DYNAMIC IMPACT OF LAND SUPPLY ON POPULATION MOBILITY WITH EVIDENCE FROM HONG KONG

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ABSTRACT

Previous literature refers mostly to planning constraints and market failure. Little has been concentrated on the linkages between the land and housing markets and population mobility, particularly the effects of land supply. The aim of this paper is to analyse the dynamic impact of land supply on population mobility in Hong Kong. The first part provides a background for the current situation in Hong Kong in terms of population and land use allocation. The second and third sections review the relevant literature and set out a new "supply-chain paradigm" framework and methodology. Within the framework, we investigate the linkages between land supply and population mobility using Granger-casuality tests. The findings suggest that there exists a causal relationship between land supply and population mobility in the New Territories. Past values of land supply help to predict population mobility, and vice versa.

Keywords: Land supply, population mobility, supply chain paradigm, Hong Kong

INTRODUCTION

Hong Kong has always been well known for its high population density. By international standards, the territory is by far one of the highest, well in excess of other Asian cities such as Seoul, Taipei, Singapore and Tokyo. With the limited resources available, Hong Kong has long faced the problem of finding suitable sites for housing. However, less than 20% of the land in Hong Kong has been urbanised.

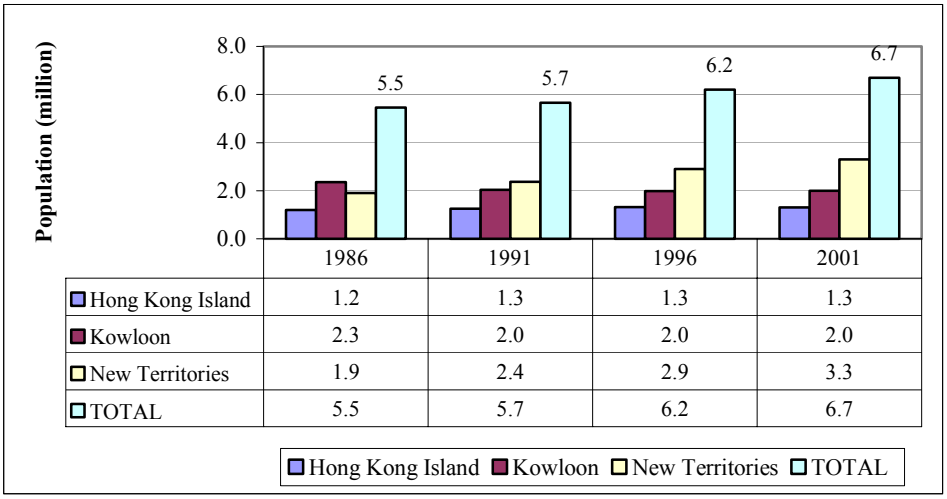
In Hong Kong, the previous colonial government and the present SAR government have been the sole supplier of new developable land. As a result, the decisions on the quantity of land to be allocated for housing development and the number of housing units to be built each year are determined by Government policy involving various departments. The Government has also established a maximum level for the amount of government land disposal each year.

In general, land supply directly determines the quantity of housing supply by imposing restrictions on locations for housing development. Since every individual has the right to pursue their ideal living environment, new housing development provides options for people to choose and therefore, influences their intentions to move. Within Hong Kong, accessibility is largely a matter of convenience and marginal expenditure. However, some key questions remain. How closely are these variables affecting each other, and in particular, what is the current situation regarding land supply and population mobility in Hong Kong? This paper attempts to address these questions by analysing the dynamic impact of land supply on population mobility in Hong Kong. The first part provides a background for the current situation in the territory, in terms of population and land use allocation. The second and third sections review the relevant literature and set out a new "supply chain paradigm" framework and methodology. Within the framework, we investigate the linkages between land supply and population mobility in Hong Kong.

BACKGROUND

By area, Hong Kong is one of the smallest cities in the world. Figure 1 shows the trends in population growth and the broad population distribution within Hong Kong. In 1996, the population of Hong Kong was 6,217,556. By 2001, the population had reached nearly 6.7 million people, and is estimated to increase to over 8 million by the year 2011.

