

IMPACTS OF COMMUTER RAIL TRANSIT ON PROPERTY VALUES :

THE CASE OF THE MONTREAL NORTH SHORE,
CANADA , 1992-2009

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Presentation outline

- Introduction
- Literature Review
- Analytical Approach
- Data
 - ▣ CRT service for *Montréal (South Shore)*
 - ▣ Computing time-varying accessibility indices
 - ▣ Transactions
- Regression Results
- Discussion
- Conclusion

Introduction

- Public Transportation (PT) plays a crucial role in social and environmental dimensions of "smart growth"
 - ▣ Improves access to workplaces and service infrastructures
 - ▣ Reduce greenhouse gas (GHG) emissions
- The PT financing Issue
 - ▣ Infrastructure costs are usually financed by several government levels
 - ▣ Operating costs are provided at the local level through property taxes and revenues generated from ticket sales
 - ▣ Recurrent deficit of PT operations prevents local governments from investing in new infrastructures

→ Financing and developing PT is crucial issue for most local authorities

Introduction

- PT Financing through value capture
 - ▣ Strong connection between accessibility to PT infrastructures and real estate markets
 - Real estate generate externalities that are internalized in building values (leading to property taxes)
 - Prices are currently influenced not only by intrinsic property attributes, but also by nearby extrinsic amenities
 - PT can be financed, at least partly, through people's willingness-to-pay (WTP) for better access to high-quality PT services
- Question of interest:
 - ▣ What is the effect of an access to commuter train stations?
 - Example for the north shore of Montreal, Canada

Literature review

- What we know:
 - ▣ Most studies dealing with the impact of rail proximity on house prices report positive, significant effects on values
 - Dubé et al., 2011
 - ▣ Commuter train effect may exceed that obtained for other rail services
 - Bartholomew and Ewing, 2011; Debrezion et al., 2007
 - ▣ Estimated effects may also vary according to:
 - Type of real estate good
 - Duncan, 2008; Cervero and Duncan, 2002
 - Characteristics of the stations and their location
 - Celik and Yankaya, 2006; Lewis-Workman and Brod, 1997; Voith, 1991
 - Cities considered
 - Debrezion et al., 2007; Ryan, 2005
 - Characteristics of the PT
 - Cervero and Duncan, 2004; Landis et al., 2004; Nelson, 2004; Bowes and Ihlanfeldt, 2001

Literature review

- A critical issue:
 - How to measure distances to PT for estimating PT proximity impacts on values ??
 - Measuring trip duration (travel time) to the nearest station is more appropriate than using Euclidian distance (Ryan, 1999)
 - Proximity effects indicators included in econometric models fall in three categories:
 - Dummy variables based on distance cut-off criteria for generating buffers around stations or along service routes
 - Dubé et al., 2011; Des Rosiers et al., 2010; Rodriguez and Mojica, 2008; Cao and Hough, 2007; Du and Mulley, 2007; Lin and Huang, 2004
 - Continuous distances from each house to the nearest station
 - Hess and Almeida, 2007; Chalermpong, 2007; Celik and Yankaya, 2006; Baum-Snow and Kahn, 2000
 - Mixed approaches combining dummies with continuous distances

Analytical Approach – Theoretical Issues

- Housing unit is a complex good:
 - Hedonic theory suggests that its sale price can be estimated as a function of the specific combination of its characteristics (Rosen, 1974)
 - Extrinsic dimensions may include various externality effects such as the proximity to PT
 - Dubin, 1998; Strange, 1992; Can, 1992; Yinger et al., 1987
 - It estimates the implicit mean price that the market assigns for each attribute
 - Some weaknesses of the hedonic price equation:
 - Risk of omitting significant variables that exert influence on house price
 - Leading to potential bias in the estimated coefficients
 - Greene, 2003; Wooldridge, 2000
 - *A priori* selection of the functional form
 - Raises a potential problem of misspecification (only partly solved through applying a Box-Cox transformation)
 - McMillen, 2010
 - Spatial and temporal spillover effects that are not taken into account.
 - Leading to potentially significant autocorrelation among residuals.
 - Can and Megbolugbe, 1997; Can, 1992, 1990

Analytical Approach – HPM vs. DID

□ Hedonic Price Model (HPM).

