

Evaluating Government Policies using Open Source Models

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This work discusses the issues around the idea that government developed models used for the purpose of policy development and evaluation should be freely available to use, distribute and modify without restrictions. Publicly releasing government policy models has the potential to play a pivotal role in public debate and policy design by opening the doors of policy evaluation and collaboration to the community.

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¹ The views in this article are those of the author and not necessarily those of the Australian Government. This article has benefited from comments provided by Ben Balter, Rohan Baxter, Michael Cordover, Phil Gallagher, Warwick Graco, Gordon Leslie, Elizabeth Melih, Anthony Nolan, Peter Phillips, Felicity Smart, Julie Tinnion and Anthony Towns. This work is licensed under [Creative Commons – Attribution 3.0 Australia](https://creativecommons.org/licenses/by/3.0/au/)

For my son.

Introduction

Public opinion on government policy is heavily influenced by political philosophies and the way policy is communicated and debated in society. The Australian public, politicians and the media engage in vibrant public debates on various policy issues some of which include climate change, migration, housing, personal taxation, the mining boom, mental health and the ageing population². Improving the quality of the debate often involves rigorous policy analysis and the ability to effectively measure the policy impacts. *Government modelling* of public policy aims to inform policymakers and public discussion of the consequences of government decisions by providing quantitative insights on policy design and effectiveness.

Traditionally, policy modelling analyses have been generated and commented on by a number of sources including electoral parties, Senate inquiries, lobby groups, think tanks, conventions, academics, economic advisory practices, tax representatives and the media. The Australian Government recognises the need to continually improve the quality of public debate on policy and has recently funded a number of independent government bodies such as the Parliamentary Budget Office (PBO)³ and a Tax and Transfer Policy Institute⁴ to better evaluate policy measures. However, the proliferation of new and emerging technologies and big data⁵ has revolutionised citizen interaction with information and created expectations for government to adapt to a digitally advanced society in new ways.

Releasing government models created for policy analysis has the potential to play a pivotal role in informing public debate by engaging the community in policy development and evaluation on a quantitative level⁶. In addition to promoting increased transparency in policy evaluation, the provision of government models has the potential for leveraging modern technological capabilities and fostering policy innovation within the public sphere. Furthermore, political decentralisation and providing opportunities for political participation raises the overall wellbeing of a community leading to greater satisfaction with government output⁷.

² In 2008, the *Australia 2020 Summit* identified 10 critical policy areas in Australia: productivity; economy, sustainability and climate change; rural Australia; health and ageing; communities and families; indigenous Australia; creative Australia; Australian governance, democracy and citizenship; and security and prosperity.

³ The Parliamentary Budget Office (PBO) was established in July 2012 to inform the Parliament by providing independent and non-partisan analysis of the budget cycle, fiscal policy and the financial implications of proposals.

⁴ The 2013-14 Australian budget provided funding for a tax studies institute to raise the quality of national debate on tax reform and the awareness of taxation policy issues by collaborating with academics and institutions across Australia and overseas.

⁵ Big data refers to datasets that are so large or complex that traditional data processing applications become inadequate.

⁶ Indeed, some countries such as Canada have already released some of their models. [Statistics Canada](http://www.statcan.gc.ca/eng/microsimulation/modgen/download), for example, has released models that simulate the propagation of infectious diseases and demographic projection models amongst others. These may be found at <http://www.statcan.gc.ca/eng/microsimulation/modgen/download>

⁷ Frey and Stutzer, 2002, demonstrated empirically that the subjective wellbeing of a population depended on the ability to decide on as many government policies as possible and make their views felt directly in the process.

Open government and policy modelling

An *open government* is one where the public has rights to access government held information, thereby allowing for better public oversight and government accountability⁸. The dynamic nature of our digital landscape means that the concept of open government is constantly changing to keep pace with new government developments and technological advances⁹. The Australian Government's declaration of open government¹⁰ and the community's overwhelming interest has recently paved the way for a new form of public involvement. Initiatives such as *Government 2.0*¹¹ and *open data*¹² have increased community expectations for open government by promoting citizen engagement, participation and collaboration.

