

Tracking impacts of light rail investment through a volatile housing market: Combining qualitative and quantitative methods to understand dynamic influences of demographic change and investment incentives

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SCHOOL OF PLANNING



URBAN
GROWTH
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RESEARCH
GROUP

**WATERLOO
ENVIRONMENT**

environment.uwaterloo.ca

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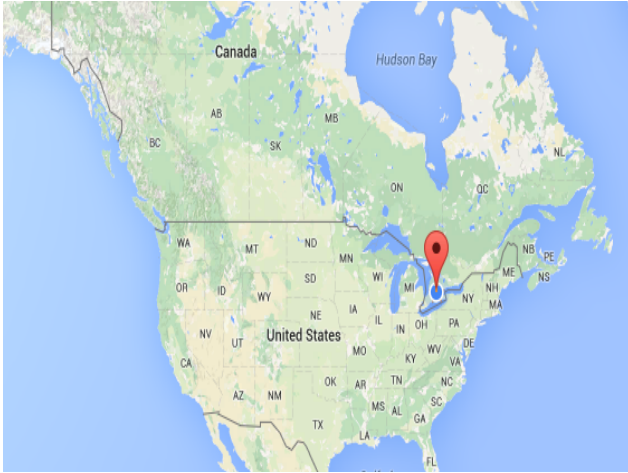
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Canada



Why is Kitchener-Waterloo Region interesting?

- **Increasing people** and employment
- **High tech hub** with entrepreneurship and knowledge-intensive economy
- A new light rail transit system as a key strategy for urban revitalization and overall economic development strategy
- **Housing boom (price volatility), but why?**



*Toronto
speculative
buyers?*

Foreign buyer tax?

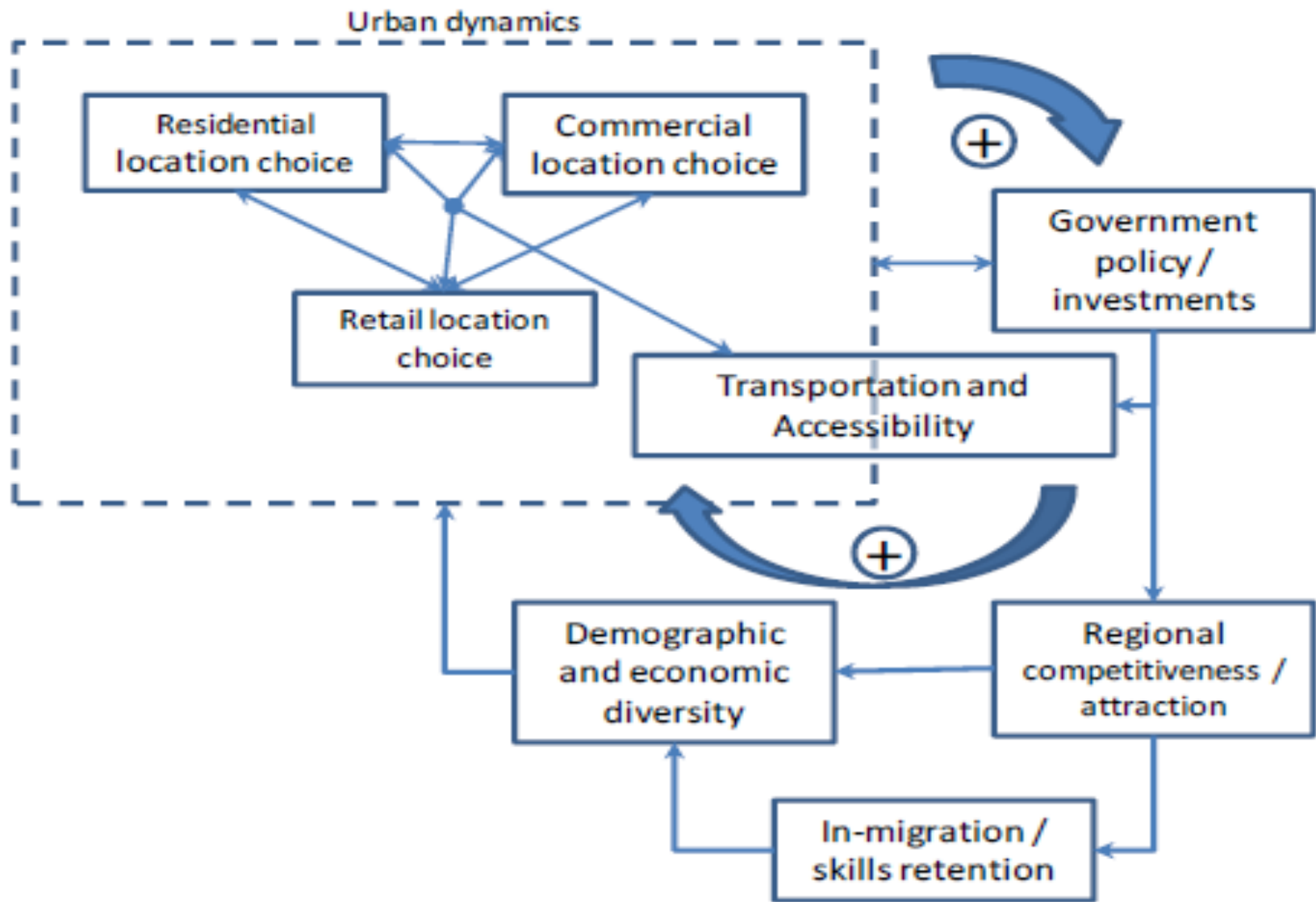
Low interest rate?

*Urban growth
boundary?*

Massive shortage?

Research questions

- Evidence of LRT-led investment in the Central Transit Corridor?
- What causal relationships and feedback are evident?
- What explains the hot housing market—expansion of Toronto influence, or LRT influence?



