House prices and the proposed expansion of Chicago's O'Hare Airport

Daniel P. McMillen

Introduction and summary

Controversial plans to expand Chicago O'Hare Airport would add an additional runway and reconfigure the seven existing runways. The proposed expansion would allow the airport to handle 1.6 million flights annually, up from approximately 928,000 in 2003. O'Hare is not alone in having expansion plans: 18 of the 31 large hub airports in the U.S. are planning to add runways in the next decade. As of 2001, these 31 airports accounted for 70 percent of U.S. air passengers, and the top 25 of these airports accounted for 86 percent of all severe air traffic delays. However, neighboring communities often oppose airport expansions, and the O'Hare expansion plans are particularly controversial. O'Hare is surrounded by a densely populated ring of suburban municipalities whose residents already complain about the noise generated by flights in and out of O'Hare.

Airports are both a direct and indirect source of employment. The area around O'Hare Airport rivals downtown Chicago in terms of number of jobs. Data from the Northeastern Illinois Planning Commission show that there were about 800,000 jobs located within five miles of downtown Chicago in 2000. More than 400,000 jobs were located within five miles of O'Hare in 2000, and about 950,000 jobs *in the suburbs* were located within a ten-mile radius of O'Hare Airport. But airports are also the source of traffic congestion, air pollution, and noise. Airport expansion plans frequently encounter strident opposition due to these unfavorable characteristics, despite the potential for more jobs.

In this article, I use recent data on sales of single-family homes to estimate the effect of noise on property values in the area around O'Hare Airport. Home values are frequently used as the basis for estimating the costs of "disamenities" such as noise. Polinsky and Shavell (1976) present the theoretical underpinnings of the standard approach, while Bartik and Smith (1987) and Sheppard (1999) provide reviews of the theory and relevant applications. The idea is simple and compelling: People generally are well informed when they make an important decision such as the purchase of a new home. They may be willing to live in an area that is subject to severe noise, but only if they receive a discount on their home price. The size of the discount measures their aversion to high aircraft noise. Home prices have been used to measure the costs of such disamenities as air pollution (Zabel and Kiel, 2000) and traffic noise (Theebe, 2004), as well as the benefits of amenities such as school quality (Black, 1999). The effects of airport expansions on home prices are important politically. A possible drop in property values is frequently cited as a key motivation for opposing new runways.

I find that home values are 10 percent lower in areas that are subject to severe noise. This noise discount may explain some of the opposition to the airport expansion. In addition to the direct suffering caused by noise, homeowners may logically expect a nearly 60 percent increase in flights to lead to a large drop in property values. But paradoxically, noise levels may actually fall after the proposed O'Hare expansion. Older, noisy aircraft are being retired and airlines are switching to quieter planes. Regional carriers, which are projected to account for a higher percentage of flights in the future, use small and comparatively quiet aircraft. Indeed, the area that is defined by the FAA (Federal Aviation Authority) as being subject to severe noise fell from 57 square miles in 1997 to 38 square miles in 2000. The severe-noise area is projected to decline further to 27 square miles after the expansion and reconfiguration of the airport. These trends suggest that noise reductions will cause the average home in an area that formerly was subject to severe noise to *increase*

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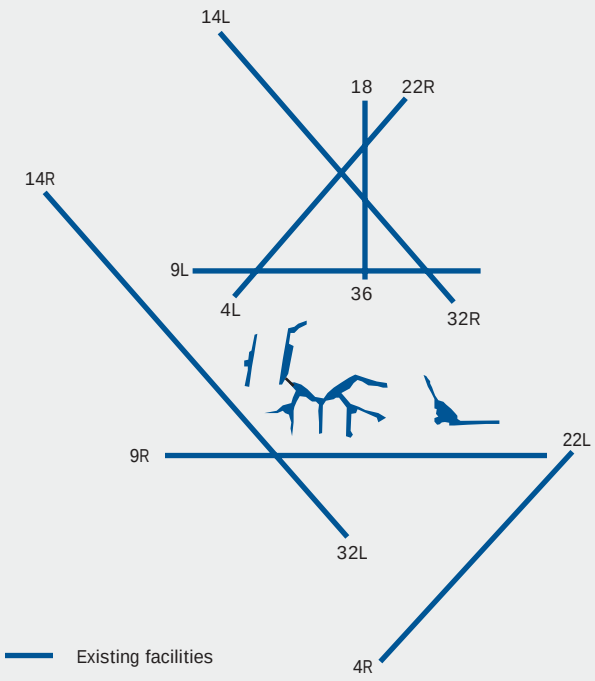
in value by as much as $17,000 (in 1997 dollars) between 1997 and the time after the expansion.

These results partially undermine one of the primary arguments against airport expansions. An important caveat is in order, however. Although the results suggest that prices may rise even if traffic at O'Hare increases significantly, they do not show how much prices would have increased if the airport remained at its current capacity. With aircraft getting significantly quieter over time, prices would presumably rise even more if the number of flights did not increase beyond current levels in the future. Nevertheless, the finding that the number of flights at an airport can increase by nearly 60 percent without generating significantly higher noise levels is a surprising result, tempering arguments against an expansion.

FIGURE 1

Existing runways



Source: http://modernization.ohare.com/program_pages/configuration.htm.