Figure 1: Population by Area in 1986, 1991, 1996 and 2001



	1986	1991	1996	2001
Hong Kong Island	1.2	1.3	1.3	1.3
Kowloon	2.3	2.0	2.0	2.0
New Territories	1.9	2.4	2.9	3.3
TOTAL	5.5	5.7	6.2	6.7

Source: Hong Kong Population Census

Notes: The population of the Marine is excluded, as it comprises a very small proportion of the total population.

Because of the limited amount of land allocated for urban development, the population density of Hong Kong is well above international standards. In 1998, the population density in Hong Kong was 6,095.9 persons per square kilometer, and the number of people per square kilometer of urbanised land is 37,358.66, which was exceptionally high, compared to Seoul, Singapore, Taipei and Tokyo (see Table 1).

Table 1: Comparison of Population Density in Major Country/ Metropolitan Areas in Asia Pacific Rim

Country/Metropolitan Areas	Population Density (No. of Persons/ Total Land Area in sq.km)	Population Density (No. of Persons/ Urbanised Land Area in sq.km)
Hong Kong	6,095.9	37,358.66
Seoul	17,046.24	31,866.30
Singapore	6,063.69	12,389.74
Taipei	9,717.85	24,611.55
Tokyo	5,627.97	8,962.12

Source: various government websites.

Table 2 provides the reason for the uneven distribution of population in Hong Kong. In 1999, the total amount of land devoted to residential development amounts to only 4.1% of the total land area in Hong Kong, which was approximately 45 square kilometres in area.

Table 2: Existing Land Use Allocation in Year 1999 for HKSAR

Category of Land Uses	Area (sq. km)	%
Commercial	2	0.18%
Residential	45	4.10%
Public Rental Housing	14	1.28%
Temporary Housing	1	0.09%
Industrial	11	1.00%
Vacant Development Land	27	2.46%
Government, Institutional & Community	21	1.91%
Roads/ Railways	33	3.01%
Open Space	17	1.55%
Other Uses	13	1.18%
TOTAL DEVELOPED LAND	**184**	**16.76%**
NON-BUILT-UP LAND	**914**	**83.24%**
HONG KONG'S LAND MASS	**1,098**	**100.0**

Source: Planning Department, 2001

LITERATURE REVIEW

This section provides a review of studies in relation to land supply and population mobility. It begins with the effects of land supply on land prices, followed by the relationships between land price and new housing provision, population density and mobility. This serves as a backdrop to establishing a new framework for the study.

Effects of Land Supply on Land Prices

From an economic perspective, increasing the quantity of land supply for development reduces the price of land, as a result of a decrease in demand. If landowners and developers accurately foresee future demand, and the land market is perfectly competitive, then the price of land should be determined by market forces (Capozza and Helsley, 1987). Popetan (1996) also believes that if the land-use planning system fails to supply sufficient quantity of land for development, and forces an increase in the price of land, developers will then reduce their investment in housing capital and thus the supply of housing services. [1] In

1. However, it must be noted that total demand relates to total stock. Demand for new housing reflects changes in living standards and willingness to (or not to) accept obsolescence. If this is left to the market, the result is an increasing amount of obsolete

contrast, if the supply of land exceeds the developers' demands, and the price of land falls below the equilibrium, developers will be more willing to increase their investment in housing capital and housing services. Downs (1993) further suggests that government zoning regulations and building codes are the two most important causes of high land prices and housing costs.

Effects of Land Prices on New Housing Provision and Population Mobility

Capozza and Helsley (1987) state that an increase in land price reduces the provision of new housing as developers become more hesitant to invest[2]. Developers generally increase the density of development in new housing projects to maximize profit, in order to compensate for the cost paid for the land. As a consequence, housing price and density only decrease in areas distant from employment centres and other facilities, where the prices of houses have declined to offset the rising costs of commuting (Capozza and Helsley, 1987).

