MULTI-FINANCIAL MODELLING FRAMEWORK FOR PUBLIC HOUSING

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Abstract

Public housing is a safety net as government program to provide affordable housing for low-income communities. A lack of public housing results in homelessness and low-income communities being forced to live in squatter settlements. The existing governments' subsidies have been heavily used to support the operation and maintenance of the existing public housing, which hinder new housing supply. Recent public housing issues from the demand-side include a lack of public housing caused by issues of affordability and accessibility to housing finance systems; while from the supply side, a lack of housing supply from housing developers which is related to building regulations associated with the capping of prices, the cost of construction, and land prices.

This thesis aimed to develop a financial model capable of ensuring affordability and project feasibility. Comprehensive research was conducted in relation to various stakeholders in the housing sector to integrate their decisions regarding the financial model for public housing and two types of public housing: rental and ownership. Primary data were collected through a tenants' survey in seven public housing communities, a housing providers' survey, and through semi-structured interviews with government and semi-private housing providers. A secondary data review was also carried out to support and strengthen the analysis. Indonesia was selected as the case study, and five cities were involved: Bandung, Batam, Jakarta, Makassar, and Surabaya. Public housing is dedicated to low-income communities, and in Indonesia this is provided for regular tenants and relocated communities, while low-cost apartments are provided for low-income and middle-income home buyers. Regular tenants are those who apply to be public housing tenants, and they have fixed income. Relocated communities are those who are compelled to move from their original neighbourhood.

The first financial model in this study was that of public housing rent determination. This study proposed the used of three rent determination approaches, which can be used for different situations. Three approaches were identified based on a tenant's household income (the income-based approach), operation and maintenance costs (the cost-based approach), and the discounted market-based approach.

Calculations were based upon the tenants' survey of seven public rental housing communities. The rent price was used as empirical evidence to compare the suitability of rent determination approaches. The study found that an income-based approach can be used to determine rent prices based on a tenant's household income and this becomes the affordability indicator. The cost-based approach can be used to determine the rent price; however, if the rent price is higher than the affordability indicator, the government needs to provide a subsidy. Meanwhile, the discounted market-based approach can only be applied for tenants who have higher income than the affordability indicator. The study outcomes provide the basis for relevant policy recommendations in relation to public rent determination and to government subsidies for low-cost housing programs. The investment feasibility analysis for public rental housing showed that by employing a cost-based approach, discounting market prices, and initiating government subsidies such as construction grants, public rental housing can contribute to effective public housing programs and attractive investment for housing developers.

The second financial model was low-cost apartments arranged in mixed-income housing schemes with a transit-oriented development concept. Based on financial modelling, the scenario was developed to analyse changes in key parameters due to different conditions, whether favourable or unfavourable, which will impact the project cash flow. The scenario included the following concepts: most likely, optimistic, pessimistic, and without any government subsidy. The model also evaluated the home buyer's affordability. This study extended the use of system dynamics simulation for investment financial analysis to analyse changes in investment variables. A case study of a low-cost apartment was used for the purpose of validation, which demonstrated how system dynamics can be used to depict and analyse changes in investment variables and to assist policy formulation. The analysis indicated that in pessimistic conditions, governments may expand home ownership credit facilities and loan-to-value flexibility in order to assist future buyers.

While this study used Indonesia as a case study, its recommendations can be generalised to the contexts of other countries that manage public housing for regular tenants. The study provides additional framework for relocated tenants who 'unwillingly' move to public housing from squatter settlements. The results make the case for housing finance policy for public rental housing and low-cost apartments. In relation to public rental housing, two different policies are discussed, as the sector involves two types of tenants: regular tenants, who can pay the income-based rental price; and cost-based (maximum price) and discounted market price tenants. However, relocated communities can only afford to pay the minimum cost-based rent price, which only covers operational costs. In this case, the government must subsidise public rental housing maintenance costs to bridge payment gaps from relocated tenants.

Finally, this study also offers advice in relation to implementation strategies for government subsidies for more viable mixed-housing developments. Mixed-income housing with transit-oriented development is feasible using a certain amount of subsidised and non-subsidised units via government subsidy schemes, such as subsidies on interest rates and down payments. Land provision from the government's land assets or semi-private companies' land assets for public housing is an effective means of lowering housing prices. Together with tax incentives from the government, discounted market rents may attract private developer participation in public housing provision.

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List of Abbreviations

Bapertarum	Badan pertimbangan tabungan perumahan pegawai negeri sipil (The housing saving program for civil servants)
BPHTB	Bea perolehan hak atas tanah dan bangunan (Duty on Acquisition of Rights to Land and Building)
BP2BT	Bantuan pembiayaan perumahan berbasis tabungan (Saving-based government housing financing subsidy)
BR	Bedroom
CBD	Central business district
CPH	Capped-price housing
DCF	Discounted cash flow
ECH	Economic comfortable housing
EWS	Economically Weaker Sections
FAR	Floor area ratio
FLPP	Fasilitas likuiditas pembiayaan perumahan (Housing finance liquidity facility)
HPL	Hak pengelolaan (management rights)
HGB	Hak guna bangunan (building rights)
IDR	Indonesian rupiahs
IRR	Internal rate of return
KAI	Kereta api Indonesia (National railway corporation)
LCC	Life cycle cost
LIG	Low-income group
NCF	Net cash flow
NPV	Net present value
PAY	Pradhanmantri Awas Yojana
Perumnas	Perumahan Nasional = National housing and urban corporation
PPP	Public private partnership
PRH	Public Rental Housing
PRIMA	Perumahan Rakyat 1 Malaysia

RAY	Rajiv Awas Yojana
RUMAWIP	Rumah Wilayah Persekutuan
SHMSRS	Surat hak milik satuan rumah susun (low-cost apartment strata title)
Sq.m	Square meter (m2)
SRH	Shanty town renovation housing
Tapera	Tabungan perumahan rakyat (Housing saving program)
TOD	Transit oriented development

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: QUT Verified Signature

Date: 25 March 2022

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Chapter 1: Introduction

Public housing provision lies in the government's domain. However, the government needs to work with other stakeholders, which is why comprehensive analysis is required in any examination of the issue. This chapter identifies the link between the selected research problems, the scope of the study, and the research approaches adopted. It introduces the process and intention of the research, organising the discussion into seven sections. Section 1.1 describes the background of the research, while Section 1.2 defines the research problem and rationale. The research aims (Section 1.3), approach (Section 1.4), significance and outcomes (Section 1.5), and scope and limitation (Section 1.6) are then presented. Finally, the thesis outline is presented in Section 1.7.

1.1 RESEARCH BACKGROUND

This research was motivated by recognising of the need for public housing for low-income communities due to urbanisation and population growth, especially in developing countries. 90% of global urban growth is happened in developing countries (World Bank, 2020). One of the prominent impacts of urbanisation is the growth of squatter settlements (Jones, 2017). It is triggered by various facilities in urban, such as infrastructure, education, and economic activity. In general, squatter settlement is defined as informal residential in an urban area, which is occupied by poor communities who do not have access to tenured land of their own (Srinivas, 2015). UN Habitat (2015) estimated that approximately 25% of the world's urban population, which was equivalent to approximately one billion slum dwellers worldwide, will continue to live in illegal settlement (UN Habitat, 2015). This number is expected to double by 2030. Informal settlements and slums are mainly found in developing countries (Jones, 2015). In Indonesia, number of slum dwellers reached 13.86% of total household on 2019 (Statistical bureau, 2019a). As the affordable housing supply in major cities is limited, people from low-income communities who intend to live in the cities closer to their workplace live in illegal squatter settlements as they would otherwise have to buy a house far from the city centre, which would increase their transportation costs (Rachmawati et al., 2015). Majority local governments in those countries do not have the technical and financial capacity to create the program to improve the quality of the informal settlement. Squatter settlements are illegal and do not comply with urban spatial planning, which triggers various problems in the context of urban economic development and public infrastructure provision (Pojani, 2013; Zubair et al., 2015). This situation has become one of the primary manifestations of housing problems experienced in most developing countries (Kumar, 2016).

Recognising a severe housing backlog problem, governments in some countries are attempting to provide public housing for low-income communities, with the hope that these families may access and afford to buy their own homes. Governments in some countries believe that public housing is the basic housing needs for low-income households (Chen et al., 2014), as it ensures that low-income communities afford to buy or to rent the adequate house (MacLennan & Williams, 1990 in Adabre & Chan, 2019). Governments also use this as an approach to provide a pathway to home ownership, with public rental housing becoming an option as a step towards home ownership (Cui et al., 2019; Weiss et al., 2011).

As such, subsidised housing initiated by governments, called public housing, is required. In general, public housing is provided through a rental scheme. As the rent is offered at significantly lower than market value, public rental housing demand is increasing, which is indicated by the increasing number of households on waiting list. (Housing Europe, 2017). However, public housing is also provided for home ownership, which is the end of home buyer's varied pathway (Sharpe, 2020). Governments should provide an access scheme for low-income home buyers (Cui et al., 2019).

Current housing supply cannot meet the needs of low-income communities, and there are many obstacles facing the implementation of affordable housing programs. From the demand side, affordability is a major issue, with household income being a primary factor (Othman & Abdellatif, 2011). Affordable housing needs to align with household needs and to be in the location which have sufficient access to key services, employment centre, and transportation facilities, and the cost of housing should not exceed 30 percent of a family's income (Wood et al., 2014). Inequality between increases in income and increases in housing price or housing expenditure is a common issue. Income inequality and house prices have risen sharply in some countries, both in developed and developing countries (van den Nouwelant et al., 2015). Owner-occupiers and renters have different income distribution, therefore, changes in the cost of renting versus ownership will raise inequality in their housing expenditures (Dustmann et al., 2018). In Indonesia, a developing country, increasing housing prices are not in line with increasing income, as described in Figure 1.1.

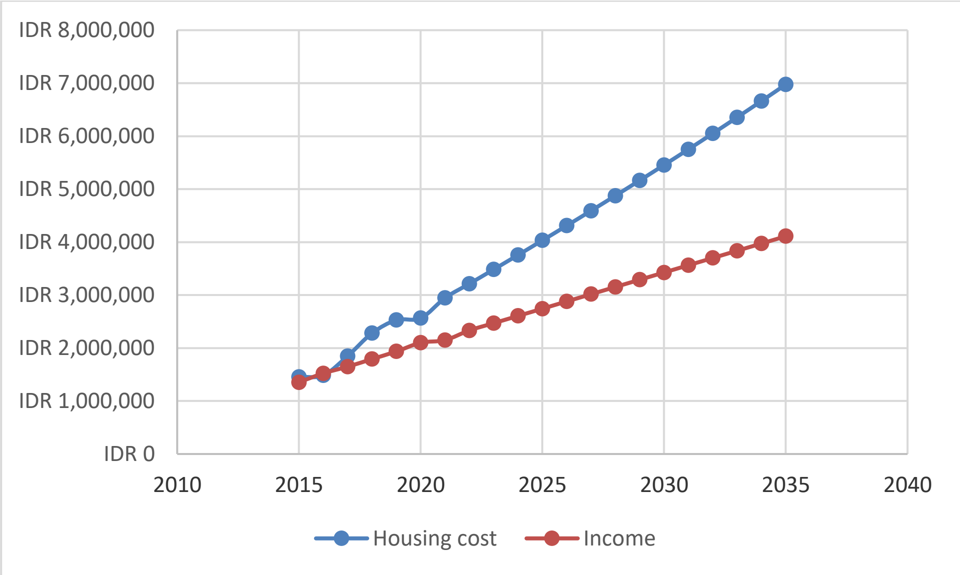

Figure 1.1 Increasing of housing cost and income comparison

(Source: Statistical bureau (2019) & Housing listings for sale Jakarta (2020)

The current affordability problem related to public housing supply is that neither the rent nor the selling price is affordable for the low-income communities, who are the targeted tenants or buyers (Rachmawati et al., 2018a). Since public housing is dedicated to low-income communities, the major issue is inevitably linked to the issue of affordability. Rents cannot be set high and cannot be based solely on market conditions, they require government intervention through regulation and policy (Liu et al., 2019). Subsidisation of rent in public housing for low-income households is substantial, especially in metropolitan areas (Morris, 2009). The price is determined in accordance with affordability, indicated by household income. However, as the occupations of public rental housing tenants vary significantly – and income is often unfixed – it is difficult to determine based on income. In this situation, rent prices can be calculated using operation and maintenance costs (Lai et al., 2008), to ensure that the housing provider can manage and maintain the building appropriately and will not suffer cash flow deficits.

Participant in this housing provider survey explained that affordability issues also happened in home ownership schemes, known as low-cost apartments. Low-income communities are ineligible for home ownership loans as they cannot afford to pay the down payment. Within these schemes the selling price needs to be affordable in terms of a monthly mortgage; it should correspond with the affordability indicator, that is, it should not exceed 30% of the low-income buyer’s income. Affordability issues for home ownership schemes relate to the ability to pay the monthly mortgage based on minimum wages (Opoku & Abdul-Muhmin, 2013; Wapwera et al., 2011). Home ownership has become the ideal and conventional wisdom in many parts of the world. For this reason, the South African Government, for example, subsidises rental households working towards home ownership (Marais & Cloete, 2015); while the Indonesian Government has capped housing prices to ensure that low-income buyers can afford to buy their homes and make their mortgage payments (Indonesian Ministry of Public Works and Public Housing, 2020).

Meanwhile, from the supply side, housing providers in Indonesia find it difficult to synchronise legal aspects related to building regulations. This is in line with what has happened in Yemen and India (Alaghbari et al., 2009; Patel et al., 2018). The costs associated with construction and with the areas of land used to build housing have been predetermined by the government, yet selling prices are capped at a low level for low-income communities (Indonesian Ministry of Public Works and Public Housing, 2020).

Similar to other countries, Indonesia faces a public housing provision problem. Land scarcity and high land prices that close to employment centres are a major obstacle to public housing provision (Rachmawati et al., 2015) and this has led to the current acute housing backlog, with housing provision being well under development targets. A key contributing factor to this situation is the rapid urbanisation caused by the growth of some major sectors in major cities in Indonesia, such as industries and education facilities, that triggers people moving from out of town (Malik et al., 2017).

The migration rate in Indonesia is increasing. Figure 1.2 illustrates top five provinces that have high migration rate in Indonesia: Riau, DKI Jakarta, West Java, East Java and South Sulawesi. These provinces have high population density and attract migrants to work in many industrial companies. West Java has the highest increase of migration rate in the last 10 years, from 65% to 80% on 2020 (Statistical bureau, 2020).

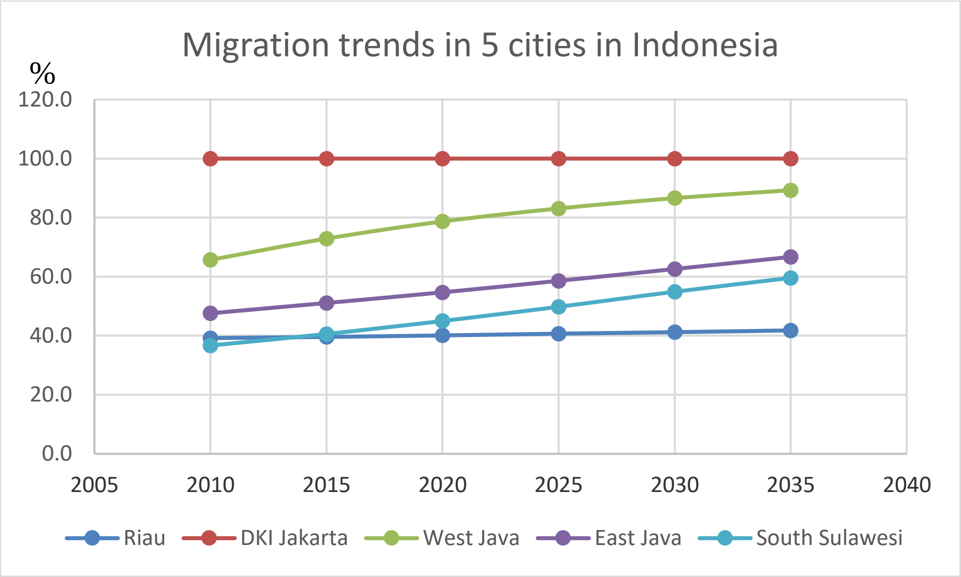

Figure 1.2 Migration trends in Indonesia

Source: Statistical bureau, 2020

With insignificant progress in relation to housing provision, the Indonesian Ministry of Public Works and Public Housing estimates that the housing backlog in Indonesia will reach 800,000 units per year. The current backlog is 7.64 million units, as of the beginning of 2020, comprising 6.48 million units for low-income communities with non-fixed income, 1.72 million units for low-income communities with fixed income, and 0.56 million units for moderate-income communities (Indonesian Ministry of Public Works and Public Housing, 2020). Another problem is the increasing migration rate, which is not in line with the effort to reduce the housing backlog. Table 1.1 provides the data related to effort to decrease housing backlog and the increasing of migration rate.

Table 1.1 Housing backlog and migration rate comparison

Province	Housing backlog decreasing		Migration increasing	
	2010-2015	2015-2020	2010-2015	2015-2020
Riau islands	15%	24%	1,02%	1,26%
West Java	14%	47%	10,96%	7,96%
Jakarta	5%	24%	0,00%	0,00%
East Java	24%	38%	7,35%	7,05%
South Sulawesi	21%	24%	10,63%	10,84%
Indonesia	15%	24%	7,03%	6,38%

Source: Statistical bureau, 2020 (migration data) & Indonesian Ministry of Public Works and Public Housing, 2019 (housing backlog data)

The supply of public housing is expected to be provided by both public and private sectors (Mahamud & Hasbullah, 2011). In Indonesia, public housing is developed by the Indonesian government to reduce the housing backlog via rental and ownership schemes; and a major part of public rental housing currently comes from the government (Kusuma, 2018), with the private sector providing a small number of public housing units. In Indonesia, there are a government program called as “Program Sejuta Rumah”, or one million housing. However, the progress was very slow and in May 2020, the progress was still 21.5% REI (2020b) noted that out of 215,662 units, 169,317 units (78.5%) is allocated to low-income community, and 46,345 units (21.5%) is allocated to moderate-income community. This 78.5% portion was provided by Indonesian Ministry Public Works and Public Housing (30%), local governments (1%), and private housing developers (69%). Meanwhile communities themselves also develop unplanned informal housing sectors to meet their housing needs (Tunas & Darmoyono, 2014).

Table 1.2 exemplifies the data related to the real construction and price of landed houses with land area 72 sqm and building area 36 sqm, compared to the government's capped price. The total cost was counted from direct cost of land and building price, and indirect cost 15% for administration.

Table 1.2 Real land price and construction cost compared to capped price by the Indonesian Government (landed house)

	Average land price (IDR) per sqm	Const cost (IDR) per sqm	Total cost (IDR)	Capped price by gov't (IDR)	Gap (IDR)
Jakarta	5,000,000	2,216,400	505,758,960	168,000,000	(337,758,960)
Surabaya	3,000,000	2,264,600	342,154,440	150,500,000	(191,654,440)

Source: Indonesian property market report, 2020

Table 1.2 describes the gap between real and capped price of the housing by the government. It shows that in two major cities in Indonesia, the average land price in suburbs is really high 132% in Surabaya and more than 225% in Jakarta above the construction cost. It is difficult to provide public housing (subsidised) in the form of landed houses in major cities, as land prices are really high in major cities, which is about fourfold compared to land prices in minor cities. The total costs of providing affordable house private developers is more than double the price capped by the Indonesian government (see the gap in Table 1.2).

The required land price for subsidised landed houses to meet the Indonesian Government's capped price is around IDR 300,000 – 500,000, which is only available in minor cities. Thus, subsidised landed houses are suitable to be built in minor cities. Minor cities refer to urban centres on a sub-metropolitan scale, which are usually located 30-40 km from major cities. These minor cities are integrated into nearby major cities and using facilities provided in the major cities (Lux, 2015).

In this study the high-rise public housing in ownership scheme will be called as low-cost apartment. Similar to the stand-alone houses mentioned above, the current policy relating to the capping of housing prices has hindered the involvement of the private sector as a partner in public housing provision. All high-rise apartments have the same building code requirements; therefore, construction costs are similar between commercial apartment and high-rise public housing projects, the only differences being in finishing costs, facilities, and sales prices. The combination of low capped sales price and high construction cost is one of the challenges for entities investing in and managing public housing (Susilawati & Yakobus, 2010). For 2 bed-rooms unit, a high-rise commercial apartment can be sold for between 400 million and 2.2 billion Rupiah, while low-cost apartment is capped at 306 million Rupiah per unit (Ministry of Public Works and Public Housing, 2020). Table 1.3 depicts data related to the real construction and land prices for high-rise apartments compared to the capped price.

Table 1.3 Real land price and construction cost compared to the capped price set by the Indonesian Government (high-rise apartment)

	Average land price (IDR)	Const cost (IDR)	Total cost (IDR)	Unit price (IDR)	Government capped price (IDR)	Gap (IDR)
Jakarta	5,000,000	2,216,400	38,579,063,808	401,865,248	331,200,000	(70,665,248)
Surabaya	3,000,000	2,264,600	26,765,632,512	278,808,672	284,400,000	5,591,328

Source: Indonesian property market, 2019 & analysis

Another demand issue is difficulty to access home loan. There is a sight of deterioration of housing affordability for a community called non-fixed income as they have limited access from financial institution for homeownership. Due to pandemic, some of the low and moderate-income people loss their job, therefore, their affordability was declined (REI, 2022).

High-rise public housing in rental scheme is called as public rental housing in this study. As it is dedicated to the low-income community, the rent price cannot be high. For this reason, the Indonesian Government also provides subsidies public rental housing operational costs, as rents are kept very low, which means that operational and maintenance costs are not covered (Rachmawati et al., 2018b).

Land prices are critical to housing development costs (Chen et al., 2018). In order to reduce initial costs (land provision and construction costs), government may provide land. In Indonesia, semi-private companies have also contributed to land provision, an example being a semi-private company in the transportation sector provide excess land in the transportation nodes to be used as transit-oriented development (TOD). TOD provides residential opportunities close to mass transportation facilities so that dwellers can reduce their transportation costs (Indonesian Ministry of Public Works and Public Housing, 2020b). The choice of location close to mass transportation facilities could also be a solution for land provision in Indonesia.

TOD approach is aimed to provide both social and economic benefits, such as the reduction of greenhouse gas emissions, the prevention of urban sprawl, and high property (real estate) prices due to better accessibility to near mass-transit facilities mass-transit facility (Cervero & Kockelman, 1997; Renne & Wells, 2002; Knowles, 2012). TOD is normally developed as mixed-use development (Thomas et al., 2018). The unit price in a TOD apartment reflects not only a location close to transportation facilities, but also the provision of appropriate amenities. Price determination theory indicates that location and amenities raise property prices (Yuan et al., 2017).

Based on the explanation offered above, there is an evident gap in housing supply between public housing tenants/buyers' affordability and project viability for housing providers' investment. The public housing rent or low-cost apartment selling prices cannot be set as high as those of mainstream residential properties due to maximum price determined by Indonesian Government. Even though low-cost apartments involve similar construction costs to commercial residential properties, the Indonesian Government caps rental or selling prices. However, investment by housing providers is required to accelerate public housing supply.

This study aims to address the evidenced gap in public housing investment analysis for both rental and ownership schemes. The purpose of the investment analysis in this study is to ensure that public housing investment is both affordable for buyers and feasible for providers. In the context of public rental housing, rent prices can recover operational and maintenance costs, but should not cause housing stress for tenants. While in the case of low-cost apartments, a mixed-income housing is proposed to include both commercial and residential units, which enable cross subsidising between market-rate and subsidised residential units. System dynamics simulation was developed to help the scenario analysis and show the relationship between the variables and rapidly simulate the change of variables throughout the project (Suryani, 2012).

1.2 RESEARCH PROBLEM AND RATIONALE

In accordance with the research background, this thesis examines the following research questions.

1. How to develop a financial model for public rental housing:
    a. Development of a financial model for public rental housing to determine how tenants' affordability – willingness to pay and ability to pay – affects public housing rent prices.
    b. What factors influence public housing rent price determination?

c. How can public housing rent prices be determined using income-based, cost-based, and discounted market-based approaches?

d. What is the role of investment feasibility analysis in public rental housing?

2. How to develop a financial model for low-cost apartments:

a. What are the critical factors for low-cost apartments (home ownership) development?

b. What are the issues associated with home buyers' affordability for home ownership?

c. What is the role of investment feasibility analysis in relation to low-cost apartments?

3. How can system dynamics be used to develop as an investment feasibility model for public housing development?

1.3 RESEARCH AIMS AND OBJECTIVES

The main aim of this research was to develop a financial model for public housing capable of ensuring both housing affordability for buyers and tenants, and project feasibility for government and housing developers. Two models will be developed for public rental housing and low-cost apartment (ownership scheme).

To achieve this aim, the major objectives of the study included:

1. The development of a financial model for public rental housing:

a. To measure tenants' affordability through their willingness and ability to pay public housing rent prices based on housing cost to income ratio;

b. To identify the factors that influence public housing rent price determination;

c. To determine public housing rent prices using an income-based approach, a cost-based approach, and a discounted market-based approach; and

d. To examine public rental housing investment feasibility analysis.

2. To develop a financial model for low-cost apartments (home ownership):

a. To identify critical factors relating to low-cost apartments (home ownership) development;

b. To examine home buyers' ability to afford home ownership; and

c. To examine low-cost apartment feasibility analysis.

3. To develop a financial model for public housing development using system dynamics to depict and analyse changes in investment variables.

1.4 RESEARCH APPROACH

The pragmatism research philosophy was used as the approach for this research, as it recognises that the problem which would be undertaken in the study, could be viewed from many perspectives as single point of view is not be able to describe a holistic picture (Morgan, 2014). The pragmatism research philosophy can integrate more than one research approach and multiple research strategies within the same study, for example, by incorporating qualitative, quantitative, and action research methods. This research involved a comprehensive study of public housing investment, focusing on two types of public housing: public rental housing and low-cost apartments (home ownership). The investigation and analysis involved both qualitative and quantitative research methods. Qualitative research methods were used to gather data relating to respondents' opinions about factors that influence low-cost apartment rental and selling prices and tenants' preferences, while quantitative research methods were adopted to support the qualitative research through numerical analysis regarding project feasibility using cash flow analysis. Furthermore, public housing in Indonesia is provided for both, regular and relocated tenants. The analysis here focused on regular tenants. Relocated tenants are a special case, with a separate recommendation provided in this case.

Given that there were two major focuses of discussion and one development model, this research was divided into three research phases: public rental housing analysis, low-cost apartment analysis, and model development. In Phase 1, the analysis focused on public rental housing investment. Since this study involved several relevant stakeholders in the housing sector, two surveys were conducted with: (1) tenants and (2) housing providers and government officers. The first questionnaire survey, referred to here as the 'tenant survey', was undertaken to obtain household income data in respect to both formal and informal employment. Monthly expenses were used as a proxy to calculate actual household income. The cost of direct substitute dwellings was also used to calculate the discounted market rental approach. The survey was conducted in five selected cities in Indonesia: Batam, Bandung, Jakarta, Makassar, and Surabaya, as these cities met the criteria of population density, housing backlog rates, and the most public rental housing development. The case study selection process is discussed in Section 3.2 in Chapter 3. Next, the 'housing provider survey' was conducted to collect data related to factors taken into account when determining public housing rentals. The first financial model represents the outcome of this phase.

Research Phase 2 consisted of semi-structured interviews conducted with experts in the housing field, including decision makers from government ministries, local government, and semi-private housing companies. Data were coded and analysed using thematic analysis in order to address the research objectives.

Data obtained from data collection were then analysed for investment feasibility in relation to public rental housing and low-cost apartments. The scenario and sensitivity analyses were also conducted to support the financial analysis and the affordability analysis. These analyses were conducted to ensure that a project is not only feasible for the housing provider, but also affordable for the user (tenants and buyers).

Finally, Research Phase 3 involved the development of an investment feasibility model using system dynamics. The model development consisted of problem articulation, dynamic hypothesis formulation, testing, and policy formulation. For testing and the validation purposes, a case study of mixed-income low-cost apartments in Jakarta (Indonesia) was used. The second financial model, as well as the process of model development, provided the outputs of Phases 2 and 3. A more detailed discussion of the methodology is provided in Chapter 3.

1.5 RESEARCH SIGNIFICANCE AND RESEARCH OUTCOMES

In general, this study is expected to fill the current gap in relation to financial modelling for public housing by integrating multi-stakeholders' decisions into the financial model for public housing. In order to achieve viable and affordable public housing, this study determined the most suitable rent price determination approach for tenants, a form of government subsidy for tenants/home buyers and housing developers, and realistic return for public housing developer. This study also extends the use of system dynamics, not only limited to pricing and economic feasibility, but also showing the relationship and predicting the effect of the changing of conditions to financial feasibility.

As this study examined two types of public housing: public rental housing and low-cost apartment (ownership scheme), the study contains two analyses. First, this study proposes a financial model for public rental housing, including the measurement of tenant affordability, identifying the factors influencing rental prices and determining prices using income-based, cost-based, and discounted market-based approaches. Rental price determination evaluation is important to bridge the existing gap if the current rent price is calculated from a tenant's willingness and capacity to pay. It is recommended that the Indonesian Government adopts a different and more appropriate approach to determining affordable rent price that accommodates variations in household income and tenants' ability and willingness to pay. This method can be applied to any cities in Indonesia with some adjustments, such as regional minimum wages and construction costs, which are calculated according to Indonesian construction cost indexes, regulated by the government annually. It can be generalised to any countries that manage public rental housing, and the model also accommodates relocated low-income communities.

Second, this study also examines low-cost apartments (ownership scheme). Mixed-income low-cost apartments, in transit-oriented development (TOD), were reviewed in this study from both the housing provider's perspective (feasibility analysis) and the buyer's perspective (affordability analysis). Analysis was also supported by scenario and sensitivity analysis and the effect of location was examined, as this is influenced by building regulations, which is supported by construction cost index for each city, and impacts on potential revenue, which allows for the determination of the proportional number of subsidised and non-subsidised units. The model can therefore be applied to other cities or other countries with some adjustments, such as to construction costs, building regulations, and different government subsidy schemes.

Finally, an investment feasibility model was developed in this study using system dynamics. This is a decision support system used to examine low-cost apartment investment feasibility for housing providers and governments. The number of subsidised and non-subsidised units can be determined using simulation. The more favourable the investment, the more public housing investment will follow, which will then increase public housing supply.

1.6 RESEARCH SCOPE AND LIMITATION

The scope and limitations of this research are listed as follows:

- This research focuses on public housing provided by the Indonesian Government via two schemes: rental, termed public rental housing; and ownership, termed low-cost apartments.
- Data collection was conducted in five cities in Indonesia: Bandung, Batam, Jakarta, Makassar, and Surabaya. Case study property project in Jakarta was used as mock data for financial feasibility analysis.
- Due to limited population, the statistical analysis used descriptive statistic
- Relevant stakeholders in the housing sector included public rental housing tenants, government ministries, local governments, and housing providers. This study does not involve direct role from financial institution.

1.7 THESIS OUTLINE

This thesis comprises eight chapters.

Chapter 1 provides the background to the research, identifies associated problems, and explains the rationale for conducting the study. The background has guided to formulate specific research aims, research questions, and research objectives addressed throughout the study. In the end of this chapter, research significance, research outcome, and research scope are presented.

Chapter 2 provides critical reviews relevant previous studies and finally summarises gaps in the existing and relevant literature. The literature review covers three topics: housing supply, housing finance systems, and policy related to housing finance. This chapter also presents existing public housing practices in Indonesia as well as regulations and policies related to housing finance, and provides the conceptual framework adopted in this research project.

Chapter 3 describes the research methodology used in this study to address the research objectives. First, it explains the research location and the research design, which is detailed in the research phases. The research design is then explained in detail, including data collection and analysis methods, and the methods used to confirm the findings. Finally, the chapter provides the ethical considerations as the basis and important part that underpinned the study.

Chapter 4 describes the results of the data collection process, including participant and respondent profiles. The results of the semi-structured interviews are provided, clustered by themes based on thematic analysis related to critical factors associated with low-cost apartment (home ownership) development. The results of the questionnaire surveys in relation to tenants' ability and willingness to pay are also presented.

Chapter 5 analyses Research Phase 1, which conducted investment analysis for public rental housing. First, factors influencing rental price determination are reviewed, followed by price determination using three approaches, namely cost-based, income-based, and market-based approaches. The chapter also discusses the investment feasibility analysis for public rental housing, using data obtained from the previous section.

Chapter 6 discusses the findings of Research Phase 2, compiled from the semi-structured interviews that were combined with secondary data and literature review discussion. Initially, investment feasibility analysis of low-cost apartment mixed-income housing sensitivity analysis and four scenarios analysis are discussed. This chapter also analyses affordability in respect to both low-income and moderate-income buyers.

Chapter 7 analyses Research Phase 3, where the feasibility investment model is developed using system dynamics, followed by discussion of the implementation of the model and some modification of the model through scenario analysis. This chapter also evidences the validation of the model by comparing it with the Microsoft Excel results presented in Chapter 6.

Chapter 8 presents the conclusions of the thesis, including list of the research contributions, categorised into the three areas of theoretical contribution, contribution to public housing practice, and contribution to public housing policy. Finally, the chapter identifies the research limitations and provides directions for future research.

Chapter 2: Literature Review

2.1 INTRODUCTION

This chapter examines the low-cost housing problem and current development in public housing policy, particularly in relation to financing. It is divided into six sections. First, the introduction summarises a general literature review. Next, the main housing issues in some countries are discussed, as are identified barriers to housing policies to provide insights into practical perspectives in the research area. Housing policy is examined in Section 2.3, including housing policy related to supply and finance; while previous studies regarding public housing financial models are presented in Section 2.4, including public housing rental price determination and public housing investment analysis. The low-cost housing financial model is presented in Section 2.5. Finally, the gaps in relevant current research are identified in Section 2.6.

Some key references underpinned the entire research project in terms of answering the main research question. In general, the major objective of this study is to contribute to boosting the supply of public housing in relation to policy around public housing project viability and affordability issues. The key reference focus of the research is in relation to the financial dimension of housing projects and the need for low-cost housing to reduce conditions of poverty. Magni and Marchioni (2020) originally argued that investment would happen only if expected returns were competitive in terms of justifying the investment, and that the answer to the question of rehabilitation versus redevelopment would always depend on which action promised the greater profit. Feasibility analysis is still important even if subsidies are required. For this study, the financial model was generated by cash flow analysis, which examined social and technical factors, including the willingness and ability to pay.

A supply of low-cost housing is expected from both the public and the private sector. According to UN Habitat (2015), housing is considered as a key strategy for poverty reduction. Low-cost housing is known as public housing or social housing. However, those term have different definition. Public housing is owned by a central or local government authority. Social housing is built and managed by the public sector, by non-profit organisations, or by a combination of them, with rental scheme, which is aimed to provide affordable housing (Czischke & Bortel, 2018). Public housing is aimed to provide affordable housing; however, every country has different context on the details, terminology, affordability criteria and rules related to ratio affordability and housing stress. This study focuses on public housing; therefore, terminology related to low-cost housing is considered as referring to public housing.

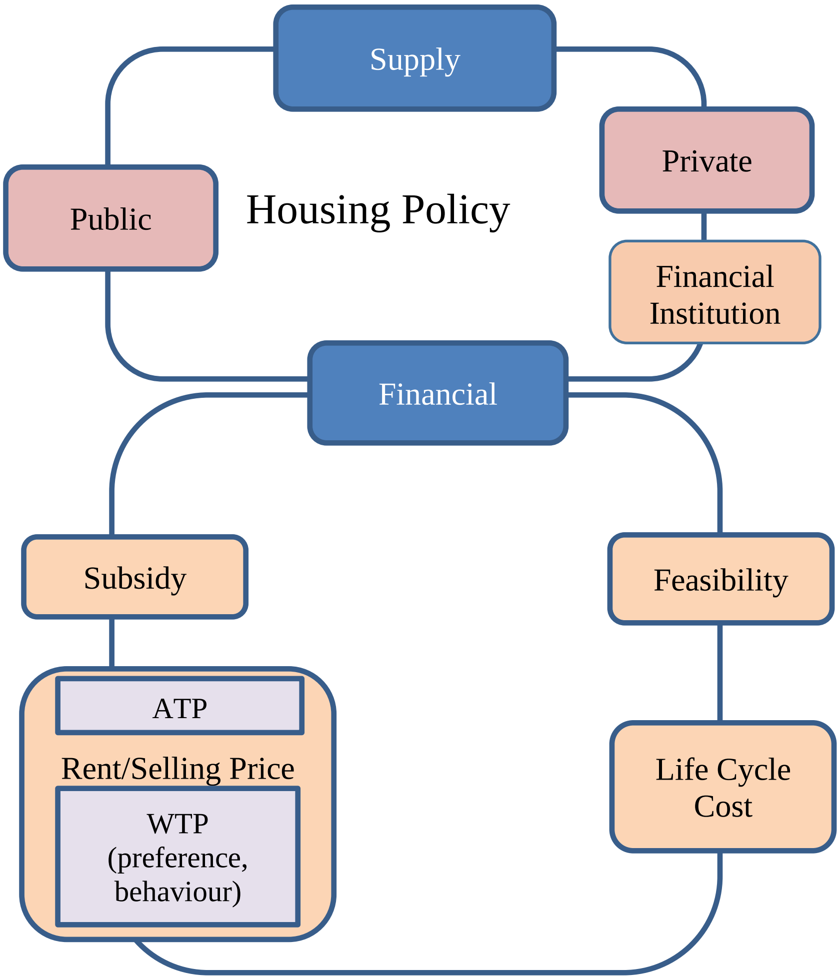

Figure 2.1 Areas of study

Housing policy is arranged to push housing supply based on certain financial arrangements. This research aims to develop a financial model to attract private sector investment in the low-cost housing sector. Involvement and engagement with stakeholders are crucial for the success of any project, and financial analysis should be conducted to verify financial viability based on life cycle cost (LCC) and expenditures such as rent, selling prices, and government subsidies. Important theories related to investment feasibility are discussed, as well as the factors that influence rent and selling prices, such as the ability to pay (ATP) and willingness to pay (WTP) in the rest of this chapter.

2.2 PUBLIC HOUSING TERMINOLOGIES

The research related affordable housing has been growing rapidly over the last decade across Europe, which is followed by variety policies formulated by the government (Czischke & Bortel, 2018). It started from the need for subsidised housing as low-income experiences overburden due to low household income. In Italy, both public housing and social housing are interchangeably as social housing often refers to affordable housing, and they both are categorised as subsidised housing. Local government (municipality) financed public housing (Hansson & Lundgren, 2015) through personal rental housing assistance for tenants and land provision for housing providers.

In England, local authorities allocated social housing based on need. They owned and managed social housing by providing rental housing, affordable home ownership, and shared housing in ownership schemes. Similar to what happen in Italy, that social housing often refers to affordable housing. Therefore, they have same allocation rules related to tenants' eligibility. However, the eligibility criteria for affordable housing are more flexible than the social housing rent, however the upper limit remains similar, that should be no more than 80% of the local market rent (Wilcox & Perry, 2014). Normally, housing associations play important roles in affordable housing provision, however local authorities and private developers are also involved.

Meanwhile, in Poland and Italy, social housing is known as public rental housing. It primarily accommodates low-income communities and those with special needs. Furthermore, social housing is mostly financed by governments (Czischke & Bortel, 2018). There are comprehensive changes on social housing sector in many European countries for several years (Scanlon et al., 2014). Similar to other countries, there has been a constant reduction of public sector funding in terms of social housing capital grants.

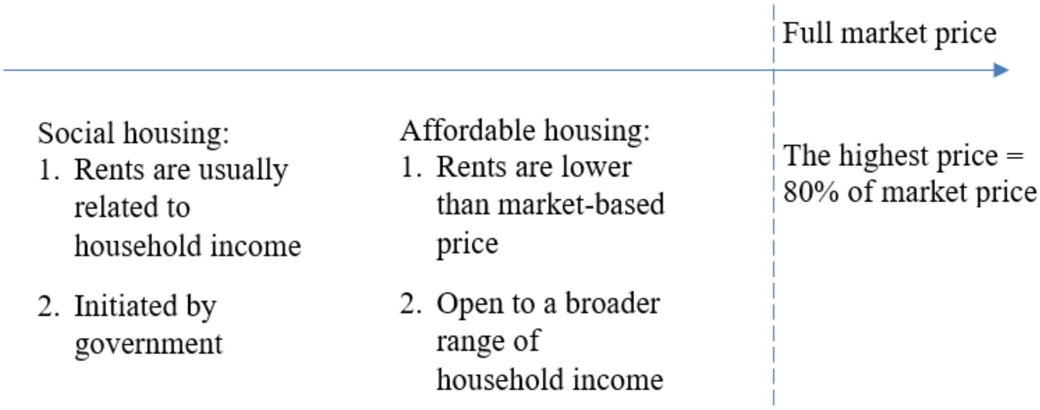

Figure 2.2 Social and affordable housing

Source: adopted from Czischke & Bortel (2018)

The terminology used in this study refers to social housing as the rent price related to household income and government subsidy dominates its implementation. However, as it is provided by the government, it is called ‘public housing’.

2.3 HOUSING ISSUES

Housing represents a basic need for every individual or family; a house being the building that provides shelter from the elements, provides storage of all daily requirements, and creates a communal life among the household (Aribigbola, 2011). Everyone wants to live in a good housing environment at an affordable price; yet, these aspirations are difficult to be achieved by people with low incomes. Major cities offer a lot of important and attractive facilities, and land downtown close to workplaces is very expensive and becoming increasingly scarce (Susilawati & Yakobus, 2010).

In general terms, housing problems are related to issues of demand and supply. Housing supply is essentially subject to limitations of land, state regulation, and territories, which should be in accordance with local planning and approval processes. The issues are extent to lack of coordination between infrastructure planning initiated by the government and housing supply from institutional (Morrison et al., 2012). The housing problem is particularly acute for poor or low-income communities, with a combination of low incomes and high housing costs creating affordability issues, such as lack of effective housing finance systems and difficulty accessing land with secure tenure (Mukhtar et al., 2016).

2.3.1 Low-cost housing problems

In the Korean context, Ha (2018) defined housing needs in several contexts in different terms, such as: (1) suitability (based on dwelling size or design), (2) affordability (based on income), (3) adequacy (based on state of repair), and (4) security of tenure (based on evictions and discrimination). In other contexts, housing needs can be viewed from either the demand or the supply side (Marzouk & Hosny, 2016). High levels of urbanisation and increasing economic growth have significantly influenced the need for additional housing – especially low-cost housing – in many countries (Ganiyu et al., 2017), for instance, in Australia and the UK (Worthington & Higgs, 2013), South Africa (Ganiyu et al., 2017), Indonesia (Manaf et al., 2016), Bangladesh (Chowdhury, 2018), India (Sengupta, 2018), Malaysia (Muhammad & Johar, 2018), and China (Chen, 2018). Many housing studies mentioned above have focused on housing policies, housing supply, housing project financing, housing quality and affordability issues, particularly for low-income, as these aspects are all linked.

Urbanisation is driven by economic, political, or social and cultural factors (Alaghbari et al., 2009). However, urbanisation without economic growth and adequate public infrastructure such as housing results in the urbanisation of poverty and squatter settlements (Brueckner, 2013). These conditions arise in countries where governments are not able to provide an adequate number of affordable houses for migrants. Informal processes of urbanisation result in rural spaces becoming urbanised, meeting housing needs in the cities, through self-help housing, and an increasing number of squatter settlements (Kumar, 2016). A summary of major housing problems in selected countries in Asia and in Australia is presented in Table 2.1.

Table 2.1 demonstrates the low-cost housing problem that reflects the influence of urbanisation on housing in India, China, Korea, Bangladesh, Indonesia, and Malaysia, showing similarities such as the rise of squatter settlements and the generation of shortages of housing supply and affordability.

Table 2.1 Low-cost housing problems in selected countries

No	Countries	Affordability	Squatter settlement	Shortage of housing supply
1	Australia	√		√
2	Bangladesh	√	√	√
3	China	√	√	√
4	Malaysia	√	√	√
5	India	√	√	√
6	Korea	√	√	√
7	Indonesia	√	√	√

Source: summarised from Chiu and Ha (2018); Worthington (2012)

The major housing problem is the need of housing, especially affordable housing as the result of urbanisation and also population growth (Opoku & Olawatayo, 2014), which is a major underlying factor in the increasing demand for housing; and without further supply of dwellings, prices rise for both renting and purchasing homes. This situation fosters housing deficits and increases the number of squatter settlements or slums. As mentioned in the first chapter, UN Habitat (2005) noted that approximately 25% of the world's urban population, which was equivalent to approximately one billion slum dwellers worldwide, will continue to live in illegal settlement. Meanwhile the Asian Development Bank (2011) reported that Asian cities are growing rapidly. As a consequence, the urban area become destination for rural people to live better. The population will be increased by 1.1 billion people who move from rural to urban area, as a result, which means that more than 55% of the population of Asia will move to urban area (UN Habitat, 2015).

Population movement to the cities combines with fewer people per household increasing the demand for more housing, especially in major cities where urbanisation occurs. For example, in Indonesia, the majority of the population live on five large islands and sub-urbanisation in metropolitan areas is typically spreading into development corridors, some of which extend beyond the city's master plan (Prasetyo et al., 2009). While in Malaysia, according to the 2017 census, 76.01 percent of the total population now live in urban areas and cities. There are 19 urban areas in Malaysia, with more than 100,000 people living in them: one urban area (Kuala

Lumpur) has more than 5 million people, while George Town and Johor Bahru are occupied by between 1 million and 5 million people, 500,000 to 1 million people live in other 5 urban area, and 11 urban areas of between 100,000 and 500,000 people. Malaysia and Indonesia face increasing challenges to provide affordable housing for low-income communities. High land and house prices in urban areas in both countries have hindered potential first-time buyers to purchase homes (Bakhtyar et al., 2013). These governments are therefore further accelerating and broadening the accessibility of affordable housing to enable low-income communities to own their own house (Susilawati & Yakobus, 2010). However, a lack of supply of low-income housing creates an increasing gap between housing market supply and housing backlog demand for affordable houses.

India currently suffers from a severe housing deficit, which has reached 18.8 million units due to the exclusion of the majority of the urban poor from the housing market (Sengupta et al., 2018). This deficit is generated by the housing needs of the economically weaker sections and low income households (Sukumar, 2001), and accounts for 95% of overall housing needs in India. Bangladesh faces similar challenges (Chowdhury, 2018). Overall, these two countries are contending with a significant shortage of housing supply and the affordability problem of middle – and lower-middle – income groups, caused by the massive and uncontrolled growth of the urban population and urban areas in Bangladesh and the inaccessibility to housing finance in India (Sengupta, 2018). In both contexts, the role of government is critical in regulating both, the demand and supply side of property markets. Yates (2008) claimed that housing demand is closely related to affordability, and in addressing the issue of affordability, it is important to consider all three elements of the equation: demand, supply, and government.

China also has a shortage of housing supply caused by rapid urbanisation and lack of public housing provision for low-income communities. This deficit in supply is posing increasingly severe challenges for the sustainability of urbanisation, where there is a particular constraint related to housing market development in the urbanisation context: the *hukou* system, an urban registration system that does not allow migrants in major cities to live alongside local residents. They generally live in the sub-urban area. This policy worsen Chinese urban housing market as migrants' have difficulties to access urban housing market (Chen, 2018).

Ha (2018) found that Korea is also experiencing housing problems related to housing deficits and poor-quality housing. Similar to other countries, housing shortages – particularly in urban areas – are generated by economic growth, urbanisation, and increasing housing prices. Approximately 1,030,000 existing households (5.4% of total households) in Korea do not conform to minimum housing standards that relate to tenure security, affordability, adequacy, accessibility, proximity to services, availability of infrastructure, and cultural adequacy (Ha, 2010). The minimum standard reflects energy and fuel poverty, lack of access to water and sanitation and air circulation, poor construction, and small space (Ha, 2008).

Yap (2016) examined low-income housing policies and practices in East, South and South-East Asia relating to housing supply for low-income groups. The study reported on many measures that should be adopted to increase low-cost housing supply for a wide range of tenants, involving low-income rental types and designs. In general, the shortage of supply is challenged by high land and construction prices, lack of private investment, lack of coordination between government institutions or affiliations responsible for housing development (Ganiyu et al., 2017), and non-preferences for vertical expansion apartments. Therefore, housing policy is designed to address these issues and to achieve the appropriate balance between housing demand and housing stock.

2.3.2 Affordability

Affordability issue is one of critical factors in developing low-cost housing. Majority households do trade off the location and their preference housing due to affordability problem. The deterioration of housing affordability has been widely discussed in several studies, conducted both in developed or developing countries.

Malaysia is a representative of developing country. The affordability issue focused on housing price. Therefore, residential property overhang is happened in Malaysia (Yip, 2020). The property overhang in Malaysia is triggered by mismatching between home buyers' preference and types of houses based on their household income. For example, the low-income households with income between RM900 and RM2,000 perceived the affordable housing is condominiums; however, the affordable range is not aligned with the mean housing price. Many low-cost properties are located in remote areas due to the cheaper land cost.

Affordability is defined as an "acceptable" ratio between household income and expenditure on housing costs (Worthington, 2012). Yap and Ng (2018) argued that affordability is not only about the ability to own a home, but also about accessibility to bank loans due to stricter lending guidelines, the most significant factor influencing affordability is income.

One of the commonly used approaches to measure affordability is income ratio approach, which the ratio of housing expenditure to income does not exceed a specified standard (Galster & Lee, 2021). Different countries have different ratios in identifying the affordability Much Australian research has applied the 30/40 rule, which means housing costs should not exceed 30% of the household income. (Cai & Lu, 2015). While in the US, 25%, 30%, 40%, and 50% affordability thresholds have all been used at different times (Cai & Lu, 2015). In Canada, a housing affordability problem is perceived when a household pays more than 30% of their household income for all core housing needs or when their income is insufficient to rent a suitable and adequate housing (Gabriel et al., 2005).

The conventional measurement includes methods that commonly used by policymakers and researchers to measure housing affordability. It includes the median multiple (MM) ratio, the expenditure-to-income ratio and the residual income approach (Rangel et al., 2019). Current financial model employed median or average prices. This result in housing prices, which is too high for many households, especially those whose income is on the lower side of the income range (Yip, 2020).

The housing affordability measurement should consider types of housing affordability. Households with short-term affordability problems are those that may have sufficient lifetime income for a house purchase but have short-term financing issues, while households with long-term affordability problems are those that have insufficient lifetime incomes to pay for a house. These two problems require certain treatment, including affordability measurement, which lead to different policy approaches.