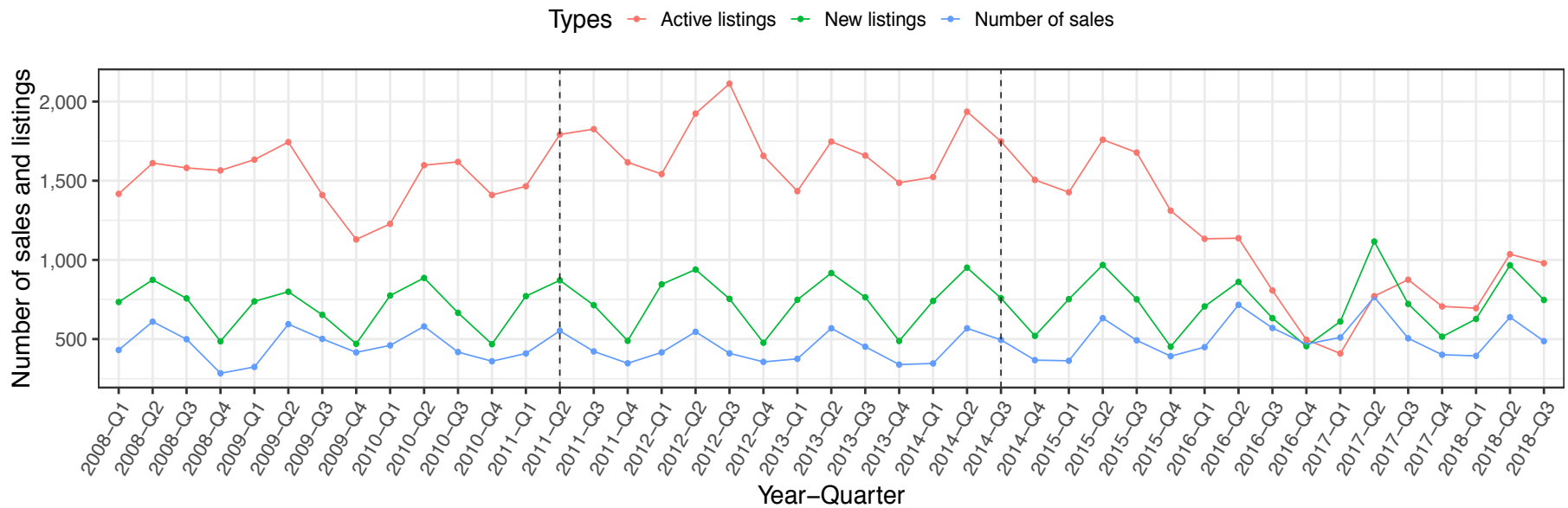
a

Historic Sales Price Trend for Kitchener Waterloo



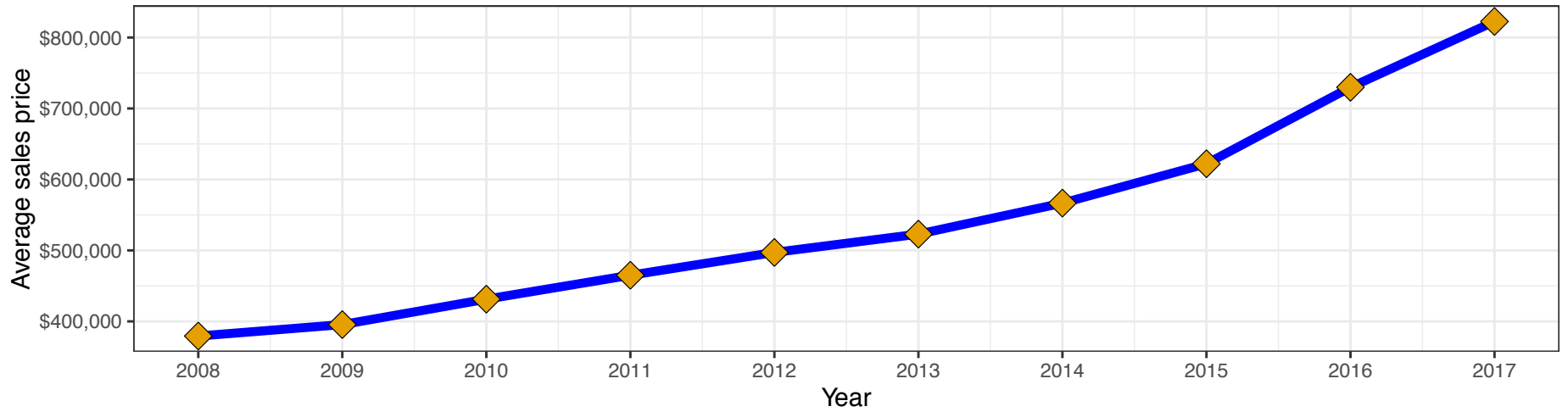
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Historic Sales and Listings Trend for Kitchener Waterloo



a

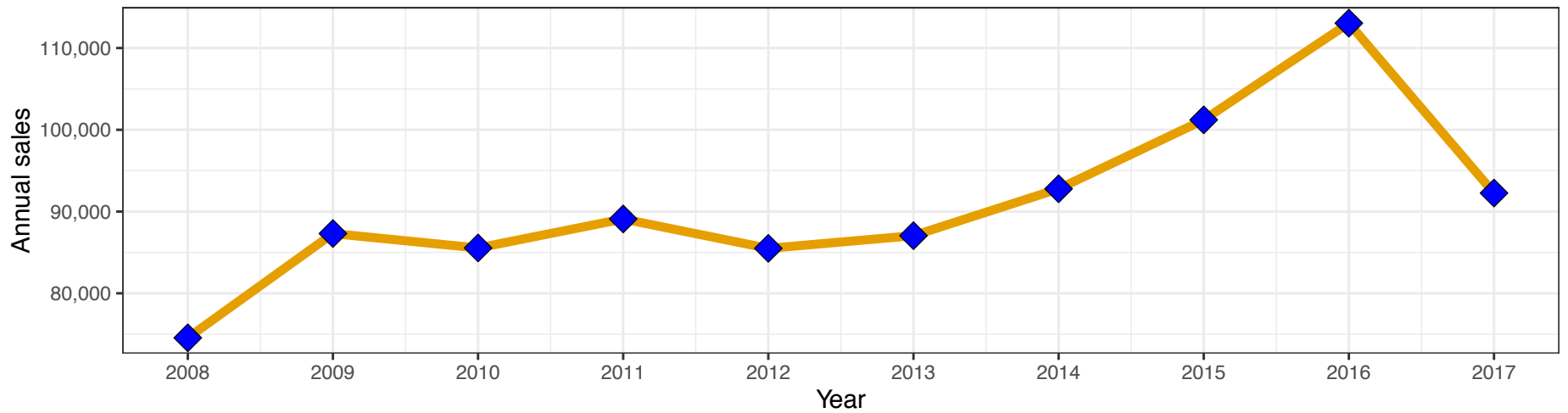
Annual Average TREB MLS® System – Sale Price for the Greater Toronto Area, 2008–2017



Source: Toronto Real Estate Board

b

Annual Average TREB MLS® System – Sales for the Greater Toronto Area, 2008–2017



Source: Toronto Real Estate Board

The story elements ..

1. What intensification has occurred to date?
2. Who is investing, and why?
3. What market effects can we identify?
4. Where are the missing markets?

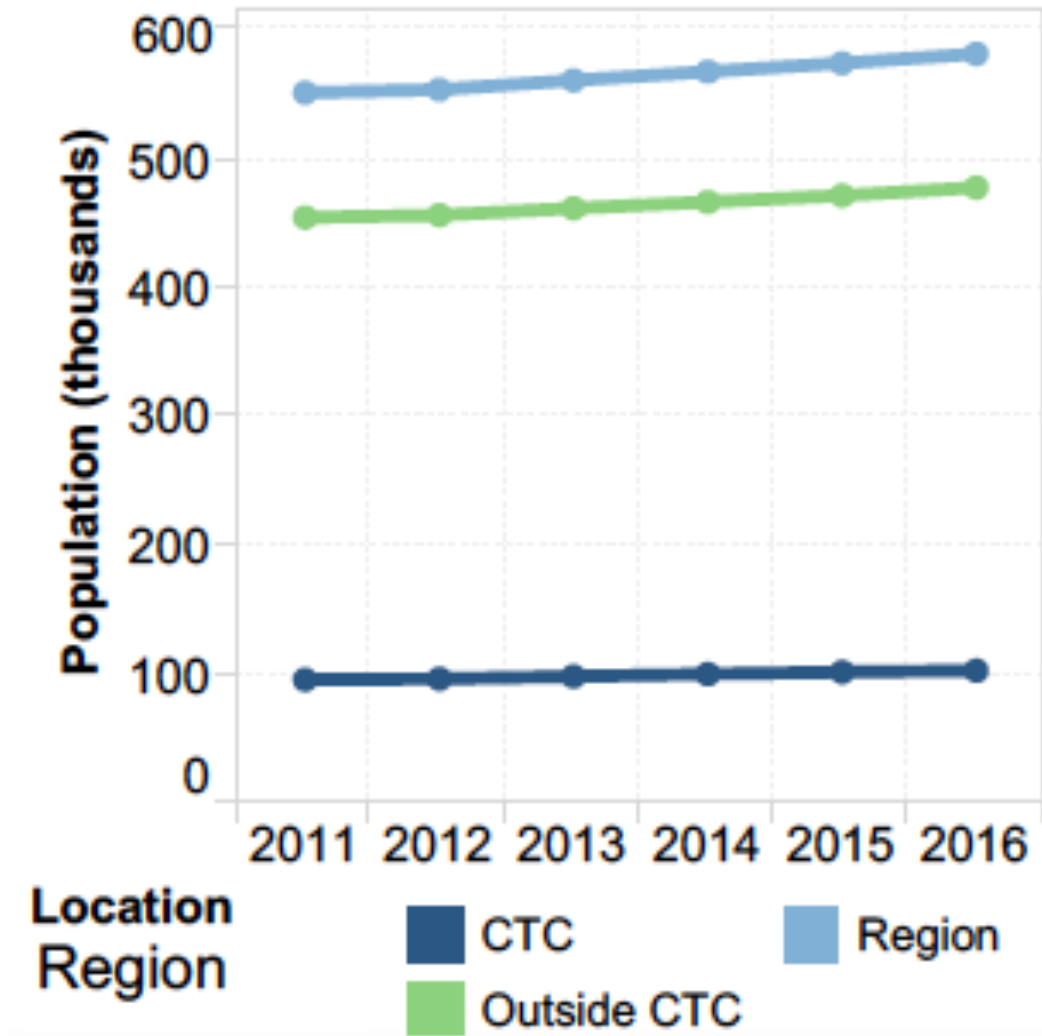
What intensification has occurred to date?