In Hong Kong, relocation is generally seen as "an investment decision", and most people only consider moving to another location if there is an expectation of better private returns (Quigley and Weinberg, 1977). Rossi (1955) and Speare et al. (1974) also believe that people move when they are no longer satisfied with their present living conditions. The function of mobility is a process by which households adjust their housing needs based on life cycles and family compositions (Hawley, 1971). According to Murie (1997), Brown (1975) and Fredland (1974), the amount of private returns can be affected by trade-offs between various costs and also other factors such as demographic changes.

Stockdale and Lloyd (1998) in the United Kingdom examined how the mobility of residence could be influenced by the level of perceived satisfaction with living environment. Their results show that the primary reason for moving was house-related, including quality of the settlement, house availability and accessibility, and location. In addition, the study also suggests that the demographic and socio-economic composition of the residential area influences the demand for land and the types of local services and facilities required. Strassmann (2001) also conducted a similar study in America, comparing findings with European countries. The results suggest that Americans tend to move twice as often as the Dutch, French and other Europeans because there is less control in the US as to how dwellings should be designed, financed, built, sold or rented (c.f. Long , 1991).

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property occupied by those on the economic margin of society. Thus social and economic consequences justify government intervention.

2. This is only if incomes remain constant.

On the other hand, Lansing and Mueller (1967) observe that most movements involved only relocation within the same metropolitan or rural area. Brown and Sanders (1981) further suggest that mobility in advanced societies tends to be higher, because people are always searching for better amenities in their living environment and improved quality of life.

As government intervention has a significant effect on population mobility, Strassmann (2000) introduced an Index of the Strength of Intervention I to examine the impact of government intervention on rent or housing price control on population mobility. By working out the indexes for data collected from 16 countries, Strassmann confirms a negative Spearman rank correlation of 0.962 between government intervention and population mobility. He concludes that this correlation coefficient was significant enough to suggest that greater government intervention would reduce population mobility.

FRAMEWORK AND RESEARCH METHODOLOGY

This section aims to establish a framework within which to analyse the relationship between land supply and population mobility. The previous section summarised major findings and techniques used in the literature. Most of these studies do not involve research and analysis directly on the relationship between land supply and population mobility.[3] The details of the types and origins of the data used were not specified. Their findings related to the effects of land-use planning systems on land supply, land prices and population mobility are mixed. In addition, the methodologies used in these literatures do not appear applicable to smaller areas, such as a district or suburb. As these studies are generally focused at the macro level, looking at the circumstances among countries and cities, the findings they produce are not closely relevant to the situation in Hong Kong.

This paper aims to explore the relationship between land supply and population mobility and hence enhance an understanding of the operation of the land market in Hong Kong. This is unique and particularly important because areas of small scale, such as Hong Kong, may have very different circumstances compared to larger cities and countries.

3. Stockdale and Lloyd (1998) and Strassmann (2001) may be the only exceptions.

Figure 2: The relationship between land supply and population mobility: a chain paradigm

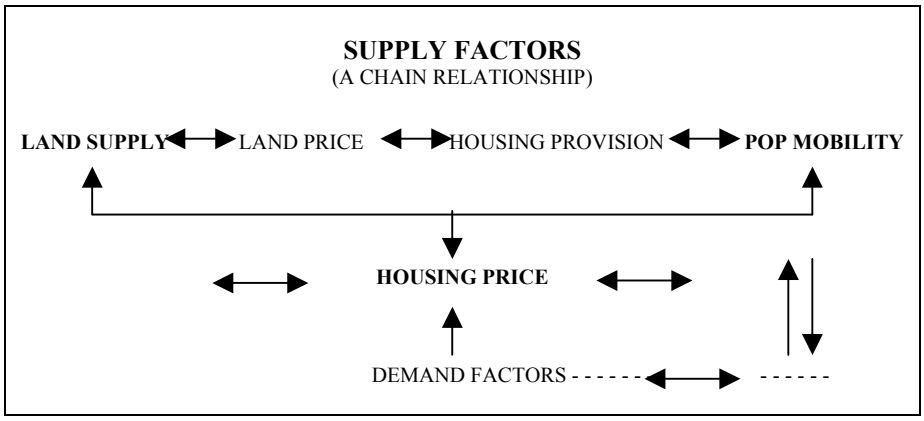


Figure 2 above depicts the relationship between land supply and population mobility as a "chain paradigm" derived from previous literature cited above. Within this framework, we may apply an appropriate methodology to test the relationship in Hong Kong, a state city. The overall relationship between land supply and population mobility can be described as indirect, with many socio-economic factors affecting them (Stockdale and Lloyd, 1998; Strassmann, 2001). This chain paradigm is in line with other studies. In particular, Popetan (1996), Capozza and Helsley (1987), Speare et al. (1974) and Graves (1983) indicate that there is a chain relationship between land supply, land price, housing provision and population mobility. These variables are closely interrelated, affecting each other.

