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Business expectations and preferences regarding the introduction of daylight saving in Queensland

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Abstract

This paper examines the role of organisational, industry and regional characteristics in determining business support for the introduction of daylight saving in Queensland, Australia. The data employed is drawn from a survey of seven hundred and eight businesspersons in 2002 that assayed support for the statewide introduction of daylight saving in Queensland and an alternative policy where daylight saving would be restricted to the more urbanised southeast regions of Brisbane and/or the Gold Coast. Organisational characteristics examined include assessment of current and future business conditions, expectations of the impact of daylight saving on profits, sales, administration costs and staffing and the number of employees. Industry and region identifiers were also specified. Binary logit models are used to identify the source and magnitude of factors associated with business support for the introduction of daylight saving. The evidence provided suggests that support for the introduction of daylight saving is a function of positive expectations regarding staffing, sales and administration costs and is primarily associated with businesses providing electricity, gas, water and communications, finance and insurance and cultural and recreational services. There also appears to be strong rural and regional resistance to the introduction of daylight saving in Queensland, even among the business community

Keywords: daylight saving time; organisational, industry and regional characteristics

Introduction

Despite being first implemented more than eighty-five years ago, daylight saving remains controversial, not least in Australia. Every October the advent of daylight saving in first Tasmania, then the remaining eastern states of New South Wales (NSW), Victoria and the Australian Capital Territory (ACT), and finally South Australia brings recurrent criticism of a practice that nearly doubles the number of Australian time zones and increases by fifty percent the time spread from east to west. In Queensland especially the conflict between those in favour of aligning the state with the other eastern states, and those maintaining standard time remains largely unresolved, despite a decades old referendum on the matter. On one hand, chambers of commerce throughout Queensland have repeatedly called for the introduction of daylight saving, especially in South-East Queensland (FVDCC 2003):

For business and those dependent on markets, the confusion caused by being on the same time as the southern states for half of the year and one hour behind for the other six months is quite costly. One-quarter to one-third of workday communication time is lost, not to mention causing confusion for customers. Travel or shipping services must adjust or reprint arrival or

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departure times to account for changes, and sometimes employee work shifts altogether. Other benefits of shifting South-East Queensland to daylight saving time are reduced energy, reduced crime and traffic accidents, improved flight schedules, increased sales, business development and recreational time.

On the other hand, rural and regional Queensland, as represented by agricultural lobby groups (AgForce 2001), has consistently opposed the introduction of daylight saving:
Fortunately, the Premier is sticking to his pledge from last Saturday night to govern for all Queenslanders and has said that daylight saving would not be introduced during this term because of the negative effect on rural and regional areas…the people of Queensland decided at a referendum that they did not want daylight saving. "How many times do we have to revisit this issue?".

And even proposals for a zonal system in Queensland with daylight saving confined to the urbanised southeast has met with little enthusiasm (AgForce 1999):
A proposal to introduce a zonal system for daylight saving could widen the divide between the Brisbane metropolitan area and regional Queensland. "It's never going to meet all the needs of businesses throughout the State and it's certainly not going to meet the needs of education and lifestyle for all our regional and rural communities".

It would appear little has changed since the early twentieth century when US congressmen referred to daylight saving as the "pet of the professional class, the semi-leisure class, the man of the golf club and the amateur gardener, the sojourner at the suburban summer resort" and the battle for its introduction as "a contest between golf stick and hoe" (Kauffman 2001: 50). And there are immediate parallels with controversies vis-à-vis non-daylight saving states in the United States (Barkey 2003: 56): "When the US economy – 98 percent of which lies outside our state's borders – trades with Indiana, there's a bump in the road. We have our own time conventions here. We can argue about whether that bump is huge or trivial, but the fact is that we put the bump here ourselves. And we should remove it immediately". Thompson (1994), Kauffman (2001) and Walter (2002) provide additional commentary on problems associated with daylight saving. To a great extent, the daylight saving debate remains open.

Apart from the presumably substantial (and as yet unquantified) improvements in household utility, the purported benefits and costs of daylight saving has concentrated on just a few small areas. To start with, it is generally thought that daylight saving saves energy. For example, a US Department of Transport study found that adopting daylight saving time in March and April 1974/75 saved the equivalent energy of 10,000 barrels of oil per day. More recently, however, a simulation study of residential energy consumption in a typical US house in 224 locations by Rock (1997) found that total energy consumption in fact increased on average by 0.147 percent when summer daylight saving time was used in conjunction with winter standard time, and was only reduced slightly when daylight saving was adopted year round.

It has also been suggested (largely anecdotally) that daylight saving is associated with a fall in crime. Because more people get home from work and school and complete more activity in the daylight, their exposure to some crimes lessens, since these are more common in darkness than in light. Another possibility is that the change in photoperiod induced by daylight saving time may have an effect on sleep deprivation and/or psychiatric presentation. In a UK study, Shapiro et al. (1990) examined the incidence of parasuicide presentations, psychiatric outpatient contacts and inpatient admission, and registered suicides following the start of daylight saving and found no discernible impact through either the change in photoperiod or the small impact on the circadian rhythm. In related work, Morano (2003) has examined how daylight saving affects nutritional intake, and Pursell (2001) discusses its impact on television ratings.

In general, a more significant amount of research has been conducted into the impact of daylight saving on traffic accidents. For example, Ferguson et al. (1995) found that there were 174 fewer vehicle occupant fatalities and 727 fewer pedestrian fatalities associated with the introduction of daylight saving in the US between 1987 and 1991 and Sullivan and Flannagan (2002) used the changeover to daylight saving to conclude that pedestrians were three to nearly seven times more likely to be injured at night than in the day. The transition to and from daylight saving has also attracted some empirical attention. Lambe and Cummings (2000) found that the sleep deprivation normally associated with the change over to daylight saving had no measurable impact on crash incidence in Sweden, though Varughese and Allen (2001) linked a small increase in fatal accidents with the Monday following the changeover in the US. In a Canadian study, Coren (1996b) also found a significant increase (some eight percent) in accident risk on the Monday following the spring change to daylight saving and a comparable decrease in the fall change from daylight saving. Studies by Green (1980), Hicks et al. (1983), Coren (1996a), Whittaker (1996) and Vincent (1998) have also examined the impact of daylight saving and/or the transition to and from daylight saving on the incidence of traffic accidents.

Finally, in a recent provocative article, Kamstra et al. (2000) found that the average Friday-to-Monday stock return on daylight saving weekends was 200 to 500 percent larger than the average negative return for other weekends in the year (the so-called 'weekend-effect' market anomaly) and thereby associated with a one-day loss of US$31 billion on the NYSE, AMEX and NASDAQ markets alone. Kamstra et al. (2000) linked this 'daylight saving effect' with the sleep desynchronosis associated with the change in the circadian rhythm and its (negative) impact on sleep patterns. Pinegar (2002) later questioned the statistical robustness of the results on the basis of the presence of statistical outliers and adjustments for heteroskedasticity, points responded to in Kamstra et al. (2002).

The purpose of the present paper is to add to the small but evolving daylight saving literature the results of a survey administered to Queensland businesspersons in 2002. The survey focuses on business preferences for the adoption of daylight saving in Queensland and links these with perceptions regarding its impact on profits, sales and administration costs, amongst others. It thereby provides an important input into current economic policy regarding preferences for daylight saving in Queensland and an indication of the benefits and costs associated with its reintroduction. To the author's knowledge this is the first survey of its kind, both in Australia and overseas, and adds significantly to the Australian literature concerning the economic benefits and costs of daylight saving. The paper itself is divided into four main areas. The first section briefly reviews the concept and adoption of daylight saving in Queensland, Australia and elsewhere. The second section explains the empirical methodology and data collection employed in the analysis. The third section discusses the results. The paper ends with some brief concluding remarks.

