

### 3. Project description, approach and outcomes

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**Lead CI name:** Dr Gideon Aschwanden

**Project title:** Policy evaluation in the housing market with Agent-Based Modelling

**Detail the aims and research questions that this pilot project seeks to address and why they are important. 250-500 words**

This project aims to produce a transparent evaluation methodology to estimate the impact of policy changes associated with changes to the Australian negative gearing and capital gains tax regime. The research question is: *How can we most effectively model the impact of policy changes to the housing market.*

Access to safe and secure housing is a basic human right. Unfortunately, however, the current political debate around affordable housing and how it may best be achieved is fraught, with opinionated conversations around negative gearing and capital gains tax at the centre of this debate.

The public domain is replete with economic models both requested and generated by industry sectors with vested interests in their outcomes. Often designed to produce ‘[nightmare scenarios](#)’ of falling house prices and unaffordable rents, such modelling does little to inform public debate or make explicit the competing forces at play within this complex policy environment. For example, a recently released report by consultancy firm [BIS Shrapnel](#) predicted that reductions in negative gearing would produce a \$19billion hit to Australia’s GDP, while pushing rents up by as much as 10%. The [Housing Industry Association](#) likewise warned of falling living standards and higher tax burden for all Australians should negative gearing be restricted.

The assumptions and dire predictions contained within such reports have been rejected by independent institutions such as the [McKell](#) and [Grattan Institutes](#), who provide a more temperate estimates of policy changes in their respective 2015 and 2016 reports. Still, the complex nature of debate and the inability of the public to effectively ‘get inside’ the numbers, assumptions and combined scenarios contained even in more balanced analyses, means that true understanding remains limited. Required is a new, transparent method for the public to interact with this heated and complex policy arena; one where the multitude of available policy options can be generated, viewed and understood by all.

The housing market contains a large number of actors, including builders, agents, banks, renters and owners with a relatively stable number of objects (houses and apartments). Each of these actors also has motivations to buy, sell, rent, invest or otherwise act in their best interests. Rather than a traditional ‘top-down’ method as has been traditionally used in the models described above, this structure lends itself to be modelled in a bottom up manner using computational social science methods; Agent-Based Modelling (ABM).

ABM has been successfully used in many complex policy environments to understand the effect that various policy-levers have on individual actor and population-level outcomes. Unlike more static, deterministic models used above, ABMs are also extremely flexible, enabling an almost infinite set of policy scenarios to be studied or for systems to seek optimisation based on desired macro-level outcomes. Developing this model will enable us to investigate the behaviour of the market as a whole over time but also to see how these changes are impacting individual population or market segments (e.g. Older vs younger investors, 2 room apartments vs detached homes, etc.). This unprecedented granularity of evidence may help guide policy and how they should be implemented to support affordability or mitigate erratic changes due to sudden policy adaptation.

**Outline the pilot project's research approach, methodology and timeline. 250-500 words**

The project creates a fine-grained representation of the housing market including all relevant actors, (e.g., buyers, sellers, investors, builders, lenders and policy-makers) relevant to the Australian housing industry. The agent-based model will be built to reflect raw figures contained within existing 'top-down' models constructed by existing independent analyses to ensure consistency with 'baseline' assumptions.

Workshops between investigators will take place following the 10-step format of van Dam, Nikolic, and Lukso (2012). The results of the pilot project will generated within 12 month.

1. Problem formulation and identification
  - 1.1. Defining the scope and aims of the model and project as described in this application
2. System identification and decomposition
  - 2.1. Workshops held with investigators and other interested / invited parties (e.g., industry groups and government) to identify the breadth and scope of actors and influences included in the model.
3. Concept formalisation
  - 3.1. Defining relationships, behaviours and interactions of the model actors. Here, the broad policy settings and underlying behavioural assumptions of buyers and sellers (for example) will be made transparent.
4. Model formalisation
  - 4.1. Here, the 'story' of the model will be built, detailing which actors do what and when. This aspect of the model build will be written in 'pseudo-code' so that people unfamiliar with reading computer code can gain an understanding of how the model 'works'.
5. Software implementation
  - 5.1. Transcribing the pseudo-code into an existing agent-based modelling platform such as Netlogo or RePast Symphony to ensure model transparency and enable iterations and update of future models.
6. Model verification
  - 6.1. Once built, the model will be iterated and run under various baseline and experimental conditions to determine whether the actors and relationships we intended to model are operating as expected.
7. Experimentation
  - 7.1. When satisfied with the operation of the model, we will then experiment with the policy settings contained within it, testing assumptions made by previous 'top-down' models and creating various future policy scenarios.
8. Data analysis
  - 8.1. Data produced by the model will be analysed to identify trends and insights as well as policy settings that produce optimal system performance. Pattern exploration will also take place based on the macro-level visualisation outputs of the model.
9. Model validation
  - 9.1. To validate the model we will compare results produced from the 'baseline' settings against those created by previous top-down models from The Grattan Institute as well as 'replay' historic policy-change events (e.g., previous efforts to limit negative gearing) in attempt to replicate observed patterns
10. Model use and dissemination
  - 10.1. Finally, the model will be published in a formal academic publication and in Pursuit. Results will be made available to policy-makers and planners, with opportunity for individual to input their own assumptions and policy-scenarios

The project aims to conclude the first 4 steps within 2 months. The software implementation and verification (steps 5 and 6) will take up to 4 months during which most of the costs occur. Running multiple experiments, generating results and evaluating them (Steps 7 – 9) is anticipated to take 3 months.

