Has SARS Infected the Property Market?

Evidence from Hong Kong

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April 2004

[†] I thank Alan Krueger, Cecilia Rouse and Robin Burgess for generous support throughout the project. I have benefited from detailed discussions with Orley Ashenfelter, Janet Currie, Harrison Hong, Rohini Pande, Jesse Rothstein, Jose Scheinkman and Pei Zhu, and comments from Kenneth Fortson, Anders Frederiksen, Richard Jackman, Alex Mas, Giovanni Mastrobuoni, and numerous seminar participants at the Princeton Labor Seminar and the LSE-STICERD Workshop. Financial support from the Industrial Relations Section, Mellon Foundation/ RPDS and MacArthur Foundation/ CIS is gratefully acknowledged.

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Abstract: This paper uses the SARS epidemic as a natural experiment to provide new evidence on how housing markets react to adverse shocks, in terms of both prices and transaction volume. I employ a weekly panel data set on 44 large-scale housing complexes in Hong Kong. To isolate the impact of this unanticipated event from underlying time trends, I exploit cross-sectional variation in SARS infection risk due to pre-SARS building characteristics. The impact of SARS is measured by an estate-specific government SARS-list indicator, a count of newspaper stories connecting SARS to each estate, an estate-level SARS infection rate and a predicted SARS infection risk variable, in addition to a Hong Kong-wide-start-of-epidemic indicator. I find a price drop of 1-2 percent in response to SARS, which is consistent with the standard asset pricing model in the event of a severe but transitory averse shock; no signs of overreaction in terms of prices are found. I also find significant volume decreases of 20-40 percent, which were persistent after the SARS infection rate declined, suggesting that SARS led to both increases in search costs and "fishing" behavior on the part of sellers. Volume fell most sharply in buildings that had experienced the least severe price drops in the preceding 7 years, which lends some support for a loss aversion model.

JEL Keywords: R0, G14, D80

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1. Introduction

Severe Acute Respiratory Syndrome (SARS) is the first new, serious and contagious illness of the 21st century. The late-February outbreak in the Metropole Hotel in Hong Kong in 2003 seeded the international spread of SARS via air travel.[1] Hong Kong was the most severely hit city in the world, accounting for 21 percent of the world total number of SARS cases and 33 percent of deaths. In just three months, the risk of contracting SARS in Hong Kong exceeded the risk of contracting AIDS in high-income countries in a full year.[2]

During the epidemic (from the end of March to June of 2003), housing prices in Hong Kong fell by 8 percent, and transaction volume decreased by about 30 percent compared to the same period in 2002. It is unclear whether these movements were a result of SARS or a continuation of past trends, however. Nonetheless, several politicians, industry consultants and media commentators attributed the drop in housing prices and sales to the epidemic.[3] SARS decreased the general quality of life in Hong Kong, which would be expected to affect housing values. Moreover, scientists drew a link between aspects of the living environment, such as density and hygienic conditions, with the risk of SARS.[4] This paper seeks to identify the impact of SARS on the housing

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[1] *Science*, July 18, 2003. WHO website.

[2] According to the Hong Kong Department of Health, 1,755 people, 0.026 percent of the total population of 6.8 million, contracted SARS in Hong Kong during the epidemic, 300 of whom died. A report by UNAIDS of the WHO estimated that approximately 76,000 people became infected with HIV in high-income countries in 2002, out of a total population of 964,739,000, which implies an infection rate of 0.008 percent.

[3] David Carse, the Deputy Chief Executive of the Hong Kong Monetary Authority, for example, attributed the increase in negative equity loans during the second quarter of 2003 by almost a third to the acceleration of housing price fall due to SARS. DTZ Debenham Tie Leung, a prominent property consultancy, claimed that SARS had a "devastating impact" on the Hong Kong housing market.

[4] Source: Hong Kong Department of Health and WHO websites

market, in terms of prices as well as volume, controlling for past trends at the city- and housing-estate levels.

The standard asset-pricing model (e.g., Poterba 1984), based on the assumption of rational, forward-looking behavior, makes precise predictions about the impact of SARS on housing prices, depending on the permanence of the shock and its effect on future housing services. However, the SARS epidemic involved unknown risks and caused a great deal of unrest and anxiety across the Hong Kong society, therefore it is not clear if rationality is an appropriate assumption. Modern theories in psychology suggest that decision-making relies on both emotion and reason, such that markets might overreact to extreme events.[5] Social amplification of risks is more likely to be triggered by adverse events that are previously unknown, uncontrollable, and that can potentially affect a high proportion of society (Slovic and Weber, 2002). This paper uses SARS as a natural experiment to investigate whether there is evidence of overreaction in the housing market.

I also investigate changes in transaction volume in the housing market. The standard asset pricing model makes no clear prediction about volume, but a search model (e.g., Wheaton 1990) predicts a decrease in volume when search costs rise.[6] It seems quite plausible that potential buyers were deterred from their usual house searching activities by the increase in search costs due to the risk of contracting SARS during the epidemic. Under this model, transaction volumes are expected to return to normal after

[5] Chaiken & Troupe, 1999; Epstein, 1994; Sloman, 1996; Slovic and Weber, 2002

[6] Krainer (1999) develops an alternative search model with information asymmetry between buyers and sellers that predicts a positive correlation between prices and volume. However, this model is less applicable in the Hong Kong housing market as the bulk of the population live in high-risers with relatively small variation in attributes as compared to single-family homes. It is hard to think of any “atypical” housing unit outside the extreme ends of the housing quality spectrum in Hong Kong.

the epidemic was over. On the other hand, the liquidity constraint model (Stein 1995) and the loss aversion model (Genesove and Mayer 2001) predict a more general volume decrease in a market with falling prices even in the absence of increased search costs. I attempt to differentiate between these models by assessing the impact of SARS at different times and on different segments of the market .

This paper relates to a large literature which attempt to quantify the economic impact of a wide range of policies and living conditions by assessing changes in housing prices (Gyourko and Tracy 1991; Chay and Greenstone 1998; Lynch and Rasmussenand 2001; Barrow and Rouse 2002). One concern in much of this literature is that the characteristics under study are endogenously determined; for example, crime could result from falling housing values. In contrast, the SARS epidemic was clearly exogenous and unanticipated.

Another obstacle in studying housing market responses to adverse shocks is the lack of new information embodied in the occurrence of many exogenous events. Graham and Hall (2001), for example, observe that no strong links have been found between the occurrence of natural disasters and property values. This might be because the natural hazards considered were widely known in the areas under study long before the events took place.[7] As for studies focusing on information release of natural calamities and health risks, instead of the actual events, it is difficult to measure changes in information on existing risks without actual changes in risk exposure (e.g., Gayer, Hamilton and

[7] For example, studying the widespread flooding in Houston, Texas area in 1979, Skantz and Strickland (1987) find no immediate housing price decrease, but the area was already known to be flood-prone. Murdoch, Singh and Thayer (1993) estimate that the Loma Prieta earthquake in the San Francisco Bay Area in 1989 led to a small reduction in housing values of 2 percent, but again seismic risks in that area were hardly unknown before.

Viscusi 2002). A previously unknown disease such as SARS provides a unique setting to explore the impact of changes in public information related to an exogenous risk.

To isolate the SARS impact on prices and volumes from underlying time trends, I exploit the cross-sectional variation in SARS risk that arises because some buildings are more susceptible to SARS than others due to their pre-SARS characteristics. Inclusion of week dummies with building-specific SARS measures absorbs any territory-wide time effects, either due to past time trends or other events that occurred during the epidemic.[8] To capture the inter-building variation, I referred to both the Health Department's (public) daily list of buildings with confirmed SARS cases and newspaper reports linking SARS to specific buildings. The Health Department SARS-list and the media were the two main sources of information available to the public. I also constructed a measure of the SARS risk for each estate by regressing the SARS infection rate on pre-SARS characteristics, such as building age, distance to the city center and the average selling price in 2002. Consistent with the literature on health and wealth (e.g., Smith 1999), the results indicate a higher SARS infection rate in lower priced housing estates, and in those located further away from the city centers.

Another analytical advantage comes from the structure of my data. I perform my analysis on a panel data set of weekly prices and sales volumes in the 44 most prominent housing estates in Hong Kong. Half of the city's 6.8 million residents live in private housing, a substantial proportion in large-scale private housing complexes, known as housing estates, which consist of many almost-identical blocks of housing units. The 44 estates in my sample encompass 18 percent of the private housing population. The large

[8] The week dummies might also absorb part of the SARS impact, depending on the extent to which the SARS risk was perceived to be localized.

size of the estates allows reasonably accurate measurements of estate-level weekly price movements, with an average of 3 transactions in an estate in a typical week. Moreover, hedonic adjustments have been made for quality variations across housing units within each estate, taking account of characteristics as floor level and view.[9] The panel structure of the data allows me to circumvent two main problems often encountered in house price studies: comparability and selection bias. Heterogeneity in housing attributes gives rise to comparability problems in studies that use data on cross-sectional samples of housing units, because structural and location characteristics are often difficult to measure. Repeat sales samples, which allow comparisons of prices at different time points for the same housing unit, alleviate this problem to a great extent, but the sample of units that are sold multiple times may not be representative.[10] The substantial similarity of units within each housing estate makes the Hong Kong sample an attractive alternative.

Several noteworthy results emerge from my analysis. Regressions using various SARS indicators reveal price decreases of around 1-2 percent. Interestingly, while only the more expensive housing estates experienced a price fall after being listed on the Health Department SARS-list, less expensive ones were more sensitive to being mentioned in newspaper reports. Overall, my findings on price changes are consistent with the standard asset-pricing model and the market belief that SARS posed a transitory, not permanent, threat. My results rule out overreaction in this particular case.

Controlling for city- and estate-level time effects, I find a decrease in transaction volume in the housing market of 20-40 percent. The decrease in volume appears to be

[9] As explained in Section 3, I primarily use a hedonic-adjusted price data series from CentaCity. This price series has a high correlation (0.96) with the unadjusted land registry data, which I have also examined.
[10] For example, Case and Shiller (1989) show that repeat sales data give rise to spurious serial correlation. For a survey of empirical issues in house price estimations, see Cho (1996).

more persistent than increases in search costs, thus suggesting the existence of liquidity constraints or loss aversion. I attempt to differentiate between the two theories using the following logic: because loss-averse homeowners are pushed towards the flatter part of their convex loss value function by a previous fall in housing prices, they should find a new adverse shock less unpalatable the larger the baseline level of nominal prospective loss. In contrast, rational homeowners are more likely to be liquidity constrained the larger the historical fall in prices, which implies that an increasing number of them are likely to find the down-payment requirement binding. I explore the differential impact of SARS by the level of past price falls, making use of the dramatic price drop from the peak in 1997 to the pre-SARS level in 2002. My results lend some support for the loss aversion model.

The remainder of this paper is organized as follows: the next section describes the background of the SARS epidemic and the Hong Kong housing market in more detail; Section 3 lays out the theoretical framework; Section 4 describes the data; Section 5 reports the empirical findings; and Section 6 offers concluding observations.

2. Background

A. Epidemiology

The agent of the severe acute respiratory syndrome (SARS) is a newly identified strain of corona-virus. The first known SARS case is believed to have occurred in the Guangdong Province of China in November 2002, though the exact origin of the virus is unknown.[11] So far there is no definitive diagnosis or any proven treatment method. The case-fatality ratio is estimated to be 11-15 percent, with the median age at 40. At least initially, the outbreak of SARS was particularly alarming because it proved fatal in healthy, young adults, and appeared to spread relatively easily from person to person. The disease had infected 8,422 people and had caused 916 deaths worldwide as of August 7, 2003. (WHO website)

The virus is believed to be moderately transmissible under normal circumstances, with an average of 3 secondary infections per case in a population which has not yet instituted control measures, but it is unclear why some virus-carriers demonstrated higher-than-normal infectivity in "super-spreading" events.[13] Transmission mechanism of the virus has so far been identified as via respiratory exudates, fecal-oral contacts, contaminated surfaces. There is also evidence of higher risk of transmission within confined spaces, such as elevators and airplanes. Rodents and cockroaches have been found to be mechanical vectors of transmission. Samples from the corridor and elevator areas near Room 911 in the Metropole Hotel, where the first (or "index") patient spent a single night, tested positive for the virus RNA 3 months after his stay, raising questions about the persistence of the virus in the environment. (Lipstitch et al., 2003; Riley et al., 2003; WHO website)

Residential density – which affects the level of person-to-person contact and sharing of communal facilities such as elevators, functioning of the sewage system and

[11] *Nature* **423**, 905 – 906, June 26, 2003; Riley et al., 2003; WHO website. The corona-virus has been found in civet cats, a popular exotic cuisine in Southern China, but the virus is suspected to have originated from another, more exotic species.
[12] Source: WHO website.
[13] In one super-spreading event, at least 16 guests and visitors contracted SARS from the "index patient" in Metropole Hotel during his stay of one night, before spreading the disease worldwide through air travel.

general sanitary conditions – therefore plays a role in determining the extent of SARS transmission within a building. The age of the building and the initial price level of the flats are also likely to correlate with these transmission factors, through their connection with residents' living habits and frequency of maintenance and cleaning of the building.

Although vigorous control and precautionary measures have proven to be effective in containing the spread of SARS, scientists and health authorities believe that SARS remains a threat (WHO website; *Science*; Hong Kong Department of Health). The lack of a definitive diagnosis test and the similarity of SARS symptoms to those of other respiratory diseases make early isolation of patients difficult, and infectivity remains high within the first 10-14 days after onset of symptoms. SARS cases can also be without clinical symptoms yet infectious – the failure to isolate a sub-clinical case led to the second outbreak in Toronto, Canada in late-May 2003. The diagnosis of a SARS case in Singapore in early September, 2003 has heightened fears about a SARS comeback.