The proposed O'Hare expansion

Chicago is currently served by two airports, O'Hare and Midway. Midway opened first in 1926. O'Hare opened in 1955 and quickly overtook Midway as Chicago's busiest airport. In 2003, O'Hare served approximately 928,000 flights, compared with 328,000 at Midway. The number of flights continues to increase as airlines switch to smaller planes. Partly due to the move to smaller aircraft, load factors (the percentage of seats that are occupied) have risen from about 60 percent in the late 1970s to more than 70 percent today, and the FAA projects a continued increase. The FAA estimates that nearly 650 billion passengers were served nationally by U.S. commercial airlines in 2003, and their projections call for the number to increase to 1,124 billion in 2015.[1]

The hub and spoke system places enormous pressure on the capacity of large hub airports such as O'Hare. Hubs operate by gathering larger numbers of flights from feeder airports and sending passengers on as quickly as possible to their ultimate destinations. As a major hub in the center of the county, O'Hare contends with Atlanta for the title of the world's busiest airport. It also is currently a major bottleneck for U.S. air traffic. The year 2003 saw 11,960 late arrivals at O'Hare, or 20.28 percent of all arriving flights.[2] The delays lead to further delays at other airports as the effects ripple through the entire system. By changing the current configuration of the airport and adding another runway, the proposed expansion is intended to reduce delays at O'Hare and elsewhere.

The existing runway configuration at O'Hare is shown in figure 1. Two runways have an east–west orientation, two run northeast–southwest, and another two have a northwest–southeast orientation. A seventh runway runs due north–south. Unfortunately, all but one of the runways intersect another. The safety concerns caused by this inefficient configuration reduce the number of flights that the airport can handle, particularly in conditions of poor visibility.

Although the expansion plans are still in flux, figure 2 shows a recent proposal. The two northwest–southeast runways would be removed. Most flights would be handled by six parallel east–west runways. Although there still is some debate over how far apart these runways must be to handle simultaneous operations, the idea is that landings and takeoffs could occur at the same time on different runways. The remaining two northeast–southwest runways would only be used in extreme weather conditions. The more efficient configuration would permit the number of flights to increase by nearly 60 percent, even though there would only be one additional runway—for a total of eight rather than seven.

The O'Hare expansion is not the only plan under consideration. The primary contending plan is to build a new airport in Peotone, Illinois, which is located about 40 miles south of downtown Chicago along I-57. As early as the 1960s, Major Richard J. Daley proposed building a new airport on landfill in Lake Michigan. A site near Lake Calumet on the city's south side was proposed as the site of a second airport in 1929, but this site was rejected in favor of O'Hare.[3] The Lake Calumet site continues to be proposed as a candidate for the location of a third airport. Another proposal is to expand the existing airport in Gary, Indiana.

The expansion plans are very controversial, and nearby suburbs have actively opposed them. The opposition is based in part on fears of additional noise and traffic congestion. In addition, politics has permeated the decision process:

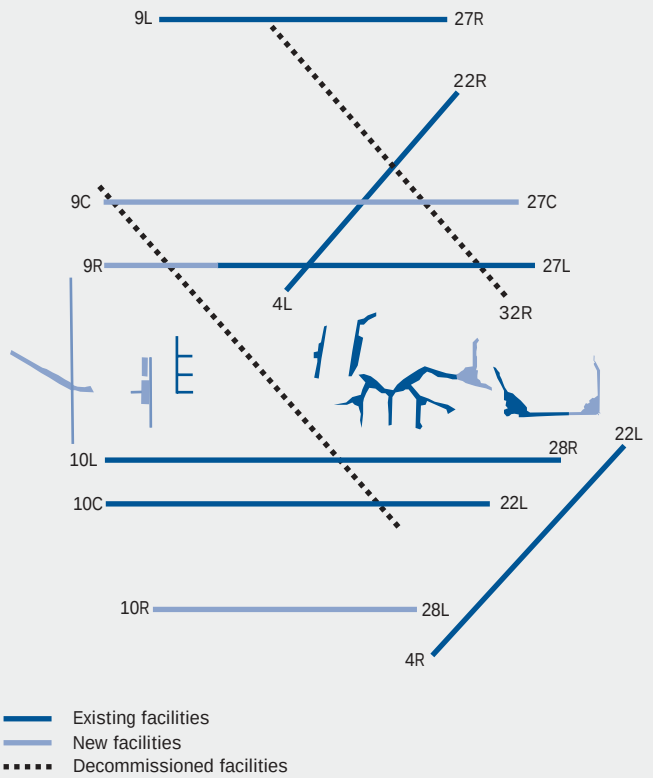
> From the start, O'Hare was used by City Hall as a means to reward political allies. Richard J. Daley's administration, for instance, gave the right to sell flight insurance to a company that had hired Daley's City Council floor leader, Thomas Keane, and it handed millions of dollars in construction work to another company that employed Keane. … O'Hare helps [Richard M.] Daley at election time. Airport vendors, concessionaires, and other businesses tied to O'Hare—and their executives and lobbyists—donated about $360,000 to Daley's campaign in an 18-month period beginning in July 1998. … Due to the length of Daley's tenure, he has hired nearly 60 percent of the 1,900 employees who work for the city's Department of Aviation, which manages O'Hare, Midway and Meigs Field. (Martin and Cohen, 2000.)

