A CASE STUDY OF THE EFFECTS OF AN AIRPORT ON LAND VALUES

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A. Introduction

Considerable attention has focused on the relationship between transportation costs and land values in urban areas,[1] but little research has been conducted on the other factors that affect land values. In particular, there is only a niggardly literature on the effects of specific public projects on residential land values.[2] These are obviously important because of the large number of such projects with significance for public policy, for example, in terms of the efficient allocation of public costs.[3]

This study could concentrate on any one of a number of different types of public projects, but we shall be concerned with the effect of airports on land values. This should suggest neither that it is the only nor the most important type of public project.

At the public level, attention has frequently been drawn to the effects of airports. On the one hand, one cannot help but notice the substantial residential and commercial development in areas immediately adjacent to airports. Of course, these developments may reflect a variety of factors besides increased demand for this particular real estate.[4] On the other hand, concerned residents have often been adamant in their opposition to airport

expansion; some have even attempted either to have air-

port facilities moved or to mitigate their effects by

other means.[5] If the real estate market reflects

preferences for particular land, the former might be

interpreted to suggest the positive influence, while

the latter suggests the negative influence of airports

on land values.

Empirical research has not satisfactorily clarified

the issues. One analyst concluded in 1960 that,

> "The factual studies.......point to only one
> conclusion; namely, that airports do not
> affect the market value of vicinal real estate
> adversely..... If these nuisances (associated
> with airports) have any adverse effect on the
> market value of real estate, it is either
> minor or it is offset by the amenities
> forthcoming from airports.[6]

More recent studies are equally ambivalent.

J.F. Gautrin used a "modified Mohring model" to examine

"the fall in price as a function of the valuation of

transportation savings and the valuation of noise" for

London Airport.[7] No effect on residential land values

was ascertained but the author accounts for the

nonsignificance of the results mainly as a function

of the method: small samples, incomparability

of areas and the fact that variance within an area

was greater than that between areas. The Third London

Airport Commission, he notes, surveyed real estate

agents and reported that if noise were eliminated

the agents thought prices of houses would increase on average 10% (5.5%, 9.5% and 14.5% for low, medium and high price housing respectively). A follow-up study and Gautrin's own survey data generally confirmed this order of magnitude.[8] In another study of Chicago, Atlanta and Detroit, the authors concluded that the effect of airports, if any, was small. However, the authors also found that residential property values in the vicinity of the airports tended to grow more rapidly than other areas in the 1950-60 decade but less so during the 1960-70 decade when the most pronounced expansion of airports and of cities in general occurred.[9]

In this paper, we present some new evidence on, and interpretation of, the effect of an airport on the market price of real estate. We do this by comparing one area adjacent to Toronto International Airport (Malton) to similar areas in Metropolitan Toronto during the period 1955 to 1969. This time span encompasses a number of major airport expansions, the introduction of jets, and a general growth in aviation activity. Before describing the method and empirical results, we outline a model in the next section.

B. Analysis

If a public project generates externalities, it should be possible to observe the nature of these indirectly by the locational choices of decision-makers.[10]

As the aggregate demand changes to reflect these choices, the capitalized market evaluation of net benefits or rent will also change.[11] In a general equilibrium framework, this follows since the demand for any particular land parcel in a given use reflects its utility relative to other parcels and would change to always equalize marginal benefits per dollar expenditure. Furthermore, if we distinguish the following uses: (a) residential, (b) commercial, (c) industrial, and (d) public, the relative prices of land in these alternative uses will change as well.

Therefore, if we assume an individual homeowner in the environs of the airport, and suppose some development at the airport resulted in an external diseconomy for him, the effect of the development might be twofold. Initially, the external diseconomy would reduce the rent on his residential property and hence reduce its capitalized value or price. The second-order effect of the external diseconomy might be to shift the land to a higher post-development rent activity, e.g., from residential to commercial or industrial use. If the external diseconomy existed, say, for only residential uses, it is possible that there may be external economies for other uses (e.g.,

increased accessibility to transportation as an external
economy for commercial use). The capitalized value or
price of the land in an alternative use may therefore
increase, possibly to a level higher than the pre-
development price. This depends on the process and
lags in the market equilibrating mechanism. Thus,
assuming other things constant, in the short run, one
might expect decreased residential land prices due to
fixed supply of residential land; over the longer run,
as land was transferred to other higher rent activities,
and externality sensitive residents were replaced
by externality insenitive residents, residential land
values might then increase. Moreover, if external
economics existed for alternative uses, the price of
land in these uses would increase. Once equilibrium had
been reached, residential land values would be
approximately the same as they were before the development.
Since an airport produces efficient transportation as
well as air and noise pollution, it is reasonable to
expect external economics for industrial/commercial use
and external diseconomies for residential use.[12]