B. Chronology of the SARS Epidemic in Hong Kong

The first SARS cases in Hong Kong are now known to have occurred in February 2003. Figure 1 shows a timeline. At least 125 people were infected on or soon after March 3, 2003 in the Prince of Wales Hospital, forming the first SARS cluster (Riley et al., 2003). In mid-March several local medical experts expressed fear that SARS might have entered the public realm. However, it was only when 7 residents in Block E of Amoy Gardens, a high-density private housing estate with 19 blocks, were diagnosed with SARS on March 26, 2003, that community transmission of the disease – i.e., its spread in the local community outside the group of close medical and family contacts of SARS patients – was confirmed by the government.

On the same day the Chief Executive of Hong Kong announced that the outbreak had reached epidemic levels. Three days later the total number of confirmed SARS cases in Amoy Gardens alone increased to 85, over 70 percent of which were from Block E (which was consequently quarantined for 10 days on April 1). The Amoy outbreak took the public by surprise, as it contradicted the high-profile denial of community transmission of SARS by the government on March 17. Until then the government had insisted that there were no signs that the outbreak had affected the general public outside close contact circles of hospitalized patients. As it turned out, less than a quarter of the SARS cases in Hong Kong were health care workers and most of the almost 400 infected residents in Amoy Gardens were strangers to each other.[14]

After the Amoy outbreak, SARS-related reports dominated newspaper headlines, and there was a large-scale shutdown of normal activities. Most people either stayed at home or wore surgical masks, while all schools were suspended on March 29 for more than 3 weeks. Unanswered questions about diagnosis, treatment and transmission mechanism added to feelings of uncertainty and trepidation about the SARS infection risk. Residents were infected across the board, including the educated, the young and the previously healthy. The WHO issued a travel advisory to suspend all but essential travel to the territory on April 2. To encourage stringent precaution measures of residents and building managements, the Department of Health published a daily "List of Buildings of Confirmed SARS Cases" on the WEB beginning April 12. This list was the main source of information available to the public.

The Hong Kong Department of Health conducted an investigation of the SARS outbreak at Amoy Gardens. The report, available on April 17, 2003, ruled out the theory

[14] Source: *The Standard*; *Oriental Daily*; WHO website.

that SARS was air-borne, but concluded that sewage flaws, environmental contamination and pests played a part in spreading the virus. An independent investigation by the WHO concluded on May 16, 2003 with similar findings. The epidemic was declared contained after three months, when Hong Kong was removed from the WHO List of Areas Affected by SARS on June 23, 2003, 21 days after the last case in the territory was isolated.

The repercussions of the epidemic were still felt in the society after the epidemic was over. A survey by the Chinese University in early July – more than a month after the last SARS case was isolated on June 2 – reported a deep fear of SARS among the respondents.[15] The government estimated that business receipts for airlines, hotels and taxi companies in Hong Kong at the end of July remained more than a fifth lower than normal.[16] Up until the end of July, the Hong Kong Equal Opportunities Commission had received more than 500 inquiries and complaints linked to the epidemic, mostly relating to employment discrimination.[17]

C. The Hong Kong Housing Market

The property market in Hong Kong is of much interest in its own right. Hong Kong has among the highest property values in the world, and the market is widely believed to have experienced a bubble in the 1990s. Hong Kong real estate prices have

[15] Survey conducted by Commission and the Moods Disorders Centre, Chinese University. More than 50 percent of the respondents confessed to remaining 'scared' of those recovered from SARS. Another 40 percent believed employers prefer applicants without exposure to SARS, and almost 30 percent still avoided meeting friends who had been exposed to it.

[16] Hong Kong government information center, "Effect of SARS on Business". http://www.info.gov.hk/hkecon/sars/index.htm

[17] Among other complaints, a SARS patient was fired, a job offer retracted after a SARS case was confirmed in the building the job applicant lives in, and workers were forced to take unpaid leaves after visiting the Mainland China.

experienced a sharp decline since mid-1997 (see Figure 2).[18] By the end of 2002, Hong Kong residential housing prices had declined by more than 65 percent from their peak level in 1997. Since 1999, however, housing prices in Hong Kong have followed a relatively steady, gradual downward trend.

The Hong Kong government owns all the land in the territory, and controls the land supply. All instruments which affect real and immovable property, including sales and purchases of flats, are usually registered with the Land Registry subject to the provisions of the Land Registration Ordinance, which prevent a loss of priority to any subsequent registered transactions. Most owners sell their properties through estate agencies, according to the Hong Kong Estate Agents Authority.

Since 1998 the Hong Kong government has devised various interim policy schemes to stabilize housing prices, but to little effect.[19] Regulations on the completion period of construction projects and on the pre-sale period on uncompleted flats (which restricts sales activities to start no more than 20 months before completion), limit the scope to which developers have to schedule completion and launching of new units. It is unlikely that supply management would have caused a discrete jump in prices during the period under study.

[18] *Business Week*, May 19, 2003. The reasons for this crash are complicated, and possibly include the land and public housing supply policies of the government before and after the handover, the Asian financial crisis, and speculative behavior by investors.

[19] JP Morgan, July 3, 2003, *The Standard*. In November 2002, the government suspended the sales of land and of all subsidized flats under the Home Ownership Scheme, limiting long-term supply of housing units to support the housing prices. However, the main property developers have a holding of farmland available for conversion equivalent to four years' supply. Many blame the excess supply of residential flats in Hong Kong for the continuous fall in prices.

3. Theoretical Framework

A. Standard Asset-Pricing Model

As a benchmark, I consider the price movements predicted by the standard asset-pricing model, where rational consumers are forward looking and therefore house prices equal the net present value of future service flows, depending solely on market fundamentals. This implies that any immediate change in prices depends on the expected change in the entire path of future values of housing services. To express this formally, I adapt the asset-market equilibrium condition in Poterba (1984) according to the tax structure in Hong Kong:

(1) $$Q(t) = \int_t^{\infty} S(z)\, e^{-r(z-t)}\, dz$$

where Q(t) is the real value of a housing unit at time *t*, and S(z) denotes the real value of housing services provided in period *z* minus depreciation, taxes, and maintenance costs.[20] The housing services are discounted by the effective real interest rate *r*:

$$r = (1-\theta)(L i_b) + (1-L) i_l - \pi$$

where θ is the salary tax rate, L the mortgage-to-value ratio, i_b the borrowing nominal interest rate, i_l the nominal lending interest rate, and π denotes the inflation rate. Because mortgage interest payments are deductible from salary taxes in Hong Kong, the nominal effective interest rate is equal to the weighted average of the nominal borrowing and lending rates by leverage L, with the borrowing rate discounted by the salary tax rate θ. *r* is equal to the nominal effective interest rate net of inflation.

A rough calculation below shows that the size of the market-wide impact under the asset-pricing model largely depends on whether the housing market considers the

SARS impact to be permanent or transitory. Assuming for simplicity the service value of the housing unit, tax rate, interest rate and inflation rate are all time-invariant, equation (2) reduces to:

$$Q(t) = S/r$$

To consider an extreme scenario of a transitory shock, suppose six months of housing services are totally destroyed by the epidemic. The percentage decrease in Q under rational expectations in this case will be:

$$\Delta Q/Q = 0.5S/ (S/r) = 0.5r,$$

or half of the real effective interest rate. During the fiscal year 2003-2004, the after-tax real interest rate in Hong Kong is approximately 2.41-2.58 percent, which implies a drop of 1.21-1.29 percent.[21] Any permanent decrease of *x* percent in annual housing service flows S, by contrast, causes a decrease of the same percentage in the real housing price Q. Unless that permanent decrease is only around 1 percent annually, it is clear that a permanent SARS threat would lead to a much larger immediate drop in prices in a rational market.

Besides decreasing the general quality of life in Hong Kong, thus creating a territory-wide impact, SARS also creates a new health risk specific to each building. To derive the implications in the asset pricing model of a change of health risk related to specific building structures in a housing market with a continuous variation of quality, higher-quality housing units can be thought of as units which produce a larger quantity of homogeneous housing services during any given time period. That is, health risk is

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[20] Two property taxes in Hong Kong – the Government Rent and Rates – are charged annually at 3 percent and 5 percent respectively on most housing units in Hong Kong.

substitutable for other building characteristics, such as number of rooms. Denote the housing services provided by housing structure *h* by H_h, $H_N > H_O$ is equivalent to the concept that housing unit *N* is of better quality than housing unit *O*. The newly recognized health risk decreases the expected units of housing services provided by low-quality housing structures, while those of higher quality are not affected. The supply of housing services in the market therefore decreases as a whole, which leads to a higher unit price for housing services. An unambiguous prediction is that prices of housing structures with high SARS risk decrease after the epidemic in comparison to those of housing structures with lower or no SARS risk.

B. Overreaction

Although appealing, the assumption of rationality that the asset-pricing model is based on might not be appropriate in predicting market responses to extreme and rare events such as the SARS epidemic. Strong emotions and uncertainty associated with the event might cause decisions to deviate from rationality.[22] Modern psychology theories and studies in the perception of risks illustrate the importance of affective reactions in decision-making, especially in situations under uncertainty. Holtgrave and Weber (1993), for example, provide evidence that affective reactions are crucial even in more "objective" contexts such as financial investment decisions.

Research within the psychometric paradigm highlights three factors that increase the level of perceived risk and the willingness to pay to reduce it: how dreaded, uncontrollable and fatal the risk is; how unobservable, unfamiliar and unknown it is; and

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[21] The average 1-month HIBOR (Hong Kong Interbank Offered Rate) during the first quarter of 2003 is 1.38 percent. Deflation rate is around 1.20 percent. I based my calculation on a mortgage ratio ranging from 0 to 80 percent.

the level of personal and social exposure to the risk (Slovic 1987). Prospect theory (Kahneman & Tversky 1979) predicts that rare events tend to be overweighed, in the absence of the risk-learning process through repeated experience. "High-signal" events – relatively small incidents in poorly understood systems – are also likely to cause a social amplification of risks and lead to higher-order rippling effects much greater than the direct impacts and far beyond the direct victims (Burns et al., 1990; Slovic 1987).

This suggests that extreme, rare events which are unfamiliar, uncontrollable and potentially catastrophic might elicit greater psychological, socioeconomic and political impacts than indicated by a standard cost-benefit analysis of risks (Kasperson et al., 1988; Slovic and Weber 2002). In the unknown-dread risk factor space of Slovic (1987), SARS would be categorized with risks related to terrorist attacks, radioactive wastes and nuclear reactor accidents. This implies that it is highly likely to trigger social amplifications of the risk.[23]

C. Transaction Volume, Search and "Fishing"

The standard asset-pricing model, which assumes a frictionless market with instantaneous adjustments to new information and shocks, has no clear implication for the effect of an exogenous shock on trading volume or the required length of time to sell an asset. The market-clearing condition abstracts from the existence of frictions, a likely phenomenon in real estate markets where both buyers and sellers are observed to invest substantial resources in the search process (Krainer 1999).

[22] One example is when a single hoax message posted by a 14-year-old on the internet resulted in a wave of panic-buying. The government quieted the fears by sending SMS messages to 6 million mobile phones.

[23] Liu, Hammit, Wang and Tsou (2003) conclude from two surveys that in Taiwan the implied value per statistical life related to reducing the SARS risk is higher than previous studies, suggesting that people in Taiwan might have overestimated the risk of SARS.

During the epidemic, search costs were likely to have increased significantly due to the risk of contracting SARS. Because this risk was expected to decrease after the epidemic ended, it would be rational to delay house searching activities. A standard search model, e.g., Wheaton (1990), predicts a decrease in transaction volume with an increase in search costs. Trading volume should return to normal after search costs do so in the standard search model.

Two alternative theories, however, predict more persistent effects of price drops on transaction volume in housing markets. Both seek to explain the strong positive correlation between housing prices and trading volume observed at the local and national levels in different countries (Stein, 1995; Ortalo-Magne and Rady 1998; Genesove and Mayer 2001). “Hot” markets are characterized by rising prices, increased intensity of trading activities and shorter selling times, while “cold” markets usually display a dry-up of liquidity and longer selling times, along with a fall in prices. The 8 percent price fall in Hong Kong during the SARS epidemic was accompanied by a decrease in volume by 30 percent. Volume also fell as prices declined from 1997 to 2002.

Stein (1995) shows that the down payment requirement leads to a dependence of housing demand on buyers’ liquidity. In imperfect capital markets, homeowners who would have been able to trade down are constrained to stay in their original housing unit when prices fall, if repayment of the mortgage prevents them from making a down payment for a new home. They might either decide not to put the flat up for sale, or set a higher asking price and wait for a longer sales period to “fish” for a high-than-average price offer. This implies an attenuated price fall in the event of an adverse shock, and a decrease in turnover rate as “fishing” does not always pay off. The more severe the shock is, and the higher the share of liquidity-constrained homeowners, the more significant the impact on volume will be. This theory explains decreases in volume in the presence of an exogenous negative shock to housing prices under the assumption of rational behavior.