The Peotone and Gary proposals call for the construction of an airport outside of the City of Chicago. Although suburban and downstate legislators have been supportive of the Peotone proposal, Chicago has consistently opposed it. The airlines tend to prefer the O'Hare expansion, in part because O'Hare has a proven record and it is unclear whether passengers would be drawn to a Peotone airport. Hub airports rely on local passengers as well as those who are simply transferring en route to other destinations, and O'Hare is closer to downtown Chicago than Peotone and is closer to firms that account for a major portion of lucrative business travel. It is unclear whether a Peotone airport would successfully draw passengers away from O'Hare who are simply transferring through the Chicago area. The federal government has given mixed signals over time, sometimes supporting the O'Hare expansion and other times preferring a third airport.[4]

In the face of this debate, Governor Blagojevich of Illinois signed legislation in August 2003 authorizing the expansion of O'Hare. Chicago submitted its expansion plan to the FAA in October 2003. The city hopes to begin construction in fall of 2004. However, Chicago cannot begin construction or receive federal funding for the expansion until it receives FAA approval. Delays in the approval process mean that the odds are low that construction will begin in the next year. In the meantime, the controversy over the expansion plans casts a cloud of uncertainty over the housing market in the area around O'Hare.

FIGURE 2

Proposed expansion plan



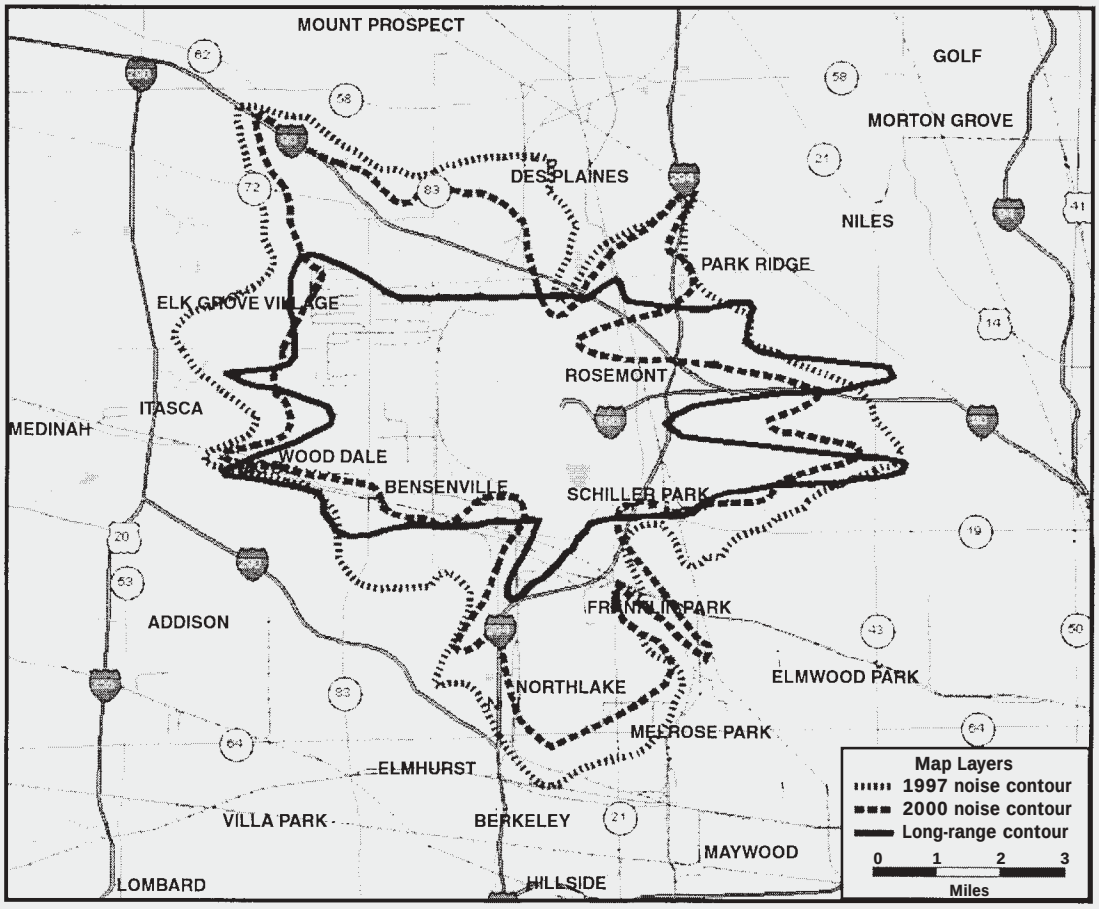
Source: http://modernization.ohare.com/program_pages/configuration.htm.

Noise contours

The FAA requires airports throughout the country to continually monitor noise

FIGURE 3

Noise contours



levels. O'Hare maintains a system of 31 permanent noise-monitoring stations. Another ten mobile monitors respond to specific complaints. Together, the monitors record more than five million data points each day, which are then used to measure monthly average decibel (db) levels. A ten-decibel penalty is included for times between 10 p.m. and 7 a.m. (for example, a 60-db reading at 11 p.m. is recorded as 70 db). The FAA and HUD (the U.S. Department of Housing and Urban Development) define areas exposed to average decibel readings in excess of 65 db as incompatible with residential housing.

Figure 3 shows 65-db noise contour bands for 1997 and 2000. It also shows a projected contour band for the time after the proposed expansion. Areas within the noise contours have average decibel readings in excess of 65 db. Although the entire area shown in figure 3 suffers to some extent from aircraft noise, I will refer to the area within the 65-db band as the "noisy" or "severe-noise" area and the area outside the band as the "quiet" area.