In theory, an increase in residential land will lead to a rise in housing production and size of housing stock in an area. As a result, housing prices in the area will be lower, other things being equal, and people would be induced to move. On the other hand, government policies may affect the market, and vice versa, leaving a residential stock of obsolete housing. Government tends to supply more land for sale when demand is high. That is usually coupled with population movements (and a high mobility across areas), other than price movements.

Methodology and Data

Within the framework, we establish an empirical model to examine the lead-lag relationship between land supply and population mobility. This empirical model is derived from theory and based on the assumption that population mobility is in part affected by demand factors (embracing socio-economic variables) and also

determined by the supply chain paradigm (see Figure 2). The Granger-causality test is employed in this study, fitted with relevant data from 1987 to 2001. The relationship is expressed as follows:

$$PM_t = \sum_{i=1}^{n} \alpha_{0i} LS_{t-i} + \sum_{i=1}^{n} \beta_{0i} PM_{t-i} + u_t \quad (1)$$

$$LS_t = \sum_{i=1}^{n} \alpha_{1i} PM_{t-i} + \sum_{i=1}^{n} \beta_{1i} LS_{t-i} + v_t \quad (2)$$

where PM_t is the population mobility at time t, and LS_t is the land supply at time t. Granger-causality implies that *LS* is causing *PM* provided that some α_{0i} is not zero in equation (1). Similarly, *PM* is causing *LS* if some α_{1i} is not zero in equation (2). This ascertains if there is a lead or lag relationship between the two variables. If both present non-zero coefficients, then a "feedback" effect exists.

Land supply (*LS*) refers to the site area of residential land for public auction tender and private treaty grant (wherever the statistics are available) in both (i) urban areas and (ii) in the New Territories. The land for those purposes is, basically, developable. In this study, all data were collected from relevant government departments; namely, the Census and Statistics Department, Rating and Valuation Department and Lands Department.

The Government defines population mobility (*PM*) as two types of residential internal migration. A person is considered to have internally migrated if they change their residence from one District Board[4] to another. The second case involves a person moving from one new town to another within a District Board in the New Territories, or to other districts and vice versa. These districts and new towns are geographical sub-divisions, with boundaries established according to the Census.

4. "District Board" is simply the demarcation basis for complying all population statistics in Hong Kong. In other words, a population base is established at each population census (or by-census) moment by district board. Currently, Hong Kong is divided into three main areas (i.e. HK island, Kolwoon, the New Territories) comprising 18 districts altogether.

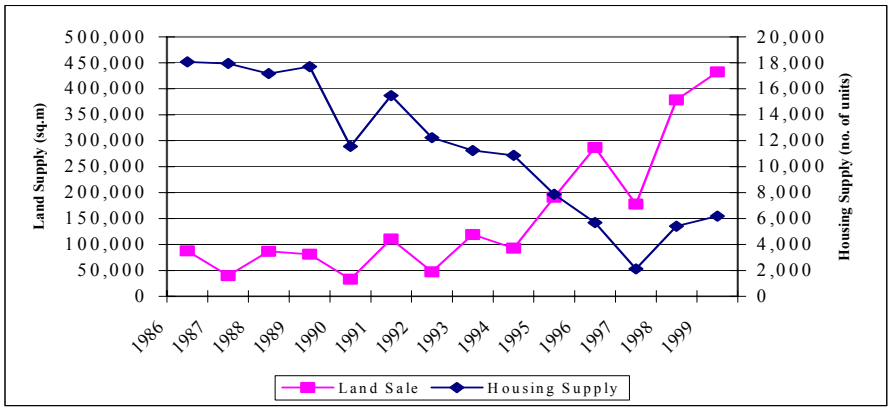
RESULTS AND DISCUSSION

Within the framework, the chain paradigm broadly concerns the relationships between land supply, housing supply and population mobility. Thus, this section first provides some general evidence on land supply, housing supply and mobility. It then presents the analytical findings to address the subject issue of our study; i.e. linkages between land supply (LS) and population mobility (PM).