Household income should be categorised using percentile range to examine the affordability based on short or long-run affordability. This is very beneficial to provide suitable types of residential property (Lee, 2014). Lee (2014) and Rangel et al. (2019) conducted the study related to long and short run affordability in Malaysia, which has an overhang issue. The financial model for long-run affordability was arranged from the modified median multiple approach to measure the affordability to access different type of properties. Different investment strategies should be adopted for various types of residential property.

Another consideration to measure affordability includes the disparity of socio-economic and demographic across metropolitan cities. Bangura and Lee (2020) discussed the housing submarket in Greater Sydney. This study found that households tend to initially buy properties in less desirable areas but trade up to more desirable areas as their equity improves. It means that low-priced submarket would be more dynamic and influenced other markets. Bangura and Lee (2021) employed system generalised method of moments (GMM) and a panel error correction model (ECM) to their study in greater Sydney as there are large number of influencing factors which determine the homeownership affordability.

The definition of affordable housing used in this study is, a house in which the ability to own or to rent is less than 30% of the household's income (Wood et al., 2014; Williamson & Anne, 2011). Housing cost is the amount of money spent for accommodation or dwelling (Dewita et al., 2020). The most significant factor influencing affordability is household income. The income-based approach is one method used to determine rent price. It uses household income data, which is recognised as a tenant's ability to pay (Worthington, 2012). Then, it is used to evaluate housing affordability using the housing cost to household income ratio approach.

2.3.3 Lack of low-cost housing supply

Housing provision programs initiated by the government often face significant challenges. In general, two major factors affect affordable housing provision: demand side and supply side. From the demand side, household income (Othman & Abdellatif, 2011) dominates the cause, while from the supply side availability of land, cost of housing (Othman & Abdellatif, 2011) and legal aspects are the main factors (Alaghbari et al., 2009). Household income is a critical factor affecting housing affordability. The ratio of household income and housing cost is commonly used to determine the affordability. It should not be no more than 30% of the family income.

Cost of housing are associated with financing issues, including the cost of building, land costs, and the supply of labour and trades (Assaf et al., 2010). Lack of capital and availability of credit are also associated factors. A study conducted in the US noted the need for a "better financing structure" to support affordable housing, as in the context of affordable housing development, especially in the urban area, the housing developers faced difficulty in seeking the appropriate location at low price. Therefore, it needs such an incentives for developers to build middle-income housing projects (Blumenthal et al., 2016). Governments can encourage housing developers to build low-cost homes through formal real estate development schemes. However, due to the limitation of funds and expected profits will lead to poor quality of low-cost housing (Mohit et al., 2010). Therefore, low-cost housing becomes synonymous with low quality housing. In the high-rise apartment context, the construction costs of low-cost and commercial apartments are similar, but unfortunately public housing is not sold at the same price as commercial apartments, which is why the private sector tends to build and sell commercial and luxury apartments – to achieve higher profits (Susilawati & Yakobus, 2010).

Alaghbari et al. (2009) identified additional factors that influence housing supply, including economic conditions and administrative and legal factors. Their study revealed that economic conditions such as lack of capital, housing costs, household incomes, projects’ feasibility, and land availability all contribute to the shortage of housing supply. In addition, other housing delivery problem were shortage of end-user finance and low private sector financial involvement, land development and housing construction issues (Alaghbari et al., 2012).

Both studies referenced above identified legal issues as one of the impediments to affordable housing provision. These involve issues such as a lack of major policy changes and limited availability of land in each jurisdiction and limited developable land, which drives the need to build with greater density to meet population growth; the housing shortage problem being aggravated by the lack of government planning to meet increasing demands. The administrative element of the problem is generated by lack of organisation and synchronisation, such as expertise in property management and development, organisational capacity, and development financing, while the legal factor is caused by a lack of legalisation of the housing issue (Alaghbari et al., 2009).

There are some legal issues associated with building regulations that directly influence the construction cost and the amount of land allocated to housing, that in turn, hinder the housing provision (Patel et al., 2018). Comprehensive analysis on regulatory impact on building intensity or space consumption are needed when municipal and development authorities require higher standards as well as considering household incomes and affordability in relation to low-income tenants (Yi et al., 2017). On the other hand, governments cap selling prices, which poses challenges for the development of low-cost apartments, construction costs of a unit apartment being more expensive than landed low-cost housing (Susilawati & Yakobus, 2010), land prices being high and the requirement to follow building regulations. Figure 2.3 summarises the factors constituting barriers to housing provision.

Land is a major component of the housing development process. However, government and housing developer often meet the problem related land provision. Accessibility and security of land tenure that is well-located, suitable for development, and affordable remaining a key obstacle to housing delivery (Gopalan & Venkataraman, 2015). A study conducted by Firman (2004) also discussed that urban land development problem has extended to management issue including poorly coordinated among stakeholders who have responsibility for land management, an inflexible land regulatory framework, inappropriate land taxation, lack of secure land tenure, and lack of the data and information related urban land (Firman, 2004). Assistance and action are required in relation to these issues if private sector participation is to be facilitated.

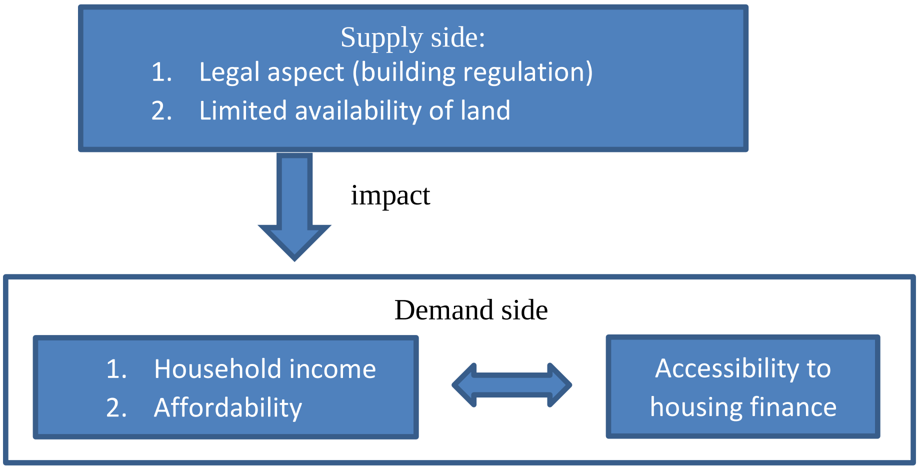

Figure 2.3 Barriers to low-cost housing provision

Source: adopted from Alaghbari, et al., 2009; Alaghbari et al., 2012; Othman & Abdellatif, 2011.

As previously noted, financial issues constitute a major impediment to low-cost housing supply in relation to both government and the private sector. Developers tend to focus on the issue of financial feasibility and on government support in the form of subsidies or incentives to ensure the financial viability of low-income housing. Financial analysis identifies risk in relation to returns on investment (Magni &

Marchioni, 2020). A study in Australia by Milligan et al. (2013) clearly identified risk return profiles and liquidity issues, as well as questions around the level and certainty of government support as barriers to potential private financiers of affordable housing.

In the effort to fulfil the need for housing in the urban area, both government and private housing developers have a role to play in providing affordable housing to lower- and medium-income families. However, a recent study in South Africa documented shortage of private housing developers from the low-income housing investment due to economic, legal and administrative challenges (Ganiyu et al., 2017); while other studies have noted a lack of government strategies to resolve housing supply (Wang et al., 2011), such as ineffective government subsidies allocation and the inability of government mortgage finance institutions to cope financial and market risks. These issues all aggravate the problems associated with housing supply in relation to government action.

There is an urgent need to strengthen financial, institutional, and economic approaches to encourage private sector involvement to contribute to housing supply program. Some studies suggest land and housing policy reforms to accelerate affordable housing provision. Furthermore, that effort should supported by financial support or incentive as finance is also considered as an issue of housing development (Wapwera et al., 2011). Ram and Needham (2016) suggested reducing development and utilities costs through VAT exemptions or fee waivers could help developer in providing affordable housing India; while in the Chinese context, Niu (2008) noted that incentives in terms of reduction in administrative fees and tax deduction had been implemented to support affordable housing programs.

Low-cost housing provision should be supported by governments, private developers, financial institutions, and communities. As public housing is mainly government's domain, the government is therefore being challenged to regulate housing policy in order to cope all issues on low-cost housing supply, to respond to the rise in demand, and to address the issue of affordability. While some previous studies have discussed the need for government support in low-cost housing development, there has been very little empirical research attention paid to quantifying the effect of government support in project feasibility.

2.4 HOUSING POLICIES IN SELECTED COUNTRIES

In response to housing needs and shortages in low-cost housing supply, governments in some countries have attempted to initiate housing policies that address issues of supply and finance (Chen, 2018). Policy approaches, or forms of government intervention in the housing sector, depend on political and economic ideologies, the availability of resources, modes of governance and specific policy objectives. Housing policy takes various forms, such as regulation, direct provision, financing or subsidising, guidance, and accountability (Clapham, 2018).

In general, housing policy is planned systematically to support government programs. Clapham (2018) pointed out that housing supply is always influenced by planning policy, regulatory environments, and fiscal policy. Some studies have identified, and summarised common steps taken in the process of formulating housing policy.

Since land is the key factor in housing provision, land supply becomes the first step in implementing policy to facilitate development. This can be achieved in many ways, including through regulation on land zoning and releasing government-owned land within the urban footprint (van den Nouwelant et al., 2015). The second necessary step is that of barrier identification to determine constraints and limitations around housing development, such as land area needed to influence development costs and housing prices (Oikarinen, 2014).

Third, Ogu and Ogbuozobe (2001) suggested implementing a planning approval process in relation to preserving existing affordable housing (or offsetting its loss). In case of existing housing relocation, the affordable housing project should consider social impact assessment and relocate the existing tenants to better neighbourhood as well as provide financial assistance of new housing construction.

Housing policy will never be implemented effectively without financial support (Sidawi, 2014). One form of financial support is that of incentives for new affordable housing development for developers and home buyer, such as planning incentives, concessions, or application fees that can make investment of affordable housing development become more competitive. These measures are explained in more detail in sub-chapter sections focused on the issue of housing shortage policy and related financial issues. Finally, it is important that governments determine the proportions of a development as related to requirements for affordable housing, such as 'inclusionary zoning' or 'value capture' planning controls.

2.4.1 Low-cost housing supply

As previously noted, affordable housing provision in major cities is an ongoing and increasing challenge for governments in relation to low-cost and decent housing provision expected to be fulfilled by the public (Milligan et al., 2013). While governments encourage the private sector to produce low-income housing at affordable prices in various ways, in many countries private developers currently construct only a small number of low-cost housing units, tending rather to build high-end residential properties.

Affordable housing for low-income households faces two main challenges. First, there are limited affordable units to meet housing needs. Second, affordable housing for low-income households tends to be concentrated in neighbourhoods with economically declining conditions and minimum housing standards. This second factor is influenced by high land prices, scarcity of land, scarcity of marketable land parcels, legal aspects of land acquisition and development, rising costs and regulatory constraints. Then, due to fund limitations, the Indonesian government, for example, also builds a limited amount of public housing, with the rest of housing needs being met by communities and individuals building informal or self-help housing (Susilawati, 2018; Wapwera et al., 2011). Therefore, the housing backlog has not been solved up to now and housing needs are continuing to increase. The only solution to the crisis is to increase supply.

The nature and character of low-cost housing varies across countries and contexts. There are two types of low-cost housing: houses and high/medium-rise apartments, also termed public housing (Rahadi et al., 2015). There are also two types of public housing schemes: ownership and rental. In Europe and Australia, as well as in public housing contexts throughout Asia, low-cost housing is also known as social housing, though there are some distinctions between terms. The institution in charge differs between social and public housing (Wilcox & Perry, 2014). Social housing is sponsored by formal or informal institutions (Scanlon et al., 2014), while public housing is funded by the government. Social housing is dedicated to the households with limited financial capability (Hansson & Lundgren, 2018) – a descriptor that could also define public housing. Across terminologies, low-cost housing shares the requirement of a home that is affordable, adequate, and provides good shelter.

As explained in Section 2.2, social housing is a low-cost housing provision type that is very popular in Europe (Housing Europe, 2012). It can be defined as housing for rent or progression to ownership for households experiencing difficulties in finding housing, or housing for "low-income households", which means "households with limited financial resources" (Hansson & Lundgren, 2018). Particular groups of households with limited financial capability refers to limited availability of funds and in the context of macro and socio-economic conditions. Boelhouwer and Priemus (2014) identified a number of social housing tenures: owner-occupied housing, commercially rented housing, social-rented housing, and cooperative housing.

Most social housing providers are public bodies and non-profit groups. However, there is still an opportunity for other providers working with different incentives. In order to provide housing to tenants or home buyers that cannot afford available housing options, the basic principle of social housing system is that the selling price or rent price should be below-market price. The system can be provided by housing associations categorised as not-for-profit organisations in affordable rental housing sector (Housing Europe, 2012). For example, in the Netherlands, the government housing sector contributes about 35% of all dwellings nationally (2002), making it the largest social housing sector in Western Europe (Susilawati & Armitage, 2006). In that country, the government and not-for-profit organisations have different role in their attempt to assist low-income people to access the affordable housing. The mission of not-for-profit organisations is to provide the affordable housing for low-income people, while governments guarantee funds to secure private finance and to minimise financial risk for private financial institutions (Housing Europe, 2012).

In Europe, public entities subsidised housing to support housing finance in various way. Subsidy could be defined as allocating funds as part of the cost of something, to implement such program (Scanlon et al., 2014). The subsidy can also be provided by the state or by private entities to resolve the housing problem when the targeted home buyer has limited financial resources. The debt guarantees, advantageous loans, investment contributions, and below-market priced land are the most common subsidies (Scanlon et al., 2014). In countries where inclusionary zoning is applied, some private developers do not include their potential profit to fund social housing.

In Australia, the low-income community is supported by the government through social or affordable housing. Social housing is mainly subsidised by the government, and rent is determined by tenant incomes, which is set at 25 or 30% of household income (Powell et al., 2019). Social housing provision is not limited to public sector's responsibilities, as community or not-for-profit housing organisations has contributed to provide social housing. Affordable housing in Australia commonly includes mixed tenure that consists of ownership or rental housing. Rent in affordable housing is market-related, generally being set at 75 or 80% of market rentals (Yates, 2013).

Housing policy is commonly determined by governments at a national level. However, implementation in each state in Australia adjusts to housing needs and conditions. Queensland, New South Wales, and South Australia each have different approaches to planning for affordable housing (van den Nouwelant et al., 2015). In Queensland, through the Urban Land Development Authority, manage 2 main affordable housing development projects, which consists of targeted new dwellings, both in urban renewal and new green field sites scheme, and low-price affordable housing (for sale or rent), which is below the affordability criteria. The South Australian Government has amended the regulation to allocate 15% of new development dwellings to be set as affordable rental housing or ownership, provided for eligible households. This development is supported by land rezoned policy for residential or higher density use and the government's asset land utilisation. Unlike the other states, the New South Wales Government has the Affordable Rental Housing State Environmental Planning Policy, which involves both the government and non-government sectors in the housing sector. This program also allows low-rise and high-rise apartments to be developed in higher density areas (van den Nouwelant et al., 2015).

Australian government has run some housing policies, such as previous National Rental Affordability Schemes (NRAS) and current Built-to-rent scheme in order to boost the supply of new and affordable rental housing. The NRAS policy aims to assist housing providers by providing an annual financial incentive for up to ten years when they are successful to provide a residential at least 20 per cent below market rates.

While build-to-rent, referred as multi-family housing to provide steady income for investors and security of tenure, but in flexible, long-term lease and in the form of discounted market rent (Newell et al., 2015).

Another source of housing supply initiated by governments is that of public housing provided by the government (Chen et al., 2014), defined by the United Nations Economic Commission for Europe (2003) as “housing where the access is controlled by the existence of allocation rules favouring households that have difficulties in finding accommodation in the market” (p. 11). From the United Nations Economic Commission for Europe (2003) perspective it can be concluded that all types of housing provided by governments, either for sale or rent, is defined as public housing.

Public housing is defined variously from country to country. This research project examines the implementation of public housing programs in India, China, Malaysia, and Indonesia as being representative of some countries in Asia, with Australia representing developed countries. The gross domestic product (GDP) in India, China, Indonesia, and Malaysia is quite similar, around 5-7%, while the GDP in Singapore, Hong Kong, Korea, and Australia is lower, averaging around 3%. As noted previously, the influence of urbanisation on housing in India, China, Indonesia, and Malaysia shows similarities, generating squatter settlements, shortages in housing supply, and issues around affordability. With these shared population characteristics government-initiated public housing provision programs are seen as comparable. Table 2.2 presents policies relating to low-cost housing supply in India, Indonesia, Malaysia, and China based on key features. The types of public housing vary across these countries, but all focus on low-income groups, particularly first home buyers. All countries promote housing ownership, whereas rental schemes have only been initiated by the Indonesian and Chinese Governments.

Public housing varies in tenure context. In general, housing tenure is categorised as fully owned, mortgaged, privately rented, rented in social housing (housing associations or landlords), and rented from local authorities. Public rental housing is owned by government body or a non-profit organisation, such as a housing association. However, the landlord of rental housing may be a private individual (Czischke & Bortel, 2018).

Table 2.2 Housing policies in India, Malaysia, China, and Indonesia

	India	Malaysia	China	Indonesia
Target	Economically weaker sections and low-income group	Low-income group or subsidised home buyer (M40)	Migrant, new worker, low-income group	Low-income group
Program	PAY RAY JNNURM	PR1MA RUMAWIP PPA1M MFHS	CRH PRH ECH CPH SRH	KIP Community-based housing development Self-help housing assistance scheme Simple and very simple house Low-cost rental and ownership apartment
Finance	Government and national bank	Government and panel bank, so that the buyer must pay 0% down payment	State and municipal government	Government and national bank
Stakeholders Involved	Public, bank, private	Public, bank, Employees Provident Fund (EPF), local banks	Public, bank, private sector	Local, provincial and ministry government, bank, private, Perumnas
Land provider	Public and private	State Government	Government, some land sold to developers	Government
Progress and Obstacles	Lack of coordination between central and local government Lack of participation from local government	The price of property is still high Most low-income communities suffer from loan rejections An increase of overhang high-price housing units	Local government initiated to classify the tenant Rent prices are still high	The price of property is still high, lack of private developer investment, development permit process, land acquisition, misdirected subsidy
Tenure	Ownership	Ownership and rent (if permitted)	40% rent, 60% ownership	Rent, ownership

source: Chiu et al., 2018; Sengupta, 2018; Susilawati, 2018; Aziz et al., 2018

Governments in some countries have initiated rent tenure from government or public housing in various ways, such as cheap rental housing and public rental housing (PRH) in China, and public housing in Indonesia. The housing program was initiated to provide temporary and interim residence for migrants, new workers, and house-poor households (Li & Wu, 2006). In China, approximately 60% of public housing provision is in the form of subsidised owner-occupied housing, with 40% being rentals. Each city in China has own the substantial eligibility criteria for PRH (Chen, 2018). However, local governments prefer to allocate PRH as subsidised benefits to specific target tenants, consists of local civil servants or high level industrial labours (Wang & Murie, 2011). In China, there is a much higher level of informal residential among rural migrant workers compared with urban locals and urban migrants, as there is an opportunity to get a job in rural area or urban village (Bi et al., 2019). In Indonesia, in addition to public housing, rental, and ownership, additional schemes to increase housing supply are initiated by governments, such as formal and informal landed (self-help) housing, direct public provision from Perumnas (National Housing and Urban Corporation), housing improvement policies, and mixed-income housing (Susilawati, 2018).

In the context of subsidised housing in China, public housing can also be in the form of economically comfortable housing (ECH), capped-price housing (CPH), and shanty town renovation housing (SRH). The housings in these schemes are all built and delivered by property developers. Local housing bureau has the responsibility to control the program. Those affordable housing scheme sold the affordable housing unit at below-market prices to eligible households; they are lowest-income, low-middle-income, middle-income, and upper-middle-income, respectively. SRH is allocated for relocated households as a result of urban renovation projects, while ECH is homeownership scheme, dedicated to low-middle income households. For the ECH scheme, land is provided to housing developers and the sale price is determined based on construction costs, with a very small profit margin (3-4%). Meanwhile, in CPH scheme, land is acquired by land acquisition mechanism. For this reason, the price could be determined slightly higher than ECH, at around 70–75% of the typical and nearby housing market price (Chen, 2018).

Other government initiatives to support home ownership are commonly grouped under the term of home buyer assistance programs. As noted previously, the scheme varies from local government to local government. For example, in Malaysia there are the Perumahan Rakyat 1 Malaysia (PR1MA), Rumah Selangorku, Rumah Wilayah Persekutuan (RUMAWIP), Perumahan Penjawat Awam 1, and My First Home Scheme. All of these are schemes are dedicated to low- and middle-income families, with the packages including financing up to 100% from PR1MA panel banks without any requirement for a down payment. Rumah Selangorku, initiated by the state government of Selangor, is also targeted at low-income households. Similar to PR1MA and Rumah Selangorku, RUMAWIP requires that the applicant has not previously owned a house, and the dwelling is only for owner occupation. It is targeted at applicants with incomes of less than RM 10,000 – RM 15,000/month (Aziz et al., 2018). There is a system of occupancy segmentation, the type of house being adjusted to the occupants and their income, as described in Table 2.3.

Table 2.3 Public housing in Malaysia

Type of House	**Area (sq.ft)**	**Age of applicants**	**Income of applicants**
A	700	18 years and above	< RM 3000/month
B	750	25 years and above	RM 3001 – 10000/month
C	800 – 1080	25 years and above	RM 3001 – 10000/month
D	1000 – 1200	25 years and above	RM 3001 – 10000/month

Source: Aziz et al., 2018

Public rental housing in Indonesia consists of four/five-floor apartment buildings of 48-64 units constructed as pre-cast structures to shorten construction time (Kisnarini, 2015). The unit area is 18, 21 or 24 sq.m. Existing public rental housing (rusunawa) is constructed by the Ministry of Public Works and Public Housing, with the land always provided by the institution proposing the public housing project (Indonesian Ministry of Public Works and Public Housing, 2014). The local government/institution holds the authority for managing these public housing projects, including selecting tenants, operation, and maintenance activities, calculating rent price and managing building cash flow (Rachmawati et al., 2015). Low-cost apartments (rusunami) are built by housing developers and non-government organisations in the housing field, with 155,000 units of rusunami planned for the period of 2014-2019.

Housing policy is not only implemented in the context of direct provision, but can also be in situ slum re-development, as in the Pradhanmantri Awas Yojana (PAY) and the Rajiv Awas Yojana (Badasyan) programs in India, and affordable housing through credit linked subsidies, private involvement in low-cost housing programs, and subsidies for beneficiary-led individual house construction or enhancement and self-help housing in Indonesia (Susilawati, 2018). These schemes include grants and subsidies as major constraints related to housing finance (Sandhu, 2013). In these contexts, infrastructure for housing, such as water supply, roads, sanitation, and transportation in urban areas (Gopalan & Venkataraman, 2015), is taken into account by housing policy.

All housing policies initiated by governments at national level needs comprehensive support from local government, as noted in relation to India, when the Jawaharlal Nehru National Urban Renewal Mission was established to encourage local government by transforming urban governance and increasing budgets to cities. Increasing funding will not necessarily improve policy if the local government is not empowered to execute the policy (Sengupta, 2018). These factors related to control have inhibited participation from the states and slowed down progress, resulting in poor performance: only 26% of targeted housing has been achieved. Unfortunately, unless targets are fully and immediately reflected in states' commitments to prepare plans of action, programs will fail to progress to the next level. Most states have expressed reluctance to comply with mandatory provisions for accessing central funds under the scheme and have opted out.

Another challenge relates to the need for housing policy to determine the most suitable targets in order to avoid misdirected subsidies or aims. The Malaysian Government has classified the opportunity to buy/rent the house in certain location based on home buyer or tenants' income (pricing tier system); for example, the five storeys apartment or more storeys in cities or town centres could be owner or rented by people with an income of RM 1200-1500. In contrast, people with an income of RM 750-1000 are not allowed to buy/rent a house/apartment in a city (Goh & Yahaya, 2011). The Malaysian Government has also implemented a cross-subsidising mechanism as one approach to engaging the private sector in housing provision programs or inclusionary zoning. This strategy enables the private sector to use cross-subsidies from higher-cost units to low-cost units (Malpezzi & Mayo, 1997). However, the private developer is required to share agreed returns with the public institution.

Housing policy in various countries demonstrates that most countries focus on facilitating home ownership programs for low-income and middle-income groups. Housing programs vary across different countries due to the following considerations:

- politics;
- the level of housing backlogs;
- the aims of government programs;
- government capacity;
- the targeted tenants;
- the maximum income of low-income communities;
- the support and coordination between ministry and local government; and
- the involvement of private developers or private sector.

In both China and Malaysia, the segmentation of tenants is clearly defined, with the aim of avoiding low-cost housing not being occupied by low-income communities. Government subsidies can be allocated to this kind of housing. Middle-income communities must pay higher prices than low-income communities; otherwise, there will be misdirection of government subsidies as well as misdirected focus and targets (Aziz et al., 2018; Chen, 2018). Discussion in the literature of low-cost public housing is still relatively limited. In overall terms there is an understanding that the problem of meeting housing needs can be effectively solved by solving the land issue limitation.

Land is crucial. Housing policy cannot be implemented if land is not provided, flexible regulations adopted, and housing finance made available that fits the circumstances of the low-income communities (Hu & Qian, 2017). Result from several studies, such as Sengupta et al. (2018), Ha (2010), and Yap (2016) clearly reveal that lack of land is the major obstacle to housing provision. There is a need for government intervention to ensure that low-income communities have access to urban land. Sengupta et al. (2018) argued that low-cost housing should be provided by governments as a commodified asset; however, other studies have asserted that the private sector has a role to play in low-cost housing investment if government supports the viability of financial conditions (e.g. Yap, 2018, Trangkanont & Charoenngam, 2014). Currently, in Indonesia, only a small amount of low-cost landed housing was constructed by private developers, with governments building a limited amount of public housing and the rest of the community building informal housing, some of which is not legally permitted (Indonesian Ministry of Public Works and Public Housing, 2019).

Finally, housing finance policy is important to ensure that housing products are affordable, and that low-income people can access housing through innovative financing solutions. The housing problems of low-income urban populations cannot be solved unless accessibility to housing finance is achieved. To reach low-income groups, housing finance system must be adapted to the circumstances of the poor (Yap, 2016). Many different schemes can facilitate the implementation of housing finance policy, such as subsidised housing improvement programs, grants, or loans that will differ between low and middle-income groups, and government support for the viability of financial conditions can be in the form of providing guarantees and subsidies. Incentive strategies and supporting the role of guarantee funds institutions should be optimised to attract greater private investment to boost the public housing supply (Rachmawati et al., 2018a). However, discussion in relation to government support is still limited to considerations of how governments can promote home ownership in low-income communities. There is a need for further discussion of government subsidies for public housing construction, operation, and maintenance.

2.4.2 Housing policies related to finance

Due to the high value and cost of construction and property, majority people cannot afford to buy a house without financial support (Warnock & Warnock, 2008). Homeownership is a concept that relates with some attached issues, such as limited resource and financial barriers. Until now, government subsidy has been the common solution for low-income community, even though the effect to monthly payment is not significant. Therefore, it needs more suitable scheme of the government subsidies to enable low-income community for homeownership.

Financial support from the government is commonly arranged into housing finance systems. King (2009) discussed the housing finance system managed by public and private institutions to eligible home buyer, and to organisations that deliver large housing projects to the greatest extent possible, in order to address the problem of insufficient housing funds.

Housing finance policy varies across countries. Most European governments try to ensure their citizens have decent living conditions through four means, which are not necessarily sequential stages. The first consists of a wide range of strategies to involve governments directly in increasing housing supply, as during the period following the second world war (Stephens & Whitehead, 2014). In relation to poor-quality housing, financial policy emphasises renovation and improvement of existing housing, two methods carried out via government funding.

Two other methods involve policies regarding accessibility and affordability of home ownership, particularly for low-income communities; two approaches relating to transition and affordability concerns (Gibb & Whitehead, 2007). Involvement of the wider financial market is required to implement these methods, as is that of private resources. This approach involves the potential to classify targeted tenants of all tenants and from supply to demand-based subsidies, with some element of private financing of housing investment and ownership.

Housing finance policies have been developed to include new methods. Taxation policies have changed to involve the removal of tax relief on mortgage interest, which is an effective strategy to reduce public expenditure without causing significant adverse effects on the housing market. Social housing finance has also been restructured to include mixed funding, which results in increasing housing rents; but government grants provide incentives to foster the implementation of social housing funding (Hulse & Yates, 2017).

Affordability continues to be a key issue related to housing finance, as low-income communities have difficulty paying housing costs from their own funds or in accessing housing finance systems. Gibb and Whitehead (2007) concluded that the main sources of housing finance are an individual household's own resources, borrowing from others, and contributions from others, mainly through government taxation and subsidies. Similarly to the previous study, Gülter and Basti (2014) categorised sources of housing finance into four types: the direct route, the contractual route, the deposit finance route, and the mortgage bank route. Borrowing from others or friends is the direct route system used by individuals who have financial limitation to purchase a house (Warnock & Warnock, 2008). The second source, the contractual route, involves depositors investing their funds in a specialised agency over a period of several years. The mortgage bank route is hypothec-based, which requires a hypothec on the real estate to secure repayment of the housing loan. The benefit of hypothec-based system, which differs according to the economic and social status of the different countries, is enable long-term housing loan with fixed or floating fixed interest rate housing loans to homebuyers (Warnock & Warnock, 2008).

These systems cannot be applied to all countries, as each has different economic characteristics. Furthermore, sources of housing funding may differ between the general housing sector and housing for low-income communities (Leece, 2004), as low-income groups have difficulty accessing formal finance systems. Some developing countries apply non-institutional structures for housing finance systems, which is traditionally based, through personal savings, support in terms of loans from extended families or relatives, or credit from certain financial institution through banks, insurance companies and pension funds (King, 2009), as financial intermediaries are unavailable (Adedeji & Olotuah, 2012). Meanwhile, developed countries have well-structured housing finance sectors, private-sector institutions and capital market instruments could be built (Gülter & Basti, 2014).

Housing finance for low-cost housing involves added complexity because central governments, local governments, and private institutions, who are the main stakeholders in housing projects, must consider the home buyer or home renter’s ability to pay. Public institutions that do not have sufficient resources for urban renewal projects mostly apply the revenue sharing model, co-operating with domestic or international private institution in housing or non-housing sector. The model is known as the public private partnership (PPP) model, private participation being recognised as one solution to reducing poverty through low-cost housing provision (Kavishe et al., 2017). In most cases, public sector has limited ability to finance the infrastructure investment cost. Therefore, private sector contributes to bridging financing gaps by financing this cost. Another private sector’s role is improving overall sector efficiency, which in turn can reduce costs and financial needs. Due to private sector’s financial ability, they can improve the sector's creditworthiness, which therefore enable to attract financing (Chileshe et al., 2020).

The PPP model, which aimed to finance infrastructure project was first developed in England and the USA through co-operation between public sector and private entities (Ibem, 2011). Over two decades, the PPP has been applied to housing projects in some countries, whereby private and public sectors jointly finance, own, and operate housing projects. Most governments in the developing world encourage the implementation of PPP to deliver low-cost housing, by witnessing some form of

PPP schemes in the housing and urban infrastructure investment (Trangkanont & Charoenngam, 2014). Project costs, risks, revenue, and profits are shared at agreed-on rates between both sectors. PPP has been considered as risk could be shared to certain entities best able to manage, according to predetermined contractual provisions. For instance, the public sector typically contributes significant funds to a project, which allows the public authority to manage over the planning and development stages while making use of the private sector's resources and expertise in those stages.

Research into the importance of private sector involvement in providing housing for low-income people has been conducted in different countries. For example, in Australia, Susilawati and Armitage (2004) revealed that involvement of a private partner is effective in affordable housing programs with some changes and adjustments, and with a comprehensive approach to policy, as the private sector needs to perceive potential benefits and incentives to overcome the lower cash flow return. Trangkanont and Charoenngam (2014) investigated factors that attract the private sector to participate in low-cost housing program in Thailand, and similar analyses have been made in the Chinese context (Liu et al., 2014) and Ghana (Ebenezer et al., 2016). In both contexts the need for policy and law regarding program financing cost payments was established. Rachmawati et al. (2018a) reported on a public housing study in Indonesia that investigated the government's concerns about site availability, public decision-making processes, and the need to form effective partnerships, to establish the ability of the private sector to pay rent on a site, macro-economic conditions and policy, housing finance availability and government support. In all of these contexts, as reflected in the various research reports, effective housing policies are recognised as being key to effective partnerships.

Current models of PPPs are not comprehensive, resulting in a "zero-cost" policymaking stand by government. The incentives, cross subsidies, and waivers of charges are inadequate. Currently, government focuses mainly on promoting partnerships to attract investors or private partner through incentives with low public sector's financial resources. It needs innovative scheme and government policy reforms. Incentives are promoted as the major way to encourage involvement by the private sector, the most attractive being tax incentives, loan guarantees and the provision of infrastructure such as streets or sewers for developments (Cheung et al., 2012).

Various types of PPPs are implemented adjusting project objectives, private involvement, and requirements. There are spectrum or phases describing the degree of private involvement (Kwak et al., 2009). In the housing provision context, at one side is public provision, where all aspects of the delivery of public services are fully managed by the public sector, such as land, building construction and building maintenance are provided by public sector. At the other side is private's responsibility, where private sector manages all aspects of the delivery of public services. As the PPP model moves from one extreme side to another extreme side, the degree of private involvement increases. Each scheme has different arrangement in terms of finance sources and ownership of properties.

As aforementioned, different project might apply different PPPs as well. PPPs model in infrastructure and housing provision are different, which results in different contribution of each stakeholder to the project. UN-HABITAT (2006) revealed that in low-income housing project, the contributions of PPPs are still limited. The contribution of the private sector, and public sector's role in the provision of land, basic amenities and other incentives by government are not significant increasing in urban housing units delivered by the PPPs (Ibem et al., 2015). The most common PPP procurement methods are turnkey (Trangkanont & Charoenngam, 2014), and supply and management (Ibem et al., 2015), although methods such as land rental and rent-to own have been applied in low-cost housing projects in some developing countries (Rachmawati et al., 2016; Trangkanont & Charoenngam, 2014).

Apart from the PPP model, governments provide assistance to fund the housing for low-income communities – especially for first-time buyers – in various ways, as outlined below.

Housing Subsidies

Government implemented affordable housing program through housing subsidies in various ways, such as subsidy on interest rate for new rental housing and new owner-occupied buildings, tax deduction to home buyer, property tax for owner-occupied buildings, and down payment subsidies (Turner & Whitehead, 2002). Different class of household will receive different subsidies. Therefore, targeting subsidies towards particular types of investments or households has become the most commonly adopted approach. Housing subsidies are aimed to decrease housing investment, which will, in turn, to lowering housing prices. This is because the private sector could not compensate for a downturn in the social sector output by expanding their own activities. As the housing price decline, most households in the targeted low-income communities are left paying a higher proportion of their income for housing. However, the project would be unfeasible and would not be sustainable if this housing subsidy scheme allocates to a very large number of poor households, as the government spends very large financial resource on this project. It cannot be the answer to all the housing problems (Sandhu, 2013).

In general, government subsidies are understood as a problem-solving strategy for specific deficit problems in many areas, such as energy, housing, and water supply (Jun et al., 2010), and government policies in the form of subsidies, tax reductions, and buy back schemes will vary depending on priorities and consistency in relation to their particular strategies or determined schemes. This variability constitutes a risk barrier caused by different uncertain factors, such as varying subsidies, reliability, maintainability, and price (Shih & Chou, 2011). Price is always directly related to cost, and this varies due to budgeted costs of particular operations and maintenance. This variability factor may be the most significant concern to consumers (Berger, 2019), even though they ultimately pay a price that is reduced through government subsidy. The concern lies in relation to how much a consumer is willing to pay by adopting certain government subsidy schemes.

In Indonesia, the government subsidises low-income group housing in the form of liquidity facilities on housing finance and support provided to workers with a monthly income less than US$ 296 to enable them to own the house or to rent public housing. First, the subsidy is provided for a low deposit on a maximum sale price and as a subsidised interest rate for low earners to be able to own the house. Second, the government subsidises the public housing operation and maintenance costs to a considerable extent. This can reach approximately 90% of all expenditure (Rachmawati et al., 2018b). In the beginning the rental price is expected to cover operation and maintenance of the building, however, in practice, the rental price is not able to cover those costs, with the annual rental income falling far short of the total cost. The significant gap between rental income and costs must therefore be covered by local government subsidies.

In Australia, the government launched first home ownership grants (FHOG) scheme in order to enhance the level of affordability. This grant is focused on apartment and townhouse units. Lee and Reed (2014) discussed the role FHOG to reduce housing price volatility. the empirical results confirm that the FHOG scheme actually reduces the level of volatility in housing price since the volatility of housing prices was negatively related with the FHOG volume.

Grants and single-digit interest

Grants are a type of loan offered by governments to ease an access to housing mortgage loan for low-income group with a low down-payment scheme. In some cases, government provides grants for low-income home buyers to pay administrative cost associated to the purchase of low-cost housing, such as closing costs and legal fees. Indonesia, India, and Malaysia offer grants to low-income people in different ways. The grants are commonly provided by the central/federal government. For example, in Indonesia, the government provides grants for infrastructure and utility installation to help reduce total development costs. According to the *Capped selling price for low-cost apartment* ministry of finance regulation. 2015. s.269 (Indonesia), a grant in the form of a minimum down payment is provided as the subsidised first home loan program and requires only a minimum 1% down payment and involves a low interest rate of 5% for the maximum of a 20-year loan. The subsidy grant/incentive is also offered to low-income housing developers to build infrastructure, utilities, and public utilities. The home can be in the form of a landed house or an apartment in a high-rise building (low-cost apartment) with a unit area 21-36 sq m.

Similar to the Indonesian scheme, in India, through the Pradhanmantri Awas Yojana (PAY) (2015-2022) program, the government provides all eligible households with a central grant of between 100,000 INR (US$1,490) and 230,000 INR (US$3,400) and loans at 6.5%, which is 4 per cent lower than prevalent housing loans, which are at about 10.5%. Grants in the form of a direct subsidy from central government are also offered as grant assistance to the public and private sectors (including parastatal agencies) for constructing a minimum of 35% of EWS units (Sandhu, 2013).

Mortgage payment subsidies

Mortgage payment subsidies are housing financing models with lower interest rate and other periodic charges to be paid by individuals or organisations that take out loans for housing projects. The Indonesian central government offers a housing subsidy in the form of lower interest rates for low-income borrowers to purchase subsidised low-income housing. The form of mortgage varies in different countries and contexts. For example, in Hong Kong, a mortgage is granted in the form of a one-off interest-free loan, a monthly mortgage subsidy; while other countries make a down payment and apply a mortgage subsidy (Chiu et al., 2018).

The Indonesian Government introduced a housing savings program (Tabungan Perumahan Rakyat – Tapera) in 2016 that not only allows low-income people to access subsidised loans but also to upgrade their self-built house or to make additional down payments to enter the mortgage market. In addition, the government offers a housing finance liquidity facility, a highly subsidised structuring of the total mortgage amount.

The Indonesian Government provides interest rate subsidies to support low-income households in owning their first homes. The First Home Ownership Mortgage Credit Program, offered by the National Saving Bank, aims to make loans affordable for low-income communities (Tunas & Darmoyono, 2014), and the government also grants a down payment reduction to 1% of the sales price as a direct subsidy to low-income people, with additional initiatives also implemented to support the home ownership program. In addition, the government provides an interest rate subsidy for loans of low and fixed interest rates for the purchase of low-cost formal housing for low-income families who can afford to buy homes, and subsidy incentives for low-income housing developers to build infrastructure, utilities, and public utilities (Susilawati, 2018).

In Malaysia, first homebuyers also receive a mortgage subsidy. Recognising the challenge associated with making a down payment, the government has included the First House Deposit Financing Scheme through the Ministry of Urban Wellbeing Housing and Local Government to assist first-time homebuyers to pay the deposit (Aziz et al., 2018). In India, mortgage subsidy is provided in the form of a mortgage risk guarantee fund to assist the accessibility of housing mortgage loan for Economically Weaker Sections (EWS) and Low-income group (LIG) under the Rajiv awas yojana (RAY) scheme (Sengupta, 2018), although it could be argued that formal finance systems in India in terms of housing finance for the urban poor are still largely inaccessible. Two other housing finance systems in India regulated by the government in relation to mortgage subsidies are mortgage interest deduction and credit enhancement. These financing model do not provide direct financing. Mortgage interest deduction uses tax code to provide for home buyer, while credit enhancement assists in overcoming home-buyer’s financial limitation.

This section described housing finance policies in some countries, and it can generally be observed that housing finance is difficult to access by low-income communities. While different governments provide grants to each group in different ways, the problem of initial down payments persists. In Indonesia, government support is structured by the segmentation of targeted groups into very low-income, low-income, and self-help homeowners. In Malaysia, the government also classifies targeted groups based on employment status (Bakhtyar et al., 2013). Yet certain groups still find house prices too high for them to afford; therefore, governments need to find new, innovative ways to increase housing supply and respond to the issue of affordability from the tenants' point of view.

In terms of poverty alleviation, government subsidies are still required to help low-income communities access housing finance and to ultimately own their home. As previously noted, various types of government subsidies are commonly used to assist with housing shortages and affordability, with both positive and negatives outcomes (Warsame et al., 2010), such as subsidies on construction and land costs, interest subsidies and property taxes. Warsame et al. (2010) reported that interest subsidies have had a positive influence in relation to housing supply; while Wang et al(2018) provide evidence that government subsidies may also increase infrastructure competitiveness and strategic significance.

There are two different perspectives in relation to investment purpose. From the government side, the objective is to maximise social welfare; it therefore prioritises decisions on subsidy levels and concession periods considering either low subsidy levels with high rents or selling prices, or high subsidy levels with low rents or selling prices. Meanwhile, from the private sector perspective, the investment objective is to maximise profit, balancing decisions on service charges and demand. For this reason, the government should consider introducing subsidy policies in order to reduce the private sector's costs and encourage it to increase building capacity and charge lower service fees, which would then attract more demand volume. Policies should be formulated to achieve the most effective use of subsidies and to avoid misdirected subsidies. The challenge for government subsidies is to maintain the private sector's revenue without increasing the burden on the low-income community.

Studies on government subsidies for low-cost housing projects have been reported in previous research. For example, Yap (2016) demonstrated ways in which many public housing agencies have been ineffective, their product of subsidised rental apartments not meeting the needs of many of the poor, in effect, being captured by other income groups. However, Yap's (2016) study did not include a focus on subsidised rental apartments and the object subsidy. Other studies have reported how the model of mixed-income housing can be applied to develop partnerships between the public and private sector (Gurran & Whitehead, 2011; Onatu, 2010;). They argued that mixed-income housing can play an important role in increasing the building of additional affordable units for ensuring high quality housing, and deconcentrating poverty by more effective cross subsidising. This scheme needs to be strengthened as policy.

2.4.3 Mixed-housing strategy

Governments in some countries have initiated a model of mixed-income residential areas to overcome urban poverty, segregation, and to support redevelopment (Onatu, 2010; Susilawati, 2018). The term mixed-income housing can refer to mixed-building, mixed-building forms, size, or designated uses. It is also known as mixed-tenure, and market and segmentation of rent levels (Tunstall & Fenton, 2006). This model is best applied to high-density areas. It provides an opportunity to increase affordability and it increases in value when a public private partnership is adopted. For example, using public land for a mixed income development can be views as subsidy, as it reduces the land cost of affordable unit, which will lowering the lower-income households' burden.

To provide its citizens with adequate, affordable, and decent housing, especially in urban areas, the Malaysian Government has built public housing purposefully and specifically to facilitate the lifestyles of lower-income communities (Abdul-Rahman et al., 2014). There are two types of public housing in Malaysia, or as it is termed, two types of tenure-houses: owner-occupied and rental apartments. These two types live alongside each other in the same buildings (Karim, 2013). Some units are for rent, some for ownership. This strategy encourages interaction among inhabitants, without looking at what kind of family they are or what kind of residence they occupy (Tunstall & Fenton, 2006). The intention behind this model is to foster integration and the sharing of common facilities between income groups (Onatu, 2010).

The mixed-income strategy is reflected in the Malaysian Government practice of classifying housing by income and location (tiers of the pricing system). For example, people with an income of RM 1200-1500 can buy/rent an apartment in a five storey building in a city or town centre, whereas people with income from RM 750-1000 are not allowed to buy/rent a house/apartment in a city (Goh & Yahaya, 2011). In this way, the Malaysian Government implements cross-subsidisation mechanisms as one approach to engage the private sector in housing provision programs or inclusionary zoning. The program enables the private sector to use cross-subsidisation from higher units for lower-cost units (Malpezzi & Mayo, 1997).

This collaboration has resulted in a certain portion and certain price range of commercial housing development being allocated for investment in low-cost housing development. This type of collaborative initiative has been recognised world-wide, being commented on in Australia (Gurran & Whitehead, 2011), the UK (Bond et al., 2011), and China (Huang & Clark, 2002), with a variety of definitions emerging in the discussion, including "inclusionary housing," "mixed-income housing" or "inclusionary zoning" (Onatu, 2010). Mixed housing has been implemented in several states in Australia, coinciding with the increasing of government grants and incentives for affordable housing development sectors. Some private developers have stated concerns regarding onerous processes and compliance increasing development costs. In addition, inclusionary zoning requires capital funding support, strong policy frameworks and effective communication, education, and engagement with communities and with the private sector (van den Nouwelant, 2014).

Some land regulation reforms have initiated inclusionary zoning, which requires the housing developer to build a certain proportion of new housing at affordable prices, which is supported by lower parking fee, lower tax, concessional zoning flexibility, or facilitation of expedited reviews and approval processes (Ayoade & Ahmed, 2014). "Inclusionary zoning" is applied when the local authority regulation required inclusionary requirements on the certain zoning code or housing element. In this circumstance, the developers agree to provide affordable housing and include it on their building plans (Onatu, 2010). Inclusionary zoning is one of policies in housing sector to boost the supply of affordable housing (rental and ownership) by providing accommodation specifically for low-income and moderate-income households in certain areas. This mixed-housing class enable housing developer to finance the housing investment and to enlarge the private sector's delivery capacity to provide affordable housing. Taking a different perspective to Onatu (2010), Livingston et al.

(2013) suggested that the problem associated to social interaction of people or resident as a result of social diversity and neighbourhood mix in different tenure, occupation, or income groups. They argue that in the effort of implementing social diversity and neighbourhood mix, it needs the existing mechanisms in the social effects identification, and the effects of any neighbourhood changes.

In general, mixed-income housing development as an urban redevelopment strategy has been positively responded to by governments and developers, particularly in relation to public housing developments in which the private sector can become involved. However, the initiative requires the support of both sectors. Private sector involvement, often known as public private partnership, involves private financing for a project due to government fund limitations. Read and Sanderford (2017) noted that mixed-income housing is structured in the form of a combination of market rates and affordable housing, with some possibilities of housing type. However, past studies recommend consideration of some critical challenges associated with financing mixed-income housing developments.

Constraints associated with this partnership in housing projects are evident in some countries, such as poor access to finance by low-income families, outdated legislation, high levels of municipal taxes, stamp duties, and sanction fees (Sengupta, 2018). However, benefits are also apparent, such as resulting costs and quality due to governments focussing more on appropriate regulation rather than on rapid changes. Another concern identified in the research relates to the need for government support in the form of favourable policies, especially financial policies. In the study by Ibem (2011) into public-private partnership (PPP), it was noted that the public sector is responsible for land provision, investment guarantees, and supporting laws and regulations, while the private sector is responsible for technology transfer and for financial resources to support feasible and viable infrastructure projects. Since the private sector is profit oriented, the public sector should assure the availability of the financial market and other financial benefits. A wide range of financial sources would represent additional revenue and benefit for the private sector involved in low-cost housing projects (Cheung et al., 2012).

2.4.4 Transit-oriented development

Transit-oriented development (TOD) is being introduced in response to the growth of mixed-use development near and/or oriented to mass-transit facilities.

Common features of TOD are mixed-use, density, and walkability. There are two advantages of implementing TOD: transit accessibility and sustainable built environments (Li & Huang, 2020; Zhang et al., 2018). In the transit accessibility context, TOD enables the provision of public spaces near mass-transit facilities called as walkable neighbourhoods that encourage people to live near to and use public transport. As the transportation facility is normally related to bus or train, therefore, there must be train or bus stations designed to be community hubs. There is network of walkable streets that connect moderate- or high-density residential and commercial buildings to the train station within a half-mile (800 m) radius (Yildirim & Arefi, 2021). In addition, in order to implement TOD for transit accessibility purpose, some facilities are included, such as urban compactness, mixed-use development (Langlois et al., 2015), facility for pedestrian and bicycle-users, which indirectly emphasis on sustainable built environments purpose.

Due to high land price in urban area, planners and developers are encouraging to implement TOD concept, which develop housing in the location near mass-transit facility. This concept refers to location affordability as well as location efficiency. Mixed-use development, density, and walkability are important moderators, all of which raise the significant impact of rail transit on housing prices (Bartholomew & Ewing, 2011). Previous studies similarly made in relation to the cities of San Diego (Cervero & Duncan, 2002; Duncan, 2011), and Wuhan (Huang &Yin, 2015). Some studies on Chinese housing context, the positive and negative influence of rail transit on housing prices have been identified (Xu et al., 2016).

Based on land rent theory, there is positive correlation between the accessibility and housing price. The transportation cost will be lower when the accessibility increases; and while there are certainly mixed rail transit effects on housing prices (Mohammad et al., 2013). In addition, mixed land use combined with rail transit facility will strongly influence housing price. This is because the integration between transit access and mixed-use will raise accessibility for working and non-working activities (Duncan, 2011). Liang (2021) also conducted a study related to the influence of transportation facility and the viability of value capture in funding infrastructure improvement. It showed that the improvement of transportation infrastructure facility is not only beneficial for the safety of traffic but also increase the housing market.

In the effort of housing development, policy maker, planner, contractor, and other stakeholders need to consider all aspects including design and characteristics before adapting the housing development concept to their own cities/region, such as TOD. They have to fully understand TOD’s barriers. Instead of noise and air pollution challenges, the institutional complexity associated with fragmentation that may lead to a lack of clarity in roles and responsibilities (Tan et al., 2014). Due to multiple stakeholders involved, the lack of clarity in roles arise from different timeliness and programs in the various sectors, land use, transport, and consolidation of each role. For example, Tan et al. (2014) identified difficulties in assembling land parcels for development as constituting one kind of barrier. Inadequate overview, lack of effective implementation from planning stages by transit authorities, and under-utilised locations were identified areas of concern, and poor coordination between different authorities (provincial, regional, local) and sectors (e.g., land use and transport) were additional challenges identified by many experts.