However, policy modelling done by government is still mostly restricted to policymakers, even though the government recognises the need for public scrutiny and debate of policy outcomes. For example, the *Charter of Budget Honesty Act 1998*¹³ aims to "facilitate public scrutiny of fiscal policy and performance" so as to improve policy outcomes through the public release of policy costings. The intention of this Act is to allow for greater public transparency on the policy costing process by providing an outline of the methodology and assumptions used, as well as an estimate of the costing itself in the form of tables and reports¹⁴.

As we progress to a more digitally transformed society where citizens are increasingly connected with technology, current forms of reporting will eventually be replaced by a technologically dynamic or an interactive alternative¹⁵. As a first step, publicly releasing government modelling on policy development, costings and effectiveness would be the natural progression of the open government initiative since it would allow citizens to become active participants in the *policy analysis* process. Emerging technologies and interactive

⁸ In 2011 the [Open Government Partnership \(OGP\)](http://www.opengovpartnership.org/about/open-government-declaration) was launched to provide an international platform for countries to promote a more open, accountable and responsive government. Since then 66 countries have joined the OGP and endorsed the *Open Government Declaration* which commits to fostering a culture of open government that empowers citizens and advances the ideals of open and participatory government. <http://www.opengovpartnership.org/about/open-government-declaration>

⁹ The contemporary *Open Government* movement goes beyond transparency and accountability, and seeks new ways to engage citizens, some of which include social media.

¹⁰ The Australian Government's declaration of open government states that it's committed to an open government based on a culture of engagement, built on better access to and use of government held information. <http://www.finance.gov.au/e-government/strategy-and-governance/gov2/declaration-of-open-government.html>

¹¹ Government 2.0 is about the use of technology to encourage a more open, transparent and engaging form of government, where the public has a greater role in forming policy and has improved access to government information. <http://www.finance.gov.au/policy-guides-procurement/gov20/>

¹² Open data in Australia is provided by data.gov.au and was created following the Government's Declaration of Open Government in response to the Government 2.0 Taskforce Report to encourage public access to and reuse of government data by providing it in useful formats under open licenses.

¹³ The *Charter of Budget Honesty Act 1998*.

¹⁴ The *Freedom of Information (FOI) Act 1982*, came into effect to provide individuals with access to government held information. However, the growing amounts of information and data used by government today make FOI requests time consuming and costly, and could potentially strain limited government agency resources.

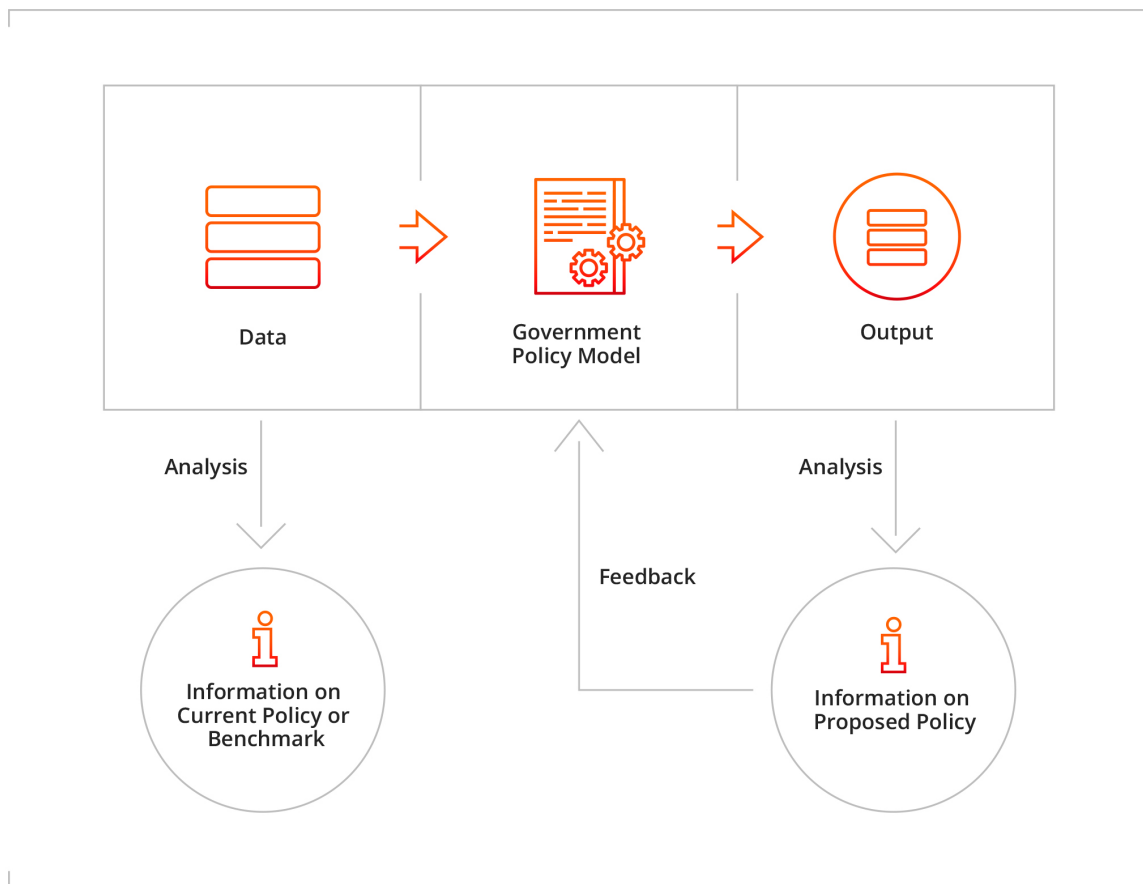
¹⁵ In July 2015, the Australian government established the '[Digital Transformation Office \(DTO\)](#)' to transform government services and access to information in a digital format to improve citizen experience.

