# Effect of Land Transfer Taxes on Real Estate Markets: Evidence from Toronto

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*June 10, 2025*

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# Land Acknowledgement

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional lands of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

# The Effect of Land Transfer Taxes on Real Estate Markets: Evidence from Toronto

Peter Wu

University of Toronto

June 10, 2025

# Table of Contents

# What is a LTT?

- A land transfer tax (LTT) is a tax which is levied on the transfer of the ownership of property as a proportion of the sale price, usually paid by the buyer
- On October 22, 2007, the Toronto City Council approved a bylaw to implement a LTT in the city to address a budget deficit
- The LTT was rather controversial: a similar motion was narrowly defeated in the City Council in July 2007, which caused the Mayor to announce cuts to municipal services
- The LTT took effect for most property sales in Toronto dated on January 1, 2008 and later

# Toronto LTT Rates

**MLTT Rates**

Effective September 6, 2023, the City adopted item EX7.1, changing the MLTT rate structure and rebate eligibility criteria.

For property containing at least one, and not more than two, single family residences with a consideration value of:

| Value of Consideration | MLTT Rate |
|---|---|
| Up to and including $55,000.00 | 0.5% |
| $55,000.01 to $250,000.00 | 1.0% |
| $250,000.01 to $400,000.00 | 1.5% |
| $400,000.01 to $2,000,000.00 | 2.0% |
| Over $2,000,000.00 | 2.5% |
| Over $3,000,000 and up to $4,000,000 | 3.5% |
| Over $4,000,000 and up to $5,000,000 | 4.5% |
| Over $5,000,000 and up to $10,000,000 | 5.5% |
| Over $10,000,000 and up to $20,000,000 | 6.5% |
| Over $20,000,000 | 7.5% |

Figure: Current LTT rates in Toronto

# Toronto LTT Revenue Over Time

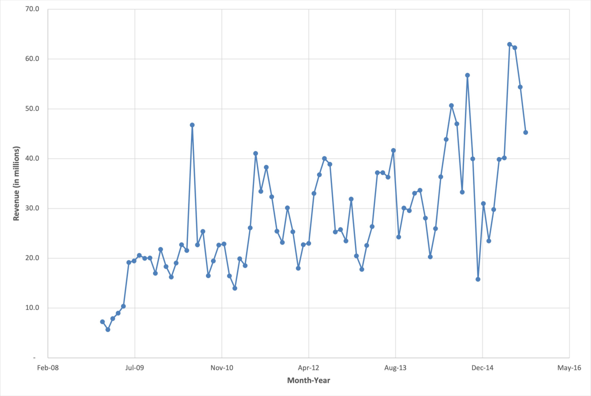


Figure: Toronto LTT revenue, January 2009-October 2015 (source: Toronto Open Data)

# Potential Pros and Cons of an LTT

**Pros:** Raise municipal revenue to fund services

**Cons:** LTTs have been shown to reduce residential transaction volumes and sale prices in the U.K. and the U.S. (Besley et al., 2014; Kopczuk and Munroe, 2015; Best and Kleven, 2018)

# Previous Research Into the Toronto LTT

**Dachis et al. (2012):**

- Used data from house sales in 3km bands inside and outside of Toronto
- Compared the average change in market outcomes between the two bands
- Conclusion: 14% reduction in transaction volume and 0.88% reduction in sale price

**Haider et al. (2016):**

- Used data from Market Watch on the number of monthly real estate sales in municipalities covered by the Toronto Regional Real Estate Board
- Compared the average change in transaction volume between all of Toronto and 3 artificially constructed regions bordering Toronto
- Conclusion: No significant change in transaction volume

Synthetic Control Main Results

# Why Study LTTs?

- Policy relevant: LTTs are increasingly popular (Bird and Slack, 2004; Heuton and Strate, 2020)
- Contradictory results: tension in the literature
- Apply a new method to address potential shortcomings

# Research Question

What was the effect of the LTT on the Toronto housing market in the months immediately following the imposition of the tax?

# Definitions

- **Outcome:** Either transaction volume or sale price
- **Treatment:** The policy which is implemented (the LTT)
- **Treated group:** The unit that received the treatment (Toronto)
- **Control group:** The unit(s) that did not receive the treatment (GTA municipalities bordering Toronto)

# Table of Contents

# Data

- The data consists of sales of single-family houses within 10km on either side of the Toronto municipal boundary between January, 2006 and August, 2008 from the Multiple Listing Service
- Estimated to reflect 85% of all sales of single-family homes in the relevant region (Hendel et al., 2009)
- The sale price and date of each house, as well as many house characteristics (e.g. square footage, number of bedrooms), are observed
- The data is clustered geographically and aggregated at the quarterly level

Clustering Metholodgy

# Data Patterns

To get a sense of the patterns in the data with respect to the two outcome variables, I estimated a simple model using regression to return the following estimate. Model