□ Sale

$$p_{is} = \alpha_s + \sum_{k=1}^K X_{isk} \beta_k + \sum_{m=1}^M Z_{ism} \delta_m + e_{is}$$

□ Resale

$$p_{ir} = \alpha_r + \sum_{k=1}^K X_{irk} \beta_k + \sum_{m=1}^M Z_{irm} \delta_m + e_{ir}$$

□ Difference-in-differences (DID) estimator (Extension of R-S)

$$p_{ir} - p_{is} = (\alpha_r - \alpha_s) + \sum_{k=1}^K (X_{irk} \beta_k - X_{isk} \beta_k) + \sum_{m=1}^M (Z_{irm} \delta_m - Z_{ism} \delta_m) + (e_{ir} - e_{is})$$

$$\Delta p_{irs} = (\alpha_r - \alpha_s) + \sum_{k=1}^{K^*} \Delta X_{irsk} \beta_k + \sum_{m=1}^{M^*} \Delta Z_{irsm} \delta_m + \Delta e_{irs}$$

Price evolution (index)

Control for change in intrinsic attributes (sales conditions)

Effect of (exogenous) change in PT services or accessibility

Data

- Study focuses on the Commuter Rail Transit (CRT) Service along the Montreal-St-Jérôme route (in all, 13 stations) that runs from Downtown Montreal (on the island) towards the north-west of the metropolitan area (on the North Shore)
 - ▣ Only the four stations brought into service on the Montreal North Shore between 1997 and 2007 (Rosemère 1998, Ste-Thérèse 1997, Blainville 1997 et St-Jérôme 2007) are considered in this paper
 - ▣ Over that period, total number of commuters along this CRT section grew at a yearly rate of nearly 24%, from 250,000 to 2,115,000
 - ▣ Each station provides parking lots enabling park-and-ride to favour multimodal moves towards the city
 - Size of parking lots has been gradually adjusted to cope with increasing demand

Data

□ Stations characteristics

Stations	1997	1998	2001	2002	2007
Departure to Montréal*	6	12	13	11	10
Total passengers	251 620	789 750	1 715 700	1 723 100	2 114 900
	Parking capacity				
Saint-Jérôme Station	--	--	--	--	378
Blainville Station	304	475	440	582	582
Sainte-Thérèse Station	475	600	525	997	664
Rosemère Station	100	128	328	350	401