Land Supply, Housing Supply and Mobility

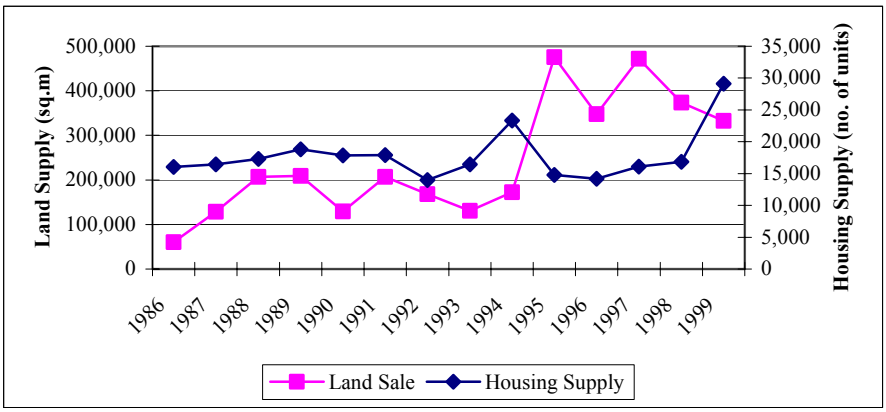
In Hong Kong, land supply directly determines the quantity of housing supply by imposing restrictions on locations and housing development. Overall, there exists a positive relationship between land supply and private housing supply. However, despite increases in the amount of Government land disposal, the supply of private housing in urban areas has been declining since 1986 (see Figure 3). This may be in part due to reasons such as time lags between the acquisition of land and the completion of construction and development. More likely, growth in housing supply has been dampened by demolition and redevelopment activity. By contrast, there appears to be a slightly stronger relationship between land supply and housing supply in the New Territories (see Figure 4).

Figure 3: Annual Land Sales and Housing Supply for Private ResidentialPurpose in Urban Areas



Source: Hong Kong Annual Digest of Statistics & Hong Kong Property Review.

Figure 4: Annual Land Sales and Housing Supply for Private Residential Purpose in New Territories



Source: Hong Kong Annual Digest of Statistics & Hong Kong Property Review.

The overall housing stock in Hong Kong had grown by 59.6% over the past 13 years, from 625,075 units in 1986 to 997,636 units in 1999. Among all three areas, growth in housing supply for the New Territories is the strongest (see Table 3). The New Territories saw an increase of 178.3% over the same period. As more people choose to settle in the New Territories, developers are somehow motivated (likely by the prospect of higher profits) to increase their housing production to satisfy the population's demand.

It is noteworthy that the housing supply to stock ratio has declined across the years (see Table 3). This phenomenon is more remarkable between 1987 and 1996. This may be due to the Government and developers' decisions to reduce housing supply during the period. Newspaper reports argued that this was possibly the result of collusion between government and developers. It is more plausible to argue that developers had taken a cautious attitude towards the prospect of the territory in the run up to the 1997 handover, thus likely affecting the volume of their building activity.

Table 3: Housing Supply and Mobility

		1987-1991		1992-1996			1997-2001		
	Hong Kong Island	**Kowloon**	**New Territories**	**Hong Kong Island**	**Kowloon**	**New Territories**	**Hong Kong Island**	**Kowloon**	**New Territories**
Mobility	203,615	260,061	645,204	197,113	267,285	673,970	176,483	313,710	601,493
Total Population	1,250,993	2,030,683	2,374,818	1,312,637	1,987,996	2,906,733	1,335,469	2,023,979	3,343,046
Mobility/ Population	**16.28%**	**12.81%**	**27.17%**	**15.02%**	**13.44%**	**23.19%**	**13.2%**	**15.5%**	**18.0%**
Supply	51,045	28,745	88,320	31,677	16,188	82,699	15,065	23,795	88,994
Stock	271,501	274,052	235,773	296,089	284,380	342,718	300,175	293,903	401,499
Supply/ Stock	**18.80%**	**10.49%**	**37.46%**	**10.70%**	**5.69%**	**24.13%**	**5.02%**	**8.10%**	**22.14%**

Source: Hong Kong Population Census and Hong Kong Property Review.

