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**“Attitudes to Leadership and Voting:
Finding the Efficient Frontier”**

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Introduction

Winning elections is essentially a matter of translating the attitudes of voters into votes. Although this proposition may sound simple, the reality is considerably more challenging as politicians, candidates, strategists, advisers, journalists and, of course, scholars can readily attest. A vast literature in political science, in particular in election studies, has examined from a seemingly inexhaustible range of angles the determinants of vote choice and the effectiveness of political campaigns across a wide field of political landscapes.

Despite the ambition, the breadth and the depth of this scholarship, a notable gap remains: we know very little, if anything, about the *efficiency* with which the inputs (voter attitudes) to the political process are converted into outputs (vote support). An enormous number of regression models of varying design and specification focus overwhelmingly on the *effectiveness* of a plethora of drivers of different outcomes in the political process, but do not address the efficiency question. And, just because something may be effective, it does not mean it is done efficiently, and thus done even better.

Data Envelopment Analysis (DEA) fills this gap, providing a statistical method to measure the efficiency with which inputs are converted into outputs. In the current study, one of the miniscule number to examine the practical application of DEA to political science, we look at the efficiency with which Australian political leaders and parties have, over the past almost three decades, converted voter attitudes (approval and disapproval) to Prime Ministers and Opposition Leaders into votes (both for their own, and for their opponents' parties).

The results of the DEA analysis and associated modelling find marked differences in the political efficiency of recent Australian political leaders. Prime Ministers Hawke and Keating had superior political efficiency in converting attitudes to political leaders into votes, while Prime Ministers Howard and Rudd were relatively less efficient in doing so. By contrast, Opposition Leaders Howard and Abbott appear to have been relatively efficient in attitudes-to-vote conversion, while Opposition Leader Rudd could have delivered the ALP an even greater winning margin in the 2007 election had he been more efficient in vote harvesting.

Data Envelopment Analysis

DEA has its foundations, and many of its applications, in industrial economics, management science and operations research. In essence, DEA takes quantitative information on the inputs for/ outputs of a firm, or part thereof (for example, a number of comparable operating units) and seeks to measure the various efficiencies with which the firm/units convert the inputs used into outputs. DEA allows corporate and management strategists to locate observed best practice (OBP), measure the efficiency of the firms/units relative to OBP, and identify peers for the individual units (from which they can seemingly learn what to do better, or not to do at all).

A simple example from public administration illustrates the point: a police command has eight operational districts units under its control, each of which has two inputs (capital, in the form of police cars; and labour, in the form of uniformed policemen/women), and a single output (the 'crime rate', say for burglaries or shop theft). All of the inputs can be measured, in their quantities. DEA allows senior police management to identify the most efficient operating district, based on its combination of inputs (police cars, and policemen/women) in producing the prescribed output (the 'crime rate'). The efficient frontier would be those operating district(s) which had the mix of police cars and policemen/women which delivered the lowest crime rate (that is, OBP) for a given combination of inputs, with the other districts measured relative to this frontier. Police management can then look to improve the efficiency of the non-frontier districts by examining their peer structures, and exploring reasons why some districts are at OBP and others are behind it.

There are two general approaches to DEA: input DEA; and output DEA. Under input DEA, the firm/unit aims to produce a given level of output with the least amount of inputs (input minimisation); under output DEA, the firm/unit aims to produce the greatest amount of output with a given amount of inputs (output maximisation). As a broad statement, the private sector in most market economies focuses on input minimisation, while the public sector would more likely adopt output maximisation given the political and public policy priority given to outputs.

DEA can produce a number of useful metrics of the efficiency of the firms/units under examination. These metrics include an efficiency score, which determines which firm(s)/unit(s) are operating at OBP and measures the distance from the other firm(s)/unit(s) from that efficient frontier, and a scale score, which measures the effects of size of the firm/unit on its efficiency score (larger firms/units may have economies of scale not available to smaller firms/units). Once these metrics are known, DEA can be extended into second-stage modelling, introducing exogenous variables into Tobit-regression models which seek to explain the various efficiency scores. In the police resourcing case discussed earlier, these exogenous variables might include time-of-day, season (cold vs hot weather), school holidays, and/or the age of the local population.