Alternatively, Genesove and Mayer (2001) turn to prospect theory for an explanation. If financial decisions are made relative to some reference point, such that value functions are concave in gains and convex in losses (Kahneman and Tversky 1979; Tversky and Kahneman 1992), we will observe loss aversion behavior. This suggests that reactions to current housing prices might differ depending on the level of prospective losses, i.e., the difference between the current price and the reference price, such as the initial price they paid for their homes or the highest price their homes have ever attained. A loss-averse seller will try to attenuate the prospective loss by setting a higher asking price, thus taking a longer time to sell. Therefore, like the liquidity constraint explanation, loss aversion will lead to an attenuated price reaction to an adverse shock, compared with the prediction of the standard asset-pricing model, and a decrease in observed trading volume. So far, empirical studies (e.g., Lamont and Stein 1997; Genesove and Mayer 1997, 2001) on housing price and volume do not offer much evidence differentiating the two theories.

The main difference between the predictions of the two models involves whether the decrease in volume in a "cold" market is related to leverage under credit constraints and prospective losses, respectively. One measure of prospective loss is the difference between the highest attained price since purchase and the current expected selling price. Unfortunately, information on the original purchase date is not available in my data set.

Disaggregated measures of leverage or household wealth, such as the loan-to-value ratio or income, are also not available.

However, because historical price falls are correlated to both the baseline level of prospective losses and the baseline liquidity position, the interaction between a historical decrease in housing prices and a new adverse shock has different implications under the two theories. Loss-averse homeowners are pushed towards the flatter part of their convex loss value function the larger the prices of their homes have fallen, so that they should react less towards a new price fall. On the other hand, rational homeowners are more likely to find the down payment requirement binding in face of a new shock the greater the past price fall has been. Therefore, in a volume regression a negative coefficient on an interaction between past changes in housing prices and the exogenous SARS shock is more consistent with loss aversion, while a positive coefficient is more consistent with liquidity constraint. While this is not conclusive evidence, this adds to our understanding of the relationship between prices and volume in the housing market.[24]

4. Data

A. Measuring Housing Prices in Hong Kong

To analyze price movements, I use a publicly-available panel data set of hedonic-adjusted prices on 44 housing estates in Hong Kong that form a widely-used residential housing market index, the Centa-City Leading Index. These prices are weekly averages

[24] Tenure, which in turn is correlated with the age of the housing estate, determines the extent to which residents are affected by a given price fall. Regressions including an interaction term between building age and the 1997-2002 price drop produced very similar results, therefore for simplicity I present results with the main effect of the price drop only. I also calculated the Spearman rank correlation between the historical price fall of each housing estate and measures such as the baseline price level, flat size, baseline flat value and travel time to city centers, to test for a systematic pattern in the size of the historical price fall

based on secondary residential property transactions handled by a leading estate agent, Centaline Property Agency Ltd., with a market share of around 20 percent. The data span 26 weeks, from January 2001 to the first week of July 2003.

To explore how representative my price sample is, it is useful to compare it with another widely-used residential housing market index in Hong Kong, the Centa-City Index (CCI). While both indices are based on hedonic-adjusted price data of the same 44 constituent estates, the CCI is computed using prices from all transactions registered with the Land Registry so it does not suffer from the potential bias the CCL might have from being based on contracts handled by Centaline only.[25] Also, the CCL is based on preliminary contract prices, which are specified on the provisional agreement with the payment of an initial deposit forfeitable in case of default (3-5 percent of the price), instead of final transaction prices. However, the estate-level prices which form the CCI are not available. Figure 3 shows the movements of the two indices over the past 9 years. Obviously, there has been a close correspondence between the two.

The 44 estates in my data set are each prominent in the territory, and they are located in 14 of Hong Kong's 18 districts. With an average population of 13,000, each estate forms a mini-city by itself, with variability in age, layout and other characteristics across the estates, and little variability within estates. Collectively, these 44 estates house 18 percent of the Hong Kong private-housing population (which is about half of the total population). Twenty of the 44 estates were listed on the Department of Health SARS-list at some point. Appendix A2 shows more details on the estates. In my empirical analysis,

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in terms of wealth or income levels. The null that the historical price fall and each of these measures were independent was not rejected.

[25] Both indices are part of a joint project between Centaline and the City University of Hong Kong (the Centa-City team) to measure price movements in the Hong Kong secondary residential housing market.

I compared weekly price movements among the 44 estates in the first half of 2003. Estate fixed effects absorb all time-invariant, between-estate differences.

B. Transaction Volume Data

I obtained access to the Memorial Day Book of the Hong Kong Land Registry from January 2001 to June 2003.[26] This source contains essential property transaction information extracted from the instruments lodged for registration each day, including the date of the instrument, address of the property, consideration (price) and date of execution. A total of 245,240 sales and purchase instruments were registered over this period, for assets including both residential and commercial property.

The weekly transaction volume of a housing estate is defined as the number of sales and purchase contracts executed during each particular week. To eliminate contracts involving non-residential properties, I have assembled these data on a weekly basis for the 44 estates covered by the Centa-City price series. To avoid a potential downward bias of volume caused by the time lag between execution and registration of a contract, I removed the last 2 weeks of observations in June 2003 from my sample, and focused on the first 24 weeks of 2003.[27]

C. Housing Estates Characteristics

I compiled data on the basic characteristics of the housing estates that might be related to the spread of SARS for the 44 estates in my sample including: age, number of floors, number of flats per floor, and number of blocks.[28] To generate an estimate of each

[26] This data purchase was generously supported by a grant from the Andrew M. Mellon Foundation through the Research Program in Development Studies, Princeton University.
[27] The mean lag between execution dates and the registration dates is 20 days.
[28] These data were compiled by research on the internet, phone calls to real estate agents and property developers, and visits to some of the estates. Age and the number of floors and flats per floor are averages across the housing estate; number of blocks are often counted from site plans of the estates.

estate's population, I multiplied the total number of flats (blocks X floors X flats per floor) by the number of households in each housing unit, and the number of persons in each household. The last two measures are district-level averages from the Hong Kong Census 2000.[29]

I also measure the travel time to city center from a housing estate, defined as the amount of time spent on the most prevalent form of public transport to the closer of the two main commercial/ financial centers in Hong Kong, Tsim Sha Tsui and Central. Twenty-two of the 44 housing estates are situated near a MTR (underground) station, and 7 others are close to a KCR (train) station. The rest of the estates are served by bus, minibus, or ferry and for those in the Mid-levels, by taxi. Information on travel time to city center was collected from the transportation companies and real estate agents.

D. SARS indicators

(i) Territory-wide Start of SARS Epidemic Indicator

The start of the SARS epidemic in Hong Kong can be defined in various ways. It can be the identification of SARS as a new illness by the WHO in mid-March, the confirmation of community-level spread of the disease by the Department of Health on March 26, 2003, or the discovery of the SARS virus in late-March 2003. I have defined the start of the SARS epidemic indicator to be equal to 1 after March 26, 2003, when the Chief Executive of Hong Kong declared that the outbreak reached epidemic levels with the news of the Amoy Gardens outbreak. As my results will show later, this is a relatively conservative definition.

[29] There is not a lot of variation across districts. Mean [s.d.] of household per quarter = 1.02 [0.03]; Mean [s.d.] of persons per household = 3.16 [0.19].

(ii) SARS-List Indicator

The main source of information about SARS is the Hong Kong Department of Health List of Building with Confirmed SARS Cases, which was published *daily* on the WEB and frequently referred to in the media. I attempt to differentiate housing estates with different levels of exposure to SARS by exploring the impact of being listed on the Department of Health SARS-list. The SARS-list indicator, therefore, is defined as 1 after any building within a housing estate was put on the list, and 0 before.

One drawback of the List is that it was first published on April 12, 2003, more than 2 weeks after the Amoy outbreak. Also, the number of cases in each building was not provided, so the List alone contained only crude information about the relative severity of the outbreak in each of the listed buildings. Buildings were only kept on the List within 10 days of hospitalization of the last SARS patient from that building. If there was more than a 10-day lag between the hospitalization of the patient and the diagnosis of SARS, the incubation period was considered to have passed, and the building in which the patient lived would not be put on the list. The list was relied upon as the main source of statistics on the epidemic, but it was by no means perfect information.

(iii) SARS-related News Count

An alternative source of information about SARS was the media; newspaper articles during the epidemic were dominated by headlines about the latest development of the spread of the disease, for example. Information content of news articles might not perfectly correspond to that of the SARS-list statistics.[30] Consequently, I counted the number of newspaper articles mentioning each of the 44 estates in connection to SARS

[30] Often rumors or unconfirmed suspicion of SARS cases in specific estates were reported in the papers. Some of them proved to be false, others to be local knowledge slightly ahead of the Health Department.

from 4 prominent newspapers, two in English and two in Chinese (the two official languages in Hong Kong), with a total daily circulation around 320,000 copies.

To account for the fact that the public might put less weight on older news reports, I created a news count by weighing the number of news articles each week by a geometric series. I included the period from when the Hong Kong government confirmed the community-level spread of SARS until the week Hong Kong was removed from the WHO SARS-list (March 26 to June 24, 2003). Outside of that period, individual housing estates were rarely mentioned in connection to SARS. The news count is calculated based on the following equation:

(2) $NEWS_{it} = \Sigma_{s \leq t}$ (no. of news report related to estate *i* during week *s*) $* \alpha^{(t-s)}$

The number of news reports during the week *s* ($s \leq t$) enters into the weighted news count in week *t* with a weight of $\alpha^{(t-s)}$. I have experimented with a range of values for α from 0, 0.1, to 1.[31] Note that an alpha of 1 simply gives a cumulative sum of the weekly count of news reports, while a value between 0 and 1 is a weighted sum of number of news reports of each week, with weights decreasing geometrically the farther back in time.

(iv) SARS Infection Rate and Predicted SARS Infection Risk

If there were a perfect measure of the perceived health risk faced by residents of each estate, any other measures of SARS should have no additional impact on prices. In actuality, perceived risks are unobserved. There is no publicly known, scientific estimate of estate-specific health risk from SARS either. In fact, the number of cases in each building or estate was not recorded by the Department of Health, outside of the 4 sites with the largest clustering of cases. For Amoy Gardens, which was the largest cluster of cases, I calculated the SARS infection rate by dividing the number of cases by estate population. Twenty-four other estates were not listed at all and I assumed the infection rate to be 0. As for the 19 other estates, I estimated the number of cases by multiplying the number of times each of them was on the SARS-list by the average number of cases per listing outside the 4 largest clusters.[32] The ratio of the estimated number of cases to the estate population gives the SARS infection rate in these 19 estates.

To estimate the risk of SARS associated with building characteristics, I estimated the following equation:

(3) $SPREAD_i = \alpha + X_i \beta + \gamma_d + \varepsilon_i$ (i = 1, …, 44)

where $SPREAD_i$ refers to the SARS infection rate of housing estate *i*, α is a constant term, X_i a vector of time-invariant pre-SARS housing estate characteristics, γ_d a district fixed effect, and ε_i is a normally distributed error term. As explanatory variables X_i, I have included the baseline price level in 2002, travel time to the center of the city, the proportional price change from 1997 to 2002, and building attributes including the average age of buildings in the housing estate, number of blocks, floors and flats per floor, and estate's population. The baseline price level reflects the quality of the housing estates pre-SARS and wealth of residents, while travel time is expected to be negatively correlated with income level since the opportunity cost of time increases with hourly wages. I attempt to proxy for the change in residents' wealth using the proportional price change for the estate since 1997 (-49 percent to –69 percent). The number of blocks,

[31] Note that the number of reports during the current week t always has a weight of 1.

[32] The average number of cases per listing outside the 4 largest clusters = (total number of cases in Hong Kong – total number of cases of the 4 largest clusters)/ (total number of listed addresses – total number of times the 4 largest clusters were listed).

floors and flats per floor are crude measures of the density of the housing estate. This regression makes use of information that might not be readily available to the public.

Because the SARS infection rate is a probability measure bounded between 0 and 1, I estimated a Tobit regression. Table 2 contains the Tobit regression results. Amoy Gardens is excluded from the sample since it was a large outlier with the most serious SARS cluster in Hong Kong, and more importantly, because infection of the residents there began before precautionary measures were enforced so the relationship between the infection rate and pre-SARS characteristics is expected to be different from that at all other estates.[33] Controlling for district fixed effects, columns (1) to (3) show that estates with a lower level of baseline price and further away from the city center were more susceptible to SARS. This is consistent with the observation that less expensive housing estates typically have inferior hygienic conditions, which might be related to the lower income and education levels of the residents, and frequency of maintenance.

Housing estates with a larger price fall from 1997 to 2002 had lower infection rates. While the price drop proxies for a decrease in wealth, which might be expected to be positively correlated with health (e.g., see Smith, 1999), the factors that determine the size of the bubble at each housing estate in 1997 complicate the interpretation. Nevertheless, it is puzzling that a larger price fall is associated with a lower SARS susceptibility. Columns (4) and (5) show that the building attributes, which proxy for building condition and density, have the expected signs, although they are not individually nor jointly significant. The last 2 columns explore the robustness of the explanatory variables by including them jointly in the model. While both baseline price

[33] The lower limit of the Tobit is 0. The upper limit is unconstrained as no estate approaches 1. Reasonably similar results, available upon request, are produced with Amoy Gardens included in the sample.

and the past price fall are still significant, travel time to city center is not. It is, however, jointly significant with baseline price. There is a high correlation between the two (-0.63). Building age is negatively correlated with SARS susceptibility, controlling for baseline price.

To explore how robust the relationship between the spread of SARS in a housing estate is with the estate characteristics, I performed analogous regressions using the total number of days that each housing estate was on the Department of Health SARS-list as the dependent variable. I estimated a Negative Binomial model because the number of days listed is a discrete variable, such that the error term is not normally distributed.[34] I found results similar to those on SARS infection rate reported earlier (Table 3).