For all these reasons, and in response to these various challenges, formal and informal incentives are required, as noted by Tan et al. (2014) in their study of three metropolitan cities. In summary, integrating land use and transport sectors/portfolio, improving regulation related to TOD, risk and profit-sharing modelling are examples of formal incentives used in Perth (Falconer & Richardson, 2010). Meanwhile in Portland, the regional authority has enacted a transportation planning rule that limits development with urban growth boundaries. In Vancouver, while high financial returns motivate developers, the motivation and pride felt by the community as a leading TOD example is evident in how behavioural change related to public opinion is seen to favour more sustainable and compact developments (Langlois, 2015). These can be seen as examples of informal incentives.

2.4.5 Public housing in Indonesia

Due to its high level of urbanisation, Indonesia suffers from a significant housing backlog. Major urban areas face problems related to the demand for basic services due to a lack of affordable housing investment. Based on housing data, the Indonesian Ministry of Public Works and Public Housing predicts that the need of housing (ownership), called as housing backlog, reach 800,000 units per year. This number increases the current housing backlog (ownership concept), which has not yet been met: 7.64 million units in 2020 (Indonesian Ministry of Public Works and Public

Housing, 2020). A public housing program has been initiated to urgently reduce this housing backlog.

The calculation of the backlog in Indonesia is defined by two concepts: home ownership and occupancy. In terms of occupancy, the backlog is calculated by occupancy in a decent house, either by leasing or buying a house or living in a house owned by a relative/family, as long as secure tenure is guaranteed. In terms of home ownership, the backlog is calculated based on the rate/percentage of households that occupy their own homes (Indonesian Ministry of Public Works and Public Housing, 2019).

According to *the Housing and Settlement Area Act* 2011 s.1 (Indonesia) there are five categories of housing: commercial housing, public housing, self-built housing, special housing, and state housing. Commercial housing is majority built by housing developer for profit, while public housing is provided by the local government for low-income people. Self-built (self-help) housing is housing built by residents individually or collectively with other residents on their own land under supervisory control of local government through building permit. Special housing is majority built by the government for a special purpose, such as senior housing, employee housing or student housing. State housing is housing built, owned, and operated by the government and allocated to low- to middle-income people.

In general, there are two types of public housing dedicated to low-income communities: low-rise housing (single housing) and high-rise apartments (public housing). Existing public housing (strata-title housing) is run by the Ministry of Public Works and the Ministry of Public Housing, while the land is always provided by the institution proposing the public housing project (Indonesian Ministry of Public Works, 2012). Public housing (strata-title housing) is known as *rusunami* or low-cost apartment (high-rise apartment). The unit tenure is homeownership. Current public housing involves high construction costs due to high land prices, high government subsidies and low rental prices. Price determination in the case of low-cost apartment is different to that of public rental housing in terms of construction costs, yet public housing construction costs are similar to those of any high-rise apartment; however, as low-cost apartment is dedicated to low-income communities, selling prices are capped by the government with low profit margins for developers (Rachmawati et al., 2018a).

The selling price of rusunami – determined by the Indonesian Government – leads to little investment in rusunami by the private sector.

Another form of public housing in Indonesia is public rental housing. Most public rental housing is allocated for relocated communities and low-income people, with local governments making some adjustments in relation to tenants' ability and willingness to pay (Purnamasari et al., 2020). Responding to scarcity of land for landed houses in areas near major city centres and in order to regulate development, ownership, mortgages, and occupancy management, the government issued the first Act regarding high-rise apartments, known as *Public rental housing act* 1985 s.16 (Indonesia). This regulation was further updated by *Public rental housing* act 2011 s.1 (Indonesia), which regulates public housing specifically.

The component of rent price that consists of operational costs covers officers' salaries, tax, insurance, and public infrastructure utilities, while maintenance costs include building components such as rehabilitation and replacement. According to *Public rental housing tariff determination* Ministry of Public Works and Public Housing 2018 s.1 (Indonesia)). The Indonesian Government regulates two rent determination options. The rent price of unit is derived by the total cost (maximum or minimum price) divided by the number of units:

- maximum price, which is determined based on operational and maintenance costs, and
- minimum price, which only considers maintenance costs.

The local government/institution then assumes responsibility for managing the public housing, management that consists of operation and maintenance activities of public utilities. Because housing is managed by the Indonesian Government, all financial procedures must abide by government financial standards. For example, all monthly income cannot be allocated directly for operation activities, which must be clearly budgeted for in the yearly financial planning. Housing is allocated to low-income community members for three years and can only be extended twice. The low-income community is expected to be able to buy their own home after this period. During the operational stage, local governments (province and district/municipality) are required to subsidise operational and maintenance costs (Indonesian Ministry of Public Works and Public Housing, 2012; Rachmawati et al., 2015b) in order to maintain low rental prices – these are so low that they cannot cover these costs – being determined as lower than 30% of the inhabitants' income.

Price determination for public rental housing in Indonesia is characterised by a lack of balance. As noted, the rental price is low, and cannot cover operational and maintenance costs, as it is determined at lower than 30% of the tenants' household income, without any consideration of factors such as location or neighbourhood (Soemitro & Rachmawati, 2020). The public rental housing units provided by the government operate on a not-for-profit basis.

Rent determination for Indonesian public housing is different to that of Malaysia. The Malaysian Government determines rent prices on an income basis, while the Indonesian Government regulates prices based on real costs adjusted to enable low-income communities to afford their rent. The applied cost in most public housing is very low, and does not cover real operation and maintenance costs, resulting in a low level of private sector investment.

In Indonesia, governments, both central and local, are key players in low-cost housing provision, private developers building only a small number of low-cost housing units. The government builds a limited amount of public housing and remaining housing needs are met by the unplanned informal housing sector – self-built housing. In summary, the aim of housing policies is to initiate programs to help low-income families to own their own homes, to reduce the housing backlog, and to reduce the amount of illegal housing and squatter settlements. Policy therefore focuses on housing supply and housing finance, with housing finance policy intending to ensure that low-income communities have the opportunity to access finance systems that will help them to own or to rent a home.

However, there are some significant constraints facing public housing financing in Indonesia. The first relates to affordability. The level of affordability for low-income families is still low, whether buying a house from a developer, undertaking construction independently, or improving a property to make it more liveable. This situation is the result of low creditability evidenced from the gross domestic product per capita of Indonesia, according to the Statistical Bureau and recorded in 2016 at 47.96 million rupiah per year. Statistical Bureau data also show that in 2012 approximately 61.3% of Indonesia's population were in the community group with monthly income below 2 million rupiah per month; and in 2020, although an increase in the number of middle-income households has been predicted, there will still be approximately 47.3% of people with monthly income below 2 million rupiah per month. Increasing levels of household income are also not in line with increasing housing prices. Consequently, home ownership mortgages in several provinces are not ideal, representing more than 30% of total household income.

A second constraint relates to eligibility and home ownership mortgages. Self-employed workers make up 60% of all workers, dominating the workforce. They are more difficult to reach than other workers as there are no community groups or institutions that regularly employ them, as is the case for formal workers; thus, the income of independent workers tends to be irregular (Indonesian Ministry of Public Works and Public Housing, 2017).

The sustainability of public finance for public housing is also an issue. Current housing finance is allocated from public financing or local government financing; however, there is need for specific funding for other public infrastructures as well as for housing and for additional innovative forms of financing (Indonesian Ministry of Public Works and Public Housing, 2017). For example, there is a need for long-term light funds that do not rely on public financing but come from the community's own funds in the form of people's savings. This could form part of the solution to the problem of sustainability of housing financing.

Some housing policies support informal housing programs developed by the community (self-help housing), such as the Kampung Improvement Program, community-based housing development, and the self-help housing assistance scheme (Rukmana, 2015). Some are funded by the World Bank and are focused on infrastructure and facilities; other programs are dedicated to improving the quality of housing and the development of public infrastructure and utilities (Indonesian Ministry of Public Works and Public Housing, 2017).

A housing policy related to supply could be the direct provision by the government of public housing via Perumnas, a government-initiated organisation. Perumnas plays an important role in some provinces. During the 1992-1998 period Perumnas built 500,000 very simple dwellings to support government housing provision. In the public housing sector, Perumnas built rental flats in the 1,000 towers program, a program that still operates, with the target of building 100,000 houses per year.

However, Perumnas can only ever be part of the overall public housing provision program. As reported earlier, the Indonesian Government has tried to involve the private sector in public housing through cross subsidies from sales of more expensive housing, an initiative supported by the Indonesian ministry of public works and public housing. *Balanced housing development* Minister of Public Works and Public Housing regulation 2013 s. 7 (Indonesia) regulated mixed-income housing, which allows for cross-subsidies for the procurement of public infrastructure and facilities based on the concept of balanced housing development with the 1:3:6 ratio: for everyone unit of luxury housing, developers have to build three units of the secondary category, and six units in the category of simple houses/very simple houses.

Unfortunately, due to aspects of profit and demand trends, this program is not running smoothly. Developers negotiate with the local government to build public facilities and infrastructure to respond to low-income housing requirements. Many developers find it very challenging to comply with the 1:2:3 composition ratio as the price of land is high. Developers are supposed to provide balanced housing in one stretch, as large developers in the capital can collaborate with small developers in the regions.

The only successful balanced housing projects are housing projects developed by Perumnas. They have one project in Western Malang, East Java. The housing complex was established in 1984, when the land price was still very low in that area. They provided approximately 500 units in the first development. The simple house type was 21 sqm with land area 90 sqm, while medium type was 45 sqm with land area 96 sqm. The luxury house was 70 sqm with land area 120–150 sqm. In the second development, house types 21 sqm were no longer built, as they were not suitable to family needs. The smallest house type was 36 sqm, and the largest was 120 sqm. It was possible to build a variety of housing types, as the area was far from the city centre and was not supported by proper access. Nowadays, the area has become an attractive urban area in Malang, which has raised the land price.

As is the case with the construction of houses, the construction of mixed-income apartments is also regulated by *Public rental housing* act 2011 s. 20 (Indonesia): A minimum of 20% of total units built are targeted for public housing. They do not have to be in the same building, but in the same area as the commercial apartments. Mixed-income housing is recommended for developers to enable cross-subsidies from commercial apartments to cover the costs of building public housing (Susilawati & Yakobus, 2010).

In relation to finance, the Indonesian Government has introduced initiatives to support home ownership for low-income communities, such as lower interest rates for low-income borrowers and housing mortgage credit programs.

Indonesian Ministry of Public Works and Public Housing (2018) has guided financial assistance in the form of housing subsidy schemes as provided by the Indonesian Government to low-income communities. The target market for subsidised housing project is private employees, government officers, and young executives who are first home buyers (never having previously owned a home). The buyer's minimum take home pay is adjusted to an affordability rate for each area. There are several types of housing subsidy schemes, including (Indonesian Ministry of Public Works and Public Housing, 2017):

Home-ownership credit – Reduced interest rate

The Indonesian Government subsidises the gap between interest rates for market-rate units and interest rates for subsidised units through the official bank using the housing loan interest subsidy program. This scheme involves eligibility for low interest rates for home loans of around 9–15%, which is half of a regular loan provided by a commercial bank, which averages about 24%. The most common option for subsidy is a subsidised interest rate loan, the current subsidised first home loan program requiring only a minimum 1 per cent down payment and applying low interest rates of 5% for a maximum of 20 years duration of the loan (Bank Tabungan Negara, 2017).

Financing of home ownership on margin price gap

Home ownership financing is issued by the official bank based on sharia principles that allow a reduced margin through the housing loan interest subsidy.

Home ownership financing – subsidy on down payment assistance

These government subsidies come in the form of applying flexibility for down payments for housing. The subsidy on down payment assistance is the down payment reduction to 1% of the sales price.

Housing Financing Liquidity Facility

Housing financing liquidity facility support for low-income communities is managed by the Ministry of Public Works and Public Housing. This scheme is similar to the reduced interest rate subsidy. Through the housing finance liquidity facility scheme (FLPP), the Indonesian Government has also developed a housing finance program in the form of down payment assistance, free value-added tax, and infrastructure/utilities grant, which is based on the *FLPP regulation* Minister of Public Works and Public Housing 2014 s. 20 (Indonesia). This was established in 2015, designed as public housing provision with maximum sales prices being in the range of IDR 267 million to IDR 600 million (36 square metre units) – the price being determined mainly by the building costs and not related to tenants' ability to pay (Tunas & Darmoyono, 2014). In public housing, units not larger than 36 sqm are eligible for the 10% value-added tax as long as the price is under the ceiling price determined by the government.

Savings-Based Housing Financing Assistance (BP2BT)

This is a government assistance program provided to low-income people who already have savings to contribute part of the down payment for homeownership or part of the funds for existing housing construction through credit or financing from the implementing bank.

The BP2BT fund is a one-time government assistance initiative for a down payment for the purchase of a house or for part of the cost of building a self-supporting house, which is distributed to the low-income community that meets the relevant requirements. The amount of subsidy funds provided to buyers is determined by income classification and housing price, with a maximum value of IDR. 32,400,000 and a minimum of IDR. 21,400,000.

Public Housing Savings (TAPERA)

The Tapera initiative aims to raise and provide long-term, low-cost, sustainable funds for housing finance for first-home buyers. The government has also launched a housing saving program for low-income employees, government officers and members of the armed forces, which is facilitated by the Bank Tabungan Negara.

Most low-income communities do not have the capacity to pay the required minimum down payment when they apply for housing credit, therefore the government subsidises it through the *bapertarum* program subsidy. Employees who have worked for a minimum of five years are eligible for a loan for housing ownership and existing housing improvement for a duration that can run for 15 years, with a fixed interest rate of 6% per year. The housing saving program is based on *Housing saving program* act 2016 s.4 (Indonesia) – Tapera being targeted for all employees when they start to buy their first home. All workers who receive more than the minimum wage, have worked for more than six months, or are self-employed must be members of the program (Soeprapto, 2020).

Housing Microfinance

Financing through low-ownership credit is generally long term, usually for 15-20 years, and this kind of financing is not suitable for low-income families with irregular incomes. However, housing microfinance offers flexible payment systems so that low-income communities can get housing loans from financial service institutions by reducing the loan repayment period or the maximum loan period to only five years. By making the instalments more affordable, the ceiling or loan value is also reduced to a maximum of Rp. 50 million for a single loan.

This scheme is interesting, as it can be given repeatedly. For example, the first loan may be IDR 30 million for a period of three years. If the debtor then pays it back on time, they can then apply for another larger loan; for example, IDR 40 million to be repaid over a loan period of four years. Government intervention in the housing micro financing scheme is new and is being promoted to the targeted group of low-income communities in small cities.

Unfortunately, this savings program terminates once members are no longer working (e.g., when they reach pension age), when they die, or are unemployed for five continuous years, including through permanent disability or by being fired (*Housing saving program* act 2016 s.4 (Indonesia)). However, their savings will be returned to them, and the weighted average of their net investment income. The investment income arises mainly from house finance payments. Members can choose conventional investments for their membership payments (e.g., bank deposits, central government bonds, local government securities in housing and human settlements and other safe investments) or they can follow Islamic investment rules (a government bond is called *sukuk*).

2.4.6 Stakeholders and tenants

In general, housing investment involves many stakeholders. In a study of stakeholder participation in subsidised housing investment in Colombia and South Africa, Lizarralde (2011) classified four major stakeholders who had roles in funding and control, beneficiaries, procurement, and delegated organisations. Some involved stakeholders were government organisations, such as national government, provincial government, and municipalities, while private organisations involved included consultants and contractors in infrastructure and urban planning.

The Indonesian Government consists of three tiers: central government (ministry), provincial government, and local government (district and municipal government). The central government (the housing ministry) develops the legal and policy frameworks for housing and the national housing policy, sets guidelines, standards and norms for housing, and compiles and maintains a housing data bank and information system to provide technical support and training programs for local and regional government officers. The central government continues to provide subsidies for low-income citizens so they can afford to buy their first home.

Local government executes the policy by providing asset land as it issues land policy, planning policy, and standards. It overlooks the spatial planning and permit systems (UN Habitat, 2008, p. 89). The role of the regional government (provincial government) is to coordinate and integrate regional housing and infrastructure programs. It must also assess and monitor the progress of local government housing programs funded by the national housing agencies. The provincial government is also able to propose public housing to the ministry to be built on the asset land. The regional government also provides emergency housing in conjunction with the central government, while the local government enables local housing development planning and delivery by private developers, NGOs, and CBOs in their local areas (Kleit & Page, 2015).

Graaskamp (1981) explained that there is constant interaction between the three groups – space users (consumers), space producers (those with site specific expertise), and public infrastructures (offsite services and facilities), as described in Figure 2.4. The figure shows that financial feasibility is not only discussed from point of view of developer/space production group when reviewing the project, the ability of space users and the capacity of public infrastructures are also discussed. The public infrastructure group includes all those entities that provide public utility/ infrastructures network to support individual space users. Public infrastructure group also includes government regulations related to building regulation and all forms of economic activities.

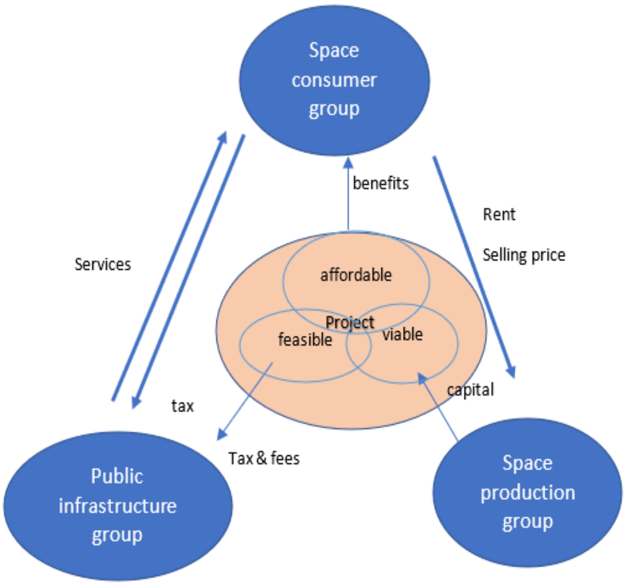

Figure 2.4 Comprehensive financial analysis

adopted from Graaskamp (1981)

In the context of subsidised or public housing, which is dedicated to low and middle-income tenants, affordability for space users (consumers) should be taken into account. These housing users can be categorised into two groups: regular tenants and relocated communities. This is very common in other developing countries, where public housing tenants are classified into:

- Regular tenants, as those who apply to be low-cost apartment tenants and have to meet eligibility (Posthumus & Kleinhans, 2014; Li et al., 2019; Huang et al., 2019);
- Relocated communities, as tenants compelled to move from their original neighbourhood (mostly illegal settlements or disaster-prone areas) as a result of urban renewal projects (Li et al., 2019).

As detailed earlier, public rental housing in Indonesia is also provided by government for low and middle-income communities (Rachmawati et al., 2015). Relocated communities are the result of relocation programs from squatter settlements, while regular tenants are families classified as low-income households who do not own their own home and are therefore eligible for public rental housing. It is expected that regular tenants will buy their first home after their occupancy in public housing (Purnamasari et al., 2020). Prior to staying in a low-cost apartment, relocated communities stay in squatter settlements, categorised as illegal areas and pay nothing. They are then relocated to public rental housing and asked to pay rent. However, the government charges them a very low rental price, which is determined based on their willingness to pay.

In order to formulate housing policy related target tenants, a housing policy groups them based on the income as affordable housing tenants have different income. It is beneficial when the government will identify groups experiencing housing affordability problems using income basis and financial indicators. Housing stress is often used to describe the financial capability, which is then used to determine whether individuals and households are under housing stress.

Different countries have different ratios for identifying affordability and housing stress. Majority studies have suggested that the 30/40 rule is the common ratio for low-income households, such as public housing tenants living in subsidised housing who should be counted as being in housing stress (Nepal et al., 2010). However, housing stress ratio for public housing tenants living in subsidised housing seem to be varied; for example, in Australia, tenants are required to pay only 25% of their income on housing costs (Rowley et al., 2015). In Canada, a housing affordability problem is perceived when a household pays more than 30% of their household income for all core housing needs or when their income is insufficient to rent a suitable, adequate home (Nepal et al., 2010). Indonesia faces similar circumstances, in which housing stress does not always align with theory or policy.

2.5 LOW-COST HOUSING FINANCIAL MODEL

Based on the discussion presented above, it is evident that there is a lack of private sector involvement in the low-cost housing sector due to the lower profit margin. The principal reason that private companies are interested in any infrastructure investment is to do with certainty and confidence in project costs and revenues. These components therefore need to be taken into account in terms of cash flow in financial analyses (Badasyan, 2018); that is, all the possible costs and revenue streams in infrastructure projects need to be carefully evaluated via a financial model – particularly in the low-cost housing sector.

A financial decision-making model, sometimes referred to as a financial model, is defined as a tool for evaluating a new project and for facilitating negotiations between the private sector, lenders, sponsor(s), and government authorities. In housing project investment there are key issues that concern all stakeholders: tariffs, financing costs, development costs, insurance, taxes, construction costs, and operation and maintenance (Kurniawan et al., 2015). Financial analysis needs to encompass all of these components, as well as associated project costs and revenue mechanisms in order to provide the private sectors with estimated profits and investment returns (Badasyan, 2018).

The financial model will show financial feasibility of a project using set of scenarios and assumptions, and the model can be developed via either a bottom-up or top-down approach. Most financial models adopt a bottom-up approach, which the basic parameter is derived from raw data associated with revenue and cost along with basic calculations. Typically, a financial model is built in the form of a spreadsheet with some supported worksheets. This model is relevant to be applied both for rental and ownership property. In this study, the financial model would be applied for low-cost apartment (ownership) and public rental housing.

2.5.1 Housing financial feasibility

A real estate investment can be represented as an amount of money by an individual with a purpose to preserving and increasing capital by generating more rate of return on capital. Investment also aims to anticipate future benefits (Oprea, 2010). A feasibility analysis should be conducted prior to any investment to decide whether the project goes ahead. Feasibility analysis determines all, none, or some of the proposed alternatives to be accepted and implemented and show an acceptable probability of achieving minimum investor's return of investment.

A comprehensive financial feasibility analysis analyses mainly consists of cash-flow and sensitivity to variations (Marchioni & Magni, 2018). There are various steps in conducting the analysis. However, the essential elements are the stage cost estimation, cash flow schedules development, and estimated cash flow evaluation in terms of acceptability of the expected outcome. Wilkins et al. (2015) investigated the issue of life cycle costs and argued that feasibility analysis must involve consideration of construction costs, interest rates, building life, and rehabilitation costs. These analyses constitute an element of the total development asset, which includes the initial condition and structure of a property's financing. A key element – or tool – is life cycle cost, which encompasses both the developing and maintenance stages of property development.

A cash flow approach is often used in financial feasibility analysis, as it attempts to model the reality of the development process. It describes the change and estimates of costs and sale values during predetermined investment period (French & Gabrielli, 2006). Investment feasibility calculations commonly use discounted cash flow analysis, which includes calculation of present, annual, and future cash inflow and outflow (Carmichael & Balatbat, 2008). The cash flow schedule estimates the timing of construction expenditure and capital receipts upon completion over the life span of the project. The user uses a period-by-period net cash flow evaluation to appraise feasibility for certain purposes. The cash flow also shows the accrued interest to each payment/receipt and compound it until the end of investment period. In the end of investment period, the total accumulation, which is presented in present worth, shows the surplus or deficit of funds. As the investment are occurred over the periods, the cash flow is subject to the time value of money, which allows the analyst to calculate the profit on a net present value (NPV) and/or an internal rate of return (IRR) basis (Marchioni & Magni, 2018). Finally, the feasibility study will result in a positive indicator, which is defined when the total present worth of the cash flow is positive. In contrast, the feasibility study will result in a negative indicator, which is defined when the total present worth of the cash flow is negative.

The financial model involves interrelationships among variables that affect the feasibility of a public housing project (Meins & Sager, 2015), factors that correlate closely with other variables. Dependency between two variables can be in positive or negative polarity, which means that the positive polarity of the first variable will increase that of the second variable. On the other hand, negative polarity means that there is a change in the first variable that decreases the amount of the second variable.

One component of cash flow is initial cost, which is made up of the land cost, construction cost and design cost. Location is the most significant factor that affects land cost. Alqahtani and Whyte (2016) pointed out that construction cost depends on the number of floors, the type of building, gross floor area, and the type of structure; that is, the total cost of the house, including electrical and mechanical equipment, the cost of construction supervision, and interest payments. In the public housing context, gross floor areas include the number of units and the unit area; while design costs include costs of the design concept, planning, office expenses and interest payments (Inoue & Yoshitake, 2016).

In the whole life cycle cost of the project, operation and maintenance costs play the most important role. Maintenance costs refers to the costs needed for regular building and equipment maintenance (Inoue & Yoshitake, 2016), while operation costs are influenced by floor area, number/amount of materials, and energy consumption rates (such as the number of electric pumps, lamps, and some electric equipment in office). Furthermore, as with construction costs, maintenance costs are affected by the building's height, type of structure, number of elevators and gross floor area (Ihsan & Alshibani, 2018), and the number of elevators involved will affect both operation and maintenance costs, as elevators absorb significant energy. The availability of elevators depends on the building height, with the Indonesian Ministry of Public Works and Public Housing regulating those buildings with five or more storeys must be equipped with elevators. In general, operation costs mostly reflect the shared need of tenants, such as electricity in corridors and in public spaces and any public infrastructures. Operation costs also include management fees.

In public housing projects, the revenue comes from the rent or selling price of the units and from other income such as subsidies; while expenditure is allocated for the initial costs, construction costs, operation, and maintenance costs. Similar to above explanation, the feasibility analysis shows the estimated expenses of the project and the estimated revenue of the project, which earns deficit or surplus in terms of the present worth analysis. The rent or selling price as revenue are influenced by various variables that affect the overall cash flow (Carmichael & Balatbat, 2008). Rent and selling price determination as the main forms of revenue of public housing are discussed in the following sub-section.

2.5.2 Public housing rent price determination

In the housing rent price determination, market-based price is commonly used to determine rental prices, which includes macro and micro level factors (Yuan et al., 2017). Macro level factors are those that influence the average rent price at the city level, while the micro level category comprises influencing factors associated with the property. Location and housing market prices are the critical factors influencing housing rent and selling prices (Kolbe & Wüstemann, 2014; Oloke et al., 2013; Clausen & Hirth, 2016); Aluko, 2011), and are categorised as involving technical and macro factors. Different locations will mean different rents or selling prices; for example, in city centres compared to suburbs (Lind, 2015). Location has a significant impact on land prices, and in many cases, households make trade-offs between location and transportation costs (Hartell, 2016; Huang et al., 2018). People often choose to live in more affordable housing in more distant areas with higher transportation costs, the alternative being to live in a prime location with higher costs and lower transportation costs (Dewita et al., 2020).

Macro-level factors are also related to the cost of housing, urban population, government policy, household living standards and the urban economy. Whilst factors at the micro level refer to rent prices for housing, they also involve features included at the housing unit level, for example, architectural elements, neighbourhood features, and indoor facilities. Architectural elements refer to features included inside the house or unit, such as the number of bedrooms, the number of bathrooms, unit location, indoor finishes, and age of the building. Neighbourhood features involve facilities included in housing rent; for example, parking facilities and water pumps (Yuan et al., 2017; Cui et al., 2018; Su et al., 2021); while indoor facilities include items such as televisions, air-conditioners, and other fixed furniture. These features are also correlated with the tenant's willingness to pay, as they relate to preferences. Bjorklund and Klingborg (2005) identified a significant relationship between rent price differences and neighbourhood amenity attributes.

Income-based approach

Housing rent or selling price are closely related to affordability. Housing can be defined as affordable if the cost of owning or renting the home is less than 30% of the household income; an evaluation also applied to the mortgage payment (Wood et al., 2014). Affordability is one key price determinant. In this context, the term refers to the relationship between household income and expenditure on housing costs and other household expenses, which reflects the ability to provide for essential needs (Worthington, 2012). The affordable housing definition used in this study is a house where the ability to own or to rent is less than 30% of household income (Wood et al., 2014). Price of housing and rental cost of housing in relation to household income are important criteria for affordable housing. Housing cost is the amount of money spent on accommodation or dwelling (Dewita et al., 2020). Affordability must ensure that a household has enough income for other daily needs after paying housing bills. In addition, as daily needs including transportation cost, the affordable housing should be located close to city center or employment center, as it will raise transportation cost (Chan & Adabre, 2019). Isalou et al. (2014) noticed that transportation cost and housing for suburban household who work in the urban area was allocated about 57% of their income which was significantly higher compared to 45% of housing and transportation expenditure spent by households in the urban areas.

Mulliner and Maliene (2015) presented indicators for affordability criteria not based solely on economic criteria. However, the most significant factor influencing affordability is household income, which is why rent prices for public rental housing are kept low, so that low-income communities can afford them.

Cost-based approach

The cost of housing influences rent price determination, including initial costs (land and construction) and operation and maintenance costs. Rising land prices and construction costs increase housing prices (Du et al., 2011). Construction cost constitutes about 40%–60% of all costs. Rent price determination not only includes the initial capital costs but also the operation and maintenance costs. Operation costs are incurred during the building operation period, including annual running costs, bank loan interest, and depreciation (Li et al., 2014); maintenance costs are calculated to ensure the components of the building perform as required (Ali et al., 2010; Park et al., 2019; Assaf et al., 2010). Some public housing development policies may not consider initial costs, which are subsidised by the government, as they may base the rental price only on operation and maintenance costs. For this reason, Government of Indonesia determines public housing rent price based on the cost of housing to ensure that it will recover the financial cost as explained in Section 2.4.5.

Discounted market-based approach

In a public context, where there is no ‘priced market’ compared to the direct market, a sub-market approach is used. Sub-market could be defined as the component or subset of a larger housing market (Burke & Wulff, 2007). The sub-market selected as the substitute can be used to measure the value of personalised recommendations, which can influence consumer preferences (Zhang & Bockstedt, 2016). Therefore, substitutes may decrease the demand for the focal product, leading to a lower market price and individual willingness-to-pay. Substitutes for public housing are types of dwellings used as an alternative for public housing applicants while they are in the waiting period (Hochstenbach & Boterman, 2014; Kleinhans, 2003).

For public low-cost rental housing, a discounted market price is applied through a limited government program (Logan et al., 2010) to account for the low-income earner's affordability. In the US, subsidised housing offers 50–80% of the market price, adjusted to the tenant's individual income (Yglesias, 2015). The Australian National Rental Affordability Scheme (NRAS) offers 80% or less of market rental value (Department of Social Services, Australian Government, 2019). Discounted market price is seen as cross subsidy affordable units and market-rate units (Anacker, 2019).

2.5.3 Public housing investment analysis

Financing affordable housing in urban centres is more challenging than other residential properties. One of the problems is that land costs in urban centres are very high (Bakhtyar et al., 2013). This study observed that increased land costs due to high demand has triggered land scarcity. As a result, development of new affordable rental housing is risky due to the difficulty to acquire appropriate locations for affordable housing. All housing provider or investor are normally expected sufficient and appropriate return at minimal risk of their investment. When the investment has no clear prospect, the investor will not put the risk of their capital by channelling their investment into affordable housing project.

Previous studies have discussed the need to accelerate the private sector's provision of public housing with varied responses and approaches. For example, in the Chinese real estate industry, real private real estate developers owning full property rights of public housing projects, both public housing and commodity housing, and running them (Chen, 2018). Furthermore, some financing alternatives have been initiated to attract the private sector's investment in the public housing provision, such as the build-operate-transfer model, which was considered as public private partnership scheme and real estate investment trusts (Li et al., 2016).

Public private partnership has been initiated in Indonesia, but two questions remain related to its investment feasibility for public housing. First, will it be financially viable in the Indonesian context? Second, can it generate affordable housing outcomes without public subsidy? It is therefore necessary to evaluate its financial sustainability.

Prior to evaluating the financial feasibility of the public housing project case study presented in this research, its construction and operation costs had to be estimated, starting with the estimated costs of the construction phase, followed by the operation phase. This process involved three components, running cost, loan interest, and depreciation (Li et al., 2016). The running cost mainly involved the operation of building management including wages and welfare, energy (water and electricity for public facilities), marketing, and advertisements. This cost also includes building maintenance costs. The last component, the estimated cost during the operation phase, that of depreciation, directly influenced the taxation and financial feasibility indicators, such as net present value. The depreciation of the public housing buildings and the accessory commercial buildings, which are utilised as rental purposes, will equals the whole project, and the depreciation rate will have the similar value of fixed assets (Li et al., 2016).

However, the costs during the project can be life cycle costing (LCC), which is an element of methodology for systematic economic evaluation of LCC throughout the analysis. Acheampong and Earl (2020) employed LCC to identify costs associated with development and operation over the investment period of real estate property. It was also used to evaluate the financial feasibility of this project.

The case study project can have three sources of income, namely, residential units, commercial buildings, and parking spaces. The price for residential properties for low-income households may not exceed 70% of the market level, while the price for commercial units may adjust to that of neighbouring private housing flats.

The base model, structured and evaluated using net present value, was then tested to observe the model's performance for different scenarios. At least three individual scenarios were considered, including the *most likely*, the *pessimistic,* and the *optimistic* scenario, with the scenario selected depending on the observed case. For example, Pang et al. (2020) employed three scenarios to test building performance, namely *conservative*, *example*, and *optimistic*.

Meanwhile, sensitivity analysis was used in order to ensure that the model's results were robust in terms of assumptions. Sensitivity analysis is a method for predicting the change of a decision if a situation turns out to be different compared to base assumption. It helps to assess the risk associated with a strategy and to identify how dependent the output is on a particular input value. For example, in a study of built-to-rent construction in Australia, Acheampong and Earl (2020) used sensitivity analysis to analyse the NPV and IRR of projects with respect to capital structure, investment periods, and net resale; while Magni and Marchioni (2020) conducted sensitivity analysis in their study to examine the estimated reduction in direct variable costs related to building life cycle costs.

2.5.4 System dynamics simulation for investment feasibility analysis

In the effort of forecasting time-by-time cash flow, most previous studies of project feasibility have utilised the statistical analysis method, such as time series and regression. For instance, Lee et al. (2019) performed regression analysis on an apartment development project; while Mulyana et al. (2019) utilised sensitivity analysis to forecast the project cash flow considering risk factors in the project development feasibility study.

However, researchers hold differing opinions. For example, Gimpelevich (2011) described that some statistical analysis methods are static, for example data-based time series and regression analysis as they cannot dynamically reflect changes that may occur over time. Those methods analyse numeric data based on the conditions only at the time of the analysis. In case of financial modelling, it needs dynamic simulation as the cash flow, which include revenue and cost occur over a long period of time. To address this problem, Shih and Tseng (2014) argued that system dynamics need to be adopted as dynamic simulation is crucial in feasibility analysis. As aforementioned, feasibility study needs to incorporate various risk factors over the investment period, therefore system dynamics can analyse the dynamic simulation of the cash flow in project feasibility analysis, where the changes will be evaluated for the future policy (Lyneis, 2000).

Furthermore, the system dynamics simulation can help to build forecasting model, which is also needed in feasibility analysis. Suryani et al. (2012) employed system dynamic for demand forecasting in the context of air cargo terminal capacity expansion. In that study, system dynamics was also used to evaluate possible scenarios based on optimistic and pessimistic projections. Theis method's ability on forecasting simulation is more powerful than other forecasting methods, such as the following (Suryani et al., 2012):

- other methods do not consider and analyse discontinuities in the external environment; and
- other methods do not capture the cause-effect relationships between variables obviously and correctly accounted for. As a result, the changing of variables might lead to false correlations and inaccurate forecasts.

In some cases, as forecasting analysis relies on historical data, it may not accurately predict the impact of changes in parameters or variables. According to Suryani et al. (2012), conventional forecasting methods do not accommodate dynamic simulation based on deep uncertainty. If uncertainties cannot be reduced, prediction of dynamic behaviours, model validity, and optimality may not be possible, and this will be harmful and time- consuming (Lyneis, 2000).

To bridge this gap, system dynamics could be employed as it can be dealing with forecasting a problem that is complex with deep uncertainty. The modelling is built to the complex issues, then the simulation and non-linear behaviour over time are conducted in order to develop and test system behaviour. For example, the summary of benefits from a study related to air travel demand forecasting using system dynamics (Suryani et al., 2012) are as follows:

- Formulation inputted in system dynamics covers expert knowledge into the model, and it enable to develop highly non-linear behaviour.
- The formula includes historical data, which is used to forecast future parameter. Therefore, it will produce accurate prediction.
- System dynamics can develop the forecasting model more accurate than statistical models, as it accommodates sensitivity and scenario analysis using structure and parameter scenario.

2.6 KNOWLEDGE GAP

Different terminologies are employed when discussing low-cost housing, social housing, and public housing. This research focuses on public housing; that is, the government's provision of housing for low-income communities. Research into housing policy in terms of housing supply and affordability issues in different countries has shown that governments in different contexts are working to provide many types of public housing, as well as housing finance systems to enable low-income communities to access formal housing finance systems. However, there are unresolved problems facing governments, such as the financial risks taken by private developers, which constitute the main reason why developers are not more involved in public housing development programs.

Previous research into the housing sector has mostly discussed public housing provision and features of public housing, which include targeted buyers and supported financial policies. Most public housing involves low-cost housing and high-rise apartments, both rental and ownership. However, low-cost housing in the form of public rental housing is only occasionally referenced in some of the literature. Public housing presents an alternative solution to providing low-cost housing in the context of high land prices and land scarcity in city centres. Public rental housing has the potential to be an interim residential solution before low-income communities can afford to own their own houses. Yet, discussion related to public housing is still limited, focusing only on price, targeted tenants, and reasons why the private sector is not interested in getting involved in low-cost rental and ownership apartment management and investment.

Common price determination was income-based, which keeps the rent at a low price, usually below 30% of tenants' income (Liu et al., 2019). In Indonesia, public housing rent price was calculated from public housing operation and maintenance cost (Indonesian Ministry of PUPR regulation no 1/2018; Rachmawati et al, 2018). Meanwhile, market-based approach considered some factors as follows: household income, location, neighbourhoods, total urban population, urban economy, urban amenities, demographic factors, mortgage features, government policy, household living standards, supply and demand, housing cost (land, const cost, running cost) (Yuan et al., 2017; Oloke et al., 2013; Kolbe & Wustemann, 2014; Clausen & Hirth, 2016; Aluko, 2011; Du et al., 2011). However, when public housing rent price was being compared to market-based price, it was not equal. There is no 'priced market' compared to the direct market. Therefore, substitute dwellings used as an alternative for public housing applicants while they are in the waiting period (Hochstenbach & Boterman, 2014; Kleinhans, 2003).

In financial terms, it is necessary to evaluate the feasibility of a public housing project, and this is indicated by the net present value (NPV). To secure a positive NPV revenue must be higher than cost. Therefore, revenue needs to be increased or costs decreased. Yet, the minimum level of building performance has to be maintained if costs are to fulfil this requirement. The major source of public housing revenue is generated by rental or sales and the various kinds of subsidy scenarios. A financial model is therefore required to examine to what extent subsidy and proper rent price can attain a positive NPV if the private sector is to become more involved in investing in public housing. Government subsidies can be adjusted according to public housing conditions, and various other factors can affect the model; yet, although extensive studies have been carried out on low-cost housing financing, no study has investigated a suitable financial model for public housing, either in rental or ownership schemes.

Previous studies in Indonesian public rental housing have investigated the impact of low rent prices on operation and maintenance programs, which has resulted in the current high government subsidy. Therefore, the first development model in this study focuses on public rental housing. The model was developed for low-cost housing and integrated low-cost rental and ownership apartments, mixed public housing was reviewed to establish the most suitable financial model. Rent and selling prices are significant factors in financial feasibility analysis. Therefore, factors influencing prices are identified before linking them to other factors in an effective financial model.

This study focuses on the adoption of tenure or mixed public housing, as this can be an opportunity to encourage social interaction between low income and social renter households with owner and higher-income inhabitants (Kearns & Mason, 2007). This type of public housing has already been developed in some countries. From the economic and service perspectives, it is viewed as enhancing local economies and better-quality public services. The government subsidy can be in the form of cross subsid y, with the higher revenue subsidising the lower revenue one. Finally, a balanced state of cash flow can be reached. The objective of the proposed financial model is to achieve a state of balance between revenue sufficiency, equity, and poverty alleviation (Whittington, 2003). With this objective in mind, the financial model integrated real costs calculation and the ability and willingness to pay in the analysis.

Studies related to financial feasibility analysis have been conducted by some scholars. Acheampong and Earl (2020) conducted a study related to feasibility analysis of built-to-rent program in Australia. However, that study focused only on developer's perspective. Liu et al. (2019) also conducted feasibility analysis that focused on rent price determination for PPP rental villages using cost benefit analysis to determine the rent price. Similar to Acheampong and Earl (2020), Czischke and Bortel (2018) discussed the housing development from housing developer perspective.

This research project contributes to filling the current gap in relation to financial modelling for public housing by reviewing project financial feasibility from the perspective of users, housing developers, and the Indonesian Government. It begins by factor identification and then model development from those factors. Discounted cash flow analysis and system dynamics were conducted to build the model as system dynamics provide analytical tools, which enabled forecasting and accommodating of some risks. The financial feasibility study which integrate dynamic analytical tools is still limited. System dynamics is often used for forecasting in some fields (Suryani et al., 2010; Marzouk & Hosny, 2016; Wang et al., 2018) and for designing pricing models (Xu et al., 2012; Wu et al., 2013). Some previous studies also used system dynamics for financial analysis; however, they were limited to pricing for wastewater infrastructure (Rehan et al., 2013) and economic feasibility of private apartment (Lee et al., 2019) without changing any conditions.

Chapter 3: Research Methodology

3.1 INTRODUCTION

The aim of this research was to develop a financial model that could ensure affordability and project feasibility. This section presents details of the research location, the methods used in the study, and the research design adopted to achieve the objective. Since this is a study of public housing investment in rental and ownership schemes, the research process comprised three phases that discuss financial models for public rental housing, low-cost apartments (homeownership), and the development of a financial model using system dynamics, respectively. As the research involved multiple stakeholders in the housing sector, two surveys and semi-structured interviews were utilised in the data collection process.

Section 3.2 discusses the location in which the case study was located, as well as the process of selection of the case study; while the research design is discussed in Sections 3.3 – 3.6, and ethical approval is outlined in Section 3.7. Finally, a summary of the research methodology used in this project is provided in Section 3.8.

3.2 RESEARCH LOCATION

Indonesia was selected as the case study for this research as it an emerging economy that pays significant attention to housing provision in response to poverty alleviation. Two major characteristics of housing markets in emerging economies are that many households self-finance or construct their own home purchase, and that a large portion of household savings do not pass-through financial institutions or markets. China, Indonesia, and India are examples of emerging economies. In addition, Indonesia has experience in involving the private sector in housing development through public-private partnership, the scheme having become an important element of low-cost housing provision. For this reason, efforts to attract the private sector to low-cost housing investment align with both government programs and housing markets in Indonesia.

Policy makers in Indonesia have focused on low-cost housing provision for some low-income groups, contributing to the growth of housing finance and to increasing access to finance for lower and informal income households. Indonesia now has a significant public housing program. However, it also has specific problems around price determination. For the most part, price determination depends on ability and willingness to pay; it is not only about affordability, but also about real public housing cost and tenants' willingness to pay. Willingness to pay rent is low, an observation evidenced by 30% of potential revenue from rental not being paid by tenants. This results in public housing suffering deficits, which results in high government subsidy of housing (Rachmawati et al., 2018b). This phenomenon results in a lack of affordable housing supply, as fewer developers involve themselves in affordable housing investment, leading to high housing backlogs. Even though Indonesia continues to run significant housing provision programs, the housing backlog remains high, with 7.6 million units provided up to 2019 (Ministry of Public Works and Public Housing). This is the background context for the selection of Indonesia as a case study in this research.

As demonstrated in the previous two chapters, The Indonesian Government has attempted to enable wider access to applicants/potential homebuyers to own their homes. Most housing programs are dedicated to low-income communities, those who have limited ability to pay for a house (*Public rental housing* act 2011 s.20 (Indonesian)). The government subsidises this group in the form of liquidity facilities in housing finance, programs that involve government ministries and local governments (Indonesia Ministry of Public Works and Public Housing, 2018). The government ministry responsible for the housing sector was invited to participate in the survey for this research. However, not all local governments were included. A selection process was used because working with multiple data sets and involving a large number of areas was difficult. Practically speaking, an entire data set would not necessarily be of importance and could contain redundant information (Bairagi & Munot, 2019). Therefore, case study selection involved specific criteria, such as population density, housing backlog, and the initiation of housing provision programs. The case study selection process is depicted in Figure 3.1.

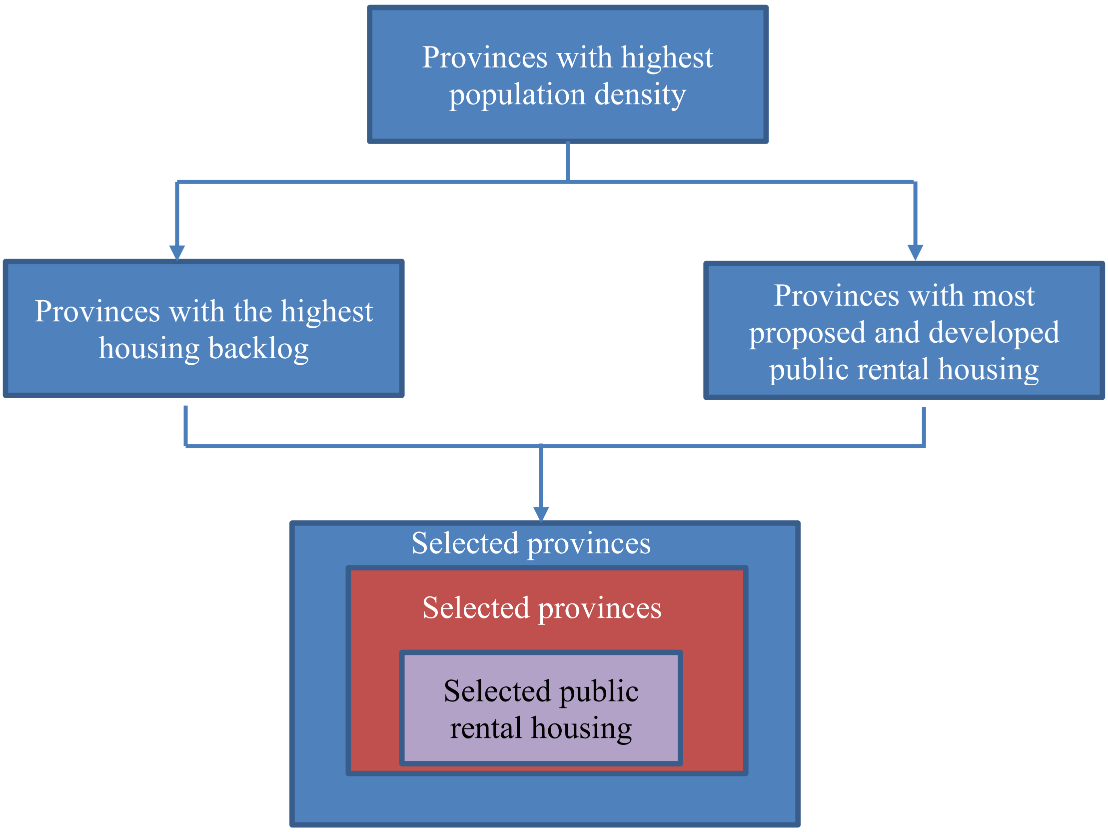

Figure 3.1 Case study selection process

Indonesia has three tiers of government, of which provincial and district/municipal are the second and third tiers, respectively. The country has 34 provinces and a total population of 272 million as of 2020 (Statistical Bureau, 2020). The population is mostly concentrated in five large islands, especially the Java Island, where the centres of education, trade and government are located (Liu and Yamauchi, 2014). West Java Province, with a population of 43 million, has the largest population, while DKI Jakarta is the province with the highest population density. The rate of urbanisation in Indonesia is predicted to reach 66.6% by the year 2035 (Bappenas, 2013), of whom 67% will live in the Java Islands. There are six provinces in the Java Island, namely Banten, DKI Jakarta, West Java, Central Java, DIY Yogyakarta, and East Java. Riau Islands constitutes one province in Indonesia, consisting of seven municipalities, with 2,408 islands (Riau Islands Government, 2019). The most populated island is Batam Island. The population density of these provinces is shown in Table 3.1.

Table 3.1 The top 10 population densities of provinces in Indonesia (source: Statistical Bureau, 2019b)

No	Province	Population density (person/km^2)	Capital city of province	Population density (person/km^2)
1	DKI Jakarta	15,804	Jakarta	15,804
2	West Java	1,394	Bandung	14,357
3	Banten	1,338	Serang	2,582
4	DIY Yogyakarta	1,227	Yogyakarta	1,227
5	Central Java	1,058	Semarang	4,780
6	East Java	831	Surabaya	8,811
7	Bali	750	Denpasar	7,500
8	Riau Islands (in Batam Islands)	244	Batam	1,100
9	South Sulawesi	189	Makasar	6,647

Source: Statistical Bureau (2019b)

Due to high population density, some local governments suffer from serious housing backlog problems (Indonesia Ministry of Public Works and Public Housing, 2020). While the Indonesian Government is trying to build housing supply, they continue to experience major problems. The provinces with high housing backlogs are listed in Table 3.2 below.

Table 3.2 Housing backlog in some provinces

No	Province	Housing backlog (unit)
1	West Java	2,320,197
2	DKI Jakarta	1,276,424
3	North Sumatera	1,033,147
4	East Java	950,557
5	Central Java	785,061
6	Banten	584,263
7	Riau Islands (in Batam island)	163,566
8	South Sulawesi	287,279

Source: Ministry of Public Works and Public Housing (2019)

Research did not examine the management of public housing in all the provinces with high population density and a high housing backlog – the term backlog referring to an under provision in housing that has accrued against previous development plan targets due to high levels of urbanisation, poverty, or high unemployment (Pillay & Naude, 2006). Most provinces with high population density in effect suffer from housing backlog problems, except for Bali, which has high population density, but does not face a housing backlog. The selection of case studies for this research project was based on the provinces that had significant experience in offering and managing public housing for regular tenants and/or relocated tenants.