Like most statistical techniques, DEA has both its strengths and weaknesses. Amongst its strengths are DEA can: take into account both multiple inputs and outputs in a single analysis in contrast to conventional simple regression models which are generally limited to a single dependent variable; provide quantitative measures of technical efficiency, and scale and allocative efficiency when size and price data are available; estimate the different sources of inefficiency and their magnitudes; and, identify OBP operators and peers against which the less than OBP firms/units can benchmark themselves. By contrast, its weaknesses include: it is deterministic in nature, and thus more vulnerable to measurement error and outliers; its sample specific, speaking only to the firms/units of analysis at hand, and cannot necessarily be used to make more generalised statements about a wider population; and, it only identifies which firm(s)/unit(s) are at the efficient frontier, and does not of itself explain *why* they at OBP, although this question can be examined through DEA second-stage modelling (DEA - SSM) which can take place after the initial DEA.

The Literature

There exists a vast literature on the theory and the applications of DEA. However, almost all of this literature is outside of political science. While it is beyond the scope of this study (or any other than a dedicated scholarly review) to even scratch the surface of the general literature, DEA has had a large footprint in disciplines (and the journals serving them) such as operations research, management science, public administration to

name but a few. Readily accessible studies looking at, *inter alia*, the application of DEA to public administration (health services and police and corrections) in Australia, for example, is available for non-statisticians or the non-technically inclined (PC, 1997).

By contrast, practical studies in political science using DEA are rare. To the best of our knowledge, there appears to be just a single study (Berry and Chen (1999)) exploring the practical application of DEA to political science. Those authors examined the efficiency with which competing candidates converted vote intention to vote outcomes in United States Presidential elections, demonstrating the utility of the method and supporting its wider use in political science research. Other theoretical studies, using artificial data sets with a political resonance, which investigate the relative merits of different DEA methodological nuances are slightly more numerous although all come from within the operations research rather than political science literature (Green, Doyle and Cook, 1996; Obata and Ishii, 2003; Wang and Chin, 2007; Llamazares and Pena, 2009). But, to reiterate, these studies were more about pushing the boundaries of DEA methodology and theory, than about the practical application of DEA in political science.

Clearly, with the exception of just one study late last century (Berry and Chen, 1999) there appears to be a near absence of any meaningful scholarship exploiting the potential insights of DEA for political science in a practical manner. The next section seeks to complement and extend the single existent offering, looking at the efficiency with which successive Australian Governments and Oppositions have translated attitudes to party leaders into vote intention. In short, this article in one step doubles the published literature on the practical application of DEA to applied political science.

The Data

The data sets used in this study are taken from the regular Newspolls published by the eponymous market research organisation. The polling data covers vote intention (primary vote for the Australian Labor Party (ALP), and for the Liberal National Party (LNP) coalition), and attitudes to the party leaders (their respective approval and disapproval ratings), calculated on a monthly basis commencing in January 1986 and ending in June 2013. The period covers five prime ministerships, and thirteen discrete

opposition leaderships, producing fifteen different prime minister/opposition leader combinations. The pattern of these combinations can be seen in Table 1.

Table 1: Australian Prime Ministers and Opposition Leaders

PM	Opp Ldr	Unit
Hawke	Howard	1
Hawke	Peacock	2
Hawke	Hewson	3
Keating	Hewson	4
Keating	Downer	5
Keating	Howard	6
Howard	Beazley1	7
Howard	Crean	8
Howard	Latham	9
Howard	Beazley2	10
Howard	Rudd	11
Rudd	Nelson	12
Rudd	Turnbull	13
Rudd	Abbott	14
Gillard	Abbott	15