5. Estimation Results

A. Impact of SARS on Housing Prices

(i) Hong Kong-wide Impact

As the first test of the magnitude of the SARS impact, I regress weekly prices of 44 estates on a territory-wide SARS indicator which is equal to 1 after March 26, 2003, when community-level spread of SARS was confirmed.[35] I estimate:

(4) $$P_{it} = \alpha + \beta_1 \text{ SARS}_t + \theta_i + \beta_2 t + \beta_3 t^2 + \beta_4 t^3 + \gamma_d t + \varepsilon_{it}$$

where P_{it} is the weekly average of transaction prices in estate *i* (after hedonic adjustment) during week *t*, α is a constant term, SARS_t is a SARS epidemic indicator that equals one after March 26, 2003 and 0 before, θ_i is an estate fixed effect, t, t^2 and t^3 are a cubic time

[34] Amoy Gardens is included in these regressions because the SARS-list only started after April 12, 2003, well after confirmation of community-level spread. Similar results are obtained if Amoy Gardens is excluded.

trend , γ_d t is a set of district-specific linear time trends, and ε_{it} is an error term assumed to follow an estate-specific AR(1) process to allow for serial correlation in the price series. I estimate equation (4) by Feasible General Least Squares (FGLS), using a sample of prices for the 44 estates for the first 26 weeks in 2003 (11 weeks before the epidemic and 15 after). Because price observations are weekly averages for estates that vary in size and number of transactions, I weight the regression by the total number of flats in each estate to adjust for heteroskedasticity.

Any confounding factors that are time-invariant are absorbed by the estate fixed effects. The break in time trend represented by the SARS indicator is unlikely to be caused by continuous and slow-evolving factors because such effects will be absorbed by the time-trend. Table 4 presents these estimates. The three groups of control variables – estate fixed effects, the cubic time effect and the district-specific linear time trends – are all significant at the 1 percent level in all specifications. Column (1) indicates that there is a decrease of close to 1 percent in average transaction prices across the 44 estates for the first 15 weeks after the start of the epidemic, as compared to the 11 weeks in 2003 pre-SARS.[36] This is a small but precisely estimated effect, and the magnitude is consistent with what the standard asset-pricing model predicts for a severe but transitory shock. I have experimented with linear and quadratic time effects and obtained similar results. To check the robustness of this finding, I repeated the regression in column (1) using data for 2001 and 2002, and no similar price drop was found.

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[35] As discussed in the previous section, there is no unambiguous way of defining the start of the epidemic. There were media reports of "atypical pneumonia" cases since February.

[36] Unweighted estimation gave similar results, with a territory-wide decrease of 0.88 percent in prices associated with the start of the epidemic.

Columns (2) through (7) include interactions of the SARS indicator with various estate characteristics to explore whether there are differential reactions by baseline price, travel time to the city center and the magnitude of the price drop from 1997 to 2002. Columns (3), (5) and (7) allow for a more flexible underlying time effect by including week dummies instead of the cubic time effect. Although the main effect of the epidemic indicator is absorbed in these models by the week dummies, the interaction terms are still identified. No significant interactive effects are found. This suggests that the impact measured by the SARS epidemic indicator is a general decrease in the quality of life due to the introduction of a new health threat that cuts across the entire territory.

To explore the territory-wide impact further, in place of the territory-wide SARS indicator in equation (3) I include unrestricted week dummies. Controlling for the estate fixed effects and estate-specific linear time trends as before, the week dummies are significant jointly as a group. Figure 4 illustrates the weekly price movements relative to the start of epidemic. Although the figure shows lower than average transaction prices after week 12, when the government confirmed the community-level spread of SARS, it also suggests that prices started falling shortly before then, around the time the first suspect cluster of medical care workers was identified. Because the start of epidemic is defined to be the government confirmation of the epidemic, it slightly understates the territory-wide impact of SARS on housing prices. A somewhat larger SARS impact (-1.3 percent) is obtained if I define the start of epidemic to be March 15 (week 10) instead. Nevertheless, Figure 4 shows that the average SARS-related change in housing prices in the 44 estates was around 1 percent, which give little support to the notion that the housing market might have overreacted to SARS.

(ii) Impact of Being on the Department of Health SARS-List

A potential drawback of using a territory-wide indicator is that there might be Hong Kong-wide time effects that are not controlled for by the cubic time effect and district-specific linear time trends. Therefore, I also exploit the cross-sectional variation in SARS occurrence to identify the SARS impact. Specifically, I estimate:

$$P_{it} = \alpha + \beta_1 \, SARS_{it} + \theta_i + \Psi_t + \gamma_d \, t + \varepsilon_{it} \qquad (5)$$

where, as before, P_{it} is the weekly average of transaction prices in estate *i* during week *t*, α is a constant term, θ_i is a set of estate fixed effects and γ_d t is a set of 14 district-specific linear time trends. The variable $SARS_{it}$ is an indicator for being listed on the Department of Health SARS-list, which equals 1 for an estate beginning with the week any building within that housing estate was listed as having a confirmed SARS case and every week thereafter, and 0 otherwise. Variability across estates in the timing of when – and whether – the estate was added to the list allows me to identify the SARS impact while controlling for unrestricted time effects with week dummies, denoted Ψ_t.[37]

Again, I estimate equation (5) by weighted FGLS allowing for estate-specific AR(1) processes, with sample weights equal to the total number of flats in each estate. The coefficient β_1 compares the average prices before a housing estate had any SARS cases (as confirmed by the Department of Health), and prices after. The three groups of control variables – the estate dummies, the week dummies and district-specific linear time trends – absorb any time-invariant estate-specific characteristics, territory-wide shocks and district-level trends; each of these sets of effects are significant at 1 percent. Table 5 summarizes the estimates.

Column (1) indicates that there was no significant decrease in prices for housing estates added to the list. Column (2), however, shows that the interaction of log baseline price in 2002 and the SARS-list indicator is significant and negative. This implies that being listed on the Department of Health SARS-list is associated with a price drop in those estates in the *upper* end of the market. Estimating the equation only for housing estates with baseline price above the median indicates that these higher-priced estates suffered a negative impact from being listed. According to the model in column (2), an increase in log baseline prices by 50 log points (just over 1 standard deviation at 0.422) in a listed estate is associated with an additional price decrease of 1.3 percent. As was shown in Section 4.D, the baseline price is negatively correlated with the SARS risk. Therefore, to the extent that the SARS-list indicator is only part of how the housing market formed its expectations about SARS risk, the coefficient of the SARS-list and baseline price interaction term would be expected to be positive, provided that the market realized the link between baseline price and SARS risk. One explanation of this puzzling finding is that the higher-income families placed a higher disutility on the health risk.[38]

In column (3), the interaction between travel time to the city center and the SARS-list indicator shows a positive effect on prices, consistent with the result in column (2), though the main SARS-list effect is insignificant. The correlation between travel time and baseline price of the 44 estates is -0.63. The net effect is negative, but smaller than 1 percent, for the entire range of travel time. No significant differential price reaction is

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[37] I have also experimented with the number of days an estate had been listed, cumulative and weighted, and they produce similar results. Therefore in this paper I present results using the simpler SARS-list dummy.

[38] For example, homeowners in lower-priced estates are likely to face more health risks associated with the living environments pre-SARS – e.g., from the cockroach/ rodent infestation – and diminishing marginal disutility implies that they might react less to a new health risk.

found according to the past price fall. Column (5) shows similar results, with less precision, when all three interaction terms are included in the same regression. Overall, these results on the estate-specific SARS-list indicator suggest a weak price effect.

(iii) Newspaper Reports

The other main source of information for the public was the mass media. As mentioned, I constructed the news count in week *t* by weighting the weekly number of news reports during the week *s* ($s \leq t$) with a weight of $\alpha^{(t-s)}$. I have experimented with α from 0 to 1. The news count indicators is substituted for $SARS_{it}$ in equation (5). Table 6 shows the results for α = 0.5, and similar results are obtained for α ranging from 0.1 to 0.8. Results with different values of α are included in Appendix C. α can be interpreted as the rate at which the public discounted information in the press. Column (1) in Table 6 shows that the news count has a significant negative impact on prices. The estimated impact of the news count at its mean is -0.05 percent, and -2.28 percent at its maximum (excluding Amoy Gardens).

Column (2) adds an interaction between the news count and log baseline price, which has a significant and positive impact. Dividing the coefficient of the main effect by that of the interaction shows that housing estates above the median baseline price are not affected by the news reports in connection to SARS. It is interesting how the Department of Health list and the newspaper reports seem to affect opposite ends of the housing market. Several explanations can explain the relation of the mass media to the lower end of the market. People with a lower income (and education) level might depend more heavily on the mass media for information and analysis. Newspapers might have a greater incentive to cover more populous housing estates, since the demand for news reports presumably increases with the number of people who can directly relate to their content.[39] If the public believes that the newspapers devote their main effort into more populous (and less expensive – the correlation between log population and log baseline price is –0.68) housing estates, news reports on those estates might be considered as more reliable and accurate than those on more expensive estates.

Results of the interaction with travel time in column (3) tell a similar story: a higher number of newspaper reports has a greater impact on housing estates further away from the city center. Dividing the coefficient of the main effect by that of the interaction term reveals that estates with travel time above 35-40 percentile are negatively affected. There is no significant differential in price reaction among estates with different price drop from 1997 to 2002. As column (5) shows, the effect of the news count remains robust when the SARS-list indicator is included in the same regression. Regardless, the effects of the news reports are small.

(iv) SARS Risk

My findings on the price reaction towards the Department of Health SARS-list and newspaper reports suggest that the housing market did react to information about SARS, although the reaction was small. To explore this further, I make use of two indicators of SARS risk: 1) my best estimate of the actual SARS infection rate in each housing estate, and 2) the predicted SARS infection risk based on the relationship between the SARS infection rate and the (time-invariant) housing estate characteristics in column (6) of Table 2.[40] Both indicators are equal to 0 before the start of the epidemic, so

[39] Negative Binomial regressions show a positive correlation between the total number of news reports and housing estate population, even after controlling for the number of SARS cases. See Appendix B.

[40] The regression in column (8) of Table 2 is more efficient, and very similar results are produced when that model is used to predict the estate SARS risk instead.

they can be viewed as a re-scaled version of the start of epidemic indicator. Therefore I begin by adding each of these risk variables to the right-hand-side of equation (4).[41]

Table 7 shows no significant price reaction to either the SARS infection rate or the predicted SARS risk. I have further explored the potential impact by allowing for a flexible underlying time trend using week dummies which absorb the start of the epidemic indicator (see columns 2 and 7), and by interacting the SARS risk indicators with baseline price, travel time to city center and proportional price change 1997-2002 (see columns 3 to 5 and 8 to 10). These results suggest the housing market did not react to the infection rate or the predicted infection risk, possibly because the public did not have access to the information I have used to create these two measures. This can also be due to measurement errors.

(v) Summing Up

The SARS-list indicator and the news count both point to a small price impact of SARS on housing estates that were more affected by SARS, after estate fixed effects and weekly fixed effects are taken into account. Although part of the SARS impact might be territory-wide and therefore absorbed by the week dummies, earlier results show that the territory-wide price change due to SARS was probably around 1 percent. The absence of a price response to the actual and predicted SARS infection risk measures reflects a lack of information. This suggests that I can rule out overreaction in the housing market in this case with reasonable confidence.

[41] Amoy Gardens is excluded from the regressions with SARS infection rate because it is a large outlier in terms of SARS risk. The predicted SARS risk for Amoy Gardens, however, is within two standard deviations from the mean, so there is no need to exclude it. Similar results are obtained whether I include or exclude Amoy Gardens in the regressions with predicted SARS risk.

B. Impact of SARS on Transaction Volume

(i) Hong Kong-wide Impact

Under the same framework as above, I assess the average impact of the epidemic on transaction volume across all 44 estates using a Hong-Kong-wide dummy indicating the advent of government confirmation of the community spread of the SARS epidemic on March 26, 2003:

(6) $$V_{it} = \alpha + \beta_1 \, SARS_t + \beta_2 \, t + \beta_3 t^2 + \beta_4 t^3 + \theta_i + \varepsilon_{it}$$

where V_{it} is the transaction volume for units in housing estate *i* during week *t* (i.e., the number of units sold in estate i each week) and the other variables are as before. $SARS_t$ denotes the start of the SARS epidemic. ε_{it} is assumed to follow an estate-specific AR(1) process to allow for serial correlation, and I use FGLS to estimate equation (6). Including district-specific linear time trends produces similar results, but the linear trends are not significant as a group in any of the volume regressions so they are omitted in this section.

Column (1) of Table 8 shows a significant and negative impact of the epidemic on volume. On average, the weekly volume decreased by 1.29 flats in the 12 weeks following the start of the epidemic, which is 46 percent of the average weekly transaction volume for the 44 estates in 2003 before the start of epidemic. Columns (2) through (7) also provide evidence that transaction volume decreased more for the estates that have a higher baseline price, a shorter travel time to the city center, and those that experienced a smaller price fall during 1997-2002. Although buyers of more expensive housing units might be expected to have a higher aversion to health risk due to a higher value of life, the larger post-SARS decline in volume at lower-priced housing estates may have resulted from the larger increase in search costs due to the higher risk of contracting

SARS, dominating the value of life effects. Estates located further away from the city center were less affected, possibly because Hong Kong residents worried less about traveling to parts of the city away from the densely populated city centers.