Table 3 summarises the percentages of population mobility for Hong Kong Island, Kowloon and the New Territories between 1987 and 2001. Comparing the population mobility percentages enables the frequency of relocation by people in different areas in a particular period to be observed. Table 3 shows that the percentage of population mobility was the highest in the New Territories between 1987 and 2001, reaching 27.17% and dropping slightly to 23.19% between 1992 and 1996. By contrast, the population mobility rates for Hong Kong Island and Kowloon were relatively low, around 15% during the same period. More people chose to move into the New Territories as a consequence of better infrastructure and in pursuit of improved living environments.

The table also suggests that the New Territories had the highest percentages of new housing supply/ housing stock. The promotion of urban expansion and new town developments in the New Territories were clearly seen as the intention of the government over the last two decades. As a result of deregulation and rezoning, more agricultural land became available for development.

Evidence of a relationship between population mobility and housing supply certainly exists in Hong Kong Island and the New Territories. This is manifested by the fact that the higher the supply/stock ratio, the higher is the mobility/population ratio. Similar evidence did not appear for Kowloon.

The Relationship between Land Supply and Population Mobility

It should be noted that this study is to test whether the release of land has an effect on population mobility. In our case, the spatial definitions of the housing market are urban areas (i.e. HK and Kowloon) and the New Territories (NT). This is

represented by the population mobility measures and matches the geographical coverage of the land supply data.

Table 4: Granger - causality Tests: Land Supply and Population Mobility

Direction of Causality	2 Lags		3 Lags	
	F-statistics	p-value	F-statistics	p-value
Urban Areas (HK & Kln)				
LS →PM	0.229	0.874	1.533	0.501
PM→LM	2.360	0.133	1.600	0.491
New Territories				
LS →PM	3.862	0.028	8.622	0.013
PM→LM	3.265	0.030	8.522	0.014

Notes: The null hypothesis of no causality is rejected of the F - statistics exceed the initial values, or if the p-value is less than 0.05.

To implement the Granger-causality test, F-statistics are calculated under the null hypothesis that in equations (1) and (2) all coefficients of $\alpha_{oi,}$ α_{li}=0.[5] As the production of residential property takes 2-3 years, the regression is run two times with lag = 2 and 3. Table 4 presents the results of the test for the relationship between land supply and population mobility. With 2 lags and 3 lags, both test statistics are significant at the 5% level for the New Territories. Thus, it would seem that past values of land supply help to predict population mobility, and vice versa, exhibiting a "feedback" effect. In other words, a causal relationship does exist between land supply and population mobility in the New Territories, where new towns are located.

These results are not surprising because the NT is where today's new towns are located, with much better planning than existing urban areas. These new towns are in general located in a semi-rural, lower density environment. They are generally better planned and equipped with better social amenities and facilities. Public transport is also easily available. More importantly, residential prices in the NT are generally not as expensive as in old urban areas. All this attracts people to move in and is exactly the reasons why there is a population increase in the NT, at the expense of urban areas. That is also coupled with the effect of a big increase in housing supply in the NT (see Table 3), compared to urban areas.

By contrast, the findings seem to suggest that there exists no causality between the *LM* and *PM* in urban areas (comprising HK Island and Kowloon). It is evident,

5. The Granger-causality test requires the use of stationery of time-series data. Stationarity of the data has been tested by inducing the first differencing of the level data. However, little causal relationships exist. Thus this study does not provide the results.

however, that the population in Kowloon has slightly decreased over time, from 2.03 million in 1991 down to 2.02 million in 2001. Evidence from the census concurs with this (see Table 3). Reasons for this are unclear and warrant further investigation. A relatively benign explanation may be offered by the effect of re-development within the established urban areas of Kowloon and Hong Kong Island.