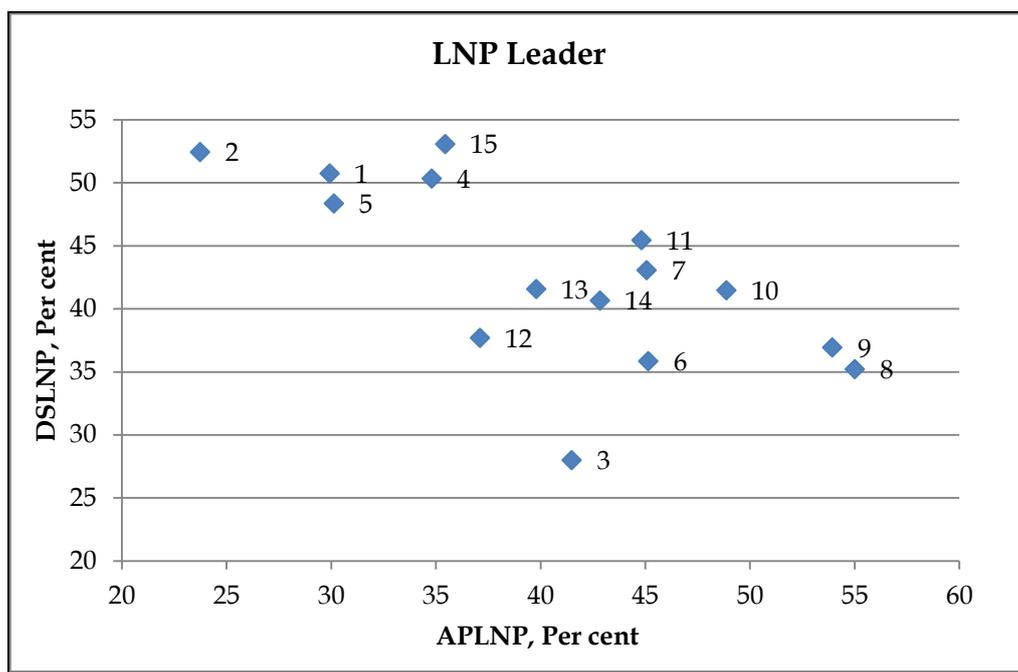
(ALP leaders during the period under review were Hawke, Keating and Gillard as Prime Ministers, as well as Beazley, Crean, Latham, with Rudd as Opposition Leaders serving as both a Prime Minister and an Opposition Leader. LNP leaders were Howard as both a Prime Minister and an Opposition Leader, and Peacock, Hewson, Downer, Nelson, Turnbull and Abbott) as Opposition Leaders.

The period under review covers four ALP (Hawke, Keating, Rudd and Gillard) and one LNP (Howard) prime ministerships. Hawke, Keating and Rudd each faced three different LNP Opposition Leaders, while Gillard confronted only one (Abbott). By comparison, Howard faced five opposition leaders (if we count Beazley's two terms

separately). Turning to Opposition Leaders, we can see Hewson, Howard and Abbott (LNP) each confronted two different ALP prime ministers (Howard on two separate, non-sequential occasions), while Beazley (ALP) confronted Howard (as Prime Minister) also on two separate occasions. The longest duration of any pairing was Howard (PM) against Beazley in his first stint as Opposition Leader (some 68 months), while the shortest was PM Rudd against Opposition Leader Abbott (just seven months). The variable ‘unit’ is an enumeration of the pairing, which is required for the DEA modelling and usefully simplifies the graphics to come.

Graph 1 provides a useful first look at the relationship between the approval and the disapproval ratings for the LNP leader, while Graph 2 does the same for the ALP leader. Recall: observation 1 is the scatter dot point for PM Hawke/Opp Ldr Howard, observation 2 is for PM Hawke/ Opp Ldr Peacock, and so on, as reported in Table 1.

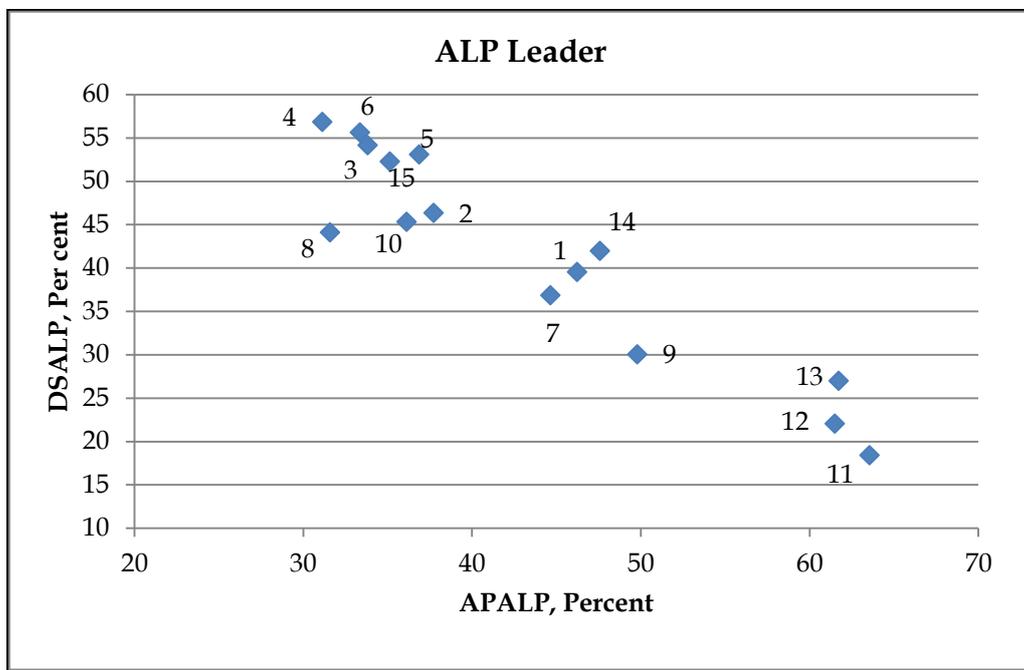
Graph 1: Approval and Disapproval for LNP Leader