Daylight saving

For millennia, the measurement of time has been based on the position of the sun, with noon being denoted when it is highest in the sky. Even with mechanical clocks replacing sundials in the Middle Ages, the measurement of local (or true or apparent) solar time has been bound with observation of the sun at noon (or its indirect calculation by means of astronomical tables) and time accordingly varied continuously with longitude. Well into the nineteenth century time was a genuinely local matter, and most cities and towns used some form of solar time, usually reflected in a well-observed standard such as a church or town hall clock. Measurement of time in this manner was, of course, entirely appropriate to a society where the hours of work and leisure were dictated by the rising and setting of the sun and the technological limitations of artificial lighting.

However, in the nineteenth century the inconsistencies of local solar time and the demands of railway timetabling in first Britain and then the United States started the process of standardising time by region and its replacement with Local Standard Time (LST). This opened the way for the eventual implementation of daylight saving. In Britain, uniform time, as credited to William Hyde Woolaston (1766-1828) and popularised by Abraham Follet Osler (1808-1903), led to the Great Western Railway voluntarily using Greenwich Mean Time (GMT) from November 1840. All other railways followed compulsorily in December 1847. By 1855, the majority of public clocks in Britain were set to GMT and full compliance was ensured in the *Statutes (Definition of Time) Act* of August 1880.

In the United States, the railways largely ignored early advocates of standardisation such as William Lambert in 1809 and Charles Dowd in 1870 until pressure by Canadian railway engineer Sandford Fleming led to the establishment of standard time meridians in both the United States and Canada in 1883. Fleming was also instrumental in establishing the *International Prime Meridian Conference* in Washington in 1884 that eventually divided the globe into 24 time zones, each 15 degrees of arc (or one hour in time apart) and reckoned from the Prime Meridian of Longitude in Greenwich (or GMT). Since then GMT (as derived from astronomical observations) has been superseded for most practical purposes by the similar Coordinated Universal Time (UTC) as the worldwide standard for time and date (as based on an atomic clock).

The origins of daylight saving itself can be traced as far back as the eighteenth century. In a whimsical essay, Benjamin Franklin (1794) – US inventor and statesman and then minister to France – reasoned how rising and retiring earlier according to the sun would prove a considerable economy to the people of Paris:

An accidental sudden noise waked me about six in the morning, when I was surprised to find my room filled with light…I got up and looked out to see what might be the occasion of it, when I saw the sun just rising above the horizon, from whence he poured his rays plentifully into my chamber, my domestic having negligently omitted, the previous evening, to close the shutters…if I had not been awakened so early in the morning, I should have slept six hours longer by the light of the sun, and in exchange have lived six hours the following night by candlelight; the latter being a much more expensive light than the former…I believe all who have common sense, as soon as they have learnt from this paper that it is daylight when the sun rises, will contrive to rise with him.

Later, London builder William Willett (1907) in a pamphlet entitled “The Waste of Daylight” outlined more fully the concept of daylight saving as it is known today [though in the form of an eighty minute gain achieved through four successive weekly jumps of twenty minutes during April]:

[S]tandard time remains so fixed, that for nearly half the year the sun shines upon the land for several hours each day while we are asleep, and is rapidly nearing the horizon, having already passed its western limit, when we reach home after the work of the day is over. Under the most favourable circumstances, there then remains only a brief spell of declining daylight in which to spend the short period of leisure at our disposal. Now, if some of the hours of wasted sunlight could be withdrawn from the beginning and added to the end of the day, how many advantages would be gained by all, and in particular by those in the open air, when light permits them to do so, whatever time they have at their command after the duties of the day have been discharged.

However, it was not until World War I, and largely as a means of energy conservation by the combatants, that Daylight Saving Time (DST) was actually implemented. Starting with Germany and Austria on 30 April 1916, Belgium, Denmark, France, Italy, Luxembourg, the Netherlands, Norway, Portugal, Sweden and Turkey all adopted DST, along with Tasmania and the Canadian provinces of Nova Scotia and Manitoba. Britain began DST on 21 May 1916 followed by mainland Australia during the period 1 January 1917 to 25 March 1917. The Canadian provinces of Newfoundland and Nova Scotia also implemented DST in 1917. The US enacted legislation on 19 March 1918 to begin DST on 31 March 1918 and this was held in place for the remainder of WWI and for another seven months in 1919.
In the United States, wartime DST proved generally unpopular and it continued only in few states (Massachusetts, Rhode Island) and cities (Chicago, New York, Philadelphia) during the interwar period. However, during World War II the Roosevelt administration implemented year-round DST, now known as 'War Time', from 2 February 1942 to 30 September 1945. From 1946 to 1996 the states and localities again reverted to a patchwork of adherence, but by 1966 some 100 million Americans were observing DST in some form or another as defined by local or regional law.

In order to eliminate what were seen as costly inconsistencies in observance [the *Committee for Time Uniformity*, for example, disclosed that on a 35-mile bus route between Moundsville, West Virginia and Steubenville, Ohio, the driver and passengers were obliged to change time seven times] the Johnston administration under the *Uniform Time Act* of 1966 implemented DST from the last Sunday of April until the last Sunday of October, with exemptions for states whose legislatures voted to keep the entire state on standard time. Congress revised the act in 1972 such that if a state was in two or more time zones, exemptions could be made for different parts of the state, while on 4 January 1974 the Nixon administration extended DST to conserve energy during the OPEC oil crisis for the fifteen-month period to 27 April 1975. Finally, in 1986 the Reagan administration brought forward the start of DST from the last Sunday in April to the first Sunday, with no change to the ending date.

DST is currently observed in all US states and territories with the exception of Hawaii, American Samoa, Guam, Puerto Rico, the Virgin Islands and Arizona (excluding the Navajo Indian Reservation). In Indiana, seventy-seven counties (including Indianapolis the state capital) in the central portion remain on Eastern Standard Time (EST) year round, and hence do not use DST, while ten counties in the western portion in Central Standard Time (CST) use both CST and Central Daylight Time (CDT), and thus move to DST in summer. The remaining five counties in the eastern portion on EST move to Eastern Daylight Time (EDT) and therefore also use DST.

In Britain, DST was also used again during World War II though with clocks moving ahead of GMT by two hours in the summer and by one hour during the winter. Between 1968 and 1971 the policy was reinstituted and since then the issue of DST, which currently begins on the last Sunday of March and ends on the last Sunday of October, has been closely tied in with lobbying for Britain to abandon GMT in favour of Central European Time (CET) (GMT +2 in summer and +1 in winter) and thereby bring it in line with the other members of the European Union, with the exception of Ireland (GMT) and Greece (GMT +2).

In common with the US and Britain, Australia also used DST as an energy conservation measure during WWII operating from 1 January to 29 March 1942, 27 September 1942 to 28 March 1943 and 3 October 1943 to 26 March 1944 (with the exception of Western Australia in the final period). DST was not used again until 1967/68 to 1970/71 when Tasmania (with the exception of King Island) initially adopted it as a means of managing the severe shortage in hydroelectric power associated with a drought. The positive experience with DST in Tasmania prompted it to champion a trial season in 1971/72 that was supported by all states and territories except Western Australia and the Northern Territory.