This analysis therefore suggests a different
rationale for land price changes than has been used
before. To test the validity of the model, we want
(1) to examine changes in land values in the vicinity
of the airport relative to changes in comparable
areas and (2) to determine changes in the mix of
residential/commercial/industrial uses.

C. Method

The null hypothesis to be tested is that airport developments have no effect on land use or land values. With respect to land use, it is popularly argued that zoning constrains the substitutability of land amongst uses; some research, however, has suggested that there are no substantial differences in land use for cities whether or not strong zoning exists.[13] If the latter is correct, then it should be possible to determine what changes occur. To the extent that zoning acts as an impediment (at least in the short run) to changing uses, however, complete substitutabliity to higher rent uses may be prevented and lags may be variable and somewhat indeterminable. Subsequently, changes may be neither complete nor coincide precisely with airport developments.

Any change in land prices (in money terms) is a function of either general or specific demand considerations. In other words, price changes might reflect general factors which change the demand for all land (such as rising incomes) or specific factors which change the demand for some particular land (accessibility or diseconomy-associated use elsewhere). To facilitate analysis unencumbered at least by the general factors affecting residential land values we have designated "control areas" to compare to the airport area. For our purposes, similar control areas were chosen with respect to (1) socio-economic
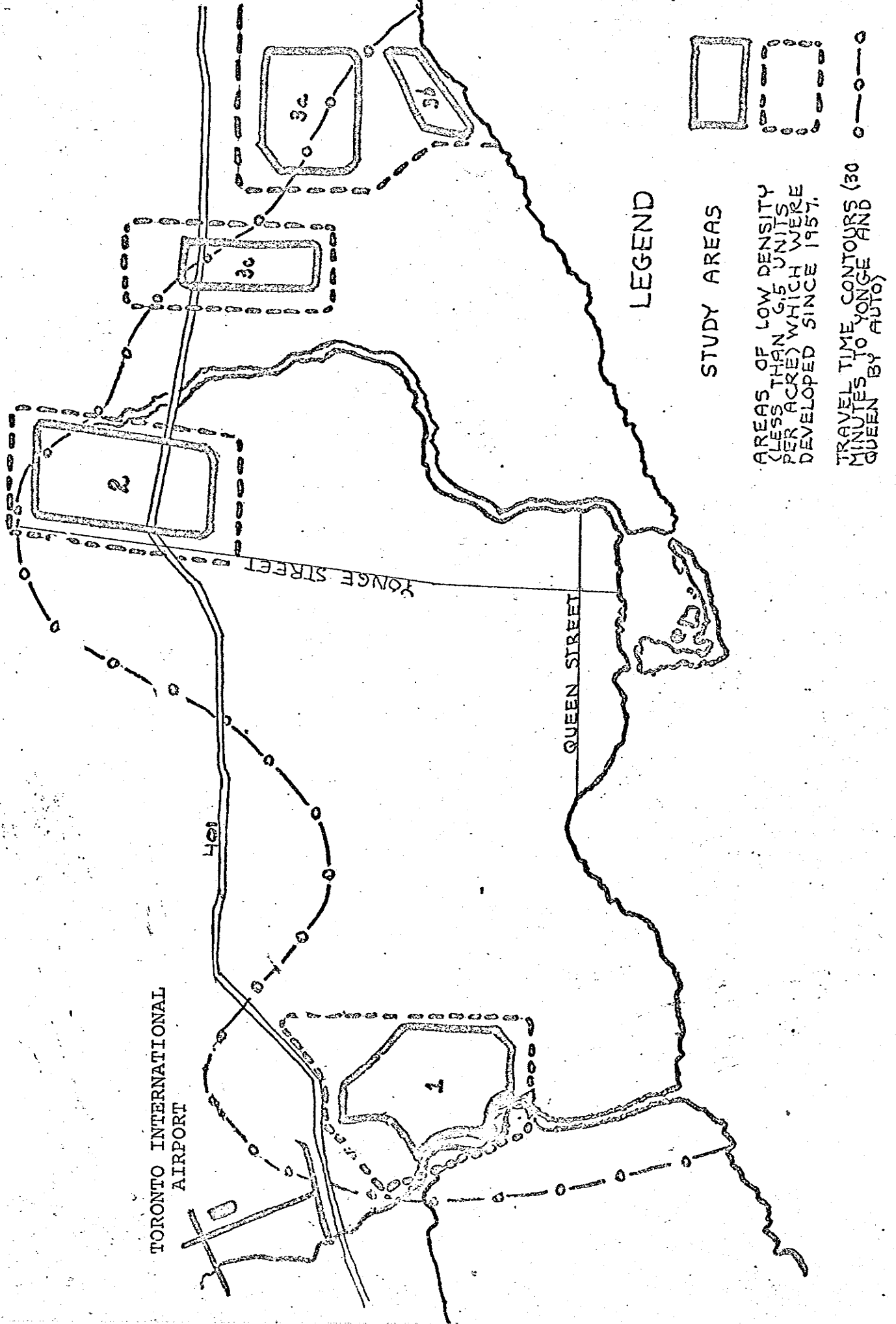
factors (e.g., similar distribution of population density and age of housing); and (2) distance (i.e., equivalent accessibility to downtown shopping areas, arterial highways, etc.).[14] The areas for which data are presented are thus (1) the airport area, (2) North York area, (3) Scarborough area, and (4) the aggregate of North York and Scarborough areas. (Figure 1)

