

## Article

# No More Illegal Subdivided Units? A Game-Theoretical Explanation of the Failure of Building Control in Hong Kong

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**Abstract:** Safety has long been regarded as one of the most important functional requirements of buildings. However, building safety in Hong Kong has long been jeopardised by the proliferation of unauthorised building works (UBWs), which are essentially works constructed without any prior approval or consent of the government. Due to the acute problem of housing supply–demand imbalance, the numbers of illegal subdivided units (ISUs) in the city have been increasing since the early 2010s, frequently resulting in injuries and deaths amongst the residents. It is therefore a matter of urgency for the government to tackle the problem. Speculative property owners construct ISUs in their premises for economic gain so the government needs to enforce rules against the construction of ISUs. Building inspection should be carried out to uncover cases of illegal construction for subsequent enforcement actions. In this article, a game-theoretic model for the strategic control of existing buildings in Hong Kong is developed to illustrate that, when the level of punishment against ISU increases, the less frequent ISU inspections needed by the government will be, and concurrently, the chances of ISU construction by property owners will decrease. The model offers valuable insights into why Hong Kong’s building control system fails to solve the problem of ISU proliferation in the city.

**Keywords:** building illegality; housing illegality; subdivided units; unauthorised building works; informal housing; building safety; game theory; building control



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## 1. Introduction

Informal housing has been an enduring urban challenge in the Global South, but housing illegality is still prevalent in many post-industrial cities. The legacies of the new town developments and massive public housing programmes in the Global North and in East Asian newly industrialised countries are collapsing. In Hong Kong, the British colonial government was devoted to the extensive construction of high-density vertical settlements to accommodate the population influx from mainland China and facilitate population growth in the post-war period. Nevertheless, substandard accommodations have never been eliminated in the city. Over the years, the form of illegal settlement in Hong Kong has progressed from land squatting into vertical slumming [1,2]. In the early years, illegal housing commonly existed in Hong Kong in the form of caged homes, cubicle units and rooftop houses [3,4], while subdivided flats are currently the most prominent form of illegal housing. Table 1 shows an upward trend of the estimated number of households living in subdivided units in the territory in the last decade. In 2015, the UN-ESCAP and UN-Habitat portrayed the informal housing in Hong Kong as “vertical slums” [5]. Some subdivided units are unauthorised building works (UBWs) that pose major risks (e.g., structural and fire risks) to building safety [6]. Yet, why did the problem of illegal subdivided units (ISUs) in Hong Kong grow over the years?

**Table 1.** Estimated Number of Subdivided Units in Hong Kong (2013–2016 and 2020).

	2013	2014	2015	2016	2020
Number of quarters with subdivided units *	18,000	24,600	25,200	27,100	29,897
Total number of subdivided units	66,900	86,400	88,000	92,700	100,943
Average number of subdivided units per quarter	3.71	3.51	3.50	3.4	3.38
Number of households living in subdivided units	66,900	85,500	87,600	91,787	100,943
Number of sub-divided unit residents	171,300	195,500	199,900	209,740	226,340
Average area of subdivided unit per capita (m <sup>2</sup> )	Not Available	5.7	5.8	10	6.6 #
Monthly rental payment (HK\$)	3790	3800	4200	4500	4800
Source	[7]	[8]	[9]	[10]	[11]

Notes: \* The definition of “subdivided unit” may vary across surveys. # Median floor area per capita is taken.

The illegal conversion or subdivision of a flat is not new around the world. For example, illegally converted dwellings are very common in big Australian cities such as Sydney and Melbourne [12,13]. Such illegal practices are also found in the United States [14]. To counter the safety and health risks associated with housing illegality, governments often rely on some building control systems [15]. This is an important goal because safety “is a fundamental human right” [16], an idea that should be upheld “in order to preserve the health and well-being of individuals and the community” [17]. Like building laws elsewhere, the *Buildings Ordinance* (Chapter 123 of the *Laws of Hong Kong*) intended to ensure building safety and prevent any building hazards in Hong Kong since it was first legislated in 1956. The law has been revised from time to time to achieve more desirable built environment in response to social changes.

The proliferation of subdivided units is largely attributable to the structural failure of housing policy in Hong Kong [18]. In its long-term housing strategy, the government ideally assumed that the residents in substandard housing units would be rehoused in public housing units sooner or later. Yet, public housing has been under-supplied in the territory since 2010. In turn, faced with budgetary constraints, the disadvantaged and low-income families are coerced into seeking extremely small private flats that command lower rents [19]. Given the increasing house rents and the higher rental returns of the small-sized units, the rental operation of subdivided units has been considered a profitable business, incentivising more property owners to carry out flat subdivisions. Legally speaking, not all subdivided units are illegal. The building works associated with flat subdivision are legal only if the administrative procedures and construction standards laid down in the *Buildings Ordinance* and its subsidiary regulations are complied with. In case of non-compliance, the subdivided units so produced are considered “illegal”.

The illegality and uncertainty about housing quality potentially pose health and safety hazards on the ISU residents and those living in the neighbourhoods. Therefore, the government should have acted promptly to contain the ISU problem. Nonetheless, the efforts of the government are in vain. It is thus necessary for us to understand why the government has failed to tackle the problem in the past years. Against this backdrop, this article aims to explain the failure of the building control system with the game theory. This work accentuates the significance of building control enforcement in response to the emerging problem of ISU proliferation in Hong Kong.

In this article, we approach the ISU issue in Hong Kong from the supply-side perspective. Nonetheless, we admit that the proliferation of illegal housing in a city or region is usually an outcome of an overall housing deficit that is driven by a combination of both supply-side and demand-side factors [20,21]. As a preliminary effort to explain ISU

proliferation in Hong Kong from the game-theoretical perspective, this study focusses on the interplay between the building control system and the supply of ISUs only. At the same time, increasing affordable housing supply, as a supply-side measure, is often regarded as the ultimate solution to the illegal housing problems in many different parts of the world [22,23]. Yet, it is not achievable within a short time horizon in nearly all cases. It is particularly true in contemporary Hong Kong, where a land-supply deadlock and bureaucratic inefficiency have been experienced. It is not our intention to belittle the significance of demand-side factors in shaping Hong Kong's illegal housing landscape. Additionally, we agree that more affordable housing should be provided in the city to deal with the housing crisis. Persuading the government to eliminate all ISUs in the city all at once without considering the proper rehousing of the affected residents is not our stance. At least, we need to find some ways to curb the further expansion of the illegal housing sector.

By applying the game-theoretical model, we will explain the deterrent effect of inspection frequency and monetary penalty in prohibiting ISUs. The rest of the article is organised as follows: What comes first is a brief contextual review of subdivided units, the negative externalities of ISUs and the current regulatory framework in addressing ISUs. That offers theoretical discussions in enforcement challenges and crime deterrence. Then, a game-theoretical model is proposed for explaining the proliferation of ISUs in Hong Kong and how the level of proliferation is related to inspection frequency and monetary fines. This article will then be concluded with discussions and recommendations in coping with illegal housing challenges in Hong Kong and other post-industrial cities.