Current practice in Indonesia is for public rental housing to be constructed by a government ministry on local government asset land (Indonesian Ministry of Public Works and Public Housing, 2012). The local government supports the program by providing the land, which it offers to the Ministry. This process of proposals for the development of public rental housing in the provinces by provincial and municipal governments – especially municipal governments of capital cities – happens every year, with the intention of reducing housing backlog in the provinces. Table 3.3 identifies the top five municipal governments that have managed public housing in Indonesia in the last 10 years, with most construction happening in the capital cities. These local governments (municipalities) have significant experience in operating low-cost apartments, which have regular and/or relocated tenants.

Table 3.3 Number of constructed public rental housing in the last 10 years

Province	Capital City	Number of public rental housing
East Java	**Surabaya**	**4901**
Riau Islands	**Batam**	**1546**
South Sulawesi	**Makassar**	**1746**
West Java	**Bandung**	**1356**
Jakarta	**Jakarta**	**1000**
Central Java	Semarang	816
North Sumatera	Medan	384
Papua	Jayapura	288

Source: Indonesian Ministry of Public Works and Public Housing, 2018

As shown in Table 3.3, population distribution is settled in capital cities, and local governments in those cities are more active and concerned with housing provision problems. Most public rental homes have been built in capital cities – an observation that aligns with the findings of Benassi et al. (2020), who reported that a capital city will always be more attractive and attract particular attention. This research project, therefore, focused on the provincial capital cities of Surabaya, Batam, Makassar, Jakarta, and Bandung. Makassar was selected even though the population density in this city is not as high as other cities. However, the local government has anticipated in addressing housing backlog by providing more public rental housing.

Seawright and Gerring (2008) made the argument that a suitable case study should be a representative sample and provide useful variation on the dimensions of theoretical interest. The selection of public rental housing was based on the tenants. Public rental housing in Indonesia is occupied by regular tenants and/or relocated communities, therefore identified public rental homes were selected to represent public housing occupied by these two groups of tenants, as listed in Table 3.4. The case study cities are described below, while observed public rental housing in each city are described in detail in Chapter 4, Section 4.2.1.

Table 3.4 List of observed public rental housing

No	Area/City	Number of observed public rental housing	Public rental housing	Relocated tenants	Regular tenants
1	Bandung	1	Cingised	√	√
2	Batam	2	Muka Kuning, Batu Ampar		√
3	Jakarta	1	Rempoa		√
4	Makassar	2	Lette, Panambungan	√	√
5	Surabaya	1	Gunungsari	√	

Bandung

Bandung is located in West Java province in Indonesia. Based on the 2015 census, as the capital city of West java province, Bandung is Indonesia's fourth major city after Jakarta, Surabaya, and Medan, with over 2.5 million inhabitants. The housing backlog in Bandung is 636,829 units. Based on the pilot survey, participants stated that there are six low-cost rental apartment developments in Bandung. This study selected Cingised as one of these developments to represent public rental housing occupied by relocated and regular tenants.

Batam

Batam is the main city, which located in one of the major islands of Riau islands. Riau islands is officially part of the province of the Riau Islands. The islands have three major islands, Batam, Rempang, and Galang (collectively called Barelang), as well as several small islands. Batam Island is the major urban and industrial estate compared to other islands. The islands among Riau islands are connected by bridge (Wikipedia, 2019). There are five public rental housing developments in Batam. This study selected public rental housing Batu Ampar and Muka Kuning as the observed public rental properties. All public rental housing in Batam is occupied by regular tenants. Tenants in these public rental housings are mostly industrial employees, who have fixed incomes.

Jakarta

Jakarta is officially the Special Capital Region of Jakarta, the capital and largest city in Indonesia. This city, which is located in the Java Island, is considered as the centre of the Indonesian economy, culture, and politics, with a population of more than ten million as of 2014. There are 19 public rental housing and three low-cost apartment developments in Jakarta. Public rental housing Rempoa was selected for the case study, a public rental development in Jakarta occupied by Ministry of Public Works and Public Housing staff. This building is therefore, operated and funded by the Ministry. It has nine floors and 234 units. The development has two types of homes: shared units and family units.

Makassar

Makassar is the capital city of the South Sulawesi province, which is located on the southwest coast of the island of Sulawesi. Among the cities in the region of Eastern Indonesia, Makassar is the largest city. It is also considered as Indonesia's fifth major city after Jakarta, Surabaya, Bandung, and Medan. There are three low-cost rental apartment buildings managed by the Makassar Municipal Government. Lette and Panambungan were chosen as the case studies for this research. They are located in the city centre and are occupied by relocated and regular tenants.

Surabaya

Surabaya is the capital of the East Java and province is the second-largest city in the country after Jakarta, with a population of over three millions. The housing backlog in East Java province reached one million units in 2019, with more than half in Surabaya. There are 17 public rental housing developments managed by the Surabaya municipal government and five managed by the East Java provincial government. This study used the Gunungsari low-cost rental apartments as the case study to represent public rental housing for relocated communities.

The case study selected for investment feasibility analysis was apartment managed by Perumnas. This apartment, located in Depok (greater Jakarta), is occupied by low-income and moderate-income buyers. For this reason, this public housing development was deemed suitable as the case study of model validation.

3.3 RESEARCH DESIGN

This study integrates qualitative and quantitative research methodologies, involving analysis of both kinds of research data in many phases across the whole research process (Taguchi, 2014). Riazi and Emami (2018) also applied mixed methods in their housing research project to examine the effect of planning policies, design, and neighbours on residential satisfaction. Qualitative research is mainly used to understand, describe, and explain social phenomena. This type of research is conducted by documenting analysing the interactions between individuals or groups (Durdella, 2020). Hyde (2000) defined qualitative research in generic terms as "a form of social inquiry that focuses on the way people make sense of their experiences and the world in which they live". In this study, qualitative research was used to gather data regarding the participants' opinions about the most relevant factors that influence public housing and housing policy. Quantitative research was adopted to support the research through numerical analysis regarding the financial model, including rent price determination, investment feasibility analysis, and model development.

Graaskamp (1981), which was cited by Reed (2021), suggested that the housing development process requires involvement from major stakeholders, including space users, space production groups and infrastructure expertise. In this study context, these major stakeholders were adopted. This research involved multi-stakeholders of public housing investment examined from the perspectives of multiple stakeholders from the housing sector. The study did not just involve housing providers, but also government and users (low-income tenants and buyers), as each stakeholder had different roles and different perspectives (Markmann et al., 2013).

This multi-stakeholder approach improved the general validity of observations or conclusions concerning public housing development. The different stakeholders involved in the study are depicted in Figure 3.2.

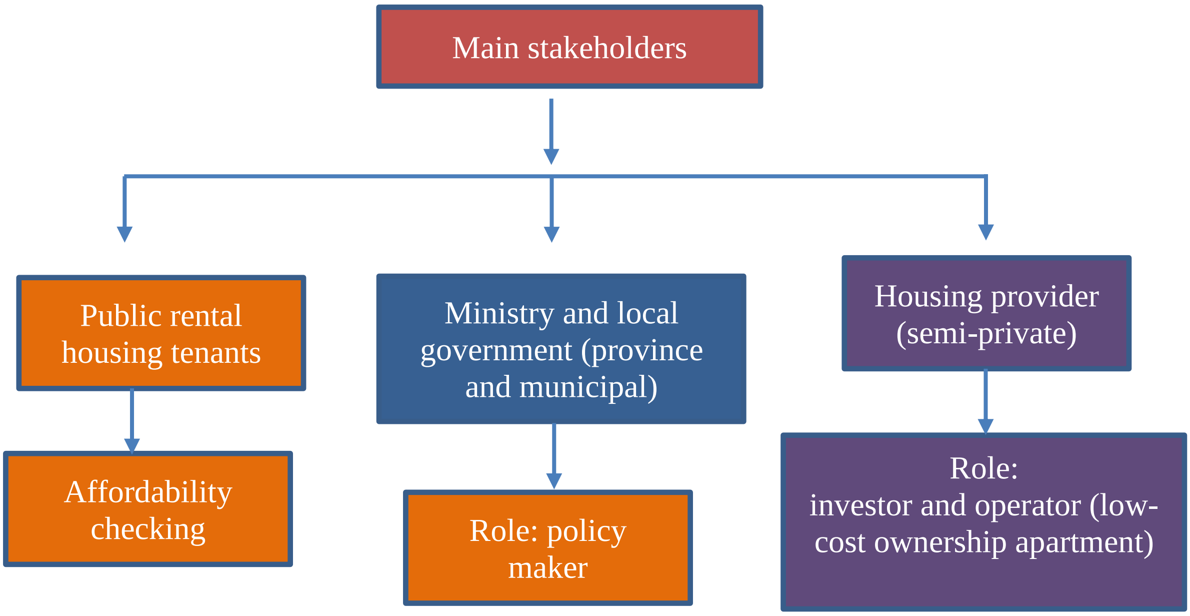

Figure 3.2 Multi stakeholders in the study

The study also examined two public housing schemes, namely, rental and home ownership. Public rental housing was examined as it is one of the key government programs to reduce housing backlog, considered a stepping-stone for low-income communities before they are able to buy their first home (Soemitro & Rachmawati, 2017). Low-cost apartments are public housing in the home ownership scheme, high-rise low-cost apartments dedicated to low-income communities (Mailiando et al., 2018). This scheme can involve the private sector, which can make money from the investment.

Affordability checking was conducted as a tenant's affordability is very critical in the context of public housing. The predetermined rent price should be in alignment with tenants' affordability. As rent prices are regulated by the local government based on guidance from the Ministry, a survey was conducted with both local government and Ministry personnel. Another main stakeholder in low-cost apartment development was the housing providers, who were mostly semi-private companies.

In order to capture multi perspectives and to focus on multi objectives, the research was designed in three phases. First, the research approach is discussed to provide a brief explanation in relation to tenants' ability and willingness to pay by collecting data related to household income and residential preferences. Second, the investment feasibility and affordability analyses were carried out to conduct feasibility analysis from the housing developer's perspective, as well as in terms of tenants' and buyers' affordability. Finally, the development of the model, using system dynamics, was conducted in Phase 3. Details about the research framework are presented in Figure 3.3 and Table 3.5, while details of each phase are explained in Sections 3.4–3.6.

The three phases were conducted through two phases of fieldwork. The first fieldwork for data collection stretched over eight months from January–October 2019 (including pilot survey which was conducted from January – April 2019). The targeted respondents were public rental housing tenants. In this phase semi structured interviews, questionnaires, and secondary data collection were also conducted with government officers and semi-private housing providers.

The second phase of fieldwork was conducted between December 2019 and January 2020, during which time additional secondary data were compiled from the project and member checking was conducted.

All data collection was conducted in an ethical manner guided by QUT policy to minimise any potential risk to respondents. Ethical clearance was received, and Commonwealth and State regulations complied with in the data collection process.

Table 3.5 Integration of Research Questions, Research Objectives, Research Methods, and Data Analysis

Phase	Research Questions	Research Objectives	Research Methods	Data Analysis	Outcomes	Chapter
1	Development of a financial model for public rental housing: 1. How does tenants' affordability –willingness to pay and ability to pay – affect public housing rent prices? 2. What factors influence public housing rent price determination? 3. How can public housing rent prices be determined using income-based, cost-based, and discounted market-based approaches? 4. What is the role of investment feasibility analysis in public rental housing?	To develop a financial model for public rental housing. 1. To measure tenants' affordability through willingness and ability to pay the public housing rent price. 2. To identify factors influencing public housing rent price determination. 3. To determine public housing rent price using income-based, cost-based, and discounted market-based approaches 4. Public rental housing investment feasibility analysis.	1. Tenant survey (184 respondents) 2. Public rental housing provider survey (18 respondents)	1. Descriptive statistic 2. Three rent price determination approaches 3. Housing to income ratio 4. Discounted cash flow	1. Tenants' ability and willingness to pay 2. Factors influencing rent price determination 3. Rent price determination using three approaches 4. Feasibility analysis for public rental housing	Chapters 4 and 5

2	Development of a financial model for low-cost apartments: 1. What are the critical factors for low-cost apartments (home ownership) development? 2. What are the issues associated with home buyers' affordability for home ownership? 3. What is the role of investment feasibility analysis in relation to low-cost apartment?	To develop financial model for public rental housing 1. To identify the critical factors for low-cost apartment (homeownership) development? 2. To examine home buyers' affordability for homeownership 3. To examine investment feasibility analysis of mixed-income low-cost apartment with transit-oriented development concept	1. Semi-structured interviews (18 participants) 2. Secondary data review	1. Thematic analysis 2. Discounted cash flow 3. Scenario analysis 4. Sensitivity analysis	1. Proposed scheme and consideration factors 2. Home buyers' affordability analysis 3. Feasibility analysis for low-cost apartment	Chapters 4 and 6
3	How can system dynamics be used to develop as an investment feasibility model for public housing development?	To develop the investment feasibility model for public housing development using system dynamics to depict and analyse the change of investment variables.	Secondary data review	System dynamics	System dynamics model for feasibility analysis	Chapter 7

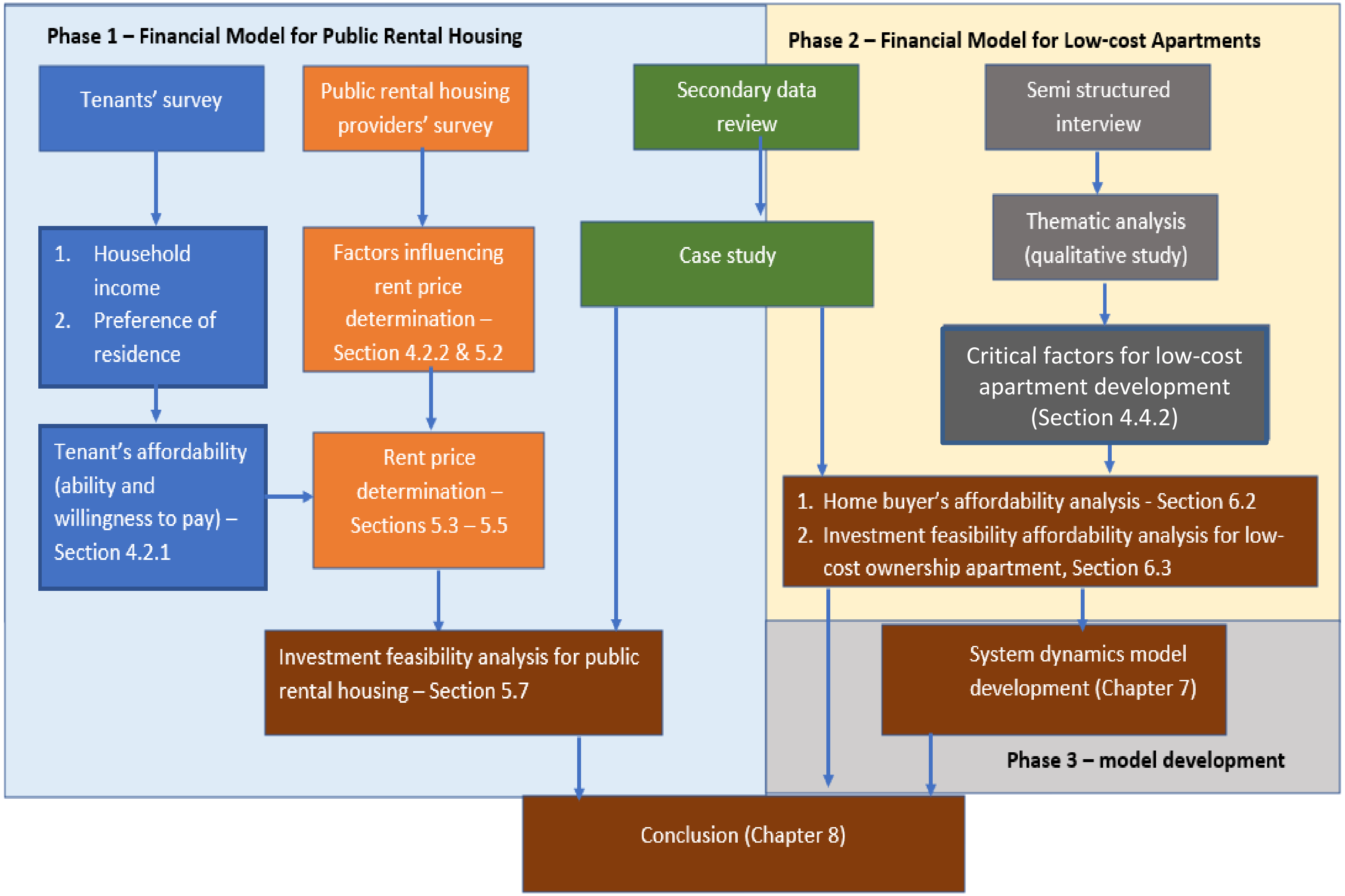

Figure 3.3 Research design

3.4 RESEARCH PHASE 1 – FINANCIAL MODEL FOR PUBLIC RENTAL HOUSING

In Phase 1, two questionnaire surveys were conducted with tenants, housing providers, and government officers. The surveys are discussed below.

3.4.1 Tenant survey

The survey, conducted in the first phase of fieldwork, collected data on tenants' current conditions in terms of household income and housing costs. Information on current conditions was required as the research needed to evaluate existing public housing rental prices in order to determine more appropriate ones. The survey also investigated tenants' preferences in terms of substitute dwellings if they did not live in public rental housing, as input from tenants was required based on their current experiences and prior to becoming public rental housing tenants. The tenant survey was administered face-to-face with public rental housing tenants from seven public rental developments in Jakarta, Batam, Bandung, Surabaya, and Makassar, as listed in Table 3.1, and presented in detail in Section 3.2. As public rental housing is occupied by two types of tenants, the questionnaire was distributed to both groups: relocated communities and regular tenants.

Surveys were conducted face-to-face using electronic/online formats during July – October 2019, where respondents filled out their responses to the questions through a survey device. The coordinator of public rental housing tenants selected available tenants as respondents on each floor of the buildings. Variety of rent price in public rental housing depends on the height of the units, which mostly it is lower in the top floor, compared to first and second floor. The first floor is mostly allocated for public facility and unit for elderly. The targeted respondents are listed in Table 4.1. The questionnaires were directly administered to respondents using stratified random sampling on each floor, so tenants were selected to represent each floor. The observation on observed public rental housing was also conducted while conducting tenant survey. Initial target are 200 respondents, however only 184 respondents (92%) filled out the survey due to tenants' availability.

The tenant survey was designed to inform rent price determination using the income-based approach and the market-based approach. The respondents were asked two questions.

First question

The first question related to monthly expenses, including.

1. monthly housing cost
2. daily needs
3. education costs
4. electricity bills
5. transportation costs
6. clothes
7. health insurance
8. telecommunication costs

Anticipating possible unwillingness on the part of respondents to divulge information related to their income using monthly expenses, summations of monthly expenses were assumed as actual household income. The eight expenses itemised above were considered the main household expenditures. The data collected were used to calculate tenants' ability to pay for rental housing. The household expenditure also showed the current housing cost or low-cost apartment rent price. The ability to pay was calculated using the affordability benchmark of 30% of total household income.

Descriptive statistics were used for data analysis using Microsoft Excel. As a spreadsheet, Excel can run various critical functions for data entry, such as recapitulation, presentation, and the statistical analysis function (Lee et al., 2018). In practical terms, this program is easy to use and makes effective comparisons.

Second question

Tenants were then asked to name their alternate substitute dwellings if they did not live in public rental housing or their dwellings prior to living in public rental housing. Substitute dwelling data were used to estimate tenants' willingness to pay. In a public housing context, where there is no 'priced market' as a comparison with the direct market, a sub-market approach was used to measure the value of personalised recommendations that influence consumer preferences (Zhang & Bockstedt, 2016)

The options included living in a boarding house, renting a house, and building self-help housing. These three options are the most popular living options for low-income communities, especially migrant communities (Ardiansyah, 2009). They live in boarding houses with shared or private bathrooms or rented houses – 2-bedroom landed houses – with a total area of around 60 sqm.

Preferred locations are downtown, suburbs, industrial or rural areas. Some public rental housings are occupied by industrial company labourers (Rachmawati et al., 2015). Therefore, industrial areas were also included in the options. Descriptive statistics were used for the data analysis. Three data sets were obtained from the questionnaire survey: the actual household income, the cost of living in a low-cost apartment, and the tenant's direct substitute dwelling.

Data relating to household income and the ability and willingness to pay were calculated for each city – Bandung, Batam, Jakarta, Makassar, and Surabaya. Each had its own market price for tenants' preferred living options. The data were then analysed using descriptive statistics, such as median analyses. The results are reported through diagrams, charts, and tables (Chapter 4).

3.4.2 Public rental housing providers' survey

This survey, conducted in the first round of fieldwork, collected data related to factors considered when public housing rent prices are determined. The survey was carried out to obtain input from participants in response to questions related to these factors. They were asked to validate their responses by adding relevant variables or removing irrelevant variables. A second questionnaire survey was administered to the same participants in semi-structured interviews. Details relating to respondents are presented in Chapter 4.

The key players in terms of existing public rental housing are the ministry and local government. The survey therefore was conducted with government officers in the public rental housing sector from three tiers of government: Ministry, provincial, and local. These three governing sectors have significant experience and are responsible for public rental housing deliverables and management, and one of their responsibilities is to determine and to evaluate rental prices (Rachmawati et al., 2015).

Respondents of this study who were semi-private developers were seen as decision makers in public housing divisions and had experience in providing public rental housing. Currently, private housing developers are not typically involved in public rental housing provision. In East Java Province, only one private sector organisation has been involved in public rental housing operations (Soemitro & Rachmawati, 2017).

The respondents in this survey were the same who participated in the Phase 2 survey related to low-cost apartments. The survey and the semi-structured interviews were conducted at the same time, as local government ownership and rental housing are operated by the one division of the department; while in the Ministry, ownership and rental housing are managed by two different departments. The semi-structured interviews with the people in charge were conducted at the same time and in the same place in a discussion forum that allowed for the sharing of knowledge and experience.

In order to address the first research objectives, important factors related to rent price determination were identified and correlated. The proposed variables are listed in Table 3.6.

Table 3.6 Factors influencing rent price determination

	Variables	Source
Macro levels	Household income	Yuan et al (2017)
	Location	(Kolbe & Wüstemann, 2014; Oloke et al., 2013)); (Clausen & Hirth, 2016)); Aluko (2011); Dewita et al., 2018
	Neighbourhoods	Miller & Peng (2006)
	Total urban population	Yuan et al (2017)
	Urban economy	Yuan et al (2017)
	Urban amenities	Yuan et al (2017)
	Demographic factors	Yuan et al (2017)
	Mortgage features	Miller & Peng (2006)
	Government policy	Yuan et al (2017)
	Household living standards	Miller & Peng (2006)
	Supply and demand	Miller & Peng (2006), Yuan et al. (2017)
	Housing cost (land, cost recovery and construction cost)	Du et al. (2011); Chan & Adabre (2019); Ali et al., 2010; Park et al., 2019; Assaf et al., 2010)
Micro levels	Architectural elements	Yuan et al (2017); Cui et al. (2018)
	Neighbourhood features	Yuan et al (2017); Su et al. (2021)
	Indoor facilities	Yuan et al (2017); Su et al. (2021)

There are two branches of statistical analysis: descriptive and inferential (Byrne, 2007). This study used descriptive analysis to analyse respondents' answers and to provide description and interpret statistical output, specifically participants' responses. The explanation and results of this analysis are discussed in Section 5.2, Chapter 5.

3.4.3 Secondary data review

Document review and analysis in this research was conducted in relation to public rental housing and low-cost apartment in order to support the analysis, especially those which is closely related to case study. The analysis will identify existing problems and existing conditions. The formats and genres of documents varied, including planning documents, guidelines, policies and regulations, and public rental housing reports. Documents of policies and plans related to low-cost apartment management were analysed to calculate the project viability analysis. Those documents were gathered directly from stakeholders and indirectly from the literature or regulation. Secondary data were collected from their respective sources, with due care being taken about relevance, adequacy for the research objective(s), accuracy, reference to the time period of interest, operational definitions of terms and phrases used, and methods of data collection and validation. Similar data from different sources were sometimes pooled with necessary care (Mukherjee, 2020).

Some secondary data were in the form of government regulations, which were used for the calculation basis or guidance, for example, data related to subsidy limitations. Secondary data that were 'primary' data already collected by some agencies – public or private – on a regular or an ad hoc basis were obtained from relevant sources. Data on socio-economic aspects of the country or region, as well as demographic data, are routinely collected by public authorities and can be accessed for research purposes (Mukherjee, 2020).

In order to support the model's development and validation process, data related to public rental housing management and public housing project financial data were gathered in the second round of fieldwork, as listed in Table 3.7.

Table 3.7 Secondary data

No	Data	Source	Used in relevant analysis
1	Number of units in public rental housing	Local government	Financial feasibility for public rental housing analysis
2	Actual public housing rent price	Local government	
3	Public rental housing initial cost (land and construction cost) as the basic price	Local government regulation	
4	Public rental housing operation and maintenance cost as the basic price	Local government and Ministry of Public Works and Public Housing	
5	Regional minimum wage 5 cities	Internet (published data)	
6	Market price of substitute dwelling	Internet (published data)	
7	Construction cost index	Internet (published data)	
8	The relevant building regulation in the location of case study	Case study project (housing provider)	Investment feasibility and affordability analysis
9	The relevant regulation related to predetermined housing price and government subsidy (subsidised price, eligible tenants to get subsidy)	Ministry of Public Works and Public Housing	
10	Operation and maintenance costs of low-cost apartments	Private apartment in Surabaya (typical high-rise apartment)	
11	Project data (construction costs, property data)	Case study project (housing provider)	
12	Loan capital and loan repayment rate and period	Financial institution (bank)	
13	Sales price	Case study project (housing provider)	
14	Inflation rates, taxes	Internet (published data)	

Previous studies of the affordable housing sector have successfully employed secondary quantitative data analysis as a data collection method. For example, Acheampong and Earl (2020) investigated the financial viability of built to rent in Australia. Their study succeeded in highlighting the whole life cost using data on construction costs, operating and maintenance costs, and other costs associated with the building operation and management as estimated by WT Partnership Australia. Similarly, Copielllo (2015) also used secondary data to examine the combination of public private partnership and building energy efficiency for affordable housing investment.

On the other hand, in their Malaysian-based study, Daud et al. (2020) employed semi-structured interviews to explore alternate fund-raising for affordable investment. Their study made a significant contribution to the knowledge base, combining semi-structured interviews, questionnaire surveys, and secondary data to analyse public housing investment and enhanced previous studies on public rental housing by providing rent price determination analysis prior to investment analysis. Regarding secondary data collection, their study also highlighted the use of a construction cost index approach to adjust the calculation of public rental housing investment in different cities. A further element of secondary data enhancement achieved in their study was the calculation of subsidy and non-subsidy schemes with types of units analysed: studio, 1 bedroom and 2 bedrooms.

3.4.4 Quantitative analysis for a financial model for public rental housing

For this study, investment analysis for public rental housing was conducted in two stages:

Rent price determination

This was determined using three approaches: income-based, cost-based, and discounted market-based approaches, as explained in Table 3.8. This section determined rent prices using three approaches with different calculation bases. The income-based approach was calculated based on tenants' household income, both actual household income (survey) and regional minimum wage (secondary data). The approach used in this investigation is similar to that used by Chen et al. (2007) in their study in Taiwan.

Table 3.8 Rent price determination approaches and data needed in the analysis

Rent price determination approach	Data used	Source
Income-based	Actual rent price and number of units	Secondary data
	Actual household income	Primary data (survey of tenants)
	Regional minimum wage	Secondary data
Cost-based	Public rental housing operation and maintenance costs	Secondary data
Discounted market-based	Market price of substitute dwellings: Boarding house Rent a house Self-help housing	Secondary data
	Tenants' preferences	Primary data (survey of tenants)

The cost-based approach was determined by operation and maintenance costs. Guerreiro and Amaral (2018) adopted a similar approach but focused on comparison of cost-based and value-based pricing. Compared with that study, a cost-based approach was employed in this study to determine rent price, although a market-based approach was subsequently also used to examine rent price determination. The substitute method was adopted due to there being limited possible comparison of public housing market prices (Bangura & Lee, 2020). Secondary data were required to determine the cost in relation to direct substitute dwellings, information obtained from market property data proving useful to assess the 'willingness to pay' calculation. This element of the questionnaire aimed to find comparable market rent price data.

These approaches were then compared, and the housing cost-to-income ratio was calculated to measure tenants' affordability. The ideal ratio is less than 30%, as noted elsewhere (Nepal et al., 2010). It is in accordance with many Australian research findings, which have applied the 30/40 rule, meaning that housing costs should not exceed 30% of the bottom 40% income strata of a household's income (Cai & Lu, 2015). The analysis of this element is presented in Sections 5.3–5.6 in Chapter 5.

Investment feasibility analysis

The investment feasibility calculation was conducted using the discounted cash flow method in Microsoft Excel. Details about the calculation are explained in Section 5.7 in Chapter 5. The case study in this basic calculation for investment analysis of public rental housing was a mixed-housing apartment in Jakarta, the capital city of Indonesia. Mixed-housing apartments have just been developed in Jakarta, but analysis was also conducted for four other selected cities, using the hypothetical case study of mixed-housing apartments in Jakarta with relevant adjustments, such as construction costs. The construction cost index (secondary data) was used as the basis of calculation of construction costs, as construction costs differ for each city.

Arranging cash flow required a life cycle cost analysis of each component, as well as of discounted cash flow in order to calculate the net present value with respect to the time value of money. Feasibility investment analysis was underpinned by mathematical financial analysis. In this analysis, the primary method used to express the annual cost and revenue was discounted cash flow (DCF). The fundamental concept of DCF analysis was the time value of money, which took into account the fact that cash flows occur at different times and was adjusted to the net present value (NPV) using discount rate quantification (Brown, 2016). In the context of public rental housing the rent price was part of revenue or cash inflow, the net current value then being calculated to examine the feasibility of the project. The NPV indicates feasibility by calculating the present value of a series of future payments minus a stipulated capital cost rate. When the calculated NPV is positive, the investment is economically viable. Cash flow is described in the following sections.

Cash outflow

The cost of public housing projects mainly includes total construction investment and operation costs (Wilkins et al., 2015). The total cost is derived from the construction cost estimation, which includes the physical building engineering fee and installation fee. Based on the *Building construction technical guidance* Minister of Public Works and Public Housing regulation 2007 s.45 (Indonesia), in this study, the initial cost also included consultant and management fees, and consultant fees encompass planning and controlling fees, which were assumed as a percentage of the construction cost.

For this study, operation costs referred to the day-to-day expenses incurred in running public housing projects, such as water bills, electricity bills and wages; while maintenance costs included building repair and maintenance, and also road access maintenance. Meanwhile, the cash outflow was classified into fixed and variable costs; initial costs or capital expenditure and operating expenses for public infrastructure categorised as fixed costs; while statutory expenses and operating expenses for each unit were categorised into variable costs, and inflation and interest rates were predicted in accordance with the planning horizon.

Since this study employed a real case study that was not yet operational, operation and maintenance costs were calculated from historical data of typical high-rise apartments which was also used to predict the escalation of operation and maintenance costs. Generally, life cycle costs are divided by separating operational costs into two categories: (1) regular, expected, operational costs; and (2) non-regular expenses. This division allows for possible factors of life cycle changes (Wilkins et al., 2015). In the present case study, factors were divided into internal factors and external factors (Arja et al., 2009), with only the internal factors focused on, as external factors included more uncertainty than the internal ones. For long term projection, they were then calculated using the time value of money. One indicator to measure economic changes is inflation. As most costs are subjected to inflation; it was therefore important to include realistic forecasting to predict inflation variations over time.

Cash Inflow

For this study, revenue from public housing was determined by rent, the lease of commercial areas, parking areas and many kinds of government subsidies. It should ensure that the project was financially viable, with revenue covering operational and maintenance costs. The investment period in this study was designed within the time span in which the investment was expected to be returned before the end of the investment period. Three rent prices were used in this analysis, income-based, cost-based, and discounted market-based rent prices.

Following the discounted cash flow analysis, this study also employed scenario analysis to examine the implications of government subsidies. Government subsidies were investment feasibility parameters referenced in this study and are different to other investment analysis. Government subsidies may come in many ways, such as grants, mortgage loans and operation subsidies. They reduce the rent or purchase price tenants pay. Some government subsidy schemes were analysed in this study to examine their effect on both developers and buyers. A study argued that subsidy level will decrease when household income increases; thus, it also influences the marginal effect (Van ommeren & Vlist, 2016).

3.5 RESEARCH PHASE 2 – A FINANCIAL MODEL FOR LOW-COST APARTMENTS

The primary data collection through semi-structured interviews was carried out with selected participants in the first round of fieldwork, the data being in the form of participants' opinions in relation to the most relevant factors influencing public housing rents and housing finance policy. Secondary data collection related to low-cost apartments as listed in Table 3.5, was conducted in the second round of fieldwork in order to support the analysis.

3.5.1 Semi-Structured Interviews

The interview method is often used when questions are complex, and the presence of the interviewer will help to enhance the interviewer-respondent rapport (Opdenakker, 2006). The semi-structured interview is the most common method used in qualitative research, as it aims to gather descriptions of interviewees' experience with respect to interpretation of the described phenomena (Opdenakker, 2006). Interviews also allow respondents to raise additional issues. The semi-structured interview is suitable for use in the context of exploring certain issues to assist in the formulation of policy (McGrath et al., 2019). A research project conducted in Malaysia by Yap and Ng (2018) used semi-structured interviews to explore the affordability of the Malaysian housing market, the sufficiency of affordable housing, and factors influencing housing affordability in Malaysia. This study conducted semi-structured interview to the major stakeholder in housing sector, including participants from developers and real estate agencies. The expert from industry were also interviewed for validation purpose.

In order to obtain valid and qualified answer, the interview was conducted to decision makers on housing sector, such as top management on housing department in ministry government and local government. Therefore, purposive and snowball sampling was the most suitable method. Using snowball technique allows one interviewee to recommend other competent participants, such as government officers and key contacts in housing provider companies. In the snowball sampling technique, the interviewer has reached all key participants when no new contacts were suggested by participants of semi-structured interviews. This method is useful in building a network for specific research when the specific population is yet to be made available (Etikan et al., 2016). Respondents were recommended by the initial respondent interviewed and suggested as they were considered experts in the problem area. The participants from ministry government were capable and know exactly the phenomenon related public housing in Indonesia. The semi-structured interviews to decision maker in local government in July to October 2019, while interview to decision maker in ministry government and housing companies were conducted during August 2019. Even though the respondents are decision makers, they are limited and small in number, however, due to their role who capable and know exactly the phenomenon related public housing in Indonesia, they could generalise the population.

As this study involved multiple stakeholders, the interviews were undertaken with two groups of participants: (1) participants from the public sector or government, which has authority for planning and stipulating policy on housing provision at national or local government level; and (2) semi-private developers who had experience in housing development. The participants were the same as those involved in the public rental housing's provider survey.

Initially, a formal letter was delivered to certain department of ministry and local government that managed regulations for housing provision in Indonesia. The next step was to approach appointed or recommended participants from the semi-structured interview phase who had been appointed by their organisation and are willing to make a time to continue their participation in the research, and to contact them through a formal phone message. Fortunately, they were willing to be interviewed and also recruited another relevant participant to join the discussion. As a result, 16 participants eventually took part in the interview phase. All participants from both government and semi-private developer groups were interviewed face-to-face in their offices.

The questions asked in the semi-structured interviews are attached in Appendix A. They were designed to elicit participants' opinions regarding housing financing schemes for public rental housing. Participants were also asked some questions related to current housing finance policy and future housing provision programs.

3.5.2 Analysing Qualitative Data

The results of the semi-structured interviews were analysed using thematic analysis, an approach categorised as one of qualitative analysis. Braun and Clarke (2006) defined thematic analysis as a method of identifying, analysing, and reporting patterns (themes) within data. It was deemed a suitable method for this study, which did not require a high level of interpretation (Vaismoradi et al., 2013). The data from the interviews were coded under particular categories and themes to assist in gaining deeper insights. The results are presented in tables, charts, and graphs to communicate useful information. More detailed analysis is provided in Chapter 4.

3.5.3 Quantitative elements of analysis for investment feasibility

Investment feasibility analysis was also conducted in relation to low-cost apartments, as discussed in detail in Chapter 6. It followed the same procedure as investment feasibility analysis for public rental housing, using the discounted cash flow method. However, there was different revenue as the low-cost apartment system sells the unit. As noted previously, public housing revenue is determined by the sale of units, the lease of commercial areas, parking areas and various kinds of government subsidy. The project must be financially viable, which means the revenue covers the operation and maintenance costs. The investment period is designed in relation to the time span in which the investment is expected to be returned before the end of the investment period (Vajpayee & Sarder, 2020). Following on from the discounted cash flow analysis, this study also employed sensitivity analysis and scenario analysis.

Sensitivity analysis is commonly considered as *what-if* or *simulation* analysis. It is part of financial model that analyse the impact of changing variables known as input variables to the whole cash flow. It is a way to predict the outcome of a decision in relation to a certain range of variables (Vajpayee & Sarder, 2020). There are some possibilities of change within variables, such as:

- expected return;
- increased operation costs;
- number of subsidised units;
- number of subsidised units based on changing of type composition.

In this study, scenario analysis was carried out in *optimistic* (most likely), *pessimistic*, and *without government subsidy* conditions. The most likely scenario was the base model, while the optimistic scenario was performed to examine favourable conditions, and the pessimistic scenario was applied to investigate the negative impact of COVID-19 to financial viability (Acheampong & Earl, 2020).

3.5.4 Confirmation of findings

Confirmation of the findings is conducted in the end of analysis to ensure accuracy. Confirmation or validation of the findings means the researcher has administered the validation procedures to ensure the credibility and accuracy of the findings (Creswell, 2015). Many procedures can be used to validate findings in qualitative research; Creswell (2015) identified three that are key, namely: triangulation, member checking, and an external audit.

This study employed member checking as a means of confirming findings. As part of member checking procedure, interview phase was conducted to confirm the questionnaire survey. As discussed in Section 3.3, the interviews were conducted to confirm the survey findings in respect to factors influencing rent prices, critical factors for low-cost apartment (home ownership) development, and any assumptions made for the investment feasibility analysis. This was conducted during the second phase of fieldwork. The auditors asked to validate the findings were previous participants who had at least five years' experience as business development managers in public housing projects. Refinement was then applied to enhance the accuracy of the calculation, while the system dynamics model was validated using model validation procedures by comparing the output of the model with output from manual calculation, as discussed in Chapter 6.

3.6 RESEARCH PHASE 3 – MODEL DEVELOPMENT

The investment feasibility model also uses system dynamics. Previous research studies have tried to link different influencing factors using factor analysis (Rahadi et al., 2015), system dynamics (Wang & Guo, 2017;Wu et al., 2013), and exponential-generalised autoregressive conditional heteroskedasticity models (Chyi, 2009). One popular simulation approach to describe the interrelationship between factors is system dynamics modelling, which is an approach that can be adopted in formulating a pricing model (Rehan et al., 2013; Kim et al., 2020). As the interrelated structures of price parameters in housing are very complex, system dynamics modelling is suitable for developing price setting. In system dynamics, a system is represented by a closed-loop structure, called as causal loop diagram, showing the relationship and feedback between and from system factors (Tharmmaphornphilas et al., 2012). By linking the factors based on their interactions, and consequently, the feedback loops, the system dynamics model enhances understanding of the overall system structure.

One advantage of system dynamics is the potential to easily modify the base model so that alternative scenarios can be effectively developed (Suryani et al., 2012). In addition, discounted cash flow analysis can be combined as a formulation basis of basic price determination. System dynamics is an advanced approach to developing an investment feasibility model. Using system dynamics, the simulation model easily and quickly calculated the variation range of changed variables, such as the number of subsidised and non-subsidised units and increasing operational and maintenance costs. For these reasons, this study utilised the system dynamics model to identify the relationship between factors and to examine investment feasibility.

The investment feasibility model was inputted cash inflow and cash outflow, then the model produces net cash flowed as an output in table and graph form. Furthermore, system dynamics was utilised to develop several scenarios and sensitivity analysis. The whole process is discussed in detail in Chapter 7, with the process summarised in Figure 3.4. The explanation of the diagram in Figure 3.4 is discussed as follows (Sterman, 2000):

- Problem articulation: this step identifies the goal, its key variables which describe real system, and determines the time horizon. It characterises the problem dynamically as the first step to understanding it and to designing policies to solve it.
- Dynamic hypothesis: modellers develop a theory of how the problem has arisen. In order to support theory development, a causal loop diagram is developed to explain cause and effect between variables and to transform the causal loop diagram into the stock flow diagram.
- Formulation: to run the model, the stock flow diagram, which includes levels, rates, and auxiliary, are inputted the accurate equations. Stock shows the quantity of study factors while flows demonstrate factors that come in

and out, changing the stock level. Subsequently, the formula is inputted to each variable and linked them.

- Testing: the aim of testing is to compare the simulated behaviour of the model to the actual behaviour of the system. This is the validation process, the process of evaluating model simulation to determine whether it is an acceptable representation of the real system. In this study, it was conducted using case studies from previous quantitative analyses. The public rental housing scheme was taken as a representative case study as the rent price was determined to be more appropriate than that of any other public rental housing. A model will be valid if the error rate for the comparison between the model and the case study is smaller than 5%.

Policy formulation and evaluation: once valid model has been developed and has been tested through simulation and scenario, the valid model can be used to design and assess policies for advancement. Output of the model could be used as basis of the policy. Different policies must be considered, because the circumstances on real systems are extremely varied and fluctuated, which influence the system. A scenario is needed to apply to better understand some conditions that might happen in the future. In this study, scenario development is conducted through both structure and parameter scenario. Parameter scenario by adding was employed by changing the value of parameters. Meanwhile structure scenario is built by changing some feedback loops and adding new parameters. for example, location, building material and number of floors, to see the impact on the models.

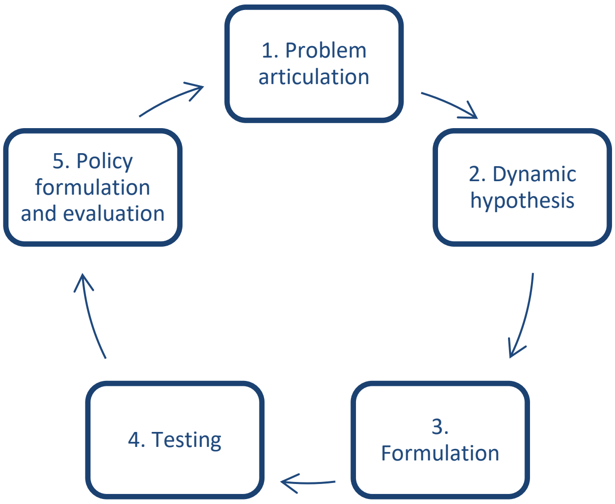

Figure 3.4 System dynamics modelling process

3.7 ETHICAL CONSIDERATION

The confidentiality of every respondent in a research project is important, and the anonymity and confidentiality of every respondent in this study has been kept. No personal identities have been disclosed. The procedure adopted to protect the collected data was submitted to the QUT Human Research Ethics Committee before commencement of data collection. The approval for this study was granted by the QUT Human Research Ethics Committee (Number 1900000284) as low risk.

3.8 CHAPTER SUMMARY

This study employed mixed methods to achieve the research objectives. It included a questionnaire survey and semi structured interviews with multiple stakeholders used in feasibility investment analysis for public rental housing (Chapter 5) and low-cost apartments (Chapter 6). The questionnaires were distributed to public rental housing tenants from seven public rental communities in five selected cities in Indonesia that had experience in managing construction projects (Batam, Bandung, Surabaya, Makassar and Jakarta). Descriptive and inferential analyses were undertaken to analyse the data gathered and to address the research questions. This phase aimed to: 1) identify factors influencing public housing rent prices; and 2) identify tenants' willingness and ability to pay.

Semi-structured interviews were subsequently undertaken with representatives from the Ministry and local government, and semi-private developers. The interviews provided richer insight into critical factors for low-cost apartment (home ownership) development. These interviews aimed to: (1) investigate key factors as well as current housing policy; and (2) confirm the survey findings on investment feasibility analysis. Thematic analysis was undertaken during qualitative analysis to address the above aims.

Secondary data were analysed to support the analysis which aim of address main research objective: to develop an investment feasibility model. This model was confirmed through a member checking validity procedure and refinements were conducted for more accurate model.

Chapter 4: Data Collection

4.1 INTRODUCTION

This chapter presents the data collection results for two of the three research phases conducted over two periods (May-August 2019 and December 2019-January 2020), as explained in Chapter 3. Data collection involved multiple stakeholders, including public rental housing tenants, representatives from government ministries and local governments, and semi-private housing developers. Data collection involved two surveys and secondary data review in Research Phase 1:

1. First survey – tenant survey: questionnaire survey to public rental housing tenants of seven public rental housing complexes in Jakarta, Batam, Bandung, Surabaya, and Makassar.
2. Second survey – housing provider survey: (1) semi-structured interviews with 18 participants from government departments and housing developers.
3. Secondary data review compiled from any relevant sources.

The remainder of this chapter is divided into five sections. Section 4.2 addresses Research Phase 1, which included the tenant survey and housing provider survey. The tenant survey presents the data collected from respondents, including information about household incomes and preferences for residence, while the housing provider survey presents factors seen to influence public housing rent prices. Section 4.3 reviews secondary data, which is examined and used in Chapters 5 to 7. Section 4.4 draws upon research Phase 2, which covers the semi-structured interviews. Within this section, discussion is presented to explore public housing policy and schemes. Thematic analysis is used in this chapter. Section 4.5 presents mixed-income housing constraints, and Section 4.6 provides the chapter summary.

4.2 RESEARCH PHASE 1 – FINANCIAL MODEL FOR PUBLIC RENTAL HOUSING

Discussion in this chapter is divided into three sections, the tenant survey, housing provider survey, and secondary data review.

4.2.1 Tenant survey

The survey was conducted in the first phase of fieldwork and aimed to collect data around tenants' current circumstances and conditions relating to household income and housing costs. The survey also investigated tenants' preferences in terms of substitute dwellings if they did not reside in public rental housing.

Location of Survey

The questionnaire survey was conducted in seven public rental housing complexes in five selected cities in Indonesia, as listed in Table 4.1. The tenants' household income data, which are presented and analysed in Chapter 5, were obtained from these locations. Each public rental housing context is discussed in detail.

Table 4.1 Observed public rental housing

No	**Area/ City**	**Public rental housing**	**No of floors**	**No of distributed question-naires**	**No of respon-dents**	**Unit type**	**Tenants**	
							Regular	**Relocated**
1	Sura-baya	Gunung sari	5	40	37	Studio		ν
2	Ban-dung	Cingised	5	40	35	1 BR	ν	ν
3	Maka-sar	Lette	5	20	20	1 BR	ν	ν
		Panam-bungan	5	20	10	1 BR	ν	ν
4	Jakar-ta	Rempoa	9	42	42	Studio	ν	
5	Ba-tam	Batu Ampar	4	20	20	Studio	ν	
		Muka Kuning	4	20	20	Studio	ν	
Total				202	184			

Questionnaires were distributed to public rental housing tenants using purposive random sampling. The tenants' coordinator guided the distribution process. The target for questionnaire distribution was 40 for every city. This number followed minimum number of sample (Gary & Diehl, 1992) who stated that minimum sample size of > 100 population is 10%. The range of number of units is 198 – 483 units, therefore the sample size or number of respondents is 10% of number of family as public rental housing tenants. The following discussion is the brief description of observed public rental housings, which were investigated while conducting tenant survey.

Public rental housing "Gunungsari" – Surabaya

This public rental housing building is located in southern Surabaya (see Figure 4.1). The building is fully occupied by relocated communities from the squatter settlements on the riverbank in Surabaya. Participant of housing provider's survey stated that the public rental housing complex has 268 units, each with a unit area of 24 sqm, with average number of dwelling 3-5 people, and it is managed by the East Java Provincial Government. The length of stay is three years, and the tenure can be renewed twice. The rent price is regulated by the East Java Provincial Governor, as listed below in Table 4.2.

Figure 4.1 Public rental housing "Gunungsari"

Table 4.2 Monthly rent price in public rental housing "Gunungsari"

Floor	Monthly rent price (IDR)
1st floor	235,000
2nd floor	215,000
3rd floor	195,000
4th floor	175,000
5th floor	156,000

Public rental housing "Cingised" – Bandung

This rental housing development is located in western Bandung (see Figure 4.2). The building is fully occupied by regular tenants and relocated communities from the squatter settlements in Bandung. There are 483 units, and the building is managed by Bandung Municipal Government. Most tenants do not have formal employment, and the length of stay is three years and can be renewed twice. Participant of housing provider's survey stated the local government initiates a program called home ownership saving, which is dedicated to public rental housing residents who want to buy their first home after their occupancy in public rental housing. The rent prices are presented in Table 4.3.

Figure 4.2 Public rental housing "Cingised"

Table 4.3 Monthly rent prices in public rental housing "Cingised"

Floor	Monthly rent price (IDR)
2nd floor	175,000
3rd floor	175,000
4th floor	145,000
5th floor	145,000

Public rental housing "Lette" and "Panambungan" – Makassar

The public rental housing developments "Lette" and "Panambungan" are located in the city centre of Makassar (see Figure 4.3). They are located close to the most famous place in Makassar, Losari Beach, and close to a new development area. Participant of housing provider's survey stated that Lette has 288 units, while Panambungan has 198 units. On average, there are 3-5 family members per unit. They are occupied by relocated communities and regular tenants and are managed by the Makassar Municipal Government. Rental prices are shown in Table 4.4.

Figure 4.3 Public rental housing “Lette” (top) and “Panambungan” (bottom)

Table 4.4 Monthly rent prices in public rental housing “Lette” and “Panambungan”

Floor	Monthly rent price (IDR)
2nd floor	160,000
3rd floor	135,000
4th floor	110,000
5th floor	85,000

As stated in the public rental housing development guidelines, the building was built by the Ministry government and proposed by local government (municipal or provincial government). Buildings are always built on local government asset land; the local government then has the responsibility of managing the public rental housing. Unfortunately, Makassar Municipal Government is no longer in a position to propose public rental housing developments as they do not have appropriate government asset land.

Public rental housing "Rempoa" – Jakarta

This public housing is dedicated to Ministry staff, both singles and families. The rental price is determined by the Minister of Public Works and Public Housing. Apartments are fully furnished, and all bills are included. Similar to other public rental housing, the length of stay is three years and can be renewed twice. Participant of housing provider's survey stated that Rempoa building has nine floors and 234 units (see Figure 4.4), with a unit area of 36 sqm. The rent price in Rempoa for a single unit is IDR 750,000, while a family unit is IDR 900,000. A single unit is occupied by two people (sharing), while a family unit is occupied by maximum of four family members.