The 1997 and 2000 noise contour bands show clearly the effects of quiet aircraft. The area covered by the 65-db contour band shrinks from 57 to 38 square miles. The overall shape of the contour bands hints at the current inefficient runway layout, in which important runways cross. A common pattern is for flights to take off to the west or northwest, while landings frequently come from the east or south. This tendency leads to the long extensions of the noise contour bands to the northwest, east, and south. With no change in the runway layout between 1997 and 2000, the 2000 noise contour fits inside the 1997 contour, with roughly the same shape.

The post-expansion ("long-range") contour band has an entirely different shape. One of the objectives of the expansion is to create a more efficient layout by eliminating crossings. The new runway configuration

will allow multiple flights to take off and land simultaneously. The new layout produces a much narrower long-range contour band. Significant noise reductions take place to the northwest and south of the airport. The only significant areas with increases in noise are east of the airport, along the landing approaches to the new runways.

A combination of forest preserve, light industry, commercial buildings, and homes surrounds O'Hare Airport. McMillen (2004) presents evidence that aircraft noise reduces the value of residential properties in this area but does not have an effect on industrial or commercial properties. Figure 3 shows that very few square miles are expected to have higher noise levels after the proposed expansion. However, the expansion could lead to a large reduction in property values if the areas with higher noise levels are densely populated residential neighborhoods. Thus, the next step in the analysis is to prepare an accounting of homes according to noise contour status.

The Illinois Department of Revenue provided transactions data for all single-family homes in Cook County for 1996–2001. Of these sales, 22,541 were located within two miles of the 1997 noise contour, which is the area chosen for study. Table 1 shows the distribution of sales by noise contour status. More than 77 percent—17,418—of the transactions are homes that were located on the quieter side of the noise contour in both 1997 and 2000. More homes (2,574) switched from the noisy to the quiet side between 1997 and 2000 than remained on the severe-noise side during both years (2,327). Only 222 of the sales were homes that switched from the quiet side of the 1997 contour to the severe-noise side of the 2000 contour. These trends are projected to continue between 2000 and the time after the proposed expansion, with 2,086 sales switching from the severe-noise side of the 2000 contour to the quieter side of the long-range contour and only 706 switching from the quieter to severe-noise side. The percentage of sales on the severe-noise side of the boundary falls from 21.7 percent in 1997 to 11.3 percent in 2000 to 5.2 percent after the expansion.

Table 1 shows that the geographic distribution of home sales is not skewed toward locations that are adversely affected by the proposed runway reconfiguration. Although the results are not shown here, an analysis of the geographic distribution of a census of all homes is not different from the distribution of the subsample of those that sold. Homes are far more likely to have switched from the severe-noise side to the quieter side of the noise contours than to have gone in the other direction. Most homes are already experiencing a reduction in noise, and the trend is forecasted to continue even after the expansion.

The noise discount

Homes that are subject to severe noise sell at a discount. Many studies use a traditional hedonic approach (Bartik and Smith, 1987; Polinsky and Shavell, 1976; Shephard, 1999) to estimate the noise discount. The hedonic approach decomposes a home's price into its various attributes, such as lot size, building square footage, and the number of bedrooms. Controlling for such housing characteristics is critical because homeowners may react to low land prices near the airport by substituting toward big homes on large lots. A simple comparison of average sales would understate the noise discount.

In a review of the initial wave of studies of house prices, Nelson (1980, p. 46) concludes, "a survey of evidence from thirteen studies suggests noise discounts in the range of 0.4 to 1.1 percent per decibel." Recent studies include Collins (1994); Espey and Lopez (2000); Feitelson, Hurd, and Mudge (1996); Levesque (1994); O'Byrne, Nelson, and Seneca (1985); and Pennington, Topham, and Ward (1990). All of these find that airport noise significantly reduces property values; a detailed comparison can be found in McMillen (2004).

In McMillen (2004), I find that homes around O'Hare Airport sold at nearly a 10 percent discount in

TABLE 1

Number of house sales by noise contour status

	Quiet 2000	Noise 2000	Quiet long range	Noise long range	Total
Quiet 1997	17,418	222	17,458	182	17,640
Noise 1997	2,574	2,327	3,914	987	4,901
Quiet 2000			19,286	706	19,992
Noise 2000			2,086	463	2,549
Total	19,992	2,549	21,372	1,169	22,541

Source: Calculations based on Illinois Department of Revenue data.

1997 if they were located within a 65-db noise contour band. In this article, I expand on that study in several ways. First, I now have sales data for 1996–2001 rather than just 1997. The additional data allow me to determine whether the noise discount is changing over time. Second, I use two methods to estimate the noise discount. In addition to the standard specification, which uses a simple dummy variable to represent locations that are subject to severe noise, I estimate a model using a continuous measure of exposure to noise—distance from the 1997 noise contour band. Finally, I expand on my previous work by estimating whether home prices appreciated more rapidly in areas that experienced significant reductions in noise between 1997 and 2000.

The Illinois Department of Revenue data provide the necessary information on sales prices for 1996 to 2001. However, the Department of Revenue does not collect any information on the characteristics of the homes. The Cook County Assessor's Office made their 1997 file available for this study. This file allows me to merge standard housing characteristics with the sales price data. Details on the construction of the dataset are provided in McMillen (2004).