Participation in DST by the various states and territories since the trial season has been erratic. Queensland did not adopt DST again until 1989/90, and then only until 1991/92 when it was abandoned following the results of a referendum. In the same thirty-year period Western Australia only followed DST in 1974/75, 1983/84 and 1991/92 and also discontinued use following a referendum on the matter. The Northern Territory has never adopted DST. Usage in the remaining states and territory was largely consistent until 1981/82 when Victoria, the ACT and South Australia ended in early March, NSW in late March and Tasmania in early April, and 1982/83 when New South Wales, the ACT, Victoria and South Australia ended DST three weeks earlier than Tasmania. Since then, there have been at least two sets of start and end dates for DST in Australia (with the exception of 1983/84 and 1984/85), with three different sets of start and end dates in 1990/91, 1993/94 and 1994/95, though since 1995/96 Victoria, NSW, ACT and SA (but not Tasmania) have begun and ended DST at the same time.

Putting aside the one-off adjustments to DST for festivals and special events that have characterised its usage in the past, even a normal year of daylight saving in Australia involves some degree of complexity. Without DST Australia has three time zones spaced over two hours: Australian Eastern Standard Time (AEST) (UTC +10) in Queensland, NSW, the ACT, Victoria and Tasmania, Australian Central Standard Time (ACST) (UTC +9.5) in the Northern Territory and South Australia, and Australian Western Standard Time (AWST) (UTC +8) in Western Australia. In 2002/03, the move to DST entailed two additional time zones and an increase in the east west time spread of one hour: Tasmania on Australian Eastern Daylight Time (AEDT) (UTC +11) from 6 October, Victoria, NSW and the ACT on AEST (UTC + 10) until the shift to AEDT (UTC +11) on 27 October, South Australia on ACST (UTC +9.5) until 27 October and then Australian Central Daylight Time (ACDT) (UTC +10.5), Queensland on AEST (UTC +10), the Northern Territory on ACST (UTC + 9.5) and Western Australia on AWST (UTC +8). On 30 March 2003 DST ended in all observing states and territories and the number of time zones and time spread fell again to three zones and two hours, respectively.

Outside of the US, Britain and Australia, DST is found in nearly all developed economies (with the exception of Japan) and many developing economies in some form or another, though observance is somewhat unpredictable. As a general rule, it is less prevalent in equatorial and sub-tropical (lower latitudes) countries where the gain in sunlight in summer over winter is less. Russia and most states of the former USSR observe DST with all of

Russia's eleven time zones two hours ahead of standard time in summer and one hour in winter. All members of the European Union implement DST with a standardised summer time running from the last Sunday in March through the last Sunday in October. Some parts of the Caribbean, Cuba, Israel, Egypt, Syria, Iraq, Iran, Chile, China, Mongolia, Paraguay, New Zealand, and even Antarctica, also observe DST. DST is found across Canada with the exception of Saskatchewan and in Brazil excluding equatorial Brazil. Mexico also uses DST, however the border city of Sonora has dispensation to align itself with non-daylight saving Arizona (Waxman 1998), while there have been moves by the left-wing mayor of Mexico City to also opt out of DST (Anonymous 2001).

Research method and data

Commerce Queensland derived the data used in this study from a survey of 708 Queensland businesspersons. A key objective of the survey was to assay not only the level of business support for the introduction of DST into Queensland as a whole (and thereby eliminate the time inconsistencies between it and the other eastern states) but also whether an alternative policy of introducing DST on a zonal basis into Brisbane (capital city) or the Gold Coast (tourist area) had support. Apart from surveying the respondents on their attitudes regarding the introduction of DST in Queensland as a whole and by region, the survey also elicited responses on the perceived impact of DST on various aspects of business operations, perceptions of current and future business conditions and the regional and industry classification of the respondents' business. The survey accompanied the regular quarterly information gathering process used by Commerce Queensland to identify trends and outlooks in state business conditions.

The analytical technique employed in the present study is to specify businesspersons' attitudes regarding the introduction of DST as the dependent variable (y) in a regression with perceptions, business conditions and outlook, and other characteristics as explanatory variables (x). The nature of the dependent variable (either support or reject the introduction of DST) indicates discrete dependent variable techniques are appropriate. Accordingly, the following binary logit model is specified:

$$\text{Prob}(y=1)=\frac{1}{1+e^{-\beta' x}} \qquad (1)$$

where x comprises a set of characteristics posited to influence the decision to support or reject the introduction of DST, β is a set of parameters to be estimated and e is the exponential. The coefficients imputed by the binary logit model provide inferences about the effects of the explanatory variables on the probability of supporting DST.

The dataset employed is composed of four sets of information. All of the sets are derived from the survey responses. The first set of information relates to preferences regarding the introduction of DST and comprises the dependent variable in the binary logit model specified in Equation (1). In the survey the respondents were asked their opinion regarding the introduction of DST into Queensland as a whole, into just the Brisbane region, and into just the Gold Coast region. Respondents' responses are thus categorised into three separate binary variables as either: (i) those who do not support the introduction of DST in Queensland or Brisbane alone or the Gold Coast alone (y = 0); and (ii) those who support the introduction of DST in Queensland (DSQ) or Brisbane alone (DSB) or the Gold Coast alone (DSG) (y = 1). These three binary variables comprise the dependent variables in three separate analyses aimed at explaining support for the introduction of DST at either the state or regional level in Queensland. Selected descriptive statistics are provided in Table 1. Overall, 426 respondents (60.2 percent) supported the introduction of DST into Queensland as a whole, 184 (26.0 percent) would support the introduction of DST into the Brisbane region alone, and 188 (26.6 percent) would support its introduction into the Gold Coast region alone.

[TABLE 1 HERE]

The next three sets of information are specified as explanatory variables in the binary logit regression models. The first of these sets of information relates to several organisational characteristics obtained by the survey. The first two variables relate to each businessperson's assessment of current (*BST*) and future (*BSF*) business conditions as defined on a five-point scale (+1 to +5) categorised from very poor to very satisfactory. As a rule, it could be expected that current and expected future business conditions play at least some role in how a specific policy change, such as the introduction of DST, is received. However, it is not known what influence the various perceptions of business conditions will have on whether the introduction of DST is supported. For example, business conditions currently and in the future may be seen as fairly satisfactory, though whether this encourages businesspeople to support the introduction of daylight saving will depend on the interaction with each person's assessment of the impact of daylight saving on these conditions now and in the future. Accordingly, no particular *a priori* sign is hypothesised when support for the introduction of DST is regressed against *BST* and *BSF*.

The next four variables in the set of organisational characteristics are derived from perceptions of the potential impact of the introduction of DST. Responses concerning staffing (*STF*), sales (*SAL*), administration/paperwork (*ADM*) and profits (*PRF*) are scored on a nine-point scale (-4 to +4) categorised from very strong negative to very strong positive. The internal reliability for these four variables is 0.925 suggesting a high degree of consistency between the various measures of the positive and negative outcomes associated with the introduction of DST. Once again, perceptions regarding the impact of DST will depend on both the interactions between the benefits and costs of aligning Queensland or the regions with the other eastern state time zones, and the benefits and costs of DST itself and its impact on these four dimensions of business operations.

Generally, positive perceptions of DST increasing sales and profits and lowering staffing and administration/paperwork requirements are expected to increase the likelihood a given respondent will support the introduction of DST in some form or another. Positive coefficients are hypothesised when support for the introduction of DST (whether *DSQ*, *DSB* or *DSG*) is regressed against *STF*, *SAL*, *ADM* and *PRF*. The final variable in the set of organisational characteristics is the number of employees (*EMP*) in each respondent's organisation. The main hypothesis here is that larger organisations may have the scale economies necessary to cope with both the transition to and from DST and a positive coefficient is expected when support for the introduction of DST (whether *DSQ*, *DSB* or *DSG*) is regressed on *EMP*.