## 2. Issue and Problem: ISUs and Building Control in Hong Kong

### 2.1. What Are ISUs?

In Hong Kong, the definition of “subdivided units” is elastic and context-dependent. When regulating tenancies of subdivided units in buildings, the administration loosely defines “subdivided units” as “premises that form part of a unit of a building” [24]. In the domain of building control, the Buildings Department often considers “subdivided units” as the output of “the subdivision of a flat as shown on the original approved plan of a building into two or more individual rooms” [25]. On the other hand, the public perceive “ISU” as the substandard housing that is “formed by the subdivision of individual quarters into two or more units for rental purposes to more than one household” [8,9]. These definitions imply the perceived nature of subdivided units—illegal accommodation for rental purposes. In the absence of statutory minimum occupancy standard, typical subdivided units in Hong Kong are sized 70–120 ft<sup>2</sup> in area.

Technically speaking, ISU is a form of UBW [6,26]. In constructing ISUs, typical building works include the alteration or addition of internal drains, the installation of new toilets and kitchens, the thickening of floor screeding to accommodate new or diverted drainpipes and the demolition and erection of internal partition walls [6,25]. Under the current building control system, the property owners must follow either the conventional statutory submission procedures for alteration and addition works or the simplified procedures under the Minor Work Control System (MWCS). Building works undertaken without complying with such procedures are illegal (i.e., they are UBWs) [6].

ISUs influence their occupants and the wider community in many ways. For example, a building with ISUs faces a greater risk in building safety and fire hazard. In the early 2010s, one building-collapse incident and two fire accidents in old Chinese tenement buildings with ISUs uncovered the problem of illegal flat subdivisions in Hong Kong [27]. In terms of building safety, the erection of internal partitions, the making of openings in load-bearing walls and the thickening of floor screeding in ISUs may undermine the structural integrity and stability of the buildings concerned [27]. The clustering of ISUs in a building endangers the overall fire safety of the building because of the increased risk of electricity leakage and overload due to inappropriate electrical wiring works [28,29]. Partitions between subdivided units occupied by different residents or households are

inadequately fire-resistant. In addition, emergency evacuation is challenging in buildings with subdivided flats, since they are densely inhabited and their means of escape are narrowed to make more rentable space [27,28].

From a public health perspective, the absence or inadequacy of windows in many ISUs disables residents' enjoyment of natural lighting and ventilation. This results in thermal discomfort in hot summers, inadequate ventilation, unsatisfactory indoor air quality and a poor visual environment, which eventually leads to or exacerbate chronic health issues (e.g., asthma, eczema, myopia and lower back pain) of the residents [30–34]. Moreover, the improper alteration of internal drainage systems and the unauthorised installation of new toilets frequently lead to water seepage [27]. In addition to the accelerated deterioration of the reinforced concrete and other building materials, the seepage problem also expedites the growth of mould in the indoor environment and the degradation of the hygienic condition, particularly when foul water is involved. Owing to the high moisture level and the lack of natural ventilation, the spread of bedbugs is noticeable in ISUs, causing sleep disturbance [35,36].

## 2.2. Regulatory Framework and Enforcements against ISUs in Hong Kong

### 2.2.1. Illegality of Subdivided Units

The legality of a subdivided unit depends on whether the unit complies with regulations, terms and conditions in both lease and building control systems. The legality of flat subdivision can be understood from two angles. First, ISUs are results of violations of the *Buildings Ordinance* and its subsidiary regulations under the prevailing building control regime. These violations may come in the form of the non-fulfilment of statutory submission requirements and the contravention of building regulations related to means of escape, fire-resistant construction, natural lighting and ventilation, and drainage. Second, in non-domestic properties (e.g., industrial premises), the construction of ISUs results in changes in building use that do not conform to the user clauses in the respective government lease. Furthermore, an unauthorised change in use can be a violation of Section 25 of the *Buildings Ordinance*. A gist of the informality of flat subdivision is summarised in Table 2.

**Table 2.** Informality of Subdivided Units under Hong Kong's Lease and Building Control System in Hong Kong.

Scenario	Lease Control		
	Subdivided Flats in Domestic Premises	Subdivided Flats in Non-Domestic Premises	
Building Control	Not contravening the <i>Buildings Ordinance</i>	Flat subdivision works in domestic buildings approved by the Building Authority <b>(Legal and conforming)</b>	Conversion of non-domestic properties into subdivided flats approved by the Building Authority <b>(Legal but non-conforming)</b>
	Contravening the <i>Buildings Ordinance</i>	Flat subdivision works in domestic buildings not approved by the Building Authority <b>(Illegal but conforming)</b>	Unauthorised conversion of non-domestic properties into subdivided units <b>(Illegal and non-conforming)</b>

The main difference between the lease and building control systems lies in their nature. Building control is statutory, while lease control is non-statutory. For the enforcement against ISUs in a building, the Buildings Department issues warning letters and statutory orders to request the building owners to reinstate the properties concerned within a specified period of time. If the reinstatement works are extensive or involve structural works, the owners will be purposely requested in the orders to appoint an authorised person (AP) and/or registered structural engineer to coordinate and supervise the reinstatement works on the owners' behalf. On the other hand, lease enforcement actions will result only if ISUs

are found in non-domestic buildings. Although the government can choose to re-enter the land concerned in case of significant breach of a lease condition, it rarely applies to cases of ISU. Therefore, enforcement against ISUs mainly rely on the building control system. The Building Authority (i.e., the Director of the Buildings Department) recognises ISUs principally through various means, including public and media reports, referrals from other government departments and large-scale operations (LSOs) undertaken on target buildings or groups of building blocks. According to the cumulative statistics of LSOs against ISUs between April 2011 and the end of 2020, the Building Authority served 3832 statutory orders upon 8555 inspected units [37].

There have been a lot of debates on what “informality” and “illegality” mean [38,39]. In general, informality embraces activities that are “unregulated by the [formal] institutions of society, in a legal and social environment in which similar activities are regulated” [40], while “illegality” usually refers to violations of building codes [38]. In this study, a spotlight will be cast on housing illegality only because the effectiveness of building control is our main concern. Although various policy options, like licensing and criminalising the construction of ISUs in industrial premises, have been discussed widely by the public [6], there has been no significant revamp in Hong Kong’s building control system in response to the ISU proliferation since 2010. With the purpose of explaining the unchecked widespread construction of ISUs in Hong Kong in recent decades, we ignore the newly introduced rent control system in the following discussion. The rest of the article will focus on the illegal construction of subdivided units mainly from the perspective of building control.

Under the *Buildings Ordinance*, the term “building works” is very broadly defined to include “every kind of building operation” (Chapter 123 of the *Laws of Hong Kong*). That means typical additions and alterations to existing buildings, including flat subdivision, fall under the scope of building works. “UBW”, jargon used by the Buildings Department, is not explicitly defined in the *Buildings Ordinance*. The term can be interpreted as both a process and an outcome that occur without the required permission of the Building Authority [41]. This view is generally echoed by other scholars [42–44]. “UBW” is used to collectively label all building works non-compliant with the *Buildings Ordinance* and/or that were carried out without any prior approval and consent obtainable from the Building Authority. Another important feature of Hong Kong’s building control system is that retrospective approval is not allowed under the *Buildings Ordinance*. That means once an ISU has been constructed without the Building Authority’s prior approval, it cannot be retrospectively approved in the future.

In 2006, it was predicted that the government would take over three decades to remove all known UBWs citywide [45]. This backlog was ascribed to the rigid system of building plan submission for building works that are relatively minor in terms of the nature, scale and level of risk involved. After a great deal of industry consultation, the *Building (Minor Works) Regulation* (Chapter 123N of the *Laws of Hong Kong*) was enacted as a subsidiary regulation of the *Buildings Ordinance* in 2008 to enable private certification and simplified approval procedures for the designated minor building works. At the beginning, there were 196 minor work items specified under the MWCS. After several reviews and revisions, the number of items went down to 187 as at the end of 2021. The MWCS is particularly relevant to flat subdivision because many associated works (e.g., erecting non-load-bearing block walls and the thickening of the floor slab) are minor works in nature.

