TE TAI ŌHANGA
THE TREASURY

AMM modelling of uncompetitive urban land markets

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Introduction

- Objective: to introduce you to our work on spatial equilibrium analysis of uncompetitive urban land markets
- This new theory better matches observed reality, and can inform Treasury's policy advice
- Will cover:
  - Wider problem framing
  - Existing AMM model
  - Our innovation
  - Analysis
  - Next steps

Wider framing

Housing unaffordability problems

- NZ house prices causing problems for distribution, stabilisation, and allocative efficiency policy
  - Kirdan Lees (2019) used 4 methods of Glaeser & Gyouko. Economic rents over $500,000 per house in Auckland, but high prices nationally
  - Peter Nunns (2021) found similar to Lees
  - Ministry of Housing & Urban Development's *Urban Development Capacity Dashboard* indicators find large price differentials at urban fringe ($200,000+ per 600m^2 section in Auckland), & price-cost ratios of 2.7 in Auckland, and high prices nationally
  - Arthur Grimes & Yun Liang (2007) found large impacts of Auckland's then *Metropolitan Urban Limit*
  - Productivity Commission *Using Land for Housing* (2015) on price discontinuities at the urban fringe
  - Ryan Greenaway-McGrevy & Peter Phillips (2016) found repeated episodes of house price exuberance and spillovers across NZ cities
  - House prices have increased over 20% in the last year, exacerbating the above

Causes of problem

- Supply constraints
  - Land regulation (eg zoning) preventing intensification & expansion
  - Public infrastructure investment
  - Lack of long-term planning to reduce future supply costs
  - High build cost and building sector capacity
  - Other (eg, land fragmentation, geography, insurance availability)
- Demand exacerbators
  - Credit availability and low interest rates
  - Population growth
  - Tax policies (eg no CGT)
- Many complex feedbacks between supply & demand, creating vicious cycles

Two avenues to model – we model the 2nd

1. Investment dynamics likely requires real options analysis
   - Why? Intertemporal; development characterised by high fixed sunk costs; development is high risk

2. Urban land markets require spatial equilibrium analysis
   - Starting with the AMM model — workhorse urban economics model

- Both required. We are working backwards:
  - We focus on spatial equilibrium assuming we can model the investment dynamics already, and can explain the extent of price-cost mark-ups γ
  - In future we will try to model investment dynamics

Competitive city (existing theory)

AMM actors modelled

- Alonso-Muth-Mills (AMM) model of city spatial structure and prices
- **Households** max utility choosing house size and distance d from centre, subject to a budget constraint
  - We start with a very simple utility function $U(C, H) = C + a \ln H$
  - **Spatial indifference**: $\frac{\partial U}{\partial d} = 0$, a long-run equilibrium condition that people cannot improve utility by relocating. Implies that house and land prices decline from centre because of transport costs
- **Developers** max profit choosing building heights h
  - Marginal cost of building taller increases, $c(h) = c_0 h^{\delta}$, where $\delta > 1$
  - Free entry, so zero profits in equilibrium
- **Landlords** (distinct from landowners) buy houses, set rents
  - House prices in equilibrium are the NPV of rents as function of interest and tax rates, LVRs, and tax deductibility and other costs. j is the 'capitalisation yield'

AMM closed competitive city outputs

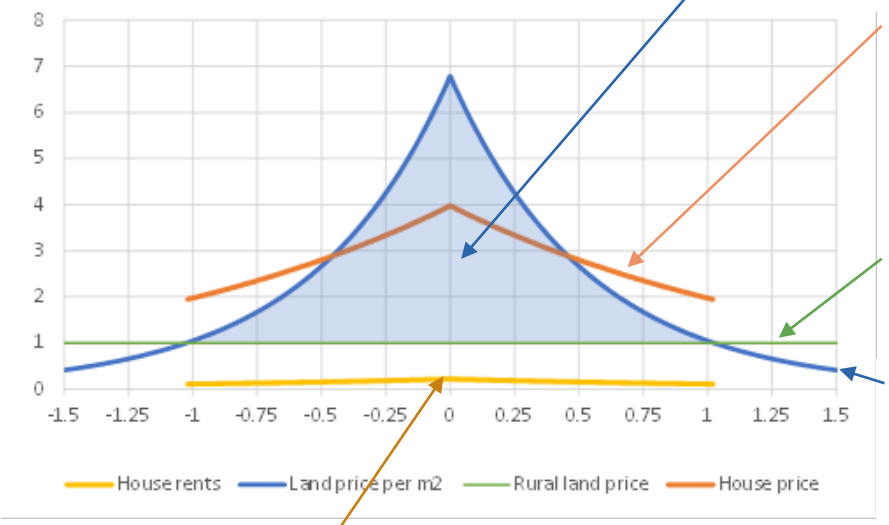
- **Always assumed that competition** at city limits $\overline{d}$ equates rural land price $\underline{r}$ to urban price net of development cost:

$$\underline{r} = r(\overline{d})$$

  - Positive reason: The spatial competition interior to the city is simply assumed to apply at and beyond its exterior boundary (ie, an oversight?)
  - Normative reason: This competitive result maximises social welfare when there are no externalities (Fujita and Thisse 2000)
- City population N
  - In **closed city** N is fixed, U endogenous. In **open city** U is fixed, N endogenous
- Urban land prices: $r_C(d)$
- House rents: $p_C(d)$
- House prices: $\underline{P_C}(d) = p_C(d)/j$
- We present only the closed city today

Competitive urban land markets

Alonso-Muth-Mills model of a city



House rent prices equal to annuity payments (post tax) derived from house prices

'Differential land rents' (or 'scarcity rents' akin to producer surplus)

- Equals the value of public good expenditure (the 'Henry George Theorem'), and can only be captured using a land tax (Arnott & Stiglitz 1979)

House price *bid-rent curve* (per m^2 of floor area):

- Gentle slope down from city centre in spatial equilibrium, as utility equalised everywhere in the *long-run*
- Extends, in this case, between -1 & 1 units of distance from centre
- Discontinuous at fringe because of fixed cost to build

Rural land prices (per m^2) based on world prices for agriculture / horticulture. Standardise by including the cost to develop

Land price *bid-rent curve* (per m2 of land area):

- Steeper than house price curve, because can substitute from land to capital improvements
- Equals rural land price at fringe (net of development costs), and city limits -1 and 1 where **farmers outbid developers in perfect competition**

Uncompetitive city (new theory)

Core innovation

- If farm prices don't determine urban land prices, what does?
- We let land prices vary between two extremes: competitive minimum, and extractive maximum
- Suppose dynamic (eg, real options) modelling could identify $\gamma \in [0\%, 100\%]$ on this spectrum
  - In other words, γ boils everything down to how bad the price-cost mark-ups are in land
- This is analogous to a bargaining game between landowners and households
  - $\gamma \in [0\%, 100\%]$ denotes bargaining power of landowners – zero when no power, and 1 when maximum monopolistic power
  - Household utility $U(\gamma) = \hat{U} + (1 - \gamma)\breve{U}$, where $\hat{U}$ is subsistence utility, $\breve{U}$ surplus utility
  - $\gamma = 0$ when urban land markets are competitive
- We generalise the AMM model by specifying γ

Generalising utility

- When $\gamma = 0$, the previous $p_C(d)$ applies, because that maximises household utility:

$$U = \widehat{U} + \breve{U}$$

$$\widehat{U} + \breve{U} = W - (1-\theta)\underline{t} - a + a\ln a - a\ln p_C(0)$$

$$\Longrightarrow U(\gamma) = \gamma\widehat{U} + (1-\gamma)\left(W - (1-\theta)\underline{t} - a + a\ln a - a\ln p_C(0)\right)$$

(For RHS of middle equation, the utility function of consumption of goods and services C and housing H after substituting the budget constraint is $U(C,H) = C + a\ln H = W - \theta td - (1-\theta)\underline{t} - p(d)H + a\ln H$. Here, W is wages; t is travel costs per unit distance (constant; no congestion); θ is share of commutes to the city centre because of job dispersion; $\underline{t}$ is fixed cost of local commutes; $p(d)$ price of renting housing per unit area of housing. Substitute the first order condition for housing $H(d)^* = \frac{a}{p(d)}$. Set $t = 0$ to calculate utility in the city centre, which is equal for all t. Refer to Glaeser (2008) *Cities, Agglomeration and Spatial Equilibrium* for details. For the LHS, one would need to specify subsistence utility/consumption levels for $\widehat{U}$.

We then substitute this now exogenous utility into the model, like one would if they were creating an open city AMM. Except rather than solve for population N, we solve for prices and the market-determined urban limit.