The model in column (8) includes all three interaction terms in the same regression to explore the robustness of the estimates. Although all coefficients are still of the same sign and similar magnitude as before, the interaction between the historical decrease in price and the start of the epidemic indicator is the most robust. The negative sign on that coefficient suggests that a larger (more negative) historical price decrease leads to a smaller drop in volume in the face of a new shock. As I have argued in Section 3, to the extent that this historical drop proxies for the average decrease in housing wealth for occupants of the housing estate, this finding is more consistent with the loss aversion model (Genesove and Mayer 2001) than the liquidity constraint model (Stein 1995) in explaining volume changes in the event of a negative price shock.

(ii) Impact of Being Listed on the Department of Health SARS-list

To explore the effect of inter-estate variation in SARS risk, I next investigate the impact of being listed on the Department of Health SARS-list. Specifically, I estimate

(7) $$V_{it} = \alpha + \beta_1 \, SARS_{it} + \theta_i + \Psi_t + \varepsilon_{it}$$

where all variables are defined as before, and Ψ_t is a set of unrestricted week effects, $SARS_{it}$ is defined as 1 after any building in housing estate *i* was listed on the Department of Health SARS-list and 0 before. Equation (7) is estimated by FGLS. Table 9 shows that the effect of being listed is around 0.50 fewer units sold, which is about 18 percent of average weekly volume before the start of the epidemic. Columns (2) to (4) indicate that the interaction terms generally show similar results as in the previous section, although some of the estimates are not precisely measured. Estates further away from the city center are found to have suffered a less severe volume decrease after they were listed.

To explore the impact of being listed on the SARS-list further, in place of the list dummy $SARS_{it}$ I include 9 week dummies denoting the week an estate was listed, 4 weeks before and 4 weeks after. These dummies are zero outside those 9 weeks for listed estates, and during all weeks for all unlisted estates. (For the estates that were listed multiple times, each of these dummies take on the value 1 on multiple weeks.) Figure 5 shows the mean volume movement before and after an estate was listed. Taking averages of point estimates of the nine list-week dummies, in a regression controlling for estate fixed effects and unrestricted, territory-wide weekly time effects, it is apparent that before an estate was listed, transaction volume was close to that of estates that were never listed. For the first 4 weeks after being listed, however, there was a fall in the number of transactions by around 0.5. The average duration on the list was 9 days, so this suggests a volume decrease more persistent than one caused by a temporary increase in search costs.

If the decrease in volume for listed estates was mainly due to less property-viewing because of the fear of contracting the illness during the epidemic, we should expect little additional decrease in volume when volume decreases on days when search costs were high are accounted for. I create an On-list dummy that is equal to 1 *only* on those days when a housing estate was on the list, and 0 otherwise, to indicate days when infection risks were the highest. Column (5) shows that this alternative indicator appears to be less robust. In Column (6), an Off-list indicator, which is equal to 1 only for the first week immediately after the removal of an estate from the SARS-list, is added to the equation to allow for a rebound in volume. It produces similar results. Although T-tests cannot reject the null that the two indicators are equal, these findings suggest that the decrease in volume persisted after an estate was removed from the list and the threat of contracting SARS from an infected resident became less imminent.

(iii) Impact of Newspaper Coverage

Next I investigate the impact of the number of newspaper reports on specific housing estates in connection to SARS. As before, the news count is a cumulative measure, with the number of reports in each week weighed by a geometric series which decreases with the time lapsed after the reports were published.

Table 10 shows results for α equal to 0.5. (Results with different values of α are included in Appendix C.) The main effect is insignificant but negative. Also, there is no clear differential according to baseline price or the price drop during 1997-2002.[42] The most robust finding is the less severe volume decrease experienced by estates further away from the city centers.

(iv) SARS Infection Rate and SARS Risk

Finally, I explore the impact of the SARS infection rate and the predicted SARS infection risk on transaction volume. Table 11 summarizes these results. As before, neither measure of risk appears to have affected the housing market. Controlling for a territory-wide impact and a cubic time effect, columns (1) and (3) indicate that the start of epidemic indicator has a robust effect, but the territory-wide effect does not vary by either the realized infection rate or the predicted SARS infection risk. In columns (2) and (4), I allow for a more flexible time trend by including unrestricted week fixed effects.

[42] Although the coefficient on the interaction between the 1997-2002 price fall and the news count is negative as predicted by the loss aversion model, it is not significant.

These results do not exhibit any evidence of a reaction in transaction volume towards these measures of SARS.[43]

6. Conclusions

SARS first struck human populations in 2003, infecting 8,422 people worldwide and killing 916 of them. This virus bears a particular relevance to the housing market because it is believed that building characteristics and environmental conditions made some housing estates more susceptible to the spread of the disease than others. Since the SARS epidemic was clearly unanticipated, unknown and dreaded, with a potential impact on a large proportion of society, it provides a unique setting to study whether emotions associated with extreme events have strong market implications as predicted by modern psychology theories, and whether standard economic models built upon the assumption of rationality serve as reasonable benchmarks in predicting housing market reactions to extreme events.

Despite the widely-held belief that SARS devastated the already-frail Hong Kong housing market, this study finds that the maximum impact on prices – either territory-wide or in affected estates – is unlikely to be greater than 2 percent in magnitude. I explore different channels through which the public obtained information about SARS risk, and potential differential impacts along the wealth distribution, and my findings all point to a small price impact. This is consistent with the predictions of the standard asset-pricing model, suggesting no signs of overreaction in the housing market insofar as price is concerned. This is also consistent with price changes found in previous studies on natural calamities; for example, Murdoch, Singh and Thayer (1993) found that the 1989

[43] Regressions that allow for differential impacts along baseline price, past price fall and travel time to city center do not show any volume reaction towards these measures of SARS risk, either. See Appendix D.

Loma Prieta Earthquake, which damaged 23,408 homes, led to an area-wide decrease in housing prices at around 2 percent.

Further findings strongly indicate a decrease in transaction volume in response to the SARS epidemic, both territory-wide and in affected estates. I also find evidence of a decrease in volume that was more persistent than the increase in search costs brought about by the epidemic. This suggests that SARS not only caused an increase in search costs, but also led to "fishing" behavior on the part of sellers. I interpret my findings on volume in the context of 2 models that can explain this phenomenon: the liquidity constraint model and the loss aversion model. To differentiate between these two models, I compare estates with different degrees of price falls from the market peak, from when the bubble burst in 1997 to just before the SARS epidemic. I find a smaller volume decrease in response to SARS for housing estates that have experienced a greater price fall, which is consistent with the loss aversion model.

Fishing behavior implies a less severe observed price fall than otherwise would be the case, and the economic impact of a negative shock will not be fully reflected by changes in observed transaction prices. Therefore, in this case the observed capitalization of the negative shock in housing prices is likely to provide something of an understatement of its full economic impact. Genesove and Mayer (2001) estimate that selling prices obtained by loss-averse sellers are higher by 3-18 percent of the prospective losses. It would be desirable if future work can more precisely quantify this band. Nevertheless, my results strongly suggest that there was no overreaction in the Hong Kong housing market in response to the SARS epidemic, in spite of the level of hysteria and panic observed during the epidemic.

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Figure 1. Timeline of the SARS Epidemic in Hong Kong

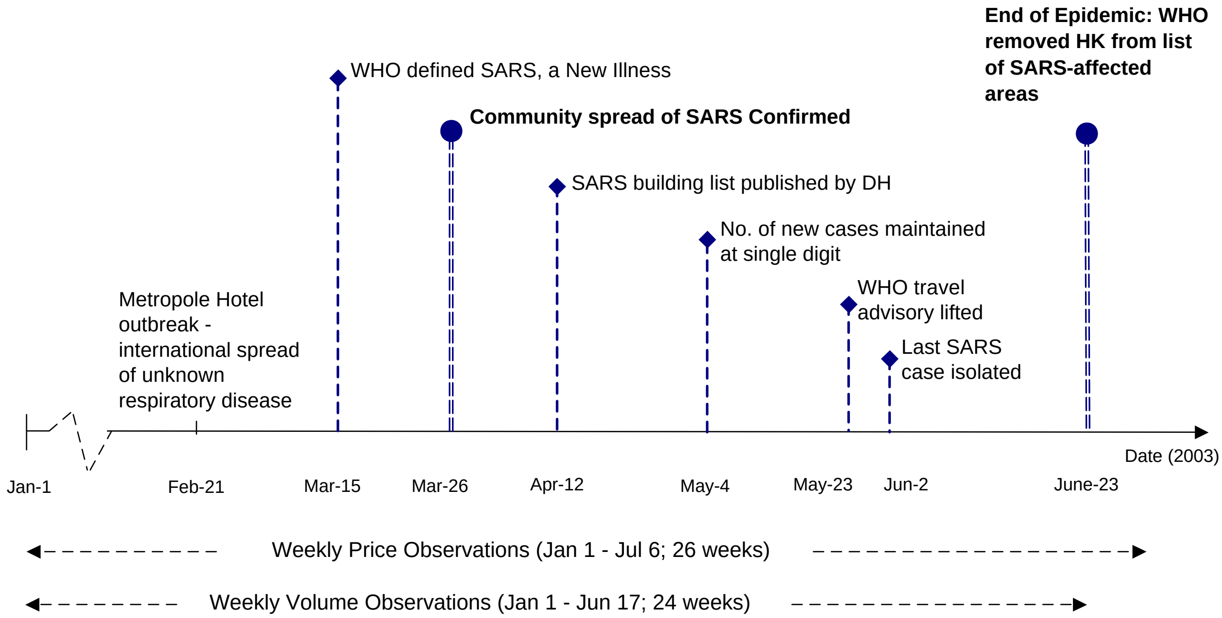


Figure 2. Hong Kong Secondary Residential Housing Prices (Centa-City Index), 1993-2003