- Region of Waterloo monitoring project, collaborative design with our group

(All graphs in this section from the Region of Waterloo “Monitoring Change in the CTC” project : <https://www.regionofwaterloo.ca/en/regional-government/land-use-planning.aspx>)

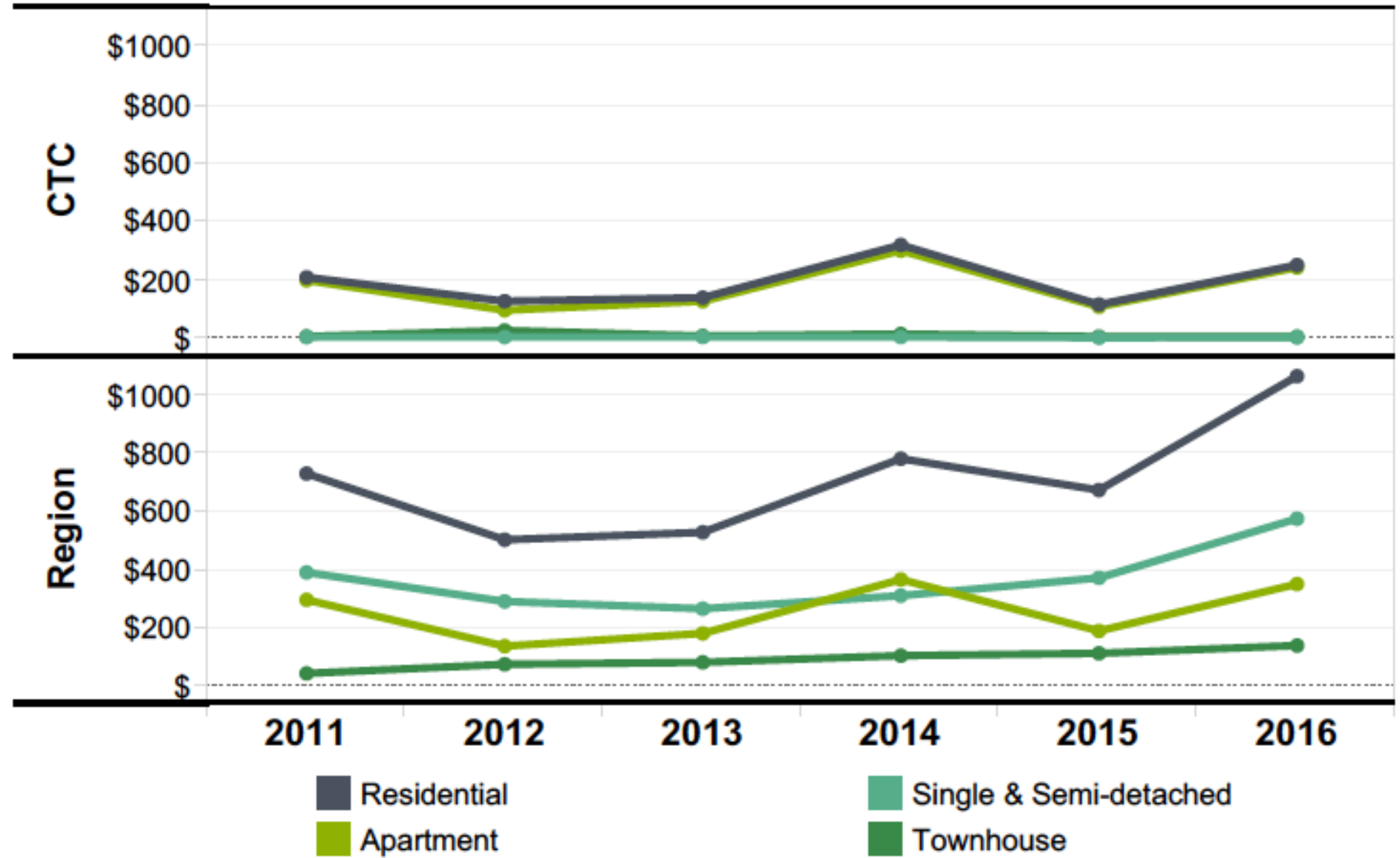
Population-
- Not growing
- Under 18% of
region's
population

Population



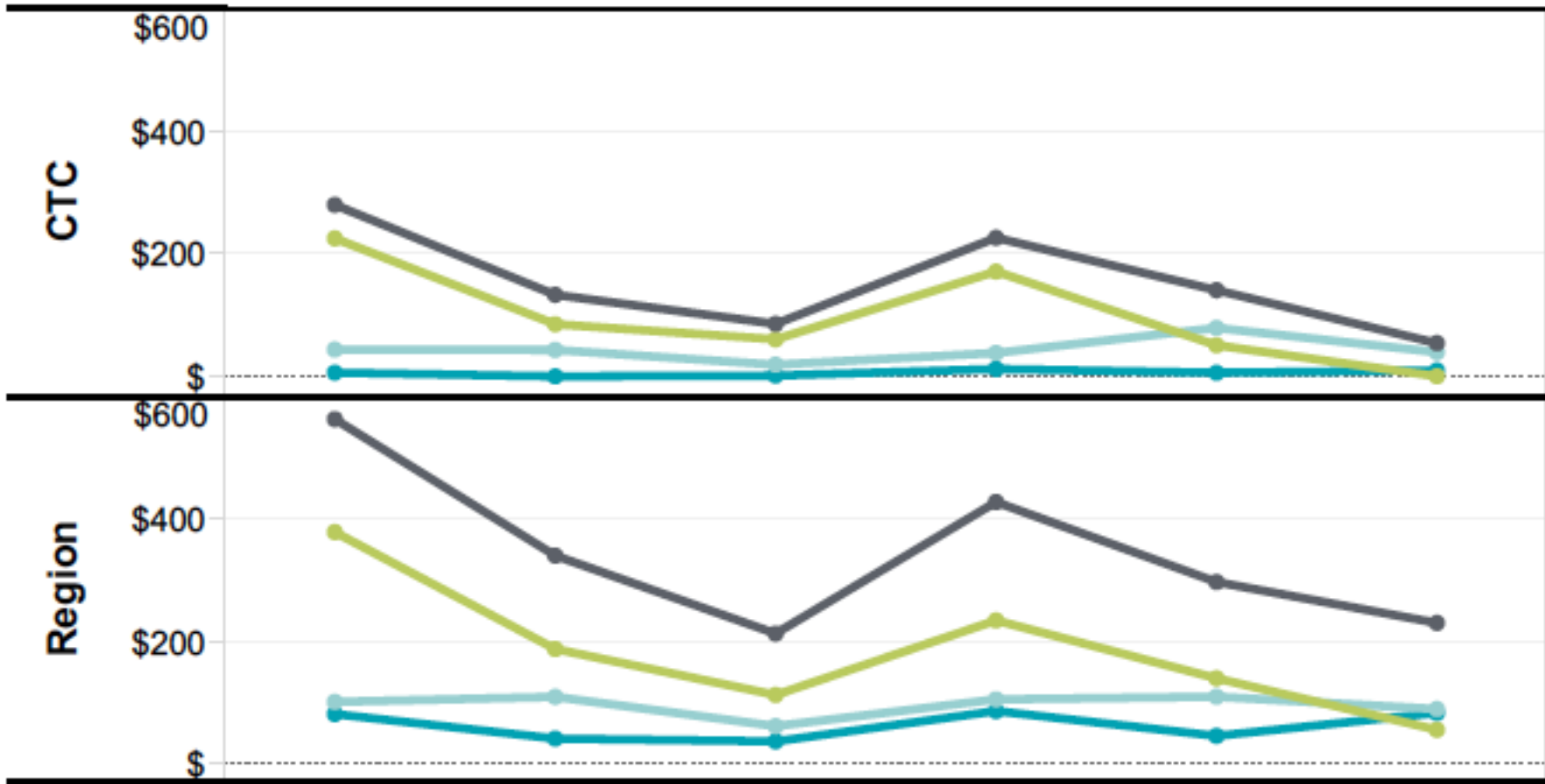
Building Permit Values (\$ millions) adjusted to 2011 dollars

Type Residential



Building Permit Values (\$ millions) adjusted to 2011 dollars

Type Non-Resi..