(Average outcome in Toronto after the LTT−
Average outcome in Toronto before the LTT)

*minus*

(Average outcome outside of Toronto after the LTT−
Average outcome outside of Toronto before the LTT)

# Data Pattern (Transaction Volume)

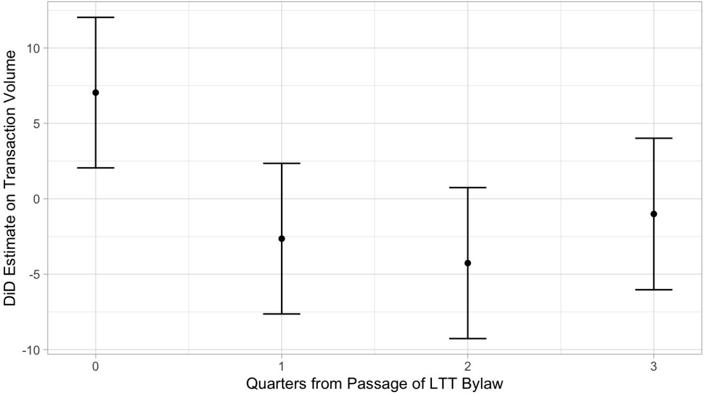


Figure: Changes in average transaction volume (95% confidence intervals shown)

# Data Pattern (Sale Price)

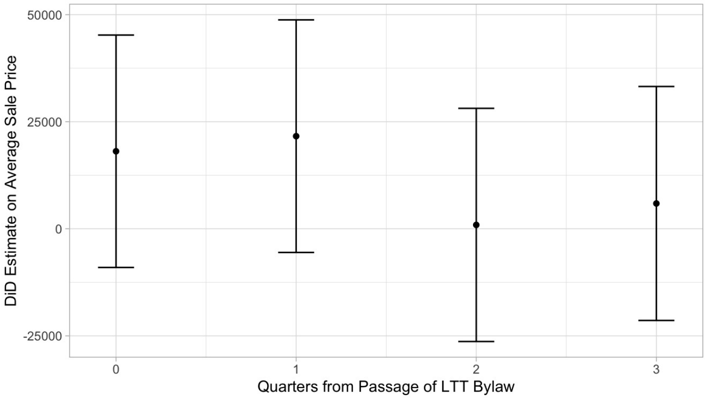


Figure: Changes in sale price (95% confidence intervals shown)

# Table of Contents

# Motivation for Synthetic Control

- Previous studies of the Toronto LTT have compared market outcomes in Toronto with those in regions outside of Toronto
- Observations inside and outside of Toronto may be systematically different due to factors such as different municipal policies (e.g. property taxes)
- These differences may cause buyers to respond differently to a LTT
- The **synthetic control** method is a method of generating an artificial control unit which resembles the treatment unit on observed variables in the pre-treatment period

# Example of Synthetic Control (1)

- Suppose that you are the owner of a green house, and you are interested in testing what will happen to it if you paint it purple
- Ideally, you would have another house that is exactly the same as yours, so that you can paint one of them purple and then compare the difference between them
- Unfortunately, you do not have another green house, but you do observe a blue house and a yellow house
- You can simulate a new house by mixing the colours of the blue and yellow houses together, thus creating an artificial green house
- You can then paint your house purple and compare the difference between your house and the simulated house

# Example of Synthetic Control (2)

- Depending on how "blue" the blue house is and how "yellow" the yellow house is, we may weight them differently when we combine them to get the same green as the original green house
- Let $\alpha$ denote the "weight" between 0 and 1 that you assign to the blue house Details


$\alpha$ $(1-\alpha)$

# Synthetic Control Results (Transaction Volume)

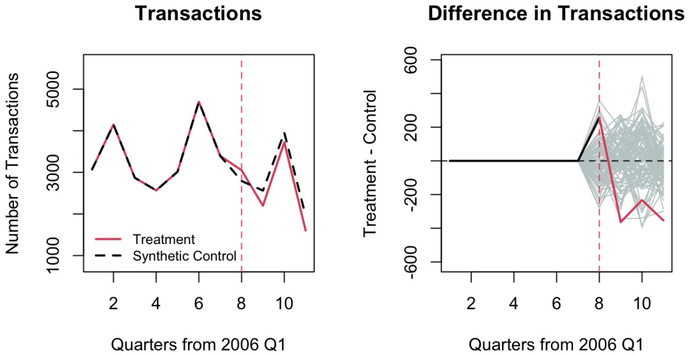


Figure: Synthetic control results for transaction volume (Treatment = Toronto, Synthetic Control = Toronto-adjacent regions; placebo results in gray)