### 2.2.2. Penalties Imposed against ISUs under the Building Control System

Section 40 (1AA) of the *Buildings Ordinance* stipulates that any individual who knowingly constructed an UBW (including an ISU but not minor work) shall be subject to a fine of HK\$400,000 and imprisonment for two years upon conviction. A further penalty of HK\$20,000 for each day of the continuance of the non-compliance will be applied. As mentioned above, pursuant to the *Buildings Ordinance*, the Building Authority can serve statutory orders on property owners for the reinstatement of the properties with UBWs. Under Section 40 (1BA) of the *Buildings Ordinance*, it is a criminal offence if the property

owner, without reasonable excuse, does not comply with a statutory reinstatement order issued by the Building Authority. The violators may be liable, upon conviction, to a fine of HK\$200,000 and imprisonment for one year. A defaulted owner may also be subject to a further fine of HK\$20,000 for each day if they continue their non-compliance with a statutory order. All these are the adjusted fines as a result of the amendment of the *Buildings Ordinance* in December 2004. Before the law amendment, the maximum one-off and per-day continuation fines for deliberate undertaking UBW were HK\$100,000 and HK\$5000, respectively. The maximum fine for non-compliance with a statutory reinstatement order was HK\$50,000, and there was no continuation fine. The amendment brought about a threefold increase in monetary punishments. Nonetheless, there has been no further increase in the monetary punishments since the law amendment in 2004.

With the introduction of the MWCS in 2008, there is another set of punishments for the UBWs that are minor works in nature. Anyone who fails to comply with relevant requirements under the *Building (Minor Works) Regulation* for executing minor works without adequate justification commits an offence and faces a fine of level 5 (currently HK\$50,000) if convicted. When an ISU involving UBWs fall within both minor work and non-minor work categories, Sections 40 (1AA) and 40 (1BA) of the *Buildings Ordinance* apply in the enforcement. In addition to the monetary fines and imprisonments, the statutory enforcements against ISUs can affect the legal titles of the properties concerned. The warning letters and statutory orders issued under the *Buildings Ordinance* are registered by the Land Registry as encumbrances in the relevant land ownership history.

### 3. Control of Illegal Housing: Theoretical and Practical Perspectives

#### 3.1. Previous Studies on Government Enforcement Actions against Illegal Housing

##### 3.1.1. Connections between Illegal Housing and the Built Environment Control System

Governments worldwide and transnational organisations like UN-Habitat endeavour to remove illegal housing because, from the state managerial view, illegal accommodations are “undesirable” and illegal urban products [46]. The presence of illegal housing is a corollary of “non-compliance” with existing regulations and “non-enforcement” by regulators [47]. Illegal dwellings in developing cities are usually self-built on others’ land without the approval and consent of the state [48,49]. In developed cities, most of the illegal accommodations are scattered geographically and small in scale. They are carried out by landlords or property owners. Illegal housing exists in two main forms: unauthorised new developments against development controls and illegal structures constructed within existing buildings. Situating this generalised argument into Hong Kong, which has moved from “the Third World to First”, we can see a temporal shift of illegal housing in the city from “visual squatting” in the post-war period to informal accommodations (including ISUs) within existing buildings after the 1990s [50–52].

##### 3.1.2. Government Strategies against Illegal Housing in Theory

Enforcement and toleration are two broad strategies of governments to tackle the issue of illegal housing [2]. Generally speaking, the eradication or removal of illegal accommodations is a type of command-and-control enforcement of regulations, while toleration is a form of non-enforcement. The enforcement mechanism, in nature, is an executive and administrative government function to ensure the developments comply with legislative requirements [53]. Whether the government regulates or not depends on availability of financial and human resources in the public sector, policy priorities and politics. Slum clearance in developing cities and building control in high-density cities are typical examples of enforcement against illegal accommodations. Very often, the inspection and enforcement processes are expensive and time-consuming [54]. As the enforcers are usually “street-level bureaucrats” [55], the enforcement outcome is discretionary and even ineffective because of different “enforcement styles” and is, in practice, case-based due to the inconsistent interpretation of the ambiguous building laws, codes and guidelines [56,57].

Building control enforcement and associated clearance usually incur high institutional and social costs. For example, inspection of and enforcement against unauthorised works within existing buildings involve high transaction costs [6,12]. The clearance of illegal housing unavoidably results in displacement and eviction, leading to urban conflicts and thus high social costs [52]. In welfare states, the governments, which are concurrently the regulators and social welfare providers, are obligated to rehouse those people affected by government-led clearance projects. In cities where a rehousing scheme is not in place or where social housing is chronically under-supplied, the evictions resulting from enforcement against illegal housing causes homelessness and social unrest. In this regard, in case of a deficiency in institutional resources and inability to enforce rules, the government may need to consider another strategy—toleration—to buy time.

Toleration with illegal housing does not mean un-regulation. Rather, toleration is an instrument of “unmapping”. Deregulation expands the state’s governability by creating “grey zones” or “spaces of exception” [58]. Toleration can allow institutional capacity to grow for the governmental actions in the future. In some situations, governments prefer formalising the toleration to evade the illegal practice temporarily. The suitability of the tolerance approach to a city is usually contingent on the government’s priorities and the broader socio-political context.

To ease the burden of governmental enforcement against housing illegality, some cities may delegate the power of approving building submissions to authorised private contractors or professionals. As such, private certification may be an extra executive arm in ensuring regulatory compliance. This approach is the opposite of the traditional command-and-control regime. Self-regulatory (or co-regulatory) initiatives in which private-sector actors enforce the laws and report the regulation compliance are considered cost-effective measures to avoid law non-compliance [57].

### 3.1.3. Enforcements against Illegal Housing in Practice

In Hong Kong, the government’s strategy to deal with illegal housing seems to be toleration-oriented. The squatter hut was once the most prevailing form of illegal housing in the city. In the interwar and early post-war periods, the huge population influx from mainland China resulted in the massive construction of illegal structures on unleased government land. Before the 1950s, the colonial government tolerated squatting because of its incapability to eradicate squatter settlements; subsequently, toleration was formalised [59]. In the 1970s and 1980s, with the aid of the extensive public housing programme, the colonial government rehoused the squatters and cleared most squatter areas in the city’s urban areas [59–62]. Besides, the government introduced a licensing system to regulate the remaining informal settlements [60]. Until now, only very few squatter areas remained in Hong Kong. They are tolerated upon the condition that no alteration or rebuilding is allowed for the illegal structures in these squatter areas [62].

While the problem of squatter settlements has been largely contained in the 1970s and 1980s, other forms of substandard housing, such as caged homes, cubicle flats and rooftop housing, burgeoned in Hong Kong. In response to the fire and health risks associated with cage homes or cubicle flats, the government once again adopted a licensing system to regulate flats with twelve bedspaces or more [6]. A new law, the *Bedspace Apartments Ordinance* (Chapter 447 of the *Laws of Hong Kong*), was enacted to back up the licensing initiative. While the government tends to take active enforcement actions against typical UBWs like flower racks and metal frames, a selective toleration approach has been adopted to deal with illegal housing in the city. It is largely because of the lack of affordable dwellings for low-incomers. Illegal accommodations like rooftop housing serves the significant function of the provision of affordable housing to the underprivileged in the city [2]. The political economic account of urban illegality suggests that the wider society may benefit from the operation of illegal housing, justifying toleration and non-enforcement [63].

