and practitioners to question whether the Victorian discount rate remains appropriate. However, low interest rates are not relevant for determining the discount rate, which, according to the current methodology, is driven by the marginal return to capital. This paper determines that re-estimating the rate using recent data would not change the discount rate.

Overview

Discount rates are used to calculate the present-value of costs and benefits that occur at different points in time. When applied to economic evaluation of government projects, discounting is used to assess the viability of projects, and consider how projects compare against alternative proposals.

The choice of discount rate can heavily influence the final result of the economic evaluation. That is, the higher the discount rate, the smaller the present-value of future costs and benefits, and the further into the future the costs and benefits are incurred, the greater the effect of the discount rate. Therefore, a lower discount rate favours projects where most costs are borne early and benefits accrue at a later point in time, while projects with low upfront costs but higher future costs appear less attractive.

The choice of discount rate also has implications for resource allocation, given an overly high rate may discourage investment in projects that are beneficial to the long-term welfare of the community, while an artificially low rate may stimulate investment in projects that make future generations worse off.

This paper explores the three principal methodologies used to determine discount rates: the weighted average opportunity cost of capital approach; the social time preference rate (STPR) approach; and the risk premium approach through a capital asset pricing model (CAPM).

The current Victorian discount rate of 7 per cent is calculated using the weighted average opportunity cost of capital approach, which reflects the opportunity cost of sources of funds to finance a project. The approach is driven by the marginal return to capital rather than interest rates, capturing the opportunity cost of a project, rather than the actual financing cost. Such an approach means low interest rates have not put downward pressure on the discount rate (as sometimes expected).

The current Victorian discount rate is based on a 2010 analysis, which relies on around 40 years of data up until 2007. This analysis re-estimates the rate and finds that it is broadly unchanged – a raw output of 6.8 per cent, rounded to 7 per cent – when the calculations are updated to include recent national accounts data over the past 25 years. This is

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driven by strong returns since the global financial crisis (GFC), principally in the financial and construction sectors.

An alternative methodology is the risk premium approach, which uses a CAPM to build a discount rate using a risk-free rate and a risk premium.[2] This was Victoria's underlying methodology until the weighted average approach was adopted in 2013.

The third methodology explored is the STPR approach, which reflects the rate at which consumers trade present consumption for future consumption. It is an after-tax, risk-free rate that reflects consumers' preference to receive goods and services sooner rather than later.

The academic literature on the preferred approach to calculate discount rates is mixed. Some, such as Harrison (2010)[3] and Jenkins and Kuo (2007), advocate for an efficiency-driven opportunity weighted average approach, which considers the returns to society the funds would have returned had they been left in the private sector. Others, such as Caplin and Leahy (1999), argue that a 'social planner' will place greater emphasis on future consumption than a representative agent maximising its utility function. This is similar to the 'normative' approach[4] advocated in Stern (2006), which derives from ethical views about intergenerational equity, and considers that individuals do not prefer to consume sooner rather than later, and that the needs of future generations should not be disregarded.

Some overseas jurisdictions and studies (such as Stern 2006) appear to have adopted this normative approach, where they may have used the parameters of the STPR approach but assigned values to variables they think reflect society's willingness to trade current consumption for future consumption.

Different discount rates are appropriate for different circumstances, and the approach used varies greatly in the academic literature and in the way discount rates are used by government agencies, with estimates ranging from 1 to 15 per cent. It is even less clear about the preferred methodology used to calculate the discount rate using the risk premium and STPR approaches.

While the risk premium approach explicitly accounts for risk and can be frequently updated based on government bond rates, the underlying calculations in the methodology use more volatile data (such as share market returns) and encounter difficulties in accounting for tax and gearing. Using a CAPM, with updated data, the analysis estimates a discount rate within the range of 4.0 to 6.4 per cent (depending on the risk exposure of the project).

Several overseas jurisdictions have shifted to the STPR approach over the past two decades (namely the United Kingdom (UK) and some western European nations), which adopts lower rates than the other two approaches. There is often limited transparency about how these rates have been determined, but it is likely that, in some cases, these reflect subjective judgements about a trade-off between current and future consumption – an approach that is arguably at odds with the empirically driven approach, which underpins cost-benefit analysis.

There are also untested complexities of practically shifting to the STPR approach, such as how to account for risk and tax distortions. The analysis estimates a discount rate of 2.4 per cent when using this methodology.

This paper begins by canvassing the nature of economic evaluations and the debate over the discount rate (Section 1). In Section 2, the three principal methodologies are reviewed and estimates of the discount rate using each methodology are updated. Section 3 concludes the paper.

1. Economic evaluations and the discount rate debate

1.1 Current economic evaluation guidelines

The Victorian Department of Treasury and Finance (DTF) is responsible for Victoria's economic evaluation guidelines, which were last reviewed in 2013[5] with an expectation they would evolve over time. The current recommended approach to discounting is outlined in Box 1.

The discount rate is a critical input into an economic evaluation, as the selected rate can significantly influence the merits of different project proposals and subsequent resource allocation.

Higher discount rates typically yield smaller present values of future costs and benefits, and the effect of the discount rate is greater for costs and benefits incurred further in the future. The relative pattern of costs and benefits is also important. For example, a lower discount rate will favour projects where the majority of costs are borne early on and benefits accrue later. It can also mean projects with low upfront costs but higher future costs (e.g. clean-up costs) appear less attractive.

2 The risk premium typically reflects systematic risk, which cannot be eliminated (even by government) rather than idiosyncratic risk, which is specific to a particular asset or project.
3 Victoria's current rate is based on this analysis, undertaken while Dr Harrison was a visiting researcher at the Productivity Commission.
4 Also sometimes referred to as the 'prescriptive' approach.
5 Although the 2013 review did not recommend changing the discount rate, the underlying methodology was updated to reflect analysis undertaken at the Productivity Commission in 2010.

BOX 1. CURRENT DTF RECOMMENDED DISCOUNT RATES

The current guidelines recommend a real discount rate based on the type of project being evaluated:

Category 1: 4 per cent for projects that provide non-commercial goods and services, where the benefits are less easily translated into monetary terms (e.g. public health, education and justice).

Category 2: 7 per cent for projects that provide non-commercial goods and services, but where the benefits are more easily translated into monetary terms (e.g. public transport, roads and public housing).

Category 3: A prevailing market rate of return for commercial projects, commensurate with the risk profile of the project.

Sensitivity analysis is recommended at 4 and 9 per cent for category 2 projects, which are the typical projects for which economic evaluations are generally undertaken.

2. The three approaches

2.1 The weighted average approach

The traditional approach to efficiency-based discounting (dating back to Harberger 1969) is the weighted average approach, which assumes projects are financed by drawing on the capital market. The weights reflect the ultimate sources of the capital used by the project, or the extent to which government borrowing reduces investment and increases savings (via delayed consumption).

2.1.1. The current discount rate (based on the weighted average approach)

Victoria's current recommended rate is based on the 2010 Productivity Commission (PC) research paper, *Valuing the future: The social discount rate in cost-benefit analysis*. The paper suggests the long-run marginal return to capital is the basis for the weighted average approach, with the marginal return to capital averaging 8.9 per cent over the four decades to 2007. This is then adjusted down by 1 percentage point for tax distortions and foreign borrowing to a rate of around 8 per cent.

2.1.2. An updated calculation of the discount rate

This paper updates earlier work by calculating the discount rate when taking a weighted average of the economic cost of funds to finance a project, using the most recent 25 years of data. To fully reflect the opportunity cost of capital, the weighted average approach includes the marginal return to capital, the cost of newly stimulated savings (from delayed consumption), and the marginal cost of foreign borrowing (necessary in a small open economy such as Australia's). Jenkins and Kuo (2007) expresses the discount rate as the economic opportunity cost of capital (EOCK):

$$EOCK = f_1\rho + f_2 r + f_3(MC_f) \quad (1)$$

where:

- ρ is the gross before income tax return on domestic investments (i.e. marginal return to capital);
- r is the social cost of newly stimulated domestic savings; and
- MC_f is the marginal cost of incremental foreign capital inflows.

Under this methodology, f_1, f_2, and f_3 are the corresponding weightings equal to the proportions of funding that are diverted (due to crowding out) from displaced investments, postponed consumption, and foreign borrowing. Using these weights, the discount rate calculation can be expressed as:

$$EOCK = \left[\varepsilon_r\left(\frac{S_r}{S_t}\right) * r + \varepsilon_f\left(\frac{S_f}{S_t}\right) * MC_f - \eta\left(\frac{I_t}{S_t}\right) * \rho\right] / \left[\varepsilon_r\left(\frac{S_r}{S_t}\right) + \varepsilon_f\left(\frac{S_f}{S_t}\right) - \eta\left(\frac{I_t}{S_t}\right)\right] \quad (2)$$

where:

- ε_r is the supply elasticity of domestic savings;
- ε_f is the supply elasticity of foreign funds;
- η is the elasticity of demand for domestic investment regarding changes in funding costs; and
- S_t is the total private-sector savings available in the economy, of which S_r is the contribution to the total savings by residents, S_f is the total contribution of net foreign capital inflows, and I_t is the total private-sector investment.

The following subsections describe the data and inputs used to calculate an updated weighted average approach discount rate using these weightings and methodology.