2011 2012 2013 2014 2015 2016

Non-Residential
 Institutional
 Commercial
 Industrial

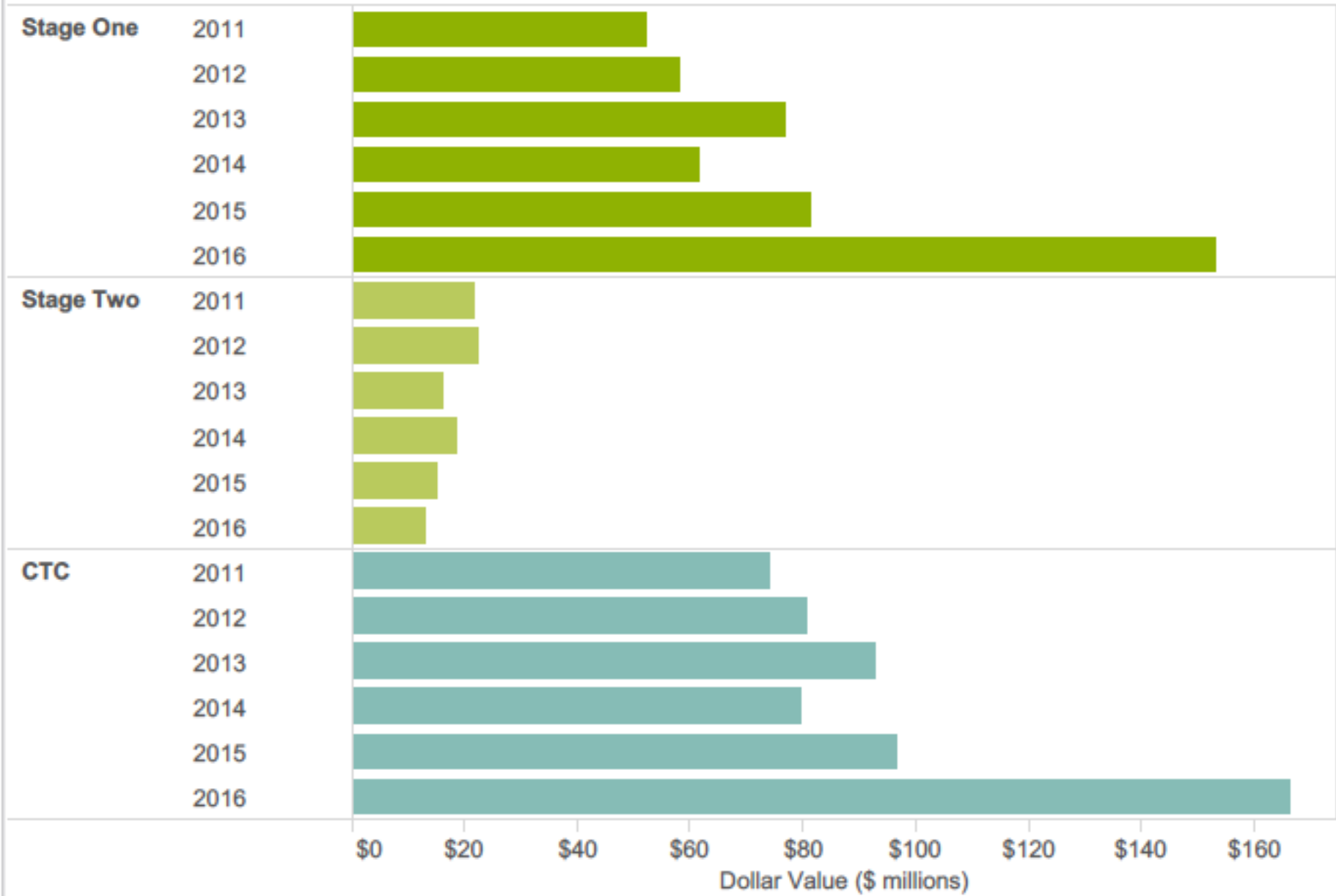
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Building Improvements

Scale^{All}

Year^{All}

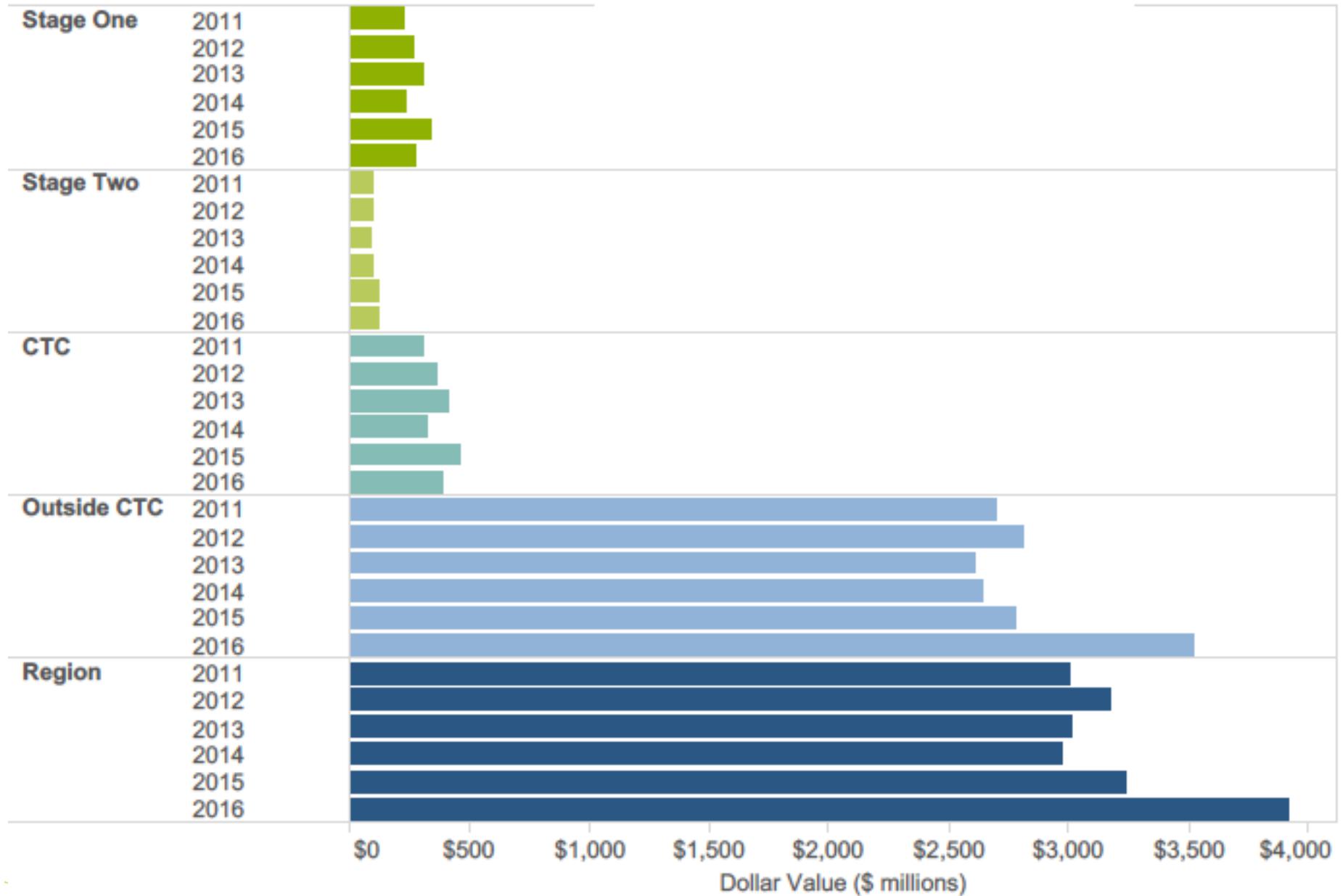


Transaction Value

Location ^{All}

Type ^{Residen..}

Year ^{All}



Who is investing, and why?

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Developer Survey Highlights (Jinny Tran)

- Conducting surveys with 17 residential developers
- Fairly wide distribution of specializations and built form found; shift towards intensified and mixed use forms-but segmented target markets (no family housing for core)
- Few developers consider what others are doing when making plans
- Response to LRT generally positive, but more so for infill developers than the other two—some “wait and see” expressed



Jinny Tran

Realtor interviews/Focus Groups (Justin Cook/Jennifer Dean)

Three broad themes emerged from discussions:

1. CTC development and investment
2. Resident perception of attractiveness of CTC
3. CTC creating connections within region and beyond

Findings: 1. CTC Development and Investment

*“We're seeing investment, local people that are buying in uptown, or downtown **just for investment purposes**. I think the families, the 30 plus demographic, that are now looking for more investment opportunities, they realize [the CTC] is something they can grasp and they realize that's **an up and coming area**.”*

Findings: 2. Resident Perceptions

*“Even some of the **older demographics**, I think they **are really looking forward to [the LRT]**. They are definitely buying to be close to it, not right on it but somewhat close to it, within a block or two. So it will be really good. I think it will impact [the Region] in a positive way.”*

Findings: 3. Creating Connections

*“In a real estate perspective, all the **condos**, the **Google** building... the **Zehr** group building; those are only there **because of the LRT**. They're looking at it as it's not just a north and south train, **it's connection** to Barrie, Hamilton, Niagara. All these places are going to have LRT that lead **to these fast trains** that all spine into Toronto. That's what [people are] investing on.”*

What market effects can we identify?

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Property Size Preferences & Value of Outdoor Space Under Intensification – DeFields, 2013



- In 2012, DeFields surveyed 206 residents in the Kitchener-Waterloo area
- Focused on property size preferences, relocation plans, landscaping choices, and factors favourable to higher density living



Low density defined as single detached houses on medium to large properties



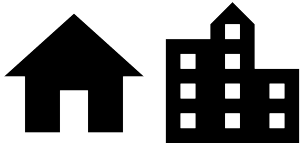
High density defined as small detached dwellings, townhouses, condominiums and apartments



What density do people prefer?



- Low density homes are preferred by:
 - Couples with children
 - 25-45 year olds
 - Household incomes of \$75k to \$99k

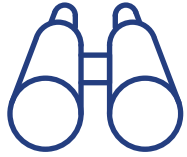


- Low and high density are preferred by:
 - Couples without children
 - 46-65 year olds
 - Household incomes of \$54k to \$75k, \$100k to \$250k



- High density homes are preferred by:
 - 66+ year olds
 - Retired

What factors are important to people when they would not have a yard?



Having a nice view



Close to a park or forest



Having a porch or balcony



Walking distance to an urban centre



Sense of privacy

How do we make high density living more attractive to low density residents?