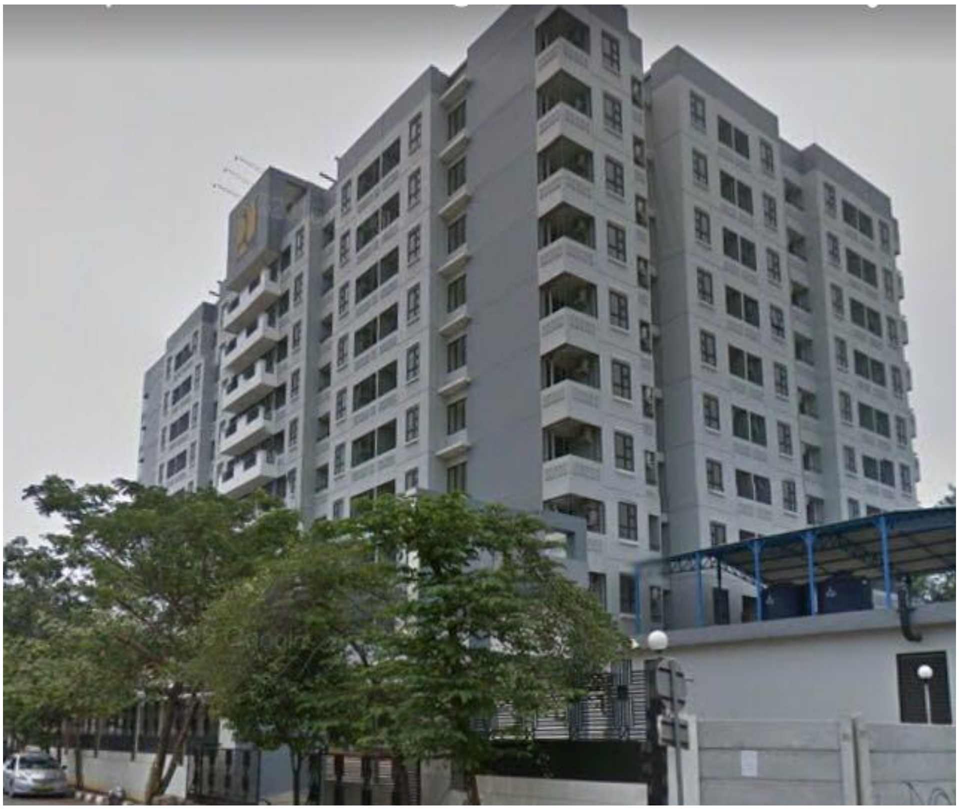

Figure 4.4 Public rental housing ''Rempoa''

Public rental housing "Muka Kuning" and "Batu Ampar" – Batam

In Jakarta and Batam public rental housing units are offered with proper indoor facilities, appropriate architectural features, and prime location as they are close to workplaces and shuttle transportation is provided. The building management applies the minimum rental price, which is adjusted to market prices for similar properties (rental houses and student accommodation).

Participant of housing provider's survey stated the Muka Kuning building has 576 units, while Batu Ampar has 276 units (see Figure 4.5). They are located in the heart of the industrial area, and are occupied by regular tenants, most of whom are industry labourers. The monthly rent for Muka Kuning and Batu Ampar is IDR 800,000 (double use) and IDR 630,000 (single use).

Figure 4.5 Public rental housing "Muka Kuning" (top) and "Batu Ampar" (bottom)

Questionnaire survey results

This sub-section presents the findings from data collection from public rental housing tenants, including information about household income, the ability and willingness to pay, and tenants' household incomes.

Tenants' household incomes

Household income was calculated by totalling tenants' monthly expenses, including daily needs, transportation, clothes, education, and communications. Table 4.5 describes the range of household incomes of public rental housing tenants in the five cities. Tenants in Jakarta had higher incomes than tenants in the other four cities. Tenants in Makassar had lower incomes than tenants in the other four cities.

Table 4.5 Tenants' household income range

	Highest income (IDR)	Lowest income (IDR)	Median (IDR)
Bandung	4,450,000	720,000	2,660,000
Batam	6,030,000	2,250,000	3,100,000
Jakarta	10,000,000	970,000	5,025,000
Makassar	3,585,000	1,615,000	2,535,000
Surabaya	5,035,000	2,972,245	3,800,000

The distribution of actual household income is presented in Figure 4.6.

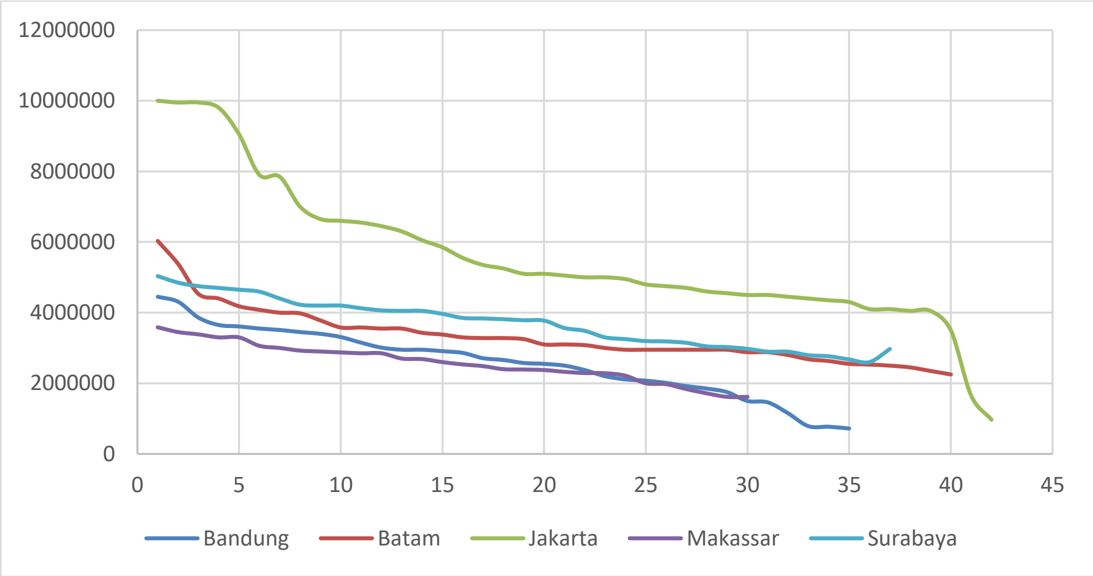

Figure 4.6 Distribution of tenants' household income

In Indonesia, there is no income indexation used by the government. The only definition of low-income family is those who have maximum monthly income IDR 8 million (total family income: husband + wife). However, for high-rise public housing, the maximum family monthly income considered is IDR 7 million (*Required income* *for eligible group for homeownership credit* Minister of Public Works and Public Housing Regulation 2020 s.242 (Indonesia)).

Participant of housing provider's survey explained that rental housing in Jakarta is occupied by ministry staff who have fixed incomes, whereas public rental housing in Batam is occupied by industrial employees who have higher incomes than tenants in Surabaya and Makassar, which feature relocated communities. On the other hand, in the case of Surabaya, Bandung and Makassar, public rental housing is unfurnished and located far from the city centre or the workplace. Some units are offered as studios, which can be divided into a few small rooms, such as a living room, bedroom, and kitchen. The local government significantly subsidises monthly payments. If the government were to raise the rent, there would be protests from renters; thus, the price is kept low and willingness to pay is adjusted.

Current housing cost

One of the survey questions was about housing costs, assumed to be current housing costs. As tenants lived in public rental housing, their current housing cost was the public rental housing rent price, which varied according to different floors. The housing costs are listed in Table 4.6.

Table 4.6 Current housing cost from the tenants' survey

Cities	Highest price (IDR)	Lowest price (IDR)
Batam	800,000	630,000
Bandung	300,000	145,000
Jakarta	900,000	750,000
Makassar	135,000	85,000
Surabaya	235,000	156,000

The actual household was used to compare ideal rent price determination, as detailed in Chapter 5.

Tenants' dwelling preferences

Tenants' dwelling preferences were used for the substitution method in order to measure willingness to pay. In this study, the substitute dwellings considered were other types of residential properties chosen by public rental housing tenants, if they did not live in public rental housing – or had not previously – such as renting a house or living in a boarding house. Regular tenants applying for public rental housing had to be on a waiting list. During the waiting period, they live in other dwellings, which might be more expensive than the public rental housing rent price. The preferences offered to respondents included living in the suburbs, city centre or industrial area. The respondents' answers are summarised in Table 4.7.

Table 4.7 Respondents' area preferences

Cities	Area preferences		
	Suburb	City Centre	Industrial area
Bandung	71%	29%	0%
Batam	22.5%	30.0%	47.5%
Jakarta	54.8%	45.2%	0.0%
Makassar	32.3%	67.7%	0.0%
Surabaya	75.0%	19.4%	5.6%

Respondents were then asked to choose the kind of dwelling they preferred to live in, the options being a boarding house, renting a house, and building self-help housing, as shown in Table 4.8.

Table 4.8 Respondents' dwelling preferences

Cities	Boarding house	Rent a house	Build own house
Bandung	17%	77%	6%
Batam	25%	55%	20%
Jakarta	23.8%	66.7%	9.5%
Makassar	35.5%	64.5%	0.0%
Surabaya	0.0%	94.4%	5.6%

In order to calculate willingness to pay, the market price of their preferred dwelling was collected using secondary data. For example, the monthly rental price of a boarding house in the downtown/city centre in Bandung based on property market data was IDR 800,000, while renting a house in the city centre cost IDR 2,500,000. The detailed market prices based on property data are shown in Table 4.9.

Table 4.9 Market-price data

		Bandung	Batam	Jakarta	Makassar	Surabaya
City centre	Boarding House	800,000	600,000	1,500,000	700,000	850,000
	Rented house	2,500,000	2,500,000	3,250,000	2,000,000	2,000,000
	Self-help housing	2,600,000	3,800,000	4,200,000	3,500,000	4,200,000
Suburb	Boarding House	600,000	550,000	850,000	450,000	550,000
	Rented house	1,500,000	1,000,000	2,500,000	1,500,000	1,250,000
	Self-help housing	1,700,000	2,500,000	3,400,000	2,500,000	3,500,000
Industrial Area	Boarding House	450,000	500,000	1,000,000	500,000	350,000
	Rented house	1,000,000	1,000,000	2,500,000	1,000,000	1,000,000
	Self-help housing	1,700,000	2,500,000	3,000,000	2,500,000	2,300,000

Based on the secondary data, tenants' willingness to pay, compiled from their stated preferences, is summarised in Table 4.10.

Table 4.10 Tenants' willingness to pay based on preferences

Rent Price	Bandung	Batam	Jakarta	Makassar	Surabaya
Market-based (Substitute: Boarding house)	620,000	550,000	1,120,000	550,000	585,000
Market-based (Substitute: Rented house)	1,700,000	1,500,000	2,750,000	1,500,000	1,500,000
Market-based (Substitute: Self help housing)	2,000,000	2,950,000	3,550,000	2,850,000	3,350,000

4.2.2 Factors influencing public housing rent prices

Participants provided their opinions and preferences relating to factors that influence public housing rent prices, as summarised in Table 4.11. The descriptive statistical analysis was conducted since the population was small, which was not sufficient for inference statistical analysis.

Table 4.11 Factors influencing public housing rent prices

No	Factors	Influence	No influence	% level of agreement
1	Household income	18	0	100%
2	Urban economy	0	18	0%
3	Housing/rent market price	3	15	16.7%
4	Costs	18	0	100%
5	Architectural features	0	18	0%
6	Neighbourhood features	6	12	33.3%
7	Location	10	8	55.6%
8	Indoor facilities	7	11	38.9%
9	Ability to pay/affordability	18	0	100%
10	Willingness to pay	18	0	100%
11	Government subsidy	12	6	67.6%

According to the data collected from the semi-structured interviews, it can be concluded that household income, cost, ability to pay, and willingness to pay are contributing factors in public housing rent price determination, even though the government may take other factors into consideration when determining prices. Meanwhile, in relation to commercial properties, neighbourhood, location, and facilities are always influencing factors. Influencing factors for rent price determination are discussed further in Chapter 5.

4.3 SECONDARY DATA REVIEW

Secondary data review was used to support model development issues related to financial feasibility analysis for public rental and ownership housing. Figure 4.7 shows the analysis plan and the related chapters.

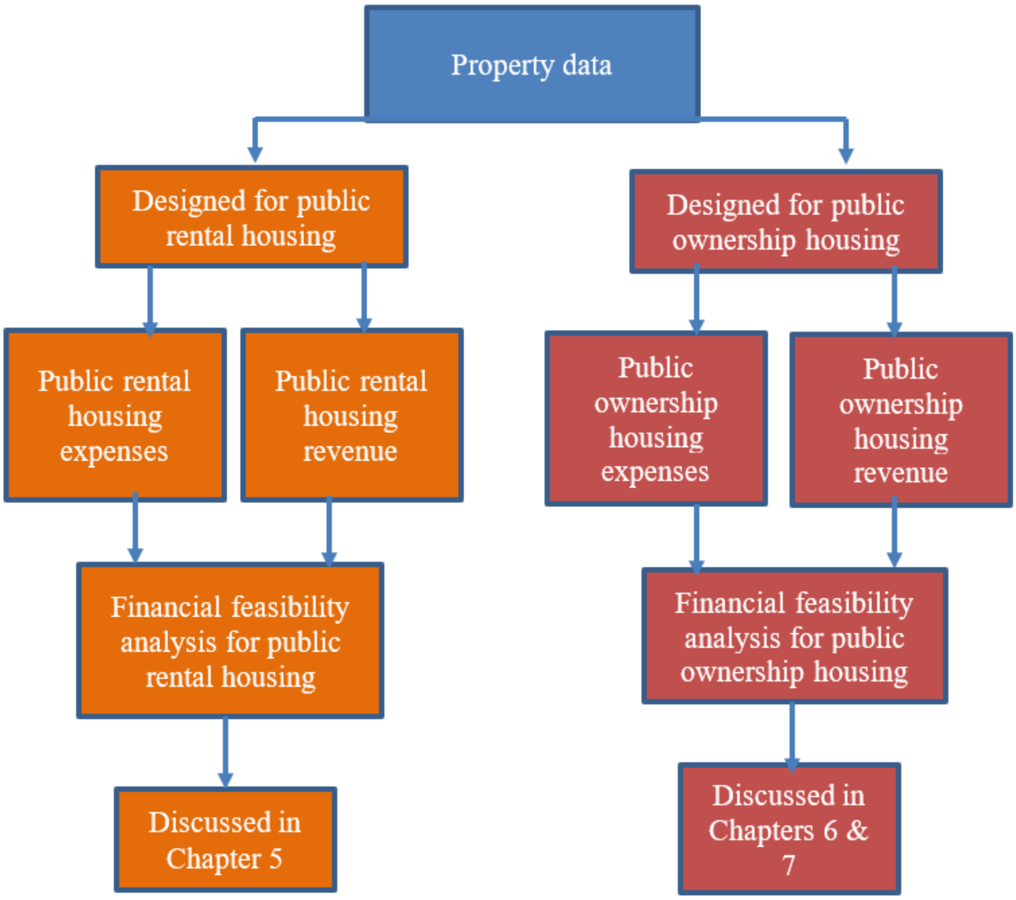

Figure 4.7 The financial analysis plans

4.3.1 Property data

As stated in the research objectives, this study examines financial feasibility from the perspectives of both tenants and housing developers. In order to achieve this objective, secondary data were collected from the case study of a high-rise apartment building in Jakarta. The property data from this case study is used to illustrate the financial calculation. The data is based on a real project information. Participant of housing provider's survey stated that the building occupies both residential and commercial areas. Rental scheme meaning that all units in the residential area are allocated for rental housing, while the ownership scheme means that all units were sold. This building also represents mixed-income housing, as there are two classes: subsidised and non-subsidised units (market-rate). Property data are presented in Tables 4.12 and 4.13. Most of the financial assumption were collected from the case study, for example project revenue and project expenditures.

Table 4.12 Property data – conformance to regulation

	Regulation	Planning as designed	Calculation based on regulation	Conformance to the regulation
Land area		27,000 sqm		
Building coverage ratio	30%	7997.61 sqm	8,100 sqm	less than max requirement
Floor area ratio (FAR)	3	76,653.13 sqm	81,000 sqm	less than max requirement

Table 4.13 Property data – allocation of commercial and residential area

Residential area	51.37%	39,373.84 sqm There are two towers in this building, with 894.86 sqm of each floor in each tower. This floor area includes 764 sqm for residential units and 130.86 sqm for common areas.
Commercial area	48.63%	37,279.29 sqm
Commercial Use		30,460.95 sqm 35% of 30,460.95 = 10,661.33 sqm are set as rentable area
Parking		6818.34 sqm Useable area for car space 55% = 55% * 6818.34 = 3750.09 sqm Useable area for motorcycle space 15% = 15% * 6818.34 = 1022.75 sqm Space for 1 car = 3.6 m* 5 m = 18 sqm Availability = (3750.09/18) = 208 car spaces (> requirement) Space for 1 motorcycle = 0.75 m* 2 m = 1.5 sqm Availability = (1022.75/1.5) = 682 motorcycle spaces (> requirement)

The building coverage ratio is the percentage rate of the comparison between the total width of building area to the overall land area. Local government regulates building coverage ratio to determine the maximum ground floor or first floor area. Floor area ratio (FAR) is the ratio between building's floor area and the size of the lot/land parcel based on the local government regulation from where the land is located on (metro council, 2015). FAR is calculated by dividing the building's floor area by the total area of the land parcel. FAR helps designers to determine the number of floors that can be constructed.

4.3.2 Project revenue

The proposed revenue was estimated in order to calculate project investment feasibility. This apartment consists of a residential area (51.37% of total area) and a commercial area (48.63% of total area). The revenue from the residential area in public rental housing was derived only from unit rentals; while revenue from the commercial area was estimated from shop leases, monthly service charges, and monthly registered parking permits. The revenue escalation was set at 2% per year. Residential areas in public ownership housing had more revenue than rental housing. Details about revenue are provided in Table 4.15.

The units are categorised as 1 bedroom, 2-bedrooms and studio. At first, they were planned with the distribution as detailed in Table 4.14.

Table 4.14 Number of units for each type of units

	Non-subsidy	Subsidy
Studio	308	0
1 BR	242	242
2 BR	176	0

Table 4.15 Project revenue

	Public Rental Housing		Low-cost apartment	
	Residential	Commercial	Residential	Commercial
Unit rental	v			
Sales unit			v	
Service charge (residential)			v	
Shop lease		v		v
Service charge (commercial)		v		v
Parking permits		v		v

A detailed explanation of public rental housing and low-cost apartment's income was derived from the following sources:

- rental of units: monthly rental price was determined based on rent price determination conducted in Chapter 5; and
- sales of units

Table 4.16 Sales price

Studio	IDR 224,000,000
1 bedroom	IDR 360,000,000
2 bedrooms	IDR 688,000,000
Subsidised rate	IDR 306,000,000

The price escalation was set at 30% per year and excludes subsidised rates.

Sales schedule

Non-subsidised units: sales of units can start at the beginning of the construction period or during its first year (pre-sales). Based on developers' estimates, it might take four years to sell all the non-subsidised units. The non-subsidy buyer pays the down payment then starts to pay off the home ownership loan.

Subsidised units: The most significant differences between subsidised and non-subsidised units relate to sales prices and sales schedules. The subsidised buyer cannot start to pay before the end of the construction period as the government will not pay the subsidy before the unit is ready to be handed over. If the construction period is planned for three years, the sales of subsidised units can begin in the third year, and it is assumed that it will take two years to sell all the units. In contrast, as noted above, sales of non-subsidy units can start at the beginning of the construction period or in its first year (pre-sales) and it can take four years to sell all the units. Sellers' tax is the income tax on income from the transfer of land and building rights based on *Tax Income Government Regulation* 2016 s.34 (Indonesia); and the rate of income tax for public housing sales is 1% of the selling price.

Service charge

Table 4.17 Service charge

	Residential area	Commercial area	Escalation
Income:			
Monthly service charge (IDR)	13,000 per sqm	120,000 per sqm	2% per year
Monthly rent lease (IDR)		300,000 per sqm	2% per year

Car parking fee: A registered car parking fee is IDR 150,000 per month, while registered motorcycle parking is IDR 50000 per month with 2% escalation yearly.

Lease of shops (commercial area): Rent lease is IDR 300,000 per sqm per month with 2% escalation yearly. The occupancy rate is assumed to be 70%.

4.3.3 Project expenditures

Project expenditures data were derived from the case study and other public institution, such as national electricity company, water company and tax office. Several project expenditures occur during the investment period. The expenditures escalation is set at 2% per year. Project expenditures are classified into initial costs, residential costs and commercial area costs.

Initial costs

In this study, initial costs included the land and construction costs. Land cost was the amount needed for land acquisition Construction cost referred to the amount of money required for the construction of the facility. These costs occurred only once during the investment period. This apartment construction was planned to take three years, with a total construction cost of IDR 436 billion = IDR 5,533,158 million per sqm. The construction cost was presumably scheduled over three progress-based years at 30%, 35% and 35%, respectively. However, in this study the cost of the land was not a one-off expense as it was calculated as a rental fee. As the land around railway tracks is owned by the Indonesian Railways Company (PT KAI), the developer has to pay the land rent fee to the landowner as the manifestation of profit sharing of the company’s contribution. The rental fee is set at IDR 215 million per year.

Residential costs

In this study, residential costs refer to expenditure embedded in the building operation and maintenance and included the following:

1. Operating expenses: the data were derived from other typical apartment complexes as this one was not yet operational. Operation costs were calculated annually.

    a. Administration salaries: The administration staff were assumed to involve 15 persons with an average monthly salary of IDR 7,500,000.

b. Waste recycling retribution: this was set at IDR 298,298,880

c. Building maintenance: Annual building maintenance was assumed to be 0.5% of total construction costs. Building maintenance expenditure for the residential area was set at IDR 1,115,449,320

d. Electricity: Electricity costs included in developers' bills relate to electricity consumption for common areas or facilities. The energy consumption was based on the electricity load from public facilities, such as corridor in similar size of apartment building, while the cost followed the unit cost regulated by national electricity company.

Electricity consumption	=	307 kwh/sqm
Floor area	=	(130.86) x 44 = 5757.84 sqm
Total consumption	=	1,767,656.88 kwh
Hourly consumption	=	201.79 kwh/hr
Peak tariff	=	2040
Non-peak tariff	=	1020
Peak duration	=	8 hours
Non-peak duration	=	16 hours
Electricity costs	=	(201.79*2040*8*365) +(201.79*1020*16*365) = 2,404,013,356.80

e. Water: There was no expense for water bills as this was borne by the unit dwellers.

f. Property tax: There was no expense for property tax as this was borne by the unit dwellers.

g. Maintenance of public infrastructures, such as landscapes, carpark, and other public infrastructures.

Commercial area operation

Commercial area operation involved the expenditure embedded in the operation of the commercial area, as below.

1. Operating expenses: data were derived from other typical apartments as this apartment block was not yet operational. Operation costs were calculated annually.

   a. Administration salaries: The administration staff were assumed to number 20 persons with an average monthly salary of IDR 7,500,000.

   b. Waste recycling retribution: this was set at IDR 580,000,000

   c. Building maintenance: Annual building maintenance was assumed to be 0.5% of total construction costs. Building maintenance expenditure for the commercial area was set at IDR 1,056,375,680

   d. Electricity: The energy consumption was based on the electricity load from commercial area in apartment, while the cost followed the unit cost regulated by national electricity company.

Electricity consumption	=	332 kwh/sqm
Floor area	=	30,461 sqm
Total consumption	=	10,113,052 kwh
Hourly consumption	=	1154.46 kwh/hour
Peak tariff	=	2040
Non-peak tariff	=	1020
Peak duration	=	8 hours
Non-peak duration	=	16 hours
Electricity costs	=	(1154.46*2040*8*365) +(1154.60*1020*16*365) =13,753,728,144

   e. Water

   The water consumption was based on the water usage for commercial area, while the cost followed the unit cost regulated by national water company.

Daily water consumption	=	0.01 m3
Floor area	=	9138 sqm (rentable area)
Water bills	=	9138 * 8000 * 0.01 *365 = 266,837,922

f. Property tax: Annual property tax conforms to the *Tax regulation* Act 2009 s.28 (Indonesia). The tax is imposed on taxable objects, which depends on the taxable area and the land price, which is called NJOP. The assessment value is 20% of NJOP, then tax deduction is also applied. Different regions have different tax deductions. For example, the tax deduction for Depok is IDR 80 million, while the tax deduction for Surabaya is IDR 75 million. The tax rate imposed on the tax object was 0.5%. The formula to determine property tax was ((NJOP – 20%x NJOP)) – tax deduction.

g. Capital expenditure: included buying, maintaining, or improving fixed assets such as buildings, vehicles, equipment, or land.

Building façade, and structure – every 10 years	=	3,314,444,775.76
M/E (water pump, HVAC, genset) – every 5 years	=	1,028,959,600.13
Elevator and escalator – every 5 years	=	211,776,845.41

The summary of annual residential and commercial building expenditure is provided in Table 4.18

Table 4.18 Annual Building expenditures

	Residential (IDR)	Commercial (IDR)
Administrators' salary	1,386,720,000	1,313,280,000
Electricity bills	2,404,013,357	13,753,728,144
Water bills		311,310,909
Waste retribution	298,298,880	282,501,120
Total operation cost	4,089,032,237	15,660,820,173
Building maintenance	1,006,541,527	953,235,589
Public facilities maintenance		120,000,000
Total operation and building maintenance costs	5,095,573,764	16,734,055,762

4.4 RESEARCH PHASE 2 – FINANCIAL MODEL FOR LOW-COST APARTMENTS

4.4.1 Participant profiles

Indonesia has three tiers of government: Ministry/central government, local government at the provincial level, and local government at the municipality level. The primary data for this study were drawn from face-to-face semi-structured interviews with experts and decision makers in each tier of these three tiers of government. Public housing provision comes under the Central government's ministry of public works and public housing program, and the Central government transfers responsibility for the operation and maintenance of public housing to the local governments. Semi-private companies are involved in public housing provision programs in the form of low-cost apartment construction, semi-private developers being business entities whose capital is mostly – or totally – owned by the government through direct participation originating from separated state assets. Some public housing projects are managed via collaboration between governments and state housing developers (Soemitro & Rachmawati, 2017). Participant profiles are provided in Table 4.19.

Interviews were conducted with employees from the Ministry of Public Works and Public Housing, which manages public housing in Indonesia. The participants were decision makers in the public housing sector, with positions related to housing provision and project financing.

In accordance with the survey explained in Chapter 3, semi-structured interviews were also conducted in five selected cities in Indonesia, namely, Jakarta, Batam, Bandung, Makassar and Surabaya. The participants were policy makers in the housing sector in those cities, most of them working in the Department of Public Works “Cipta Karya”. The semi-private housing developers represented two companies, Perumnas (National Housing Company) and Pembangunan Perumahan (PP). Both companies are involved in the development of public housing in Jakarta and Bandung. Interviews were conducted with two members in top management in the two companies and two members in middle management of Pembangunan Perumahan to obtain information related to business planning.

Table 4.19 Participant profiles

ID	Government			Semi-Private	Role (level management)	Years of experience in housing sector (policy maker or developer)	Gender	Area
	Ministry	Province	Municipal					
R1	√				Top	15	M	
R2	√				Top	15	M	
R3	√				Top	15	M	
R4	√				Middle	10	F	
R5	√				Top	15	M	
R6	√				Top	10	M	
R7	√				Top	15	M	
R8	√				Middle	5	M	
R9		√			Middle	8	F	
R10			√		Top	8	M	Batam
R11			√		Top	10	M	Batam
R12			√		Top	10	M	Surabaya
R13			√		Top	15	M	Makassar
R14			√		Top	5	M	Bandung
R15				√	Top	6	M	
R16				√	Top	10	M	
R17				√	Middle	5	M	
R18				√	Middle	7	M	

4.4.2 Semi-structured interview results

Indonesia has been suffering from a housing backlog that requires policy support to boost housing provision and government subsidies for existing public rental housing are currently at a high level (Indonesian Ministry of Public Works and Public Housing, 2012). The aim of the semi-structured interviews was to identify key aspects and issues underlying the public housing situation relating to rental and ownership schemes. This information was then used to inform the building of a financial model for public housing.

The interview questions related to issues such as:

1. The evaluation of current public sector efforts and practices in public housing (e.g., strengths and weaknesses, access to public housing financing, affordability etc.)
2. The possibility of involvement of private developers in housing provision and to what extent they may be involved in:
    a. land provision;
    b. building provision;
    c. public housing management;
    d. finance provision; and
    e. other.
2. Challenges associated with proposed public housing financing
3. Aspects of housing finance policy that need to be improved to enable low-income communities to access housing finance systems:
    a. down payments of public housing price;
    b. government subsidies for land and interest rates of loan; and
    c. mortgage loans
4. The most suitable forms of government subsidy for public housing management.

Data from the interviews were transcribed and then analysed. The initial coding yielded approximately 100 codes, which were then reviewed by merging several codes as themes which emerged during the analysis process. Finally, clusters were formed by organising themes empirically into larger categories. The overarching theme clusters that emerged related to public housing financial models are listed below:

- land provision;

- design and construction;
- financing; and
- partnership.

Table 4.20 outlines the theme clusters, themes, and sub-themes that emerged from the data. Explanation of each theme cluster is provided in Sections 4.4.4 – 4.4.7.

Table 4.20 Theme clusters, themes, and sub-themes as the output of interviews

Theme clusters	Themes	Sub-themes
Land Provision	Land price	
	Land acquisition	Need for land banking
		State-owned companies' land utilisation
		Rights of land
Design and Construction	Construction	Building design
		Unit area
		Number of units
	Facilities	
Housing Financing	Subsidy	Kind of subsidies
		Viability Gap Funding
		Availability Payment
	Pricing	Ability to pay
		Capped price of public housing
Partnership Scheme	Partnership scheme	Mixed-income housing
		Mixed-use
		Mixed tenure
	Constraint	

4.4.3 Themes Cluster 1 – Land provision

This cluster comprised respondents' views related to land provision for public housing. Two themes emerged under this category: *land pric*e and *land acquisition*, while under land acquisition there were sub-themes of *land banking, state owned companies' land utilisation,* and *rights of land*.

Land price

Public rental housing act 2011 s.20 (Indonesia) states that public housing development is aimed to fulfill housing needs in urban areas. Most interviewees viewed land price as the most important issue in relation to housing provision. They noted that land criteria are well-located, suitable for housing development and affordable. However, accessibility and security of land that meets those criteria are difficult things for low-cost housing delivery. Most interviewees also identified the bottom line: that land prices are higher in prime locations. Land in the centre of activities, such as in city centres or areas close to employment centres and universities, is priced higher than land in other areas.

> "Land is the most important component of the housing development process. It is approximately 15% of total initial cost. Therefore, the acquisition cost of land is very high and affects the whole cost" (R17, personal communication, August 29, 2019).

However, interviewees from the public sector (government) mentioned that public housing is built on the government's asset land in order to reduce housing cost.

> "The most ideal, [is that] the government provides the land, as the land cost component is 15% of all costs" (R2, personal communication, August 8, 2019).

> "The public housing development does not consider the price of land, as the land is provided by the government as part of [the] government's responsibility to provide accommodation for low-income communities" (R1, personal communication, August 8, 2019).

Land acquisition

According to participant of semi-structured interview, current public rental housing was located far away from city centres, as land prices in city centres were very high. Some local governments also needed to mitigate the scarcity of land by providing government asset land. This issue could be solved by utilising land banking – all interviewees from the public sector suggested initiating land banking programs to reduce initial costs, to be provided by the public sector.

> "In relation to the land availability, the government attempted to initiate to utilise the land banking and the state-owned company's asset land with a

> particular mechanism. Then, the partnership between public and private sector for land provision would be encouraged" (R5, personal communication, August 7, 2019).

> "Although the responsibility to provide land depends on the partnership scheme, the strategy such as land banking and the state-owned company's asset land will render the project more attractive for investors, as they will not be required to allocate funds to provide and prepare land" (R5, personal communication, August 7, 2019).

Regarding land provision by the public sector and increasing access to low-cost land, some interviewees proposed two options:

> "We can enhance the land pool or land banking, owned by local government, state-owned companies, or government agencies, which are very poorly utilised and are often illegally encroached [upon] (R2, personal communication, August 8, 2019).

> "Redevelop ineffective public urban areas to increase the value of land. It has the potential to create value by combining government's program and the ability of the private sector to design, construct and operate the asset effectively" (R3, personal communication, August 8, 2019).

> "The most possible scheme is long lease (building rights title). Government is now analysing the possibility to introduce transit-oriented development (TOD) as the suitable approach for new urban design with proper accessibility to deal with location selection matter. The housing would have integrated land use with transportation planning and transportation features. The tenants could easily travel to their workplace in a short time and a cheap cost" (R1, personal communication, August 8, 2019).

Similar to semi-structured interview participants' opinions related to land acquisition, participants from the private sector suggested overcoming the issue of high land prices by using under-utilised land or land banking from state-owned companies. They claimed that land could be rented from the private sector to reduce the selling price, as the cost of land acquisition is more expensive.

> "As the housing price (rent or buy) is very crucial to tenants, especially the low-income community, the housing price could not [be] determined [as]

high. If the government intended to reduce low-income community's transportation costs, government initiated to provide public housing close to their workplace, the government should consider utilising the land banking or government's asset land" (R16, personal communication, August 29, 2019).

4.4.4 Themes Cluster 2 – Design and construction

This cluster was derived from suggestions by interviewees relating to the design and construction of public housing. It includes technical issues of public housing provision. Two themes emerged under this category: *construction* (including unit area and number of units) and *facilities*.

Construction

The construction theme provides information about building design, unit area, and number of units in the public housing rental and ownership schemes. Interviewees from the government noted that public rental housing building is typically designed by government, the construction being provided by the Ministry of Public Works and Public Housing, with local government being allowed to propose their particular need for public housing. In order to reduce rent price, the building should be constructed on local government legal asset land. Local government would manage the building after the construction and the handover process, including selection of tenants, operation, and maintenance activities, rent determination and financial management. This particular public housing building has five floors, which common area is located on the first floor, such as a common hall and administration office. Tenant's unit are located on the second to fifth floor, unless elderly and disabled tenants, which occupy the units on the first floor.

> "Public rental housing is by government grants and is a government program, so that the building is constructed by [the] ministry government" (R12, personal communication, September 4, 2019).

The building is designed to minimise operation costs, as it is allocated to a low-income community, and the rent price cannot be high. The interviewees explained that the maximum number of floors should be built to minimise operation costs.

> "The maximum floor of the building is five floors, as if the building has more than five floors, government should provide lifts, which is very expensive, both in construction and operation stage. Government defines that affordable public rental housing is the building with five floors, dedicated to low-income

communities. As defined as affordable housing, this building with a maximum provision of five floors is eligible to achieve government subsidy in the form of infrastructure, facilities, and public utilities" (R4, personal communication, August 7, 2019).

In relation to unit area, public rental housing is designed to be occupied by singles or families with two children. Therefore, current public rental housing has been developed to be larger than previous designs.

> "Previous public housing design had [a] unit area [of] 21 and 24 sqm. However, this design has been updated as this is not suitable for families. Therefore, [the] current unit area in public rental housing is larger, that is 27 and 36 sqm, which is suitable to be occupied by [a] small family (parents and two children). Unit area, which is designed for family in public housing (ownership) is 34 to 36 sqm" (R4, personal communication, August 7, 2019).

Participants explained that while public ownership housing design was planned to adjust the capped selling price, which was determined by the government, the maximum price of a subsidised apartment is 250 million rupiahs, which includes all cost structures, such as land cost, construction cost and development cost. Relating to the design of high-rise public buildings, the interviewees from the private sector offered some suggestions:

> "The most favourable location is the prime location in [the] CBD or close to [a] transportation facility, where the land price is very expensive. Since the price of a subsidised apartment is kept low, the developer should consider earning more profit by maximising floor area ratio to maximise the number of units" (R15, personal communication, August 29, 2019).

> "The private developers must consider the location and the regulation related to building permits in the selected location. A higher ratio is more likely to indicate a dense or urban construction. Local governments use FAR for zoning codes. The floor area ratio (FAR) is the relationship between the total amount of usable floor area that a building has been permitted by the local government and the total area of the lot on which the building stands. The ratio is determined by dividing the total or gross floor area of the building by the gross area of the lot" (R15, personal communication, August 29, 2019).

Facilities

This theme reflects interviewees' perspectives related to public facilities included in both rental and ownership of public housing. Interviewees from local government highlighted the public facilities provided by the government as part of their subsidisation and support for provision of low-cost housing. In Indonesia, government grants for infrastructure and utility installation help to reduce total development costs.

> "There are various forms of subsidy by the Government of Indonesia for public housing. The first subsidy is the funding allocation of land and building construction. Second, a government subsidy is assigned for the public housing operation and maintenance expenses" (R9, personal communication, August 15, 2019).

The design of public housing is integrated with free public utilities, such as electricity, gas, and water networks. Local government also grants some integrated public facilities, such as praying area, education, and health facilities. Interviewees from local government also provided additional information about indoor and outdoor public facilities:

> "Subsidy in the form of indoor facilities in each unit has just launched. Some of the public housings are improved to attract new applicants. It is anticipated that the additional features will add value to the property, for which in turn, the price could be more competitive" (R10, personal communication, August 14, 2019).

Without government subsidies, operation and maintenance programs cannot run properly, as the expected revenue from rent prices is too low to cover them. As noted in the above commentary, neighbourhood and public facilities are being built around public housing, such as trading booths, management offices, and other public facilities, commercial facilities, health and education facilities, hall facilities, praying areas and playgrounds, as well as the primary utilities such as clean water, garbage disposal, and electricity networks.

Participants stated that public rental housing was generally unfurnished, and some units were designed as studios. Tenants need to arrange and furnish the units themselves. However, in some contexts there are new initiatives, as in Batam where some public housing is being planned as luxurious public rental housing, with the provision of furniture designed to increase market competition.

> "These two apartments would be the pilot project for low-cost mixed apartments (public housing management). The furniture would be provided to add [to] the value of the building and lead to market competition." (R12, personal communication, September 4, 2019)

Interviewees emphasised that public facility provision is in accordance with *Public rental housing* act 2011 s.20 article 14 (Indonesia), which rules that public housing may be built in an area with consideration of the following factors:

a. building density;
b. population density;
c. spatial planning;
d. public facilities;
e. public transportation;
f. public housing needs analysis.

4.4.5 Themes Cluster 3 – Housing Financing

This theme cluster was summarised from interviewees' expressed opinions relating to housing finance. It includes discussion of the financial issues associated with public housing provision. Two themes emerged in this category: *subsidies* and *pricing*. Since public housing is dedicated to low-income communities, participants in the semi-structured interviews claimed that housing financing is the key factor in public housing development and that due to home buyers' limited affordability, subsidies and housing prices are two crucial factors.

Subsidies

According to public housing provider's survey, as public rental housing tenants' affordability was limited, the government needed to provide subsidies in different ways to low-income tenants who earn less than the regional minimum wage. The local government subsidised building operations and maintenance costs, and public ownership housing was allocated to moderate-income buyers. Interviewees from government ministries highlighted the two issues of government subsidy and targeted public housing buyers or tenants.

> “The target market for this project is private employees, government officers, and young executives, which are first homebuyers (have never owned a house before). Employees with an income [of] less than seven million Rupiah per month can afford to buy two-bedroom units for 250 million Rupiah per unit. Low-cost apartments are often called subsidised apartments” (R15, personal communication, August 29, 2019).

> “The eligible tenants are those who have [a] maximum take home pay of seven million, [they can have] either formal or informal jobs, as we are trying to convince the financial institutions to approve the applicants from informal job areas” (R16, personal communication, August 29, 2019).

One interviewee from a semi-private company offered a definition of affordability in relation to eligibility to receive a subsidy:

> “Eligibility is also assessed by affordability and monthly expenses in order to ensure that the applicants do not have over credit” (R16, personal communication, August 29, 2019).

Low-income tenants are expected to be able to buy their first home after they have been tenants of a public rental housing unit. They are allowed to stay there for three years, and this can be extended twice. An interviewee from a local government raised the issue of home ownership subsidies:

> “We are concerned about their accommodation after they leave this public housing. We are here, not just giving a home, but we have to think [about] where they will live afterwards. So that GEMPUR program (homeownership saving program) is initiated as a bridge to prepare [them for] their home ownership. Ministry of public works and public housing will grant 40 million for [a] down payment through [the] BP2BT program” (R14, personal communication, September 3, 2019).

Participant indicated in semi-structured interview that related to the private sector involvement in housing development programs, termed public private partnership (PPP), the government was now initiating mixed-housing programs, with planned cost recovery coming from the non-subsidised units and commercial areas. Furthermore, as an apartment was a social infrastructure that tends to only have economic feasibility, but was not financially viable, the government could provide financial support in the form of an availability payment for service availability. An availability payment paid by the government under the PPP scheme cannot be considered as debt, but rather as a binding obligation that requires a commitment to allocate funding in the budget implementation document.

> "Viability gap funding is a grant from [the] government in the form of [a] contribution of some of the construction costs, given in cash to a PPP project that is already economically viable but has not had financial feasibility" (R6, personal communication, August 9, 2019).

Pricing

As public housing is dedicated to low-income tenants or buyers, prices are controlled by the government and calculated by affordability. The interviewees explained that the government regulates pricing for both public rental housing and public ownership housing.

> "The rental price is determined by the minister. The apartment is fully furnished, and all bills are included" (R8, personal communication, August 9, 2019)

> "As the tenant's or buyer's affordability is different from one city to other cities, the selling price or rental fee is different" (R9, personal communication, August 15, 2019)

Respondents in the semi-private sector commented on price capping by government:

> "Private developers are not interested to build [sic] apartments for low-income communities as the sales price of these apartments has been capped at 250 million Rupiah per unit or 12 million semi gross area. That price includes land and construction costs" (R17, personal communication, August 29, 2019).

> "The proportion of subsidised and non-subsidised units should be determined proportionally and enable the semi-private developer to make a profit" (R18, personal communication, August 29, 2019).

> "The development of low-cost apartments is more difficult than landed houses. The construction costs for all buildings in all areas are quite similar, but the selling price will be based on affordability. Furthermore, the sales

activity could be started after 100% completion” (R18, personal communication, August 29, 2019).

“If all units are set as subsidised units, the project will not be feasible, it must be mixed use, subsidised and non-subsidised” (R16, personal communication, August 29, 2019

“As the low-cost apartment has the maximum selling price, the private [sector] prefer to develop non-subsidised apartments” (R16, personal communication, August 29, 2019).

4.4.6 Themes Cluster 4 – Partnership scheme

This cluster emerged from interviewees’ explanations related to housing provision policy. Two themes emerged in this category: *schemes* and *constraints*.

Partnership schemes

As noted previously, the Indonesian Government is now planning for mixed-housing developments to enable the involvement of private housing developers. There are various possible schemes that the government needs to evaluate from different perspectives, such as financial and legal. Interviewees from government ministries argued that mixed housing would be the most suitable policy to implement.

“Mixed housing should be initiated to enable the cross-subsidy program. It is in accordance with Government Regulation no. 20/2011 that government requires mixed housing through ministry regulation. All developers should allocate 20% of all lands for low-cost housing” (R5, personal communication, August 7, 2019).

“Mixed housing can also be arranged to support the public private partnership program for the housing sector. PPP has been adopted in Indonesia for the energy and the toll road sectors” (R6, personal communication, August 9, 2019).

Interviewees from the semi-private developer group commented on the issue of proportions of subsidised and non-subsidised units. They suggested that the government should differentiate the subsidy for different classes of buyers.

> "Mixed-income housing is also classified by the different types of subsidies used to make housing units affordable to low- and moderate-income families" (R18, personal communication, August 29, 2019).

Constraints

Three possible schemes are mixed-income, mixed-tenure, and mixed-use. Each has its own advantages and disadvantages. However, there is a legal constraint related to rights to land.

> "The most difficult part to initiate for the public and private collaboration is tenure when it relates to a government asset. Mixed housing, which is rental and ownership, is impossible. However, if it is required, land could be rented privately to reduce the selling price because land acquisition is more expensive. The most possible scheme would be a long lease (building rights title)" (R9, personal communication, August 15, 2019).

4.4.7 Critical factors for low-cost apartment (home ownership) development

The discussion in sub-sections 4.4.4–4.4.7 of this chapter revealed four emerging themes that correlated with each other. The four themes are described in the Figure 4.8.

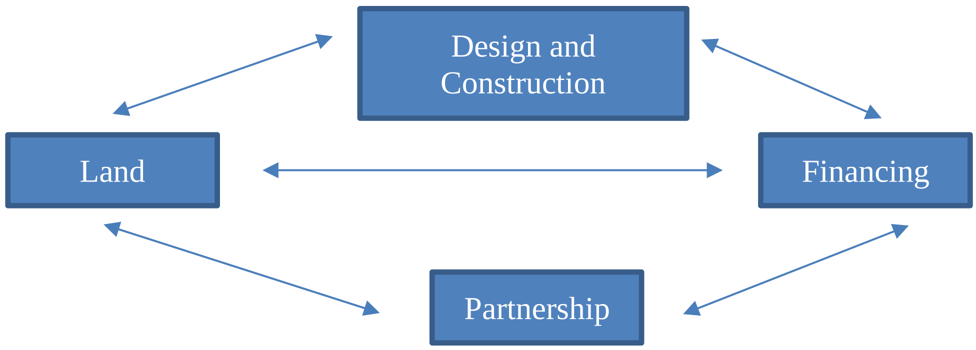

Figure 4.8 Major factors influencing housing finance

The Indonesian Government has initiated mixed-income transit-oriented development (TOD), which allows communities (low and middle) and public and private partners to obtain affordable housing which has significant economic, environmental, and quality-of-life benefits. *Public rental housing* act 2011 s.20 (Indonesian) regulates mixed housing projects by requiring developers to set aside 20% of all land for low-cost housing. However, there are variety form of mixed-income project as the adoption of mixed-income housing as a planning strategy did not define what mixed-income housing is and its main characteristics.

The participants in this study acknowledged that land is an important component of the housing development process; yet, access to land for housing has been problematic in many countries (Gopalan & Venkataraman, 2015), particularly in terms of location or accessibility and land rights. As location influences land costs, prime locations such as in the CBD or close to the city have a significant impact on land prices, and in many cases, households make trade-offs between location and transportation costs (Hartell, 2016; Huang et al., 2018; Dewita et al., 2020). Furthermore, because project development companies factor in land costs at only 15% of the total structure costs, and with construction accounting for around 40% of all costs, high land prices will deter tenants, who then seek accommodation in the suburbs or areas further from the city centre.

Therefore, in some major cities in Indonesia, high land prices in prime locations have meant that low-income communities have had to live in areas far from the city centre, which means they are burdened with high transportation costs or have to live in illegal squatter settlements in the city centres. As public housing (rental and ownership) developments are generally built on local government land, the location selection depends on availability, which means that some are located far from the city or employment centres.

The Indonesian Government has tried to overcome these problems by providing affordable low-cost rental/ownership residences in vertical buildings on minimal land in city centres. However, many members of low-income communities are reluctant to live in vertical buildings. This poses the challenge of how to encourage people to overcome their reluctance in order to be close to the city centre or TOD. Some participants expressed other strong concerns about land issues, stressing that locations needed to be in walkable neighbourhoods, and that low-cost apartments need to be near transit-oriented developments such as commuter trains.

There are several definitions for mixed housing programs. This study discusses three schemes: mixed-income, mixed-use, and mixed-tenure housing.

Mixed-income housing

Mixed-income housing is a planned program to build a multi-family development with a mix of income group tenants. In mixed-income housing, low-income and middle-income familier typically together within the same site, with the primary intention being to encourage social interactions through spatial proximity.

Respondents of semi structured interview from Ministry government claimed that, in Indonesia, mixed-income housing is occupied by both lower and middle-income communities, with subsidised prices being available for the lower income groups and market-rate prices for the middle-income group. Mixed-income housing is also classified by the different subsidy schemes available to reduce the rent/sale price for the low- and moderate-income families.

Mixed-use: low-cost rental apartments and commercial units (retail).

The term 'mixed-use building' refers to a building that has more than one function, that is, it can be utilised as rental and ownership residential units, as well as commercial units such as kiosks, retail stores, or stalls that support and increase tenants' incomes. This scheme is suitable for public housing developments for low-income or relocated communities and provides opportunities for tenants to be involved. Commercial units rented by individuals or ventures enable cross-subsidy programs and increase the revenue of the public housing operators.

As discussed previously, the Indonesian Government has initiated TOD, where residential units most suitable for low-income communities are integrated with public facilities such as train terminals and other support facilities such as shops. In these cases, the developer or public housing operator manages both the residential and commercial buildings. New urbanists mix manage this initiative by locating retail shops and consumer services near housing developments (Cervero, 2006). The mixed-use of buildings in this development concept has a positive impact on various parties. Talen (2013) identified the mixed-use building concept as adding advantages such as sustainability, increased transit ridership, and walkability; benefits that are only achieved through physical and functional integration, whereby facilities and infrastructures become more efficient, and good circulation and transit paths are created with clear separation between the different transport systems.

There are challenges involved in creating convenient neighbourhoods when buildings integrate residential units and retail outlets. For example, there are potential problems related to noise and to gentrification. In order to reduce gentrification problems relating to issues around upscale and lower classes, public spaces in which residents can interact socially and professionally and accommodate the needs of the informal sector should be created and protected.

Mixed tenure

Mixed tenure means that the project has a mix of rental and owned apartments. The different tenures can be in the same building or in different buildings in the same area (neighbourhood). Similar to the other schemes, it also involves a cross-subsidy program to reduce government subsidies. Previous studies have found that tenure mixes have little if any effect on problems and/or benefits, and only a slight impact on resident neighbourhood satisfaction.

However, none of those schemes apply if the public housing is constructed by the government-on-government land, as it is then classified as a government asset that cannot be owned by individuals. *Local government asset management* Minister of Home Affairs regulation 2016 s.19 (Indonesia) states that these types of public housings are classified as government assets; therefore, while the apartments can be rented, the rent determination needs to consider the renter's ability and willingness to pay (ATP/WTP). That regulation also states that the land and building values should be a factor in rent determination. For that reason, mixed-tenure housing is difficult to be applied.

Figure 4.9 shows that mixed-income housing involves consideration of four major factors: land, design and construction, partnership, and financing. Based on the explanation provided above, the strategies related to these four major factors are summarised in Figure 4.9. These strategies inform the development of the financial model.