Descriptive statistics are provided in table 2. The Assessor's Office file provided standard housing characteristics, such as building square footage, land area, age, and the number of bedrooms. I supplemented these variables with measures of proximity to standard amenities—the Chicago central business district (CBD), the entrance to O'Hare (the intersection of I-294 and the Kennedy expressway), stops on the elevated train line, commuter stations, and highway interchanges. I also include a variable indicating that a home is within one-eighth of a mile of a rail line, which is the regular length of a city block in Chicago's grid street system. As a proxy for neighborhood quality, I include the median income in 2000 for the census tract as an explanatory variable.

I include two measures of aircraft noise. The first is a simple dummy variable indicating that a home is located within the 1997 noise contour band. The second measure is a continuous variable representing straight-line distance in miles from the 1997 contour band. The value of this variable is zero at the contour line and it is positive when homes lie outside the noise contour band. I record negative values for this variable for homes than lie within the noise contour band. Thus, larger values of the distance variable indicate quieter locations. The mean value for this variable, 0.710, indicates that more homes lie outside the noise contour band than on the severe-noise side. Despite the FAA and HUD's definition of average noise levels in excess of 65 db as incompatible with residential housing, 21.7 percent of the home sales lie within the 1997 noise contour band, and homes lie as far as 1.5 miles within the contour band.

The basic equation for a standard hedonic model of house price is $y_i = \beta' X_i + \delta' D_i + u_i$, where y_i is the natural logarithm of the sales price of home i, X_i is a vector of house characteristics such as square footage and lot size, D_i is a vector of dummy variables indicating the date of sale, and u_i is an error term. I supplement this standard model with two measures of airport noise—*NOISE97*, a dummy variable that equals one when a home is located within the 1997 noise contour band; and the continuous measure of distance from the noise contour band, *DCONTOUR*. I then estimate the following two equations:

Model 1: $y_i = \beta' X_i + \delta' D_i + \gamma NOISE97 + u_i$.

Model 2: $y_i = \beta' X_i + \delta' D_i + \lambda DCONTOUR + u_i$.

Table 3 (p. 35) presents the regression results. All sales prices are in nominal terms; the year dummy variables adjust for inflation as well as real price increases. The key results are at the top of the table. Controlling for standard housing characteristics and other location variables, houses sell at a 10 percent discount when they are located within the 1997 noise contour band. Alternatively, the second regression indicates that each additional mile from the noise contour line increases home values by 8 percent. The t-values indicate that these discounts are highly significant. The discounts are at the high end of existing studies—not a surprising result given how intensively O'Hare is used.[5] Not only are average noise levels high around O'Hare, they are nearly unrelenting (at least in the daytime) because the airport has long operated at or near capacity levels.

Other results are standard. For example, an additional 10 percent of building square footage increases sales prices by about 36 percent, and prices rise by about 18 percent with an additional 10 percent of land area. However, these variables simply serve as controls for the purpose of this analysis. The coefficients for the years of sale are more important because they produce a constant-quality price index. Prices rose by 2.9 percent between 1996 and 1997 and by another 4 percent during the following year. Prices rose especially rapidly between 1999 and 2001. By 2001, prices were a full 34.2 percent higher than in 1996, or an average annual appreciation rate of 5.9 percent.

TABLE 2

Descriptive statistics

	Mean	Standard deviation	Minimum	Maximum
Sale price nominal dollars	186,637.800	76,163.790	10,000	1,380,000
Within 1997 noise contour	0.217	0.413	0	1
Within 2000 noise contour	0.113	0.317	0	1
Within long-range noise contour	0.052	0.222	0	1
Distance from 1997 noise contour	0.710	0.816	–1.501	2.000
Distance from Chicago CBD	14.304	3.839	8.683	23.995
Distance from O'Hare entrance	5.045	1.329	1.444	8.739
Distance from El stop	3.126	1.795	0.083	8.800
Distance from highway interchange	1.519	0.727	0.057	3.590
Distance from commuter train station	1.136	0.638	0.037	4.104
Within 1/8 mile of train line	0.085	0.279	0	1
Building area (sq. ft.)	1307.310	450.670	400	5644
Land area (sq. ft.)	6401.150	3705.199	536	195279
Age	45.842	17.484	1	128
Number of bedrooms	3.002	0.735	1	7
More than one story	0.348	0.476	0	1
Multi-level	0.072	0.259	0	1
Masonry construction	0.702	0.457	0	1
Slab foundation	0.108	0.310	0	1
Partial basement	0.208	0.406	0	1
Crawlspace	0.091	0.287	0	1
Basement is finished	0.277	0.448	0	1
Attic	0.405	0.491	0	1
Attic is finished	0.136	0.343	0	1
Central air conditioning	0.364	0.481	0	1
One car garage	0.337	0.473	0	1
Two or more car garage	0.525	0.499	0	1
Garage is attached	0.259	0.438	0	1
Fireplace	0.180	0.385	0	1
2000 Census median income (000s)	54.861	10.943	16.250	96.006
Within Chicago city limits	0.272	0.445	0	1
1996 sale	0.179	0.384	0	1
1997 sale	0.179	0.383	0	1
1998 sale	0.199	0.399	0	1
1999 sale	0.214	0.410	0	1
2000 sale	0.150	0.357	0	1
2001 sale	0.078	0.269	0	1

Note: The sample includes 22,541 single-family homes that are in Cook County and within two miles of the 1997 noise contour.
Source: Calculations based on Illinois Department of Revenue and Cook County Assessor data.