Marginal returns to capital (ρ)

The 2010 PC paper estimates the marginal return to capital using 1965–2007 national accounts data to calculate capital earnings before interest and direct tax, in each year, as a percentage of the net capital stock at the beginning of the year. It uses data that form part of the income measure of gross domestic product (GDP):

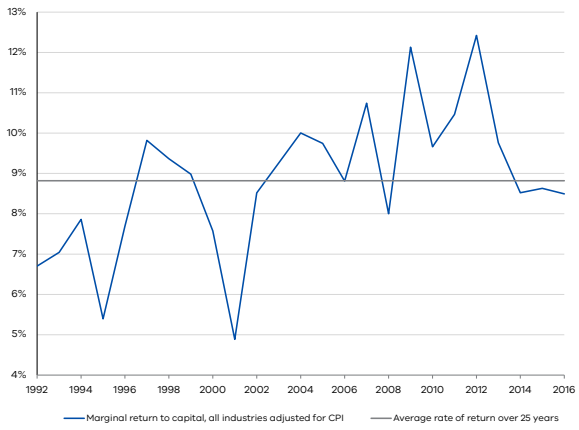
- the gross operating surplus of corporations;
- less the cost of physical depreciation of the capital stock during the year;
- plus the carrying gain that firms make because the price of capital increases over time; and
- indirect taxes and subsidies are also removed.

This paper uses national accounts data (ABS catalogue numbers 5204.0, 5260.0) from 1992 to 2016 and employs an arguably more robust method than Harrison (2010) for calculating factor income that can be attributed to capital.[6] The analysis focuses on the past 25 years accounts for changes in the institutional environment in the early 1990s, which have resulted in a more predictable monetary policy environment and lower inflation volatility (Hall and Jaaskela 2011).

To estimate capital earnings, the capital income shares for value-added based estimates of multifactor productivity have been multiplied by gross value added, with depreciation (i.e. consumption of fixed capital) then removed. This has been divided by the net capital stock and adjusted for inflation, as determined by the consumer price index (CPI).

The final result is an average marginal return to capital over the past 25 years of 8.8 per cent (Figure 1).

Figure 1: Marginal return to capital, 1992–2016



Newly stimulated savings (r)

When governments invest, the supply of funds in the private market may be reduced, increasing the rate of return (i) of an investment. This represents the crowding out of investment[7] and therefore i is often used in discounting to represent the opportunity cost of the capital displaced by the public investment. However, as increases, so does the return on savings (r), and people will save more at the expense of consumption. Note that this increase in savings is not seen as a crowding out of private investment.

The market impact should therefore take into account the crowding out effect of public investment, as well as the shift away from consumption towards savings.

A weighting method can be used to take both effects into account; however, the respective weights to be applied are difficult to determine.

The academic consensus[8] is that savings are fairly inelastic in response to changes in the interest rate, but investment is relatively elastic. Therefore, most of the government borrowing comes at the expense of investment. While many assume a 100 per cent weighting of i for simplicity, others argue for a weight of 10 per cent or more for domestic savings. In line with the IMF (2014), this paper uses 15 per cent, assuming that an increase in i will induce some increase in savings in addition to a reduction in capital.

This additional saving comes at the expense of consumption, which has an average opportunity cost equal to the return obtained from the additional savings, net of all taxes and financial intermediation costs. This is equivalent to the net operating surplus of corporations plus the capital component of net mixed income, less corporate income tax, tax paid by households on capital income, and financial intermediation costs. The resulting return to domestic savings is divided by the mid-year value of the net capital stock (of corporations and households), then adjusted for CPI. The cost of newly stimulated domestic savings is estimated as 3.4 per cent from 2005–16.

Foreign borrowing (MC_f)

Increased demand in the capital market can also be met from increased capital funds from abroad. When there is an increase in the demand for funds for investment, the market interest rates increase to attract funds. As the quantity of foreign obligations increases relative to the country's capacity to service them, the return demanded by investors is expected to rise, as lenders charge more for risk of default. The cost of foreign borrowing is the cost of servicing the additional unit of the foreign fund, and the extra financial burden on all the other borrowings, which are responsive to the market interest rate.

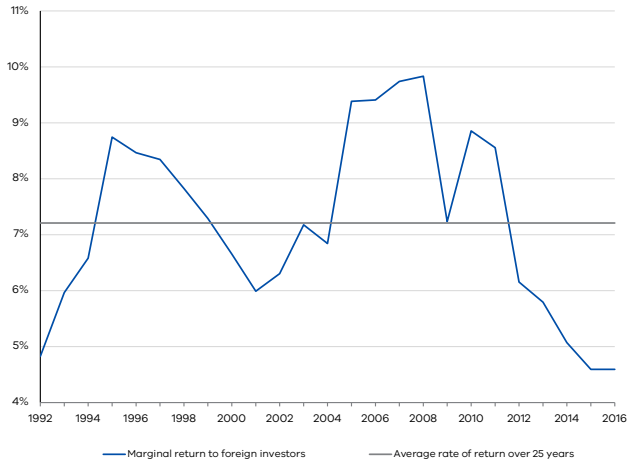
Accounting for these issues, the marginal cost of foreign borrowing, based on the marginal return to foreign investors over the past 25 years has been estimated to be 7.4 per cent (Figure 2).

[6] This analysis determines the factor income attributable to capital via a gross value-added-based measure. This approach does not involve making a judgement to determine the share of gross mixed income that should accrue to capital, unlike the Harrison (2010) analysis, which refers to adding a 'portion' of gross mixed income to the gross operating surplus. Hence, the results in the Harrison (2010) analysis and this paper's analysis are not directly comparable. Further details on the marginal return to capital calculation are provided in the appendix, while details on the selected time period are provided in section 2.3.

[7] While crowding out is assumed to occur in an open economy, the extent to which it takes place depends on capital market assumptions. However, given newly stimulated savings are taken to represent only 5 per cent of total funding sources, any change to the extent of crowding out will not make any material change to the final discount-rate calculation.

[8] As suggested in Harrison (2010).

Figure 2: Marginal return to foreign investors, 1992–2016



Government project risk

A risk-free rate has been suggested as appropriate for discounting public sector projects. Governments have powers of taxation and rule-making that can help lower the risk of default.

However, government projects are very rarely free of risk. Even when governments can diversify project-specific risk by holding a balanced portfolio of assets, most government projects involve some amount of undiversifiable risk (e.g. demand for infrastructure services is linked to the state of the economy, as are wage rates used to calculate the time savings of public sector transport projects).

The current DTF discount-rate guidance includes an additional downward adjustment of 1 percentage point, on top of adjustments for domestic saving and foreign borrowing, to account for lower government risk.

A new estimate

This paper calculates the discount rate using updated calculations for the long-run marginal return to capital (ρ), the cost of newly stimulated savings (r), and the marginal cost of foreign borrowing (MC_f). The weights of each of these sources, based on the relative elasticities of savings and investment to interest rates, are 42.5 per cent, 5.0 per cent and 52.5 per cent, respectively.[9] Taking a weighted average of the cost of funds produces a discount rate of 7.8 per cent.

This differs from solely relying on a marginal return to capital rate (8.8 per cent) by 1 percentage point, by accounting for newly stimulated savings and foreign borrowing. This is consistent with the 1 percentage point adjustment described in the 2010 PC analysis to jointly account for foreign borrowing and tax distortions. Adjusting the rate down by 1 percentage point for lower government risk reduces the rate to 6.8 per cent. Table 1 summarises the different discount rates from the different approaches.

A discount rate of around 7 per cent is also relatively consistent with Applied Economics' recent analysis (Abelson and Dalton, 2018), which concludes that an appropriate discount rate for Australia is approximately 6.5 per cent. This rate, however, has been determined using an alternative methodology, where the opportunity cost of capital is represented by the alternative project rate of return, rather than the weighted cost of funds. This alternative rate of return is calculated using CAPM and weighted average cost of capital (WACC) measures (reflecting the average return on all sources of a company's financing), with national accounts measures used as a cross check of the results.

Table 1: Different approaches to calculate the discount rate

	DISCOUNT RATE (REAL)	APPROACH
Harrison (2010) PC method	7.9% rounded to 8%	The paper describes the discount rate calculation as taking marginal return to capital (8.9%) less tax 'distortions' and foreign capital flows (1 percentage point), which equals around 8%.
Current DTF guidelines headline rate	6.9% rounded to 7%	The discount rate is calculated by taking marginal return to capital (8.9%) less tax 'distortions' and foreign capital flows (1 percentage point) less government project risk (1 percentage point), which equals around 7%.
New calculation	6.8% rounded to 7%	The discount rate (7.8%) is a weighted average of marginal return to capital (8.8%), newly stimulated savings, and foreign capital flows. It is then reduced for lower government project risk (1 percentage point) to around 7%.

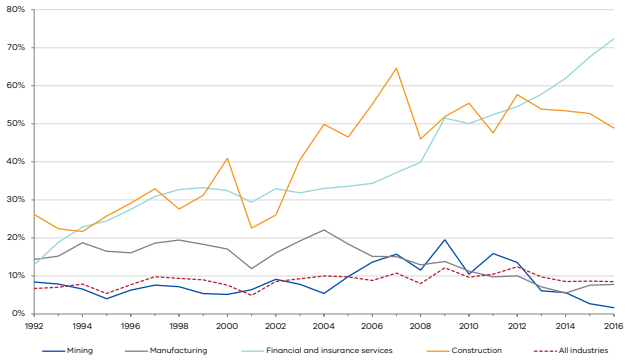
[9] The weightings, based on the relative elasticities of savings and investment to interest rates, are equal to the proportions of funding that are diverted from displaced investments, postponed consumption, and foreign borrowing. Displaced investment represents a relatively large proportion, given that Australian investment has traditionally exceeded savings (i.e. the current account deficit). The foreign borrowing proportion is also due to the high supply elasticity of foreign funds (reflecting Australia's small population), and traditional reliance on foreign capital to finance the difference between national investment and savings. The small proportion of postponed consumption (newly stimulated savings) is driven by an inelastic supply of domestic savings.