# Synthetic Control Results (Sale Price)

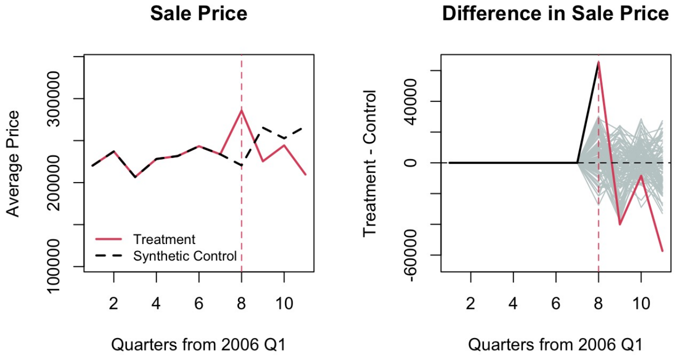


Figure: Synthetic control results for average sale price (Treatment = Toronto, Synthetic Control = Toronto-adjacent regions; placebo results in gray)

# Main Results Summary

Between the passage of the LTT bylaw and the end of August 2008:

- 692 transactions were lost on net due to the LTT
- Average home prices were reduced by as much as $57295 in 2008 Q3 due to the LTT, which represents a 24.5% drop from the pre-LTT period Dachis et al. (2012)
- In 2007 Q4, there was a sharp increase in both transaction volume and sale prices in Toronto, potentially indicating a rush to buy property before the LTT was to take effect in January 2008 (e.g. Toronto Star: "New tax jolts home buyers")

These results are qualitatively similar to the findings of Dachis et al. (2012).

Robustness Check

# Table of Contents

# Welfare Analysis

- Dachis et al. (2012) estimate that between the passage of the LTT bylaw and the end of August 2008, the average welfare loss from a lost transaction was $6559 and the average LTT exaction was 1.1%
- Therefore, in this period, the total welfare loss from lost transactions was about $4,538,284 and the total revenue from the LTT was about $19,143,052
- The revenue gained from the LTT exceeds the damage from lost transactions, but the final welfare calculation depends on whether the revenue was used productively
- Note: The potential welfare loss from buyers substituting to lower quality houses as a result of the LTT was not measured

# Conclusion

- Using a synthetic control approach, the Toronto LTT was estimated to have reduced both the transaction volume and sale prices of residential properties over time
- There was a sharp increase in transaction volume in the period that the LTT bylaw was passed, likely indicating a rush to buy before the tax was to take effect
- The LTT led to an estimated welfare loss from lost transactions, but also a much larger increase in government revenue

Thank you!

# Clustering Methodology

**Motivation:**

- If we want to determine why houses get sold, we would ideally like to compare the characteristics of houses that got sold with those of houses that did not. However, the data only consists of house sales.
- To avoid this truncation problem, I cluster the observations on either side of the Toronto border so that there is at least 1 sale in each cluster in each quarter

**Clustering methodology:**

- Use the kmeans clustering algorithm to randomly split observations inside and outside Toronto into $J$ clusters based on the location of their postal code centroid
- I set $J = 97$, because this is the largest number of clusters such that there is at least 1 sale in each cluster in each quarter given the seed that I used

Back to presentation

# DiD Estimation

To get a sense of the pattern in the data, I estimated the following difference-in-differences (DiD) model via OLS:

$$y_{it} = \beta_0 + \beta_1 LTT_i + \sum_{t=0}^{3} \beta_{t+2} T_t + \sum_{t=0}^{3} \alpha_t LTT_i \cdot T_t + \mathbf{X}_{it}^{\top} \gamma + u_{it} \quad (1)$$

Where,

- $y_{jt}$ is the outcome variable for cluster $j$ in quarter $t$
- $LTT_i$ is an indicator which equals 1 if cluster (or observation) $j$ is in Toronto
- $T_t$ is an indicator which equals 1 if the quarter is $t$ quarters away from the passage of the LTT bylaw
- $\mathbf{X}_{jt}$ is a vector of mean-valued controls for cluster (or observation) $j$ in quarter $t$

Back to presentation

# Notation

- $Y_{jt}$: The observed value of the outcome in cluster $j$ at quarter $t$
- $\mathbf{R}_j$: Length-$r$ vector of covariates for cluster $j$
- $T$: Total number of quarters in the data
- $T_0$: The number of quarters prior to the passage of the LTT bylaw
- $J$: The total number of clusters
- $J_0$: The total number of clusters in the control region

This means that $t \in (1, \ldots, T_0, T_0 + 1, \ldots, T)$.

# Synthetic Control Method (1)

Each outcome $Y_{jt}$ has the representation $Y_{jt} = Y_{jt}(0) + \alpha_{jt} D_{jt}$.