The next set of explanatory variables is twelve dummy variables reflecting each respondent's Australian New Zealand Standard Industrial Classification (ANZSIC): namely mining (*MNG*), manufacturing (*MFG*), electricity, gas, water and communications (*EWC*), construction (*CON*), wholesale trade (*WTR*), retail trade (*RTR*), accommodation, cafes and restaurants (*ACR*), transport (*TRN*), finance and insurance (*FIN*), property and business services (*PRP*), government services (*GOV*) and cultural and recreational services (*CUL*). The control group for the industry dummy variables is agriculture, forestry and fishing. It is thought that support for the introduction of DST amongst the business community is closely aligned with the industry in which they operate, and some differences in preferences may arise other than that reflected in *STF*, *SAL*, *ADM* and *PRF* above.

For example, one potential outcome from the introduction of DST is the substitution from indoor to outdoor leisure activities. This could be expected to have a positive impact on businesses like cafes, restaurants and other recreational activities and these industries could be expected to support DST. As an alternative, the negative impact associated with the introduction of DST is thought mainly to relate to industries where problems are associated with work practices adjusting from solar/standard time. Industries that rely on outside activities such as agriculture, forestry and fishing, mining and construction may then by and large not support DST. Finally, several industries are thought to favour the introduction of DST in Queensland because of the negative impact from the lack of conformity nationally and internationally and the reduction of common work hours. The finance and insurance, transport and storage and communications industries are usually regarded as supporting DST for this reason. The *ex ante* sign on *MNG*, *MFG*, *EWC*, *CON*, *WTR*, *RTR*, *ACR*, *TRN*, *FIN*, *PRP*, *GOV* and *CUL* may therefore be positive or negative depending on the relative strength of these competing factors. However, since the control industry, agriculture, forestry and fishing, is usually regarded as the industry most against the introduction of DST in Queensland, positive coefficients are expected.

The final set of information comprises several dummy variables reflecting each respondent's regional location: namely, Sunshine Coast (*SUN*), Gold Coast (*GLD*), Southwest Queensland (*SWE*), Central Queensland (*CEN*), Central Coast (*CNC*), North Queensland (*NRQ*) and Far North Queensland (*FNQ*). The control group for the regional dummy variables is Brisbane. As discussed, the debate on DST in Queensland has highlighted the divide between the more populous and urbanised southeastern portion of the state (as represented by Brisbane and the Gold and Sunshine Coasts), which is generally in favour of DST, and rural and regional Queensland (corresponding to Southwest, Central, North and Far North Queensland and the Central Coast), which is mostly against. Being Australia's most decentralised (with 54 percent of the population residing outside the state capital) and second-longest state (stretching more than 2,000 kilometres from 10 degrees 41 minutes south to 28 degrees 33 minutes south) with two-thirds of its area lying in the tropics are further reasons why DST remains controversial in Queensland.

Since Brisbane is the control region, and the region usually regarded as most in favour of the introduction of DST, negative coefficients are hypothesised when support for the introduction of DST in Queensland as a whole (*DSQ*) is regressed on *SUN*, *GLD*, *SWE*, *CEN*, *CNC*, *NRQ* and *FNQ*. However, the directions of preferences regarding the introduction into the Brisbane and Gold Coast regions alone are less clear. Two competing hypotheses are likely. On one hand, rural and regional Queensland may regard the zonal adoption of DST in Brisbane and/or the Gold Coast as a means of reducing the political pressure for statewide DST. Positive coefficients are then hypothesised. Alternatively, introduction of DST into one or two regions may be seen as merely pre-empting statewide DST. In this case, negative coefficients are hypothesised.

Tests for differences in means and proportions for the explanatory variables in Table 2 indicate statistically significant differences between businesspersons who support or do not support the introduction of DST. All other things being equal, supporters for the introduction of DST across Queensland have a more optimistic outlook on current (*BST*) and future (*BSF*) business conditions and see the introduction of DST as having more positive effects on staffing (*STF*), sales (*SAL*), administration and paperwork (*ADM*) and profits (*PRF*) than those who do not support its introduction. On average, support for DST is also drawn disproportionately from the manufacturing (*MFG*), electricity, gas, water and communications (*EWC*) and wholesale trade (*WTR*) industries, and resistance to its introduction is relatively stronger in the construction (*CON*) and retail trade (*RTR*) industries. And as expected, rural and regional Queensland (*SUN*, *SWE*, *CEN*, *CNC*, *NRQ*, *FNQ*) is less in favour of the introduction of statewide DST. Overall, there are significant differences in expectations, perceptions and other characteristics between supporters and non-supporters of DST across eighteen of the twenty-six dimensions (69.2 percent).

[TABLE 2 HERE]

The tests for differences in means and proportions between those who do or do not support the introduction of DST into Brisbane or the Gold Coast provide generally comparable results to that concerning its introduction into Queensland as a whole. But several of the differences in means and proportions are no longer statistically significant. In terms of the introduction of DST into Brisbane alone the proportion of supporters drawn from the manufacturing (*MFG*) and electricity, gas, water and communications (*ENG*) industries is no longer significantly different from those that oppose its introduction, while the wholesale trade (*WTR*) industry does not disproportionably support its introduction into the Gold Coast alone. Finally, and in terms of regional preferences, the proportions of Sunshine Coast businesspersons that either favour or do not favour the introduction of DST into Brisbane and/or the Gold Coast are no longer significantly different.

Empirical findings

The estimated coefficients, standard errors and *p*-values of the parameters for the logit regressions are provided in Table 3. To facilitate comparability, marginal effects are also calculated. These indicate the marginal effect of each outcome on the probability of supporting the introduction of DST. Also included in Table 3 are statistics for likelihood ratio (LR) tests and the Nagelkerke R^2 as an analogue for that used in the linear regression model. Six separate models are estimated. The estimated coefficients, standard errors, p-values and marginal effects employing the entire set of organisational, industry and regional characteristics as predictors for the support of DST in Queensland as a whole (*DSQ*) are shown in Table 3 columns 1 to 4 with a refined version of this model in columns 5 to 8. The results of estimations for the beginning and refined models predicting support for the introduction of DST in Brisbane alone (*DSB*) are detailed in columns 9 to 12 and 13 to 16 respectively. The models concerning the introduction of DST in the Gold Coast alone (*DSG*) are shown in columns 17 to 24.

[TABLE 3 HERE]

The estimated models are all highly significant, with likelihood ratio tests of the hypotheses that all of the slope coefficients are zero rejected at the 1 percent level or lower using the chi-square statistic. The results in these models also appear sensible in terms of both the precision of the estimates and the signs on the coefficients. To test for multicollinearity, variance inflation factors (VIF) are calculated. As a rule of thumb, a VIF greater than ten indicates the presence of harmful collinearity. Amongst the explanatory variables the highest VIFs are for

SAL (4.800), *PRF* (4.291), and *MNG* (3.387). This suggests that multicollinearity, while present, is not too much of a problem. Somewhat atypically for cross-sectional data the R^2 of the first two regressions are fairly large, ranging from 0.648 to 0.664, though those for the remaining four regressions lie between 0.141 and 0.219.