2.1.3. The low interest rate environment and a revised time period

The low interest rate environment has prompted investigation into whether the discount rate would decrease if calculations included data from the past decade. This is not the case, as the calculations for the current discount rate are based on the marginal return to capital rather than interest-rate data. Marginal returns to capital have actually increased on average since the GFC, primarily driven by strong returns in financial and insurance services, construction, and mining – although in recent years, mining and manufacturing returns have declined (Figure 3).

This paper uses data from 1992 to 2016, which includes the GFC and subsequent years of weaker economic growth. The analysis uses a 25-year period, rather than a 40-year period, which underpins the current discount rate. This is due to the availability of data, and a change in the economic environment from the unofficial introduction of inflation targeting in the early 1990s. This has provided a more predictable monetary policy environment, less output and inflation volatility (Simon 2001, and Hall and Jaaskela 2011, respectively), and a more stable basis for estimating the future economic environment.

Figure 3: Returns to capital for all and key industries, 1992–2016



2.2 Social time preference rate (STPR) approach

The STPR approach reflects the equilibrium rate at which consumers trade consumption over time. It uses empirical estimates from consumer choices to estimate the risk-free rate at which consumers are willing to trade present consumption for future consumption.

This section estimates an empirical STPR, which reflects the average historical cash rate, or the risk-free rate at which consumers have been willing to trade consumption over the past 25 years.

2.2.1. Developing a social time preference rate

The Ramsey formula (Ramsey, 1928) is often used to determine the discount rate (r) by those who support the STPR approach:

$$r = \rho + \mu g \qquad (3)$$

where:

- ρ is the utility discount rate (i.e. the rate that reflects consumption decisions now compared to consumption in the future);
- μ is the elasticity of marginal utility of consumption (the percentage decrease in marginal utility when consumption increases by 1 per cent); and
- g is the annual rate of per capita consumption growth.

Data from the ABS (Catalogue Numbers 5220.0 and 3101.0) indicates consumption per capita has grown by an average of around 2 per cent per year for both Victoria and Australia over the past 25 years.

2.2.2. The utility discount rate, ρ

The utility discount rate reflects the pure rate of time preference. This assumes that individuals prefer to consume in the present rather than in the future and have an unchanging level of consumption over time. The rate has two components: people's impatience and risk of death.

Impatience

Some academics suggest this component should be zero for ethical reasons (Stern, 2006 inter alia). That is, all generations should be treated alike so current time preferences should not be considered. However, setting it at zero assumes that the pure time preference is ignored and that preferences do not come with trade-offs. This element is the least consistent to empirical evidence, with studies citing rates ranging from 0.3 to 0.5 per cent (often calculated to reflect long-term savings behaviour). This paper uses a rate of 0.4 per cent based on an average of these empirical estimates, as formed in Zhuang et al. (2007).

The risk of death

The second component captures the increasing risk of not being alive in the future as people age, meaning individuals prefer to consume sooner rather than later, as outlined in Moore, Boardman and Vining (2013).

The calculation uses average death rates, which is an estimate of an individual's instantaneous probability of death, over a 10-year period. The crude death rate for Australia over the past 10 years has been around 0.7 per cent.

Utility discount rate

The utility discount rate (ρ) has been determined by adding the rate of impatience to the risk of death, which comes up to be 1.1 per cent. This is close to the econometric estimate of ρ calculated from the lifecycle behavioural model, which comes up to 1.0 per cent. It is also in line with international studies over the past two decades, which have estimated values of between 1 and 2 per cent, as referenced in Zhuang et al. (2007).

2.2.3. The elasticity of marginal utility of consumption (μ)

The elasticity of marginal utility of consumption, which is a measure of risk aversion, can be derived by considering the lifecycle model of household behaviour. This assumes that households allocate consumption over time in order to maximise a multi-period discounted utility function, subject to an inter-temporal budget constraint. Consumption decisions are affected by the rate of interest and households' attempts to smooth consumption over time.

The lifecycle model has been influential in the UK calculation of the STPR, which was adopted in the formal evaluation guidelines (HM Treasury's *The Green Book*) in 2003. The UK uses a value of unity for μ. However, the paper that provides the calculation for the recommended rate uses a sample data period from more than 20 years ago. A recent calculation for the UK yields a value of 1.5 per cent, as outlined in Groom and Maddison (2013).

2.2.4. Lifecycle behavioural model — estimates for ρ and μ

This paper determines ρ and μ by estimating a rational consumer's Euler equation[10] via the generalised method of moments (GMM) econometric technique.

In this framework, households are assumed to choose their savings balances so that the market interest rate matches the rate at which households are willing to trade one unit of current consumption for some greater volume of future consumption. As a result, the STPR equals the average interest rate used in the econometric estimation. In this approach, the STPR is sensitive to the interest rate used.

The method used to calculate ρ and μ involves a circular interpretation between the Ramsey and Euler equations. The Ramsey formula is a simplified and re-arranged version of the Euler equation. Therefore, using interest-rate data to estimate the unknown parameters of the Euler equation (ρ and μ), and then using those same parameters in the Ramsey formula to calculate the STPR, causes the interest-rate data used in the Euler equation to equal the STPR estimated in the Ramsey formula.

This paper uses the real cash rate as a proxy for the STPR in the econometric estimation. The cash rate is followed closely by savings accounts[11] and reflects the closest thing to a risk-free return that is readily accessible to households. It also represents the rate at which households are willing to trade present consumption for future consumption, which is essentially what the STPR attempts to capture.

The STPR is therefore estimated to be equal to the average real cash rate over the past 25 years, which is 2.4 per cent. The estimates for ρ and μ when using the GMM are 1.0 and 0.7, respectively.

2.2.5. Accounting for risk

Moving to the STPR approach would mean risk is no longer captured in the discount rate. The weighted average approach takes the average long-run marginal rate of return on capital, which has an implicit risk premium that compensates investors for the risk they bear.

In other jurisdictions where the STPR is used, there is no explicit method to account for systematic risk. In these cases, risk is captured in other parts of the cost-benefit analysis. If Victoria was to move to the STPR approach, it would be necessary to consider how to capture systematic risk in cost-benefit analysis.

2.3 This risk premium approach

The risk premium approach is based on the concept that, given systematic or market risk cannot be eliminated, investors demand a risk premium for bearing unavoidable risk relative to holding a risk-free investment. This relationship is expressed by the CAPM.

2.3.1. Estimates using the capital asset pricing model (CAPM)

A simplified presentation of the discount rate R is as follows:

$$R = R_f + R_p \qquad (4)$$

where R_f is the risk-free rate and R_p is the risk premium.

The more traditional specification of the CAPM is:

$$R_i = R_f + \beta_i[R_m - R_f] \qquad (5)$$

where:

- R_i is the return on investment i;
- R_f is the risk-free rate;
- R_m is the return on the total stock (market) of risky assets;
- $R_m - R_f$ is generally referred to as the market risk premium; and
- β_i indicates the investment's systematic risk, or the degree to which asset returns are expected to vary with returns of the market as a whole.

The risk-free rate (R_f)

The latest interest rate on AAA-rated 10-year Commonwealth Government Bonds is considered to be a good proxy for the risk-free rate in Victoria. The latest interest rate (or latest monthly average) is used rather than a long-term historical average, as the pricing of bonds, and thus their interest rate return, is forward looking.

The interest rate on a 10-year Commonwealth Bond was 2.65 per cent per annum in December 2017 which, when adjusted for an inflation rate of 1.9 per cent in the 2017 December quarter, comes to a real rate of 0.75 per cent. For the sake of simplicity, the assumed risk-free rate is 1 per cent.

[10] The Euler equation is often used to summarise the inter-temporal choices of a representative household.
[11] Particularly online savings accounts.

The risk premium ($R_m - R_f$)

Partnerships Victoria guidelines[12] propose a market risk premium ($R_m - R_f$), or the extra return that investors demand for holding a risky asset, of 6 per cent[13], which this paper uses in its calculations.

The asset beta (β)

The asset beta (i.e. the investment's systematic risk) is based on direct government investment and captures all the systematic risk inherent in the project. The Commonwealth Department of Infrastructure, Regional Development and Cities' 2013 guidelines outline an asset beta range of 0.3–0.8. This range is similar to previous Partnerships Victoria and Infrastructure Australia guidance, which recommended asset betas to be applied to different projects that sit within different risk categories:

- very low-risk projects – β of 0.3;
- low-risk projects – β of 0.5; and
- medium-risk projects – β of 0.9.

Although these categories may not be practical, given most asset betas are determined on a case-by-case basis, they can help to determine a discount-rate range in the section below.

Applying the real risk premium

Category 2 projects span low and medium-risk bands, depending on their level of exposure to the economy. Low-risk projects include road projects and water infrastructure, while medium-risk projects include telecommunications and information technology.

Using the asset betas of 0.5 and 0.9 for low and medium-risk projects, respectively, a market risk premium of 6 per cent and a risk-free rate of 1 per cent, this paper estimates the discount rates, ranging from 4 to 6.4 per cent.

While the CAPM model has been widely used in the past and is another way of estimating returns in the private sector, it should be treated with caution given volatility in share market returns and difficulties in accounting for tax and gearing. Furthermore, an asset beta is arguably not a complete description of an asset's risk (particularly when it is applied across categories of projects).

3. Conclusion

This paper explores the three principal methodologies used to calculate discount rates – the weighted average opportunity cost of capital approach the social time preference rate (STPR) approach, and the risk premium approach – using a capital asset pricing model (CAPM). Using recent data, the discount rate calculated for each of the for three methodologies was 6.8 per cent (rounded to 7 per cent), 2.4 per cent, and 4 to 6.4 per cent, respectively.

Out of the three methodologies, the weighted average approach remains the preferred option for economic evaluations of government projects in Victoria. This is in part because the drawbacks of the other two methodologies outweigh their benefits from the perspective of economic evaluations.

While the risk premium approach explicitly accounts for risk and can be frequently updated, the underlying calculations in the methodology use more volatile data (such as share market returns) and cannot easily account for tax and gearing.