**Excepted for the week-end (no departure)*

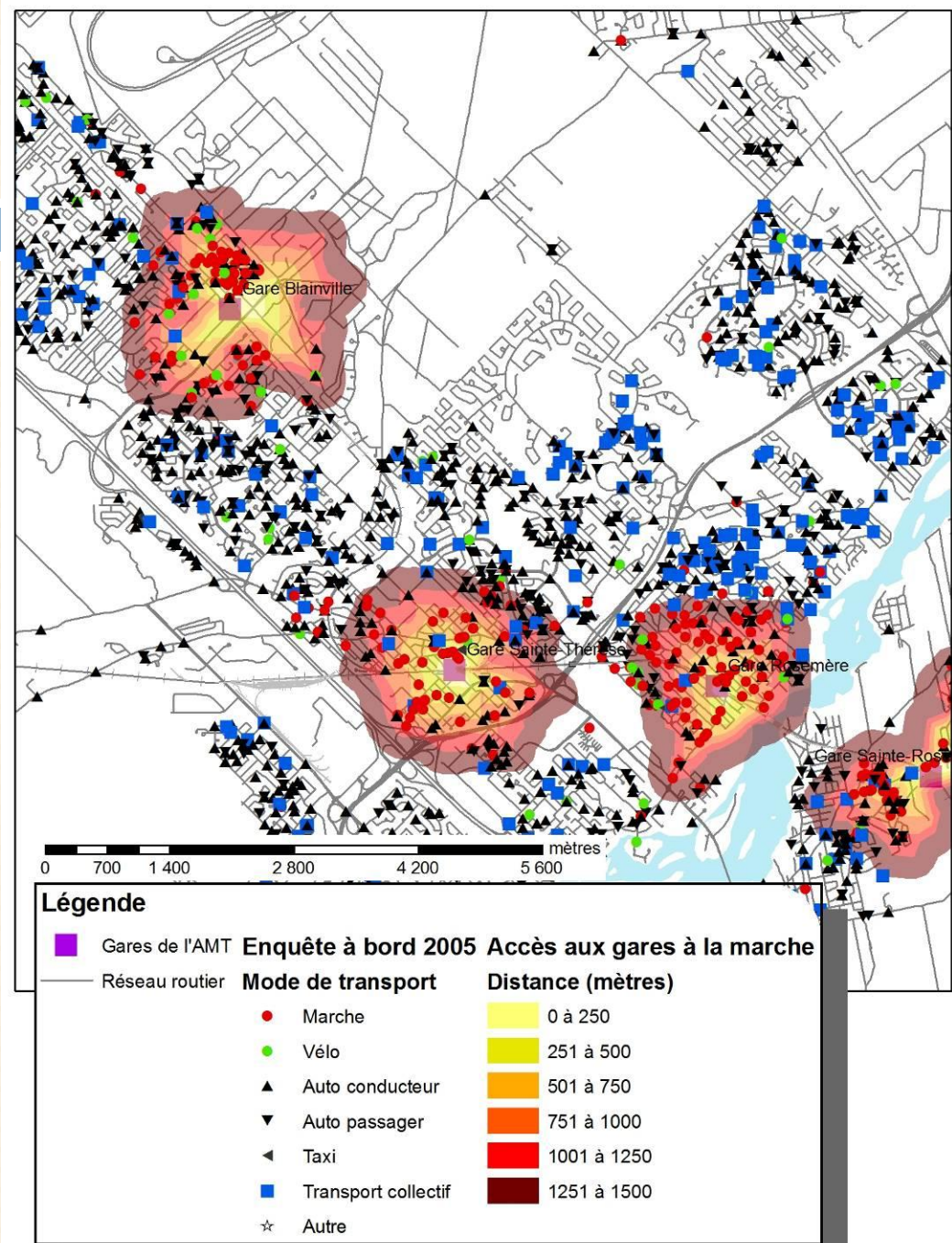
Data – Time-varying Accessibility Indices

- GIS application includes an operational road network (based on DMTI CanMap RouteLogistics version 3, 2008)
 - Handles road trip simulations for both cars and pedestrians, considering allowed travel speed, one-ways and access restrictions
- Analyses of the spatial distribution of actual train riders considering access modes (walking, biking, car as driver, car as passenger, taxi, bus) provide criteria for modelling various types of access
 - Frequencies of some access modes being too low to enable any analysis (biking, taxi) it was impossible to include them in the model
 - Detailed information on bus service being incomplete, it is not accounted for here
 - Car passengers and drivers are found to display the same spatial patterns and most of them are living at less than 20 minutes (travel time) from the nearest station
 - 20-minute maximum threshold was set to delimit service areas, and a travel time of 22 minutes was assigned to any property outside this limit
 - Pedestrian access to stations is restricted to the very close vicinity (less than 1,500 metres, or 0.9 miles)

Pedestrian Access To Stations

❖ Based on Metropolitan Transport Agency (MTA) 2005 on-board survey

❖ Overall, proportion of passengers accessing on foot amounts to between 16.1% (1999) and 14.2% (2007), as opposed to 77.2% and 70.5% for car trips