visualisations have recently enabled citizen interaction with government data in a way that allows for more insights into policy development¹⁶.

The Government Modelling System (GMS)

Sound policy analysis is an important factor underpinning the quality of public debate since it provides information on possible outcomes for alternative policies and is able to evaluate the effectiveness of existing policies. Government models are a powerful tool in policy analysis as they are able to provide quantitative insights into how key elements of a policy affect society. Given the complexity of our modern society, policy modelling for the purpose of quantifying policy effects, is often a difficult task. It is nevertheless important in guiding and evaluating policy design for decision making. Generally, government models aim to describe policies within our economy using a simplified framework based on available data.

Figure 1: A schematic representation and flow diagram of the main components in the Government Modelling System (GMS)



In its simplest form, the *Government Modelling System (GMS)*, as shown in Figure 1, consists of three main parts: data used by the model; the Government policy model along with its key assumptions; and the output produced by the model. The individual

¹⁶ For example, an interactive visualization of the breakdown of Government revenue and expenditure in 2013-14 and the projected estimates for future financial years can be found at <http://www.abc.net.au/news/2015-05-12/budget-2015-sliced-diced-interactive/6460102#spending/breakdown/2016/general-public-services>

characteristics of each of these components, as well as their contribution to the GMS, will be briefly discussed below.

Data

The data used for policy modelling may come from many different sources including census data, survey data and various government administration data. Analysis of this data is invaluable in providing insights into the effects of existing or historical policies. The Australian Government has recently employed unique ways¹⁷ of encouraging citizens to analyse and interact with open data¹⁸ so as to invent new and better ways of delivering this information to the public. In the context of the GMS, analysis of the input data also provides a “*benchmark*” against which the effects of new policy proposals or alternatives may be compared¹⁹.

Government policy models (GPMs)

Government policy models (GPMs) are at the heart of the GMS and are a simplified representation of the workings of policy within a prescribed economic environment. They are an essential tool in understanding how policies affect society and the economy, as well as how different policies interact with each other. GPMs are generally used for two main purposes: simulating alternative policy outcomes relative to some counterfactual policy or economic condition; and for forecasting policy trends over a short or long term period. The accuracy and effectiveness of the policy models are usually reliant on observational feedback for improvements or adjustments of the model’s methodological design and key assumptions.

Typically, as shown in Figure 2, there are four main elements that need to be considered when designing and developing GPMs: *policy implementation* which is the legislative interpretation of the policy being modelled; *software development*, which is the programming of the policy rules and forms the architecture of the policy model; the *economic assumptions* used by the model which form the framework within which the policy is implemented; and the use of *behavioural economics* which aims to simulate the decision making of the individuals and groups affected by the policy being modelled²⁰.

¹⁷ GovHack, <http://www.govhack.org>, an initiative of the Australian Government 2.0 Taskforce, is an annual event that draws people from government, industry, academia and the community together to mash up, reuse, remix and visualise open data.