**Outline the expected research outcomes and potential impact of this pilot project. 250-500 words.**

The topic of housing affordability and associated federal and state tax regimes such as negative gearing, capital gains tax, and stamp duty have been front and centre of national policy debates for the past three to four years. In order to understand the implications of these changes, a range of independent and industry bodies delivered reports and analyses in various forms in efforts to persuade and influence public debate. Despite each of these reports and ‘models’ strengths and weaknesses, however, none were delivered in an interactive or dynamic format that enabled engagement and understanding from the audience. Instead, assumptions and initial model conditions are generally ‘set’, with the audience required to agree with these in order to agree with the findings.

By contrast, this project will create an interactive and dynamic model which users will be able to manipulate the motivations, nature and strength of relationships between actors in the model to explore outcomes of potential policy futures. Rather than simply producing a single scenario or set of scenarios for discussion, a wide array of policy combinations could be tested and trialled hence stimulating the public debate. For example, if just 10 policy levers or system settings are included in the model, each with 3 ‘levels’, a total of 59,049 individual policy combinations are possible, each of which may deliver a unique outcome.

Through basing assumptions within our model on those of established and respected independent policy analysis institutes such as Grattan, we also hope to gain acceptance for the non-traditional, bottom-up, modelling approach we plan to use, and demonstrate the methodological utility of ABMs and computational social science in delivering public policy insight. Whilst complexity theory, systems thinking and agent-based modelling are increasingly accepted methods in academic circles, it has yet to become as widely utilised as traditional economic or statistical modelling and is a novel method to evaluate policy changes. We aim for this research to provide an exemplary platform upon which further public policy modelling efforts can be launched.

The availability of the model will also inform the public on the behaviour of the housing market and will hence improve the understanding and guide investment decisions towards sustainable long-term growth. This information will be valuable to investors and developers who are looking to anticipate market movements. This will allow us to further engage with the industry sectors and will foster future projects and grant applications.

Ultimately, we hope that this project stimulates significant public debate, enabling the Australian population to better engage with and understand an issue that has thus far been obscured by a mix of political and vested interests. We have no agenda to pursue, except that our academic efforts are a catalyst for a transparent and healthy discussion on this important Australian economic and social policy issue.

**Describe the role and contribution of each named Chief Investigator and Partner Investigator to the pilot project.**

The project team consists of two ECRs with complementary backgrounds in agent-based modelling, property and behavioural modelling. Prior work by both Dr Thompson and Dr Aschwanden used agent-based models to investigate the behaviour in hospitals and injury rehabilitation systems through agents and to simulate pedestrian and cyclist decision processes in the urban fabric. This expertise is augmented with the expertise of Brendan Coates from the Gratten institute in public and economic policy issues.

**Dr Gideon Aschwanden** – Chief Investigator. MSc (Architecture), PhD (Science). In his role as lecturer of Urban Analytics he is responsible for maintaining the data structure, integrating additional urban parameters into the risk model that play a crucial role and investigate alternative methodologies for risk assessment. This expertise complements the teams extensive knowledge in property valuation and the behaviour of the property market.

**Dr Jason Thompson** – Chief Investigator. BSc (Hons), M.Psych (Clinical), PhD (Medicine) is a Senior Research Fellow within the School of Design

Jason's work is focused on the translation of research into policy and practice across the areas of transportation, heavy-vehicle safety, public health, post-injury rehabilitation, and system design. Jason has expertise in methods of computational social science for the modelling of urban, social, organisational, safety, rehabilitation, and transport networks and has pioneered their use and

**Brendan Coates** – Partner Investigator - has extensive experience advising on public and economic policy issues. Brendan worked with the World Bank in Indonesia, and prior to that, he undertook a number of roles with the Australian Treasury, including as part of the Treasury's China Policy Unit. Brendan holds a Masters of International Development Economics from the Australian National University and Bachelors of Commerce and Arts from the University of Melbourne.

**For Stream 1 only**

**Outline your strategy and intended actions to engage with existing or potential target industry and/or government collaborators through this pilot project. 500-1000 words**

The subject of affordable housing, negative gearing and capital gains tax is a particularly ‘hot topic’ in Australia at present, with media outlets and policy-makers grasping at opportunities to dissect and discuss the pros and cons of policy change. Whilst this is somewhat affected by the timing of the Australian election cycle, it is expected that interest in this area will continue and peak again toward in the lead up to the 2019 (or prior) Federal election or in periods where differences in housing and investment policies between Australia’s major political parties are laid bare.

Further, the \$6 trillion value of housing investment and Australia’s [‘obsession’](#) with the property market is such that the interested audience for the results of this project will be extremely broad. Further, for those not directly invested in (or excluded from) the property market and their representatives, this project will also provide insight into policy settings that may optimise housing affordability both from a price and rental perspective.

In this regard, we expect that the project will naturally garner attention from policy-makers, industry, and interest groups (e.g., Australian Council of Social Service) – particularly when results are made public through academic and broader media communication sites such as The Conversation, Pursuit and existing contacts such as Fairfax media’s ‘Domain’. Therefore, whilst we have not specifically budgeted for industry or government liaison or communication activities, we believe the strength of the subject matter, itself, combined with release through existing media outlets will generate high levels of engagement.

A further aim is to harness this industry interest through a linkage grant in 2017 and maybe further CRC proposals. The existing collaboration with APM (Fairfax Media) will be leveraged. This initial linkage grant would extend the exiting pilot project in the following way:

- Expand the model to all capital cities.
- Include a rent model that allows to incorporate behaviour of the rental market
- Evaluate different implementation methods of policy changes

Since the industry business model is based on traffic on their homepage additional tools on their homepage will be of great interest.

Beyond the Grattan Institute this project allows us to start collaborations with other research institutes like the Future Cities Laboratory in Singapore and UCL’s CASA (Centre for Advanced Spatial Analysis) who both are looking at the interplay of space and policy.