The data used are actual sales in the period 1955 to 1969 which are available by street and house number. A random sample of streets in each "control" area was selected and all sales from 1955 to 1969 on each street were recorded and catalogued according to date of sale. The streets are geographically distributed throughout each of the areas and exhibit similar types of construction.[15]

The analysis of residential land values proceeds in three stages. First, the mean sale price in each area in each year is compared to determine whether there exist any statistically significant differences. Second, simple regressions with the dependent variable as the ratio of annual mean values in the airport area compared to other areas is used to determine whether there existed differences in the rates of change among the areas. Third, for years in which significant airport changes were effected ("shock periods"), changes are analyzed

Figure I

MAP OF TORONTO AREA AND STUDY AREAS

LEGEND

STUDY AREAS

AREAS OF LOW DENSITY
(LESS THAN 6.5 UNITS
PER ACRE) WHICH WERE
DEVELOPED SINCE 1957.

TRAVEL TIME CONTOURS (30
MINUTES TO YONGE AND
QUEEN BY AUTO)

YONGE STREET

QUEEN STREET

TORONTO INTERNATIONAL
AIRPORT

401

3d

3c

3b

2

1

to determine whether there occurred short run capitalization of the effects.

D. Results

Table 1 presents the results of the first test. The mean prices in the airport area were found to be consistently lower than those in Area 2 but higher than in Area 3. The differences are statistically significant for more than half of the observations. When compared to the total non-airport area, however, the differences are statistically significant for only three years. The F-statistic indicates that the differences among the means in the four areas are significant for most years.[16] These data, however, yield little information on the time pattern of changes in prices.

Regression equations of the form $A_1/A_i = a + bt$ where A refers to area and t to the year suggest that mean prices in the airport area did not change at a significantly different rate from Areas 2 and 4 but did increase significantly faster than Area 3.[17]

Table 2 and Figure 2 indicate yearly percentage changes in mean prices for the areas under consideration. Table 3 lists the number of sales in each of the control areas. For purposes of analysis shock periods have been designated as 1956-58, 1960-62, and 1967-69. Significant (more than 300 acres) land acquisitions were made by airport authorities in 1955, 1956, and 1961.[18] These periods of extensive areal expansion coincide with other