### 3.2. Deterrent Effects of Building Enforcement: Certainty, Severity and Celerity

On many occasions of ISU construction, the offenders are not owner-occupiers. They can be individual property owners or corporate landlords. The effects of enforcement actions could be different between the occasional violators (the one-shotters) and the structural violators (the repeat offenders) [56]. Typically, enforcement against building regulation violations has a higher deterrent effect on the former. The frequent or repeated violators, usually corporate landlords, are more calculative and profit-driven [56,64]. They take costs, revenues and enforcement risks into account to ensure their ISU business is profitable and sustainable. Given the same enforcement risks, the higher the profit, the more likely the landlords will engage in ISU operation. Apart from net monetary returns, what are the other factors affecting the property owners' decisions in constructing ISU from the perspective of classical criminological theory?

Deterrence theory and the rational choice model are two classical explanations of crime and regulatory conformity in criminology. Criminologists believe that certainty, severity and celerity are three instrumental sanction determinants of regulatory compliance [65–67]. Celerity (or swiftness) refers to the promptness of the enforcer's response to a violation. If the institution does not respond to the violation timely, more offenders will break the regulations and rules to grab transient benefits. Certainty signifies the probability of an offender being caught and punished, while severity denotes the level of punishment once the offender is caught and found guilty. Becker sees violating a regulation as a process of rational choice that maximises the expected utility of revenue [68]. From the classic economic utility perspective, the offenders commit crimes on account of calculative rationality. In theory, the more certain the prosecution and the more severe the punishment, the stronger will be the deterrent effect on potential violators. The optimal penalty can be achieved when the expected total penalty for an illegal act equals the total social loss resulted from the illegal act.

Previous empirical studies on violations of environmental regulations suggest that non-monetary sanctions have no discernible impact on corporations' compliance, while increasing fines has a more decisive deterrent effect than having more frequent inspections of environment-polluting firms [69]. Besides, the certainty and celerity of enforcement collectively shape the potential violators' perceptions towards enforcement [69]. If the regulator successfully sanctions a violator upon the initial inspection, there will be signalling effects of the punishment, which make other potential violators learn from the case. On the other hand, if the regulator fails to stop violators' non-compliance upon the initial inspection, the enforcement mechanism will lose its credibility, affecting the effectiveness of the subsequent enforcement actions. In this light, timely enforcement is critical in constructing deterrence.

Going beyond the rational model, new theoretical explanations of crime and regulatory non-compliance have been put forwards. From the sociological perspectives, the social bond theory [70], legitimacy theory [71] and social learning theory [72] explain law compliance (and non-compliance) through exploring the offenders' connection to the wider societal systems. For example, Tyler [71] associates law obedience with trusts and suggests that individuals respecting legitimate authority think of themselves as moral persons. In this sense, the norm of compliance is viewed as a main factor in justifying why people obey regulations and moral sanctions are considered effective in ensuring law compliance.

While the sociological explanations of violation may be persuasive in explaining certain forms of violation, it seems unfit in the case of ISU construction. From the Marxist viewpoint, all property owners are unscrupulous because they expropriate the surplus of labour [73]. As suggested by the political economists, the "bad landlords" are a component of the economic system, and there lacks clarity between economic and ethical perspectives in the historical development of the private rental market [74]. This view challenges the usefulness of social-cultural deterrent theories that are built upon morality and ethics. Numerous grounded studies have suggested that the growth of informal and illegal dwellings is attributed to profitability and speculation [13,64,75,76]. Conceivably, classic criminologi-

cal theories based on the rational choice model seem to offer a better explanation of the game between enforcers and property owners who produce ISUs.

### 3.3. Applicability of the Game-Theoretical Models on Explaining the Proliferation of ISUs

Similar to other regulations, building regulations display many features of a command-and-control instrument that aims at ensuring compliance using tools of deterrence and fear of sanctioning [57,64,75]. Synthesising the regulatory aims and practical understanding, the magnitude of monetary sanction is central in deterring violations against building regulations (including the production of substandard housing). In the same vein, several studies on housing regulation in Australia [12,13], Czechia [75,76] and the United Kingdom [77] suggest that illegal housing production results when the risks of penalty are outweighed by the expected profitability. Considering the failure of building control, we particularly draw on Vols and Belloir's [56] qualitative findings in investigating the rogue landlords who frequently infringe on building control regulations in the Netherlands. They point out the gambling nature of the building-regulation violators that "repeat offenders have managed to weigh the pros and the cons of their activities" [56]. The violators recognise that the costs of compliance with building regulation are offset by the profits generated by the leasing of substandard units in the long run. Consequently, they "gamble on not being caught [if] they are aware that the cost of the sanction will be less than those incurred by [regulatory compliance]" [56]. In this sense, property owners who construct and operate ISUs are rational game players. Provided that landlords' return maximisation is the motivation of constructing and operating ISUs, the application of the game-theoretical model appears to demonstrate explanatory power in the proliferation of ISUs and the failure of building control.

### 3.4. Research Gaps and Conceptual Framework

Previous studies that examine the crime of illegal housing insinuate that offending landlords usually are rational players. The landlords violate regulations with an eye to the possible monetary gains. However, whether landlords in Hong Kong follow this line of thought is still unanswered. Although much has been written on the ineffectiveness of building control against both UBWs and ISUs [42,43,73–85], studies on the efficiency of the current legal device to tackle the problem of ISUs have been rare. Whether or not the increase in the monetary penalties like fines can prohibit the expanding trends of ISU remains unreciprocated. To straddle the gap, this article aims to explore why Hong Kong's building control system fails to curb the ISU problem from the perspective of the interplay between property owners and enforcement agency. Drawing on the theoretical and empirical literature, the conceptual framework illustrated in Figure 1 was developed to underpin the research. Game-theoretic modelling will be adopted to investigate how the certainty of enforcement action perceived by property owners and the level of punishment shape the outcome of building-control enforcement. The property owners' illegal building behaviour will be also explained from the angle of the speediness of the enforcer's response to a violation. The analytical study described in the article is essential to generating valuable insights for formulating effective building safety policies and coping with ISU issues.

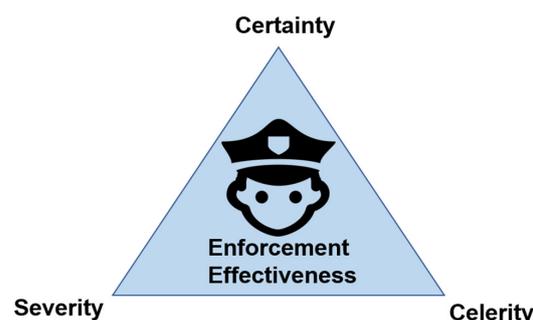


Figure 1. Conceptual framework of the research.