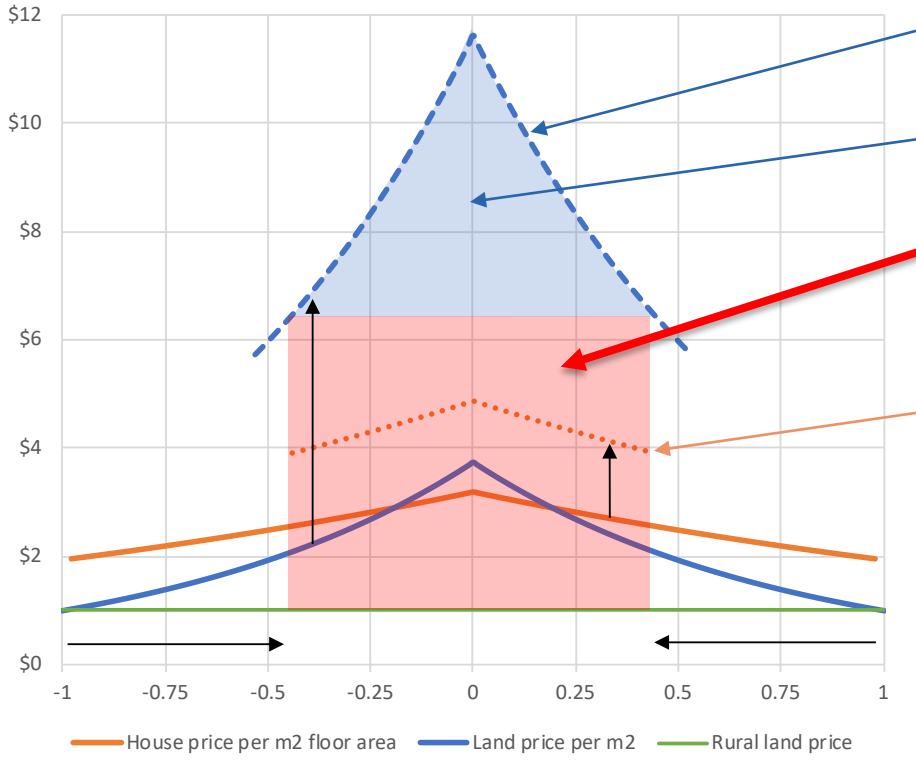
Results

- The new price functions become scaled up versions of the competitive city results, because

$$e^{\frac{\gamma}{a}\breve{U}} \geq 1$$

- Land prices: $r(d,\gamma) = e^{\frac{\gamma\delta}{a(\delta-1)}\breve{U}} r_C(d)$
  - Land prices are scaled more ($\frac{\delta}{\delta-1} > 1$) because land is used even more intensively
- House rents: $p(d,\gamma) = e^{\frac{\gamma}{a}\breve{U}} p_C(d)$
- House prices remain $\underline{P}(d,\gamma) = p(d,\gamma)/j$
- New city limits $\tilde{d}$ can be solved

Uncompetitive urban land markets



Land prices decoupled from rural land prices
Not equal to marginal social cost

'Differential land rents' — unchanged. Still can't be contested away

Economic rents (eg, $500,000++ per house) – can be contested away

Much higher house prices per m^2

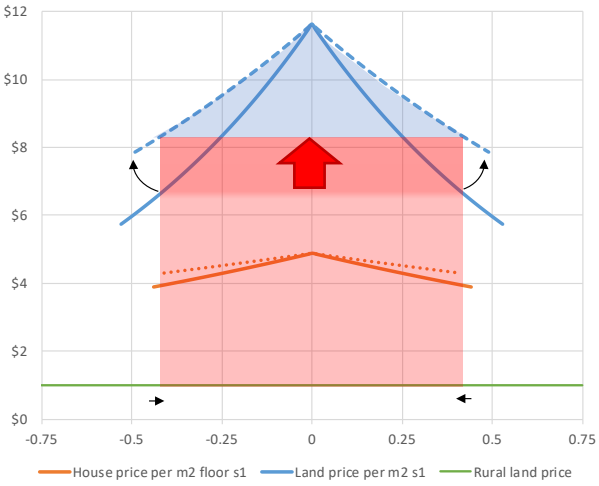
- Market response is small, crowded houses
- Market response is a compact & congested city (radius <0.5) – city circular area shrinks over 75% in this example

For this result to be sustained in cross-city spatial equilibrium (ie, open cities), all cities as a system would need to constrain competitive urban expansion. This means the underlying causes are systemic, not city-specific