1. Market high density living to those 55+
2. Incorporate private greenspace into buildings
3. Design open space to accommodate private uses
4. Preserve urban forests, parkland & open space
5. Use attractive landscape styles around buildings

Only the first point happening!

Pre-LRT hedonic Model (Babin)

- Statistical model to deconstruct property value (assessment and transaction models)

$$\ln(Y_i) = \rho W y_i + \beta_0 + \beta_1 \times S_i + \beta_2 \times N_i + \beta_3 \times E_i + u_i$$

$$S_i = \begin{bmatrix} \text{Living Area}_i \\ \text{Yard Size}_i \\ \text{Building Age}_i \end{bmatrix}$$

$$N_i = \begin{bmatrix} \ln CTC_i \\ \text{Rate of Appreciation}_i \\ \text{Education Rate}_i \\ \text{Population Density}_i \\ \text{Time Period}_i \\ \ln CTC \times \text{Time Period}_i \end{bmatrix}$$

$$E_i =$$

$$\begin{bmatrix} \text{Open Space Access}_i \\ \text{Transit Access}_i \\ \text{Walkability}_i \\ \text{Open Space Adjacent}_i \\ \text{Regional Road Adjacent}_i \\ \text{Open Space Access} \times \text{Yard Size}_i \\ \ln CTC \times \text{Open Space Access}_i \\ \ln CTC \times \text{Transit Access}_i \\ \ln CTC \times \text{Walkability}_i \\ \text{Open Space Access}_i \times \text{Transit Access}_i \\ \text{Open Space Access}_i \times \text{Walkability}_i \\ \text{Walkability}_i \times \text{Transit Access}_i \end{bmatrix}$$

Hedonic model highlights

- Model run using data from 2005-2015, to establish pre-LRT baseline
- Neighbourhoods with higher appreciation rates showed higher values
- After 2011, houses inside the CTC sold for around 4.5% more than houses outside
- Walkability showed a premium; more so inside the CTC

Renter's survey and hedonic model (Xinyue Pi)

- Showed 7.5% rental premium in CTC
- Showed around 8% premium for high-rise and 8% discount for low-rise apartments, relative to other types
- Students paid more; households with children and singles paid less

Housing Types: by Subgroups

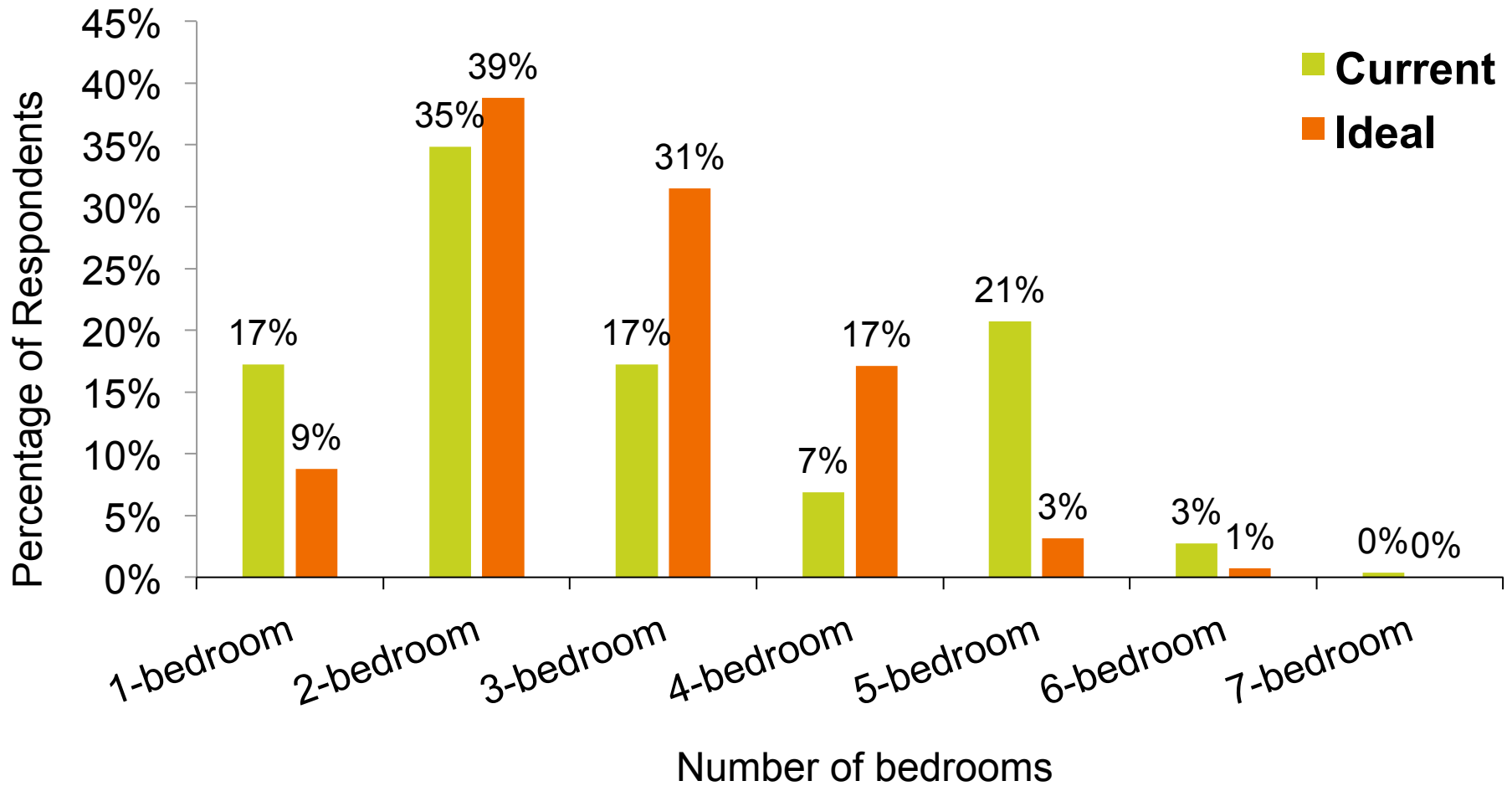
Current

- **18-24 and 55+ age groups** mostly live in apartment buildings
- The **higher the income** is, a higher the percentage of respondents of the group lives in high-rise apartments.

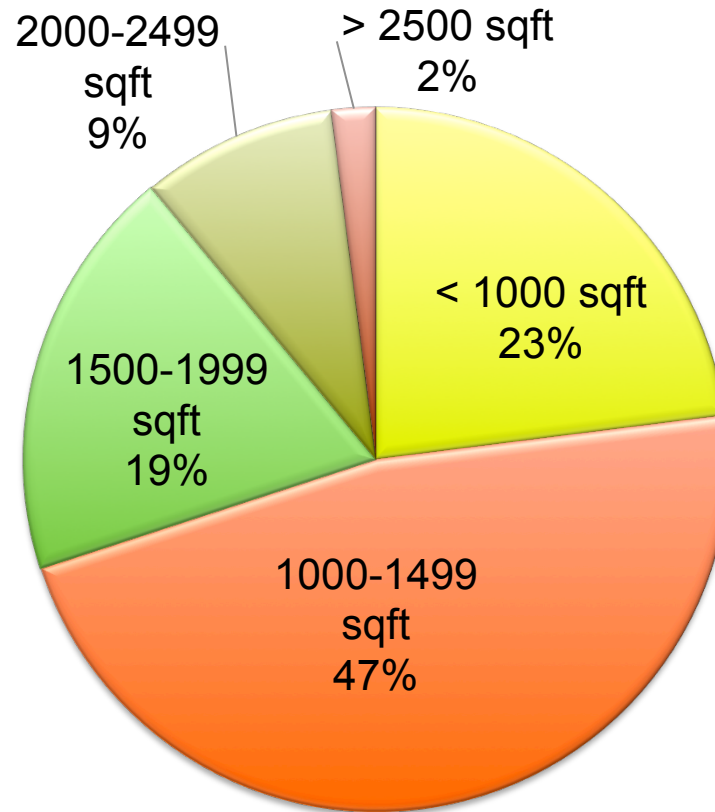
Ideal

- **Couples with children** have the greatest desire towards renting a house, especially single-detached
- **Retired, seniors and students** generally prefer apartments to houses.