TABLE 1

RESULTS OF THE ANALYSIS OF VARIANCE AND
THE DIFFERENCE - BETWEEN - MEANS TESTS

Year	Difference Among Means 'F' Value	Difference Between Means		
		Area 1 - Area 2	Area 1 - Area 3	Area 1 - Area 4
1955	14.088 *	$-6496.28 *	$ 1467.56 *	$-2051.35 *
1956	4.992 *	-2661.76	2312.78 *	211.72
1957	1.813	- 262.18	997.15	433.05
1958	5.248 *	-4677.30 *	765.60	-2486.75 *
1959	4.207	-4726.72 *	1292.29	-1466.42
1960	2.758 *	-3450.84	1178.43	131.14
1961	.821	1015.74	2555.36	1869.64
1962	22.869 *	-4010.05 *	4112.18 *	- 559.43
1963	14.150 *	-6888.82 *	4060.88 *	2525.40 *
1964	17.158 *	-6143.91 *	4393.24 *	-1653.64
1965	18.324 *	-6623.45 *	5014.00 *	466.07
1966	15.778 *	-6062.64 *	5689.79 *	484.02
1967	6.284 *	-5471.55	5820.51 *	427.29
1968	6.399 *	-5097.93	5011.62 *	1181.46
1969	4.229 *	-5290.39	5383.07 *	104.98

* significant at .05 level

TABLE 2

YEARLY PERCENTAGE CHANGES IN
THE RESIDENTIAL MEANS

Years	% CHANGE Area 1	% CHANGE Area 2	% CHANGE Area 3	% CHANGE Area 4*
1955-56	+ 8.74%	- 10.83%	+ 3.81%	- 4.79%
1956-57	+ 1.49	- 10.66	+ 10.44	+ 0.22
1957-58	- 8.06	+ 16.69	+ 2.04	+ 8.69
1958-59	+ 6.69	+ 5.44	- 5.71	+ 0.35
1959-60	+ 7.25	- 0.09	+ 8.54	+ 2.77
1960-61	+ 13.72	- 8.70	+ 6.74	- 0.26
1961-62	- 2.08	+ 22.80	- 10.75	+ 10.33
1962-63	- 4.36	+ 8.00	- 5.13	+ 5.01
1963-64	+ 7.96	+ 3.11	+ 7.90	+ 3.15
1964-65	+ 6.27	+ 6.61	+ 4.23	+ 0.66
1965-66	+ 17.69	+ 11.78	+ 18.89	+ 13.23
1966-67	+ 13.51	+ 9.21	+ 16.54	+ 13.98
1967-68	+ 5.01	+ 3.20	+ 9.48	+ 2.54
1968-69	+ 15.67	+ 14.03	+ 17.23	+ 19.80

* The mean of Area 4 is not an average of Areas 2 and 3 because of
different numbers of sales in Areas 2 and 3 in various years.