Some overseas jurisdictions (such as the UK and several European nations) have adopted the STPR approach, which places a greater emphasis on ethical judgement in government resource allocations over time. However, this paper considers that the methodology is appropriately separated from the efficiency-based approach that underpins cost-benefit analysis. Coupled with this, the STPR does not account for risk, and while this can be done in other ways, it is technically difficult. In practice, accounting for risk and making adjustments for tax distortions, the STPR approach is likely to be considerably more difficult for practitioners to apply, less transparent for comparison, and may yield similar results to the weighted average approach.

The weighted average approach is an efficiency-based methodology (the same approach that underpins economic evaluations), and it determines a pre-tax rate that has an implicit risk premium, which compensates investors for the risk that they bear. While the calculations using this methodology are sensitive to the data and weightings used,[14] this drawback can be mitigated by conducting sensitivity analysis around the discount rate.

On balance, the weighted average approach remains the most appropriate, robust, and theoretically sound methodology for determining a discount rate in Victoria. The updated results from this method confirm that the current recommended rate of 7 per cent is still appropriate for use in economic evaluations of government projects.

[12] The 6 per cent market risk premium is specified in the Partnerships Victoria 2003 technical note *Use of discount rates in the Partnerships Victoria process 2003* and its 2016 paper *Financial analysis inputs for Partnerships Victoria projects*.
[13] The Commonwealth Department of Infrastructure, Regional Development and Cities' 2013 *National Public Private Partnership (PPP) Guidelines* also recommend 6 per cent.
[14] That is, the extent to which government investment displaces other investment or domestic consumption or draws on foreign borrowings.

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Appendix: Determining the marginal return to capital

Harrison (2010) uses the Dolman (2007) methodology to calculate the marginal return to capital. To determine the factor income attributable to capital, Harrison (2010) adds a portion of gross mixed income from unincorporated enterprises to the gross operating surplus received by incorporated entities. This step involves significant judgement as it is difficult to determine what share of gross mixed income, which comprises around 10 per cent of GDP(I), should accrue to capital.

Given this paper focuses on the more recent period (1991–92 to 2015–16), a more robust method for calculating factor income that can be attributed to capital is used. The ABS publication *Estimates of industry multifactor productivity* (ABS catalogue number 5260.0.55.002) provides capital income shares on a gross value added (GVA) basis for the 16 industries comprising the market sector. Data for 12 of these industries is available on a consistent basis from 1989–90, while four service-related sectors (rental, hiring and real estate services; professional, scientific and technical services; administrative and support services; and other services) are available from 1993–94. The calculations in this paper's analysis back-cast the capital income shares for the latter four sectors by applying the 1993–94 capital income share to the preceding two financial years.

Multiplying the capital income shares on a GVA basis by current-price industry GVA provides a robust estimate of the factor income accruing to capital in the 16 market sector industries. This can then be added up across industries to give the capital income shares for the market sector, from which market-sector-related consumption of fixed capital can be subtracted. This series is then divided by the market-sector capital stock available in the Annual System of National Accounts (ABS catalogue number 5204.0) to derive the nominal return on capital for the market sector. Adjusting for CPI provides an estimate of the annual real marginal return to capital.

Estimating Victoria's fiscal multiplier

By Shenglang Yang, Gillian Thornton and Marcella Choy[1]

ABSTRACT

This article provides an empirical study of fiscal multipliers in Victoria and provides insight into the relative effectiveness of different policy levers available to the Victorian Government. We estimate fiscal multipliers for taxation and government spending, including separate multipliers for public investment and consumption – the two components of government spending. Consistent with the literature, we find that the multiplier for government spending is positive. Our analysis shows that expenditure in the form of public investment has historically been more effective at stimulating State final demand (SFD) compared to public consumption, with an estimated on-impact multiplier of 0.96 for public investment.

Overview

As a response to the global financial crisis (GFC), many governments sought to avoid the consequences of recession through the implementation of various fiscal stimulus packages, such as the *American Recovery and Reinvestment Act 2009* (ARRA) and the $42 billion stimulus package introduced by the Australian Commonwealth Government in 2008 and 2009.[2] These stimulus packages reignited the debate about the effectiveness of different fiscal levers in stimulating the economy and led to the resurgence of empirical fiscal policy research.

This article provides an empirical study of fiscal multipliers in Victoria and contributes to the research on fiscal policy in subnational economies. A fiscal multiplier is defined as the dollar response of output to an exogenous dollar increase in spending or tax (Caldara and Kamps 2017) and measures the impact on the economy of a dollar expended via exogenous fiscal policy, i.e. fiscal policy that is separate from the normal responses to business-cycle developments.

We estimate multipliers for taxation and government spending, and those associated with the different types of government spending: public consumption and public investment. The multipliers are estimated in a structural vector autoregression (SVAR) framework, where changes in fiscal policy that are exogenous to the business cycle are identified using a methodology that is closely related to that used by Blanchard and Perotti (2002).

The estimated fiscal multipliers provide insight into how effective different fiscal policy levers have been, on average, in Victoria since 1985. The multipliers should not be used to quantify the net benefit of individual investment or expenditure decisions. Instead, a cost-benefit analysis (CBA) framework that quantifies the current and anticipated future costs and benefits of the project from a likely future state of the world is more appropriate.[3] Indeed, in the second edition of *Victoria's Economic Bulletin*, Morton-Cox (2018) argues for including the value of flexibility in infrastructure contracts as part of the traditional CBA framework for evaluating infrastructure projects.

[1] The authors would like to thank Madeleine Tan, David Hedley and James Brugler for their comments. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Victorian Department of Treasury and Finance (DTF).

[2] The stimulus package comprised five separate components: the Economic Security Strategy (ESS), the Nation Building Package (NBP), the Nation Building and Jobs Plan (NBJP), the Skills Jobs Package, and the *2008–09 Federal Budget*.

[3] CBA is founded on the principles of welfare economics (Taks et al. 2011). In this method, current and expected future costs and benefits from the project are quantified and discounted to produce a net present value (NPV). A positive NPV indicates the policy or project should be undertaken, as it yields a net benefit. The opposite is true for a negative NPV.

Our results show that the fiscal multiplier for government spending is positive, and the multiplier associated with public investment is larger than that associated with public consumption. Specifically, the on-impact fiscal multiplier for government spending is 0.59. That is, every dollar of gross government expenditure adds 59 cents to SFD in that quarter. The multiplier for public investment is 0.96 and for public consumption 0.61 but insignificant.[4] The larger boost to SFD from public investment compared with public consumption is possibly due to the long-term benefits of investment that accrue over and above the short-run boost to demand for goods and services from increased public consumption or investment. This is because higher public investment increases the productive capacity in the economy by expanding the capital stock, meaning that the benefits of public investment accrue over time. In addition, Aschauber (1989) argues that public investment should theoretically have a much larger stimulatory impact compared with public consumption as public investment increases the rate of return to private capital and induces private investment.

In contrast to the existing literature that finds negative multipliers associated with increased taxation, our results indicate that the tax multiplier for Victoria is insignificant. A potential explanation is that the own-source tax burden in Victoria is small with state taxation revenue accounting for only around 4.6 per cent of the Victorian economy compared with 22.1 per cent at the national level.[5] The low tax burden suggests that the economic impact of state taxes is small, and so modest changes in state taxation policy (as have been observed between 1985 and 2018) may not have a significant distortionary effect on the economy. In addition, given that there have been only modest changes in state taxation policy over the sample period, this limits the observed variation in state tax revenue and may be complicating the identification of tax revenue shocks.

The conclusions we draw about the impact of different fiscal policy levers on SFD should not be generalised to conclusions about the effect of fiscal policy on gross state product (GSP). SFD is conceptually equivalent to domestic final demand nationally and measures the final demand for goods and services within Victorian borders. SFD does not account for interstate or international trade. This may be an important consideration if Victorian investment has a higher import share than consumption. Further research in this area is necessary to draw broader policy insights about the effect of fiscal policy on aggregate state output.

The structure of this article is as follows. Section 1 summarises trends in revenue and expenditure in Victoria. Section 2 reviews previous literature and provides context for the methodology and results in this article. Section 3 details the methodology used to estimate government spending and tax shocks for the Victorian economy, drawing heavily on Blanchard and Perotti (2002). Section 4 discusses the dynamic responses of key variables to the estimated fiscal shocks. Section 6 details the methodology used to compute fiscal multipliers and presents these estimates. Section 7 summarises the findings from this article.