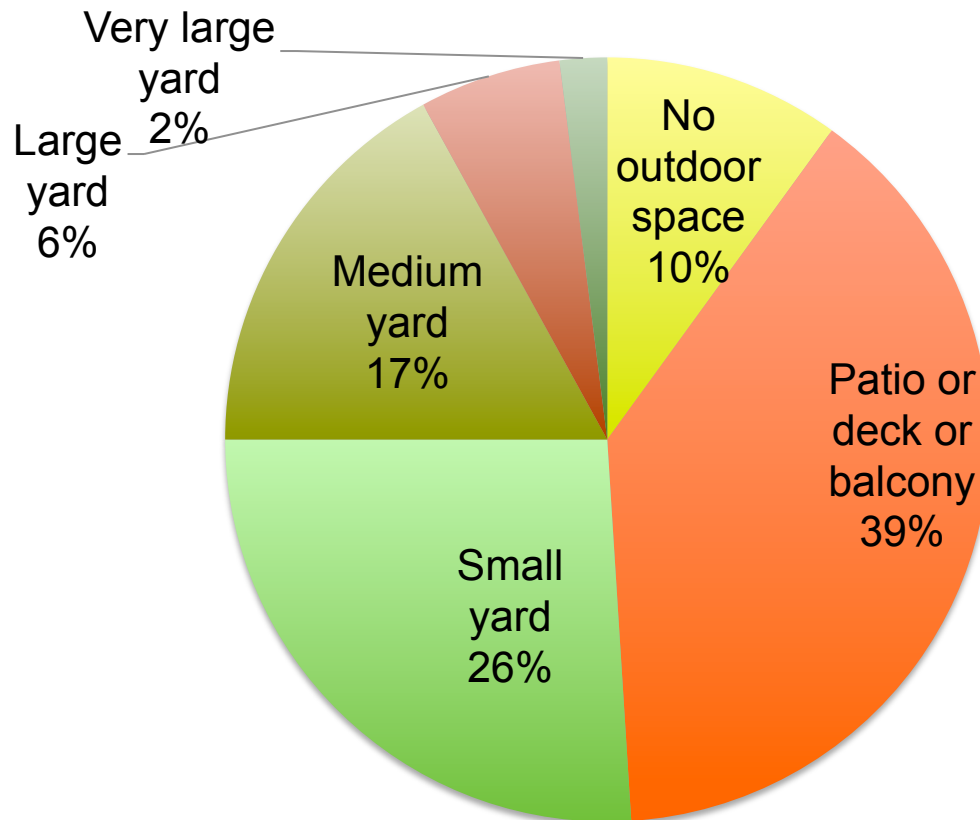
Number of bedrooms: Current vs. Ideal



Ideal Housing Size



Ideal Yard Size



- **Medium/small yards:**

- Couples with children
- Couples without children
- Lone-parent families

- **Patio/deck/balcony:**

- Students
- Seniors
- One-person households

Buyer/seller survey and two-Stage Demand analysis

1. Key points from the first-stage hedonic model

- Model run using housing survey data with 357 transactions from 2015 to 2017
- Housing structural characteristics (housing type, bedroom, bathroom, yard size, garage) strongly correlated with values
- Most neighbourhood characteristics (open space amenity, residential density) not significantly correlated with values
- **No significant property value premium from the LRT** has been realized (limited samples in the CTC, especially for high-rise condos)

2. Key points from the second-stage regression

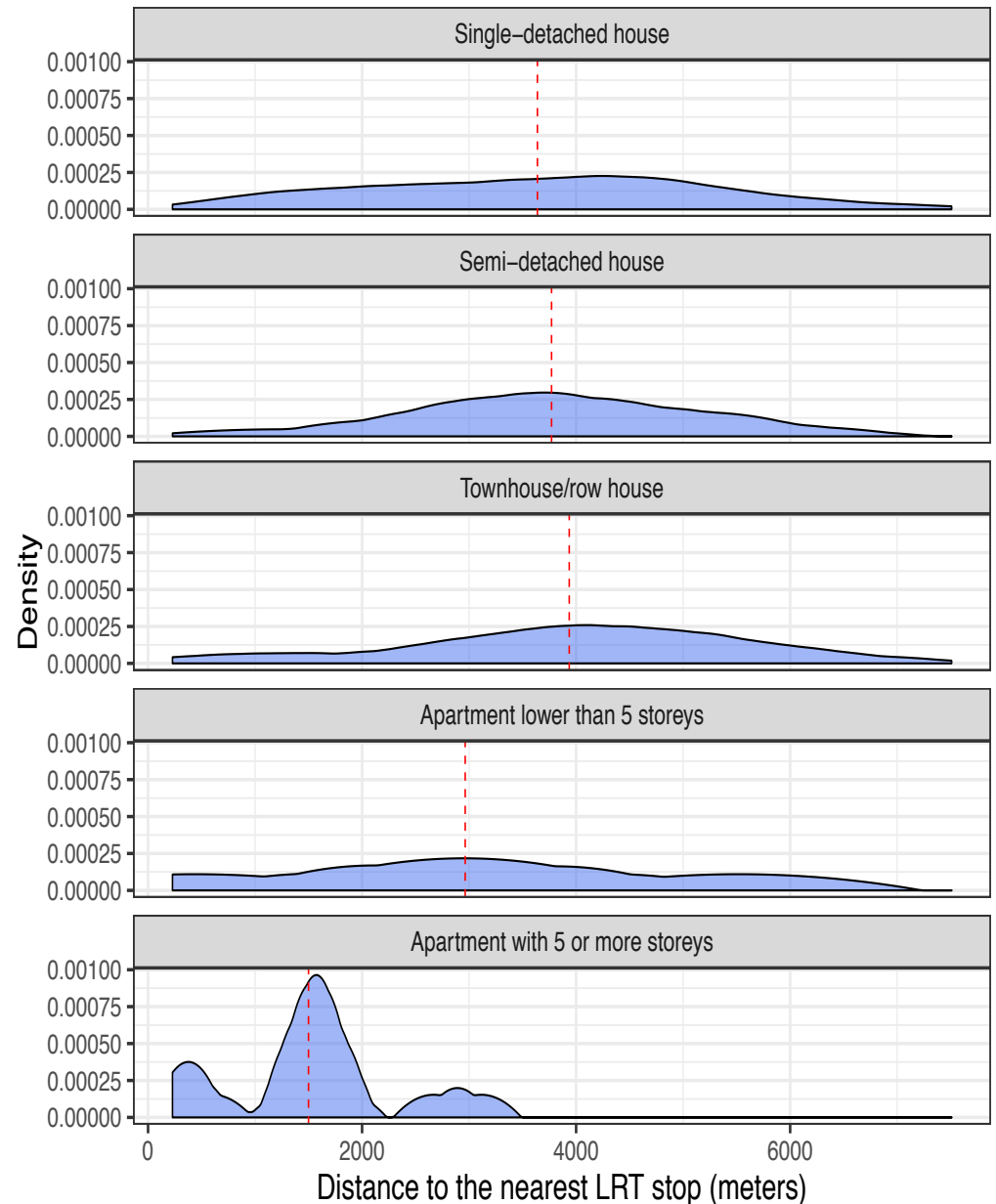
- 1) Households choose structural attributes of homes, mainly based on household **income** and **household composition**
 - Households with **children** are willing to pay more for single-detached housing with larger private yard and more garage space
- 2) The GTHA buyers are significantly willing to pay more for single-detached housing; with no other preference difference compared to the local buyers