DIFFERENCES BETWEEN THE AIRPORT AREA RESIDENTIAL MEAN
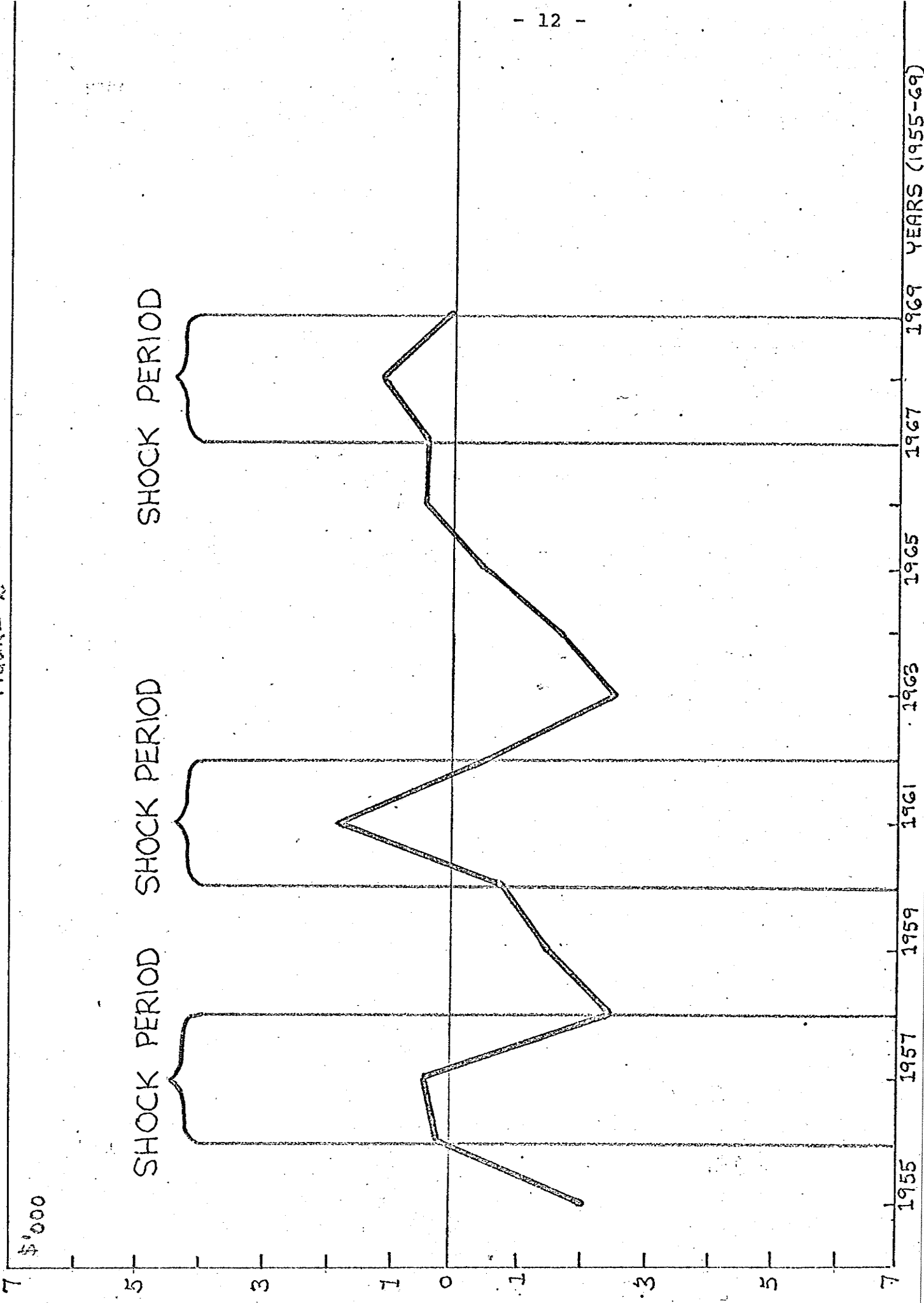AND THE MEAN OF AREA 4

FIGURE 2

TABLE 3

NUMBER OF RESIDENTIAL
SALES BY YEAR

Years	Area 1	Area 2	Area 3	Area 4
1955	34	57	72	129
1956	34	49	67	116
1957	24	47	58	105
1958	62	33	42	75
1959	25	33	39	72
1960	25	33	47	80
1961	44	53	66	119
1962	106	88	65	153
1963	47	80	53	133
1964	44	101	75	176
1965	68	89	100	189
1966	75	66	83	149
1967	69	64	70	134
1968	69	39	64	103
1969	56	45	46	91

developments. Turbo prop jets were introduced in
the later 1950's, although jet planes were not
extensively used until the early 1960's. In the
later years of the 1960's, "second generation"
commercial jets were introduced; as well, in 1968
announcement was made of significant airport
expansion.[19]

Table 2 and Figure 2 indicate clearly that the
mean value of land in the airport area decreased
both absolutely and relative to other control areas
during the initial two shock periods. In the case
of the second period this decrease continued after
the designated shock period. The evidence is not
as strong for the third shock period but there is some
indication of a relative if not absolute decrease.
More recent data might have confirmed a pattern
similar to 1960-62.

In view of the nature of our sampling procedure,
it is difficult to give extensive interpretation to
the number of sales in each area (Table 3). Nevertheless,
it is interesting to note that Areas 2 and 3 followed
similar patterns of increasing and then decreasing
number of sales whereas the airport area exhibited
a dissimilar pattern and two distinct increases in
1958 and 1962, both during "shock periods".

Overall, this evidence thus generally supports
the original model with respect to residential land
values. The remaining question is whether the

hypothesis with respect to non-residential land values
and use is also supported. Unfortunately, it is not
possible to obtain data on industrial/commercial sales
on the same basis as residential sales because of
difficulties in determining precisely what was sold
(e.g., plant, equipment, or a "going concern").[20]
However, it is possible to obtain some information
on changes in zoned land use during the period.
Table 4 presents data for one municipality (Etobicoke)
in the vicinity of the airport. Very interesting
indeed is the fact that many more acres were transferred
from residential to commercial use during the three
shock periods than during other periods.