¹⁸ [Data.gov.au](http://data.gov.au) encourages public access to and reuse of government data by providing it in useful formats under open licenses. <http://data.gov.au/about>

¹⁹ Moreover, newly available data may also be capable of assessing the effectiveness of previous modelling efforts in evaluating the effects of implemented policy. However, it is difficult to quantify how much of these differences may be attributed to the limitations of the modelling process.

²⁰ Policy models that employ behavioural economics aim to integrate the effects of psychological, social, cognitive and emotional factors in explaining the economic decisions made by individuals or groups. Models that do not have a behavioural component in their design often rely on historical data, which inherently contains behavioural characteristics and information on decision making.

Figure 2: A schematic of the components required for developing a Government Policy Model (GPM)



Output

The output of GPMs provide a quantitative measure of the effects of policies and their sensitivity to various assumptions or economic conditions modelled in the GMS. This information may be compared to data that's based on current policies or an appropriate benchmark, and used for the purpose of refining the GPM's methodologies and assumptions. Often the output is complex and various analytic methods and visualisation techniques may be employed to understand the policy implications. The output can also be interpreted in the context of how the policies modelled affect certain population groups, such as by age group, generation cohort, income level, industry type or by electorate. The output of economic or policy models generate a lot of interest in the public sphere and are often highly contested by the general public, political parties, stakeholders and the media.

Government Open Source Models (GOSMs)

Government open source models (GOSMs) refer to the idea that government developed models whose purpose is to design and evaluate policy²¹, are freely available to everyone to use, distribute and modify without restrictions. GOSMs extend the definition of GPMs by allowing for model distribution and modification. In fact, of the four components of GPMs discussed earlier, current policy and legislation is freely available and behavioural economic theories are often published in academic research and are widely accessible²². The availability of GOSMs would therefore predominantly require the release of the economic

²¹ Although this paper presents GOSMs with a focus on public policy, a wider range of government models may be included in the definition of GOSMs.

²² Ideally, access to such research would also be freely available and not limited to academic journal subscriptions.

assumptions and software used in GPMs. Increased transparency and openness in policy modelling would promote a better understanding of the policies themselves as well as improve the accountability of our elected representatives. GOSMs also have the capacity to promote greater citizen participation and collaboration in our democracy, which would enhance the process of government and improve the policy outcomes sought²³.

Open Source Software (OSS) inherently addresses many of the key principles of an open government. It is capable of providing broad access, is vendor independent and is also able to meet specialist government and security requirements. In developing government models for policy analysis in accordance with the Australian Government's open source software policy²⁴, it is important to consider issues around public accessibility and interoperability for optimal citizen collaboration. Ideally, government models released to the public should be developed using OSS for optimal availability, freedom and transparency.

Public Development of GOSMs

Publicly releasing GOSMs has the potential to deliver new and undiscovered benefits to policy modelling and analysis by utilising previously untapped capabilities for creativity, innovation and efficiency in the broader community. It is well understood that diversity is a key driver for innovation²⁵ and is often employed as a critical resource in the workforce. Allowing public access to the source code of Government policy models encapsulates a wide range of inherent and acquired characteristics required for optimal levels of diversity²⁶, which could lead to novel improvements to existing policy modelling issues.

Contributions to the development of GOSMs from the public have the potential for advancements in each of the four components of a GPM described earlier. However, the most significant gains in policy modelling are expected to occur in areas involving advanced analytic technologies due to the recent global digital revolution²⁷. The development of GOSMs enables technological entrepreneurs to better utilise government data and employ 'cutting edge' modelling techniques to improve the quality, reliability and accuracy of the models. Whereas in the past policy analysis primarily involved economists, policymakers and politicians, a digital transformation of government policy modelling now paves the way for model development to also include a wide range of technological and other specialists, for example data scientists²⁸, amongst others from the public.

Software and model developers of OSS today are well aware of the issues relating to ownership of software and various open source licensing options. Although GOSMs may be initially developed by specialist policy analysts in government agencies, publicly releasing these models would allow informed and interested citizens to modify and redistribute the

²³ From a policy maker's perspective policy intervention is about influencing behaviour, and policy modelling is an important tool in quantifying the effects of the intervention.