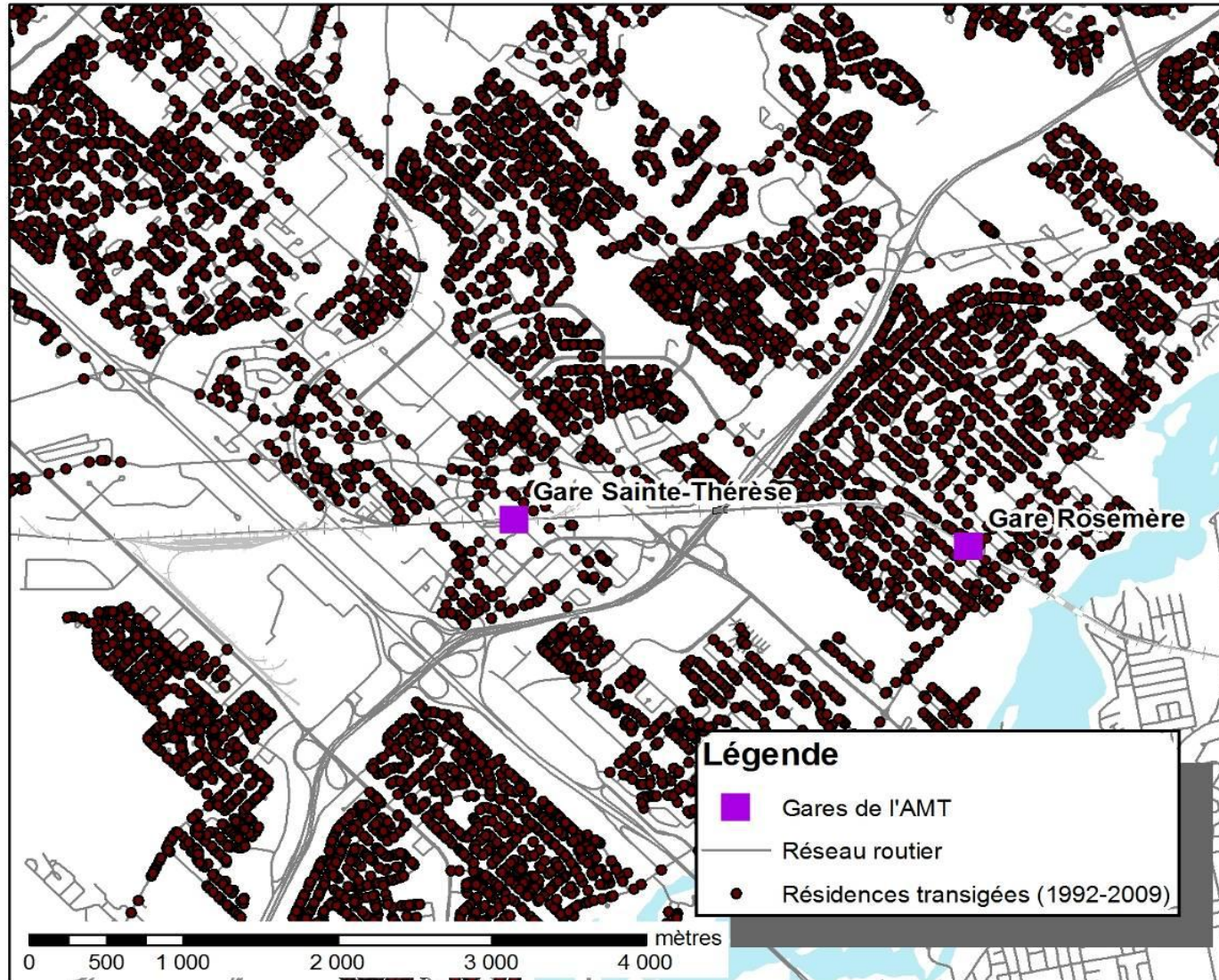
Sales Data

□ Property transaction data

- Property transactions, property characteristics and prices provided by the Greater Montreal Real Estate Board (GMREB) over 1992-2009
 - Validated and structured by the Altus Group (Quebec City, Canada)
- More than 26,400 pairs of sale and resale data of identical properties
 - Transactions are only considered in the estimation process if:
 - i. the sale or resale price is available;
 - ii. the transaction date is available;
 - iii. the resale price does not exceed three times the sale price;
 - iv. the property is located within the geographical area under analysis.

→ **Once filtered, 23,978 pairs of observations are actually used for model estimation**

Location of Sales-Resales Around Stations, 1992-2009



Sales Data

- Based on spatio-temporal accessibility indices:
 - ▣ Relatively small number of sold-resold properties experience better accessibility to train stations

	<u>Sale</u>	<u>Resale</u>	<u>Experiencing improvement</u>
0 to 500 meters	236	267	31
500 to 1,000 meters	510	619	109
1,000 to 1,500 meters	902	1157	255

- ▣ Overall, the opening of the train stations has reduced the driving dist-time to the closest station by 1.6 min.