Predicted changes in home values

The reduction in noise around O'Hare Airport should make the area more attractive for homeowners. The area is well served by public transportation and is in the midst of a concentration of jobs that rivals Chicago's traditional business district in size and scope. Even after the proposed expansion, more homes are predicted to change from the severe-noise to the quiet side of the noise contour than vice versa. Data for 1997 from the Cook County Assessor's Office allow us to make tentative predictions regarding the change in home values over time. This dataset allows us to base our predictions on an entire census of homes in the area rather than on the subsample of sales.

Calculations using the 1997 data from the assessor's office imply that the average market value was $174,883 for the 13,311 homes that switched from the severe-noise side of the 1997 noise contour to the quieter side of the 2000 contour.[6] In contrast, the average market value was $113,306 for the 1,167 homes that switched from the quieter side of the 1997 noise contour to the severe-noise side of the 2000 contour. Based on this estimate, we would expect the average home price to increase by $17,488 in the area that switched from the severe-noise side of the 1997 noise contour

TABLE 3

Regression results for sales of single-family homes

	Coefficient	T–value	Coefficient	T–value
Within 1997 noise contour	–0.100	–22.798		
Distance from 1997 noise contour			0.080	25.509
Distance from Chicago CBD	0.025	25.018	0.025	25.185
Distance from O'Hare entrance	–0.025	–16.893	–0.044	–24.085
Distance from El stop	–0.085	–38.499	–0.085	–38.258
Distance from highway interchange	0.058	24.136	0.045	17.785
Distance from commuter train station	0.026	9.816	0.028	10.827
Within 1/8 mile of train line	–0.073	–15.072	–0.069	–14.263
Log of building area	0.367	49.543	0.356	47.934
Log of land area	0.183	45.036	0.186	45.859
Age	–0.002	–19.250	–0.002	–21.395
Number of bedrooms	0.027	10.210	0.028	10.696
More than one story	–0.027	–7.711	–0.024	–7.015
Multi-level	0.081	12.661	0.078	12.196
Masonry construction	0.007	2.014	0.002	0.690
Slab foundation	–0.062	–13.275	–0.058	–12.411
Partial basement	–0.047	–11.658	–0.048	–12.049
Crawlspace	–0.150	–28.415	–0.143	–27.001
Basement is finished	0.004	1.136	0.003	0.888
Attic	0.003	0.818	0.003	1.051
Attic is finished	–0.030	–6.121	–0.028	–5.803
Central air conditioning	0.014	4.525	0.012	3.928
One car garage	0.017	3.856	0.024	5.354
Two or more car garage	0.059	13.709	0.068	15.801
Garage is attached	0.024	6.149	0.024	6.012
Fireplace	0.093	23.045	0.092	22.861
2000 Census median income (000s)	0.007	47.443	0.007	46.866
Within Chicago city limits	0.160	37.940	0.160	38.121
1997 sale	0.029	6.672	0.029	6.585
1998 sale	0.069	16.206	0.068	16.036
1999 sale	0.135	32.365	0.134	32.347
2000 sale	0.249	54.811	0.249	54.857
2001 sale	0.342	61.399	0.343	61.693
Constant	7.428	60.092	7.338	135.123
R^2	0.689		0.690	

Notes: The dependent variable is the natural logarithm of the sales price. The number of observations is 22,541.
Source: Calculations based on Illinois Department of Revenue and Cook County Assessor data.

to the quieter side of the 2000 contour. Similarly, the average decline in home prices in the other area experiencing a change in noise contour would be $11,331. On net, the total value of homes in the area would increase by $219.6 million.

Home values should continue to increase even after the expansion since the trend toward quieter aircraft is continuing. The 4,079 homes in locations that are predicted to change from the quieter side of the 2000 noise contour to the severe-noise side of the post-expansion contour had an average value of $200,862 in 1997. More homes are predicted to switch from the severe-noise to the quiet side—9,889 homes, with an average value of $143,043 in 1997. Our 10 percent noise discount implies that the estimated net increase in home values between 2000 and the time after the expansion is $59.5 million. In addition to the change between 1997 and 2000, I estimate that aggregate home values will increase by nearly $280 million (in 1997 dollars) between 1997 and the time after the expansion of the airport.

These predictions are based solely on changes in noise contour status. The value of other homes may also increase, as nearly the entire area around O'Hare is experiencing reductions in aircraft noise. The predictions do not take into account other changes in the area affecting home prices. For example, Brueckner (2003) estimates that the O'Hare expansion would raise service-related employment in the Chicago area by 185,000 jobs. Some of these workers would move into the area around the airport, driving prices up further.

The crucial result is the counter-intuitive prediction that declines in aircraft noise can lead to increases in home prices even as the number of flights rises by nearly 60 percent.

Noise contour changes and home prices, 1996–2001

Three critical assumptions underlie the prediction that home prices will rise over time in areas experiencing reductions in aircraft noise. First, the noise contour maps must be accurate, including the one representing the time after the proposed expansion. Second, noise reductions must be generally known and understood so that they can be capitalized into home prices. Third, my predictions do not take into account uncertainty regarding future noise levels.

The proposed expansion plans create an enormous amount of uncertainty. Small changes in flight paths can produce large variations in noise levels. The densely populated area to the east of the airport lies under the expected landing patterns for the reconfigured runways. Quieter aircraft can still lead to noisier neighborhoods for homes lying under the paths of thousands of new flights. Uncertainty may well work to keep home prices from rising even in the short term, during which surrounding areas are clearly becoming quieter.