²⁴ In January 2011, the Australian Government introduced a policy requiring agencies to consider Open Source Software (OSS) for all software procurements and comply with the OSS policy procedures.

²⁵ Harvard Business Review article, "[How diversity can drive innovation](#)", by Sylvia Ann Hewlett, Melinda Marshall and Laura Sherbin discuss their findings that demonstrates the role of diversity in driving innovation.

²⁶ Ideally, barriers to entry for contributing to innovation such as education, access to required technologies etc. would need to be minimised to allow citizens equal opportunities to contribute to policy analysis.

²⁷ Examples include smarter mobile devices, the Internet of Things (IoT), cloud computing and big data analytics.

²⁸ IBM describes data scientists as having a foundation in computer science and applications, modelling, statistics, analytics and math. <http://www-01.ibm.com/software/data/infosphere/data-scientist/>

models in accordance with the model's original licensing agreement²⁹. Ideally, any improvements and efficiencies made to policy models should be quality assured and incorporated into the 'official version' for optimal public benefit³⁰.

The public provision of GOSMs

Government provision of GOSMs have the capacity to provide significant benefits to the general public. In an age where citizens gain vast amounts of knowledge by digitally interacting with information, GOSMs would provide users with an application that allows them to better understand their policy environment. Citizens would gain valuable insights into how various policies affect their circumstances, as well as being able to identify the key drivers of the policy models. Government is in a unique position to be able to provide objective policy models compared with lobby groups or private stakeholders, since it is ideally concerned with the wellbeing of the general public.

Much like with the public benefits of education, GOSMs would be important for a more efficient and better functioning democratic society. GOSMs may be considered to be a public good since they satisfy the criteria of being *non-rival* and *non-excludable*³¹, and accessible to a broad range of members of society³². Figure 3 illustrates how GOSMs are a special type of public good, one that is also *modifiable*. The implication of this additional criterion is that these types of public goods may be tailored to the specific needs of individuals and entities, and therefore offer greater efficiencies and public benefit.

²⁹ One could argue that in the interest of policy analysis transparency, GOSMs would require a copyleft license or Affero General Public License (AGPL).

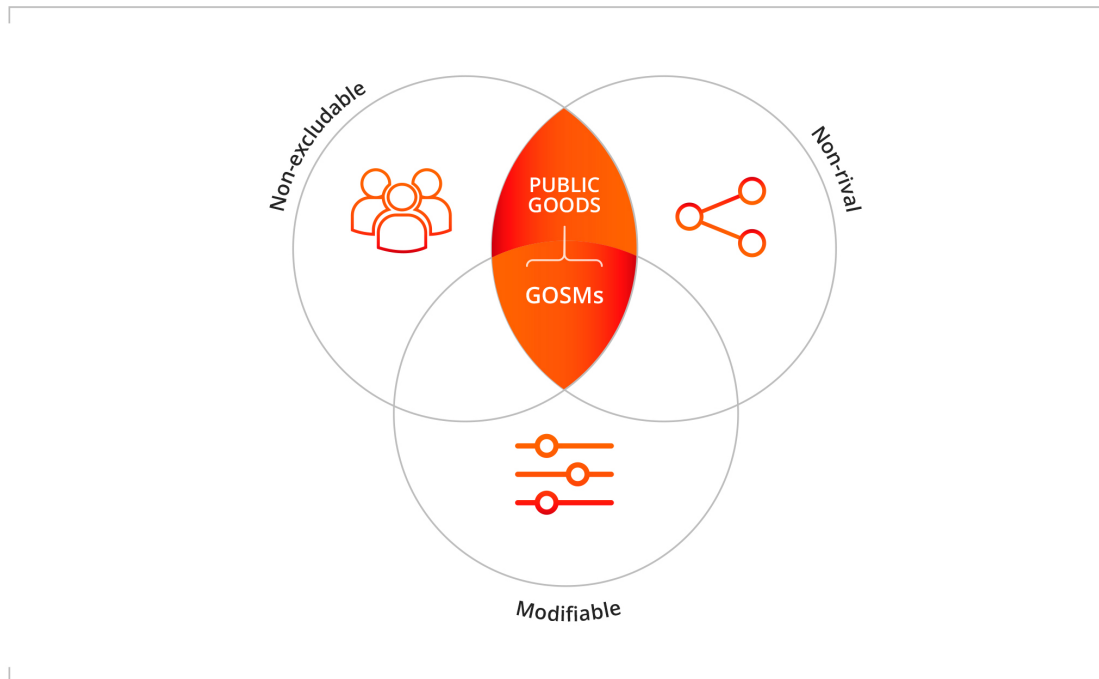
³⁰ Setting up the digital infrastructure required for the provision of GOSMs, for example an up-to-date source code repository maintained by government, may require additional government resources and expertise. However, in Australia www.data.gov.au already exists and currently hosts a github page (a web-based Git repository hosting service, which offers distributed revision control) at <https://github.com/datagovau>