	<u>Sale</u>		<u>Resale</u>	
	Mean	Standard deviation	Mean	Standard deviation
Car driving distance to nearest station:	14.51	8.05	12.92	8.21
Time-dist. improvement to nearest station:	1.60	4.28	Minimum 0	Maximum 21

Regression results

	Base model - Time dummies		Sales particular features		Spatio-temporal on-foot accessibility indices		Spatio-temporal on-foot and car accessibility indices	
	Coefficients	Sign.	Coefficients	Sign.	Coefficients	Sign.	Coefficients	Sign.
2009 - Q1	0.7496	***	0.7506	***	0.7478	***	0.7434	***
2009 - Q2	0.7572	***	0.7579	***	0.7551	***	0.7507	***
2009 - Q3	0.7661	***	0.7724	***	0.7699	***	0.7656	***
2009 - Q4	0.7811	***	0.7897	***	0.7869	***	0.7826	***
Foreclosure sale			-0.1156	***	-0.1156	***	-0.1154	***
Risk sale			-0.0754	***	-0.0755	***	-0.0756	***
Succession sale			-0.0821	***	-0.0813	***	-0.0813	***
Transfer sale			-0.0185	***	-0.0185	***	-0.0184	***
Within 0 to 500 m. walking distance					0.0556		0.0475	
Within 500 to 1,000 m. walking distance					0.0305	*	0.0220	
Within 1,000 to 1,500 m. walking distance					0.0430	***	0.0350	***
Driving time accessibility improvment (in min.)							-0.0007	***
R2	0.8971		0.9080		0.9081		0.9082	
Number of observations	26,366		26,366		26,366		26,366	
Log-likelihood (LL)	15,973		17,446		17,466		17,472	
Akaike Information Criteria (AIC)	-31,805		-34,743		-34,779		-34,788	
Schwartz Information Criteria (BIC)	-31,232		-34,148		-34,149		-34,150	

Legend: ***p<0.001; **p<0.01; *p<0.05

Regression results

□ Overall impact on house prices:

Zones	Number of observations	Car travel time gain (in min.)	Car travel gain price effect (in %)	Walking distance price effect (in %)	Total effect (% rise in price)
Within 0 to 500 m. of nearest station	31	15.13	1.13	n.s	1.13
Within 500 to 1,000 m. of nearest station	109	15.19	1.13	n.s	1.13
Within 1,000 to 1,500 m. of nearest station	255	14.36	1.07	3.50	4.57
Beyond 1,500 m. of nearest station	25,971	1.40	0.10	n.a	0.10
Mean effect (car time travel improvement)	26,366	-1.60	-0.12		

Legend: n.s.: not significant; n.a.: not available

Discussion

- Findings clearly suggest that:
 - ▣ The implementation of the CRT service results, *ceteris paribus*, in an overall market premium of roughly 4.6% of mean house price for properties located within a 1 to 1.5 km radius of the nearest station
 - ▣ Although positive in sign, price impacts within a 1 km radius are not significant, which contrasts with a similar study performed on the Montreal South Shore where the market premium stands at 13% and 10% for houses located within 500 m and between 500 m and 1 km from the nearest station, respectively
 - ▣ Overall, the opening of the train stations reduces the driving dist-time to the closest station by 1.6 min.
- A quite accurate estimate of the economic impact of the CRT service improvement could be obtained from our findings based on Montreal South Shore homeowners' asset appreciation as well as on municipalities' increment in property tax revenues (work in progress...)

Conclusion

- The originality of this paper rests on three elements:
 - **First:** the model relies on spatio-temporal accessibility indices, a major improvement when compared with the usual, static accessibility indices used for modelling dynamic phenomena
 - **Second:** the regression equation includes sales condition attributes that could influence price appreciation, such as foreclosure sales, risk sales, transfer sales and succession sale
 - This approach could be extended so as to incorporate further information such as renovations and improvements to house amenities
 - **Third:** the DID estimator allows to control adequately for spatial autocorrelation among residuals
- This paper corroborates the prevailing conclusion arrived at in the literature to the effect that commuter rail transit does exert a positive, and significant, impact on real estate values, although with large variations among cases