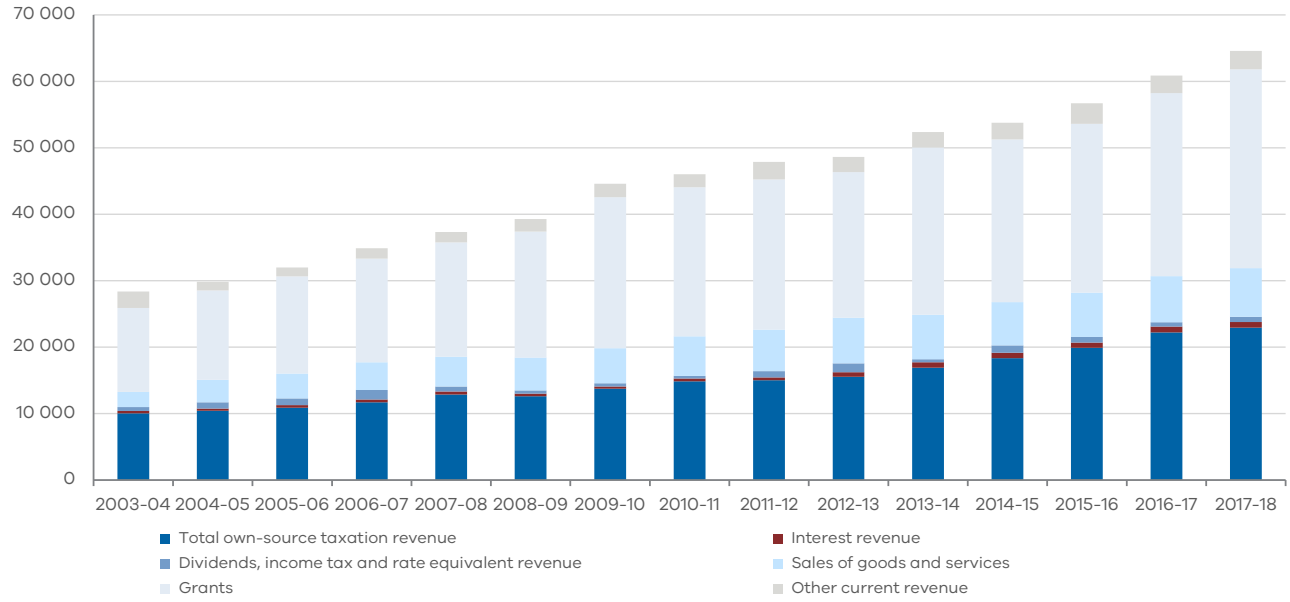
1. Trends in revenue and expenses

Own-source taxation revenue is a substantial component of total state revenue in Victoria, accounting for approximately 34 per cent of total state revenue. Grants relating to the goods and services tax (GST) and other Commonwealth payments are also large contributors to total state revenue, each accounting for 23 per cent of total state revenue. The components of Victoria's total revenue are shown in Figure 1.

In this article, we use Victorian own-source tax revenue as the relevant revenue measure for estimating fiscal multipliers. We exclude GST and other Commonwealth grants from the analysis for two reasons.[6] First, the objective of the analysis is to shed light on levers available to the State Government, and own-source taxation revenue is the component of state revenue that can be directly influenced by legislated tax changes in Victoria. In contrast, states and territories have less ability to influence their own GST receipts. The supporting principle of policy neutrality at the core of the GST distribution framework limits states and territories from directly influencing their GST revenue via fiscal policy.[7] Secondly, focusing on own-source tax revenue allows us to capture the effects on the Victorian economy of taxation revenue collected and spent in Victoria itself.

[4] The multiplier for public consumption is not significantly different from zero at the 95 per cent confidence level.
[5] The Organisation for Economic Cooperation and Development (OECD) defines tax burden at the national level as the ratio of total taxation revenue to GDP: https://data.oecd.org/tax/tax-revenue.htm
[6] To check for robustness, fiscal multipliers were computed using a specification with revenue consisting of both own-source tax and GST revenue and yielded similar results.
[7] This methodology ensures that states are not disincentivised from tax reform or from introducing revenue-raising measures (Commonwealth Grants Commission 2015).

Figure 1: Components of Victorian state revenue 2003–2018



We obtain data on subnational government expenditure (gross) from the Australian Bureau of Statistics (ABS). This measure of spending includes expenditure by both local and state governments. Expenditure could take the form of public consumption (government final consumption) or public investment (public gross fixed capital formation). Public consumption refers to current expenditure by general government bodies on services to the community such as education, defence, and public order and safety. Public investment refers to the building of infrastructure assets such as roads, railway networks and public health and education institutions. Between 1985 and 2018, public consumption accounted for approximately 87 per cent of total public spending, with the remaining 13 per cent being public investment.

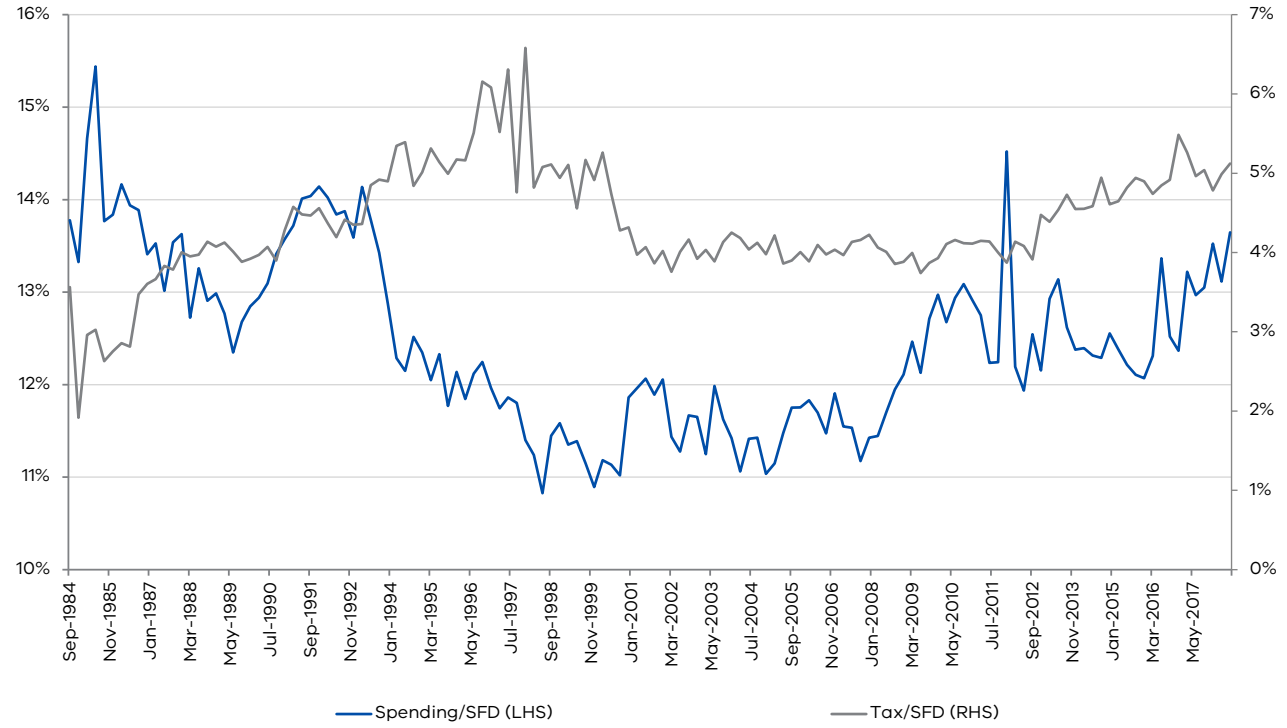
Figure 2 shows a few notable episodes of fiscal policy in Victoria. The recession of the early 1990s saw the gap between spending and taxation widen considerably, with growth in spending outpacing that of taxation. This trend was later reversed during the mid-to-late 1990s.

A major tax change occurred in the 2000s, where states agreed to abolish indirect taxes in exchange for a national consumption tax, the GST. As a result, there was a corresponding dip in the level of own-source taxation revenue as a share of SFD after the implementation of the GST.

Since 2012, Victorian own-source revenue has grown quickly relative to SFD. Between February 2012 and November 2017 residential house prices grew by 53.7 per cent, and supported strong increases in stamp duty and land tax collections. The increase in tax collections were matched with similar increases in government service provision and spending on major infrastructure projects to meet demand from strong population growth. In the period between 2014 and 2018, both own-source taxation and expenses as a share of SFD each increased by approximately 1 percentage point.

Data on subnational government spending, SFD and GSP are sourced from the ABS, whereas the taxation data is sourced internally from the Department of Treasury and Finance (DTF). All nominal variables are deflated using the relevant implicit price deflator and transformed into real per-capita variables. All data used are seasonally adjusted. The sample period used in this estimation is from the June quarter of 1985 to the March quarter of 2018.

Figure 2: Victorian own-source revenue and expenses as a share of SFD



2. Literature review

Identifying fiscal shocks

Identifying spending or taxation shocks involves separating fiscal policy decisions from business-cycle fluctuations. This can be tricky because of the two-way relationship between fiscal policy and economic conditions. For example, an increase in property market revenue in a housing market upswing is an automatic revenue response to the business cycle. Changes in taxation policy may also be related to the business cycle if governments use fiscal policy levers to stimulate or dampen the economic cycle. An exogenous fiscal policy shock is a change in fiscal policy that is independent of current economic conditions.

There are two popular econometric methods used for identifying exogenous fiscal shocks: the narrative approach and the SVAR approach. Identification in the narrative approach uses public records, speeches and related announcements to determine fiscal policy changes that were discretionary policy decisions and whether these announcements were or were not previously anticipated. In contrast, the SVAR framework directly models endogenous movements in spending and taxation. Although the magnitude of fiscal multipliers is fiercely debated, empirical studies broadly agree that fiscal spending multipliers are positive whereas tax multipliers are negative.

The benefit of using the SVAR framework, as we do in this article, is its simplicity. The model is typically estimated using readily available macroeconomic data and there are a number of identification techniques available in the literature to address the simultaneity problem that is present in SVARs. One of the main criticisms of the SVAR framework is that it does not account for fiscal foresight by economic agents (Castelnuovo and Lim 2018). In particular, because of the lags associated with implementing fiscal policy changes, it may be the case that what is identified as a fiscal policy shock in the SVAR is in fact a change in fiscal policy that was previously announced and anticipated by economic agents (Blanchard and Perotti 2002). For example, if tax cuts were announced before their implementation, consumers may choose to adjust their spending decisions in anticipation of future changes in income. The issues associated with fiscal foresight can be addressed through more targeted identification strategies, demonstrated by Blanchard and Perotti (2002), Ramey (2011) and Forni and Gambetti (2016), and should be investigated in future extensions of this paper.