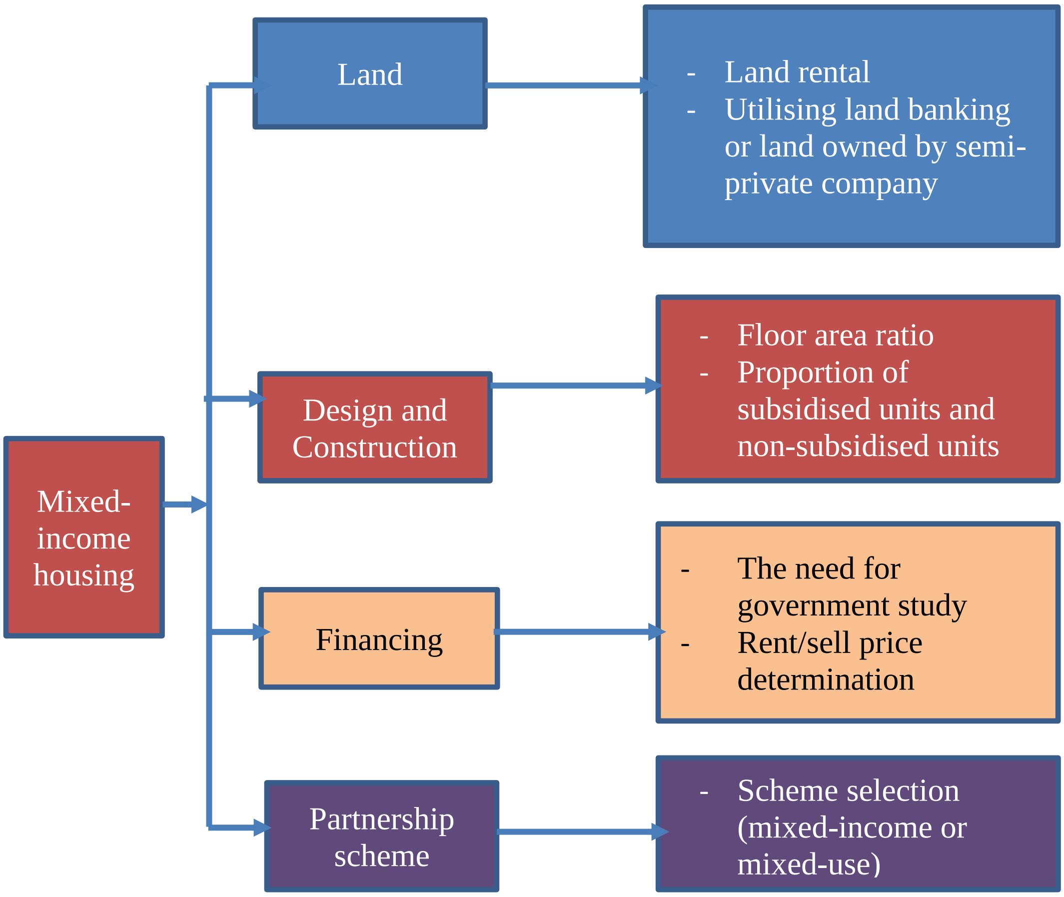

Figure 4.9 Strategies to develop mixed-income housing

4.5 MIXED-INCOME HOUSING CONSTRAINTS

Mixed-income housing schemes offers several benefits. However, there are two major issues related to the implementation of mixed housing in Indonesia: *rights to land* and *project viability*.

Rights to land

A problem related to land rights needs to be considered. According to *Public rental housing* act 1985 s.16, which was amended by *Public rental housing* act 2011 s.20 (Indonesia), public housing can be built on land according to:

- property rights;
- rights to build or use rights on state land; and
- rights to build or use rights over management rights.

The high-rise apartment project in this study is planned to be built on government or a state-owned company's land. Land owned by the government or by a state-owned company has use rights or management rights. A state-owned company has management rights, which are legalised into use rights for a period of no longer than 30 years. This rights can be extended further until next 20 years (*Land rights* government regulation 1996 s.40 (Indonesia)). Use rights refer to the right to utilise the land directly controlled by the state, or land owned by other people who grant the rights to an authorised official as long as it meets the local or state regulation and in accordance with land use policy.

In the case of mixed-income housing TOD, the land is owned by a state-owned company, which means that the local government or government-owned legal entities, such as the railway company, would have land management rights. In practice, the developer and the low-cost housing operator might need to pay an annual land rental fee to the landowner/state-owned company. Related to rights of land, public housing would be built with some alternative schemes. These involve the rights to build or use rights on state land or rights to build or use management rights. Ownership of an apartment unit is indicated by property rights of apartment unit certificate (SHMSRS) or a strata title. Strata titles can also be interpreted as joint ownership of an apartment, not only horizontally, but also vertically. This joint ownership refers to two things: the exclusive right of private space and the common right of the public space of a building complex.

A problem can arise in relation to the period of use rights. For example, the use rights period is for a maximum of 25 years; if the developer manages the building for more than 25 years, the right to use should be extended by official authorisation. If the rights expire, it creates problems for the next operator or apartment tenants related to the legalisation of land ownership and unit ownership. Therefore, long lease land rental should set out the rule of rights to land.

Project viability

Mixed-income housing developments rely on project viability; either the rent or the sales price should be affordable for low-income communities. However, as revenue from rents, sales, and monthly service charges must cover rising operating costs, in order to provide financial assistance to low-income owners the government has to offer subsidies, such as low unit prices, down payment subsidies, or low mortgage interest rates. As these subsidies could impact the developer’s cash flow, the project needs to be attractive to the private sector to encourage them to invest in housing development

(Rachmawati et al., 2018b). As the price should not exceed affordability, that is, 30% of household income, the number of and price of subsidised units and market-rate units need to be proportionally estimated.

Public housing (rental and ownership) is generally planned to be TOD housing, which is why it is built next to train stations. It is also usually located close to several universities. As the land around railway tracks is owned by the Indonesian Railways Company (PT KAI), developers need to collaborate with that company to develop mixed-income housing. PT KAI rents the land out for 50 years, which affects the land's status. KAI's initial land status is "rights to use", it is then changed into "management rights", while the building status is "building rights". The building rights status can be used for 30 years with a possible 20-year extension. The developer must pay the land rent fee to the landowner as an element of profit sharing for the company's contribution.

One factor relating to project viability is revenue. The main revenue comes from unit sales. As mixed-income housing must allocate subsidised and market-rate units, the proportion of those types needs to be considered in order to ensure the project feasibility. Furthermore, the subsidy needs to be formulated to ensure tenants' affordability through the provision of financial incentives, which may include property tax rebates, subsidised debt financing, and direct equity investments. Financial assistance, therefore, is provided to both tenants and developers. Chapters 5 and 6 examine a project's viability through investment analysis for rental and ownership scheme, respectively

4.6 CHAPTER SUMMARY

This chapter presented data collection results from the two questionnaire surveys, the semi-structured interviews, and the secondary data. Based on the first survey – the tenant survey – tenants in Jakarta were found to have higher household incomes than tenants in the other cities investigated, the median income being IDR 5 million. The lowest reported income was that of tenants in Makassar.

Current rent prices were also obtained from the tenant survey, that is, the actual housing cost paid by tenants every month. Current rent prices were found to be low, much lower than tenants' ability to pay. In relation to preferences for dwellings, tenants' responses indicated that most were more interested in renting a house than in living in a boarding house. The preferred areas were the suburbs and the city centres, rather than close to industrial areas.

Respondents who contributed to the housing provider survey identified three new factors that they saw to be influencing public housing rent prices: government subsidies and the ability and willingness to pay. Overall, respondents rated the most influential factors as the ability to pay, willingness to pay, government subsidy, location, running costs and household income. Only the first three factors were selected by all respondents.

Research Phase 2 involved semi-structured interviews with participants from the government and semi-private housing developers. The findings from these interviews identified four theme clusters: land provision, design and construction, financing, and partnership schemes. These theme clusters included sub-themes, which provided more detail. These themes were used to consider low-cost apartment development. Chapters 5 and 6 present discussions relate to the data analysis.

Chapter 5: Financial Model for Public Rental Housing

5.1 INTRODUCTION

This chapter presents a financial analysis of public rental housing data, as included in Research Phase 1. The expected outputs relate to the evaluation of approaches to public housing rent price determination, namely, income-based, cost-based, and discounted market-based approaches, and to feasibility analysis for public rental housing. Descriptive statistics and discounted cash flow were employed to address the question and inform discussion of the issues. Primary data were collected from questionnaire surveys, while secondary data were gathered from government and private institutions.

The chapter comprises eight sections. Section 5.1 presents the introduction, Section 5.2 discusses the results of the questionnaire surveys related to factors influencing public housing rent price, household income, and ability to pay, while Section 5.3 examines rent price determination using an income-based approach. This is followed by rent price determination using a cost-based approach in Section 5.4 and rent price determination using a market-based approach in Section 5.5. Section 5.6 then provides housing costs to income ratios, Section 5.7 presents financial analysis of public rental housing investment, while a final discussion is presented in Section 5.8. The progression flow of the chapter is depicted in Figure 5.1.

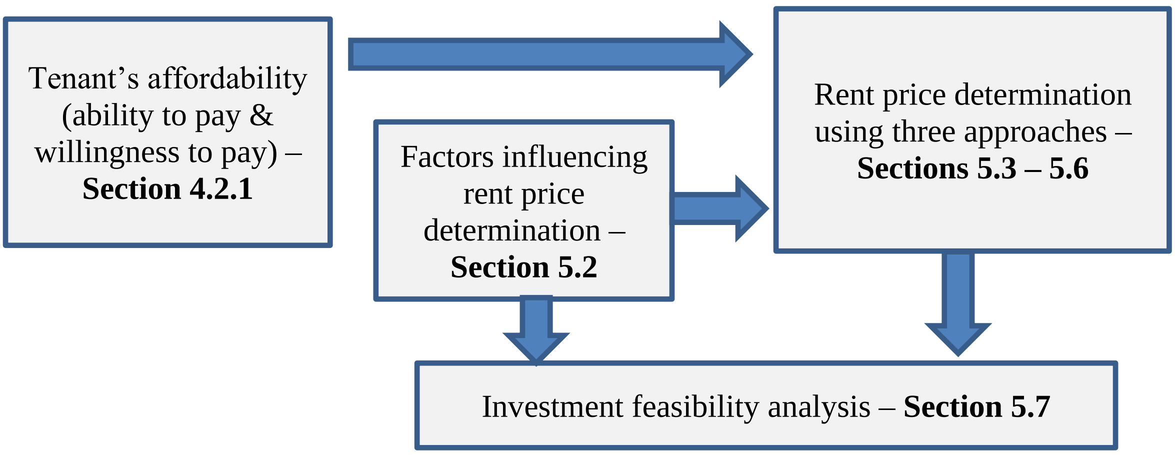

Figure 5.1 Financial model for public rental housing

5.2 FACTORS INFLUENCING RENT PRICE

The initial list of factors was compiled from the literature review, as presented in Chapter 3. Participants from government offices and housing providers subsequently validated 15 proposed factors by suggesting the removal of seven irrelevant factors and adding three others considered suitable and specific to rent price determination. These factors were summarised as macro and micro factors influencing rent prices (Yuan et al., 2017), as mentioned in Chapter 2. The participants from public and private sectors indicated their preferences and ideas about dominant factors in public housing rent pricing, which was important as they currently determine rent prices. The additional factors were willingness to pay, ability to pay and government subsidies. Eleven factors influencing public housing rent price were identified by descriptive statistical analysis. All respondents selected household income, cost, ability to pay, willingness to pay, location, and government subsidy as dominant factors that influence rent price determination. These top six factors (as reported previously in Table 4.12) are discussed in more detail in this section.

5.2.1 Household income

Monthly household net income refers to the gross income after personal income tax. Previous studies have reported that household income is a major factor that affects rent price determination. For example, Zhai et al. (2018) argued that household income, as indicated by the household living standard, is a demand factor in the housing rental market. Their finding aligns with that of Yuan et al. (2017), as discussed in their study of public rental housing (PRH) in China. Household income ranked second among 14 factors influencing rental prices, indicating that household income has a significant impact on PRH rents.

One government expectation in relation to public housing development is that tenants will own their first home after a period of rental; thus, rent prices of public rental housing in Indonesia are kept low and do not exceed the regional minimum wage (*Public rental housing tariff determination* Minister of Public Works and Public Housing regulation 2018 s.1 (Indonesia)). The minimum public housing rent price is IDR 100.000, while the maximum is IDR 700.000. The questionnaire survey in this study collected data related to the tenants, and it was established that not all had formal jobs, and that their income did not follow regional minimum wage levels. Comparison between regional minimum wages and tenants' income is presented in Section 5.3. Public housing tenants in Bandung and Makassar had an income below the regional minimum wage, whereas in Jakarta and Batam, incomes were higher than minimum regional wages, as public housing in Jakarta and Batam were occupied by regular tenants who had formal and settled jobs. The rent price of public housing was higher than that in the other three cities.

5.2.2 Ability to pay

The ability to pay factor reflects the affordability of tenants for renting a home and can be assessed by household income and how much of this goes on housing. Housing affordability and affordable housing are correlated to the household budget, as higher housing cost will leave less to pay for food, utilities, transportation costs, health, and education (Anacker, 2019).

As discussed in Chapter 4 that some public rental housing in Indonesia, for example, in Batam and Jakarta, which are occupied by certain classes of community, have applied adjustable rent prices according to the ability to pay. Unfortunately, some public rental apartments are not classified based on tenants' incomes, and rent prices are set very low.

5.2.3 Willingness to pay

Willingness to pay (WTP) is related to behaviour. It is a factor that is commonly measured to inform additional or particular development features or attributes (Gupta & Malhotra, 2016). In the case of this study, WTP is defined as the price that tenants were willing to pay for the rented unit in public housing.

In this study, two public housing developments in Jakarta and Batam exemplified public housing with proper willingness to pay. They are occupied by residents who have formal jobs, so all are willing to pay the given rental price, which can be determined higher if appropriate. In contrast, public housing buildings in Surabaya and Makassar are mostly occupied by tenants who have been relocated, and for whom rents cannot be set high. Consequently, the local government must significantly subsidise rents.

Relocating communities and managing revitalised slum areas can lead to unpredictable consequences, one of which is a political issue (Tuti & Mawar, 2018). Most relocated communities are from lower-income or working-class districts that are highly diverse and heterogeneous. These people can be easily provoked by each other. When the low-income communities are required to move to new neighbourhoods, they are often unwilling to pay the required rent price. In their former accommodation they only paid occasionally to their "land-owner", whenever they were able. In this situation the government sets a low rent price, adjusted to tenants' willingness to pay.

5.2.4 Government subsidy

As public rental housing is dedicated to low-income communities, the government cannot determine rental prices higher than market prices or higher than the prices of properties with the same features (Randy, 2013). In general, government subsidies are seen as a problem-solving strategy for deficit problems in many areas, such as energy, housing, and water (Jun et al., 2010). The Indonesian Government subsidises a significant proportion of public housing operation and maintenance costs, as the annual income from the existing rent prices is far lower than the total cost. This significant gap between income and costs needs to be covered by local government subsidy (Rachmawati et al., 2018b).

This subsidy can be reduced if the ability and willingness to pay increases. Some public housing buildings are currently being improved, with management trying to attract applicants by including indoor facilities in each unit, hoping that additional features will give added value to the property and result in more competitive pricing. In this case the government subsidy could then be reduced, and the funds allocated for other supporting facilities (Rachmawati et al., 2018b).

5.2.5 Costs

As discussed in Section 4.3.3, the costs related to the public rental housing life cycle include investment costs (land/acquisition costs and construction costs) and running costs. Regulations related to public housing state that the maximum price should take operation and maintenance costs into consideration, while the minimum price only calculates operation costs. Investment costs are ignored and calculated as a government subsidy. While operation and maintenance costs are considered factors influencing rent price determination, due to the demographics of the targeted tenants, construction costs and land acquisition are negligible. This finding aligns with rent price determination, which is part of financial sustainability analysis (Li et al., 2016). However, in order to keep a building in appropriate condition for use, periodic maintenance is required; thus, all respondents acknowledged that costs are primary factors for rent price determination.

5.2.6 Location

Interestingly, location was the most commonly reported factor that influences rental or selling prices. Location was critical in the case of public housing; yet there was a common pattern for low-income communities. Due to their limited resources, they tend to purchase apartments in unfavourable locations, or they decide to live in closer proximity to their workplace or city centre by lowering their expectations about decent housing (Huang et al., 2108).

Location affordability theory asserts that transportation costs and housing costs in urban systems are correlated (Hartell, 2016). In many cases, households make trade-offs between location and transportation costs. They live in more affordable housing in remote areas with higher transportation costs. Another option is to live in housing in a prime location with higher costs and lower transportation costs (Dewita et al., 2020).

Transport affordability references households' financial burden with regard to transportation costs (Dewita et al., 2020). Private transportation costs include the operational cost for private vehicle users, including fuel, parking fees, routine maintenance cost, vehicle tax, and insurance. Previous research has established that transport ability is achieved when it constitutes between 10–20% of a household's income (Litman, 2013).

Participants from the government sector did not recognise location as one of the most critical factors, as they regarded land as a kind of government subsidy, as the land price in some areas is negligible. Most public rental housing in Indonesia is built on government asset land, where the location depends on the availability of such land in the city. However, the Indonesian Ministry of Public Works and Public Housing suggests that public housing should be built close to workplaces or to transportation facilities in order to ease tenants' financial burden (Rachmawati et al., 2015). In providing land for proposed public rental housing, local governments obviously need to consider the location of the land in this regard.

Both ministry and local government also needs to change some of the negative perceptions regarding public housing. For example, some applicants are reluctant to live in vertical buildings. They prefer to stay in their existing accommodation, ignoring transportation costs. They normally have more than one motorcycle in one family, the motorcycle being the most popular mode of transport in many Asian countries, as it is affordable, accessible, and reliable (Dewita et al., 2020). A study regarding the use of motorcycles conducted in Indonesia by Herwangi et al. (2015) established that due to the quality and quantity of public transport in some major cities in Indonesia – which does not meet low-income communities' needs – the motorcycle has become the major mode of transportation.

Factors influencing rent prices are used to evaluate current rent prices and to examine rent price determination. This study used three approaches for rent price determination:

income-based, cost-based, and market-based approaches. The relationship between factors influencing rent price and rent price determination approaches is illustrated in Figure 5.2.

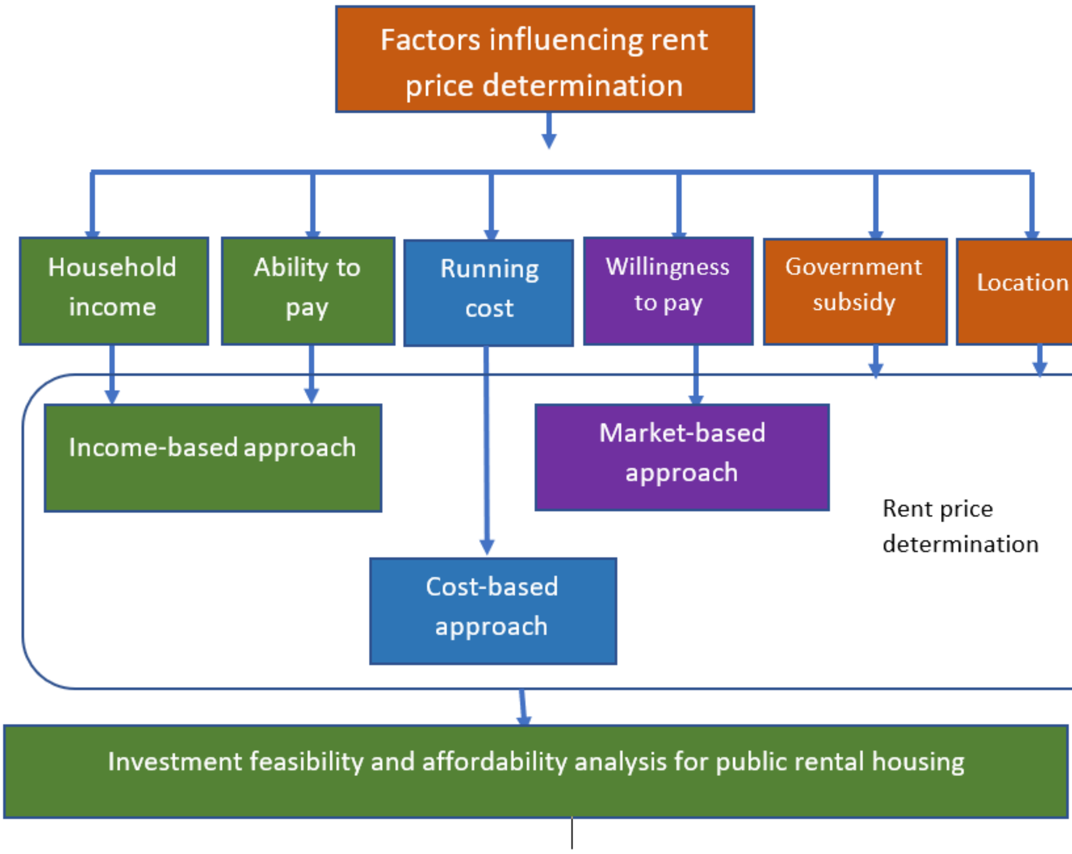

Figure 5.2 Relationship of factors influencing rent price and rent price determination approaches

Figure 5.2 shows the link between questionnaire results regarding factors influencing rent price. The ability to pay was employed to determine rent price using an income-based approach as it uses the affordability criteria, that is 30% of household income, while willingness to pay was based on the real substitute preference survey used to determine tenants' preferences about where they lived prior to occupying public rental housing. All participants had lived in 'private' housing, where prices followed market-based trends. Therefore, willingness to pay for substitute housing was used to determine rent price when a market-based approach was used. Detail of the three approaches in each location of the investigated case study are explained in the following sections.

5.3 INCOME-BASED APPROACH

The income-based approach is one method used to determine rent price. It uses household income data, which is recognised as a tenant's ability to pay (Worthington, 2012). In this study, the concept of household income involved regional minimum wage and actual household income data, while actual rent price was set as housing cost

5.3.1 Household Income

As noted previously, the calculation of household income used two data sets: regional minimum wage (secondary data), as listed in Table 5.1 and actual household income (based on questionnaire survey as explained in Chapter 4).

This study conducted primary data collection with tenants in seven public housing buildings in five cities, as listed in Table 5.1, which presents case study data, including population density and regional minimum wages. Minimum wage data were then used in comparison to actual household income obtained from the questionnaire interviews.

Table 5.1 Baseline data for the case study areas

No	Area/City	Number of observed public rental housings	Population density (persons/km^2)	Number of respondents	Regional minimum wage in 2020 – capital city (monthly – IDR)
1	Bandung	1	14,357	35	3,339,454
2	Batam	2	1,100	40	3,806,324
3	Jakarta	1	15,804	42	3,940,918
4	Makassar	2	6,647	30	2,860.309
5	Surabaya	1	8,811	37	3,870,980

The Indonesian Government's aim in determining the minimum wage is to create a wage system that can meet the decent living needs of workers and their families (*Minimum regional wage regulation* Minister of Labour Regulation 1999 s.1 (Indonesia)). The minimum wage does not apply to all parts of Indonesia. Each region has a different standard for wages. For example, the minimum wage in DKI Jakarta is higher than the minimum wage in Bandung, and the Karawang minimum wage is higher than the minimum wage in Surabaya. In other words, each region applies their regional minimum wage, which is released by the local government every year. A current year's regional minimum wage is calculated by a percentage increase in the minimum wage from the previous year, which is influenced by national inflation and national economic growth (*Minimum regional wage regulation* Minister of Labour regulation 1999 s.1 (Indonesia)). It provides guidance for an organisation to pay their employees. Therefore, the regional minimum wage can be regarded as the standard for household incomes.

In real terms, the actual household income can be lower, equal, or higher than the regional minimum wage. The questionnaire survey collected this data, which is reported in Table 4.5 (Chapter 4).

As reported in Chapter 4, regular tenants generally had formal employment and a fixed monthly income. However, not all public rental housing occupants had formal employment. Some run their own small business, usually as a street food vendor. Some hold other primary jobs, for example, as a fisherman, gardener, garbage collector, casual construction labourer, or as a driver of a ride-share vehicle. Their monthly income is approximately IDR 1,000,000 – 4,500,000.

The actual household income is mostly lower than the minimum regional wage. The comparison between regional minimum wages and tenants' income is presented in Figure 5.3.

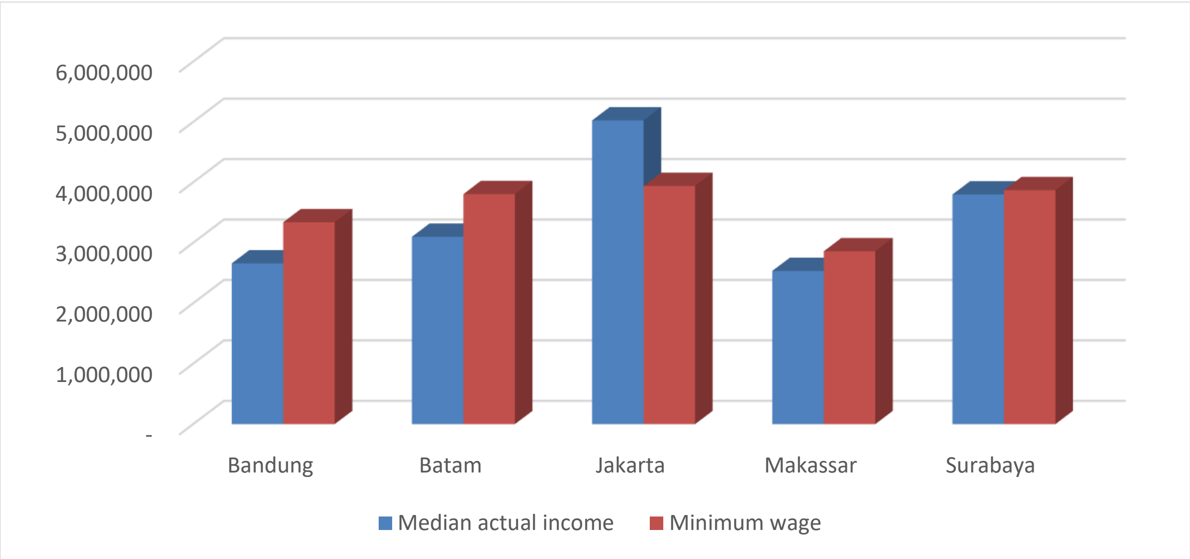

Figure 5.3 Comparison between regional minimum wages and median actual incomes (based on questionnaire surveys) – (in IDR)

5.3.2 Housing costs

Housing costs in this study refer to amount of money paid or charged, usually periodically, to pay or to rent any property, land, or buildings. Ideal housing cost, based on 30% of both actual household income and regional minimum wage as affordability indicators, is provided in Table 5.2. This was calculated based on regional minimum wage and actual household income.

Tenants' affordability, or the maximum housing cost they should pay based on their income, was measured from the calculation.

Table 5.2 Rent price determination based on household income

Cities	Regional minimum wage (IDR)	Rent price (using regional wage) - IDR	Actual median household income (IDR)	Rent price (using actual household income) – IDR
Bandung	3,339,454	1,001,836	2,660,000	798,000
Batam	3,806,324	1,141,897	3,100,000	930,000
Jakarta	3,940,918	1,182,275	5,025,000	1,507,500
Makassar	2,860,309	858,093	2,535,000	760,500
Surabaya	3,870,980	1,161,294	3,800,000	1,140,000

As public rental housing tenants in Jakarta had higher monthly income than tenants in the other observed cities, they should pay higher rent than the others. In general, rent price determined from a regional minimum wage was higher than those determined by the actual household, as in practice, the real tenant's household income was lower than the regional minimum wage.

As reported in Section 4.2, public rental housing in Indonesia was occupied by regular tenants and relocated communities. Regular tenants were those who apply to stay in public rental housing for a pre-determined period, while relocated communities refer to people who had been relocated to certain areas due to urban restructuring. People in both groups might not have formal jobs. Therefore, their income was not equal to the regional minimum wage. For example, one public rental housing in Jakarta was occupied by Ministry staff, known as government officers, who have formal jobs and fixed monthly incomes. Another issue was that due to capital capacity, not all industrial companies are able to pay their workforce according to the regional minimum wage. Only large-scale companies can pay the minimum wage – or a higher wage.

As also previously noted, public rental housing was often occupied by relocated communities, who mostly consist of low-income people; thus, the rent price cannot be determined on their income (Rachmawati et al., 2018a). Most public rental housing prices in Indonesia are very low. The actual rent prices are presented in Table 5.3. Tenants' ability to pay was measured by affordability, that is, according to the formula of 30% of household income is the tenant's ability to pay the housing cost. As public rental housing in Batam and Jakarta was occupied by employees with formal jobs and fixed incomes, the ability to pay was higher than that of public housing renters in Makassar and Surabaya. However, the ATP in Batam and Jakarta were also different, as the cost of living in Jakarta was found to be higher than in any other cities in Indonesia. Meanwhile, the ATP in Makassar and Surabaya were also dissimilar, with the ATP in Makassar being slightly higher due to higher living costs.

Table 5.3 Actual average housing costs

No	Cities	Housing cost – actual public housing rent price (monthly – IDR)
1	Bandung	300,000
2	Batam	800,000
3	Jakarta	750,000
4	Makassar	135,000
5	Surabaya	165,000

Table 5.3 shows the actual average housing costs determined by this study. An average cost as rent price on each floor was different, and in Makassar and Batam two different public rental housing developments had different rent prices. The housing cost data were obtained from the questionnaire surveys.

Table 5.3 demonstrates that the actual public housing rent price was lower than the ideal or maximum housing cost. According to the definition of affordable housing used in this study, the housing cost should be less than 30% of the household income. In order to determine the ability to pay, the tenant's affordability was used as an indicator. The results show that the current rent price was lower than the estimated rent price determination using the income-based approach, which means that the current rent price was lower than the tenant's ability to pay. Tenants' ability to pay was measured by comparing the current housing price with 30% of the household income. Furthermore, Table 5.4 and Figure 5.4 compare rent price determination using the income-based approach and the current rent price. Actual housing costs are symbolised by the green box.

Table 5.4 shows that the current rent price was very low compared to affordability criteria, the housing cost being less than 30% of the household income based on both the regional minimum wage and the actual household income. It shows that the current rent price was lower than the estimated rent price determination using the income-based approach, which means that the current rent price was lower than the tenant's ability to pay. The only exceptions were a few of the lowest income group in Bandung and Jakarta, who would need to pay 42% of their income and 77% of their income, respectively. Public housing in Jakarta was occupied by regular tenants; public housing in Batam was similar; so that all of these tenants were willing to pay the rent price, which could be determined at a higher and more appropriate rate. In contrast, public housing in Surabaya and Makassar was mostly occupied by relocated communities. Therefore, the rental price could not be determined at a higher or more appropriate rate. The government controls the price by determining a low price.

Table 5.4 Rent price determination using income-based approach

No	Cities	Rent price based on actual median household income (monthly – IDR)	Rent price based on regional minimum wage (monthly – IDR)	Actual rent price (IDR)
1	Bandung	798,000	1,001,836	300,000
2	Batam	930,000	1,141,897	800,000
3	Jakarta	1,507,500	1,182,275	750,000
4	Makassar	760,500	858,093	135,000
5	Surabaya	1,140,000	1,161,294	165,000

Source: Researcher's analysis

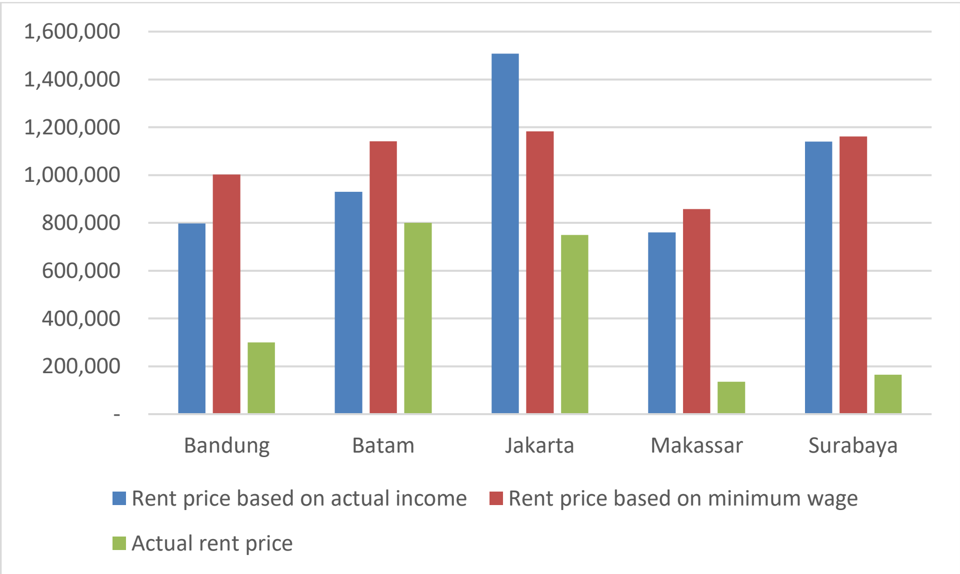

Figure 5.4 Comparison between housing cost (actual rent price) and rent price based on ability to pay (in IDR)

Overall, the preferred rent determination approach is the income-based approach (Xu et al., 2015). However, there are some obstacles related to its implementation, such as public rental housing occupied by relocated communities with informal jobs and irregular incomes gives rise to difficulties in determining the rent price.

The variability in tenants' ability to pay may cause different problems when housing providers face high operation and maintenance costs for their buildings. The income-based approach calculation has shown that the actual rent price was lower than the maximum that tenants can pay. However, this may not be feasible for public housing providers, as they need sufficient funds to operate the building. The rent price should be affordable for tenants but also be viable for providers.

As the regional minimum wage for each city differs, housing costs will need to be adjusted to meet affordability criteria. For example, public rental housing in Batam and Jakarta, occupied by middle income communities, were found to have higher rents than the other three cities. Public rental housing in Jakarta and Bandung has similar construction costs; however, the rents were different as the affordability of tenants in Bandung was lower compared to Jakarta.

The cost-based approach to rent determination can be used to assess the cost needed by the public rental housing provider to operate and to maintain the building. It is anticipated that tenants could at least pay the price for operation and maintenance costs.

5.4 COST-BASED APPROACH

The life cycle costs related to public rental housing include investment costs (land/acquisition cost and construction cost) and running costs (operation and maintenance costs) (Du et al., 2011). According to *Public rental housing tariff determination*, Ministry Public Works and Public Housing regulation 2018 s.1. (Indonesia), the Indonesian Government has issued regulations related to public housing rent pricing, which offer two rent prices: maximum (includes operation and maintenance costs) and minimum (operation costs only). The current actual rent price is determined below the minimum rent price, which is adjusted based on tenants' willingness to pay. As a result, the government must subsidise public housing operation and maintenance expenses. Without the government subsidy, the operation and maintenance program cannot be run appropriately, as the expected revenue from the rent price is too low to cover these costs. Every year the subsidy has reached 95% of total operation and maintenance costs (Rachmawati et al., 2018b). If tenants have increased ability and willingness to pay, the rent price can be determined higher, which will help to cover operation and maintenance costs. The government could then reallocate the operation and maintenance subsidy to build more public housing (Rachmawati et al., 2018b).

Rent price determination using the cost-based approach was divided into two groups. Group 1 consisted of Jakarta and Batam, which have similar housing costs, costs that are higher compared to Bandung, Makassar and Surabaya, which were categorised as Group 2. Table 5.5 depicts the rent price determined using the cost-based approach for the two groups.

Table 5.5 Rent price determination using cost-based approach

Rent price	Group 1 – Batam & Jakarta (monthly – IDR)	Group 2 – Bandung, Makassar & Surabaya (monthly – IDR)
Maximum price	1,245,000	712,500
Minimum price	900,000	288,450

Source: survey (Public housing operators)

The operation and maintenance data were compiled from secondary data collected from typical public rental housing in Jakarta and Surabaya. The operation and maintenance costs included:

a) administration salaries;

b) electricity bills for administration office and public facilities (corridors, parks and parking areas);

c) water bills for public facilities operation; and

d) public facilities maintenance.

Based on the tenant survey results, for example, in Bandung, the range of ‘ability to pay’ fell within IDR 220,000 – 1,400,000 (30% of actual household income in Figure 5.5. Seventy-five per cent of all surveyed tenants had an income less than minimum regional wage. However, 63% could afford to pay the maximum rent price based on the cost-based approach, while 29% and 8% could not afford to pay the maximum and minimum price, respectively, as evidenced in Figure 5.5.

Figure 5.5 also shows that a small number of tenants in five cities could not afford to pay either minimum or maximum rent prices. In these circumstances, in order to meet the liveability conditions for public housing and to meet proper maintenance costs, the government must subsidise the gap of approximately IDR 150,000 per month per tenant.

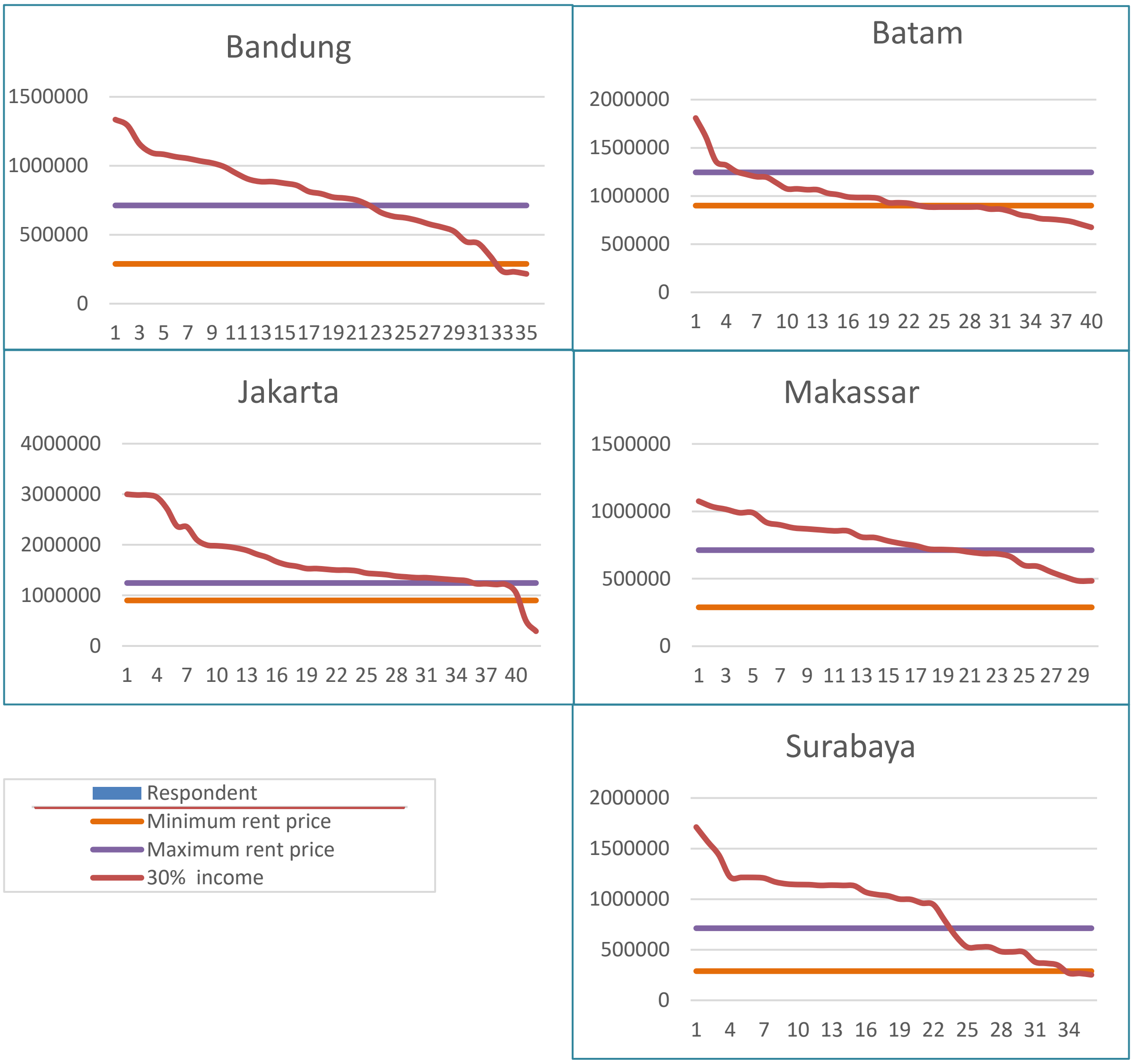

Figure 5.5 Comparison household income and rent price (in IDR) using cost-based approach

Source: Survey (household income) and analysis

5.5 MARKET-BASED APPROACH

The actual rent price was determined by relocated communities' willingness to pay, which is lower than regular tenants' willingness to pay. In order to determine the rent price, tenants' preference or willingness to pay was measured using the direct substitution method. Because there were two different types of tenants, there were two ways to assess willingness to pay.

5.5.1 Willingness to pay by relocated communities

According to the survey, it was reported that most forced relocated communities were not willing to pay a high rent as it is beyond their means; while others were not willing to pay for what can be seen to be behavioural or mindset reasons. In response to this situation, the government stipulated a very low rent price, and even gave the apartment free of rent at the beginning of the tenancy. This low price became the actual rent price.

5.5.2 Willingness to pay by regular tenants

Willingness to pay by regular tenants was measured using the substitution method. This method used a substitute dwelling in which they might prefer to live. In this study, the substitute dwellings considered were other types of residential properties chosen by public housing tenants not actually living in public housing, or prior to their occupation of public housing. These might typically include a rented house or a boarding house. During the period when they are waiting for public housing, they live in other dwellings for which the housing cost might be higher than the low-cost residences, for example, boarding houses, which are privately owned commercial housing for public dwellings, consisting of rooms and in-room facilities for a family or single tenant. The price is set by the boarding house owner, while the period of rental is determined by the tenant (Hidayat & Komarudin, 2019). Renting a house is an option that includes a small house with a land area of about 40-60 sqm, which is normally located in the suburbs. Regular tenants' willingness to pay was relatively higher than that of relocated communities.

Based on the results of the tenant survey, the market price of the substitute dwelling was then calculated as an average for each city, as shown in Chapter 4. In Chapter 4, three options for substitute dwelling are described. However, in this study the self-help housing option was removed, as this was not related to a rental dwelling. The comparison focuses on rental dwellings. Therefore, only boarding houses and rent-a-house options were used. The housing cost or rent price for public housing was 80% of the substitute market price, which was the adopted ratio from Australian NRAS and the US Department of Housing and Urban Development (Kutty, 2005). Table 5.6 shows the tenants' willingness to pay based on assumptions from direct substitute dwellings, namely, a boarding house and a rental house.

Table 5.6 Rent price determination using market-based approach

Cities	Substitute market price (monthly – IDR)		Rent price (80% market price) (monthly – IDR)	
	Boarding house	Rent a house	Boarding house	Rent a house
Bandung	620,000	1,700,000	496,000	1,360,000
Batam	550,000	1,500,000	440,000	1,200,000
Jakarta	1,120,000	2,750,000	896,000	2,200,000
Makassar	550,000	1,500,000	440,000	1,200,000
Surabaya	585,000	1,500,000	468,000	1,200,000

Source: survey (property price)

5.6 HOUSING COST TO INCOME RATIO

The affordability benchmark uses housing cost-to-income ratio with the 30% rule, where the housing cost should be less than 30% of household income (Nepal et al., 2010). Income data were based on household income, as shown in Table 5.2. Figure 5.6 presents comparison of three rent price determination approaches and actual rent prices. It includes minimum and maximum rent price of cost-based approach and market-based approach using shared house and ren house scheme. Meanwhile, Figure 5.7 presents the housing cost-to-income ratio for public housing tenants in Indonesia, using two rent price determination approaches, the discounted market-based and the cost-based approach. The housing cost-to-income ratio shows the affordability gap between rent price determination approaches. In this study, the housing cost was derived from the public housing rent price, which was then compared to income to obtain the housing cost-to-income ratio. Income from income-based calculation was used as the benchmark. Cost and discounted market-based approaches use the actual income as the income variable. There are two conditions in the cost-based approach, as explained above, namely, maximum, and minimum rent prices. In addition, discounted market-prices were also analysed under two conditions of substitutes, namely, boarding houses and rental houses.

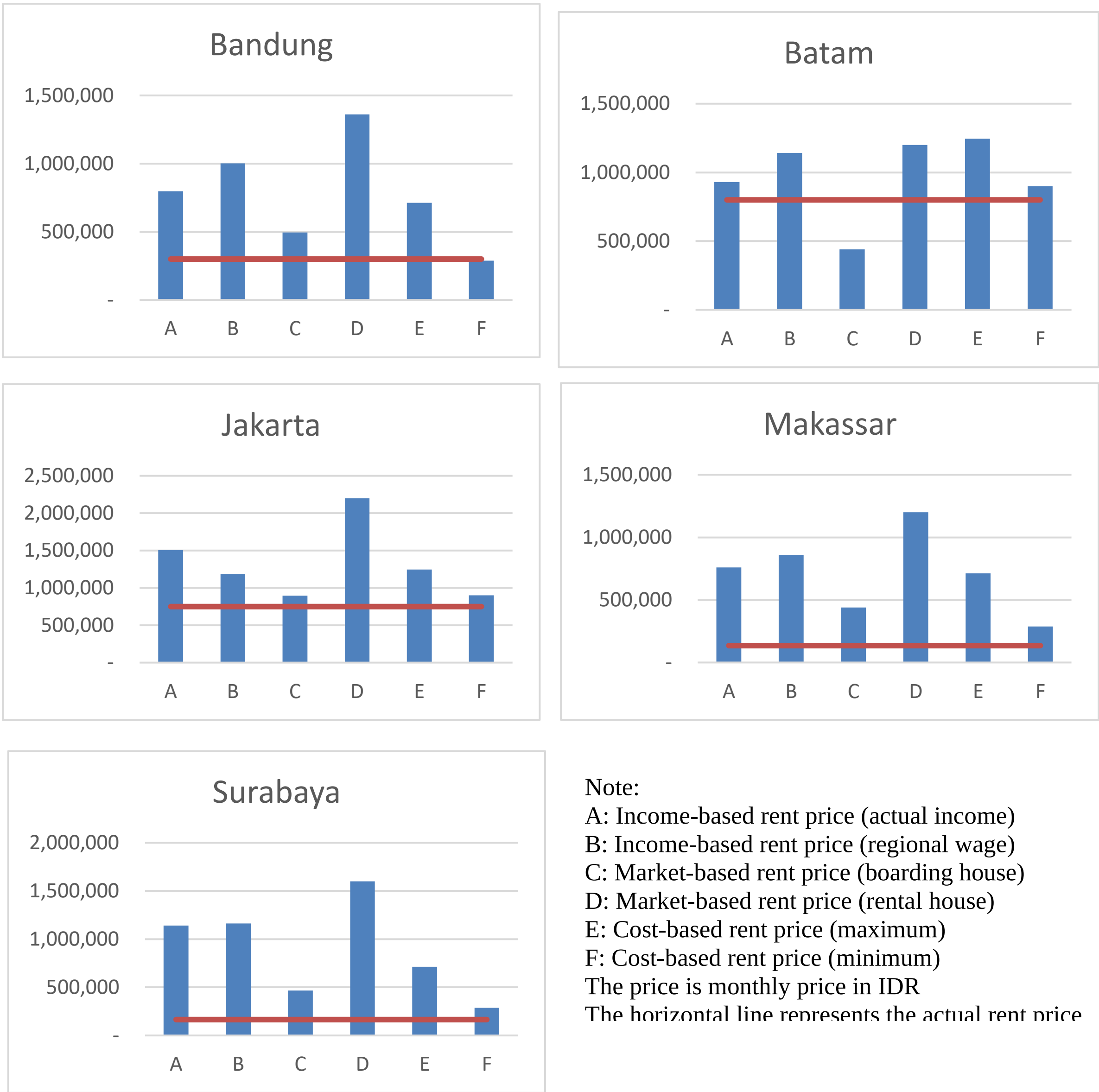

Figure 5.6 Comparison of three rent price determination approaches and actual rent prices

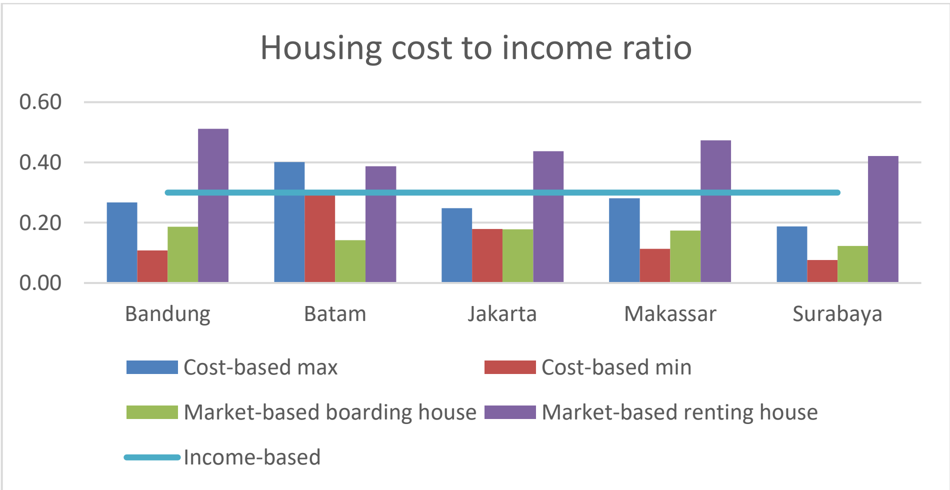

Figure 5.7 Housing cost-to-income ratio comparison using three approaches

From Figure 5.7 it is evident that the housing cost-to-income ratios in all cities were rising in the market-based price conditions. For tenants in all cities the ratio would be worse if they decided to rent a house. Family households with modest incomes could suffer from the heavy burden of monthly expenses. According to the 30/40 rule (Australian Housing and Urban Research Institute [AHURI], 2019) a tenant is said to be in housing stress if more than 30% of the household income is spent on rent. At first, the income-based approach was used to determine rent price for public rental housing. This was the easiest approach as it was based on affordability, which was less than 30% of household income. In the Indonesian context, based on Figure 5.6, if people pay 30% of their income it would satisfy the cost-based approach, except in Batam, where the government might need to provide a subsidy for maintenance cost. Therefore, the maximum cost-based approach should ideally be used to determine public housing rents, as public housing operators would have sufficient resources from rent revenue to meet their operation and maintenance costs. In contrast, market-based price determination using rent a house scheme could not be applied, as the price was very high.

AHURI (2019) formulated 30/40 rule as the housing stress indicator, if more than 30% of the household income is spent on rent. This finding accords with housing stress theory (Rowley & Haffner, 2014). Housing stress is defined as a situation in which households in the bottom 40% of the income distribution spend 30% or more of their gross income (Rowley, 2012) on direct housing costs. Housing cost also included recurrent household costs, such as mortgage or rent costs. Furthermore, the ratio is commonly used to define the criteria of housing affordability, which used as the basis for formulating housing policy (Rowley & Ong, 2012).