The Illinois Department of Revenue data allow me to test whether home prices have in fact appreciated more rapidly in areas that became quieter between 1997 and 2000. As model 1 is the standard for the literature, I use it as the basis for a model in which the noise discounts are allowed to vary over time and depend on the change in the contour status between 1997 and 2000. In the base location, a house is on the quiet side of the noise contour in both 1997 and 2000. Alternatives are to be 1) located on the quiet side of the noise contour in 1997 and the severe-noise side in 2000, 2) located on the noisy side of the 1997 contour and the quiet side of the contour in 2000, and 3) located on the severe-noise side of the contour in both years. These locations define three dummy variables showing the change in noise contour status between 1997 and 2000. Letting C denote this vector of dummy variables, the final estimating equation is

Model 3: $y_i = \beta' X_i + \delta' D_i + \gamma' C_i + \lambda' C_i \times D_i + u_i$,

where $C \times D$ represents the set of dummy variables obtained by interacting the time of sale variables with the variables representing changes in noise contour status. This flexible specification permits the appreciation rates to vary by both year and region.

Table 4 shows the results for time and noise contour status. Although the full model also includes the other variables listed in table 3, these results do not change substantially. The coefficients for year of sale indicate that the sale price of a home that is on the quiet side of the contour in both 1997 and 2000 increased by 3 percent between 1996 and 1997, by 7 percent between 1996 and 1998, and by 34.7 percent between 1996 and 2001. These appreciation rates are virtually identical to the results reported in the simpler, table 3 specification.

The coefficients for the noise contour status dummy variables are listed next in table 4. They show the discount (or premium) associated with sites in different regions. The insignificant t-value of 1.444 for sites that were on the quieter side of the 1997 contour and the severe-noise side of the 2000 contour indicates that there is not a significant difference between prices in this area and the base, quiet-quiet region. In contrast, homes that were on the severe-noise side of the boundary in 1997 sell at an 8.3 percent to 8.8 percent discount, compared with homes that were on the quiet side of the boundary in 1997. This discount is approximately the same for homes that fall on either the severe-noise or quieter side of the 2000 boundary.

The remaining variables show differences in appreciation rates over time. Accepting the estimates at face value, a property that was on the quieter side of the 1997 contour and the severe-noise side of the 2000 contour appreciated by only 3% – 2.4% = 0.6% between 1996 and 1997 and by 34.7% – 4.6% = 30.1% between 1996 and 2001. However, none of these coefficients is significantly different from zero, which implies that the appreciation rates for homes in this region are statistically no different from rates for homes that are on the quieter side of the boundary in both 1997 and 2000.

There is some evidence that homes on the severe-noise side of the boundary in 1997 appreciated somewhat less rapidly than homes that started on the quieter side of the boundary. The statistically significant coefficient for a 2000 sale of a property that changed from the severe-noise side of the 1997 boundary to the quieter side of the 2000 boundary indicates that the appreciation rate was 3.1 percent lower (22.7 percent versus 25.8 percent) than the base, quiet-quiet region. However, the appreciation rates are not significantly different for this noise-quiet region in any other year. The one-time difference in appreciation rates disappears by the following year: The difference in appreciation rates between 1996 and 2001 for homes in the noise-quiet and quiet-quiet regions is not statistically significant. The price path is similar for homes

TABLE 4

Regression results for changes in noise contour status

	Coefficient	T–value
1997 sale	0.030	6.066
1998 sale	0.070	14.629
1999 sale	0.140	29.573
2000 sale	0.258	49.803
2001 sale	0.347	54.460
Quiet side in 1997, noisy side in 2000	0.043	1.444
Noisy side in 1997, quiet side in 2000	–0.088	–8.759
Noisy side in 1997, noisy side in 2000	–0.083	–7.582
1997 sale, Quiet side in 1997, noisy side in 2000	–0.024	–0.523
1998 sale, Quiet side in 1997, noisy side in 2000	–0.016	–0.385
1999 sale, Quiet side in 1997, noisy side in 2000	–0.017	–0.420
2000 sale, Quiet side in 1997, noisy side in 2000	–0.036	–0.767
2001 sale, Quiet side in 1997, noisy side in 2000	–0.046	–0.877
1997 sale, Noisy side in 1997, quiet side in 2000	–0.005	–0.349
1998 sale, Noisy side in 1997, quiet side in 2000	0.005	0.376
1999 sale, Noisy side in 1997, quiet side in 2000	–0.018	–1.364
2000 sale, Noisy side in 1997, quiet side in 2000	–0.031	–2.171
2001 sale, Noisy side in 1997, quiet side in 2000	–0.016	–0.955
1997 sale, Noisy side in 1997, noisy side in 2000	–0.002	–0.107
1998 sale, Noisy side in 1997, noisy side in 2000	–0.021	–1.493
1999 sale, Noisy side in 1997, noisy side in 2000	–0.030	–2.197
2000 sale, Noisy side in 1997, noisy side in 2000	–0.043	–2.860
2001 sale, Noisy side in 1997, noisy side in 2000	–0.027	–1.472
R^2, number of observations	0.689	22,541

Notes: The dependent variable is the natural logarithm of the sales price. The full regression includes the explanatory variables listed in table 3.
Source: Calculations based on Illinois Department of Revenue and Cook County Assessor data.

that were on the severe-noise side of the boundary in both 1997 in 2000: Appreciation rates are lower by 3 percent in 1999 and 4.3 percent in 2000, but there is no significant difference in the rate of appreciation for the full 1996–2001 period for any of the regions.