The first models discussed are those predicting support for the introduction of DST in Queensland as a whole (*DSQ*). In the beginning specification, the estimated coefficients for perceptions of the impact on staffing (*STF*), sales (*SAL*) and administration and paperwork (*ADM*) are significant at the 5 percent level of significance or lower and conform to *a priori* expectations. The estimated coefficients in the beginning specification also indicate that businesspersons in the electricity, gas, water and communications (*EWC*) industry are more likely to support the introduction of DST (then when compared to the agriculture, forestry and fishing industry), while businesspersons in Southwest (*SWE*), Central (*CEN*), North (*NRQ*) and Far North (*FNQ*) Queensland are less likely to support its introduction (than when compared to Brisbane). The three greatest marginal effects on the decision to support the introduction of DST are being in the electricity, gas, water and communications (*EWC*) industry, which is associated with a six fold increase in the probability of supporting DST, and positive perceptions of the impact of DST on staffing (*STF*) and administration and paperwork (*ADM*) where there is a 190 and 170 percent increase respectively in the probability of supporting DST in Queensland for a 10 percent increase in positive perceptions of DST on these factors.

These results are generally consistent with the estimated coefficients in the second refined regression, which is obtained by forward stepwise regression using a Wald criterion. Nine variables (excluding the constant) are stepped into the model on this basis (*W*-statistics and *p*-values in brackets): *STF* (34.405, 0.000), *ADM* (21.870, 0.000), *FNQ* (15.920, 0.000), *SAL* (14.605, 0.000), *NRQ* (8.174, 0.004), *SWE* (7.999, 0.005), *CON* (7.103, 0.008), *CEN* (5.733, 0.017) and *GLD* (3.169, 0.075). The estimated coefficients for the staffing (*STF*), sales (*SAL*), administration and paperwork (*ADM*), Southwest Queensland (*SWE*), Central Queensland (*CEN*), North Queensland (*NRQ*) and Far North Queensland (*FNQ*) parameters found to be significant in the initial specification are also significant (at generally higher levels) in the refined model. In addition, in the second regression the estimated coefficients for the construction industry (*CON*) and the Gold Coast region (*GLD*) are significant at the 1 percent level of significance and the signs conform to *a priori* expectations. Overall, businesspersons with positive perceptions of DST on staffing, sales and administration and paperwork costs and who are located in the Gold Coast are more likely to support the introduction of DST in Queensland (then when compared to Brisbane), while those in the construction industry or located in Southwest, Central, North or Far North Queensland are less likely to support DST (when compared to the agriculture, forestry and fishing industry and Brisbane respectively).

The results in the third and fourth regressions in Table 3 are where the support for the introduction of DST in Brisbane alone is regressed against the same set of explanatory variables. Perceptions of favourable current business conditions (*BST*), the finance and insurance (*FIN*) and cultural and recreational services (*CUL*) industries, and the Southwest Queensland (*SWE*), Central Queensland (*CEN*), Central Coast (*CNC*), North Queensland (*NRQ*) and Far North Queensland (*FNQ*) regions are significant at the .05 level or lower and the signs on these coefficients are consistent with *a priori* expectations. A refined model based on forward stepwise regression includes nine variables (excluding the constant) in the order of (*W*-statistics and *p*-values in brackets): *STF* (13.510, 0.000), *SWE* (12.938, 0.000), *FNQ* (9.722, 0.002), *CNC* (9.370, 0.002), *NRQ* (8.162, 0.004), *CEN* (7.995, 0.005), *CUL*

(5.915, 0.015), *BST* (4.880, 0.027) and *FIN* (4.238, 0.040). Overall, businesspersons who have a more positive outlook on current business conditions and staffing, and in the finance and insurance or cultural and recreational services industries (as compared to agriculture, forestry and fishing) are more likely to support the introduction of DST into Brisbane alone, while those in located in Southwest, Central, Central Coast, North or Far North Queensland (as compared to Brisbane) are less likely to support its introduction on this basis. The greatest marginal effects on support for the introduction of DST into Brisbane alone are being in the finance and insurance or cultural and recreational services industries.

The last eight columns in Table 3 are where support for the introduction of DST in the Gold Coast regional alone is regressed against the set of organisational, industry and regional characteristics. The results in the beginning model are directly comparable to the beginning model for the introduction of DST in Brisbane. However, in the refined model only seven variables (excluding the constant) are stepped in using the Wald criterion. These are (*W*-statistic and *p*-value in brackets): *SWE* (11.364, 0.001), *NRQ* (9.985, 0.002), *CNC* (9.034, 0.003), *FNQ* (8.674, 0.003), *STF* (7.063, 0.008), *CEN* (6.828, 0.009) and *CUL* (3.861, 0.049). The suggestion is that businesspersons with more positive perceptions of the impact of DST on staffing or in the cultural or recreational services industry are more likely to support the introduction of DST in the Gold Coast region alone, while businesses located in Southwest, Central, Central Coast, North or Far North Queensland (as compared to Brisbane) are less likely to support its introduction in this manner.

As a final requirement, the ability of the various models to accurately predict outcomes in each businesspersons support or not of DST is examined. Table 4 provides the predicted results for each model specification and compares these to the probabilities obtained from a constant probability model. The probabilities in the constant probability model are the values computed from estimating a model that includes only an intercept term, and thereby correspond to the probability of correctly identifying support for or against the introduction of DST on the basis of the proportion of support for or against DST in the sample. To start with, on the basis of the 426 respondents who support the introduction of DST in Queensland, the beginning model specification identifies 367 cases (86.2 percent) as supporters and 59 cases (13.8 percent) as non-supporters. Of the 282 respondents who did not support DST in Queensland, the beginning specification correctly identifies 226 (80.1 percent) as non-supporters and 56 (19.9 percent) as supporters.

[TABLE 4 HERE]

This means that the beginning specification correctly identifies 593 (83.8 percent) as either supporting or rejecting the introduction of DST in Queensland and incorrectly identifies 115 (16.2 percent) respondents as supporters or rejecters of DST. This reflects an absolute improvement of 61.1 percent over the constant probability model (in terms of correct predictions) and a relative improvement of 69.8 percent over the constant probability model (in terms of incorrect predictions). The refined model delivers a comparable level of correct and incorrect predictions regarding the introduction of DST in Queensland, albeit with a smaller number of estimated parameters. Of course, these are 'in-sample' predictions and the results could differ if 'out-of-sample' data was made available. The Hosmer-Lemeshow goodness-of-fit test statistics for the beginning and refined models (*HL* = 8.096, *p*-value = 0.424 and *HL* = 4.153, *p*-value = 0.843) in Table 4 both fail to reject the null hypotheses of no functional misspecification for the model of support for DST in Queensland.

At first impression, the prediction success of the models concerning the introduction of DST into the Brisbane and Gold Coast regions alone appears to offer a relatively lower improvement in the overall percentage correct over the constant probability model. For example, the refined version of the Brisbane only model correctly identifies 74.9 percent of respondents while the constant probability model correctly identifies 61.6 percent while for the Gold Coast only refined model the prediction success is 73.4 percent and 61.0 percent in the constant probability model. This would suggest that knowledge of the organisational, industry and regional characteristics of businesspersons in Queensland gives only marginal predictive accuracy in identifying supporters for the zonal introduction of DST. For instance, in the refined model for introducing DST in Brisbane alone 95.4 percent of respondents are predicted as non-supporters of zonal DST and just 16.3 percent are correctly identified as supporters.