The best net approval (approval/disapproval) situation for an LNP leader, regardless of office held, was during the PM Howard/ Opp Ldr Crean period (observation 8), with a ratio of 1.56 times (that is, Howard’s approval rating was 1.56 times his disapproval rating), closely followed by PM Howard/ Opp Ldr Latham (observation 9; ratio = 1.46 times). By contrast, the worst net approval situation for an LNP leader was the PM

Hawke/Opp Ldr Peacock period (observation 2; ratio = 0.45 times), followed closely by PM Hawke/Opp Ldr Howard (observation 1; ratio = 0.59 times). Interestingly, Opp Ldr Abbott experienced a substantial net disapproval rating (observation 15; ratio = 0.67 times) during the period under review when he was up against PM Gillard, but he (Abbott) still went on to win the subsequent federal election. As a visual inspection of Graph 1 indicates, and as would be expected, there was a clear negative correlation between approval and disapproval ratings for the LNP leader ($r = -0.683$; $t = -3.37$; $p = 0.01$).

Graph 2: Approval and Disapproval for ALP Leader

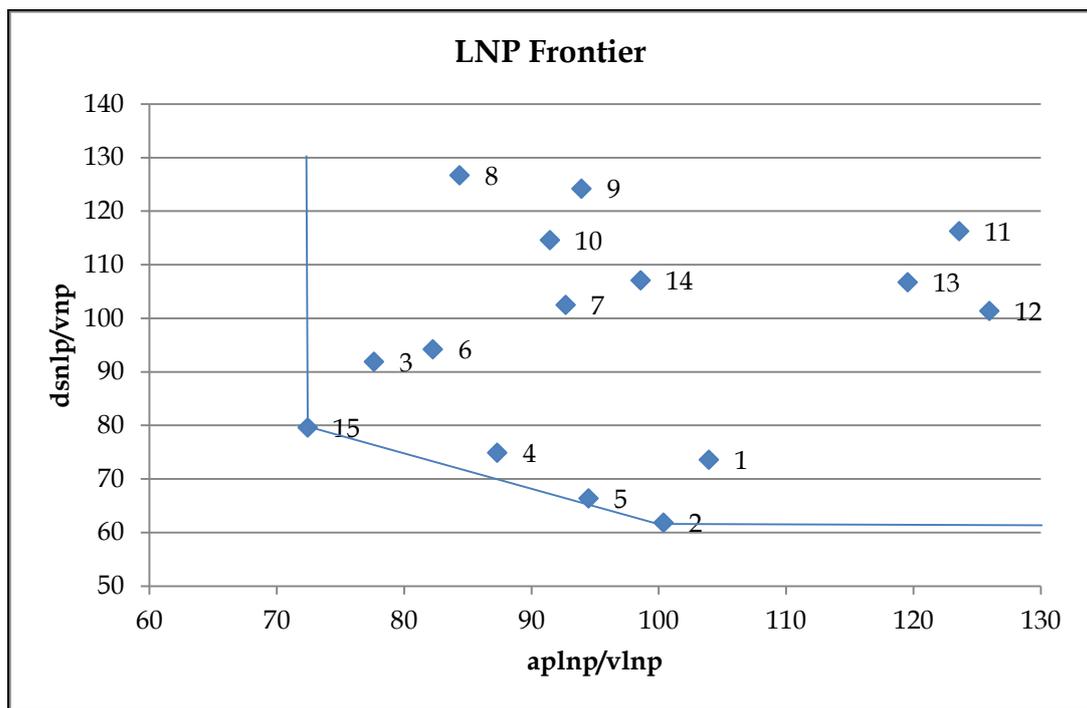


The best net approval situations for an ALP leader, again regardless of office held, were those where Kevin Rudd was Opposition Leader against Prime Minister Howard (observation 11; ratio = 3.44), followed by when Rudd was Prime Minister against Opposition Leaders Nelson (observation 12; ratio = 2.78) and Turnbull (observation 13; ratio = 2.29). The worst net approval situation for an ALP leader was PM Keating against Opp Ldr Hewson (observation 4; ratio = 0.55), and PM Keating against Opp Ldr Howard (observation 6; ratio = 0.60). Again, there was a clear and negative correlation between approval and disapproval for ALP leaders ($r = -0.941$; $t = -10.01$; $p = 0.00$).

DEA Analysis

Identifying the efficient frontier for the conversion of party leader approval and disapproval ratings into vote support – the core interest of DEA – can be undertaken in a two-step process. The first step, again, involves the use of scattergrams, being modified forms of Graphs 1 and 2 reported earlier, with the second step involving dedicated DEA modelling. The scattergrams have to be reconfigured, however, with the axes normalised by dividing the approval or disapproval scores by their respective vote intention scores (eg approval for LNP leader/ vote intention for LNP party). The efficient frontier is likely to be found where the party leader has the lowest disapproval-to-vote-intention, and the highest approval-to-vote-intention ratios. Graph 3 reports a scattergram of where the efficient frontier may lay for the LNP leader/party, while Graph 4 does the same for the ALP leader/party.

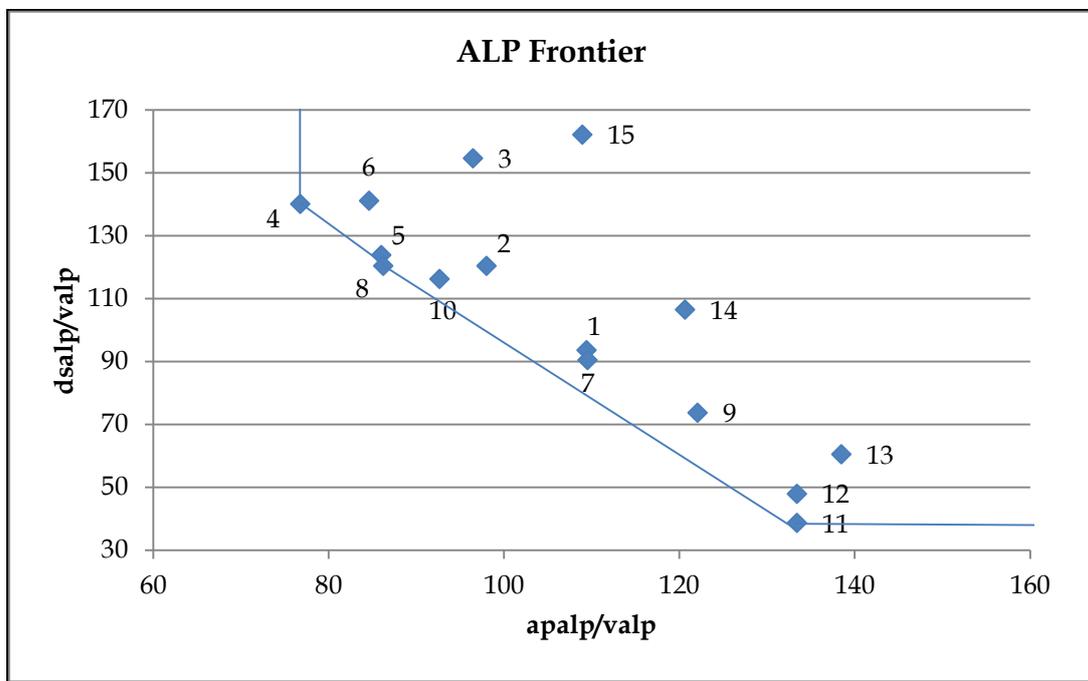
Graph 3: The LNP Frontier



The efficient frontier for the LNP leader/ party is the vertical line rising from observation 15, the diagonal line connecting observations 15 and 2, and the horizontal line running from observation 2. As such, the most efficient LNP leaders appear to be Opp Ldr Abbott (against PM Gillard: observation 15), and Opp Ldr Peacock (against PM