The narrative approach, on the other hand, is criticised for 'indeterminacy' (Carnot and De Castro 2015; Hebous, 2011) – narrative approaches can fail to identify some fiscal shocks that are known to occur in the identified episodes. Mertens and Ravn (2014) developed a hybrid approach, using narrative measures as proxies for shocks in a SVAR framework to distinguish between anticipated and unanticipated tax news.

The magnitude of fiscal multipliers widely varies within and across the methodologies used to quantify the size of the impact on output. Economists are divided on explanations of the source of variation within the empirical estimates. Favero and Giavazzi (2012) find that estimates generated using the SVAR approach tend to be larger than those generated using the narrative approach, which is supported by their findings from merging the two approaches. Chahrour,

Schmitt-Grohé and Uribe (2010) conversely find that fiscal multiplier estimates from SVAR are smaller than the narrative method but reject the hypothesis that the difference between estimates from the two approaches stem from the reduced-form transmission mechanism in the two approaches. They conclude that variation in the two methods stems from sub-sample volatility and failure to identify the same shocks. Ramey (2018) alternatively argues that differences in the methodology for computing multipliers, rather than the identification method, leads to large differences in the magnitude of multipliers.

Estimates of fiscal multipliers

Ramey's (2018) survey of the literature consolidates a range of fiscal multipliers and proposes this range is 0.6 to 1 for spending, and -2.5 to -3 for tax multipliers. Most of the literature Ramey draws on focuses on fiscal multipliers for the United States at the national level. These estimates therefore capture the effect of fiscal policy on GDP.

The research on fiscal multipliers at the subnational economy level is more limited. Nakamura and Steinsson (2013) estimate fiscal multipliers for subnational regions within a monetary union and compare these to estimated fiscal multipliers for a closed national economy. Their results show that the closed economy multiplier is more sensitive to the inflationary consequences of fiscal policy than at the state level and this leads to smaller multipliers at the national level.

Clemens and Miran (2012) estimate an on-impact spending multiplier below 1 for subnational governments in the United States, whereas Shoag (2013) exploits idiosyncratic differences in the returns of state-funded pension plans to estimate a subnational spending multiplier of 2.12. Acconcia, Corsetti and Simonelli (2014) estimate a local spending multiplier in the provinces of Italy by isolating episodes in which the implementation of laws used to combat corruption and Mafioso influence resulted in large reductions in local government spending.

There is also limited research that disaggregates government spending into public investment and consumption. Aschauber (1989) contends public investment should, theoretically, have a much larger stimulatory impact compared with public consumption. He argues public investment increases the rate of return to private capital, and thus induces private investment.

Our survey of the literature concludes that public investment multipliers can range from 0.4 to 2.1, and public consumption multipliers can range from 0.6 to 1. Ilzetzki, Mendoza and Végh (2010) do not find a statistically significant difference in public investment and public consumption multipliers for developed countries but found developing countries benefit more from public investment. However, Auerbach and Gorodnichenko (2012) estimate a public investment multiplier that is greater than their estimated multiplier for public consumption. Table 1 summarises some of the research into fiscal multipliers that are relevant to this study.

Table 1: Summary of estimated fiscal multipliers

SOURCE	COUNTRY	GOVERNMENT LEVEL	TYPE OF MULTIPLIER	ESTIMATE (ON IMPACT)	METHODOLOGY
Li and Spencer (2014)	Australia	National	Public spending	1.04	Dynamic Stochastic General Equilibrium (DSGE)
Hamer-Adams and Wong (2018)	New Zealand	National	Public consumption	0.59	SVAR
			Public spending	0.43	
			Public investment	0.33	
Mertens and Ravn (2014)	United States	National	Tax	-2	SVAR (Using proxy narrative measures)
Blanchard and Perotti (2002)	United States	National	Public spending	0.6	SVAR
Auerbach and Gorodnichenko (2012)	United States	National	Public investment	2.12	SVAR
Gordon and Krenn (2010)	United States	National	Public spending	1.8	VAR (Cholesky decomposition)
Clemens and Miran (2012)	United States	Subnational	Public spending	0.77	Narrative (Instrumental Variables)

3. Methodology

We closely follow Blanchard and Perotti (2002) to estimate government spending and tax shocks using the SVAR framework. The system of simultaneous equations with uncorrelated structural shocks in the benchmark model can be represented as below. Although the model estimated includes three lags and a deterministic trend, the following system of equations can be written without loss of generality:

$$T_t = B_{0,12}G_t + B_{0,13}Y_t + \ldots + B_{p,11}T_{t-p} + B_{p,12}G_{t-p} + B_{p,13}Y_{t-p} + \varepsilon_t^T$$

$$G_t = B_{0,21}T_t + B_{0,23}Y_t + \ldots + B_{p,21}T_{t-p} + B_{p,22}G_{t-p} + B_{p,23}Y_{t-p} + \varepsilon_t^G$$

$$Y_t = B_{0,31}T_t + B_{0,32}G_t + \ldots + B_{p,31}T_{t-p} + B_{p,32}G_{t-p} + B_{p,33}Y_{t-p} + \varepsilon_t^Y$$

Here T defines tax revenue in quarter t. Government spending is defined as G and SFD as Y in the relevant quarters. As is common in the empirical literature on fiscal multipliers, all variables are in real, per capita terms in logarithmic form.[8]

The terms $\varepsilon_t^T, \varepsilon_t^G, \varepsilon_t^Y$ represent the structural shocks for tax revenue, government spending and SFD in Victoria, respectively. The identification of structural shocks that are uncorrelated contemporaneously with economic conditions is critical to our study of fiscal multipliers. This is because it allows us to estimate the contemporaneous and dynamic effects of taxation and government spending on the Victorian economy separately from how taxation and government spending responds to economic conditions.

However, this system of simultaneous equations cannot be solved empirically without some identifying assumptions. In the spirit of Blanchard and Perotti (2002), we use institutional information about taxes and government spending to inform the identification methodology. Specifically, we assume government spending is not contemporaneously influenced by SFD or taxation ($B_{0,23} = B_{0,21} = 0$), taxation is not contemporaneously influenced by government spending ($B_{0,12} = 0$), and we calibrate the elasticity of taxation to SFD ($B_{0,13} = 0.73$). We also assume the government makes decisions on spending before tax policy decisions, although the result is not sensitive to whether spending or tax policy decisions are made first. The rationale for each of these assumptions is discussed below.

The assumption that government spending is not contemporaneously influenced by SFD relates primarily to the automatic effect of changes in SFD on government spending in Victoria – for example, through transfer payments. In Australia, the Commonwealth Government administers the social security system rather than the state and territory governments and we therefore assume that there is no contemporaneous automatic feedback from economic conditions to government spending at the state level.

The assumption that government spending does not respond contemporaneously to revenue changes is supported by institutional information about the nature of spending decisions. Government expenditure decisions are usually made on a financial-year basis and revisited typically only twice a year. Funding for major projects are much less likely to be announced outside these funding rounds. In response to a change in taxation revenue in a given quarter, a government may alter future spending decisions, but this would only occur after due consideration of its financial position as a whole.

We calibrate the elasticity of taxation revenue to SFD based on results from the computable general equilibrium model from the Centre of Policy Studies, Victoria University Regional Model with a tax extension (VURMTAX). The elasticity of tax revenue to changes in SFD in Victoria from this model is 0.73 on impact. This implies that a demand shock of 1 per cent increases taxation revenue by 0.73 per cent contemporaneously.[9]

As outlined above, we also assume the government makes decisions on spending before any changes to tax policy. This means taxation revenue can be influenced contemporaneously by structural shocks on both tax and expenditure.[10] Further detail on the SVAR set up and the identification assumptions are set out in Appendix A.

In the extension to the benchmark specification, we use a four-variable SVAR to separately account for public investment and public consumption. The modified identification assumptions in this system are that public consumption is not contemporaneously influenced by public investment, SFD or taxation revenues, and public investment is not contemporaneously influenced by unexpected changes in public consumption, SFD or taxation revenue.

[8] Strictly, $\beta_g \varepsilon_t^G$ should be present in the first equation of the SVAR. The full model setup is detailed in the Appendix.
[9] Since Caldara and Kamps (2017) show that changes in the values of tax elasticities imposed in the system can lead to substantially different fiscal multipliers, we checked the sensitivity of the SVAR by varying the elasticity from 0.5 to 1.5. It did not materially change the results.
[10] This assumption restricts the contemporaneous response of variables to the structural shocks rather than the previous assumptions, which restrict the contemporaneous relationship between variables. These restrictions are set out in Appendix A.