#### 4. Proposed Game-Theoretical Framework: Game Theory and Its Implications

In this study, an analytical model was developed based on the theories drawn from the extant literature with adaptation to the scenario of ISU construction in Hong Kong. The proposed analytical model for studying the proliferation of subdivided units in Hong Kong originated from the game theory, which began with the work of Zermelo [86], Borel [87], von Neumann [88] and the seminal work of von Neumann and Morgenstern [89]. Game theory concerns how individuals behave in strategic situations [90]. The term “strategic” refers to a situation in which each individual, when deciding what action to take, has to rationally consider others’ possible responses to that action. In the language of the game theory, a “game” means any situation involving two or more rational individuals, or so-called “players”, with a number of possible strategies to take [91]. In the game, each player strives to maximise the expected value of his or her own payoff that is measured in some monetary or utility scale [92]. Among the “games” of various types, a particularly important one is called the prisoner’s dilemma, which was first introduced by Flood [93]. It offers an insight into the complexity in maintaining cooperation among different parties in a game. In many cases, in spite of the more preferable outcome from cooperation, people fail to cooperate with one another. While hypothetical scenarios were set up to illustrate different possible outcomes, real-life secondary data were also used to substantiate the model. These data were collected from various sources, such as government reports and press reports.

##### 4.1. The Prisoner’s Dilemma

The prisoner’s dilemma is a game involving two criminals, Alex and Brooklyn, who are caught by the police for possessing an unregistered handgun. Alex and Brooklyn will spend one year in jail if the police obtain sufficient evidence to find them guilty of the minor crime of possessing the handgun. In addition to the possession of unregistered gun, the two criminals are also suspected to have committed a bank robbery together. Yet, the police lack solid evidence to convict them of this serious crime. The police question Alex and Brooklyn separately. In the separate questioning, the police present each of the offenders with the following deals:

1. Both criminals can remain silent, and they will be locked up for one year;
2. One of the criminals remains silent, while the other one confesses to the bank robbery and implicates his partner. The one who confesses will be given immunity from prosecution and set free while his partner will get 20 years in jail; and
3. Both criminals confess to the crime, with both getting intermediate sentences of eight years each, as testimony and trial are not required.

In summary, each prisoner has two strategies: either remain silent or confess. The sentence each prisoner eventually has (i.e., the payoff) depends on the strategy each prisoner chooses. The choices in the deal and the respective payoffs are summarised in Figure 2. Given that both Alex and Brooklyn are self-centred bank robbers who only care about their own sentences, each will decide what is best for himself. Yet, the robbers can choose to cooperate with or go against each other, although they cannot communicate with each other.

##### 4.2. Deriving Game-Theoretical Framework in the Inspection and Construction of ISU

Since its evolution, game theory has been extensively applied to the business field. Yet, its applications in studies in the field of real estate and construction have been sparse [94,95]. In fact, game theory can be applied to scrutinise the interplay between property owners and the government on matters of ISU construction. As ISU operators and the government should be opposites in the game of ISU construction, it is quite obvious that each party must act strategically. It is, therefore, worth our while to study analytically what factors underlie property owners’ decisions to construct ISUs in their properties. In the development of the

game-theoretic model of UBW construction in this article, the work of Wu and Wu [96], which investigated the land-use inspection in China, is heeded.

		<b>Brooklyn's Decision</b>	
		Confess	Remain Silent
<b>Alex's Decision</b>	Confess	Each is jailed for 8 years	Brooklyn is jailed for 20 years Alex is set free
	Remain Silent	Brooklyn is set free Alex is jailed for 20 years	Each is jailed for 1 year

**Figure 2.** The choices and payoffs for the two criminals.

Generally speaking, property owners construct ISUs for higher profitability, as illustrated in the former sections. Hence, there must be some gain, which can be measured in economic terms, for the property owners who erect them. Yet, the monetary returns from the property owners' illegal actions come at a cost to ISU residents and the community, because UBWs associated with ISUs degrade the overall safety performance of the built environment and prompt health consequences on the ISU residents.

In the game of ISU construction, the gain by the ISU operators of the loss to the community (because of greater health and safety hazards and negative externalities) are tightly related. These two variables should, therefore, be duly considered when regulating the construction of subdivided units through building control. For simplicity, four assumptions in the proposed model are followed:

1. When an ISU is constructed, the economic gain to the offending ISU operator is  $M$ , while the loss to the community is  $L$ .
2. When a UBW is identified by the government in an inspection, the government will act to punish the offending operator. The ratio of the punishment, in monetary terms, to the economic gain of the ISU operator is  $r$ , where  $r \geq 1$ . The punishment comprises two parts. One is the mandatory removal of the identified UBW in the ISU by the property owner. Another is the payment of a fine for the guilty act. That means that, in addition to depriving an offender of any economic gain from his or her ISU, a punishment equal to  $(r - 1)M$  will be imposed on the property owner. The government can use the proceeds from this punishment for other public expenditures to benefit the community.
3. The costs of constructing and demolishing an ISU are negligible compared to the value of  $M$ . Meanwhile, the cost for the government to inspect a potentially illegal subdivided residential unit is  $C$ .
4. Property owners and the government are rational players.

Focused on these assumptions, the payoffs when the government and the ISU owner adopt different strategies are conceptualised in Figure 3.

		Government's Decision	
		Inspect	Not Inspect
Property Owner's Decision	Construct and Operate ISU	$-(r-1)M, -C + (r-1)M$	$M, -L$
	Not Construct and Operate ISU	$0, -C$	$0, 0$

**Figure 3.** The choices and payoffs in monitoring and constructing & operating ISU.

For the ease of computation, the entries in Figure 3 can be represented by the following payoff matrices:

$$G = \begin{bmatrix} -C + (r-1)M & -C \\ -L & 0 \end{bmatrix} \quad (1)$$

and

$$P = \begin{bmatrix} -(r-1)M & 0 \\ M & 0 \end{bmatrix} \quad (2)$$

where  $G$  and  $P$  denote the government's and ISU owner's payoffs, respectively. The economic gain from ISU operation to the offending property owner is further taken to be a multiple of the cost of inspection by the government, so that  $M = mC$  where  $m > 1$ . By the same token, the loss of the community due to the construction and operation of an ISU is taken to be a multiple of the cost of inspection by the government, so that  $L = lC$  where  $l > 1$ . With these transformations, the payoffs of the government and property owner become

$$G = \begin{bmatrix} -1 + m(r-1)C & -C \\ -lC & 0 \end{bmatrix} \quad (3)$$

and

$$P = \begin{bmatrix} -m(r-1)C & 0 \\ mC & 0 \end{bmatrix} \quad (4)$$

respectively.

Since the main purpose of this game-theoretic model is the propensity of property owners to illegally subdivide the property units, the possibility of property owners undertaking the unauthorised subdivision of property units and of governments to monitor them should be examined. Given that the probabilities of the government to inspect property units are  $a$  and  $1 - a$ , in which  $a \in [0, 1]$ , and the probabilities for property owners to construct ISUs are  $b$  and  $1 - b$ , in which  $b \in [0, 1]$ , the respective probability matrices for the strategies of the government and property owners are:

$$\alpha = [a \quad 1 - a] \quad (5)$$

and

$$\beta = [b \quad 1 - b] \quad (6)$$

From all of the above, the respective expected returns for the government and property owners in the game of ISU construction are

$$E_G = \alpha G \beta^T = [a \quad 1 - a] \begin{bmatrix} -1 + m(r-1)C & -C \\ -lC & 0 \end{bmatrix} \begin{bmatrix} b \\ 1 - b \end{bmatrix} = a(mrbC - mbC - C - b + bC + lbC) - lbC \quad (7)$$

$$E_P = \alpha P \beta^T = [a \quad 1 - a] \begin{bmatrix} -m(r-1)C & 0 \\ mC & 0 \end{bmatrix} \begin{bmatrix} b \\ 1 - b \end{bmatrix} = mbC(1 - ra) \quad (8)$$