Analysis insights

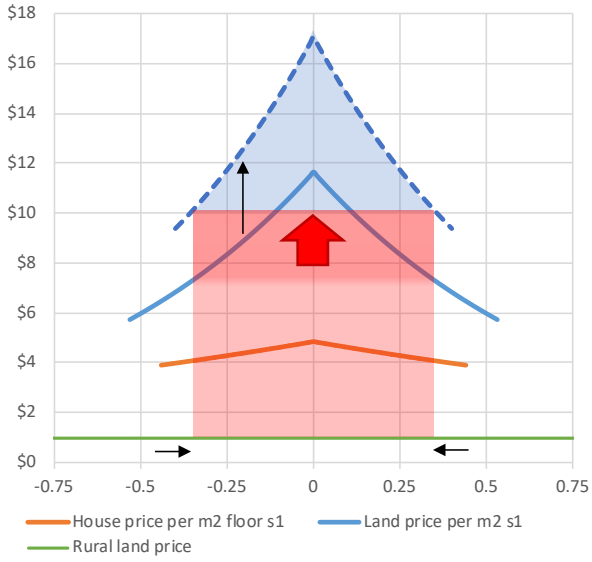
Traditional solutions increase transfers to urban landowners

Without competitive urban expansion these events may increase benefits, but they're captured by **increasing economic rents and inequality** & **do nothing for housing problem**

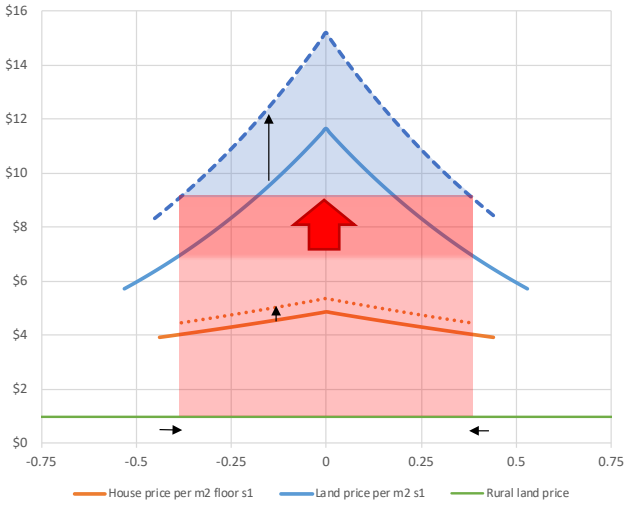


Inner-city transport improvements & **more working from home**

Up-zoning & reducing costs to constructing tall buildings



Increasing wages & productivity



Impact of interest, tax rates and LVRs on prices vs rents

- The direction of causality between rents and house prices reverses
  - House prices become the NPV of rents rather than rents the annuity of house prices
  - Eg, the impact of interest rate i rises is to increase rents in competitive cities, and to lower house and land prices in uncompetitive cities (or a mix of both depending on γ)

Table 1 Direction of impact of interest rates on key variables

Urban land market	House rents $\frac{\partial p(d)}{\partial i}$	House prices $\frac{\partial P(d)}{\partial i}$	Land prices $\frac{\partial r(d)}{\partial i}$	Household utility $\frac{\partial U}{\partial i}$
Competitive	$++$	0	0	$--$
Initially uncompetitive*	$++$	$-$	$-$	$-$
Moderately uncompetitive	$+$	$-$	$-$	$-$
Extremely uncompetitive	0	$--$	$--$	0

Theory relevance

- We now have the start of a general spatial theory of high house prices, one that better matches our reality
- Still consistent with the *Henry George Theorem* of Arnott and Stiglitz (1979) that differential land rents equal spending on public goods
- Consistent with the concepts of *ATCOR* (All Taxes Come Out Of Rents) and *EBCOR* (Excess Burdens Come Out of Rents), Gaffney (2009)

Policy relevance

Cabinet Minute: CAB-21-MIN-0045 **Objectives for the housing market**

4	**confirmed** that the government's overarching policy objectives for the housing market are to:	
	4.1	ensure that every New Zealander has a safe, warm, dry, and affordable home to call their own – whether they are renters or owners;
	4.2	support more sustainable house prices, including by dampening investor demand for existing housing stock, which would improve affordability for first-home buyers;
	4.3	create a housing and urban land market that credibly responds to population growth and changing housing preferences, that is competitive and affordable for renters and homeowners, and is well-planned and well-regulated;

- We can fix the housing crisis in the long-run by re-establishing competitive urban land markets by reforming land regulation, long-term growth-enabling planning, and public infrastructure supply
- Key focus of the *Urban Growth Agenda* and *Resource Management Act* reforms

Next steps

- Model open city
  - Will create a new parameter that governs the balance between prices or people relocating being the primary adjustment mechanism. Existing AMM assumes it's all the latter
  - Anticipate the result is that spatial equilibrium increasingly drives price adjustment rather than population relocation when land markets highly uncompetitive. This would harm people's access to opportunity and suppress agglomeration economies
- Model dynamics of land market competition to solve for γ
- Calibrate models to NZ data

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