F. Conclusions

The results of this study are reasonably clear in
confirming the model originally postulated. Statistically
significant differences exist in the pattern of price
changes in the vicinity of the airport compared to non-
airport areas. The evidence suggests that residential
land values fall during periods of substantial change
but then after the change approximately increase to their
previously established long-run trend.[21]

While one might be concerned that the evidence
presented here is insufficient to reject the null
hypothesis that airports have no effect on land values,

TABLE 4

ZONING CHANGES FOR
BOROUGH OF ETOBICOKE,
1955-69

Year	Residential to Commercial (acres)
1969	8.47
1968	1.36
1967	0.10
1966	1.00
1965	3.99
1964	0.66
1963	2.30
1962	11.47
1961	16.31
1960	2.21
1959	2.77
1958	0.94
1957	5.43
1956	13.30
1955	24.66

Source: Letter form Mr. M. Kivistik, Planner,
Borough of Etobicoke, August 25, 1971.

there can be no doubt that it brings the validity of the hypothesis into question. A more likely explanation than the null hypothesis is that during a "shock" period, noise-avoiders sell their residential property driving down the price; noise-indifferent people move in and some land is shifted to other uses, thus, in turn, bidding up the price. The overall result of this process is that relative land values ultimately end up about the same as before the shock. The important difference is that the type of resident and the pattern of land use (the "econoscape") change substantially.

[1] The classical reference on this topic is W. Alonso,
Location and Land Use, (Boston, 1964).

[2] An interesting paper is Herbert D. Simpson, "The
Influence of Public Improvements on Land Values",
The Annals, March, 1930, pp. 120-131: see also
H. O. Walther A Study of the Impact of Airports
on the Market Value of Real Estate in the
Adjacent Areas, (New York: Port of New York
Authority, 1960?); Paul F. Wendt and William
Goldner, "Land Values and The Dynamics of Residential
Location" in Essays in Urban Land Economics,
(Los Angeles: University of California Real Estate
Research Program, 1966); Stanislaw Czmanski,
"Effects of Public Investments on Land Values",
Journal of the American Institute of Planners, July
1966, pp. 204-217. M. Gottlieb, "Influences on

Value in Urban Land Markets, U.S.A.", _Journal of_
Regional Science, Summer, 1965, pp. 1-16 and
J.W. Kitchen and W.S. Hendon, "Land Values Adjacent
to an Urban Neighbourhood Park", _Land Economics_,
August, 1967, pp. 35-60.

3 Some costs are allocated to property through special
assessments and "charges" (approximately 7% of
municipal tax revenue.) D.B.S., _Financial Statistics_
of Municipal Government, Catalogue 68-203, pp. 14-15.

4 Casual empiricism suggests that in Ontario, at least,
residential areas around airports are characterized
by relatively expensive houses and hence the high-
income owners are likely to be able to exercise
choice in location. See, for example, R.W. Crowley,
Benefit - Cost Analyses for Local Airports: A
Case Study of Oshawa Airport, (Ottawa: Department
of Transport, 1970), pp. 33-34.

5 This has been the case, for example, of residents
in the vicinity of Oshawa Airport. cf., Crowley,
op. cit. For Toronto Airport, regulations exist
to control runways used and landing and take-off
schedules (prohibited between 11:00 p.m., and
7:00 a.m.). See Department of Transport, _Special_
Procedures and Facilities, Land Aerodrome (August,
1969).

[6] Walther, <u>A Study of the Impact of Airports on the Market Value of Real Estate in the Adjacent Areas</u>, pp. 89-90.

[7] J. F. Gautrin, "The Economics of Aircraft Noise," unpublished paper delivered to the Canadian Economics Association, St. John's, Newfoundland, June, 1971, p. 115 cf., H. Mohring, "A Measurement of Highway Benefits," <u>Journal of Political Economy</u>, June, 1961, pp. 236-249.

[8] B. Anstey, "A Strategy for the S.E.: A discussion of the First Report of the S.E. Economics Planning Council," <u>Architecture and Building News</u>, (January 31, 1968). Third Airport Commission, <u>Papers and Proceedings</u>, Vol. 7, (London: Queen's Printer, 1970).

[9] R. de Neufville and T. Yajima, "Economic Impact of Airport Development" unpublished paper, M.I.T., no date, (1971?)