In actual practice, in Indonesia, the housing industry use a 50% indicator to determine housing affordability. A homeownership credit will be granted if the housing cost (loan repayment) was less than 50% of net family household income (after tax and other mortgage deductions).

The rent price determined using the three approaches was additionally analysed to ensure that the project was feasible from the housing provider perspective. Further analysis uses income-based approach, cost-based approach (maximum and minimum rent price), and market-based (boarding house).

5.7 INVESTMENT FEASIBILITY ANALYSIS FOR PUBLIC RENTAL HOUSING

This section reports on the investment and affordability analysis conducted for public rental housing. The aim was to investigate whether public rental housing would be viable as an investment capable of generating net present value (NPV) and required return for housing developers. The study also explored the possibility of public rental housing generating affordable housing outcomes using predetermined rents. The rent prices obtained from the previous section were used as input for this analysis, the aim being to conduct public rental housing feasibility analysis with three rent prices inputted based on three rent price determination approaches (income-based, cost-based and market-based). The evaluation also included the government subsidy and implications for public rental housing investment. The case study used a high-rise apartment in Depok City (Greater Jakarta). The building consists of both residential and commercial areas, with all units in the residential area allocated for rental housing. Project revenue and expenditure on both, residential and commercial areas were reported in detail in Chapter 4, Sections 4.4.2 and 4.4.3. This chapter discusses the financial analysis, using discounted cash flow.

5.7.1 Income-based approach economic parameters

The first analysis is feasibility analysis with the rent price determined using income-based approach as an input. Economic parameters used in this study included investment periods, inflation rates, tax rates, capital loans, and repayment periods. Table 5.7 illustrates the key parameters set as constants in the public rental housing feasibility analysis as the case study, and to determine the effect of key parameters on project feasibility in order to complete each case scenario for financial assessment.

Table 5.7 Economic parameters

Economic parameters		Source of assumption
Investment period	20 years	Secondary data from several apartment investments
Inflation rate	2%	Secondary data from several apartment investments and internet (published data)
Tax rate	21%	based on Indonesian perppu 1/2020
Required rate of return	10%	Secondary data from several apartment investment
Equity	50%	Interview with housing developer
Capital loan	9%	Secondary data from financial institution
Loan repayment period	3 years	Secondary data from financial institution
Capitalisation rate	7.5%	Secondary data from several apartment investments

In this study, economic parameters assumption including inflation rate, tax rate, equity, capital loan and loan repayment period. For housing investment capital budgeting, some financial institutions, such as bank, employed 9% capital loan for a company. The loan was allocated for building construction. Furthermore, the financial institution determines the duration to pay the loan in 3 years. For sale price calculation in the end of investment period, the capitalisation rate at 7.5% was used.

As there were five observed cities with different construction costs, there were five net present values as outputs. The base scenario was Jakarta, while the analysis results from other cities are summarised in Table 5.13. Construction cost was calculated based on the Indonesian construction cost index (IKK) (Statistical bureau, 2019c), which includes material, heavy equipment, and wages. It is published by the government yearly. In 2019, the reference city for IKK was Semarang city. The index was then applied to other cities. Based on IKK 2019, the construction cost index of Jakarta was 118.52%, which means that construction cost in Jakarta is higher than construction cost in Semarang. IKK for other cities is shown in Table 5.8, which also presents the rent price of each of the observed cities, based on the income approach calculated in Section 5.3.

Table 5.8 Input variables (rent price and construction cost)

Cities	IKK	Construction cost (IDR)	Rent price
Jakarta	110.82%	434,365,000,000	1,182,275
Surabaya	113.23%	443,811,125,699	1,161,294
Batam	124.08%	486,338,289,117	1,141,897
Makasar	97.15%	380,784,693,647	858,093
Bandung	108.95%	427,035,433,586	1,001,836

5.7.2 Discounted Cash Flow – Income-based approach

The variable inputs for the financial model were construction costs, revenues, and expenses. As mentioned previously, public rentals only have one source of revenue for residential properties, rental units, as listed in Table 5.8. These were varied methodically to produce an output of project indicators, the number of subsidised units. Complete cash flow is shown in Table 5.9 for cash flow before tax and finance, while Table 5.10 for cash flow after tax and finance.

Table 5.9 Cash flow before tax and finance (in million IDR)

	0	1	2	3	4	5	6	7	8	9	10
Construction cost		-130309.50	-152027.75	-152027.75							
Land			-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00
Income from rent price:											
Rental unit					6866.75	13733.50	13733.50	14883.69	14883.69	16130.20	16130.20
Income from service charge (commercial)					6716.64	7279.16	7888.79	8549.48	9265.50	10041.48	10882.46
Income from parking					204.55	409.10	417.28	425.63	434.14	442.82	451.68
Income from shops					22388.80	22836.57	23293.31	23759.17	24234.36	24719.04	25213.42
Operation expenses (Residential)					-4089.03	-4170.81	-4254.23	-4339.31	-4426.10	-4514.62	-4604.91
Operation expenses (Commercial)					-15660.82	-15974.04	-16293.52	-16619.39	-16951.78	-17290.81	-17636.63
Building maintenance (residential)					-1006.54	-1026.67	-1047.21	-1068.15	-1089.51	-1111.30	-1133.53
Building maintenance (comm)					-953.24	-972.30	-991.75	-1011.58	-1031.81	-1052.45	-1073.50
Property tax					-148.72	-148.72	-148.72	-148.72	-148.72	-163.59	-163.59
Net Income (NIBIT)	0	-130309.50	-152242.75	-152242.75	14103.39	21750.80	22382.46	24215.81	24954.76	26985.77	27850.60
Sale price											
Less selling cost											
Net Cash Flow	0	-130309.50	-152242.75	-152242.75	14103.39	21750.80	22382.46	24215.81	24954.76	26985.77	27850.60
Discount factor	1	1.12	1.25	1.40	1.57	1.76	1.97	2.21	2.48	2.77	3.11
PV of Net Cash Flow	0	-116347.77	-121366.99	-108363.38	8962.96	12341.99	11339.65	10954.00	10078.81	9731.34	8967.15
Net present Value	-99344.9										
IRR	**9.17%**										

	11	12	13	14	15	16	17	18	19	20	21
Construction cost											
Land	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215.00	-215
Income from rent price:											
Rental unit	17481.10	17481.10	18945.15	18945.15	20531.80	20531.80	22251.35	22251.35	24114.90	24114.90	52272.00
Income from service charge (commercial)	11793.86	12781.60	13852.06	15012.17	16269.45	17632.01	19108.70	20709.05	22443.44	24323.08	26360.14
Income from parking	460.71	469.93	479.33	488.91	498.69	508.66	518.84	529.21	539.80	550.60	596.71
Income from shops	25717.69	26232.05	26756.69	27291.82	27837.66	28394.41	28962.30	29541.54	30132.37	30735.02	33309.08
Operation expenses (Residential)	-4697.01	-4790.95	-4886.77	-4984.51	-5084.20	-5185.88	-5289.60	-5395.39	-5503.30	-5613.37	-6083.48
Operation expenses (Commercial)	-17989.36	-18349.15	-18716.13	-19090.45	-19472.26	-19861.71	-20258.94	-20664.12	-21077.40	-21498.95	-23299.49
Building maintenance (residential)	-1156.20	-1179.32	-1202.91	-1226.97	-1251.51	-1276.54	-1302.07	-1328.11	-1354.67	-1381.77	-1497.49
Building maintenance (comm)	-1094.97	-1116.87	-1139.20	-1161.99	-1185.23	-1208.93	-1233.11	-1257.77	-1282.93	-1308.59	-1418.18
Property tax	-163.59	-163.59	-163.59	-179.95	-179.95	-179.95	-179.95	-179.95	-197.94	-197.94	-214.52
Net Income (NIBIT)	30137.24	31149.80	33709.62	34879.19	37749.45	39138.88	42362.51	43990.81	47599.26	49507.98	79809.762
Sale price										1064130.16	
Less selling cost										-31923.90	
Net Cash Flow	30137.24	31149.80	33709.62	34879.19	37749.45	39138.88	42362.51	43990.81	47599.26	1081714.24	
Discount factor	3.48	3.90	4.36	4.89	5.47	6.13	6.87	7.69	8.61	9.65	
PV of Net Cash Flow	8663.74	7995.38	7725.37	7136.97	6896.68	6384.40	6169.86	5720.55	5526.60	112137.82	
Net present Value											
IRR											

Table 5.10 Cash flow after tax and finance (in million IDR)

	0	1	2	3	4	5	6	7	8	9	10
Equity Cashflow before tax	0	-71516.19	-106877.13	-133974.80	-63318.53	-32444.55	-4715.21	24215.81	24954.76	26985.77	27850.60
Tax payable				0.00	-2742.52	-4348.47	-4481.12	-4866.13	-5021.31	-5447.82	-5629.43
Equity after tax	0	-71516.19	-106877.13	-133974.80	-66061.05	-36793.03	-9196.33	19349.68	19933.45	21537.95	22221.17
Discount factor	1	1.12	1.25	1.40	1.57	1.76	1.97	2.21	2.48	2.77	3.11
PV of Net Cash Flow	0	-63853.74	-85201.79	-95360.62	-41982.99	-20877.35	-4659.15	8752.81	8050.79	7766.80	7154.62
Net present Value	-119598										
IRR	8.30%										

	11	12	13	14	15	16	17	18	19	20
Equity Cashflow before tax	30137.24	31149.80	33709.62	34879.19	37749.45	39138.88	42362.51	43990.81	47599.26	1081714.24
Tax payable	-6109.63	-6322.26	-6859.83	-7105.44	-7708.19	-7999.97	-8676.93	-9018.88	-9776.65	-10177.48
Equity after tax	24027.61	24827.53	26849.79	27773.75	30041.26	31138.91	33685.57	34971.93	37822.61	1071536.75
Discount factor	3.48	3.90	4.36	4.89	5.47	6.13	6.87	7.69	8.61	9.65
PV of Net Cash Flow	6907.36	6372.61	6153.28	5683.06	5488.43	5079.43	4906.11	4547.74	4391.46	111082.75
Net present Value										

In this study, capitalisation was assumed that after the investment period (20 years), the residential area would be leased based on the market price and not on the subsidised price, while the commercial area was operated in the same way as during the investment period. The assumed market price was IDR 4,500,000, therefore, with total revenue for 968 units was IDR 522,720,000,000 in year 21.

This study used 9% capital loan for three-year construction period. It gave a consequence to pay the loan, which was started from year 2. The loan repayment followed the amount of construction cost each year, as described in Table 5.11.

Table 5.11 Detail of loan repayment

Loan for corporate	9%
1+i	1.09
Payment period (yrs)	3
Annual payment factor	0.3951
Investment loan	50%
Loan 1	65,154,750,000
Loan 2	76,013,875,000
Loan 3	76,013,875,000
PMT Loan 1	- 25,739,693,950
PMT Loan 2	- 30,029,642,942
PMT Loan 3	- 30,029,642,942

This calculation was captured in the equity before tax cash flow as follows.

Table 5.12 Equity before tax cash flow (in million IDR)

EQUITY BEFORE TAX											
	0	1	2	3	4	5	6	7	8	9	10
Net Cash Flow	0	-77579.3	-25174.3	-37881.1	93428.95	48920.33	13272.49	13545.21	11272.53	14092.26	14381.68
Less Loan Repayment			-25739.7	-55769.3	- 85,799	- 60,059	- 30,030				
Net income before finance	0	-77579.3	-50914	-93650.5	7629.973	-11139	-16757.2	13545.21	11272.53	14092.26	14381.68
Less Outstanding Loan		65154.75	76013.88	76013.88							
Equity cashflow before tax	0	-12424.6	25099.91	-17636.6	7629.973	-11139	-16757.2	13545.21	11272.53	14092.26	14381.68
Discount factor	1	1.105	1.221025	1.349233	1.490902	1.647447	1.820429	2.011574	2.222789	2.456182	2.714081
PV of Net Cash Flow	0	-11243.9	20556.43	-13071.6	5117.689	-6761.34	-9205.06	6733.639	5071.347	5737.466	5298.912
Net present Value	71744.037										
IRR	39.30%										

	11	12	13	14	15	16	17	18	19	20
Net Cash Flow	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	249598.47
Less Loan Repayment										
Net income before finance	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	249598.47
Less Outstanding Loan										
Equity cashflow before tax	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	249598.47
Discount factor	2.999059	3.313960566	3.661926	4.046429	4.471304	4.940791	5.459574	6.032829	6.666276	7.3662348
PV of Net Cash Flow	4893.829	4519.665022	1616.644	3850.813	3556.363	3284.395	2519.247	2801.183	2584.193	33884.132
Net present Value										
IRR										

Price escalation of the commercial area was set at 2%, following the inflation rate, while escalation of the residential area was set at 8% per two years, following the increasing level of household income. The assumption refers to an increase in the regional minimum wage. The average of regional minimum wage increase for the last five years was 8%. This assumption was made based on last five years regional minimum wage data. However, rent prices in Indonesia are evaluated every two years. The escalation price was therefore set at 8% over two years.

The net present value (NPV) and the internal rate of return (IRR) as feasibility indicators were obtained based on discounted cash flow. When the NPV is positive and IRR > the required rate of return, it means that the project is attractive to private investors and a partnership project may be worth pursuing. Table 5.9 and 5.10 shows that NPV was less than zero, means that the project is not feasible.

Figure 5.8 visualises the cash flow for the project. Based on the financial feasibility analysis, NPV was less than zero and IRR was less than the required return. It can therefore be concluded that the project is not feasible as the revenue from unit rentals and commercial leases does not equal the construction cost. However, there are dramatic increases at the end of the investment period, which reflects the capitalisation calculation after the investment period.

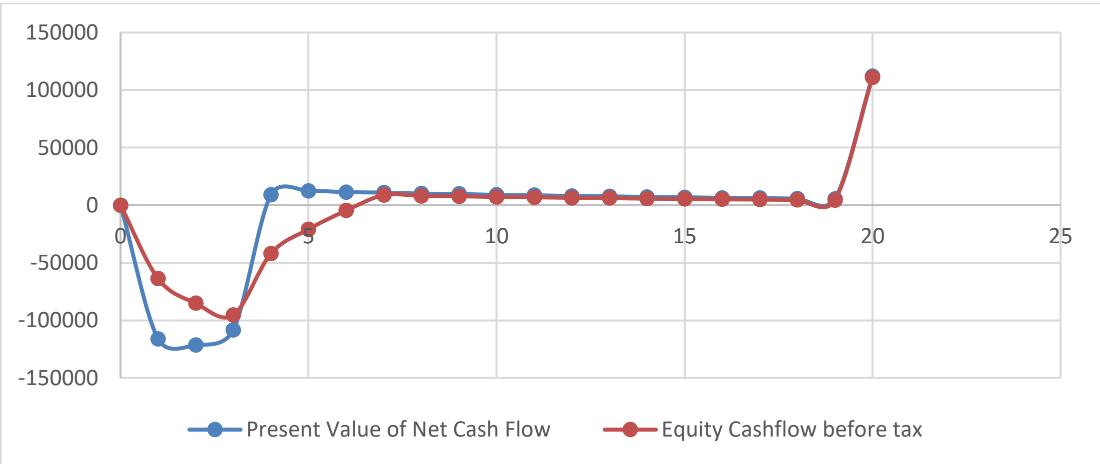

Figure 5.8 Cash flow (income-based approach) - (in million IDR)

The financial analysis for the other observed cities used the same procedures. The results are shown in Table 5.13.

Table 5.13 Result of net present financial analysis in five cities

Cities	Net present value (Million IDR)
Jakarta	- 119,599
Surabaya	- 127,702
Batam	- 162,091
Makasar	- 85,986
Bandung	- 118,801

This table shows that the project in all observed cities were not feasible, which were indicated by negative NPV based on cash flow after tax and finance. The highest negative was NPV of the project in Batam, as the construction cost as part of investment cost was higher, while the revenue cannot cover the investment and operation maintenance cost.

5.7.3 Cost-based approach economic parameters

Similar to that reported in Section 5.7.1, the financial analysis was conducted in relation to the five observed cities. The input variables are listed in Table 5.14. According to *Public rental housing tariff determination* Minister of Public Works and Public Housing regulation 2018 s.1 (Indonesia), in cost-based approach to rent price determination, there are two rent prices: maximum and minimum. The maximum rent price covers operation and maintenance costs, while the minimum rent price only covers operation costs. As stated in Section 5.4, due to limited availability of data, the cities were allocated into two groups based on similarities of operation costs. Group 1 consisted of Jakarta and Batam, while Group 2 included Makassar, Bandung, and Surabaya.

Table 5.14 Input variables (rent price and construction cost)

	IKK	Construction cost (IDR)	Rent price (max) (IDR)	Rent price (min) (IDR)
Jakarta	110.82%	434,365,000,000	1,184,659	856,380
Surabaya	113.23%	443,811,125,699	677,968	274,470
Batam	124.08%	486,338,289,117	1,184,659	856,380
Makasar	97.15%	380,784,693,647	677,968	274,470
Bandung	108.95%	427,035,433,586	677,968	274,470

5.7.4 Discounted Cash Flow (Cost-based approach)

The variable inputs for the financial model were construction costs, revenues, and expenses. As previously mentioned, public rental price only has one revenue for residential rental units. However, the revenues were varied as there are two types of units: non-subsidised and subsidised units.

The assumption of capitalisation and increasing revenue was similar to that presented in the previous section. Based on discounted cash flow, the NPV and the IRR were obtained as feasibility indicators. When the NPV is positive and the IRR > the required rate of return, that means the project is attractive to private investors, and a partnership project may be worth pursuing. Similar to income-based analysis, this analysis yielded negative NPV, that is, IDR (119,599) million.

Based on the financial feasibility analysis NPV was less than zero and IRR was less than the required return. It can therefore be concluded that the project is not feasible as the revenue from unit rental and commercial leases will not equal the construction cost. However, there are dramatic increases at the end of the investment period, which reflects the capitalisation calculation after the investment period.

The financial analysis for the other observed cities used the same procedures. The results are shown in Table 5.15.

Table 5.15 Net present value of financial analysis in five cities

Cities	Net present value (million IDR)	
	Using max. price	Using min. price
Jakarta	- 119,532.19	- 128,690.55
Surabaya	- 141,300.26	- 152,513.83
Batam	- 160,903.42	- 170,061.19
Makasar	- 91,131.34	- 102,344.91
Bandung	- 127,946.84	- 139,160.41

This table shows that the project in all observed cities were not feasible, which were indicated by negative NPV based on cash flow after tax and finance. The highest negative was NPV of the project in Batam, as the construction cost as part of investment cost was higher, while the revenue cannot cover the investment and operation maintenance cost. Public rental housing project in Surabaya also had high negative NPV. This is because, the rent price of public rental housing in Surabaya is low.

5.7.5 Market-based approach economic parameters

Two rent prices were calculated using a market-based price: a boarding house and a rented house. The input variables are listed in Table 5.16. According to tenants' preferences, there were three preferred locations: suburbs, downtown, and industrial areas. However, as the land price difference was not significant, the rent price of two substitute dwellings was obtained from average prices. In this analysis, the project feasibility study using market-based rent price determination only used boarding house scheme, as rent price using rent a house scheme was not affordable.

Table 5.16 Input variables (rent price and construction cost)

Cities	IKK	Construction cost (IDR)	Rent price (boarding house) (IDR)
Jakarta	110.82%	434,365,000,000	896,000
Surabaya	113.23%	443,811,125,699	468,000
Batam	124.08%	486,338,289,117	440,000
Makasar	97.15%	380,784,693,647	440,000
Bandung	108.95%	427,035,433,586	496,000

5.7.6 Discounted Cash Flow (Market-based approach)

The variable inputs for the financial model included construction costs, revenues, and expenses. The assumption of capitalisation and the increasing of revenue was similar to those in the previous section. Based on discounted cash flow, NPV and IRR were obtained as feasibility indicators. When NPV is positive and IRR > required rate of return, that means the project is attractive to private investors, then a partnership project may be worth pursuing. This analysis gained a negative NPV, that is, IDR (127,496) million.

Based on the financial feasibility analysis the NPV was less than zero and IRR was less than the required return. It can therefore be concluded that the project is not feasible as the revenue from unit rentals and commercial leases will not equal construction costs. However, there are dramatic increases at the end of the investment period, which reflects the capitalisation calculation after the investment period.

The financial analysis for the other observed cities uses the same procedures. The results are shown in Table 5.17.

Table 5.17 Net present value of financial analysis in five cities

Cities	Net present value (million IDR)
Jakarta	- 127,496.06
Surabaya	- 146,960.08
Batam	- 181,607.94
Makasar	- 97,587.48
Bandung	- 132,810.33

Similar to previous analysis, the project in all observed cities were not feasible, which were indicated by negative NPV based on cash flow after tax and finance. The highest negative was NPV of the project in Batam, as the construction cost as part of investment cost was higher, while the revenue cannot cover the investment and operation maintenance cost. Public rental housing project in Surabaya and Bandung also had high negative NPV. This is because, the rent price of public rental housing in Surabaya and Bandung are low. Considering that all schemes yielded negative NPV, it means that this investment was not attractive to housing providers or investors. Government subsidy was needed to raise NPV which will attract the housing providers.

5.7.7 Scenario analysis

Financial modelling is typically aimed to analyse the project viability through the project cash flow, with regard to favourable and unfavourable events that could impact the project (Acheampong & Earl, 2019). Scenario analysis is conducted when there are some possibilities facing the project's implementation, when the analysis aims to estimate changes in the value of parameter in the cash flow. Conditions can change due to various circumstances. This study examined the impact of some significant variables on the calculation of the rent price and the project's financial feasibility. In the previous section, the analysis yielded a positive NPV, with IRR a little above the private sector's requirement. However, to make the investment more attractive for the private housing provider, this chapter explores two scenarios related to government subsidies as explained detail in Table 5.18:

- All parts of the building granted a government subsidy
- Partial building construction subsidised by the government, such as public infrastructure and utility, or one tower

Table 5.18 Two scenarios of investment analysis

Scenario name	Subsidy on all building construction	Partly Subsidised building construction
Input:		
Construction cost	Structures, architectural and mechanical electrical (M/E)	1. Public infrastructure and utility 2. Tower structures are provided by government (50% of all building construction)
Land	Land is provided by local government	Land is provided by local government
Required return	12%	12%
Escalation for residential unit	8% yearly	8% yearly

In current practice, the Ministry government grants subsidised construction through the local government, while local government provided the land. In this context, government might subsidise construction in both residential and commercial areas (two towers and a podium), or only construction for a residential area (two towers). Government subsidy has risen NPV, compared to the investment without subsidy. Subsidies on both, residential and commercial projects yielded higher returns than subsidies on two towers. This would reduce the rent price, which was calculated from the operation cost, including the investment cost. The scenario was applied to three feasibility analysis using different rent price determination, which were presented in Table 5.19 to 5.21 and Figure 5.9 to 5.11. Table 5.19 to 5.21 show the cash flow after tax and finance.

Table 5.19 Output of two scenarios of investment analysis using income-based approach

Scenario name	Without subsidy (NPV – million IDR)	Part subsidy on building construction (NPV – million IDR)	Subsidy on all building construction (NPV – million IDR)
Jakarta	- 119,599.29	49,288.30	164,070.71
Surabaya	- 127,702.15	44,944.98	162,310.32
Batam	- 162,091.29	27,481.62	156,475.48
Makassar	- 85,986.29	61,576.39	161,707.94
Bandung	- 118,801.18	47,169.24	159,947.48

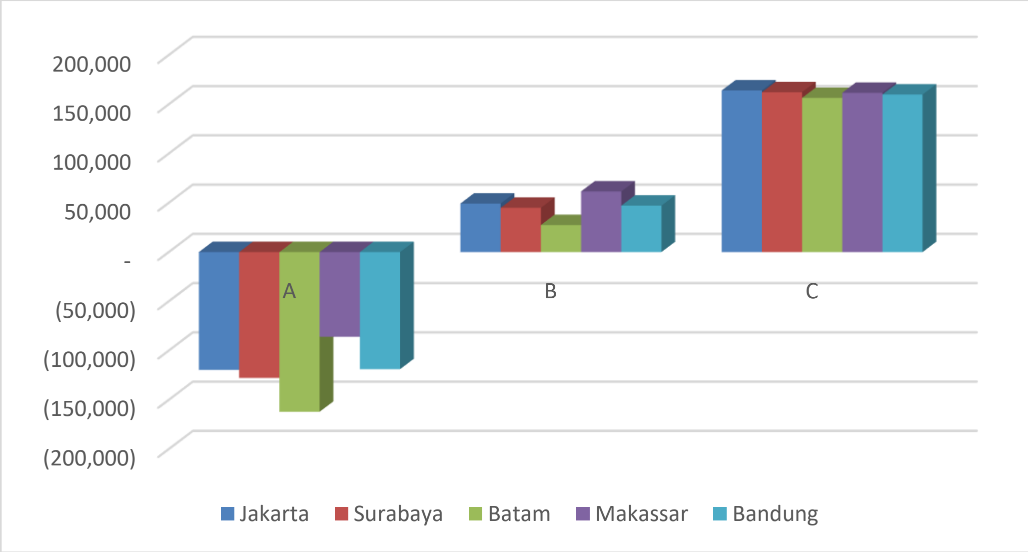

Figure 5.9 Output (NPV) of two scenarios of investment analysis using income-based approach

Note: A: Without subsidy
B: Part subsidy on building construction
C: Subsidy on all building construction
NPV is in million IDR

Table 5.20 Output of two scenarios of investment analysis using cost-based approach

Scenario name	Without subsidy (NPV – million IDR)		Part subsidy on building construction (NPV – million IDR)		Subsidy on all building construction (NPV – million IDR)	
	Maximum rent price	Minimum rent price	Maximum rent price	Minimum rent price	Maximum rent price	Minimum rent price
Jakarta	- 119,532	- 128,690	49,354.80	40,197.03	175,665.07	150,517.74
Surabaya	- 141,300	- 152,513	31,346.88	20,133.31	133,286.41	102,750.37
Batam	- 160,903	- 170.061	28,669.48	19,511.71	154,979.75	129,832.42
Makassar	- 91,131	- 102,344	56,431.34	45,217.77	158,370.87	127,834.83
Bandung	- 127,946	- 139,160	38,023.59	26,810.02	139,963.12	109,427.08

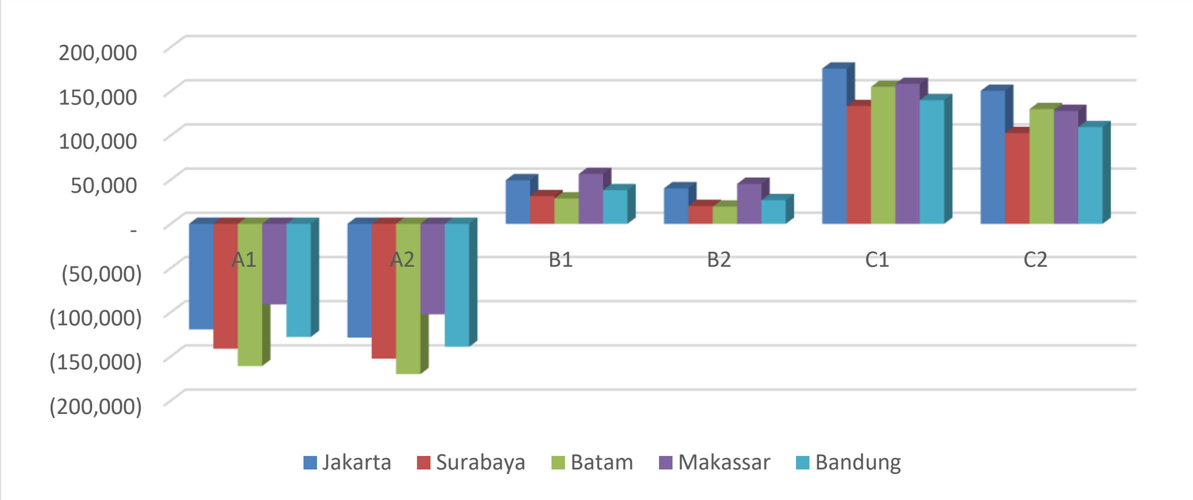

Figure 5.10 Output (NPV) of two scenarios of investment analysis using cost-based approach

Note: A1: Without subsidy (maximum rent price)
A2: Without subsidy (minimum rent price)
B1: Part subsidy on building construction (maximum rent price)
B2: Part subsidy on building construction (minimum rent price)
C1: Subsidy on all building construction (maximum rent price)
C2: Subsidy on all building construction (minimum rent price)
NPV is in million IDR

Table 5.21 Output of two scenarios of investment analysis using market-based approach

Scenario name	Without subsidy (NPV – million IDR)	Partial building construction (NPV – million IDR)	Subsidy on all building construction (NPV – million IDR)
Jakarta	- 127,496.06	41,391.53	156,173.94
Surabaya	- 146,960.08	25,687.06	143,052.40
Batam	- 181,607.94	7,964.96	136,958.82
Makassar	- 97,587.48	49,975.19	150,106.74
Bandung	- 132,810.33	33,160.098	145,938.33

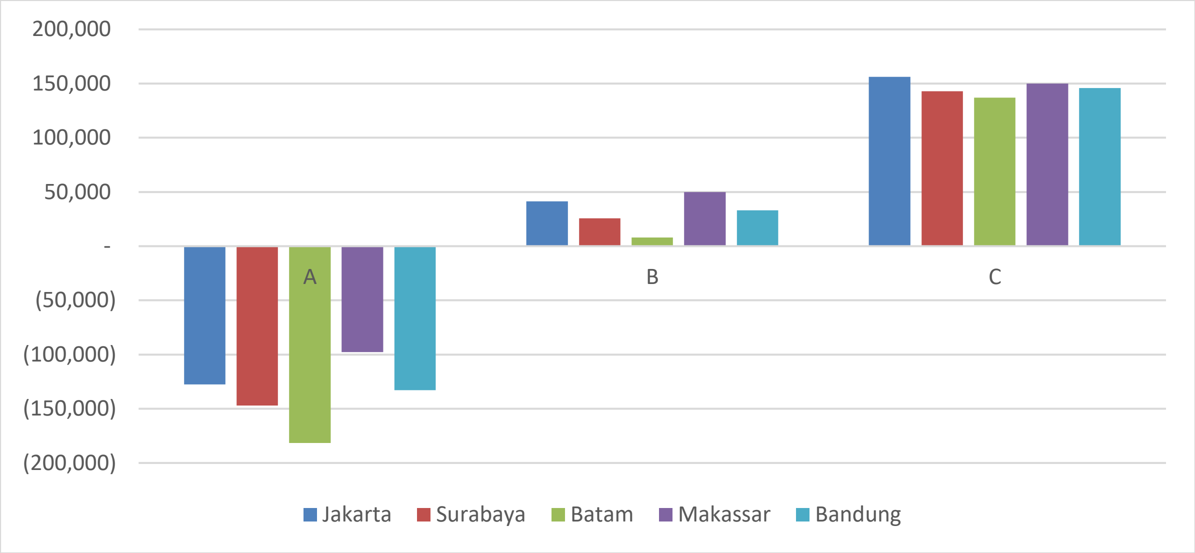

Figure 5.11 Output (NPV) of two scenarios of investment analysis using market-based approach

Note: A: Without subsidy
B: Part subsidy on building construction
C: Subsidy on all building construction
NPV is in million IDR

Analysis in this section shows that using three rent price determination approaches, public rental housing could not be viable in Indonesia without substantial government support. For example, in Jakarta, under part subsidies, the investment produces a NPV IDR 49,288.30 million, which indicates that the project is feasible when 50% equity is used to fund the investment and 30% - 50% investment loan is available over 20 years. The investment loan could be in the form of amount of fund from government for project development facility (PDF) or subsidy in the form of part of construction (50% of construction cost) or public infrastructure utilities (30% of construction cost). These forms of subsidy can raise project viability. If subsidy less than 30% of construction cost, the investment remains unfeasible.

The capitalisation rate was set 4% of the initial outlay on the investment after 20 years, which yield positive NPV. If the capitalisation rate is higher, the NPV is getting higher. With full subsidy on building construction, the NPV is higher, at IDR 164,070.71 million. This condition represented similar result for all rent price determination as shown as Figure 5.9 to 5.11, that some forms of government subsidy could increase NPV. Without government subsidy, NPV were below zero, while it became bigger than zero when government subsidy applied. This is expected to attract more housing providers to increase number of public housing supply.

This finding seems supports the study by Pawson et al. (2019), who studied built-to-rent with government subsidy and this study showed similar circumstances that public housing development will not produce affordable housing without some form of public subsidy.

5.8 FINANCIAL MODEL FOR PUBLIC RENTAL HOUSING AND DISCUSSION

A financial model for public rental housing was developed as the summary of a whole financial analysis process from the perspective of tenants, government, and housing developers. The study aimed to develop a model that is not just viable for space production group (housing developer), but also affordable for users (tenants) and feasible for government in their role as policy makers, regulators, and subsidisers. The model describes the role and interaction of all major stakeholders. The process began from rent price determination, which was expected to accommodate tenants' affordability, then moved to investment feasibility analysis. The flow and model are represented in Figure 5.13 and 5.14.

This study suggests that the Indonesian Government can select the most appropriate pricing mechanism after reviewing the types of tenants. Different pricing mechanisms will not only optimise government subsidies to more targeted needs but will also ensure that the housing is well maintained for low-income tenants within an affordable rent price. These approaches can be used to determine rent price for any subsidised public housing.

In the Indonesian context as discussed in the previous section, income-based calculation is used as the affordability benchmark ratio, that is, 30% of income. Using the cost-based approach, regular tenants can afford to pay the maximum price that will cover operation and maintenance costs. However, relocated tenants with lower incomes can only afford to pay the minimum cost-based rent, which only covers the operation cost. In this circumstance, the government needs to subsidise the public housing maintenance costs to top up the payment gaps of the relocated tenants.

The discounted market price determination was too high for relocated communities but could be used for regular tenants. The housing cost-to-income ratio was higher, which would generate housing stress if the ratio increased beyond 30% of household income. This study could be improved and broadened by including a broader range of survey participants and by using a dynamic market price to match the housing market. The discounted market rent plus the tax incentive from the government may increase private developer participation in public housing provision. This method has been used in Australia to attract private developers to supply affordable products under the former NRAS scheme. Australian renters also receive rent assistance and income support from the government (Acheampong & Earl, 2018).

Regarding rent price determination and classification in the public rental housing market, there should be an initial categorisation at the beginning of occupancy. Relocated communities should be allowed to pay the minimum rent price while regular tenants should pay the maximum rent price. In this way, government income supplement subsidies through direct government support can be prioritised to support the relocated communities. In Indonesia, direct government support is called availability payment, an annual government support payment to public rental housing operators for operation and maintenance costs (Indonesian Ministry of Public Works and Public Housing, 2020). As a result, the rent price can be determined lower, as described in Figure 5.12. Based on analysis in the previous sections, if a public housing project was only occupied by one type of tenant, then the categorisation could be formulated using the income-based approach. Tenants would pay up to 30% of their income to meet the maximum price to cover both, operation and maintenance costs. If the maximum price was higher than the tenants' ability to pay (more than 30% of income), the government would need to help the public housing management to cover maintenance costs through subsidy, called as availability payment, as described in Figure 5.12. However, if the maximum price were lower than 30% of tenants' income, tenants would only need to pay to cover the operation and maintenance costs (maximum price). The lower cost of housing would improve tenants' quality of life and help them to move to the next stage (e.g., home ownership). The government subsidy is expected to lower the rent price.

The subsidy for production group could be designed in the form of more attractive indoor facilities, and government could grant incentives to developers for development and maintenance costs, such as tax incentives or cash back when they developed a public rental housing building successfully. The most significant is a subsidy on construction costs, either partly or for the whole building. The sensitivity analysis for this study showed that a subsidy would make investment more favourable.

Given that regular tenants could pay the standard cost of public housing rent, the sector had sufficient resources to cover the operation and maintenance costs, as represented in Figure 5.12. Furthermore, as there are two types of tenants with different affordability, there was differentiation in suggested policies. The relocated communities' affordability was less than 30%. Their income was mostly lower than the regional minimum wage.

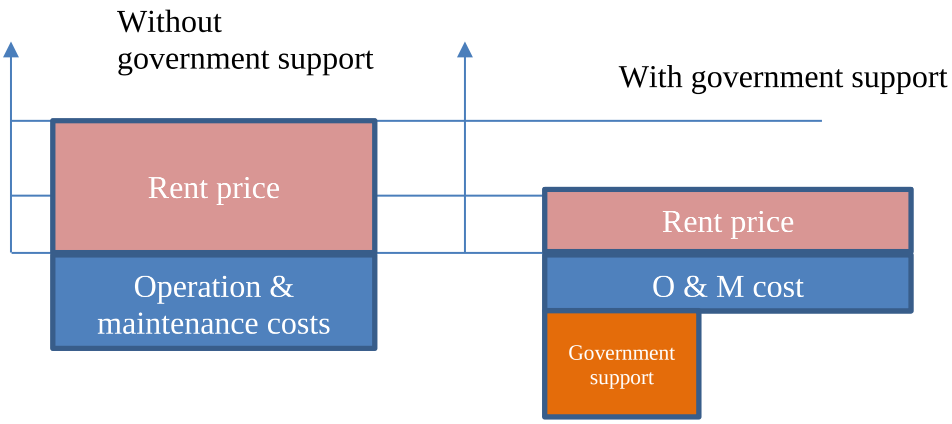

Figure 5.12 Effect of government support on public housing

Semi-structured interview participant suggested that another subsidy mechanism was the use of cross-subsidy through mixed housing. This mechanism supports cross-subsidy of maintenance costs and enables mixed tenants' groups to live in the same location with differentiation based on income levels. However, if public housing was fully dedicated to a relocated community who can only pay the minimum rent, the government still needs to provide a subsidy to pay the maintenance costs. The financial analysis for public rental housing is depicted in Figure 5.13, while financial model for public rental housing is shown in Figure 5.14.

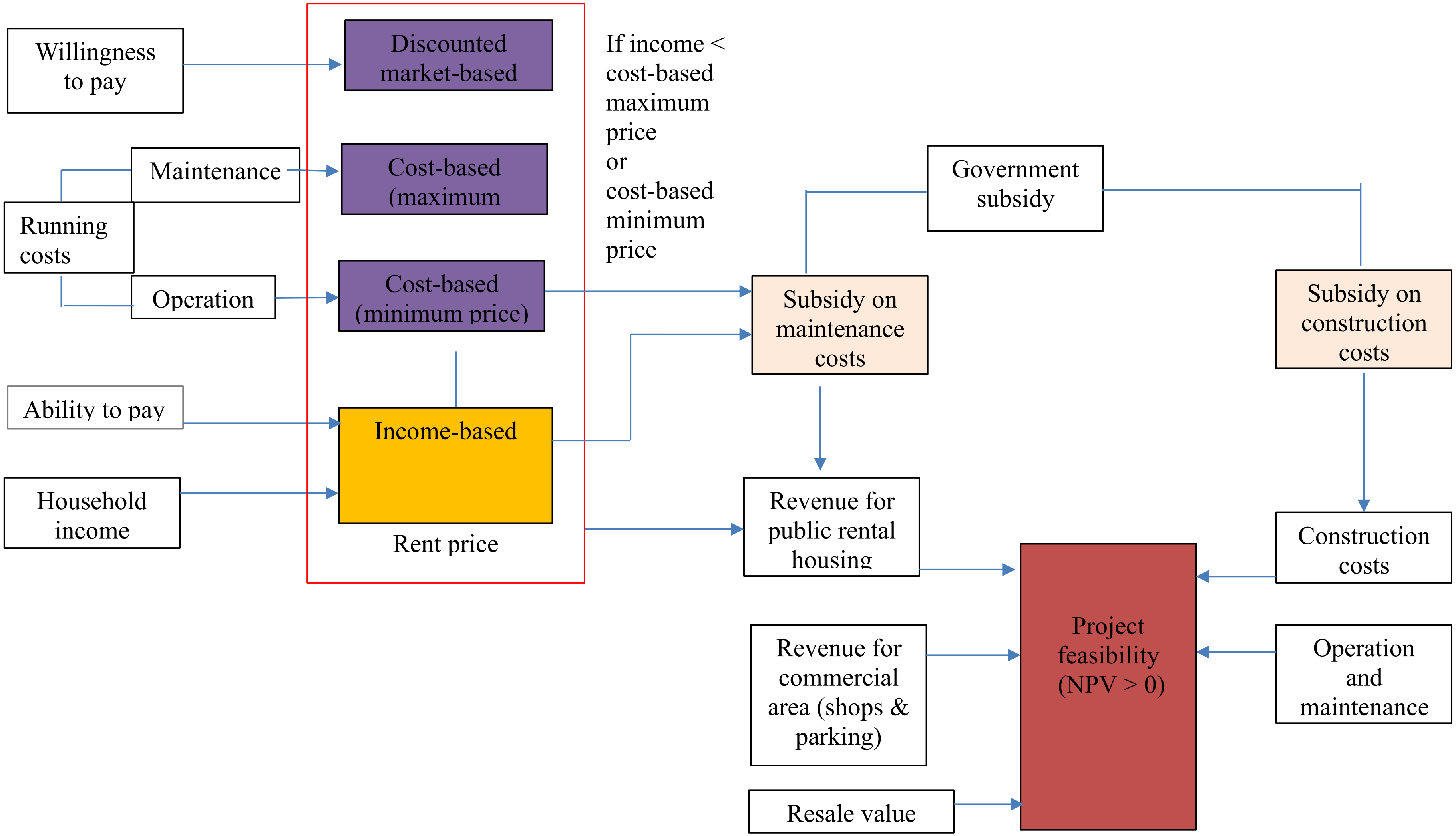

Figure 5.13 Flow of financial analysis for public rental housing

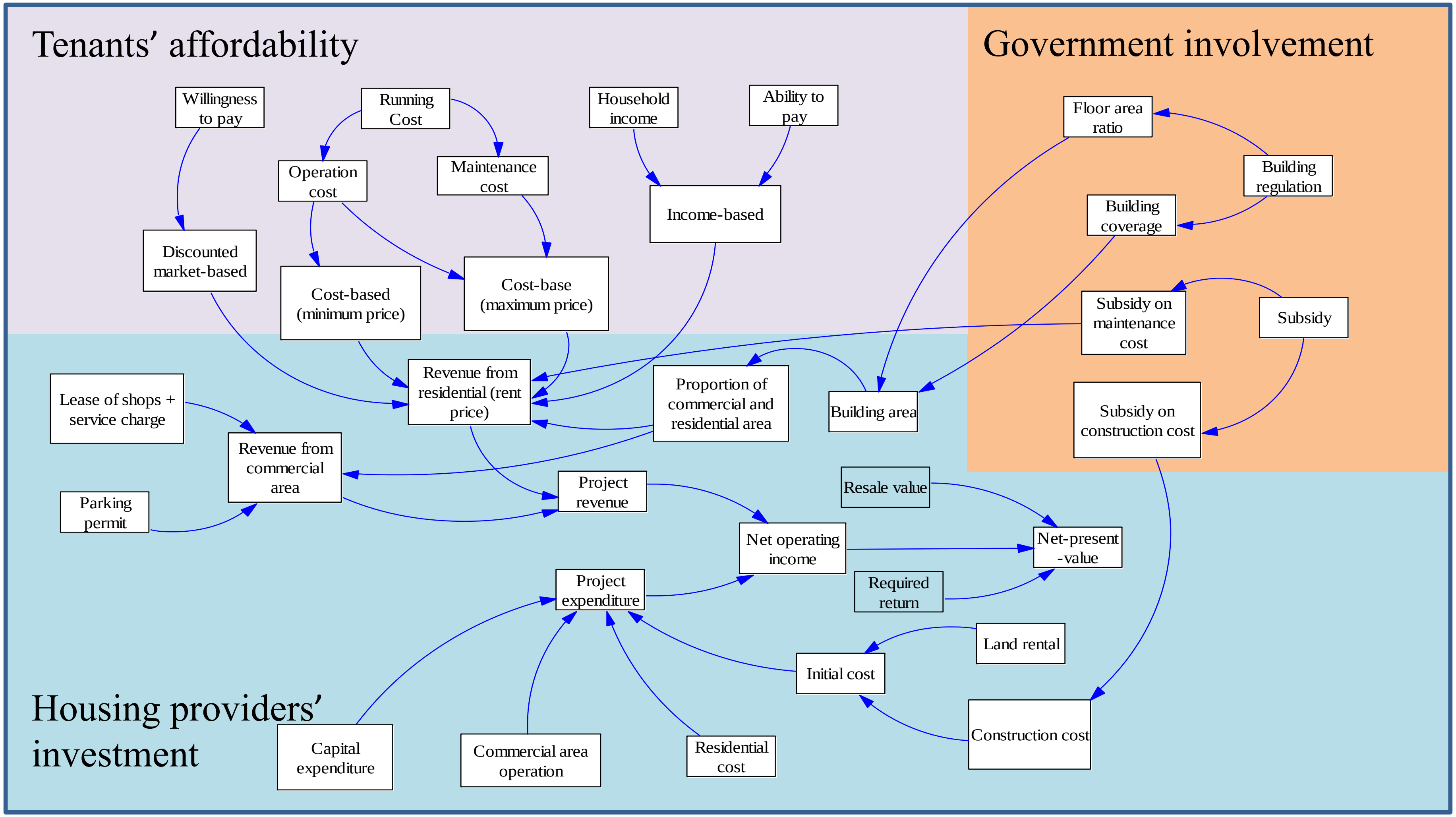

Figure 5.14 Financial model for public rental housing

Phase 1 financial model used some equations that reflect the relationship among factors. The equations are listed below.

5.8.1 Tenant's affordability

1. Discounted market-based = willingness to pay = 80% * preference dwelling's price
2. Income-based = 30% * regional minimum income
3. Running cost:
    a. Operation cost = administration salary + (electricity + water bills for public infrastructure) + tax + building repair
    b. Building maintenance = 0.5 – 2% * new construction cost
4. Cost-based:
    a. Maximum price = (operation cost + building maintenance)/number of units
    b. Minimum price = operation cost/number of units

5.8.2 Government's involvement

1. Building coverage ratio: depends on local government regulation (i.e., 30%) maximum building coverage = land area * 30%
2. Floor area ratio: depends on local government regulation (i.e., 30%) Maximum floor area = land area * 3
3. Subsidy on maintenance cost = total annual building maintenance cost – annual revenue
4. Subsidy construction cost = total construction cost or half construction cost

5.8.3 Housing provider's investment

1. Revenue
    a. Commercial area
        1. Shop lease = number of units * monthly lease price
        2. Service charge = number of units * service charge/sqm * unit area
    b. Residential area

        Monthly rent price = income-based price * number of units

        Or discounted market-based price * number of units

        Or cost-based price * number of units

2. Expenditures
    a. Initial cost
        1. Land acquisition = (land price * land area) + land preparation cost
           Or
        2. Land rental = monthly land rental
        3. Construction cost
        4. Building permit
    b. Commercial area operation = operating expenses = administration salary + electricity and water bills of public infrastructure + waste recycling retribution + building maintenance + property tax + capital expenditure
    c. Residential area operation = operating expenses = administration salary + electricity and water bills of public infrastructure + waste recycling retribution + building maintenance + property tax
3. Net operating income = Revenue – expenditures
   Resale value = (total net operating income year 21)/2.5%
   Net cash flow = net operating income + resale value
   Net present value = ∑ (net cash flow/required return)

5.9 CHAPTER SUMMARY

This chapter presented a financial analysis of public rental housing data, as included in Research Phase 1. The outputs related to the use of three rent price determinations of public rental housing: income-based, cost-based, and discounted market-based approaches, and feasibility analysis for public rental housing. Descriptive statistics and discounted cash flow were employed to address research questions and inform discussion of the issues. Primary data were collected from questionnaire surveys, while secondary data were gathered from government and private institutions.

This study investigated the factors that influence rent price. A list of factors was compiled from the literature review, which was then validated by the respondents. Fifteen factors adopted from previous studies were seen to influence rent prices of mainstream commercial properties. Three factors were added and seven were removed from the housing providers' survey. The additional factors were willingness to pay, ability to pay, and government subsidy. These three new factors were added to the previously identified factors influencing rent prices of mainstream commercial properties, factors such as location and accessibility, size and age, and property attributes. The ability to pay and willingness to pay played the most important roles in public housing rent price determination; thus, these factors became the calculation basis for the income-based and market-based rent price determination approaches. Government subsidies are always required, as limited affordability rent prices cannot be set high (Warsame et al., 2010).

The identification of the importance of household income, running costs, and location as factors in this study aligns with previous studies. For example, Zhai et al. (2018) identified household income as a major factor affecting rent price determination. Their study argued that household income, indicated by the household's living standard, is considered a possible demand factor in the housing rental market, a finding that accords with that of Yuan et al.'s (2017) investigation of public rental housing in China. Finally, this study provides evidence that running costs (operation and maintenance costs) influence price determination, a finding consistent with Du et al. (2011); Chan & Adabre (2019); Ali et al. (2010), and Wilkinson (2016), who identified key factors that inform rent price determination. The comparisons noted here indicate the relationship of this study to the existing literature.

In relation to location, tenants in existing public rental housing were seen to trade-off between housing price and transportation costs. They tended to live far from the city centre or their workplaces, which increased transportation costs, while housing prices were lower in the suburbs than in the city centre. They typically reduced transportation costs by riding motorcycles – the most popular mode of transport in many Asian countries, including Indonesia, as they are affordable, accessible, and reliable (Dewita et al., 2018). The respondents stated that they normally had more than one motorcycle in a family. A study of the use of motorcycles in Indonesia by Herwangi et al. (2015) showed that due to the quality and quantity of public transport in some major Indonesian cities – which does not meet the needs of low-income communities – the motorcycle has become the major mode of transport.

Subsequently, this chapter discussed the rent price determination using three approaches that reflected factors influencing rent price. Household income and ability to pay were used to calculate rent price using income-based approach, while cost was used to determine rent price using cost-based approach. An income-based approach can be used to determine rent prices based on a tenant's household income and this becomes the affordability indicator. The cost-based approach can be used to determine the rent price; however, if the rent price is higher than the affordability indicator, the government needs to provide a subsidy. The discounted market-based approach was determined based on ability to pay. From these three approaches, income-based and cost-based (minimum and maximum rent price) could be applied. The discounted market-based approach could only be applied in shared house scheme, as a rental house was not affordable. The most suitable approach was indicated by housing cost-to-income ratio using the 30% rule, where the housing cost should be less than 30% of household income. The maximum cost-based approach is ideally used to determine low-cost apartment rent prices, as the low-cost apartment operator will have sufficient resources from rent revenue to meet the operation and maintenance costs. As discussed in the previous section, the housing cost to income ratio is rising in market-based prices. This situation is likely to increase housing stress, as the housing cost to income ratio is higher than 30% (affordability criteria), and might not have income left over for other daily needs (Baker et al., 2015; Chan & Adabre, 2019).