Redevelopment activity might have distorted the *supply chain paradigm*, particularly in terms of land supply and population mobility. First, redevelopment involves demolition (re-building) that hampers the sequential links between land supply and housing supply in the chain. For example, given the same amount of land supply, the quantity of housing supply could diminish (or increase) as a result of redevelopment, at least at some point in time. Therefore, redevelopment activity may represent "shocks" or "noises", and adversely affect the accuracy of estimation. Second, redevelopment does affect mobility. Those affected by redevelopment, for example in Kowloon, may choose to move elsewhere or even to other areas. This is likely to happen in the presence of a "push and pull" phenomenon. Demolition represents the "push" that households are to move as a result, while new town development is the "pull" that offers them the enticements. Either case, the possible result is a net outward migration[6] from where they used to live, or more precisely the areas that redevelopment takes place. All in all, redevelopment activity blurs the possible linkages between land supply and population mobility in urban areas.

However, there are less benign explanations, two of which may be summarized as (a) demographic effects, and (b) inner city obsolescence. The new-town developments in the New Territories may be expected to appeal to young, middle-income families. The new, clean, well-planned environment of the new settlements in the NT is better suited to the needs of young families with children and the financial advantages of moving from expensive, congested and polluted inner city areas may be particularly appealing. However, this leaves older, low-income individuals or households remaining within the inner city area. However, those areas contain an aging housing stock and urban infrastructure that is expensive to maintain or renew. In other words, this suggests the classic symptoms of inner-city decay and urban dereliction. Thus, whilst the new settlements appear to offer an improved living environment, the established urban areas suffer from the un-corrected effects or urban obsolescence.

In other words, the release of rural land for new urban settlements that are relatively cheap to plan, develop and manage ignores the mounting social and environmental costs of urban obsolescence in the old urban centres. There is little market incentive for developers to focus attention on the re-development of

6. For the sake of the census, only *inward* migration is counted.

existing urban areas if they can generate greater profits by developing new, large-scale green-field settlements. Whilst new settlements can be justified on the basis of an increase in the number of households outstripping the existing housing stock, this policy may activate demographic changes that have profoundly damaging consequences on the long-term attractiveness and viability of existing central urban areas.

CONCLUSION

In Hong Kong, land supply directly determines the quantity of housing supply by imposing restrictions on locations for housing development. Since every individual has the right to pursue their ideal living environment, land supply also restricts the options for people to choose and, therefore, influences their intentions to move. This paper has confirmed and clarified a chain relationship in Hong Kong. The graphical tools adopted provided a visualisation of the interesting interrelationship between land supply, housing supply and population mobility in Hong Kong. Within the supply chain paradigm framework, we have investigated the linkages between land supply and population mobility using Granger-casuality tests. The major findings of the paper are as follows:

- There is a positive relationship between the quantity of Government land disposal and the quantity of land available for private residential development.
- There is an unclear and indirect relationship between the quantity of Government land disposal and the growth of housing stock, which is caused by time lags between the acquisition of land and the completion of construction, and various other reasons including redevelopment activity.
- There exists a causal relationship between land supply and population mobility in the New Territories. Past values of land supply help to predict population mobility, and vice versa.
- Redevelopment activity blurs the possible linkages between land supply and population mobility in urban areas.

As regards the chain paradigm, our findings are generally in line with other studies (Speare et al. (1974), Graves (1983), Capozza and Helsley (1987) and Popetan (1996)). However, this research has raised further questions relating to the long-term viability of current government land use policies for sustaining the quality of the urban environment in existing centres of HKSAR. This paper also has implications for a larger and detailed study on the dynamic impact of land supply on population mobility in Hong Kong. Land supply is one major factor that restricts “the options of people to choose their location of residence”. This study concerns only the supply side issues. At the same time, demand factors are also at work. To consumers, infrastructure, environment and affordability, for example,

are also primary considerations. Future studies could also take into account the mobility patterns of the population, living in social housing, or private housing under Government's subsidy schemes.

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