Distance to the nearest LRT stop

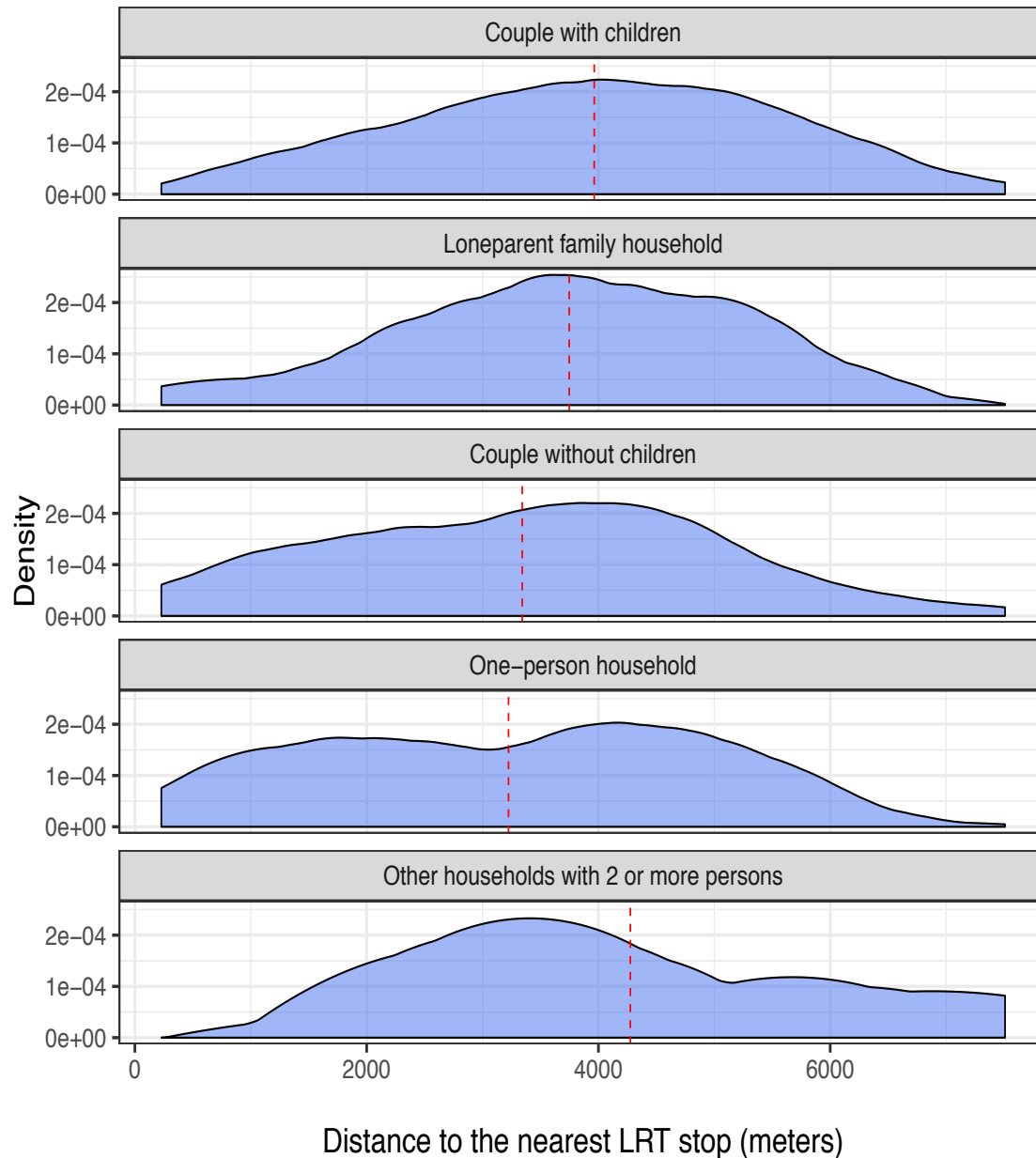
- Most homes are more than 3km away from the LRT stop
- No significant difference among single, semi and town houses in terms of locational distribution.
- Apartments are closer to LRT stops, but fewer samples

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Kernel density estimates of distance to the nearest LRT stop by dwelling types



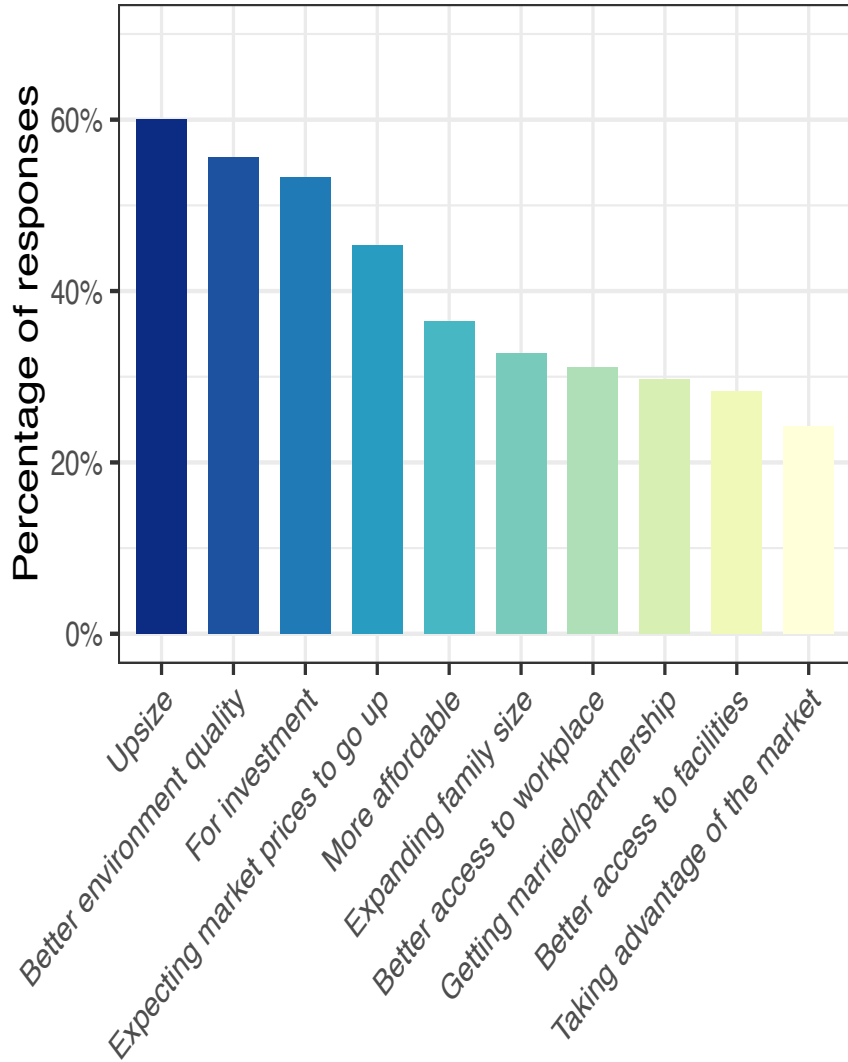
Kernel density estimates of distance to the nearest LRT stop, by household types



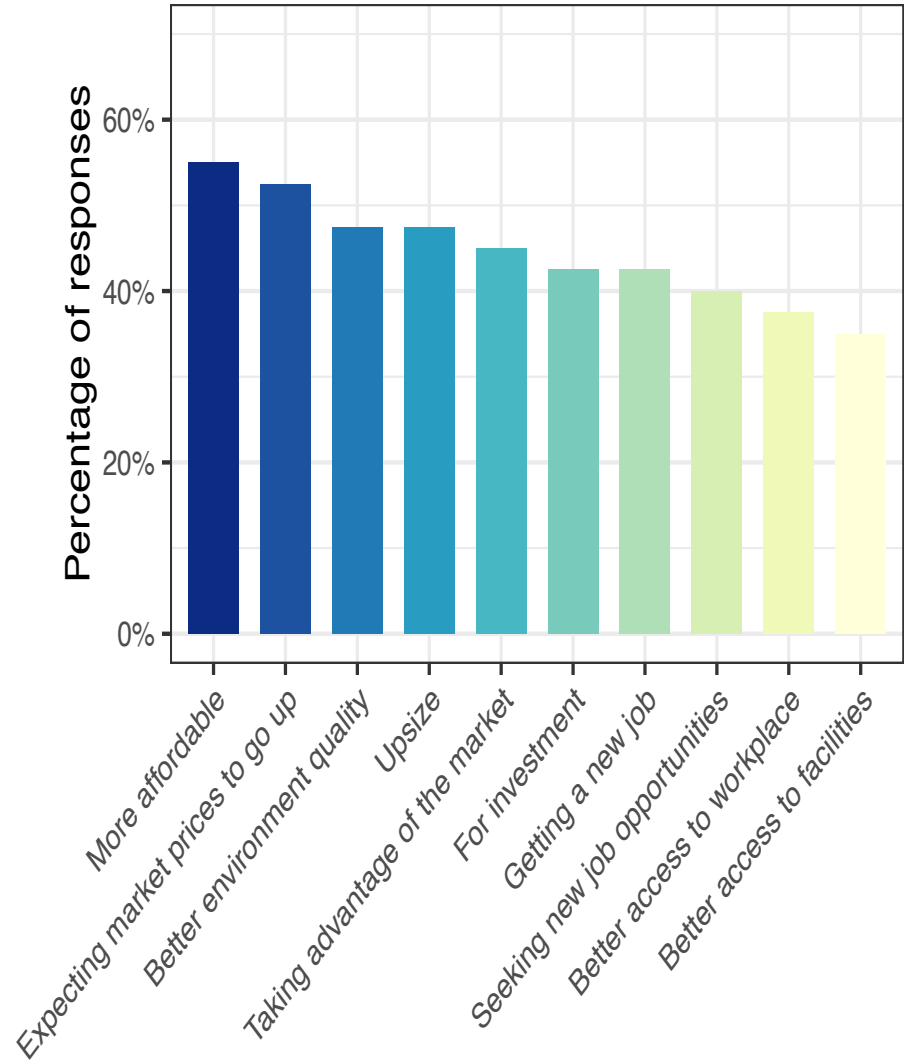
- One-person households and couples without children have purchased homes closer to LRT, compared to families with children, including couples with children and loneparent families