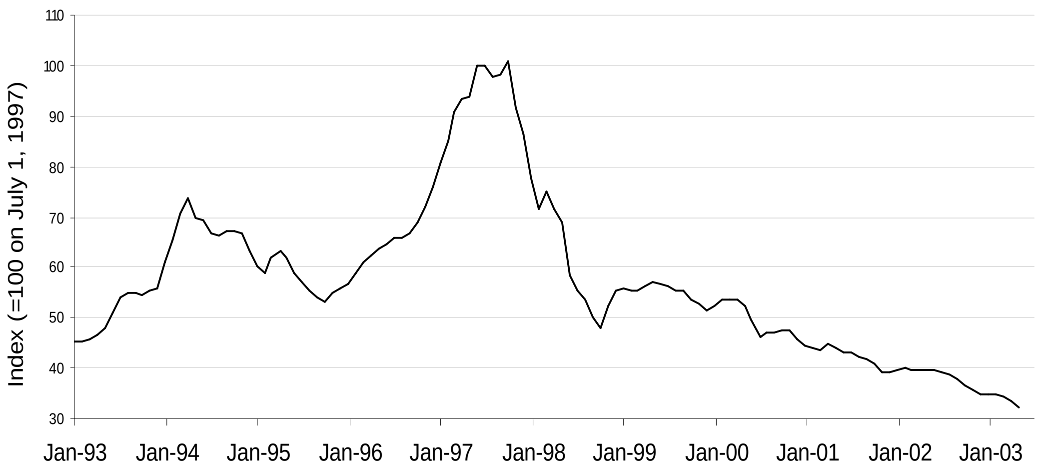


Figure 3: CentaCity Index vs. CentaCity Leading Index, 1994 - July 2003

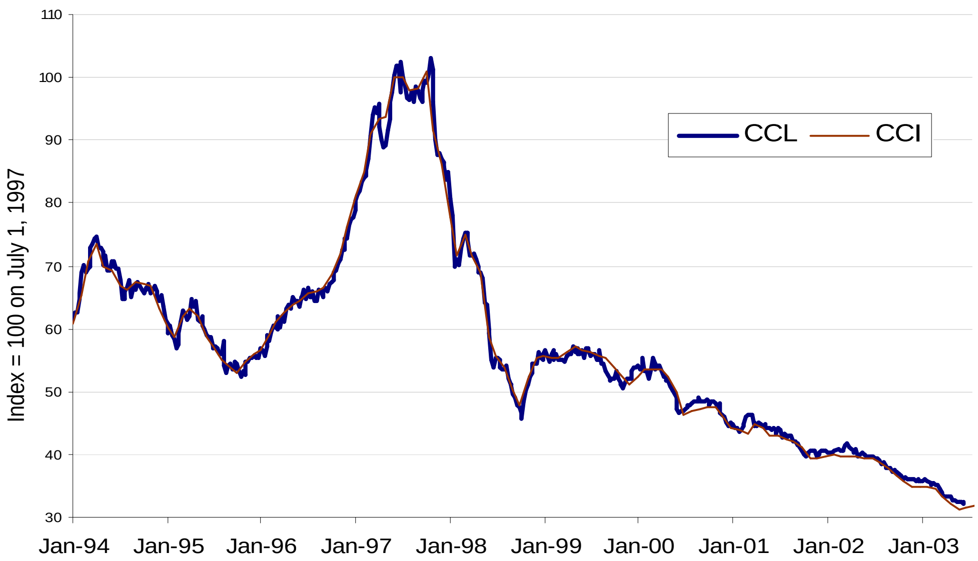


Figure 4. Weekly Price Movements in the First 26 weeks of 2003

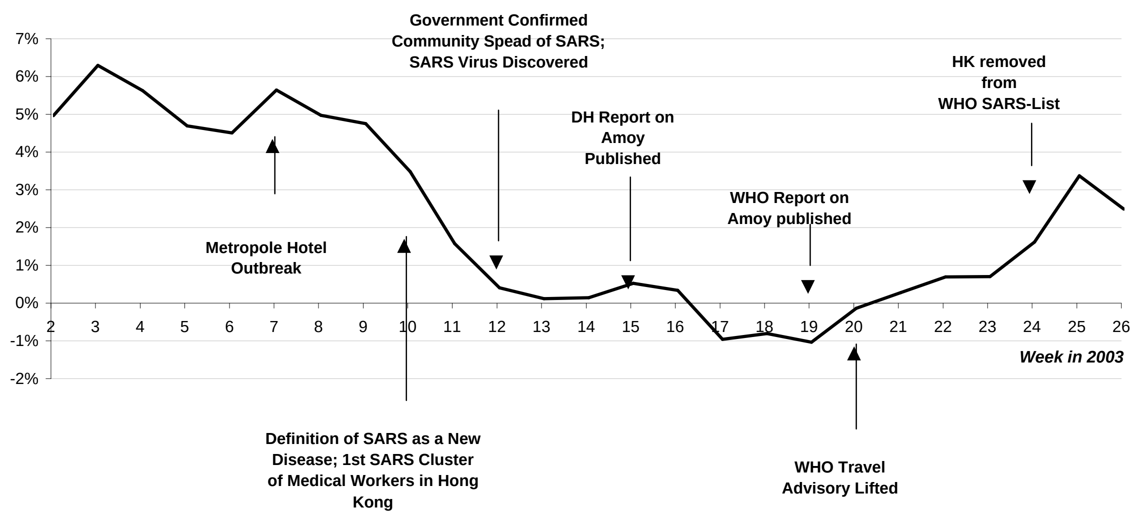
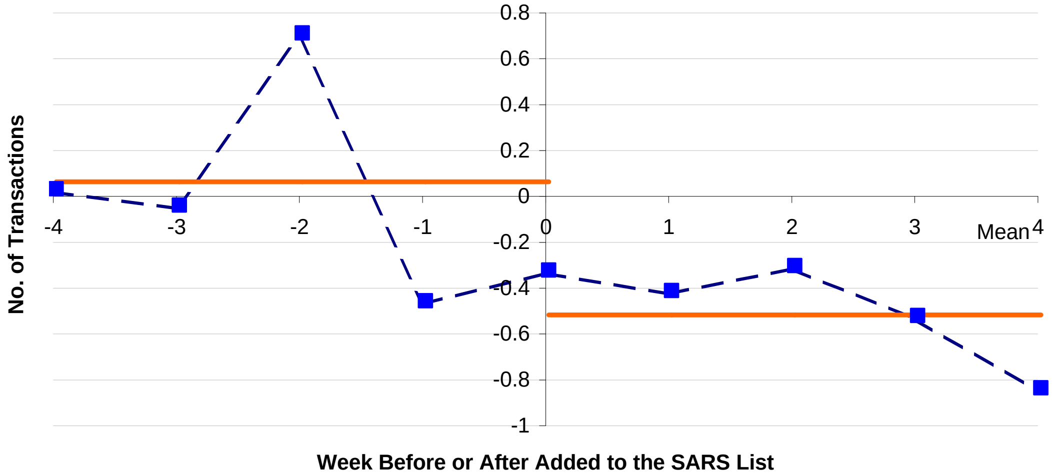


Figure 5. Weekly Volume Movements for Estates Ever Listed



[1] Points are regression estimates of dummies denoting week before/ after an estate was listed, controlling for estate fixed effects and territory-wide weekly fixed effects. Orange line denotes the average change in volume 4 weeks before/ after being listed.

Table 1: Summary Statistics

Mean
(s.d.)

	All 44 Estates	20 Listed Estates	24 Unlisted Estates
Sales price in Jan-July 2003 (per sq. ft.; USD	370.08 (176.81)	281.78 (93.42)	391.84 (185.57)
Sales price in 2002 (per sq. ft.; USD)	417.17 (195.41)	329.47 (96.93)	490.26 (226.64)
Weekly transaction volume in Jan-June 2003	2.79 (3.62)	4.12 (4.30)	1.69 (2.43)
Weekly transaction volume in 2001-2002	3.89 (4.60)	5.67 (5.33)	2.40 (3.22)
Turnover rate in Jan-June 2003	0.07 (0.08)	0.06 (0.05)	0.07 (0.10)
Turnover rate in 2001-2002	0.09 (0.09)	0.09 (0.06)	0.09 (0.11)
Travel time from city center (hours)	0.45 (0.33)	0.50 (0.34)	0.41 (0.32)
Proportional price change from 1997 to 2002	-0.59 (0.04)	-0.57 (0.03)	-0.60 (0.04)
Number of blocks	23.07 (21.84)	30.60 (23.07)	16.8 (19.01)
Number of floors per block	31.66 (10.20)	29.10 (5.99)	33.79 (12.43)
Number of flats per floor	6.67 (5.52)	7.02 (1.71)	6.38 (3.05)
Estate resident Population ('000)	13.74 (12.97)	19.53 (14.09)	8.92 (9.86)
Building age	14.27 (5.37)	16.13 (5.52)	12.72 (4.82)
Sars-List indicator	0.20 (0.40)	0.43 (0.50)	0.00 (0.00)
Number of times listed	1.24 (2.17)	2.70 (2.58)	0.00 (0.00)
Number of times listed excluding Amoy Gardens	1.03 (1.72)	2.32 (1.97)	--
Number of days listed	5.12 (7.66)	11.20 (7.97)	0.00 (0.00)
Number of days listed excluding Amoy Gardens	4.91 (7.63)	11.05 (8.16)	--
Number of Sars cases	10.37 (49.46)	22.35 (72.35)	0.00 (0.00)
Number of Sars cases, excluding Amoy Gardens	2.76 (4.52)	6.21 (5.09)	--
Sars infection rate (%)	0.07 (0.31)	0.15 (0.46)	0.00 (0.00)
Sars infection rate (%), excluding Amoy Gardens	0.02 (0.03)	0.04 (0.04)	--
Total number of news mentions in connection to Sars up to 24 June	5.84 (46.46)	27.67 (101.38)	0.46 (4.55)
Weighted total of news mentions in connection to Sars up to 24 June	1.13 (10.01)	4.72 (20.59)	0.24 (4.14)
Total number of news mentions excluding Amoy Gardens	1.36 (2.96)	3.61 (4.68)	--
Weighted total of news mentions excluding Amoy Gardens	0.17 (0.70)	0.58 (1.39)	--
Predicted Sars risk (%)	0.02 (0.03)	0.05 (0.03)	0.01 (0.01)

[1] Listed refers to housing estates that were ever listed on the Department of Health "List of Buildings with Confirmed Cases". Amoy Gardens was the first and most serious cluster site.

TABLE 2: Relationship between SARS Infection Rate and Pre-SARS Estate Characteristics

Dependent Variable: 100*No. of Cases/ Estate Population, excl. Amoy Garden
Tobit Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln pre-SARS baseline price	-0.191***	--	--	--	--	-0.231***	-0.175**	-0.241**
	(0.094)					(0.066)	(0.079)	(0.059)
Travel time to city center (hours)	--	0.002**	--	--	--	0.057	0.082	--
		(0.001)				(0.046)	(0.049)	
Proportional price change (1997-2(	--	--	1.539***	--	--	2.211***	2.340***	2.507***
			(0.399)			(0.419)	(0.441)	(0.440)
Building Attributes								
Log building age	--	--	--	0.029	0.050	-0.093**	-0.054	-0.114***
				(0.035)	(0.035)	(0.034)	(0.036)	(0.029)
Log no. of blocks	--	--	--	0.029	--	0.028*	--	0.035**
				(0.018)		(0.015)		(0.013)
Log no. of floors	--	--	--	-0.007	--	-0.013	--	--
				(0.046)		(0.031)		
Log no. of flats per floor	--	--	--	-0.013	--	-0.027	--	--
				(0.029)		(0.023)		
Log estate population	--	--	--	--	0.015	--	0.018	0.018
					(0.016)		(0.013)	(0.013)
14 district dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P-values of Chi-Squared test:								
District dummies	0.52	0.48	0.23	0.21	0.58	0.00	0.01	0.00
Building attributes	--	--	--	0.10	0.16	0.10	0.26	0.00
P-value of model Chi-squared	0.12	0.18	0.00	0.19	0.22	0.00	0.00	0.00
Model log likelihood	21.55	20.52	27.71	22.18	20.66	43.94	40.96	42.41
No. of observations	43	43	43	43	43	43	43	43

[1] Standard errors reported in parentheses. *** denotes statistical significance at 1%, ** at 5% and * at 10%. All regressions include a constant term. Amoy Gardens has been excluded from the sample, being the first SARS cluster in Hong Kong before community transmission of the disease was known and precautionary measures taken.

[2] Mean [standard deviation] of the dependent variable is 0.020 [0.033].

TABLE 3: Relationship between Number of Days on SARS-List and Pre-SARS Estate Characteristics

Dependent Variable: No. of Days on Dept of Health SARS-List
Negative Binomial Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln pre-SARS baseline price	-6.728***	--	--	--	--	-9.938***	-9.283***
	(2.075)					(3.358)	(3.460)
Travel time to city center (hours)	--	3.490**	--	--	--	1.262	1.846
		(1.578)				(1.844)	(1.768)
Proportional price change (1997-2002)	--	--	32.509***	--	--	47.754***	36.948***
			(11.339)			(16.544)	(12.146)
Building Attributes							
Log building age	--	--	--	0.952	0.965	-1.913	-0.343
				(0.732)	(0.703)	(2.063)	(1.613)
Log no. of blocks	--	--	--	1.004**	--	1.154*	--
				(0.448)		(0.678)	
Log no. of floors	--	--	--	-0.040	--	-1.284	--
				(1.079)		(1.275)	
Log no. of flats per floor	--	--	--	1.174	--	-0.121	--
				(0.871)		(0.911)	
Log estate population	--	--	--	--	0.885**	--	0.491
					(0.377)		(0.439)
14 district dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P-values of Chi-Squared test:							
District dummies	0.00	0.05	0.04	0.14	0.09	0.00	0.00
Building attributes	--	--	--	0.01	0.00	0.03	0.48
P-value of model Chi-squared	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Model log likelihood	-81.13	-87.19	-84.35	-81.52	-81.91	-65.90	-68.11
No. of observations	44	44	44	44	44	44	44

[1] Standard errors reported in parentheses. *** denotes statistical significance at 1%, ** at 5% and * at 10%. All regressions include a constant term. Similar results are obtained excluding Amoy Gardens from the sample.

[2] Mean [standard deviation] of the dependent variable is 5.09 [7.74].

TABLE 4: Impact of SARS on Housing Prices in Affected Estates, Jan - June 2003

Dependent Variable: Ln(Hedonic-adjusted Weekly Prices of 44 Housing Estates)
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Territory-wide post-SARS dummy	-0.011***	0.025	--	-0.004	--	0.025	--
(=1 after March 26 2003)	(0.003)	(0.059)		(0.006)		(0.056)	
Interaction Terms:							
Territory-wide post-SARS dummy*	--	-0.006	-0.009	--	--	--	--
Ln pre-SARS baseline price		(0.010)	(0.010)				
Territory-wide post-SARS dummy*	--	--	--	-0.014	-0.009	--	--
Travel time to city center (hours)				(0.009)	(0.008)		
Territory-wide post-SARS dummy*	--	--	--	--	--	0.061	0.082
Proportional price change (1997-2002)						(0.093)	(0.086)
Time effects:							
Cubic time trend	YES	YES	--	YES	--	YES	--
Weekly time effects	--	--	YES	--	YES	--	YES
Linear time trend*District dummies	YES	YES	YES	YES	YES	YES	YES
P-values of F-test:							
SARS effect	0.00	0.00	0.34	0.00	0.28	0.00	0.34
Cubic time trend	0.00	0.00	--	0.00	--	0.00	--
Weekly time effects	--	--	0.00	--	0.00	--	0.00
Linear time trend*District dummies	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No. of observations	1,072	1,072	1,072	1,072	1,072	1,072	1,072

[1] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[2] Mean [standard deviation] of the dependent variable is 5.81 [0.43].

[3] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is -0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

TABLE 5: Impact of SARS on Housing Prices in Affected Estates, Jan - June 2003

Dependent Variable: Ln(Hedonic-adjusted Weekly Prices of 44 Housing Estates)
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)
Estate-specific Ever-Listed dummy	0.004	0.183***	-0.053	-0.009	0.088
= 1 After first day of listed	(0.004)	(0.070)	(0.077)	(0.006)	(0.180)
Interaction Terms:					
Ever-Listed dummy*	--	-0.031***	--	--	-0.014
Ln pre-SARS baseline price		(0.012)			(0.020)
Ever-Listed dummy*	--	--	0.026***	--	0.018
Travel time to city center (hours)			(0.009)		(0.013)
Ever-Listed dummy*	--	--	--	-0.097	0.020
Proportional price change (1997-2002)				(0.132)	(0.156)
Time effects:					
Weekly time effects	YES	YES	YES	YES	YES
Linear time trend*District dummies	YES	YES	YES	YES	YES
P-values of F-test:					
SARS effect	0.20	0.02	0.01	0.47	0.03
Weekly time effects	0.00	0.00	0.00	0.00	0.00
Linear time trend*District dummies	0.00	0.00	0.00	0.00	0.00
No. of observations	1,072	1,072	1,072	1,072	1,072

[1] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[2] Mean [standard deviation] of the dependent variable is 5.81 [0.43].