Hawke: observation 2), although Opp Ldr Downer (against PM Keating: observation 5) appears to sit close to the LNP's efficient frontier. By contrast, the least efficient LNP leaders were PM Howard when up against Opp Ldr Rudd (observation 11), and Opp Ldrs Nelson (observation 12) and Turnbull (observation 13) against PM Rudd. Interestingly, then Opp Ldr Abbott (against PM Gillard) essentially shifted the efficient frontier for the LNP (the connecting line between observations 15 and 2), away from the previous frontier connecting observations 2, 5, 4 and 3 – being LNP leaders Peacock, Downer, Hewson and Hewson, respectively).

Graph 4: The ALP Frontier



The efficient frontier for the ALP leader/party is likely to be found at the vertical line rising from observation 4, the diagonal lines connecting observations 4 and 8, and 8 and 11, and then the horizontal line running from observation 11. The most efficient ALP leaders appear to be PM Keating (against Opp Ldr Hewson: observation 4; and potentially against Opp Ldr Downer: observation 5), Opp Ldr Crean (against PM Howard; observation 8), and Opp Ldr Rudd against PM Howard (observation 11). In general terms, Keating and Crean may have done well in minimising the adverse impact of their relatively high disapproval ratings, while Rudd did well in maximising the positive impact of his relatively high approval rating, on ALP vote intention.

Three DEA models were specified: the first examined the impact of approval ratings for party leaders on votes for the two parties (that is, approval for the LNP leader and approval for the ALP leader, on vote for the LNP and vote for the ALP: $aplnp, apalp \rightarrow vlnp, valp$; DEA allows both multiple explanatory and dependent variables); the second replicated the first, except using disapproval ratings for the leaders ($dslnp, dsalp \rightarrow vlnp, valp$); and, the third used the net approval (that is, approval divided by disapproval) ratings for the party leaders, on vote for each of the two parties ($netlnp, netalp \rightarrow vlnp, valp$). Table 2 summarises the results for the first two models (approvals and disapprovals, on vote intention).

Table 2: Efficient Frontier :

Approvals and Disapprovals, and Vote Intention

			App	App	Disapp	Disapp
PM	OL	Unit	rank	theta	rank	theta
Hawke	Howard1	1	8	88.4	12	71.8
Hawke	Peacock	2	1	100.0	15	62.9
Hawke	Hewson	3	7	89.5	1	100.0
Keating	Hewson	4	1	100.0	13	71.1
Keating	Downer	5	1	100.0	11	74.8
Keating	Howard2	6	4	96.3	6	91.4
Howard	Beazley1	7	11	72.9	8	85.6
Howard	Crean	8	5	92.1	5	91.6
Howard	Latham	9	15	63.7	1	100.0
Howard	Beazley2	10	9	82.9	10	81.0
Howard	Rudd	11	13	69.5	1	100.0
Rudd	Nelson	12	10	76.6	1	100.0
Rudd	Turnbull	13	12	70.0	7	88.6
Rudd	Abbott	14	14	69.0	9	81.1
Gillard	Abbott	15	6	90.7	14	67.5

Looking first at the approval DEA scores, the efficient frontier (the combinations of political leaders most efficient in translating approval ratings into vote intentions – those with theta's of 100 per cent) were Hawke/Peacock, Keating/Hewson and Keating/Downer. By contrast, the least efficient in translating approval ratings into vote

intention (those with the lowest theta's) were Howard/Latham, Rudd/Abbott, and Howard/Rudd, with an average theta of 67.3 per cent (that is, almost 33 per cent behind the efficient frontier). Turning to the disapproval DEA scores, the efficient frontier (the most efficient at translating disapprovals into vote intention) were Hawke/Hewson, Howard/Latham, Howard/Rudd and Rudd/Nelson, while the least efficient at doing so were Hawke/Peacock, Gillard/Abbott and Keating/Hewson, with a theta average of 67.2 per cent (or around 33 per cent behind the efficient frontier). The average of the approvals and the disapproval thetas were essentially the same (84.1 per cent and 84.5 per cent), while the standard deviations were almost identical (12.8 per cent respectively), implying no statistically significant differences between the means for the two series.