³¹ Non-rival means that an individual's use of GOSMs does not affect or reduce the ability for others to use them, whereas non-excludable means that it is not possible to exclude anyone from using GOSMs once they are available. However unlike traditional public goods, GOSMs, much like OSS, are a dynamically changing public good which may be modified or tailored to the user's needs.

³² According to the Australian Bureau of Statistics (ABS) approximately 7.3 million households (or 83 per cent of all households) had access to the internet in 2012-13. Data obtained from the 'Australian Bureau of Statistics, 8146.0 – Household Use of Information Technology, Australia, 2012-13' publication.

<http://www.abs.gov.au/ausstats/abs@.nsf/mf/8146.0>.

Figure 3: An illustration of how GOSMs fit the public goods criteria



Privacy and security issues

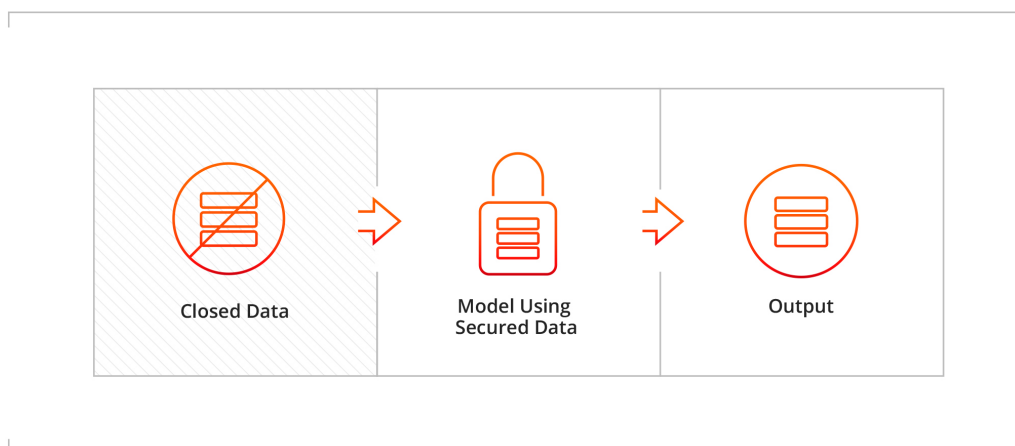
The big challenge for the government in releasing policy models to the public is in finding a balance between increased transparency and innovation in government modelling, and protecting citizen privacy and autonomy³³. The current big data environment presents its own challenges in preserving individual privacy with the increasing presence of sophisticated algorithms that may be used for profiling of individuals³⁴.

In the context of GOSMs, it is possible for policy models to be designed in such a way as to allow the public release of these models, without releasing the data that's used by the models. For example, it would be possible to provide public users with a labour force model which includes algorithms specifying the participation and unemployment rates, without providing data on an individual who could be identified. However, also providing the output of the models may allow the input 'closed data' to be reconstructed or reverse engineered. Ideally, releasing GOSMs that employ closed data would require securing the data in a way that preserves the key features of the modelling output as shown in Figure 4.

³³ By preserving choice in relation to an individual's personal information, different individuals may make different decisions as to the degree of privacy protection they want.

³⁴ It is even possible that anonymised datasets may contribute to the identification of individuals when matched with other available data using state-of-the-art pattern identification and data matching techniques.

Figure 4: A schematic representation showing how closed data may be used by GOSMs



Apart from protecting citizens from privacy concerns, the government is also responsible for ensuring the integrity of our policy environment and national security. For example, releasing government modelling pertaining to compliance activities or defence may pose considerable risks to the state and would not be in the public’s interest, since it could do more harm than good³⁵. The main idea behind publicly releasing government policy models is to empower citizens to gain a better understanding and confidence in their policy environment and their elected representatives through the principles of open government.