The loss of the community due to ISU construction and operation by the property owners is further assumed to be equal to the economic gain from the operation of ISUs. This is because, in order to secure the increased number of leasable residential units illegally, the property owner has to apply to the government to undertake the required building works and pay the government administrative fees. Generally speaking, the associated cost is more or less equal to the economic gain originating from the construction of these works. In this case,  $M$  and  $m$  become equal to  $L$  and  $l$ , respectively. With the loss of generality, it is also assumed that the cost of inspection by the government is equal to unity (i.e.,  $C = 1$ ), and therefore:

$$E_G = a(mrb - 1) - mb \quad (9)$$

and

$$E_P = m(1 - ra)b \quad (10)$$

With the availability of Equations (9) and (10), we then explore the equilibrium. For the government to maximise its expected returns,  $E_G$ , it should adopt the following strategy:

$$a = \begin{cases} 0 & \text{if } 0 \leq b < \frac{1}{mr} \\ \text{between 0 and 1} & \text{if } b = \frac{1}{mr} \\ 1 & \text{if } \frac{1}{mr} < b \leq 1 \end{cases} \quad (11)$$

Equation (9) showed that, if the probability of a property owner undertaking illegal subdivision,  $b$ , is less than  $\frac{1}{mr}$ , the government will choose not to inspect it in order to maximise its expected returns, because the coefficient of  $a$  in Equation (9) is negative, or  $(mrb - 1) < 0$ . In this case, the probability of the government monitoring it is zero. Conversely, the probability of the government inspection is unity when  $b > \frac{1}{mr}$ . The reason is that the coefficient of  $a$  in Equation (9) is positive, or  $(mrb - 1) > 0$ . Therefore, for the optimisation of the expected return, the government has to survey UBW construction related to the illegal subdivision of property units. When  $b = \frac{1}{mr}$ , the expected returns for the government are independent of the value of  $a$  as a coefficient of  $a$  in Equation (9), which is zero, or  $(mrb - 1) = 0$ . The government can select its inspection probability,  $a$ , in its own will.

In summary, whether or not the Buildings Department should inspect depends on the probability of a property owner constructing and operating illegal subdivision in the property units. Meanwhile, the point at which the probability of a property owner to subdivide his or her property unit,  $b$ , is equal to  $\frac{1}{mr}$  is the critical point for the government to decide whether or not to inspect. Similarly, the strategies to be adopted by the property owner to maximise his or her expected returns are:

$$b = \begin{cases} 0 & \text{if } \frac{1}{r} < a \leq 1 \\ \text{between 0 and 1} & \text{if } a = \frac{1}{r} \\ 1 & \text{if } 0 \leq a < \frac{1}{r} \end{cases} \quad (12)$$

Equation (12) shows that, when the probability of the government inspecting an ISU is less than  $\frac{1}{r}$ , a property owner will be more likely to construct an ISU on his or her property to maximise his or her expected returns. Such a probability is unity because the coefficient of  $b$  in Equation (10) is greater than zero, or  $m(1 - ra) = 0$ . The property owner can choose the probability of constructing a UBW,  $b$ , based on his or her own will.

In general, whether or not a property owner constructs and operates an ISU depends on the probability that the government will inspect his or her property. Synchronously, the probability that the government will inspect at  $a = \frac{1}{r}$  is the critical point for the property owner to decide on unlawfully subdividing their unit into ISU. According to the theoretical analyses above, the strategies adopted by the property owners and the government are interconnected. By solving Equations (11) and (12) simultaneously using the graphical method, the equilibrium can be found, as depicted in Figure 4. In the graphical presentation, Point E  $(\frac{1}{r}, \frac{1}{mr})$  is an equilibrium situation. From Equations (7) and (8), Point E also indicates the solved equilibrium of the game:

$$[(a, 1 - a), (b, 1 - b)] = \left[ \left( \frac{1}{r}, \frac{r - 1}{r} \right), \left( \frac{1}{mr}, \frac{mr - 1}{mr} \right) \right] \tag{13}$$

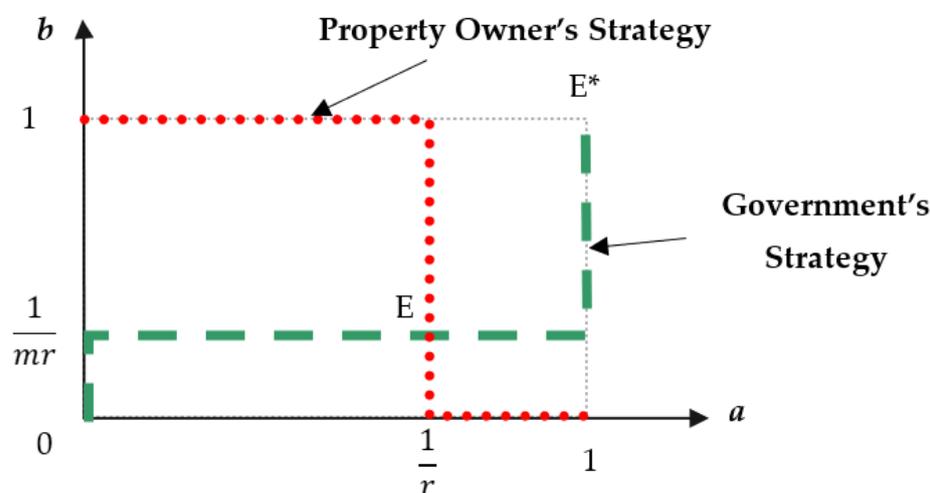


Figure 4. The equilibrium condition of the game in combatting and constructing and operating ISU between the government and a property owner.

As indicated by Equation (13), the strategy that the government adopted was to either survey UBWs in a particular unit in an interval of  $r$  years or to conduct an inspection on ISU construction. Clearly, the larger the value of  $r$ , the lower the frequency of the inspections of the properties. On the other hand, it is the case that either a property owner, on average, constructs and operates ISU on his or her property every  $mr$  years or ISU is spotted in every  $mr$  units. When the degree of punishment,  $r$ , increases, the number of offences will go down. This is also noteworthy that when the ratio of punishment to economic gain,  $r$ , is kept constant, a higher economic-gain-to-survey-cost ratio,  $m$ , results in fewer cases of ISU construction. This implies that the number of offending cases decreases once the cost of the inspection is reduced. From these results, the government should be recommended to consider less costly approaches to ISU inspection, including outsourcing ISU inspection to building surveying consultants. Alternatively, the government could also reduce the cost of inspection by means of economies of scale. Large-scale ISU surveys rather than ad hoc inspections should be conducted.

If truth be told, there is another significant implication of the theoretical model when  $r = 1$  or merely depriving the offending property owner of his or her economic gain without any extra punishment or penalty imposed on him or her. From Equation (10), we have:

$$E_{p|r=1} = m(1 - a)b \tag{14}$$

where  $a \leq 1$ , the coefficient of  $b$  was not less than zero, or  $m(1 - a) \geq 0$ . To optimise the expected returns,  $E_p$ ,  $b$  should be equal to one. This situation is represented by Point E\* in Figure 4. In other words, in spite of efforts by the government to survey ISU, property owner will continue to undertake illegal subdivision for profit-making. The reason behind this is

straightforward. When a property owner adopts a non-law-breaking (conforming) strategy, the expected returns to him or her are zero. On the contrary, since the government merely forfeits the economic gains obtained from constructing and operating illegal subdivided units without any extra punishment, it is always a non-negative expected return for the property owner if he or she follows the law-breaking (non-conforming) strategy. When the government detects an ISU, its expected return to the property owner are zero; when the government fails to detect an ISU, its expected returns are greater than zero. This means that even if the government puts in substantial effort to monitor ISUs by inspections, the phenomenon of ISU construction and operation will not be eradicated, given that the punishment for an offender is too light.