Nevertheless, any political practitioner would likely quickly point out while it is interesting to examine approvals and disapprovals separately for the efficiency with which they are translated into vote intention, the better approach is to combine both into a single model. That is, the efficient vote intention frontier for both parties is formed by taking into account both approval and disapproval for both party leaders. Regrettably, there are insufficient observations ($n = 15$) to sustain a specification containing all four of the explanatory variables ($aplnp$, $apalp$, $dslnp$ and $dsalp$), although when reduced to net approval for the LNP leader ($netlnp = aplnp/dslnp$) and for the ALP leader ($netalp = apalp/dsalp$) such modelling can proceed. The results of such modelling are reported in Table 3.

Table 3: Efficient Frontier : Net Approval and Vote Intention

PM	Opp Ldr	Unit	Rank	Theta
Hawke	Howard	1	6	83.8
Hawke	Peacock	2	1	100.0
Hawke	Hewson	3	5	85.3
Keating	Hewson	4	1	100.0
Keating	Downer	5	7	83.4
Keating	Howard	6	1	100.0
Howard	Beazley1	7	12	51.7
Howard	Crean	8	8	64.6
Howard	Latham	9	15	37.3
Howard	Beazley2	10	9	57.0

Howard	Rudd	11	11	52.5
Rudd	Nelson	12	13	48.4
Rudd	Turnbull	13	14	45.0
Rudd	Abbott	14	10	54.0
Gillard	Abbott	15	4	91.2

The Hawke/Peacock, the Keating/Hewson and the Keating/Howard combinations were at the efficiency frontier for translating net approval ratings for the party leaders into vote intentions, while Gillard/Abbott were not far behind. In a manner, this result is not all that surprising, given the tendency for at least three of the party leaders (Keating, Gillard and Abbott) to have been regarded as ‘hard ball political players’. By contrast, the least efficient (farthest behind the efficient frontier) were Howard/ Latham (37.3 per cent, the latter having a reputation as something of a ‘policy wonk’), Rudd/Turnbull (45 per cent) and Rudd/Nelson (48.4 per cent), again when Rudd was seen as a ‘bookish nerd’.

Second Stage Modelling

While it is possible to speculate on possible drivers of these different efficiency profiles and locations, DEA modelling per se only tells us ‘who sits where’ on and relative to the efficiency frontier; of itself, it does not answer the inevitable question of ‘*why*’ – “why do the parties/leaders have different locations on/relative to the efficient frontier?” However, so-called ‘second stage modelling’ provides a platform for such investigation, using tobit regression, with the theta results from the DEA modelling used as the dependent variables, along with exogenous political variables likely to cause those efficiency scores.

The exogenous variables used in the second stage modelling are dummy variables for the individual Prime Ministers (being equal to one when the person was Prime Minister, and zero otherwise), thus seeking to identify a ‘prime ministerial effect’. As such, we are asking ‘were there practical and statistically significant differences in the efficiency of translating voter approval and disapproval ratings into vote intention across the different prime ministers?’. The results of this second stage modelling are reported in Table 4. The dependent variable is the theta scores for each Prime Minister/ Opposition Leader pairing (as reported earlier in Table 3). The ‘x’ variable in the Hawke Model would be

equal to one when Hawke was Prime Minister, and zero otherwise; in the Keating Model it would be equal to one when Keating was Prime Minister, and zero otherwise; and so on; assuming the prime minister sets the political agenda, and the political tone during their incumbency.

Table 4: Second Stage Modelling: Prime Ministers

	Hawke	Keating	Howard	Rudd	Gillard
Cons					
> b	65.43	64.23	79.11	75.57	68.79
> p	0.00	0.00	0.00	0.00	0.00
X var					
> b	24.28	30.23	-26.49	-26.43	22.41
> p	0.05	0.01	0.00	0.03	0.30
LL	-65.69	-64.57	-64.34	-65.33	-66.87
AIC	9.16	9.00	8.98	9.11	9.32
SBIC	9.30	9.16	9.12	9.25	9.46

Looking at the parameter coefficient's for the prime ministerial dummy variables indicates the presence of Paul Keating as prime minister had the greatest marginal impact on the efficiency with which voter attitudes to the political leaders were translated into votes ($b = 30.2$; $p = 0.01$) when compared to the other prime ministers, which is not all that surprising given the highly charged political environment in which Keating operated (either by circumstance, or by his own political design). By contrast, Howard and Rudd both appear to have been relatively less efficient than their prime ministerial peers in translating voter attitudes to political leaders into vote intention ($b = -26.49$; $p = 0.00$; and, $b = -26.43$; $p = 0.03$, respectively).