However, this still represents an absolute improvement (in terms of correct predictions) over the constant probability model of 11.4 percent and a relative improvement (in terms of incorrect predictions) of 61.8 percent. The Hosmer-Lemeshow goodness-of-fit test statistic for the beginning and refined models of support for DST in the Gold Coast only (*HL* = 15.925, *p*-value = 0.043 and *HL* = 13.800, *p*-value = 0.087) in Table 4 both accept and reject the null hypotheses of no functional misspecification at the .05 level, respectively. We may conclude that the organisational, industry and regional characteristics as specified in this analysis are somewhat better at predicting the supporters or non-supporters for DST in Queensland as a whole (83.8 percent) than for the lower level of support for DST in Brisbane alone (74.9 percent), and in the Gold Coast alone (73.4 percent). One suggestion is that preferences for the introduction of DST into Brisbane and/or the Gold Coast may bear less relation to the business conditions specified than that modelling the introduction of DST into Queensland as a whole. For example, the variables specified take no account of Queensland businesses operating in a number of different regions (who would therefore not favour intrastate time differences), let alone the personal preferences of those sampled supporting DST regarding improvements in their own leisure.

Concluding remarks and policy recommendations

The present study uses binary logit models to investigate the role of organisational, industry and regional characteristics in determining support for the introduction of daylight saving in Queensland. The current paper extends empirical work in this area in at least two ways. First, it represents the first attempt to apply qualitative statistical models to preferences and expectations concerning daylight saving in Australia. In fact no comparable study is thought to exist elsewhere in terms of the focus on the perceived business impact associated with the possible introduction of daylight saving. The evidence provided suggests that support for the introduction of daylight saving is very much a function of the potential impact of daylight saving on profits, sales, staffing and administration/paperwork costs in Queensland businesses and to a lesser extent on industry type and regional location. Second, the study analyses in detail different expectations and preferences as they relate to the policy of the statewide introduction of daylight saving as against an alternative policy of introducing daylight saving on a regional basis. A number of policy changes are suggested.

First, it has been shown that a primary driver of business support for daylight saving is expectations of increased profits and sales and lower administration/paperwork costs and staffing levels following its introduction. This suggests that daylight saving is not regarded as merely a nominal business adjustment, but is perceived to have the potential to exert a real influence on the functioning and performance of the Queensland economy. Unfortunately, the data gathered in this particular study is unable to shed light on whether the benefits to business following the possible introduction of daylight saving in Queensland would flow more from the time conformity with the practicing daylight saving states and territories of NSW, Victoria, Tasmania, South Australia and the ACT or from daylight saving *per se*. Second, the study has also shown that there is little business support for the introduction of daylight saving on a regional basis. That support which exists appears to bear little relation to the organisational, industry and regional characteristics found to be so useful in predicting the support for daylight saving on a statewide basis.

Third, even after taking into account the posited impact of daylight saving on business conditions, there are strong divisions between industries and regions supporting or rejecting the move to daylight saving in Queensland. All other things being equal, industries strongly in favour of daylight saving in Queensland in one form or another include the finance and insurance, electricity, gas, water and communications and cultural and recreational services industries while opposition is mostly drawn from the construction industry (as compared to agriculture, forestry and fishing). Putting aside organisational and industry characteristics, there is also a strong rural and regional bias against the introduction of daylight saving in most of Queensland with support largely restricted to the Gold Coast and Brisbane. This suggests that factors outside of potential business impacts may influence the preferences for and against the introduction of daylight saving. Possibilities may include longstanding cultural and social norms and the lower marginal benefit associated with summer daylight saving in the sub-tropical and tropical areas that cover much of the state.

Finally, there is little support for an alternative policy of introducing daylight saving into selected regions. While businesses with most of their operations concentrated in Brisbane and/or the Gold Coast may benefit from time harmonisation with the daylight saving states, those spread across a number of regions may find this outcome even more problematic than the present situation. While this could address the strong regional biases towards and against the adoption of daylight saving, such a policy change may also be regarded as an incremental move towards statewide DST and the lack of support may reflect such opposition. However, opposition may also exist for rather more prosaic reasons. For example, the fact that the state includes tropical, sub-tropical and temperate zones means that the marginal benefits of daylight saving (in terms of extra summer evening time) are significantly less in most of rural and regional Queensland. By itself, this may be enough to dissuade popular support for policy change.

There are, of course, a number of ways in which research into the economic impact of daylight saving could usefully be extended. Certainly, there is no known analysis quantifying the presumably significant increase in household utility associated with daylight saving, in Australia, let alone Queensland. Nor has any research effort been directed at how the nominal change in daylight influences expenditure decisions by households. Combined together, a better understanding of the impact of daylight saving on households would complement this research and provide meaningful quantifiable input into this ongoing policy debate.

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TABLE 1. *Dependent and Independent Variable Definitions and Descriptive Statistics*

Variable description	*Code*	*Mean*	*Std. dev.*	*Skewness*	*Kurtosis*
Dependent variables					
Opinions regarding the introduction of DST					
Favour the introduction of DST in Queensland	DSQ	0.602	0.490	-0.416	-1.832
Favour the introduction of DST in Brisbane alone	DSB	0.260	0.439	1.097	-0.798
Favour the introduction of DST in the Gold Coast alone	DSG	0.266	0.442	1.064	-0.870
Independent variables					
Organisational characteristics					
Perceptions of current business conditions	BST	3.332	1.039	-0.674	1.151
Perceptions of future business conditions	BSF	3.153	1.081	-1.143	1.510
Perceived impact of DST on staffing	STF	0.806	1.820	-0.432	0.009
Perceived impact of DST on sales	SAL	0.756	1.693	-0.292	0.248
Perceived impact of DST on administration	ADM	0.874	1.749	-0.277	0.054
Perceived impact of DST on profits	PRF	0.643	1.571	-0.191	0.547
Number of employees in organisation	EMP	85.651	446.960	12.082	163.564
Industry characteristics					
Mining	MNG	0.032	0.177	5.285	26.008
Manufacturing	MFG	0.206	0.405	1.455	0.118
Electricity, gas, water and communications	ENG	0.032	0.177	5.285	26.008
Construction	CON	0.061	0.239	3.686	11.620
Wholesale trade	WTR	0.082	0.274	3.055	7.356
Retail trade	RTR	0.092	0.289	2.833	6.044
Accommodation, cafes and restaurants	ACR	0.045	0.208	4.388	17.303
Transport	TRN	0.062	0.242	3.635	11.245
Finance and insurance	FIN	0.044	0.205	4.469	18.020
Property and business services	PRP	0.081	0.272	3.090	7.570
Government services	GOV	0.095	0.293	2.776	5.720
Cultural and recreational services	CUL	0.090	0.287	2.863	6.214
Regional characteristics					
Sunshine Coast	SUN	0.034	0.181	5.162	24.718
Gold Coast	GLD	0.145	0.353	2.015	2.067
Southwest Queensland	SWE	0.109	0.312	2.519	4.356
Central Queensland	CEN	0.068	0.252	3.446	9.901
Central Coast	CNC	0.062	0.242	3.635	11.245
North Queensland	NRQ	0.071	0.256	3.359	9.310
Far North Queensland	FNQ	0.090	0.287	2.863	6.214

Notes: (a) Dependent variables are binary variables (not in favour 0, in favour 1) regarding the introduction of DST throughout Queensland (DSQ), in Brisbane region alone (DSB) and in Gold Coast region alone (DSG). (b) Independent variables for perceptions of current (BST) and future quarter (BSF) business conditions are derived from responses to the following statements: Very poor 1, poor 2, satisfactory 3, good 4, very satisfactory 5. (c) Independent variables for the perceived impact of DST on staffing (STF), sales (SAL), administration costs/paperwork (ADM) and profits (PRF) are derived from responses to the following statements: Very strong negative -4, strong negative -3, some negative -2, little negative -1, no influence 0, little positive +1, some positive +2, strong positive +3, very strong positive +4. (d) The control for the industry dummy variables (MNG, MFG, ENG, CON, WTR, RTR, ACR, TRN, FIN, PRP. GOV, CUL) is agriculture, forestry and fishing. (e) The control for the regional dummy variables (SUN, GLD, SWE, CEN, CNC, NRQ, FNQ) is Brisbane. (f) The critical values for skewness and kurtosis are 0.092 and 0.184, respectively.