Figure 4 shows the price paths implied by the results presented in table 4. Prices clearly are lower throughout this time for homes that start on the severe-noise side of the 1997 boundary. But the price paths are almost parallel. There is no evidence that prices appreciate more rapidly for homes that change from the severe-noise to the quiet side of the noise contour bands.

Although these results might simply indicate that homeowners are unaware of the noise reductions, a more likely explanation is that appreciation rates will not rise significantly near the airport as long as uncertainty looms regarding the expansion plans. The number of flights could increase from 928,000 to 1.6 million. Homes located in areas that currently are experiencing noise reductions could be faced with large increases in noise levels in the future. As long as the well-publicized expansion plans are cloaked in uncertainty, it is not surprising that prices are not appreciating unusually rapidly near the airport. Nevertheless, noise reductions should eventually result in higher appreciation rates, as neighborhoods near the airport become more attractive places to live.

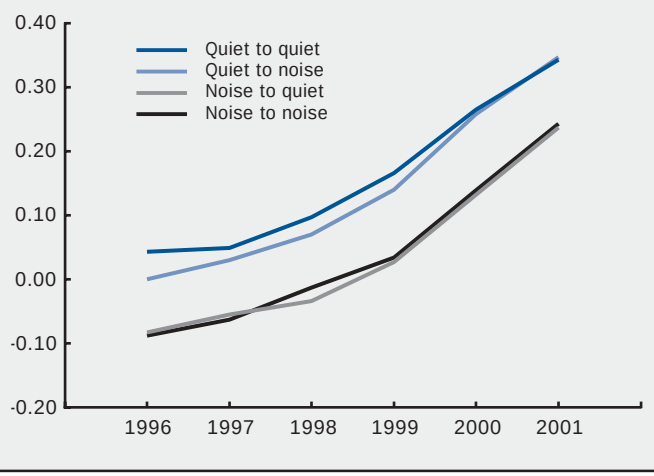
Conclusion

Empirical studies uniformly find that aircraft noise significantly reduces home prices. The area around Chicago O'Hare is no exception to this rule. Using transactions data for 1996–2001, I find that homes inside a 65-db noise contour band sell at a 10 percent discount relative to homes in quieter locations. Each additional mile from the noise contour band raises property values by 8 percent. In 1997, nearly 25,000 homes were located within the 65-db noise contour band, despite the fact that the FAA and HUD consider these noise levels to be inconsistent with residential housing.

As older aircraft are retired and airlines switch to smaller aircraft, residential neighborhoods near airports are becoming significantly quieter. The area within the 65-db contour band around O'Hare Airport fell from 57 square miles in 1997 to 38 square miles in 2000. More than 13,000 homes that were on

FIGURE 4

Estimated price indexes



the severe-noise side of the contour are now on the quieter side. Only 1,167 homes were in areas that changed from the quiet side to the severe-noise side. Aggregate home values can be expected to increase significantly as the area becomes more attractive for residential housing. My estimates imply that home values will increase by nearly $280 million (in 1997 dollars) between 1997 and the time after the expansion of the airport.

The regression models suggest that home prices did not appreciate any more rapidly in areas that were formerly on the noisy side of the noise contour line. All homes in the area around O'Hare Airport appreciated by about 34 percent between 1996 and 2001—an average annual appreciation rate of 5.9 percent. Reductions in airport noise do not yet appear to be capitalized into property values. Homes that were in severe-noise areas in 1997 sold for the same discount in 2001 as in earlier years.

It is unlikely that homeowners and potential buyers are unaware of reductions in very loud and very obtrusive aircraft noise. A more likely explanation for the parallel price paths is that uncertainty concerning potential expansion plans for O'Hare Airport keeps prices from appreciating rapidly in areas that are becoming quieter. Plans call for the addition of one runway, along with major reconfiguring of the existing runways. Together, these changes could lead to nearly 700,000 additional flights at O'Hare each year, an increase of nearly 60 percent over current volumes. Despite this enormous increase in traffic, the area covered by the 65-db noise contour band is projected to decline still further to 27 square miles. If the projections are correct, home values may continue to rise even in the face of higher air traffic at O'Hare.

However, small changes in flight paths can affect many households, and homeowners may well be skeptical that such a large increase in the number of flights will not actually increase noise levels. Further, homeowners may dislike greater flight frequency even when average noise levels are the same. Faced with this uncertainty, it is not surprising that home prices have not appreciated unusually rapidly in areas that have experienced reductions in noise levels.

NOTES

[1]The source for the earlier load factor is the Metropolitan Planning Council (1996a). The source for current load factors and current and projected commercial passengers is the FAA website, http://apo.faa.gov/foreca03/actable10.xls.

[2]The source for these figures is the Bureau of Transportation Statistics: http://www.transtats.bts.gov/HomeDrillChart.asp?URL_SelectMonth=2&URL_SelectYear=2004.

[3]Metropolitan Planning Council (1996b).

[4]The history of the controversy is described in Martin and Cohen (2000).

[5]These results are robust. Other specifications that include nonlinear effects for the distance variables, distance to the CBD, the entrance to the airport, train stops, and highway interchanges all produce statistically significant noise discounts that are at the high end of the range of existing estimates.

[6]The assessor's data show assessed value rather than market value. Although the statutory assessment rate is 16 percent, on average homes in this area were assessed at 9.4 percent of market value in 1997. I divide assessed values by 9.4 percent to estimate market values.

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