4. Estimated impulse responses to fiscal shocks

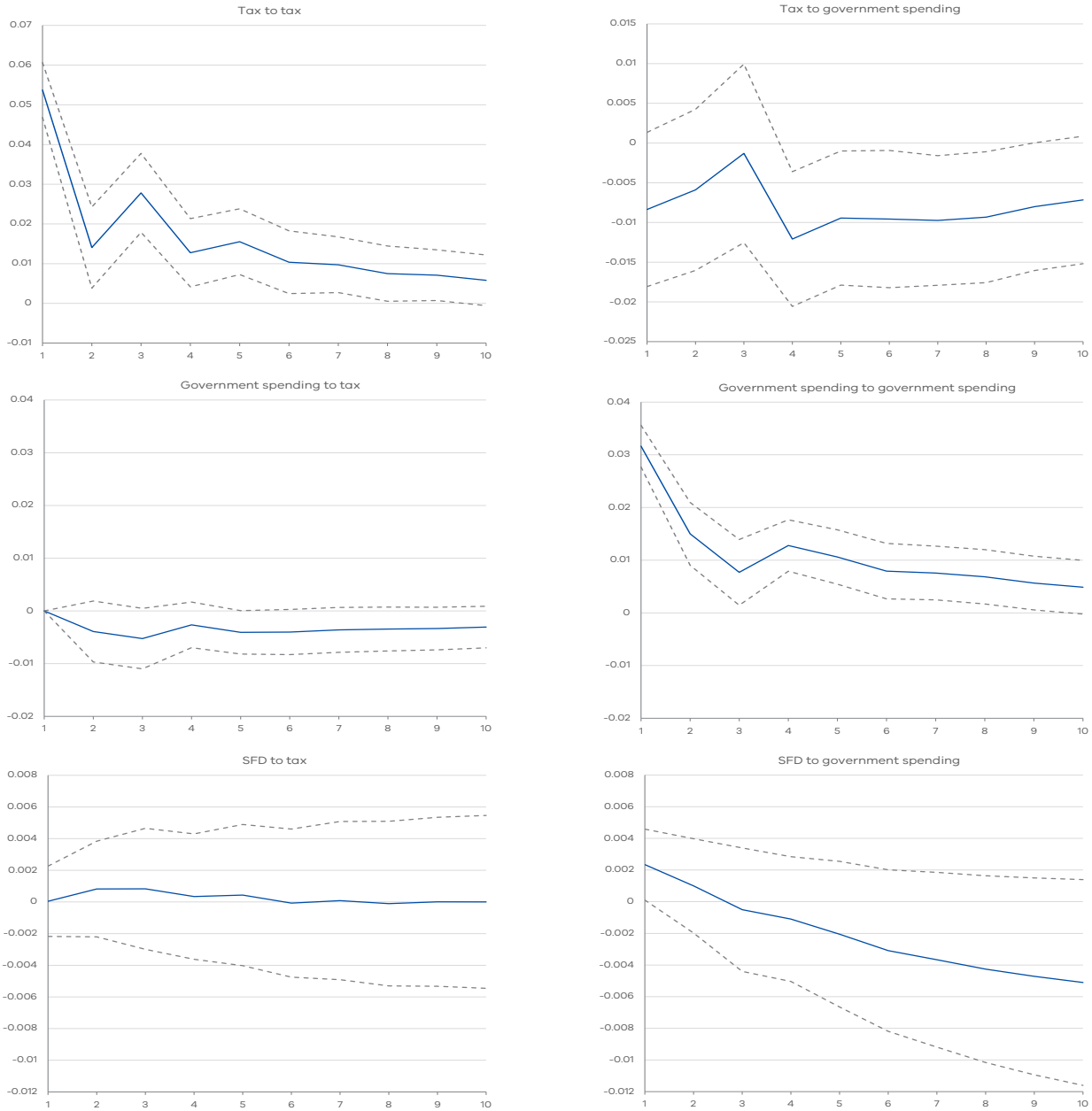
This section presents the dynamic responses of each of the variables to the fiscal shocks identified, based on observed historical correlations between each of the variables during the sample period.

Figure 3 presents the estimated historical impulse response for both government spending and tax revenue shocks from the three-variable SVAR.

The first column describes how each of the three variables respond to a tax revenue shock, where the shock is equal to a one-standard deviation increase in exogenous tax revenue. The second column demonstrates how each variable responds to the government spending shock.

Figure 3: Estimated impulse response functions for tax revenue and government spending shocks

Response to structural VAR innovations +/- 2 S.E.



Note: The horizontal axis represents quarters from impact. SFD represents state final demand. Government spending in the graph refers to state and local government spending. Tax in the graph refers to state government own-source tax revenue. Dashed lines denote the 95 per cent confidence interval.

A one-standard deviation tax shock represents a 5 per cent increase in tax revenue relative to its trend. The response of tax revenue to an exogenous tax shock is highly significant and persistent. This suggests past changes in tax policy influence tax revenue over an extended period.

The surprising result in these impulse responses is that the SFD response to a positive tax shock is not significant. This contrasts with the existing literature, which suggests that output, in this case SFD, should decrease in response to a positive taxation shock due to the distortionary nature of taxation. The insignificant impact of tax policy changes on SFD arguably reflects the fact that own-source taxation is a small share of GSP and therefore has a more limited distortionary impact on the economy. Compared with a tax-to-GSP share of 4.6 per cent in Victoria, the tax-to-GDP ratio is 22.1 per cent in Australia and 16.4 per cent, on average, in comparable countries.[11] In addition, Victoria has not had large changes to tax policy over the sample period. This may be translating into only muted variation in tax revenue outside of the automatic response of the business cycle and could be complicating the identification of the tax revenue shock.

For the government spending shock, one-standard deviation is approximately a 3 per cent increase in expenditure relative to its trend. As with the tax revenue shock, the government spending shock is quite persistent and remains significant after two years. As expected, increased government spending significantly increases SFD on impact, but the response turns insignificant and negative very quickly. The temporary impact of government spending on SFD may be a consequence of the composition of government spending. State and local government spending in Victoria mainly consists of public consumption, with public investment accounting for less than 13 per cent of total spending, on average. Unlike public investment, public consumption only affects aggregate demand over a business-cycle horizon and does not have a longer-term effect on the economy via capital formation for future production.

In the four-variable VAR specification, which decomposes government expenditure into public consumption and public investment, the responses of each variable to a tax shock is similar to that in Figure 3: tax responds to its own shock persistently, but the impact of the positive tax shock on the wider economy is insignificant and should be treated with caution.[12]

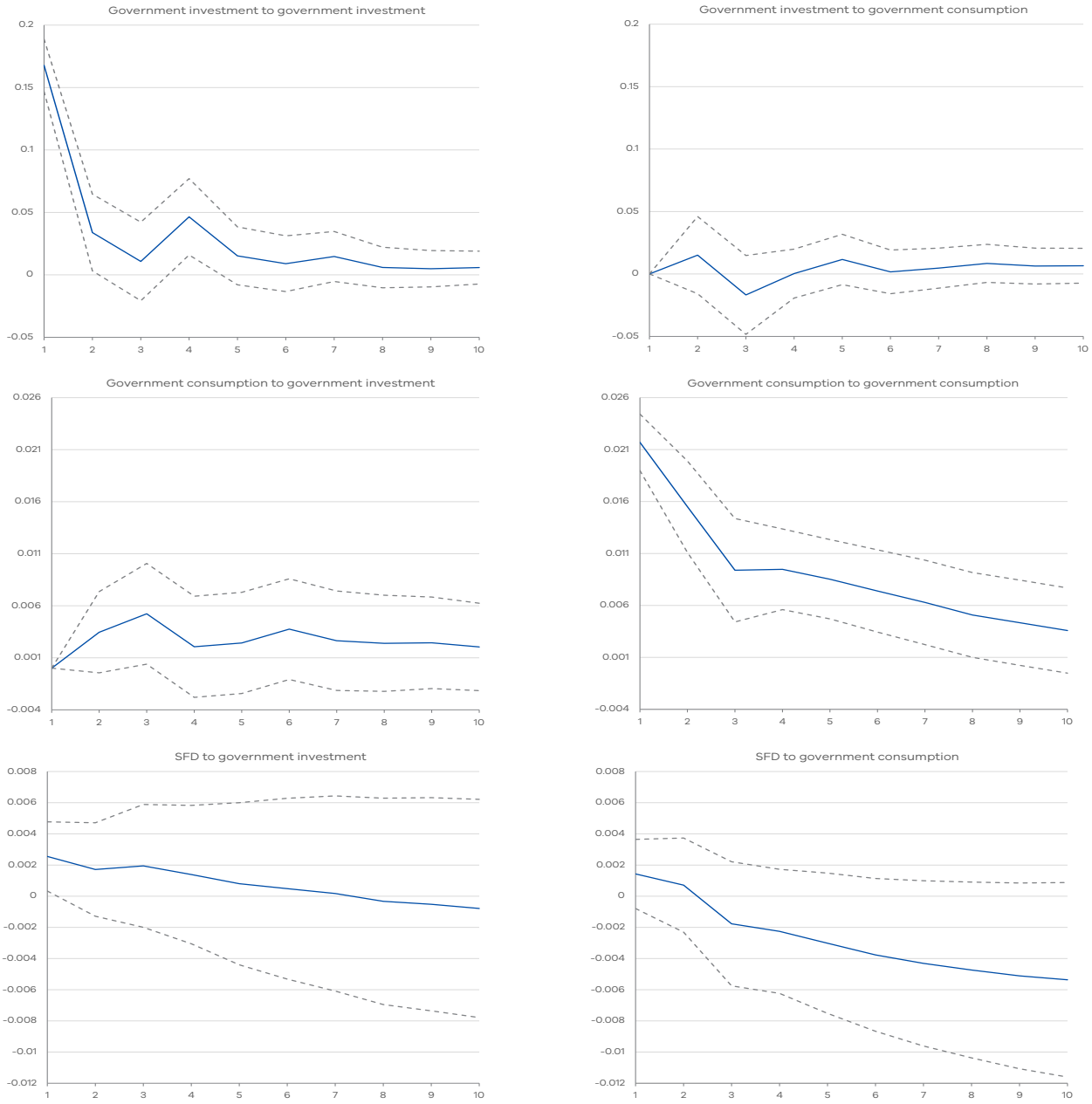
Responses to the public investment shock are presented in column 1 of Figure 4. A one-standard deviation shock to public investment represents an increase of approximately 16 per cent from trend. This own-response to the shock is again quite persistent and remains significantly positive for two quarters. Higher public investment increases SFD in Victoria significantly on impact and remains positive for six quarters, although the increase in SFD is insignificant after impact. The boost that public investment provides to the economy also stimulates an endogenous response of increased provision of goods and services via higher government consumption, and this increase is significant for three quarters after the initial impact.

In response to a 2 per cent increase in public consumption (column 2 of Figure 4), SFD increases on impact, but the increase is not significant. The response also turns negative very quickly, which is consistent with the temporary nature of the boost to public consumption, as discussed above.

[11] Excludes unitary OECD countries. Statistics are from OECD Revenue Statistics 2018.
[12] The relevant charts not shown in Figure 4 are available upon request.