TABLE 2. *Tests for Differences in Means and Proportions for Independent Variables in Logistic Regressions*

	Introduction of DST throughout Queensland						Introduction of DST in Brisbane alone						Introduction of DST in Gold Coast alone					
	No		Yes		*t/Z-tests*		No		Yes		*t/Z-tests*		No		Yes		*t/Z-tests*	
Code	Mean	Standard deviation	Mean	Standard deviation	Absolute t/Z-value	p-value	Mean	Standard deviation	Mean	Standard deviation	Absolute t/Z-value	p-value	Mean	Standard deviation	Mean	Standard deviation	Absolute t/Z-value	p-value
BST	3.209	1.045	3.413	1.028	2.567	0.010	3.267	1.063	3.516	0.947	2.812	0.005	3.277	1.048	3.484	1.000	2.350	0.019
BSF	3.032	1.120	3.232	1.047	2.425	0.016	3.107	1.125	3.283	0.933	2.079	0.038	3.117	1.112	3.250	0.985	1.444	0.149
STF	-0.582	1.586	1.725	1.313	20.260	0.000	0.550	1.866	1.538	1.456	7.334	0.000	0.600	1.842	1.378	1.632	5.109	0.000
SAL	-0.450	1.409	1.554	1.361	18.915	0.000	0.542	1.703	1.364	1.512	5.796	0.000	0.579	1.690	1.245	1.607	4.689	0.000
ADM	-0.387	1.438	1.709	1.402	19.268	0.000	0.653	1.777	1.505	1.500	5.822	0.000	0.692	1.755	1.378	1.632	4.673	0.000
PRF	-0.408	1.321	1.338	1.317	17.238	0.000	0.447	1.559	1.201	1.470	5.730	0.000	0.471	1.538	1.117	1.567	4.910	0.000
EMP	91.770	565.342	81.601	347.804	0.296	0.767	80.567	429.881	100.130	493.335	0.511	0.610	80.400	431.165	100.176	488.925	0.520	0.603
MNG	0.046	0.210	0.023	0.152	1.560	0.120	0.036	0.187	0.022	0.146	0.955	0.340	0.035	0.183	0.027	0.161	0.531	0.596
MFG	0.170	0.376	0.230	0.421	1.973	0.049	0.193	0.395	0.245	0.431	1.433	0.153	0.194	0.396	0.239	0.428	1.264	0.207
ENG	0.014	0.118	0.045	0.207	2.483	0.013	0.032	0.177	0.033	0.178	0.011	0.991	0.035	0.183	0.027	0.161	0.531	0.596
CON	0.085	0.280	0.045	0.207	2.085	0.038	0.069	0.253	0.038	0.192	1.708	0.088	0.069	0.254	0.037	0.190	1.800	0.072
WTR	0.043	0.202	0.108	0.311	3.394	0.001	0.071	0.256	0.114	0.319	1.671	0.096	0.071	0.257	0.112	0.316	1.581	0.115
RTR	0.128	0.334	0.068	0.252	2.551	0.011	0.113	0.316	0.033	0.178	4.196	0.000	0.113	0.317	0.032	0.176	4.304	0.000
ACR	0.043	0.202	0.047	0.212	0.275	0.783	0.046	0.209	0.043	0.204	0.130	0.896	0.046	0.210	0.043	0.202	0.203	0.839
TRN	0.053	0.225	0.068	0.252	0.802	0.423	0.063	0.243	0.060	0.238	0.154	0.877	0.062	0.241	0.064	0.245	0.111	0.911
FIN	0.035	0.185	0.049	0.217	0.880	0.379	0.036	0.187	0.065	0.248	1.448	0.149	0.038	0.192	0.059	0.235	1.048	0.295
PRP	0.074	0.263	0.085	0.278	0.480	0.631	0.076	0.266	0.092	0.290	0.688	0.492	0.075	0.264	0.096	0.295	0.895	0.371
GOV	0.085	0.280	0.101	0.302	0.704	0.482	0.092	0.289	0.103	0.305	0.464	0.643	0.090	0.287	0.106	0.309	0.642	0.521
CUL	0.096	0.295	0.087	0.282	0.403	0.687	0.080	0.272	0.120	0.325	1.473	0.142	0.081	0.273	0.117	0.322	1.375	0.170
SUN	0.050	0.218	0.023	0.152	1.757	0.080	0.038	0.192	0.022	0.146	1.203	0.230	0.037	0.188	0.027	0.161	0.645	0.519
GLD	0.082	0.274	0.188	0.391	4.248	0.000	0.118	0.323	0.223	0.417	3.087	0.002	0.119	0.324	0.218	0.414	2.961	0.003
SWE	0.135	0.342	0.092	0.289	1.748	0.081	0.128	0.334	0.054	0.227	3.307	0.001	0.127	0.333	0.059	0.235	3.035	0.003
CEN	0.128	0.334	0.028	0.166	4.635	0.000	0.084	0.278	0.022	0.146	3.835	0.000	0.081	0.273	0.032	0.176	2.782	0.006
CNC	0.089	0.285	0.045	0.207	2.237	0.026	0.080	0.272	0.011	0.104	4.902	0.000	0.079	0.270	0.016	0.126	4.203	0.000
NRQ	0.117	0.322	0.040	0.196	3.604	0.000	0.088	0.283	0.022	0.146	4.025	0.000	0.088	0.284	0.021	0.145	4.114	0.000
FNQ	0.167	0.373	0.040	0.196	5.244	0.000	0.107	0.309	0.043	0.204	3.132	0.002	0.106	0.308	0.048	0.214	2.805	0.005

Notes: (a) For the continuous variables (BST, BSF,STF, SAL, ADM, PRF, EMP) Levene's test for equality of variances determines whether the *t*-values and *p*-values for equality of means assume equal or unequal variances. (b) For the binary variables (MNG, MFG, ENG, CON, WTR, RTR, ACR, TRN, FIN, PRP, GOV, CUL, SUN, GLD, SWE, CEN, CNC, NRQ, FNQ) the *Z* and *p*-values are for differences between proportions.