- $D_{jt}$: Indicator which equals 1 if cluster $j$ has received treatment at quarter $t$
- $Y_{jt}(0)$: Value of the outcome in the absence of treatment
- $\alpha_{jt}$: Treatment effect for cluster $j$ at quarter $t$

The cluster-averaged treatment effect (CATE) in quarter $t$ is then

$$\alpha_t^* := \frac{1}{J - J_0} \sum_{j=J_0+1}^{J} \alpha_{jt} \tag{2}$$

Calculating $\alpha_t^*$ requires knowledge of $Y_t^*(0) := \sum_{j=J_0+1}^{J} Y_{jt}(0)$ for $t > T_0$, but this is unobserved.

# Synthetic Control Method (2)

Instead, the synthetic control method aims to calculate a set of weights $(w_1, \ldots, w_{J_0})$ that satisfies:

$$\sum_{j=1}^{J_0} w_j Y_{jt} = \sum_{j=J_0+1}^{J} Y_{jt} \tag{3}$$

$$\sum_{j=1}^{J_0} w_j \mathbf{R}_j = \sum_{j=J_0+1}^{J} \mathbf{R}_j \tag{4}$$

$$\sum_{j=J_0+1}^{J} w_j = J - J_0 \tag{5}$$

# Synthetic Control Method (3)

For weights that satisfy equations (3)-(5), the outcome values for $t > T_0$ can be approximated by $\hat{Y}_t^*(0) := \sum_{j=1}^{J_0} w_j Y_{jt}$.

Therefore, the estimated CATE is

$$\hat{\alpha}_t^* := \frac{1}{J - J_0} \Big( \sum_{j=J_0+1}^{J} Y_{jt} - \sum_{j=1}^{J_0} w_j Y_{jt} \Big) \tag{6}$$

# Calibration of Weights

**Notation**:

- $\mathbf{X}_j := (1, Y_{j1}, \ldots, Y_{jT_0}, \mathbf{R}_j^\top)^\top$
- $\mathbf{t}_x := \sum_{j=J_0+1}^{J} \mathbf{X}_j$
- $(d_1, \ldots, d_{J_0})$: The initial weight values
- $G(x) := \begin{cases} \frac{1}{2}(x-1)^2, & \text{if } x \geq 0 \\ \infty, & \text{if } x < 0 \end{cases}$

$G(\cdot)$ is a distance metric from Deville et al. (1993) that satisfies regularity conditions. The optimal weights $(w_1^*, \ldots, w_{J_0}^*)$ are chosen so that

$$(w_1^*, \ldots, w_{J_0}^*) = \underset{(w_1,\ldots,w_{J_0})}{\arg\min} \left\{ \sum_{j=1}^{J_0} d_j G(w_j/d_j) - \xi^\top \left( \sum_{j=1}^{J_0} w_j \mathbf{X}_j - \mathbf{t}_x \right) \right\} \quad (7)$$

# Placebo Group Generation

The sampling distribution of the CATE under the hypothesis of null effect can be approximated by generating placebo groups. The procedure is as follows:

1. Randomly re-order the $J$ clusters
2. Designate the first $J_0$ clusters as the "control group"
3. Apply the synthetic control method to this data and calculate the average treatment effect

Steps 1-3 can be repeated many times to get a distribution of the CATE. The estimated CATE can then be compared to this distribution to determine its statistical significance. Back to presentation

# Robustness Check

- One concern may be that the observed treatment effect is partly reflective of buyers switching from purchasing in the band inside Toronto to the band outside of it after the LTT bylaw was passed
- Following the argument of Abadie and Gardeazabal (2003), I conducted a robustness check by expanding the control region to encompass areas within 30km outside of the Toronto border
- The micro synthetic control procedure was then run on this region
- This should marginalize the effect of buyer substitution from Toronto to the neighbouring regions

Back to presentation

# Robustness Results (Transaction Volume)

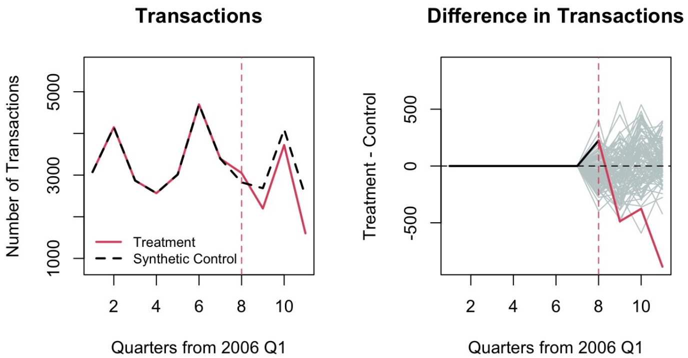


Figure: Robustness results for transaction volume (Treatment = Toronto, Synthetic Control = Toronto-adjacent regions; placebo results in gray)

# Robustness Results (Sale Price)


Figure: Robustness results for average sale price (Treatment = Toronto, Synthetic Control = Toronto-adjacent regions; placebo results in gray)