Figure 4: Estimated impulse response functions for public investment and consumption shocks

Response to structural VAR innovations +/- 2 S.E



Note: The horizontal axis represents quarters from impact. SFD represents State final demand. Government in the graph refers to state and local government. Dashed lines denote the 95 per cent confidence interval.

5. Fiscal multipliers

Fiscal multipliers are calculated from the impulse response functions shown in Section 4 by multiplying the implied elasticities from the impulse responses by the average share of output to the fiscal variable (see Box 1). Table 2 shows the estimated fiscal multipliers computed using the methodology in Mountford and Uhlig (2009) on impact, after one year and after two years. The estimated tax multiplier is slightly different between the three and four-variable SVARs and therefore the average of the two estimated multipliers across the two different specifications is presented.

The results in Table 2 indicate that the contemporaneous impact of an additional dollar of exogenous government spending generates 59 cents in domestic demand (SFD). Underpinning this is an on-impact multiplier of 96 cents for public investment and 61 cents for public consumption.[13] Only the on-impact multipliers for aggregate government spending and public investment are significant at the 95 per cent confidence level.

BOX 1: CALCULATING FISCAL MULTIPLIERS

Estimates for fiscal multipliers vary across different studies for various reasons. Ramey (2018) shows that computing fiscal multipliers using different multiplier methodologies on the same set of impulse-response functions can lead to drastically different multiplier estimates.

Blanchard and Perotti (2002) use the ratio of the peak output response to the initial fiscal shock. It has been widely acknowledged within the literature that this method can lead to the estimates of fiscal multipliers being overstated, as it does not consider the persistence of the fiscal shocks.

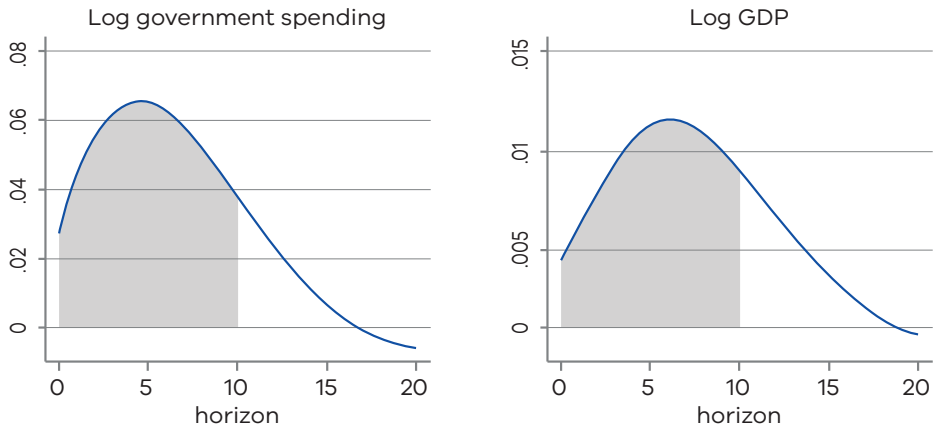
To overcome the shortcomings of the Blanchard and Perotti (2002) approach, Mountford and Uhlig (2009) proposed a new method for calculating cumulative multipliers. This method takes into account the persistence of government spending by discounting the future realisations of output.

The accumulative response is defined as the cumulative change in output in response to the cumulative change in government spending (Figure 5). In reality, the increase in government spending is unlikely to be one-off and often lasts for at least several quarters. Mathematically, it is expressed as follows:

$$\frac{\sum_{i=0}^{t} \Delta \log Y_{t-p}}{\sum_{i=0}^{t} \Delta \log G_{t-p}} \times \frac{\bar{Y}}{\bar{G}}$$

$\bar{Y}/\bar{G}$ is called the 'scaling factor' denoting average output as a share of average government expenditure and is used to convert the results into more interpretable dollar terms.

Figure 5: Accumulative impulse response



[13] While the multiplier associated with total government expenditure identified in the first row of Table 2 is fractionally smaller than the multipliers associated with the components of expenditure (rows 2 and 3 of Table 2), the fact that the component multipliers are estimated in a separate framework with additional structural assumptions for identification implies there is no simple mapping of the multipliers from the expenditure components to their sum. It is important to note that the multiplier on the consumption component of expenditure in row 3 is not statistically significant from zero and we would also clearly fail to reject a hypothesis that it is equal to the total multiplier on expenditure in row 1.

Table 2: Estimates of Victoria's fiscal multiplier

	ON IMPACT	ONE YEAR	TWO YEARS
Government spending	0.59**	0.21	-0.91
Public investment	0.96**	1.85	1.81
Public consumption	0.61	-0.31	-1.95
Tax	-0.04	0.14	-0.09

Note: ** indicates statistical significance at the 95 per cent confidence level.

Although the estimates of the public investment multiplier are not significant one to two years after the initial fiscal shock, the magnitude of the multiplier increases over time, which affirms the role of public investment as a mechanism for longer-term growth through its contribution to fixed capital formation. At these horizons, estimates for fiscal multipliers for both total government spending and public consumption decline and are even estimated to have negative long-term impacts for the Victorian economy. These estimates are not significant at the 95 per cent confidence level.

In comparison to estimated government spending shocks on impact, the tax shocks estimated using the SVAR framework yield much smaller impulse responses, and thus, small and insignificant estimates for the tax multiplier.

The fiscal multipliers presented above represent the impact of the different policy levers on SFD rather than a measure of aggregate output (GSP or GDP). Therefore, the estimates are not directly comparable to the ranges in the existing literature: multipliers of 0.6 to 1 for government spending and 0.4 to 2.1 for public investment. Indeed, given the high import intensity of investment in Australia, it is likely the effect of increased public investment on GSP is smaller than the 96 cents presented in Table 2. This result has been found in studies of small open economies like Australia. Belinga (2016) found estimates for a government spending multiplier within the range of 0.2 and 1.1 in Canada, while Hamer-Adams and Wong (2018) found that the fiscal multiplier associated with public consumption in New Zealand at 0.59 was larger than the multiplier for investment (0.33).

6. Conclusion

In this article, we closely followed the Blanchard and Perotti (2002) methodology to estimate fiscal multipliers associated with the different fiscal levers available to the Victorian government: taxation versus government spending, with government spending further broken down into public investment and consumption. The study concludes that public investment is more effective than public consumption for stimulating Victorian SFD. Our results show that the investment multiplier for SFD is 0.96 on impact with persistent positive impacts on SFD while the consumption counterpart is 0.61 (but insignificant) on impact with its effect on SFD quickly dying out and even turning negative after several quarters. We also find that the tax multiplier at the state level is insignificant, which itself is a surprising result. As discussed in the paper, this finding may reflect the low tax burden of state taxes on the Victorian economy and the modest changes to tax policy observed over the sample period.

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Appendix

Benchmark model of tax, government spending and SFDs

The SVAR is an extension of a VAR that decomposes the VAR residual into contemporaneous variables and orthogonal residuals (structural shocks). The three-variable SVAR estimated in this article can be set out as be low:

$$AY_t = A_1 Y_{t-1} + CX_t + B\eta_t \quad (1)$$

where $Y = \begin{bmatrix} State\ own\ source\ tax\ revenue \\ State\ and\ local\ government\ spending \\ State\ final\ demand \end{bmatrix}$; and A, A_1, C and B are coefficient matrices; X_t is the vector of exogenous variables and η is the vector of uncorrelated structural shocks with $E(\eta_t \eta_t') = I_K$ where I is the Identity matrix with $K = 3$ variables.[14]

This SVAR can be transformed into a reduced form:

$$Y_t = A^{-1}A_1 Y_{t-1} + A^{-1}CX_t + A^{-1}B\eta_t \quad (2)$$

At the same time, the estimated reduced-form VAR can be written as:

$$Y_t = A^* Y_{t-1} + C^* X_t + e_t \quad (3)$$

with $E(e_t e_t') = \Sigma_K = A^{-1}BB'A^{-1'}$

Here A^* and C^* are the coefficient matrices of the reduced-form VAR and e_t is the VAR residual. There are $k(k+1)/2$ moments in Σ_K but there are more than $k(k+½)$ moments in A and B to be estimated. We therefore need restrictions to solve the system.

Since these two representations of the reduced-form VAR – i.e. equations (2) and (3) are equivalent:

$$A^{-1}B\eta_t = e_t \text{ and } Ae_t = B\eta_t$$

The A and B matrix based on the assumptions discussed in Section 3 are presented below.

$$A = \begin{bmatrix} 1 & 0 & -0.73 \\ 0 & 1 & 0 \\ NA & NA & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} NA & NA & 0 \\ 0 & NA & 0 \\ 0 & 0 & NA \end{bmatrix}$$

Extended model with tax, public investment, public consumption and SFD

In this SVAR system $Y = \begin{bmatrix} State\ own\ source\ tax\ revenue \\ State\ and\ local\ government\ investment \\ State\ and\ local\ government\ consumption \\ State\ final\ demand \end{bmatrix}$;

and the identifying restrictions are as follows:

$$A = \begin{bmatrix} 1 & 0 & 0 & -0.73 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ NA & NA & NA & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} NA & NA & NA & 0 \\ 0 & NA & 0 & 0 \\ 0 & 0 & NA & 0 \\ 0 & 0 & 0 & NA \end{bmatrix}$$

[14] The mapping between the structural shocks in Section 4 and those in Appendix A is as follows: $B\eta_t = \begin{bmatrix} \frac{\varepsilon_t^T}{a} + \frac{\varepsilon_t^G}{b} \\ \frac{\varepsilon_t^G}{c} \\ \frac{\varepsilon_t^Y}{d} \end{bmatrix}$ where a, b, c and d are the unknown parameters in Matrix B.

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