TABLE 3. *Estimated Logistic Regression Models*

	Introduction of DST in Queensland (DSQ)								Introduction of DST in Brisbane (DSB)								Introduction of DST in Gold Coast (DSG)							
	Beginning model (i)				Refined model (ii)				Beginning model (iii)				Refined model (iv)				Beginning model (v)				Refined model (vi)			
Variable	Estimated coefficient	Standard error	p-value	Marginal effect	Estimated coefficient	Standard error	p-value	Marginal effect	Estimated coefficient	Standard error	p-value	Marginal effect	Estimated coefficient	Standard error	p-value	Marginal effect	Estimated coefficient	Standard error	p-value	Marginal effect	Estimated coefficient	Standard error	p-value	Marginal effect
CONS.	-0.447	0.627	0.476	-0.639	-0.255	0.174	0.142	-0.775	-2.052	0.581	0.000	-0.129	-1.666	0.355	0.000	-0.189	-1.601	0.528	0.002	-0.202	-0.809	0.132	0.000	-0.445
BST	0.060	0.138	0.663	1.062					0.261	0.113	0.020	1.298	0.209	0.094	0.027	1.232	0.212	0.109	0.051	1.236				
BSF	-0.128	0.130	0.326	-0.880					-0.127	0.109	0.241	-0.880					-0.127	0.105	0.229	-0.881				
STF	0.686	0.126	0.000	1.985	0.714	0.122	0.000	2.043	0.117	0.090	0.193	1.124	0.218	0.059	0.000	1.244	0.042	0.087	0.626	1.043	0.149	0.056	0.008	1.161
SAL	0.378	0.167	0.024	1.459	0.487	0.127	0.000	1.627	0.045	0.119	0.707	1.046					0.007	0.116	0.949	1.007				
ADM	0.544	0.132	0.000	1.723	0.573	0.123	0.000	1.773	0.035	0.094	0.708	1.036					0.008	0.092	0.932	1.008				
PRF	0.280	0.190	0.141	1.323					0.056	0.122	0.642	1.058					0.118	0.119	0.321	1.125				
EMP	0.000	0.000	0.128	1.000					0.000	0.000	0.908	1.000					0.000	0.000	0.939	1.000				
MNG	0.150	0.823	0.856	1.162					0.739	0.782	0.345	2.095					0.796	0.704	0.259	2.216				
MFG	0.431	0.572	0.450	1.539					0.679	0.508	0.181	1.973					0.492	0.460	0.285	1.635				
ENG	1.834	0.874	0.036	6.261					0.530	0.687	0.441	1.698					0.099	0.671	0.883	1.104				
CON	-0.673	0.661	0.308	-0.510	-1.176	0.441	0.008	-0.309	0.078	0.636	0.903	1.081					-0.162	0.594	0.785	-0.850				
WTR	0.543	0.678	0.423	1.721					0.769	0.551	0.163	2.157					0.613	0.507	0.226	1.846				
RTR	0.333	0.633	0.599	1.395					0.182	0.655	0.781	1.199					-0.156	0.612	0.799	-0.856				
ACR	0.643	0.776	0.407	1.902					0.582	0.649	0.370	1.790					0.365	0.604	0.546	1.440				
TRN	0.867	0.727	0.233	2.380					0.530	0.603	0.379	1.699					0.491	0.552	0.373	1.634				
FIN	0.644	0.721	0.371	1.905					1.524	0.622	0.014	4.589	0.866	0.420	0.040	2.377	1.100	0.580	0.058	3.005				
PRP	0.000	0.645	1.000	1.000					0.784	0.563	0.164	2.190					0.664	0.516	0.199	1.942				
GOV	0.977	0.612	0.111	2.656					0.876	0.553	0.114	2.401					0.724	0.503	0.150	2.063				
CUL	0.740	0.622	0.234	2.096					1.368	0.551	0.013	3.926	0.760	0.312	0.015	2.137	1.090	0.503	0.030	2.975	0.591	0.301	0.049	1.806
SUN	-0.841	0.678	0.215	-0.431					-0.767	0.607	0.206	-0.465					-0.532	0.552	0.336	-0.587				
GLD	0.608	0.386	0.115	1.836	0.630	0.354	0.075	1.878	0.099	0.252	0.695	1.104					0.135	0.250	0.588	1.145				
SWE	-1.196	0.391	0.002	-0.302	-1.007	0.356	0.005	-0.365	-1.304	0.387	0.001	-0.271	-1.315	0.366	0.000	-0.268	-1.163	0.370	0.002	-0.313	-1.164	0.345	0.001	-0.312
CEN	-1.194	0.517	0.021	-0.303	-1.134	0.474	0.017	-0.322	-1.310	0.564	0.020	-0.270	-1.535	0.543	0.005	-0.215	-0.942	0.483	0.051	-0.390	-1.193	0.456	0.009	-0.303
CNC	-0.259	0.493	0.600	-0.772					-2.195	0.756	0.004	-0.111	-2.263	0.739	0.002	-0.104	-1.830	0.636	0.004	-0.160	-1.841	0.613	0.003	-0.159
NRQ	-1.582	0.486	0.001	-0.206	-1.304	0.456	0.004	-0.272	-1.540	0.552	0.005	-0.214	-1.543	0.540	0.004	-0.214	-1.610	0.550	0.003	-0.200	-1.699	0.538	0.002	-0.183
FNQ	-1.934	0.451	0.000	-0.145	-1.601	0.406	0.000	-0.202	-1.310	0.438	0.003	-0.270	-1.287	0.413	0.002	-0.276	-1.191	0.417	0.004	-0.304	-1.142	0.388	0.003	-0.319
LR(p)	473.707		0.000		490.369		0.000		696.887		0.000		708.878		0.000		729.079		0.000		747.641		0.000	
R^2	0.664				0.648				0.219				0.197				0.175				0.141			

Notes: (a) The dependent variable in models (i) and (ii) is DSQ, DSB in models (iii) and (iv) and DSG in (v) and (vi). (b) The beginning models in (i), (iii) and (v) are obtained by including all the independent variables in Table 1; the refined models in (iii), (iv) and (vi) are obtained by using forward stepwise regression using the Wald criterion. (c) *LR* – likelihood ratio statistic; *p*-value of *LR* calculated using χ^2(p) where *p* = number of explanatory variables; R^2 – Nagelkerke R-squared; marginal effects calculated at sample means.

TABLE 4. *Observed and Predicted Values for the Binary Logit Models*

Model	Outcomes		Observed in sample		Constant probability model		Beginning model		Refined model	
			No	Yes	No	Yes	No	Yes	No	Yes
Introduction of DST in Queensland (DSQ)	Prediction	No	282	0	112	210	226	56	228	54
	Prediction	Yes	0	426	170	256	59	367	61	365
	Percent correct		100.0	100.0	39.7	60.1	80.1	86.2	80.9	85.7
	Overall percent correct			100.0		52.0		83.8		83.8
	H-L statistic and p-value		NA	NA	NA	NA	8.096	0.424	4.153	0.843
Introduction of DST in Brisbane (DSB)	Prediction	No	524	0	388	136	498	26	500	24
	Prediction	Yes	0	184	136	48	153	31	154	30
	Percent correct		100.0	100.0	74.0	26.0	95.0	16.8	95.4	16.3
	Overall percent correct			100.0		61.6		74.7		74.9
	H-L statistic and p-value		NA	NA	NA	NA	8.019	0.432	10.476	0.233
Introduction of DST in Gold Coast (DSG)	Prediction	No	520	0	382	138	505	15	513	1
	Prediction	Yes	0	188	138	50	162	26	181	7
	Percent correct		100.0	100.0	73.4	26.6	97.1	13.8	98.7	3.7
	Overall percent correct			100.0		61.0		75.0		73.4
	H-L statistic and p-value		NA	NA	NA	NA	15.925	0.043	13.800	0.087

Notes: (a) Observed is the number of 0 (No) and 1 (Yes) responses in the sample; the probabilities in the constant probability model are the values computed from estimating a model that includes only an intercept term, and thereby corresponds to the probability of correctly identifying 0 and 1 responses on the basis of their proportion the sample; the beginning model is obtained by including all variables as specified and corresponds to the results obtained in models (i), (iii) and (v) in Table 2; the refined model is obtained by using forward stepwise regression using the Wald criterion and corresponds to the results obtained in models (ii), (iv) and (vi) in Table 2. (b) H-L – Hosmer-Lemeshow test statistic; NA – not applicable. (c) Percent correct is the number of correct predictions for each model and for each response (i.e. 0 or 1) as a percentage of the observed values for 0 and 1; overall percent correct is the number of correct predictions (i.e. 0 and 1) as a percentage of the total observed values for 0 and 1.