## 5. Discussions and Policy Recommendations on Theoretical Model in Explaining the Proliferation ISUs

### 5.1. Hypothetical Explanation of Proliferation of ISUs in Hong Kong

The game-theoretic model aforementioned can be applied to analyse the strategy for the illegal subdivision of units by the government using real-life secondary data. Prior to the model application, the value of the economic-gain-to-survey-cost ratio,  $m$ , should be first determined, followed by the degree of punishment,  $r$ . The equilibrium of the game can be solved using Equation (13). To determine the value of  $m$ , we assume that each illegal subdivision brings the property developer who subdivides his or her units a direct economic gain of HK\$12,000 and the inspection cost of each dwelling unit is HK\$4000. Every year, the government inspect 3000 units and discovers 4000 UBWs including illegal subdivisions. Therefore, the total economic gain for offending property owners is HK\$48 million and the total cost of ISU inspections is HK\$12 million. By the formula  $M = mC$ , the value of  $m$  equals to 4.

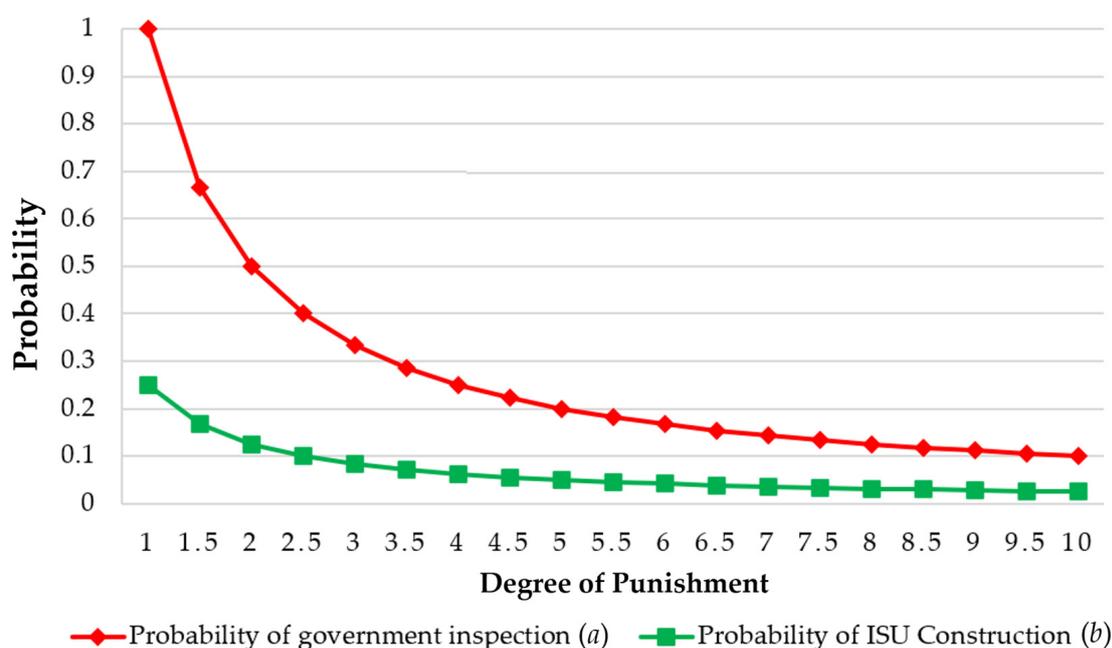
Under the condition that  $m = 4$ , we analysed the probability of the government inspecting ISUs and of the property owner undertaking illegal subdivision under different levels of punishment,  $r$ . When  $r = 2$ , the government forfeits all economic gain from offending property owners and imposes fines equal to the amount of their economic gain on them. In Equation (13), the equilibrium is presented as:

$$[(a, 1 - a), (b, 1 - b)] = \left[ \left( \frac{1}{2}, \frac{1}{2} \right), \left( \frac{1}{8}, \frac{1}{8} \right) \right] \quad (15)$$

In the scenario, if the government randomly chooses one-third of the buildings in Hong Kong to survey, it will find an ISU for every twelve buildings inspected. The steps are repeated and finally the probabilities  $a$  and  $b$  under different values of  $r$  are obtained. The results are graphically shown in Figure 5, which clearly indicates that, when the degree of punishment,  $r$ , increases, inspections by the government are less frequent and the chance of a property owner subdividing his or her units are smaller. These findings in effect echo what has been suggested above: no matter how much effort the government has been put into the building control of the illegal subdivision of residential properties, the degree of punishment is still a critical issue.

### 5.2. Real-Life Situation in Hong Kong

Next, we move to provide real-life evidence of the ISU proliferation in Hong Kong to explain why building control fails. We evaluate the government enforcement action against ISUs in the criteria of three deference determinants, namely penalty level (severity), inspection frequency (certainty) and responsiveness of the enforcers and enforcement actions (celerity).



**Figure 5.** The relationship between the degree of punishment and the probabilities of SIU construction and government inspection.

#### 5.2.1. High Profitability of Operation and Low Level of Penalties: Unchanged Penalties across Time

Operating ISUs is highly profitable. According to the figures from local media, the construction cost of subdivided units can be quickly offset by a more-profitable rental return. Two decades ago, subdividing a flat three to four rooms cost approximately HK\$100,000 in return for a rental yield return of 15% at least [97]. Although subdividing a room in a flat is getting more costly recently, it still yields 5–6% rental returns of operating subdivided units (compared to 2% rental returns in letting a non-subdivided unit) [97]. The costs of erecting ISU are even lower because of cheaper unqualified labour engaged in carrying out the minor building works without fulfilling the statutory design and construction standards. The ISU owner can maximise the layout in the subdivision works and neglect the building codes.

As mentioned in various studies [12,13,64,75–77], the ISU operators are relatively rational and consider the severity of the regulation violation. Empirically, past enforcement experience in coping with ISUs exhibited low severity. To recap, severity stands for the consequences of being caught in terms of monetary and non-monetary terms.

For monetary severity, the magnitude of fines penalising violation against ISUs has not changed across time. Since the law amendment in 2004, the government has never increased the monetary sanction of violating the *Buildings Ordinance*. Currently, the maximum penalties of offending relevant regulation are Chapter 123 and Chapter 123N are level 5 fines (i.e., HK\$50,000 or about US\$6410). According to the *Criminal Procedure Ordinance* (Chapter 221 of the *Laws of Hong Kong*), this level of offence magnitude was baselined in 1994. Taking the inflation of local currency into consideration, the degree of monetary severity devalues across the time, but the property owners benefit from ever-increasing and speculative rental returns.

Regarding non-monetary severity, the non-monetary sanction against ISUs is not common. There are brokers (or informal property agents) involved in letting ISUs and ISU owners are usually non-resident landlords. It shows little impact on personal sanction, not to mention that some operate in corporate form. The prosecution rate, relative to the total number of ISUs in the city, has been very low over the years so the ISU operators appear not to risk any non-monetary sanction for violations of the building regulations.