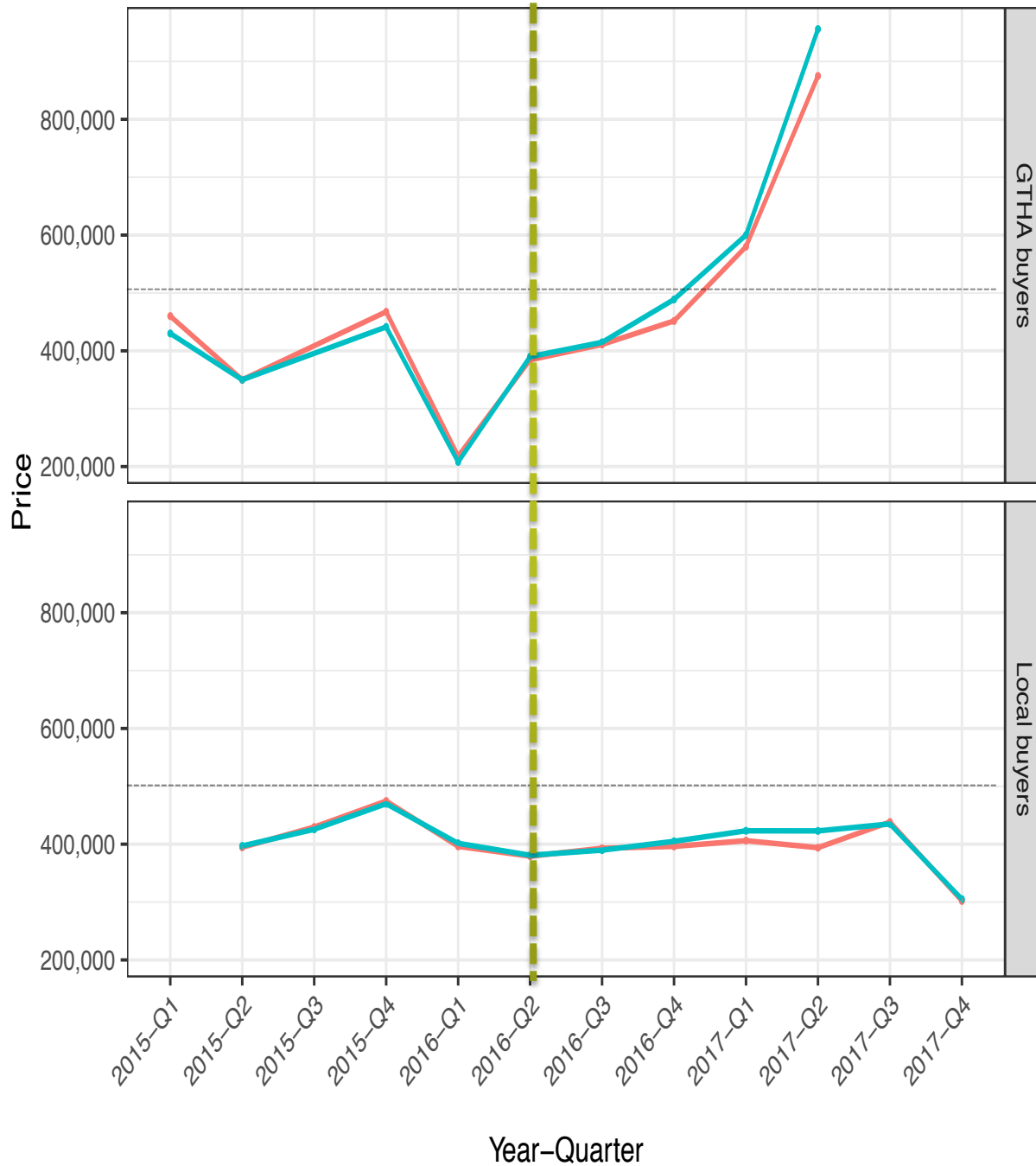
Top 10 move motivations of local buyers
(with sample size = 293)



Top 10 move motivations of GTHA buyers
(with sample size = 40)



Listing prices and sales prices – KW buyers



- GTHA buyers have purchased higher-price homes
- They bid higher above listing prices

Type

- Mean listing price
- Mean sales price

- Since 2016-Q2, Mean sales price is above Mean listing price, for both types of buyers



Where are the missing markets?

- Residential home owners—green space in compensation for downsizing/intensification
- Renters—lack of appropriate size option in all income categories-open space less important
- New buyer survey
 - May under-sample core area buyers due to methods and lack of supply
 - Ideally want a larger, less intensified product than renters
 - Still, intensified product as bundles of desired attributes not there
- Developers are unresponsive to information about demand

Take-home points

- Builder investors responding to LRT/intensification promise through brick-and-beam investments, small residential, and some office
- Certain demographics responding strongly to perceived investment and amenity opportunities
- Potential over-build of small residential threatens market stability
- New family residential is completely missing in core areas
- Creates a washing-machine cycle of migration between cores and suburbs through life course
- Housing bubble and LRT investment appear to be independent

Implications for modelling

- Clear supply constraints
 - Lack of supply for families in the central transit corridor
 - Lack of strategic behaviour likely to lead again to oversupply dynamics
 - Actual demand seems poorly understood/anticipated
- Clear evidence of market segmentation
 - “Urban lifestylers” create demand for core properties
 - Locals more likely to see suburban properties
 - Future regression/modelling will respond to this new information

Acknowledgements

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 - Former post-doc Xiongbing Jin
 - Students: Andre Antanaitis, Robert Babin, Justin Cook, Pedram Fard, Yu Huang, Erica Ogden, Xinyue Pi, Veronica Sullivan, Filiz Tamer, Jinny Tran, Kevin Yeung, AJ Wray, Ginny Hang
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 - China scholarship programme (Yu Huang)

Collaborating partners

- Region of Waterloo
- Cities of Waterloo and Kitchener
- Kitchener-Waterloo Association of Realtors,
- Coldwell Banker Peter Benninger Realty

Student Theses Cited

- *Property size preferences and the value of private and public outdoor spaces amid a shift to high-density residential development: A case study of Kitchener-Waterloo, Ontario* (DeFields, 2013) <http://hdl.handle.net/10012/7778>
- *Understanding Accessibility, Analyzing Policy: New Approaches for a New Paradigm* (Neudorf, 2014) <http://hdl.handle.net/10012/8759>
- *Developing Up and not Out: Understanding the Barriers to and Opportunities for Reurbanization along Waterloo's Central Transit Corridor* (Antanaitis, 2014) <http://hdl.handle.net/10012/9022>
- *The Development of a Household Travel Resource Allocation Model for Kitchener – Waterloo* (Yeung, 2015) <http://hdl.handle.net/10012/9705>
- *Understanding Developer's Decision Making in the Region of Waterloo* (Tran, 2016) <https://uwspace.uwaterloo.ca/handle/10012/11163>
- *Estimating Homebuyer Preferences Under Intensification: Hedonic Modelling of Open Space and Multimodal Transit Amenities Preceding Light Rail in Kitchener-Waterloo* (Babin, 2016) <http://hdl.handle.net/10012/10936>
- *Exploring the Rental Housing Market in Kitchener-Waterloo, preceding Light Rail Transit* (Pi, in final revisions)

References

- Parker, D., Filatova, T., Huang, Y., Huang, Q. and Jin, X., 2015. The implications of land-market representation for the interpretation of empirical land-use change models. *Advancing Metropolitan Modeling*. Anas, A. Riverside, CA.
- Sun, S., Parker, D. C., Huang, Q., Filatova, T., Robinson, D., Riolo, R., Hutchinson, M. and Brown, D., 2014. Market Impacts on Land-Use Change: An Agent-Based Experiment. *Annals of the Association of American Geographers* 104 (3), 460-84.
- Parker, D. C., 2014. An economic perspective on agent-based models of land-use and land-cover change. In: Duke, J. and Wu, J. (Eds.), *Oxford Handbook of Land Economics*, Oxford University Press pp. 402.
- Huang, Q., Parker, D., Filatova, T. and Sun, S., 2014. A Review of Urban Residential Choice Models Using Agent-based Modeling. *Environment and Planning B* 41 (4), 661 – 89.
- Huang, Q., Parker, D., Sun, S. and Filatova, T., 2013. Effects of agent heterogeneity in the presence of a land-market: a systematic test in an agent-based laboratory. *Computers, Environment, and Urban Systems* 41, 188-203

Reference, cont.

- Filatova, T., van der Veen, A. and Parker, D., 2011. The implications of skewed risk perception for a Dutch coastal land market: insights from an agent-based computational economics model *Agricultural and Resource Economics Review* 40 (3), 405–23.
- Filatova, T., van der Veen, A. and Parker, D., 2009. Land market interactions between heterogeneous agents in a heterogeneous landscape: Tracing the macro-scale effects of individual trade-offs between environmental amenities and disamenities. *Canadian Journal of Agricultural Economics* 57 (4).
- Filatova, T., Parker, D. and van der Veen, A., 2009. Agent-Based Urban Land Markets: Agent's Pricing Behavior, Land Prices and Urban Land Use Change. *Journal of Artificial Societies and Social Simulation* 12 (1), 3.
- Parker, D. and Filatova, T., 2008. A theoretical design for a bilateral agent-based land market with heterogeneous economic agents. *Computers, Environment, and Urban Systems* 32 (6), 454–63.