A similar exercise can be undertaken looking at the efficiency effects of different opposition leaders. However, given there were 11 different opposition leaders across the period under review, a simple replication of the prime ministerial is likely to prove tedious, and potentially generate more noise than light. As such, we will focus our attention on the three opposition leader periods where the Leader concerned won election as prime minister (Howard, defeating Keating; Rudd, defeating Howard; and,

Abbott, defeating Gillard), and the special case of Latham vs Howard (for the standout nature of the former’s political personality). The analytical approach is the same as for the prime ministers; results for these second stage models are reported in Table 5.

Table 5: Second Stage Modelling: Opposition Leaders

	Howard	Rudd	Abbott	Latham
Cons				
> b	68.16	71.55	68.79	72.64
> p	0.00	0.00	0.00	0.00
X var				
> b	31.84	-19.50	22.41	-35.34
> p	0.13	0.38	0.30	0.08
LL	-66.30	-67.01	-66.87	-66.02
AIC	9.24	9.34	9.32	9.20
SBIC	9.38	9.47	9.46	9.34

Looking first at the results for the Howard, Rudd and Abbott models (that is, those opposition leaders who subsequently won office, to become prime ministers), the stand out message is while the two LNP Leaders (Howard and Abbott) added to the political efficiency of attitude-to-vote transfer, while Rudd (ALP) diminished efficiency, none of these results were statistically significant at conventional levels; they could have been due to chance alone. By contrast, the Latham incumbency as Opposition Leader saw a substantial fall away in the relative efficiency of attitude-to-vote transfer, a result which was close to statistical significance ($b = -35.34$; $p = 0.08$).

Conclusion

DEA provides a very useful mechanism for assessing the efficiency with which political parties are able to harvest voter attitudes to political leaders, both the approval and disapproval of ‘our’ and ‘their’ leader on ‘our’ and ‘their’ votes. It enables political scholars and strategists to measure the electoral importance of positive (working to raise/lower the approval/disapproval level of ‘our’ leader) compared to negative (lowering/ raising the approval/ disapproval levels of ‘their’ leader) political imaging.

Used strategically, DEA allows scholars and strategists to identify the efficient frontier for, in this case, the conversion of attitudes to political leaders to vote support, locate where ‘our’ and ‘their’ leaders are relative to this efficiency frontier, and use accessible modelling techniques to get insights as to what might have to be done to get to that frontier. The seeming paucity of scholarly articles applying DEA to political science, is for this reason alone, somewhat surprising; but, we have at least attempted to fill the gap.

In the current context, it would appear Hawke and Keating were political assets for their parties (in both cases, the ALP) in their superior efficiencies in translating attitudes to political leaders into votes, with Howard and Rudd being much less efficient. As such, Hawke and Keating likely delivered their respective governments larger than otherwise vote outcomes, and hence number of seats in Federal Parliament, while Howard and Rudd did the opposite (lower than otherwise vote outcomes, and less than otherwise seats). Gillard appears to have had no real impact either way.

By contrast, the capacities of Howard and Abbott as opposition leaders to increase the efficiency of attitude-to-vote transfer likely helped their political parties (in both cases, the LNP) to win greater than otherwise vote outcomes which in turn likely meant higher-than-otherwise number of seats in the federal election which saw them elected to the prime ministerships. By contrast, Rudd as opposition leader appears to have subtracted from the ALP’s vote performance, in the sense that while they won the 2007 federal election, they could have done even better still. Latham, to put it nicely, was ‘sand in the wheels of the ALP’, at least in terms of efficiency in converting attitudes to political leaders into votes.

Bringing it all together, it would appear Hawke and Keating (both ALP leaders) are case studies of what Prime Ministers and their advisers need to do to efficiently convert attitudes to political leaders into vote, while Howard and Abbott (both LNP leaders) are similarly positioned for Opposition Leaders. By contrast, Howard and Rudd as Prime Ministers, and Rudd as Opposition Leader, may well be case studies in what not to do.

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