[3] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

TABLE 6: Impact of News Reports of Estates in Connection to SARS on Housing Prices, Jan - June 2003

Dependent Variable: Ln(Hedonic-adjusted Weekly Prices of 43 Housing Estates, Excl. Amoy Gardens)
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)
Weighted no. of news reports to-date	-0.002	-0.094***	0.006***	0.025	-0.137***
in connection to SARS	(0.001)	(0.030)	(0.002)	(0.032)	(0.031)
Estate-specific Ever-Listed dummy	--	--	--	--	0.278***
= 1 After first day of listed					(0.070)
Interaction Terms:					
Weighted no. of news reports*	--	0.016***	--	--	0.023***
Ln pre-SARS baseline price		(0.005)			(0.005)
Ever-Listed dummy*	--	--	--	--	-0.046***
Ln pre-SARS baseline price					(0.012)
Weighted no. of news reports*	--	--	-0.022***	--	--
Travel time to city center (hours)			(0.006)		
Weighted no. of news reports*	--	--	--	0.044	--
Proportional price change (1997-2002)				(0.054)	
Time effects:					
Weekly time effects	YES	YES	YES	YES	YES
Linear time trend*District dummies	YES	YES	YES	YES	YES
P-values of F-test:					
SARS effect	0.15	0.00	0.00	0.22	0.00
Weekly time effects	0.00	0.00	0.00	0.00	0.00
Linear time trend*District dummies	0.00	0.00	0.00	0.00	0.00
No. of observations	1,047	1,047	1,047	1,047	1,047

[1] $NEWS_{it} = S_{s=t}$ (no. of news report related to estate *i* during week *s*) * a^(*t-s*). a is 0.5 in this table. Results are similar for a between 0.1 to 0.8. Amoy Gardens has been excluded from the sample, since it is an outlier in terms of news coverage as the first and largest SARS cluster in Hong Kong.

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 5.81 [0.43].

[4] Mean [standard deviation] of weighted number of news reports is 0.173 [0.701]. Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

TABLE 7: Impact of SARS risk on Housing Prices in Affected Estates, Jan - June 2003

Dependent Variable: Ln(Hedonic-adjusted Weekly Prices of 44 Housing Estates)
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Territory-wide post-SARS dummy	-0.015***	--	--	--	--	-0.014***	--	--	--	--
(= 1 after March 26 2003)	(0.004)					(0.004)				
SARS infection rate	17.050	15.674	11.204	16.425**	75.010	--	--	--	--	--
(= 0 before March 26, 2003)	(12.199)	(10.485)	(107.047)	(7.821)	(72.235)					
Predicted SARS risk	--	--	--	--	--	9.870	11.898	-13.61	15.700**	85.07
(= 0 before March 26, 2003)						(10.818)	(9.378)	(96.249)	(8.132)	(72.461)
Interaction Terms:										
SARS infection rate*	--	--	3.522	--	--	--	--	--	--	--
Ln pre-SARS baseline price			(17.543)							
Predicted SARS risk*	--	--	--	--	--	--	--	3.717	--	--
Ln pre-SARS baseline price								(16.004)		
SARS infection rate*	--	--	--	-14.215	--	--	--	--	--	--
Travel time to city center (hours)				(12.759)						
Predicted SARS risk*	--	--	--	--	--	--	--	--	-16.253	--
Travel time to city center (hours)									(13.218)	
SARS infection rate*	--	--	--	--	121.249	--	--	--	--	--
Proportional price change (1997-2002)					(136.581)					
Predicted SARS risk*	--	--	--	--	--	--	--	--	--	142.113
Proportional price change (1997-2002)										(134.567)
Time effects:										
Cubic time trend	YES	--	--	--	--	YES	--	--	--	--
Weekly time effects	--	YES	YES	YES	YES	--	YES	YES	YES	YES
Linear time trend*District dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
P-values of F-test:										
SARS effect	0.00	0.12	0.92	0.11	0.13	0.00	0.27	0.89	0.16	0.22
Cubic time trend	0.00	--	--	--	--	0.00	--	--	--	--
Weekly time effects	--	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	0.00
Linear time trend*District dummies	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No. of observations	1,047	1,047	1,047	1,047	1,047	1,072	1,072	1,072	1,072	1,072

[1] SARS infection rate = 100*no of SARS cases/ Estate population. Amoy Gardens has been excluded from the sample of regressions (1) to (5), being the first SARS cluster in Hong Kong before community transmission of the disease was known and precautionary measures taken. Predicted SARS risk is calculated based on Column (6) of Table 2. Similar results are obtained when Amoy Gardens is excluded from the sample for regressions (6) to (10).

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 5.81 [0.43].

[4] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

TABLE 8: Territory-Wide Impact of SARS on Transaction Volume in Housing Market, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes in 44 Housing Estates
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(3)	(5)	(6)	(7)	(8)
Territory-wide post-SARS dummy	-1.291***	1.344	--	-1.778***	--	-5.980	--	--
(=1 after March 26 2003)	(0.308)	(2.839)		(0.406)		(2.203)		
Interaction Terms:								
Territory-wide post-SARS dummy*	--	-0.443	-0.371	--	--	--	--	0.083
Ln pre-SARS baseline price		(0.476)	(0.308)					(0.409)
Territory-wide post-SARS dummy*	--	--	--	1.055*	0.629*	--	--	0.612
Travel time to city center (hours)				(0.579)	(0.365)			(0.472)
Territory-wide post-SARS dummy*	--	--	--	--	--	-7.993**	-5.099	-4.239
Proportional price change (1997-2002)						(3.727)	(3.248)	(3.309)
Time effects:								
Cubic time trend	YES	YES	--	YES	--	YES	--	--
Weekly time effects	--	--	YES	--	YES	--	YES	YES
Linear time trend*District dummies	YES	YES	--	YES	--	YES	--	--
P-values of F-test:								
SARS effect	0.00	0.00	0.23	0.00	0.09	0.00	0.12	0.21
Cubic time trend	0.00	0.00	--	0.00	--	0.00	--	--
Weekly time effects	--	--	0.00	--	0.00	--	0.00	0.00
Linear time trend*District dummies	0.00	0.00	--	0.00	--	0.00	--	--
No. of observations	1,056	1,056	1,056	1,056	1,056	1,056	1,056	1,056

[1] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[2] Mean [standard deviation] of the dependent variable is 2.79 [3.62].

[3] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is -0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

[4] Regressions with district-specific linear time trends and weekly time effects together produce similar results, which are omitted from the table since the group of linear time trends are insignificant.

TABLE 9: Impact of SARS on Transaction Volume in Affected Estates, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes in 44 Housing Estates
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)	(6)
Estate-specific Ever-Listed dummy	-0.496**	-3.961	-0.988***	-1.827	-0.427*	-0.649**
= 1 After first day of listed	(0.242)	(4.350)	(0.368)	(3.481)	(0.226)	(0.267)
Estate-specific On-List dummy	--	--	--	--	-0.387	-0.254
= 1 Only when estate was listed that day					(0.459)	(0.457)
1st Week Off-List dummy	--	--	--	--	--	1.222***
= 1 For the 1st week after removal from list						(0.503)
Interaction Terms:						
Ever-Listed dummy*	--	0.601	--	--	--	--
Ln pre-SARS baseline price		(0.754)				
Ever-Listed dummy*	--	--	0.946*	--	--	--
Travel time to city center (hours)			(0.541)			
Ever-Listed dummy*	--	--	--	-2.321	--	--
Proportional price change (1997-2002)				(6.051)		
Time effects:						
Weekly time effects	YES	YES	YES	YES	YES	YES
P-values of F-test:						
SARS effect	0.04	0.09	0.03	0.11	0.08	0.01
Weekly time effects	0.00	0.00	0.00	0.00	0.00	0.00
No. of observations	1,056	1,056	1,056	1,056	1,056	1,056

[1] Standard errors reported in parentheses. All regressions include a constant term, estate fixed effects and week dummies. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[2] Mean [s.d.] of the dependent variable is 2.79 [3.62]. Mean [s.d.] of log pre-SARS baseline price is 5.94 [0.42]. Mean [s.d.] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [s.d.] of travel time to city center is 0.45 [0.32].

[3] Mean [s.d.] of log pre-SARS baseline price is 5.94 [0.42]. Mean [s.d.] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [s.d.] of travel time to city center is 0.45 [0.32].

[4] Regressions with district-specific linear time trends in addition to weekly time effects produce similar results, which are omitted from the table since the group of linear time trends are insignificant.

TABLE 10: Impact of News Mentions in connection to SARS on Transaction Volume in Affected Estates, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)
Weighted no. of news reports to-date in connection to SARS	-0.072 (0.100)	-0.202 (0.142)	-1.546*** (0.251)	-0.143 (0.119)
Interaction Terms:				
Weighted no. of news reports* Ln pre-SARS baseline price	--	-0.649 (0.576)	--	--
Weighted no. of news reports* Travel time to city center (hours)	--	--	4.049*** (0.643)	--
Weighted no. of news reports* Proportional price change (1997-2002)	--	--	--	-4.887 (4.873)
Time effects:				
Weekly time effects	YES	YES	YES	YES
P-values of F-test:				
SARS effect	0.47	0.35	0.00	0.44
Weekly time effects	0.00	0.00	0.00	0.00
No. of observations	1,032	1,032	1,032	1,032

[1] $NEWS_{it} = S_{s=t}$ (no. of news report related to estate *i* during week *s*) * a^(*t*-*s*). a is 0.5 in this table. Amoy Gardens has been excluded from the sample, since it is an outlier in terms of news coverage as the first and largest SARS cluster in Hong Kong.

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 2.79 [3.62].

[4] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

[5] Regressions with district-specific linear time trends and weekly time effects together produce similar results, which are omitted from the table since the group of linear time trends are insignificant.

TABLE 11: Impact of SARS risk on on Transaction Volume in Affected Estates, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)
Territory-wide post-SARS dummy	-1.191***	--	-1.191***	--
(= 1 after March 26 2003)	(0.325)		(0.329)	
SARS infection rate	-336.027	-297.231	--	--
(= 0 before March 26, 2003)	(380.069)	(365.663)		
Predicted SARS risk	--	--	-268.864	-307.544
(= 0 before March 26, 2003)			(408.541)	(386.349)
Time effects:				
Cubic time trend	YES	--	YES	--
Weekly time effects	--	YES	--	YES
P-values of F-test:				
SARS effect	0.00	0.33	0.00	0.39
Cubic time trend	0.00	--	0.00	--
Weekly time effects	--	0.00	--	0.00
No. of observations	1,032	1,032	1,056	1,056

[1] SARS infection rate = 100*no of SARS cases/ Estate population. Amoy Gardens has been excluded from the sample of regressions (1) to (5), being the first SARS cluster in Hong Kong before community transmission of the disease was known and precautionary measures taken.

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 2.79 [3.62].

[4] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

[4] Regressions with district-specific linear time trends in addition to cubic or weekly time effects produce similar results, which are omitted from the table since the group of linear time trends are in most cases insignificant.

Appendix A1: Hedonic Adjustment of Price Data

Because observed prices are affected by quality variation among flats sold during a week even within the same estate, the sales prices in the primary contracts were adjusted using a hedonic regression model by the Centa-City team. Specifically, the following type of equation for each estate, denoted *i*, is estimated using data from flats, denoted *j*, within that estate:

(2) $\mathrm{Ln}(P_{ij}) = \alpha_i + \beta_i A_{ij} + \gamma_i B_{ij} + \lambda_i C_{ij} + \tau_i D_{ij}$

Variables A through D are dummy indicators of the presence of building attributes such as parking space or harbor view. The list of attributes used for each estate varied. The coefficients, which represent the shadow prices for each building attribute specific to each estate *i*, are estimated using historical transaction price data. To derive comparable, hedonic-adjusted prices for each flat sold during the previous week, the shadow value of the attributes are removed from the actual sales price. For example, for a flat in estate *i* sold at \$3000 per square foot with attributes A and C but not B and D, the hedonic-adjusted price is:

$$P_{ijt}^{h} = P_{ijt} - \beta_i - \lambda_i = \$3000 - \beta_i - \lambda_i$$

The hedonic adjusted price for estate *i* is the average of P_{ijt}^{h} over all sold flats *i* during the week *t*. I find a high correlation (0.93-0.94) between the hedonic-adjusted preliminary contract prices and the raw transaction prices from the land registry for years 2001-2003, which adds to my confidence in the data.