[10] For a recent discussion of some problems of using market correlates, see Gordon Tullock, "Public Decisions as Public Goods", <u>Journal of Political Economy</u>, July/August, 1971, pp. 913-18.

[11] These arguments are initially based on fixed supply. They could also be cast in terms of variable units since the "effective" supply of land will change

with public projects. See Simpson, p. 121 and

J. Rothenberg, Economic Evaluation of Urban Renewal

(Washington: The Brookings Institution, 1967).

[12] A theoretical discussion dealing with this way of

formulating the problem of externalities is

Lawrence D. Schall, "A Note on Externalities and

Property Valuation" Journal of Regional Science,

April, 1971, pp. 101-106. D.V. Donnision, The

Government of Housing (London: Penquin, 1967), A.C. MacKennel,

Aircraft Noise Annoyance Around London (Heathrow)

Airport (London: Social Survey Report 337, 1963)

and Gautrin, op. cit., all found evidence to

support the argument that the turnover of owner-

ship increases with the amount of noise.

[13] M.H. Yeates, "The effect of zoning on land values

in American Cities: A case study" in J.B. Whitton

and P.D. Wood (eds.) Essays in Geography for

Austin Miller, (Reading: University of Reading

Press, 1965), pp. 317-333; John Delaphons, Land

Use Controls in the United States, (Cambridge:

Joint Center for Urban Studies of the

Massachusetts Institute of Technology and Harvard

University, 1962), especially Chapter IV. See

also Richard Babcock, The Zoning Game. (University

of Wisconsin Press, 1966).

[14] The values for these variables were obtained from W.G. Dean, editor, Economic Atlas of Ontario, (Toronto: Queen's Printer, 1969). While "composite noise rating" (CNR) contours are unlikely (at best) to be reliable, C.N.R. contours at levels deemed incompatible with residential development bound the airport area (Area 1). See Canadian Air Transport Administration, Land Use in the Vicinity of Airports, (Ottawa, December, 1970).

[15] These were obtained from Teela Market Surveys of Toronto. The most obvious distortions - intra-family sales for abnormally low prices - were eliminated by inspection. Zoning maps provided information for choice of streets.

[16] The statistics were adopted from H. C. Fryer, Concepts and Methods of Experimental Statistics, (Boston: Allyn and Bacon, 1966), p. 271.

[17] The values for a and b are as follows:

Areas	a	b
1 and 2	.83	.003
1 and 3	1.05	.014
1 and 4	.93	.005

18 This information was obtained from the files of
the Ministry of Transport in an unpublished memo
dated February 25, 1970 from W.F. Whitman,
Director, Real Estate Branch to Mr. H. Eichner,
Policy and Research Branch of the Ministry of
Transport, Ottawa. The increases in the land
enclosure of Toronto airport were as follows:
1954, 174 acres; 1955, 877 acres; 1956, 688 acres;
1957, 219 acres; 1958, 187 acres; 1959, 96 acres;
1960, 31 acres; 1961, 305 acres; 1962, 36 acres;
1963, 160 acres; 1964, 41 acres; 1965, 0 acres;
1966, 99 acres. Data following 1966 were
unavailable from this file. Primarily vacant non-
presidential land was enclosed.

19 At time of writing the government has not specified
exactly where expansion will take place. Consider-
able uncertainty must characterize the market in
the light of this consideration and this third
"shock period" is subsequently the most tenuous.

20 Information from Toronto based reactors confirmed
that airport area commercial and industrial prop-
erties are among the highest priced and
increasing more rapidly than other areas in Met-
ropolitan Toronto.

21 It should be noted that this latter statement may
be too strong a conclusion because of the operation
of specific demand factors not accounted for in our
method. This is sometimes referred to as "westerly
bias" and one important study has noted that
"responding to the direction of markets and major
transportation centres - such as Toronto International
Airport - the historic westerly bias of industry
within Toronto is repeated at the metropolitan and
regional scales". Metropolitan Toronto and Area
Regional Transportation Study, Growth of Travel Past
and Present, (April, 1966). Between 1958 and 1968,
for example, the percentage change in zoned acreage
for residential use was approximately 67% whereas,
for similar areas (Area 4), it was only 43%. "Land
Use/Actual Use by Minor Planning Districts", un-
published data prepared by Metropolitan Toronto
Planning Board, no date.