The role of GOSMs on policy development

Political debates involving policy modelling are often based on discussions around government spending commitments and fiscal planning, and usually tend to intensify during election campaigns and when the government delivers its annual budget. Until recently³⁶, the policy costing process in such debates usually favoured the government against the opposition mainly because the government had greater access to specialised policy advice and modelling provided by government agencies³⁷. The effect of this imbalance was that when they did get access³⁸, major parties in opposition became reluctant to request public costings for their policy proposals so that their economic credibility remained unquestioned. As a consequence, a number of policy proposals would circumvent the public costing process and so these spending promises avoided quantitative scrutiny.

Ideally, the public availability of GOSMs would allow political parties, the media and other stakeholders equal opportunities and freedom to test policy options for themselves to

³⁵ Before releasing any government modeling, it is important for government to consider whether publicly released modeling has the potential to be abused by individuals or entities such as organized crime.

³⁶ The taxpayer funded Parliamentary Budget Office (PBO) improves the apparent imbalance in policy advice and analysis between political parties by providing all non-government members the opportunity for policy proposals to be costed in a private process.

³⁷ Ross Gittins identifies these unintended consequences of the *Charter of Budget Honesty Act* 1998 during election campaigns. <http://www.smh.com.au/articles/2004/10/17/1097951555335.html>

³⁸ During the ‘caretaker period’ which starts when parliament is dissolved by the Governor-General prior to a general election until the next ministry is appointed, policymakers and government officials are given their independence and permitted to treat political parties equally.

potentially develop better policy proposals³⁹. However, in practice this is largely dependent on various constraints such as the usability of the models and expert policy and modelling knowledge. Nevertheless, it allows for increased transparency and accountability of public policies particularly during election campaigns and budget processes, making our elected representatives more economically responsible in their policy proposals. From a public policy development perspective, improved transparency in the policy modelling process could shift political debate more towards issues around policy design such as efficiency and equity rather than based on costings⁴⁰. Moreover, this improved transparency may enable stakeholders and the government to have access to modelled policy outcomes for the purpose of putting forward policy proposals that would otherwise have been overlooked.

Aside from the benefits of government accountability, citizen engagement and innovations in model development, GOSMs also have the potential to influence the evolution of the policy development process. The technological capabilities and processing power of computers today have enabled government policy models to produce more output with a much quicker turnaround compared to the past. This accessibility and availability of policy costings has reshaped the policy development process making it an iterative and dynamic process between policymakers and politicians⁴¹. The availability of GOSMs to the public could result in an 'information explosion' of policy modelling options and output, thereby creating a virtual *policy ecosystem* where policies interact and evolve in a digital environment. The implication of this concept is that only the most optimal policies influencing public behaviour or achieving a desired outcome would survive. Modern technologies such as Apache Spark, Apache Hadoop and cloud computing are well placed to create such a digital environment for these policy system interactions⁴². The evolution of policies in an open virtual environment has the potential for increased efficiencies in policy development and improvements in equity considerations.

Conclusion

GOSMs have the potential to enable the public to become active participants in the policy analysis process through greater modelling transparency and by allowing users to interact with a 'virtual policy environment'. The technological and innovative benefits to the modelling process by tapping into public capabilities and a constantly evolving digital landscape has the capacity to improve policy development and public debate. Empowering citizens by promoting greater understanding and participation into their democracy would ultimately lead to improved policy outcomes and public satisfaction.

³⁹ It is important, however, that policy costing options be prepared on the same economic framework i.e. ensuring that model assumptions, parameters and forecasts are consistent for cross policy comparisons.

⁴⁰ Of course, there will always be debate around the methodologies, assumptions and output of the models, but it is expected that openness through the provision of GOSMs will promote a better understanding of the key drivers of the policies being modelled and hopefully less variability in quantifying the effectiveness of these policies.

⁴¹ It is possible that this may result in policy development that's more closely focused on costings rather than policy ideas, beliefs and values.

⁴² Both Apache Spark and Apache Hadoop are Open Source Software (OSS) cluster computing frameworks that are used for large scale data processing. Cloud computing enables the use of a network of remote servers to store, manage and process data.

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