### 5.2.2. Low-Inspection Certainty: Inspection Difficulties and Institutional Incapacity

The enforcement agency faces difficulties with inspections of and enforcements against ISUs. Due to the high-density built environment, the inspections against ISU incur high transaction costs [6]. We recapitulate the statistics from the Buildings Department's policy budgets in various years. Table 3 compares the yearly enforcement targets of buildings with ISUs and actual performance against ISUs between 2011 and 2020. In 2016, after an audit on the governmental performances in clearing ISUs, the Buildings Departments scaled back the inspection targets because they had to reallocate institutional resources in settling the accumulated cases across years [98]. Although some illegal UBWs in subdivided units are still being rectified, the ten-year statistics suggest the successful prosecution rate is approximate 10%. This rate is close to the prosecution rate of 10.1% (871 instigated prosecutions out of 8555 inspected subdivided units) as derived from the cumulative statistics of enforcement actions against ISUs in LSOs between April 2011 and December 2020 [37]. Therefore, the inspection exercise may not be cost-effective.

**Table 3.** Buildings Department's Annual Enforcement Targets and Indicators [98–109].

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
<b>Target:</b> No. of buildings targeted for the rectification of irregularities associated with subdivided flats	116	369	300	308	210	100	100	100	100	100	/
<b>Indicator (1):</b> No. of subdivided flats inspected	800	1786	1212	2218	3466	3045	2230	1798	1612	1045	19,212
<b>Indicator (2):</b> No. of subdivided flats with irregularities rectified	12	82	217	295	207	254	253	249	275	167	2011
<b>Ratio</b> between rectified ISUs and inspected subdivided flats	1.5%	4.6%	17.9%	13.3%	6.0%	8.3%	11.3%	13.8%	17.1%	16.0%	10.5%

Note: The target buildings include those industrial buildings with subdivided flats.

The under-performance of regulatory inspection is partially attributed to institutional incapacity. Since there is no specific team or regulations in controlling illegal ISUs and ISUs are controlled in the same way for UBWs, previous studies on UBW enforcement shed light on how the low inspection frequency results in ineffective enforcement against ISUs. Over the years, various researchers have indicated three grand obstacles of building control in Hong Kong. The local enforcement challenges can be concluded, as three interlinking factors on governmental capacity, manpower and institutional adaptability to the new challenges [43,110,111]. This view has been supported in various governmental audit reports [112–114].

First, the building control authority is constrained by the bureaucratic organisation structure and is irresponsive to emerging tasks. Given the clearly defined responsibilities and procedures, as well as the duties of routine inspection, there is no room for the enforcement agency to shuffle its manpower in handling emerging tasks like a sudden increase of workloads in inspecting ISUs. The inherent organisational deficiencies of the enforcement agency have confined the effectiveness in taking inspection and enforcement action.

Second, there has already been massive violations of unsettled unauthorised building work in Hong Kong. The continuous upgrading of regulatory standards in ensuring building safety and health have heightened the workload of the enforcement agency for a new round of inspection and enforcement. Given that the backlog of UBW enforcement has been swelling over the years, the enforcement agency is unable to digest the emerging workloads, including ISUs.

Third, similar to the manpower accounts for enforcement failure elsewhere, the building control authority has long been short of staff for inspection and enforcement. In the case of ISUs, Yau's [115] findings imply that the government would not have sufficient manpower for enforcement policy change from toleration to active enforcement. In short, the inspection certainty is relatively low.

### 5.2.3. Weak Celerity: Precedent Failure on Large-Scale Enforcement Actions

The celerity of the enforcement actions is regarded as low. To fasten the enforcement actions, the government launched an LSO and involves private consultancy in inspecting targeted buildings. The action has been criticised as ineffective. Without sufficient public housing, the government has no resources to re-house the ISU tenants into public housing and take a toleration approach, resulting in weak celerity against ISU violations.

### 5.3. Policy Recommendations in Coping with the Proliferation of ISUs

Synthesising the theoretical insights and the proposed game-theoretical models into a real-life situation, the Building Authority can effectively enforce against ISUs in Hong Kong with higher inspection frequency, severer penalties and more credible enforcers' authority. In this regard, the following policy recommendations are offered:

1. The government should review the current regulation and increase the magnitude of fines in constructing UBWs. Since the property owners balance the costs and benefits, the increasing penalties can undeniably disincentivise the illegal subdivision of a flat.
2. The government should inspect more strategically and frequently to demonstrate deterrence on property owners against ISU construction. The Building Authority also adopts institutional innovation. Yau and Lau's [6] recommendation on analysing unusual water and electricity utility prices can be a strategic direction in detecting ISUs. While big data analytics are more advanced and widely applied in different governmental platforms, the Building Authority should leverage the digital transformation and calibrate inspecting targets of buildings with ISUs to increase deterrence.
3. To rebuild the celebrity of the authority, more inspection manpower is demanded in enforcement and monitoring the outsourcing inspection operations.

## 6. Conclusions

The inspiration for this article came from the serious problem of ISU proliferation in Hong Kong, which mainly resulted from the attractive, speculative return from the illegal subdivision of flats. Given that the ISUs are detrimental to building safety and public health and pose negative externalities on the ISU dwellers and the surrounding neighbourhood, the government should review the current enforcement strategy and take bolder and more determined steps to address the issue. In this study, we adapted Wu and Wu's [96] game-theoretical model to illustrate how the probability of ISU construction depends significantly on the degree of punishment against such an unlawful alternation, relative to the economic gains to the offending property owners arising from the act. In this light, the government seems to be on the right track in suppressing the ISU problem by increasing both inspection frequency and offending penalties for ISU constructions. Acutely, the existing penalties had not been reviewed for some 20 years before the amendment of the *Buildings Ordinance*, so their deterrent effect was negligible. This study also informs that the ISUs enforcement action should take the synergetic effect of the deterrent "trial" into policy considerations.

However, it was shown that the increase in penalty level did not curb the ISU problem in the city. It could be ascribed to the insufficient increments in the level of penalty. There should be further studies to investigate the optimal level of punishment that should be taken to inhibit ISU construction using more accurate real-life empirical data. Furthermore, comparative research on the cost efficiency of different approaches for the authority to monitor ISUs (e.g., outsourcing) is awaited. Ultimately, the proliferation of ISUs in the city reflects the structural problems of the inadequate supply of formal affordable housing. It is no doubt that increasing housing supply is a long-term solution to crack on the problem of substandard, informal housing in Hong Kong.

This research is still under development, and this article is the output of preliminary efforts in developing a grand theory that can offer the government insights into how to discourage property owners from subdividing their units illegally. This research is one of the first attempts to use a game-theoretical model to investigate the relationship between enforcement and building code violation. It is particularly relevant to those violations that

are not so easily observable outside a building. While the model was developed based on Hong Kong's context and data, it is still applicable to other cities around the world. Since one city was investigated in the current study, it is not possible to explore how the economic and political system affects the illegal building behavior that eventually shapes the pattern of the urbanisation of a city. Further studies on the relationship between politico-economic factors and illegal building behavior using a comparative study approach are warranted. Moreover, demand-side factors were ignored in the theoretical modelling in this article. We suggest scholars could build up a three-party (landlord–tenant–government) dynamic evolution game model in future studies.

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