Appendix A2: Characteristics of Housing Estates

Estate	No. of times Listed	No. of days on list	No. of blocks	No. of floors	No. of flats per block	Age	Travel time to city center	Flat size	Per Sq. Ft. Price, 1997 (USD)	Per Sq. Ft. Price, 2002 (USD)	Total Value 2002 (USD mil)	Price Change, 1997-2002
1	1	4	61	30	208	21	12	911	1,007	432	4,999	-57%
2	2	12	48	19	136	15	19	894	983	397	2,318	-60%
3	0	0	17	30	242	11	21	791	942	362	1,177	-62%
4	3	23	20	40	288	15	27	600	680	265	917	-61%
5	0	0	88	16	120	15	20	775	981	374	3,062	-62%
6	2	13	19	33	318	13	33	770	672	281	1,305	-58%
7	1	2	15	30	240	12	70	740	461	194	516	-58%
8	1	8	23	33	240	17	38	440	599	274	666	-54%
9	5	19	52	27	216	19	26	707	708	305	2,423	-57%
10	10	14	19	33	264	19	23	490	692	293	719	-58%
11	0	0	32	30	208	16	12	909	996	396	2,394	-60%
12	0	0	33	27	47	26	23	1,500	851	399	919	-53%
13	0	0	2	47	651	8	10	1,243	1,757	744	1,204	-58%
14	2	10	58	35	274	8	70	1,162	537	209	3,850	-61%
15	0	0	10	38	250	7	28	1,329	1,198	473	1,571	-61%
16	0	0	13	33	178	9	28	706	807	263	430	-67%
17	0	0	18	20	60	13	57	2,266	1,911	791	1,936	-59%
18	2	7	38	27	212	11	21	790	888	330	2,106	-63%
19	0	0	5	40	79	11	10	2,100	2,408	1,019	845	-58%
20	1	1	11	35	69	14	3	1,700	1,231	633	817	-49%
21	0	0	14	28	171	18	10	1,044	985	438	1,094	-56%
22	0	0	34	42	332	10	35	1,000	1,000	387	4,373	-61%
23	8	29	99	20	153	30	12	850	602	236	3,038	-61%
24	0	0	33	7	48	8	10	1,000	1,338	538	853	-60%
25	1	1	41	26	122	22	21	570	778	308	878	-60%
26	0	0	33	28	147	12	60	750	777	242	879	-69%
27	0	0	5	29	208	9	35	630	649	285	187	-56%
28	3	21	11	38	296	13	20	580	735	316	596	-57%
29	6	22	20	32	240	9	70	800	791	344	1,321	-57%
30	0	0	12	27	200	12	46	600	564	238	343	-58%
31	1	6	6	24	192	9	48	550	689	312	198	-55%
32	0	0	1	46	595	13	3	976	2,102	709	411	-66%
33	2	12	17	25	100	20	10	1,200	908	417	850	-54%
34	0	0	3	47	261	6	10	808	1,242	497	315	-60%
35	1	8	17	19	135	15	12	728	954	422	706	-56%
36	0	0	20	27	212	23	18	600	781	340	866	-56%
37	1	6	20	26	154	22	39	570	664	307	539	-54%
38	1	6	17	30	235	20	23	570	742	315	718	-58%
40	0	0	7	22	44	16	5	1,900	1,608	754	441	-53%
41	0	0	2	40	120	9	10	2,250	1,988	778	420	-61%
42	0	0	2	45	352	10	5	800	1,272	564	317	-56%
43	0	0	3	66	187	18	10	2,800	1,877	764	1,201	-59%
44	0	0	6	32	240	15	60	710	554	212	217	-62%
45	0	0	10	44	350	13	60	650	485	199	453	-59%
Sum	54	224									55,387	
Mean	1.23	5.09	23.07	31.66	213.50	14.27	26.89	994	1,009	417	1,259	-59%
s.d.	2.19	7.74	21.84	10.20	121.95	5.37	19.69	538	474	195	1,135	4%

Appendix B: Relationship between News Coverage and Pre-SARS Estate Characteristics

Dependent Variable: Total Number of Newspaper Reports during the Epidemic, excl. Amoy Garden
Tobit Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln pre-SARS baseline price	-2.632***	--	--	--	--	0.800	--
	(1.094)					(1.243)	
Travel time to city center (hours)	--	0.702	--	--	--	--	--
		(0.982)					
Proportional price change (1997-2002)	--	--	2.523	--	--	--	--
			(6.288)				
Building Attributes							
Log building age	--	--	--	0.296	1.271***	1.404***	1.240***
				(0.499)	(0.377)	(0.432)	(0.386)
Log no. of blocks	--	--	--	1.304***	--	--	--
				(0.316)			
Log no. of floors	--	--	--	0.579	--	--	--
				(0.711)			
Log no. of flats per floor	--	--	--	-0.517	--	--	--
				(0.505)			
Log estate population	--	--	--	--	0.689***	0.746***	0.652***
					(0.213)	(0.229)	(0.230)
Estimated no. of SARS cases	--	--	--	--	--	--	0.022
							(0.055)
14 district dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P-values of Chi-Squared test:							
District dummies	0.00	0.02	0.04	0.00	0.00	0.00	0.00
Building attributes	--	--	--	0.00	0.00	0.00	0.00
P-value of model Chi-squared	0.00	0.04	0.04	0.00	0.00	0.00	0.00
Model log likelihood	-67.76	-71.17	-71.34	-53.34	-58.58	-58.38	-58.50
No. of observations	43	43	43	43	43	43	43

[1] Dependent variable is the total number of news reports that mentioned housing estate *i* during the epidemic (March 26 - June 23, 2003).

[2] Standard errors reported in parentheses. *** denotes statistical significance at 1%, ** at 5% and * at 10%. All regressions include a constant term. Amoy Gardens has been excluded from the sample, since it is an outlier in terms of news coverage as the first and largest SARS cluster in Hong Kong.

[3] Mean [standard deviation] of the dependent variable is 2.116 [3.692].

Appendix C1: Impact of News Reports of Estates in Connection to SARS on Housing Prices, Jan - June 2003

Dependent Variable: Ln(Hedonic-adjusted Weekly Prices of 43 Housing Estates, Excl. Amoy Gardens)
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)
Weighted no. of news reports to-date	-0.002	-0.076**	0.004	0.020	-0.108***
in connection to SARS	(0.001)	(0.032)	(0.002)	(0.032)	(0.033)
Estate-specific Ever-Listed dummy	--	--	--	--	0.237***
= 1 After first day of listed					(0.070)
Interaction Terms:					
Weighted no. of news reports*	--	0.013**	--	--	0.018***
Ln pre-SARS baseline price		(0.006)			(0.006)
Ever-Listed dummy*	--	--	--	--	-0.039***
Ln pre-SARS baseline price					(0.012)
Weighted no. of news reports*	--	--	-0.015**	--	--
Travel time to city center (hours)			(0.006)		
Weighted no. of news reports*	--	--	--	0.036	--
Proportional price change (1997-2002)				(0.054)	
Time effects:					
Weekly time effects	YES	YES	YES	YES	YES
Linear time trend*District dummies	YES	YES	YES	YES	YES
P-values of F-test:					
SARS effect	0.14	0.02	0.01	0.26	0.00
Weekly time effects	0.00	0.00	0.00	0.00	0.00
Linear time trend*District dummies	0.00	0.00	0.00	0.00	0.00
No. of observations	1,047	1,047	1,047	1,047	1,047

[1] NEWS $_{it}$ = S $_{s=t}$ (no. of news report related to estate *i* during week *s*) * a^(*t-s*). a is 0.1 in this table. Results are similar for a between 0.1 to 0.8. Amoy Gardens has been excluded from the sample, since it is an outlier in terms of news coverage as the first and largest SARS cluster in Hong Kong.

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 5.81 [0.43].

[4] Mean [standard deviation] of weighted number of news reports is 0.097 [0.512]. Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

Appendix C2: Impact of News Reports of Estates in Connection to SARS on Housing Prices, Jan - June 2003

Dependent Variable: Ln(Hedonic-adjusted Weekly Prices of 43 Housing Estates, Excl. Amoy Gardens)
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)
Weighted no. of news reports to-date in connection to SARS	-0.002 (0.001)	0.018 (0.020)	-0.004** (0.002)	0.013 (0.021)	-0.017 (0.027)
Estate-specific Ever-Listed dummy = 1 After first day of listed	--	--	--	--	0.196** (0.092)
Interaction Terms:					
Weighted no. of news reports* Ln pre-SARS baseline price	--	-0.003 (0.004)	--	--	0.003 (0.005)
Ever-Listed dummy* Ln pre-SARS baseline price	--	--	--	--	0.023** (0.005)
Weighted no. of news reports* Travel time to city center (hours)	--	--	0.007 (0.004)	--	--
Weighted no. of news reports* Proportional price change (1997-2002)	--	--	--	0.026 (0.035)	--
Time effects:					
Weekly time effects	YES	YES	YES	YES	YES
Linear time trend*District dummies	YES	YES	YES	YES	YES
P-values of F-test:					
SARS effect	0.06	0.12	0.05	0.15	0.01
Weekly time effects	0.00	0.00	0.00	0.00	0.00
Linear time trend*District dummies	0.00	0.00	0.00	0.00	0.00
No. of observations	1,047	1,047	1,047	1,047	1,047

[1] NEWS $_{it}$ = S $_{s=t}$ (no. of news report related to estate *i* during week *s*) * a^(*t-s*). a is 1 in this table. Results are similar for a between 0.1 to 0.8. Amoy Gardens has been excluded from the sample, since it is an outlier in terms of news coverage as the first and largest SARS cluster in Hong Kong.

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 5.81 [0.43].

[4] Mean [standard deviation] of weighted number of news reports is 0.921 [2.516]. Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

Appendix C3: Impact of News Mentions in connection to SARS on Transaction Volume in Affected Estates, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)
Weighted no. of news reports to-date	0.044	5.246	-1.610***	-1.420
in connection to SARS	(0.130)	(3.833)	(0.306)	(3.535)
Interaction Terms:				
Weighted no. of news reports*	--	-0.903	--	--
Ln pre-SARS baseline price		(0.663)		
Weighted no. of news reports*	--	--	4.428***	--
Travel time to city center (hours)			(0.756)	
Weighted no. of news reports*	--	--	--	-2.448
Proportional price change (1997-2002)				(5.924)
Time effects:				
Weekly time effects	YES	YES	YES	YES
P-values of F-test:				
SARS effect	0.74	0.39	0.00	0.88
Weekly time effects	0.00	0.00	0.00	0.00
No. of observations	1,056	1,056	1,056	1,056

[1] $NEWS_{it} = S_{s=t}$ (no. of news report related to estate *i* during week *s*) * a^(*t-s*). Results are similar for a between 0.1 to 0.8. Amoy Gardens has been excluded from the sample of regressions (1) to (4), since it is an outlier in terms of news coverage a

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 2.79 [3.62].

[4] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

[5] Regressions with district-specific linear time trends and weekly time effects together produce similar results, which are omitted from the table since the group of linear time trends are insignificant.

Appendix C4: Impact of News Mentions in connection to SARS on Transaction Volume in Affected Estates, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)
Weighted no. of news reports to-date in connection to SARS	-0.056 (0.035)	-2.279* (1.359)	-0.152 (0.099)	-2.54** (1.149)
Interaction Terms:				
Weighted no. of news reports* Ln pre-SARS baseline price	--	0.387 (0.236)	--	--
Weighted no. of news reports* Travel time to city center (hours)	--	--	0.282 (0.273)	--
Weighted no. of news reports* Proportional price change (1997-2002)	--	--	--	-4.12** (1.908)
Time effects:				
Weekly time effects	YES	YES	YES	YES
P-values of F-test:				
SARS effect	0.11	0.07	0.16	0.03
Weekly time effects	0.00	0.00	0.00	0.00
No. of observations	1,056	1,056	1,056	1,056

[1] NEWS $_{it}$ = S $_{s=t}$ (no. of news report related to estate *i* during week *s*) * a^(*t-s*). Results are similar for a between 0.1 to 0.8. Amoy Gardens has been excluded from the sample of regressions (1) to (4), since it is an outlier in terms of news coverage a

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 2.79 [3.62].

[4] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

[5] Regressions with district-specific linear time trends and weekly time effects together produce similar results, which are omitted from the table since the group of linear time trends are insignificant.

Appendix D: Impact of SARS risk on on Transaction Volume in Affected Estates, Jan - June 2003

Dependent Variable: Weekly Transaction Volumes
GLS regressions with Estate-specific AR(1)

	(1)	(2)	(3)	(4)	(5)	(6)
SARS infection rate (= 0 before March 26, 2003)	11.204 (107.047)	16.425** (7.821)	75.010 (72.235)	--	--	--
Predicted SARS risk (= 0 before March 26, 2003)	--	--	--	-2195.89 (6677.210)	-511.54 (538.582)	-2512.25 (4992.160)
Interaction Terms:						
SARS infection rate* Ln pre-SARS baseline price	3.522 (17.543)	--	--	--	--	--
Predicted SARS risk* Ln pre-SARS baseline price	--	--	--	314.677 (1108.193)	--	--
SARS infection rate* Travel time to city center (hours)	--	-14.215 (12.759)	--	--	--	--
Predicted SARS risk* Travel time to city center (hours)	--	--	--	--	751.159 (684.591)	--
SARS infection rate* Proportional price change (1997-2002)	--	--	121.249 (136.581)	--	--	--
Predicted SARS risk* Proportional price change (1997-2002)	--	--	--	--	--	-4048.556 (9144.663)
Time effects:						
Weekly time effects	YES	YES	YES	YES	YES	YES
P-values of F-test:						
SARS effect	0.92	0.11	0.13	0.68	0.53	0.66
Cubic time trend	--	--	--	--	--	--
Weekly time effects	0.00	0.00	0.00	0.00	0.00	0.00
No. of observations	1,032	1,032	1,032	1,056	1,056	1,056

[1] SARS infection rate = 100*no of SARS cases/ Estate population. Amoy Gardens has been excluded from the sample of regressions (1) to (5), being the first SARS cluster in Hong Kong before community transmission of the disease was known and precautionary measures taken.

[2] Standard errors reported in parentheses. All regressions include a constant term and estate fixed effects. P-values of estate fixed effects in all 7 regressions are equal to 0.00. *** denotes statistical significance at 1%, ** at 5% and * at 10%.

[3] Mean [standard deviation] of the dependent variable is 2.79 [3.62].

[4] Mean [standard deviation] of log pre-SARS baseline price is 5.94 [0.42]. Mean [standard deviation] of proportional price change from 1997 to 2002 is 0.59 [0.04]. Mean [standard deviation] of travel time to city center is 0.45 [0.32].

[4] Regressions with district-specific linear time trends in addition to cubic or weekly time effects produce similar results, which are omitted from the table since the group of linear time trends are in most cases insignificant.