These three approaches can be applied to other countries and can also accommodate tenant's specific special cases. In the Indonesian context, there are two types of tenants, relocated and regular tenants. As aforementioned that most relocated tenants do not have high and fixed income. Thus, the rent price cannot be determined high, and it is difficult to determine rent price using an income-based approach. A cost-based price (minimum rent price) can be applied; however, both a cost-based (maximum price) and discounted market-based price will result in housing stress. In this case, the government must subsidise public rental housing maintenance costs to bridge payment gaps from relocated tenants. This study supports the study conducted by Anacker (2019), which witnessed that even though discounted market price is seen as government cross-subsidy, which was expected to help inability low-income household to rent the public housing, it should be followed by other variety schemes of government subsidy for housing developer to raise the project viability.

Subsequently, three rent price determination approaches were then used for financial feasibility analysis to measure tenants' affordability, while financial feasibility was conducted to measure project feasibility from the developers' side. The analysis was conducted in five observed cities: Jakarta, Batam, Bandung, Makassar, and Surabaya, as location can impact construction costs and income. Tables 5.13, 5.15, and 5.17 showed that the NPV for all schemes was negative, as the negative NPV was derived from low rent price. On the other hand, some tenants could not afford to pay the rent price, and for this reason.

Section 5.7.7 also presented a scenario related to government subsidies to raise NPV and project feasibility. The scenario was partial building construction on infrastructure and public utility. The government subsidy on land provision is not enough to deliver public rental housing investment viability. For this reason, the government needs to extend the subsidy in the form of partial building construction, such as public infrastructure utilities, part of building construction, or amount of fund for project development facility (PDF), which in some case, is called as viability gap funding (VGF). Table 5.22 describes the summary of all calculation using Net Present Value. NPV negative indicates unfeasible, while NPV positive indicates feasible. The red font shows unfeasible condition.

Table 5.22 Calculation summary

		Net present Value (million IDR)				
		Batam	Bandung	Jakarta	Makassar	Surabaya
Income-based	Without subsidy	-162,091	-118,801	-119,599	-85,986	-127,702
Cost-based (max)		-160,903	-127,946	-119,532	-91,131	-141,300
Cost-based (min)		-170,061	-139,160	-128,690	-102,344	-152,513
Market-based		-181,608	-132,810	-127,496	-97,587	-146,960
Income-based	Part subsidy	+27,481	+47,169	+49,288	+61,576	+44,945
Cost-based (max)		+28,669	+38,023	+49,355	+56,431	+31,347
Cost-based (min)		+19,512	+26,810	+40,197	+45,218	+20,133
Market-based		+7,965	+33,160	+41,391	+49,975	+25,687
Income-based	Full subsidy	+156,475	+159,947	+164,070	+161,707	+162,310
Cost-based (max)		+154,980	+139,963	+175,665	+158,371	+133.286
Cost-based (min)		+129,832	+109,427	+150,518	+127,83	+102,750
Market-based		+136,959	+145,938	+156,174	+150,107	+143,052

As in the context of public rental housing, one government subsidy scheme is a construction grant, which aims to lower the rent price (Indonesian Ministry of Public Works and Public Housing, 2019). In the case of sensitivity, it was assumed that the housing developer would be offered free land and that all land rates and related taxes would be exempted, the building – partly or in its entirely – being built by the government, which means that the developer's total cost would be reduced. This study found that public rental housing will not generate affordable housing without support from government.

This finding supports earlier studies by Pawson et al. (2019) and Acheampong and Earl (2020), who noted that public rental housing can contribute to affordable housing programs when supported by some forms of government subsidy. Finally, in order to summarise the financial analysis for public rental housing, the flow of financial analysis was depicted in Figures 5.13 and 5.14.

Chapter 6: Financial Model for Low-cost Apartments

Chapter 5 discussed the financial analysis of public rental housing, while this chapter discusses the feasibility and affordability of low-cost apartments. One benefit of low-cost apartment investment is that the housing developer can make more money than in public rental housing investment. The Indonesian Government provides subsidies for developers and homebuyers of low-cost housing. In this chapter, a discounted cash flow model is developed to recommend the proportion of subsidised units to be offered in a mixed-income public housing project to ensure that the project is both, viable for the developer and affordable for the home buyer. The main input to the model came from the semi-structured interviews and secondary data from government and private institutions.

In this chapter, the quantitative analysis was designed to determine whether low-cost apartments would be viable as an investment capable of generating net present value (NPV) and required returns for housing developers. The study also explores the possibility of low-cost apartments generating affordable housing outcomes, while providing housing developers with the required returns. This investment feasibility analysis provided two results for the various estimations of non-subsidised or commercial units (prices are set at market prices) and affordable units (the price is discounted to incorporate the element of affordability).

This chapter comprises four sections. Section 6.1 presents the primary and secondary data. Section 6.2 examines the investment feasibility analysis, followed by affordability of home buyer analysis in Section 6.3. Section 6.4 provides a discussion of the results, while Section 6.5 provides the summary. The discussion flow is depicted in Figure 6.1.

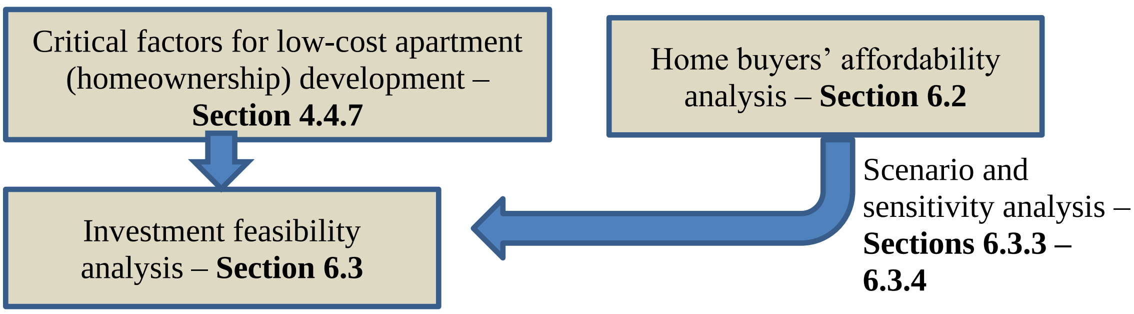

Figure 6.1 Financial model for low-cost apartments

6.1 PRIMARY AND SECONDARY DATA

As mentioned in Chapter 4, the primary data for this study were drawn from face-to-face semi-structured interviews with 14 experts or decision makers in the Ministry and in provincial and municipal governments, and four respondents from the semi-private development sector. The participants were asked to comment on some issues that underlie public housing in relation to both rental and ownership schemes. Data from the interviews suggests that mixed-income housing is regarded as the most suitable public housing development scheme, as it is in line with the government regulation to allocate a certain proportion of dwellings to low-income communities (*Balanced housing development* Minister of Public Housing regulation 2013 s. 7 (Indonesia)). *Public rental housing* act 2011 s.20 (Indonesia) also regulates mixed housing projects by requiring developers to set aside 20% of all land for low-cost housing.

This observation matches Tunstall and Fenton's (2006) findings in relation to characteristics of mixed-income housing in terms of mixed-building, mixed-building forms, size, and designated uses. It is also known as mixed-tenure, or market and segmentation of rent levels. Generally speaking, there are some clear benefits to this policy, such as the provision of accommodation opportunities for low-income and lower-middle-income households and boosting the supply of affordable housing (both for purchase and rental) in certain areas.

However, there is a constraint in relation to developing high-rise public housing that relates to tenants/buyers' behaviours, as they are not used to living in high-rise residential buildings. Responding to this challenge, the Indonesian Government has initiated mixed-income transit-oriented development (TOD), an initiative that allows communities and public and private partners to reap significant economic, environmental, and quality-of-life benefits (Indonesian ministry of public works and public housing, 2020). The term *walkabl*e refers to neighbourhoods with land use that is pedestrian-friendly, with good access to services and transit systems (Talen, 2013). In the Indonesian context, TOD brings benefits to tenants due to excellent locations, with transportation facilities on their doorstep. These developments involve the integrated building of residential properties, transportation facilities, and commercial areas. This results in reduced transportation costs and time (Indonesian Ministry of Public Works and Public Housing, 2020).

Regarding this program, analysis is required to ensure that the investment will be feasible for the developer yet affordable for the buyer. This chapter analyses the feasibility and affordability of mixed-income housing with the support of secondary data obtained from the case study. It includes information on housing prices, local government regulations, and unit areas. Other secondary data include tax regulation and electricity and water bills compiled from a different but typical high-rise apartment.

6.2 AFFORDABILITY OF THE HOME BUYER ANALYSIS

A low-cost apartment unit in Indonesia used in this study was considered mixed-income housing. Therefore, apartments are provided under two schemes: subsidised unit and non-subsidised unit (market-rate). They are different in some facilities, such as loan interest, repayment period and sales schedule. The detail different facilities between subsidised and non-subsidised units are listed in Table 6.1. The apartment unit is provided in three types of units. Table 6.2 and Figure 6.2 present comparison of monthly loan repayment, required minimum income and regional minimum wages of those units. The most dominant difference is the loan interest differences. Normal interest rate (for non-subsidised units) is 7.25% per year, while subsidised unit buyers should only pay 4.25% per year. Therefore, government subsidies the interest gap. The difference of monthly loan repayment between non-subsidised unit and subsidised unit are provided in Table 6.2 and 6.3.

Table 6.1 Subsidised and non-subsidised unit

	Subsidised unit	Non-subsidised unit
Subsidy for home buyers		
Loan interest	4.25% for 10 years The remaining periods will be 7.25%	7.25%
Repayment periods	Max 20 years	Max 15 years
Sales schedule	could be sold after year 2 (end of construction period)	could be sold in the beginning of construction period
Maximum monthly income	IDR 7 million	-
Eligible units	Studio & 1 BR (based on price & unit area)	Studio, 1 BR, 2BR
Subsidy for housing developer		
Sellers' tax	1%	2.5%
Maximum sales price (capped price)	IDR 306 million	-

Table 6.2 Comparison of monthly loan repayments and minimum income of non-subsidised unit buyers

	Studio	1 Bedroom	2 Bedrooms
Home value (selling price) – IDR	224,000,000	360,000,000	688,000,000
Loan amount (IDR)	201,600,000	324,000,000	619,200,000
Monthly loan repayment (IDR)	1,840,332	2,957,676	5,652,447
Minimum income (IDR)	6,457,304	10,377,810	19,833,147
Regional minimum wages (Jakarta) – IDR	3,940,918		
Housing cost based on regional minimum wage (IDR)	1,182,275		

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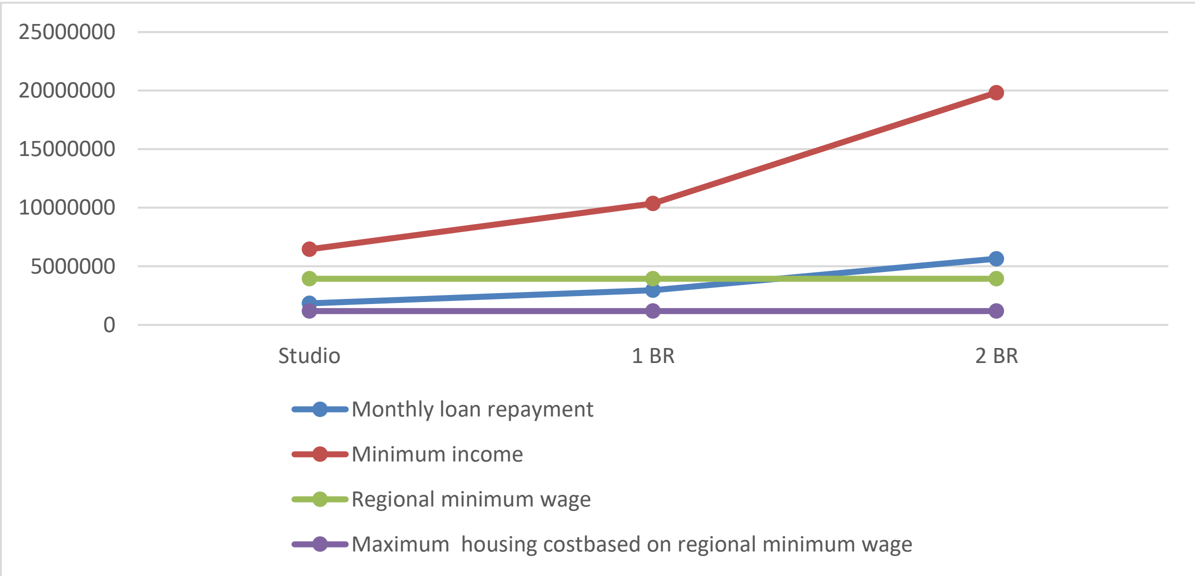


Figure 6.2 Comparison of monthly loan repayment, required minimum income and regional minimum wages (non-subsidised unit) - in IDR

For a subsidised unit, defined as affordable housing, the loan interest is 4.25% for 10 years. Total amortisation is 15 years. The loan interest for the remaining five years applies the regular interest rate of 7.25%. If the down payment is 10%, the monthly loan repayment is IDR 2,106,792, as explained in Table 6.3.

Table 6.3 Comparison of monthly loan repayments and minimum incomes of subsidised unit buyers

Home value (IDR)	306,000,000
Loan amount (IDR)	275,400,000
Monthly loan repayment (year 1-10) (IDR)	2,106,792
Required minimum income (IDR)	7,392,251
Regional minimum wage (Jakarta) (IDR)	3,940,918
Housing cost (based on regional minimum wage) (IDR)	1,182,275

Based on the affordability criteria, a subsidised unit is not affordable for low-income buyers, as the government and housing developers have defined tenants eligible for a subsidy as those with a maximum income as IDR 7 million. However, this is higher than the regional minimum wage. Based on the regional minimum wage, the sales price should be IDR 1,182,275. The analysis shows that the monthly housing cost (loan repayment) was in accordance with the discounted market prices by 30%, which is consistent with the US Department of Housing and Urban Development, which regulated that for subsidised housing the price can be determined at 50%–80% of the market price, which is referred to as a discounted market price (Yglesias, 2015).

Table 6.4 shows the initial payment to be paid by the buyer. It includes the down payment, the first-month loan repayment, fees on the acquisition of land rights and building, insurance, and loan agreement fees (notary and bank).

Table 6.4 Initial payment of home ownership

Initial Payment	**Studio**	**1 BR**	**2 BR**	**Subsidy**
Down payment (IDR)	22,400,000	36,000,000	68,800,000	30,600,000
Fees on acquisition rights of land & building (IDR)	7,200,000	14,000,000	30,400,000	11,300,000
Insurance (IDR)	3,000,000	3,000,000	3,000,000	3,000,000
Agreement fee (appraisal, notary) (IDR)	1,000,000	1,000,000	1,000,000	1,000,000
First-month loan repayment (IDR)	1,840,332	2,957,676	5,652,447	2,106,792
Total payment (IDR)	35,440,332	56,957,676	108,852,447	48,006,792

Fees on the acquisition of land rights and building costs vary depending on the location of the house, which determines the amount of deductible tax. When tax is fixed, it is 5%. For example, in Jakarta, tax deductible is IDR 80 million. Therefore, fees can be calculated at 5% * (selling price – tax deductible).

Tables 6.5–6.7 describe the configuration of minimum income required based on down payments and applied interest rates to show buyer's ability to pay monthly loan repayments. The higher the down payment, the lower the monthly loan repayment.

Table 6.5 Configuration of minimum income required based on down payment for studio unit.

	Interest rate				
Down payment	6.5%	7.25%	8%	9%	10%
0%	1,951,280	2,044,813	2,140,661	2,271,957	2,407,115
Required min. income	6,504,268	6,816,043	7,135,536	7,573,190	8,023,718
5%	1,853,716	1,942,572	2,033,628	2,158,359	2,286,760
Required min. income	6,179,055	6,475,241	6,778,759	7,194,531	7,622,532
10%	1,756,152	1,840,332	1,926,595	2,044,761	2,166,404
Required min. income	5,853,841	6,134,439	6,421,982	6,815,871	7,221,346
15%	1,658,588	1,738,091	1,819,562	1,931,164	2,046,048
Required min. income	5,528,628	5,793,636	6,065,205	6,437,212	6,820,160
20%	1,561,024	1,635,850	1,712,529	1,817,566	1,925,692
Required min. income	5,203,415	5,452,834	5,708,428	6,058,552	6,418,975
25%	1,463,460	1,533,610	1,605,496	1,703,968	1,805,337
Required min. income	4,878,201	5,112,032	5,351,652	5,679,893	6,017,789
30%	1,365,896	1,431,369	1,498,462	1,590,370	1,684,981
Required min. income	4,552,988	4,771,230	4,994,875	5,301,233	5,616,603

Table 6.6 Configuration of minimum income required based on down payment for 1 BR unit.

	Interest rate				
Down payment	6.5%	7.25%	8%	9%	10%
0%	3,135,987	3,286,306	3,440,348	3,651,360	3,868,578
Required min. income	10,453,288	10,954,355	11,467,825	12,171,199	12,895,261
5%	2,979,187	3,121,991	3,268,330	3,468,792	3,675,150
Required min. income	9,930,624	10,406,637	10,894,434	11,562,639	12,250,498
10%	2,822,388	2,957,676	3,096,313	3,286,224	3,481,721
Required min. income	9,407,960	9,858,919	10,321,043	10,954,079	11,605,735
15%	2,665,589	2,793,360	2,924,295	3,103,656	3,288,292
Required min. income	8,885,295	9,311,201	9,747,651	10,345,519	10,960,972
20%	2,508,789	2,629,045	2,752,278	2,921,088	3,094,863
Required min. income	8,362,631	8,763,484	9,174,260	9,736,959	10,316,209
25%	2,351,990	2,464,730	2,580,261	2,738,520	2,901,434
Required min. income	7,839,966	8,215,766	8,600,869	9,128,399	9,671,446
30%	2,195,191	2,300,414	2,408,243	2,555,952	2,708,005
Required min. income	7,317,302	7,668,048	8,027,478	8,519,839	9,026,683

Table 6.7 Configuration of minimum income required based on down payment for 2 BR unit.

	Interest rate				
Down payment	6.5%	7.25%	8%	9%	10%
0%	5,993,219	6,280,497	6,574,886	6,978,154	7,393,283
Required min. income	19,977,396	20,934,989	21,916,288	23,260,514	24,644,277
5%	5,693,558	5,966,472	6,246,142	6,629,246	7,023,619
Required min. income	18,978,526	19,888,239	20,820,473	22,097,488	23,412,063
10%	5,393,897	5,652,447	5,917,398	6,280,339	6,653,955
Required min. income	17,979,656	18,841,490	19,724,659	20,934,462	22,179,850
15%	5,094,236	5,338,422	5,588,653	5,931,431	6,284,291
Required min. income	16,980,786	17,794,740	18,628,845	19,771,437	20,947,636
20%	4,794,575	5,024,397	5,259,909	5,582,523	5,914,627
Required min. income	15,981,916	16,747,991	17,533,030	18,608,411	19,715,422
25%	4,494,914	4,710,372	4,931,165	5,233,616	5,544,962
Required min. income	14,983,047	15,701,242	16,437,216	17,445,385	18,483,208
30%	4,195,253	4,396,348	4,602,420	4,884,708	5,175,298
Required min. income	13,984,177	14,654,492	15,341,401	16,282,360	17,250,994

While Table 6.8 shows the minimum income required based on the down payment, there is no variation for interest rates as the Indonesian Government has capped interest rates for subsidised units at 4.25% and capped selling price, based on *Required income for eligible* *group for homeownership credit* Minister of Public Works and Public Housing regulation 2020 s.242 (Indonesia))

Table 6.8 Configuration of minimum income required based on down payment for subsidised units.

Down payment	Monthly loan repayment	Minimum income
0%	2,340,879	7,802,932
5%	2,223,835	7,412,785
10%	2,106,792	7,022,638
15%	1,989,748	6,632,492
20%	1,872,704	6,242,345
25%	1,755,660	5,852,199
30%	1,638,616	5,462,052

As noted previously, Indonesian Government regulations determine that targeted tenants for subsidised units are those who have a maximum family income of IDR 7,000,000 (*Required income for eligible group for homeownership credit* Minister of Public Works and Public Housing regulation 2020 s.242 (Indonesia))

The sales price for a subsidised unit therefore met the affordability criterion, and the higher down payment would then ease the monthly mortgage. Technically, the housing developer is allowing the buyer to take out a mortgage for the down payment.

From government side, the interest rate subsidy means the government provide funding to close the interest rate gap between normal rate and subsidised rate. The total cost was:

Gap = 2,514,024 (normal monthly payment) – 2,106 407 (subsidised monthly payment) = 407,233

Total cost = IDR 407,233 * 12 months * 10 years * 242 units = IDR 11,826,042,167

6.3 INVESTMENT FEASIBILITY ANALYSIS

A case study for the most likely scenario was used as the basis of the investment analysis. The case study data were presented in Chapter 4, including the project revenue and expenditure.

6.3.1 Discounted Cash Flow

Economic parameters

Some economic parameters were applied in this study, such as investment periods, inflation rates, tax rates, capital loans, and repayment periods. Table 6.9 identifies which key parameters were set as constants in the apartment project financial model as the case study, and to determine the effect of key parameters on project feasibility in order to complete financial assessment for each case scenario. For example, the interest rates for capital loan (construction loan) assumed based on corporate loans in commercial banking, with the repayment period then assumed based on historical data from other similar high-rise apartments. The capital loan to value ratio was set at 60%.

Table 6.9 Economic parameters

Economic parameters		Source of assumption
Investment period	20 years	Secondary data from several apartment investments
Inflation rate	2%	Secondary data from several apartment investments and internet (published data)
Tax rate	21%	based on perppu 1/2020
Required rate of return	10%	Secondary data from several apartment investment
Equity	50%	Interview with housing developer
Capital loan	9%	Secondary data from financial institution
Loan repayment period	3 years	Secondary data from financial institution
Capitalisation rate	7.5%	Secondary data from several apartment investments

Portion of subsidised units

As previously indicated, the case study property was developed using the mixed-income housing scheme. Therefore, there were two types of units: subsidised and non-subsidised. In addition, there were three units area options, as described in Chapter 4. Based on the Indonesian Government regulation, the maximum unit area for a subsidised unit is 36 sqm (*Required income for eligible group for homeownership credit* Minister of Public Works and Public Housing regulation 2020 s.242 (Indonesia)). Therefore, both studios and 1 bed-room units fulfilled this criterion. However, as the targeted buyers were a young family, a proportion of all 1-bedroom units were set as subsidised units.

It was assumed that the developer would build 20% of all units as low-cost units as a portion of subsidised units was assumed under the government regulation (*Balanced housing development* Minister of Public Housing regulation 2013 s.7 (Indonesia)). However, to increase the availability of low-cost units, the Indonesian Government has increased the fraction of subsidised units to 25%. Therefore, the initial value of a subsidised unit was 25% of all units.

Revenue and cost

The revenue comes from the sales of subsidised and non-subsidised units. As explained in Chapter 4.3.3, the sales were happened in 4 years. The sales schedule is listed in Table 6.10

Table 6.10 Sales schedule

	Year 1	Year 2	Year 3	Year 4
Non-subsidy	20%	40%	30%	10%
Subsidy			50%	50%

The assumption of sales timeline for non-subsidised units were 4 years, and subsidised units were 2 years, starts from year 3 and 4 and depends on the completion of building construction. Therefore, the revenue was influenced by the percentage of all types of units and the sales price of each type of units. The sales price and unit categorisation are listed in Table 4.14 and Table 4.16. The revenue could be illustrated in Table 6.11 as follows:

Table 6.11 Example of revenue calculation

Year 1	Number of units	Sales schedule	Sales price (IDR)	Revenue (IDR)
Studio	308	20%	224,000,000	13,798,400,000
1 BR	242	20%	360,000,000	17,424,000,000
2 BR	176	20%	688,000,000	24,217,600,000
Non subsidy	0			
Total revenue				55,440,000,000

While the cost related to sales were selling cost. Both subsidised and non-subsidised unit buyers have to pay selling cost. It was the tax attached to the transaction, as explained in Chapter 4.3.2. Other costs were operation and maintenance costs have been described in Chapter 4.3.3.

Government subsidy

Participants in the semi-structured interviews from the government sector explained some current forms of financial assistance for public housing buyers, such as the Housing finance liquidity facility, assistance subsidy, interest rate subsidy, and savings-based housing finance assistance (BP2BT). Given that the selling price margin between subsidised units and non-subsidised (market-rate) units is so large, the Indonesian Government provides two suitable subsidy schemes, the interest rate gap scheme and the down payment subsidy (Indonesian Ministry of Public Works and Public Housing, 2018). The interest rate for subsidised units is lower than for non-subsidised ones, which is regulated by the financial institution and paid for by the government for a maximum period of 20 years (*Required income for eligible group for homeownership credit* Minister of Public Works and Public Housing regulation 2020 s.242 (Indonesia)). In that regulation, the interest rate for non-subsidy units (market-rate) is 7.25% and the repayment period is 15 years, while the interest rate for subsidy units for the first 10 years is a maximum of 5%. While the down payment subsidy is a maximum of 1% for the house price, the normal down payment for non-subsidised units is 15%. This study followed that rule in NPV calculation.

Discounted Cash Flow

The variable inputs for the financial model were construction costs, revenues, and expenses. These were varied methodically in order to create an output of project indicators, that is, the number of subsidised units. This cash flow also used capital loan, which have similar assumption with public rental housing feasibility analysis in Chapter 5. Complete cash flow is shown in Tables 6.12 – 6.13:

Table 6.12 Cash flow before tax and finance (in million IDR)

	0	1	2	3	4	5	6	7	8	9	10
Construction cost		-130310	-152028	-152028							
Land		-215	-215	-215	-215	-215	-215	-215	-215	-215	-215
Income from sales price:											
Non-subsidy		55440	133056	119750.4	47900.16						
Subsidy					37026	37026					
Income from service charge					4160.957	5244.096	5348.978	5455.957	5565.077	5676.378	5789.906
Income from service charge (commercial)					6716.639	6850.972	6987.992	7127.752	7270.307	7415.713	7564.027
Income from parking					327.2803	327.2803	333.8259	340.5024	347.3125	354.2587	361.3439
Income from shops					22388.8	22836.57	23293.31	23759.17	24234.36	24719.04	25213.42
Operation expenses					-21460.9	-21890.1	-22327.9	-22774.5	-23229.9	-23694.5	-24168.4
Selling cost											
Non-subsidy		-2494.8	-5987.52	-5388.77	-2155.51						
Subsidy					-1110.78	-1110.78					
CAPEX									-2550.86		
Property tax					-148.718	-148.718	-148.718	-148.718	-148.718	-163.59	-163.59
Net Income (NIBIT)	0	-77579.3	-25174.3	-37881.1	93428.95	48920.33	13272.49	13545.21	11272.53	14092.26	14381.68
Sale price											
Less selling cost											
Net Cash Flow	0	-77579.3	-25174.3	-37881.1	93428.95	48920.33	13272.49	13545.21	11272.53	14092.26	14381.68
Discount factor	1	1.12	1.2544	1.404928	1.573519	1.762342	1.973823	2.210681	2.475963	2.773079	3.105848
PV of Net Cash Flow	0	-69267.2	-20068.8	-26963	59375.79	27758.71	6724.255	6127.166	4552.787	5081.81	4630.515
Net present Value	48189.024										
IRR	**18.28482%**										

	11	12	13	14	15	16	17	18	19	20	21
Construction cost											
Land	-215	-215	-215	-215	-215	-215	-215	-215	-215	-215	-215
Income from sales price:											
Non-subsidy											
Subsidy											
Income from service charg	5905.704	6023.817915	6144.294	6267.18	6392.524	6520.374	6650.782	6783.797	6919.473	7057.8628	7199.02
Income from service charg	7715.307	7869.61365	8027.006	8187.546	8351.297	8518.323	8688.689	8862.463	9039.712	9220.5067	9404.917
Income from parking	368.5708	375.9422129	383.4611	391.1303	398.9529	406.9319	415.0706	423.372	431.8394	440.47622	449.2857
Income from shops	25717.69	26232.0455	26756.69	27291.82	27837.66	28394.41	28962.3	29541.54	30132.37	30735.022	31349.72
Operation expenses	-24651.8	-25144.8379	-25647.7	-26160.7	-26683.9	-27217.6	-27761.9	-28317.2	-28883.5	-29461.19	-30050.4
Selling cost											
Non-subsidy											
Subsidy											
CAPEX			-9365.09				-2805.94				
Property tax	-163.59	-163.589726	-163.59	-179.949	-179.949	-179.949	-179.949	-179.949	-197.944	-197.9436	-197.944
Net Income (NIBIT)	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	17579.739	17939.59
Sale price										239194.57	
Less selling cost										-7175.84	
Net Cash Flow	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	249598.47	
Discount factor	3.47855	3.895975993	4.363493	4.887112	5.473566	6.130394	6.866041	7.689966	8.612762	9.6462931	
PV of Net Cash Flow	4219.253	3844.477399	1356.718	3188.394	2905.159	2647.058	2003.195	2197.546	2000.165	25875.066	

Table 6.13 Cash flow after tax and finance (in million IDR)

	0	1	2	3	4	5	6	7	8	9	10
Construction cost		-130310	-152028	-152028							
Land		-215	-215	-215	-215	-215	-215	-215	-215	-215	-215
Income from sales price:											
Non-subsidy		55440	133056	119750.4	47900.16						
Subsidy					37026	37026					
Income from service charge					4160.957	5244.096	5348.978	5455.957	5565.077	5676.378	5789.906
Income from service charge (commercial)					6716.639	6850.972	6987.992	7127.752	7270.307	7415.713	7564.027
Income from parking					327.2803	327.2803	333.8259	340.5024	347.3125	354.2587	361.3439
Income from shops					22388.8	22836.57	23293.31	23759.17	24234.36	24719.04	25213.42
Operation expenses					-21460.9	-21890.1	-22327.9	-22774.5	-23229.9	-23694.5	-24168.4
Selling cost											
Non-subsidy		-2494.8	-5987.52	-5388.77	-2155.51						
Subsidy					-1110.78	-1110.78					
CAPEX									-2550.86		
Property tax					-148.718	-148.718	-148.718	-148.718	-148.718	-163.59	-163.59
Net Income (NIBIT)	0	-77579.3	-25174.3	-37881.1	93428.95	48920.33	13272.49	13545.21	11272.53	14092.26	14381.68
Sale price											
Less selling cost											
Equity Cashflow before tax	0	-12424.6	25099.91	-17636.6	7629.973	-11139	-16757.2	13545.21	11272.53	14092.26	14381.68
Tax payable		0	0	0	-19400.9	-10054.1	-2568.03	-2625.3	-2148.04	-2740.18	-2800.96
Equity after tax	0	-12424.6	25099.91	-17636.6	-11770.9	-21193	-19325.2	10919.91	9124.494	11352.08	11580.72
Discount factor	1	1.105	1.221025	1.349233	1.490902	1.647447	1.820429	2.011574	2.222789	2.456182	2.714081
PV of Net Cash Flow	0	-11243.9	20556.43	-13071.6	-7895.16	-12864.2	-10615.7	5428.541	4104.976	4621.84	4266.902
Net present Value	40561.644										
IRR	19.54%										

	11	12	13	14	15	16	17	18	19	20	21
Construction cost											
Land	-215	-215	-215	-215	-215	-215	-215	-215	-215	-215	-215
Income from sales price:											
Non-subsidy											
Subsidy											
Income from service charg	5905.704	6023.817915	6144.294	6267.18	6392.524	6520.374	6650.782	6783.797	6919.473	7057.8628	7199.02
Income from service charg	7715.307	7869.61365	8027.006	8187.546	8351.297	8518.323	8688.689	8862.463	9039.712	9220.5067	9404.917
Income from parking	368.5708	375.9422129	383.4611	391.1303	398.9529	406.9319	415.0706	423.372	431.8394	440.47622	449.2857
Income from shops	25717.69	26232.0455	26756.69	27291.82	27837.66	28394.41	28962.3	29541.54	30132.37	30735.022	31349.72
Operation expenses	-24651.8	-25144.8379	-25647.7	-26160.7	-26683.9	-27217.6	-27761.9	-28317.2	-28883.5	-29461.19	-30050.4
Selling cost											
Non-subsidy											
Subsidy											
CAPEX			-9365.09				-2805.94				
Property tax	-163.59	-163.589726	-163.59	-179.949	-179.949	-179.949	-179.949	-179.949	-197.944	-197.9436	-197.944
Net Income (NIBIT)	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	17579.739	17939.59
Sale price										239194.57	
Less selling cost										-7175.84	
Equity Cashflow before tax	14676.88	14977.99165	5920.03	15582.04	15901.58	16227.51	13754.02	16899.06	17226.94	249598.47	
Tax payable	-2862.95	-2926.18529	-1024.01	-3053.04	-3120.14	-3188.58	-2669.15	-3329.61	-3398.46	-3472.552	
Equity after tax	11813.93	12051.80637	4896.017	12529	12781.44	13038.92	11084.87	13569.45	13828.48	246125.92	
Discount factor	2.999059	3.313960566	3.661926	4.046429	4.471304	4.940791	5.459574	6.032829	6.666276	7.3662348	
PV of Net Cash Flow	3939.212	3636.677663	1337.006	3096.311	2858.549	2639.036	2030.354	2249.268	2074.393	33412.717	
Net present Value											
IRR											

6.3.2 Results of the investment analysis

The project indicators were assessed for equity IRR and net present value (NPV). If the NPV was positive and IRR > the required rate of return, this meant that the project would be attractive to private investors and that a partnership project may be worth pursuing.

The worksheets contained details of initial investment, revenue, expenses, depreciation, and tax, which were adjusted specifically for this case study. Likewise, the annual cash flow was figured in a graphical financial model. The graphical output of the cash flows beginning in Year 1 and ending in Year 20 is shown in Figure 6.3. One of the outputs of the financial model was NPV as one of the financial indicators. Another output was internal rates of return, which describes the rate of investment returns based on the financial parameter calculations.

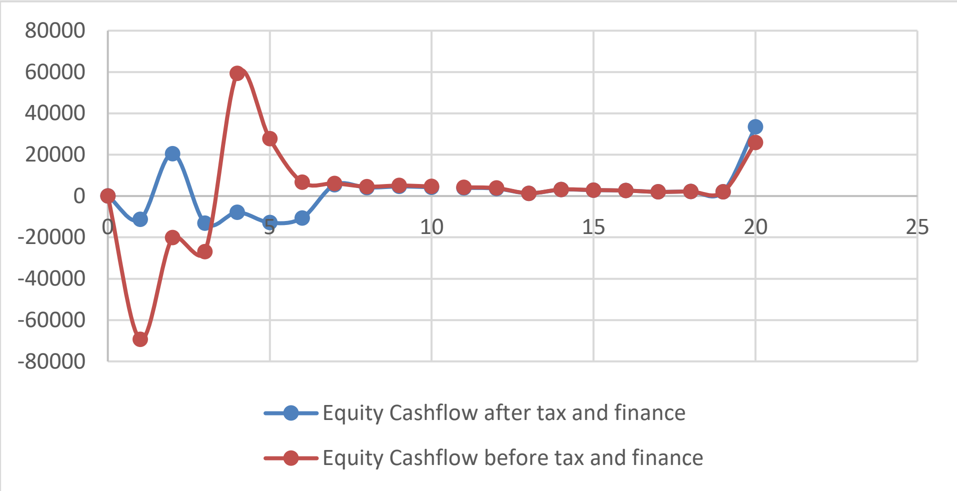


Figure 6.3 Cash Flow (most likely scenario) – (in million IDR)

The variable inputs for the financial model for the most attractive case scenario of this case study was 25% of all units allocated for subsidised units. The minimum subsidised unit allocation was 10% with an incremental 5%. The NPV (from a developer's perspective) was the present value after tax and finance over the entire investment period. According to this model, the project would generate financial resources for developers because the NPV was greater than zero.

Table 6.14 Results of investment analysis

	NPV (million IDR)	IRR
Cash flow before tax and finance	48,189.02	18.28%
Cash flow before tax	71,744.04	39.30%
Cash flow after tax	20,552.26	14.53%
Cash flow after tax and finance	40,561.64	19.54%

The analysis results in this study show that affordable housing outcomes have been reached through the viability of low-cost apartments with government intervention such as land provision in the land rental scheme. Where there was an opportunity to recapitalise at least 7.5% of the initial outlay on the investment after 20 years, the IRR of the development improved.

When at least 50% of investment loan at an amortised cost of debt of 9% was incorporated into the capital structure of the development, the NPV before tax is 39.30%, and 19.54% after tax. The finding suggests that in low-cost apartment investment could be more feasible if developers can access debt capital to make the investment more favourable.

6.3.3 Sensitivity analysis

The aim of sensitivity analysis was to calculate what-if of the change of key variables as a result of changes in other variables through simulation. This is a means of predicting the outcome of a decision given a certain range of variables. In the case of some variables, a small percentage change in their value can have a significant impact on the decision of investment feasibility (Marchioni & Magni, 2018). This study examined changes in parameters, including:

- the number of subsidised units;
- required return;
- increased operation costs;
- number of subsidised units based on changing on type composition.

The most effective way to present the results of sensitivity analysis is by plotting sensitivity graphs. All changed variables are plotted on the same graph or different graph. The most sensitive variables are showed by the slopes of the lines; the steeper the slope, the more sensitive the outcome is to change in a particular variable (Marchioni & Magni, 2018). However, in this study the sensitivity analysis was conducted one by one for each variable, with the highest IRR changes showing the most sensitive variables. The sensitivity analysis of the variables is detailed below. There are four changed variables, which are detailed in Table 6.15 to 6.18. While Figure 6.4 to 6.6 present the variable changing.

Number of subsidised units

Table 6.15 Sensitivity analysis by changing the number of subsidised units

Subsidised unit (in unit)	Subsidised unit (in percentage)	NPV (million IDR)
0	0%	71,744.04
25	3%	110,276.31
50	5%	106,295.70
75	8%	102,315.10
100	10%	98,334.49
125	13%	94,353.88
150	15%	90,373.28
175	18%	86,392.67
200	20%	82,412.06
225	23%	78,431.46
250	25%	74,450.85
275	28%	70,470.24
300	30%	66,489.64
325	33%	62,509.03
350	35%	58,528.42
400	38%	54,547.82
425	40%	46,586.60
450	43%	42,606.00
475	45%	38,625.39
484	48%	34,644.78

The data show that if the number of subsidised units increased by 1%, it would decrease the IRR by 0.77%. If the housing developer allocated more than 50% of all units for subsidised housing, the planned project would not be feasible. If number of subsidised units is higher than 30%, NPV and IRR would be lowered, which means that the project would not be feasible.

Required return

Table 6.16 Sensitivity analysis by changing the required return

Required return	NPV (million IDR)
10%	74,370.75
12%	48,189.02
15%	20,324.87
20%	-7,800.02

According to the sensitivity analysis, changing the required return showed that if the required return was set higher than 20%, the planned project would not be feasible**.**

Changes to operation expenses

Operation expenses can be decreased or increased as there is possibility for such change. Changes can relate to staff salaries, electricity and water bills, waste retribution and building maintenance. The effect of sensitivity analysis is shown in Table 6.17 and Figure 6.4.

Table 6.17 Sensitivity analysis relating to increasing & decreasing operation expenses

O/M cost increasing/decreasing	NPV (million IDR)	IRR
0%	40,561.64	19.54%
Increase 2%	37,308.08	18.83%
Increase 5%	32,427.73	17.77%
Increase 10%	24,293.82	16.00%
Increase 15%	16,159.91	14.21%
Increase 20%	8,026.00	12.38%
Increase 25%	-107.91	10.47%
Increase 30%	-8,241.82	8.46%
Decrease 5%	48,695.56	21.33%
Decrease 10%	56,829.47	23.15%
Decrease 15%	64,963.38	25.01%
Decrease 20%	73,097.29	26.94%

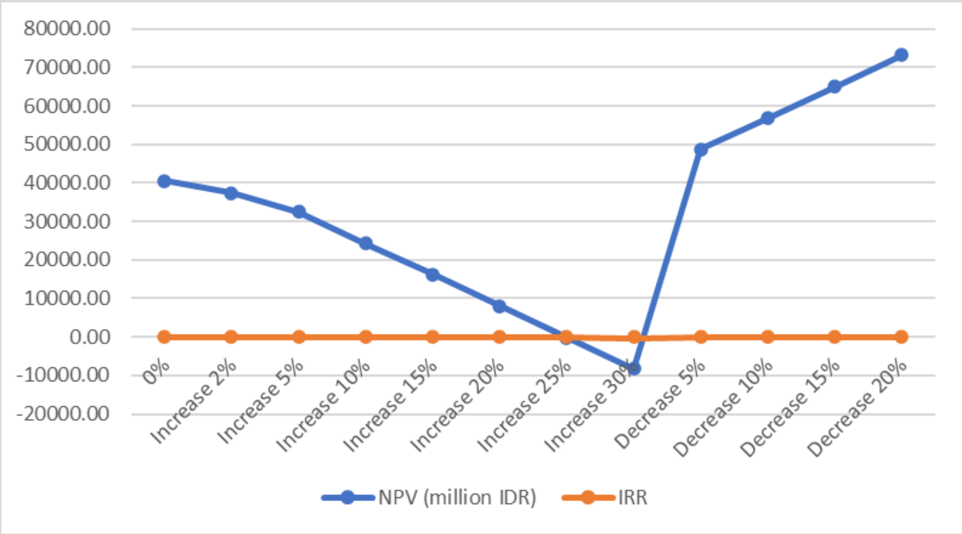


Figure 6.4 The influence of changes to operation costs on NPV and IRR

The sensitivity analysis showed that increasing operation costs by 1% would decrease IRR by 0.35%. It can therefore be concluded that the increase in operation expenses is more sensitive than the changing of required returns or the number of subsidised units and that of all the operation expense components, staff salaries is the most sensitive. If salaries increased by 20%, IRR would decrease by 0.58%.

As seen in Figures 6.4, small changes in input values can significantly affect the outcome of the analysis. More changes will result in financially unfeasible investment, and this would be the maximum percentage that the variables can change (Magni & Marchioni, 2020). The sensitivity results will be important for decision makers to formulate the strategy to mitigate risks associated with changes in key parameters. This study also conducted sensitivity analysis on number of subsidised units based on changing on type composition. As aforementioned that there are three types of units. However, the subsidised unit is allocated to studio and 1 bedroom only to required unit area. Table 6.18 to 6.21 present unit allocation and sensitivity analysis based on changing on type composition. Initial number of subsidised unit allocation is 25%. Number of subsidised units is 25% x 968 units = 242 units, which is allocated on studio unit.

Number of subsidised units based on changing on type composition

Table 6.18 Subsidy on studio

	Non-subsidy	Subsidy
		25%
Studio	66	242
1 BR	484	0
2 BR	176	0
Total unit	726	242

Table 6.19 Sensitivity analysis by changing number of studio unit as subsidised units

Number of subsidised units	NPV (in million IDR)
5%	86,753.47
10%	85,893.02
15%	85,032.58
20%	83,936.45
25%	83,076.01
30%	81,979.88

Table 6.20 Subsidy on studio and 1 BR unit

	Non-subsidy		Subsidy
			25%
Studio	187	50%	121
1 BR	363	50%	121
2 BR	176		

Table 6.21 Sensitivity analysis by changing number of studio & 1 BR unit as subsidised units

40561.64	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
0%	86627.1	77414	68200.91	58987.82	49774.73	40561.64	31348.55	22135.46	12922.37	3709.283	-5503.81
5%	84345.12	75132.03	65918.94	56705.85	47492.76	38279.67	29066.58	19853.49	10640.4	1427.306	-7785.78
10%	82063.14	72850.05	63636.96	54423.87	45210.78	35997.69	26784.6	17571.51	8358.419	-854.671	-10067.8
15%	79543.76	70330.67	61117.58	51904.49	42691.4	33478.31	24265.22	15052.13	5839.036	-3374.05	-12587.1
20%	77261.78	68048.69	58835.6	49622.51	40409.42	31196.33	21983.24	12770.15	3557.059	-5656.03	-14869.1
25%	74742.4	65529.31	56316.22	47103.13	37890.04	28676.95	19463.86	10250.77	1037.676	-8175.41	-17388.5
30%	72460.42	63247.33	54034.24	44821.15	35608.06	26394.97	17181.88	7968.789	-1244.3	-10457.4	-19670.5

Note: NPV in million IDR (Cash flow after tax and finance)

From the Table 6.18 to Table 6.21, the analysis shows that if subsidised units were allocated from studio type, they could produce more subsidised units compared to combination of studios and 1 bedroom. In Table 6.18, it shows that number of subsidised units was set 25%. Of all portions, 50% was allocated from studio and 50% was from 1-bedroom. Combination of studio and 1 bedroom also yielded higher NPV. Figure 6.5 shows the NPV which was derived from combination of 1 BR and studio as subsidised units. It can be seen that when subsidised unit was set to 1 BR of 50%, the project would not be feasible. The maximum combination was 1 BR of 45% of all 1 BR units and studio of 10% of all studio units

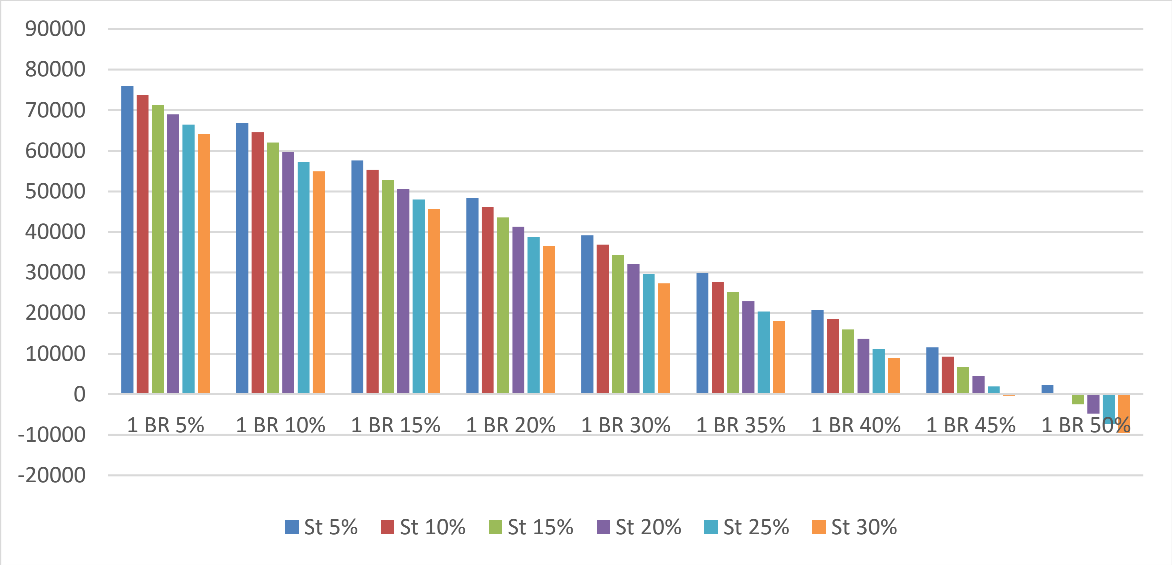


Figure 6.5 NPV of combination of 1 BR and studio as subsidised units (in million IDR)

Note: St = studio; 1 BR = 1 bedroom

6.3.4 Investment scenario analysis

Due to change on favourable or unfavourable events, in *financial modelling*, investment scenario is conducted to estimate that changes. The scenario analysis is used when there are potential changes in condition that could impact the project (Acheampong & Earl, 2020). Conditions can be changed due to various circumstances. Each scenario normally combines optimistic, pessimistic, and more and less probable developments. The upper and lower limits of optimistic and pessimistic scenario will be used as interval forecasts.

The first step in conducting a scenario analysis is to determine variables which have potential changes on pessimistic and optimistic scenario (Acheampong & Earl, 2020). Conducting scenario analysis is easier when the sensitivity analysis has been conducted as the sensitivity analysis' results can show which variables affect the outcome the most. This is because in the sensitivity analysis, the base case scenario is obtained from the most likely values for each variable.

This study used four scenarios:

1. **Optimistic:** This refers to favourable situations, such as a boom in the cycle of property development, or the escalation of house prices by 100% in a year for all types of units. The parameter was defined based on property data (2020).
2. **Most likely:** This is the baseline scenario, which mostly occurs in actual practice.

3. **Pessimistic (the worst-case scenario)**: This refers to unfavourable situations, such as a stagnant cycle of property values, or constant increases in house prices. The pessimistic scenario is used to describe the impact of the COVID-19 pandemic. In pessimistic scenarios, the sales price of low-cost units (subsidised) was more stable than that of medium-cost units (2 BR). This was because there is no regulation change regarding subsidy for homebuyers. The Indonesian Government still grants subsidies to low-income homebuyers (REI, 2020b).
4. **Without subsidy:** This scenario describes the condition wherein there is no government subsidy on selling cost. In this condition, all units are sold at market price and without subsidy tax.

The four basic scenarios are explained on Table 6.22 as follows. In the scenario for the worst-case economic conditions, the unit sales were expected to be sold after six years. In order to boost unit sales, the escalation price at which the developer would sell their product was also lower. However, based on data from the Indonesian Real Estate Association (2020), the sales of subsidised units remain constant, as the Indonesian Government continues to subsidise low-income buyers. Furthermore, the market for first-home buyers is not influenced by the worst economic conditions; and price escalation is different between studio, 1 BR, and 2 BR apartments. The sales schedule of non-subsidised housing is longer than expected.

In contrast to the worst economic scenario, stronger economic conditions could result in more sales and higher prices, and the sales schedule would be set shorter. The result and comparison of four scenarios are described in Table 6.23, while visualisation could be seen on Figure 6.6. As seen from the results in Table 6.23, if the pessimistic estimation for key variables was decreased, the net present value of the project was negative, as the IRR became lower than the required return. Meanwhile, when optimistic scenario was applied, the performance of the project was very good and significantly exceeded the required return of the investment. This resulted in more favourable project feasibility, resulting in an IRR of the project of around 29.54% (cash flow before tax and finance).

Table 6.22 Four scenarios of investment analysis

	Scenarios:			
Scenario name	Base	Optimistic	Pessimistic	Without subsidy
Probability of scenario	40%	20%	30%	10%
Inputs:				
Unit sales year 1	Subsidised unit: - Non-subsidised unit: 35%	Subsidised unit: - Non-subsidised unit: 50%	Subsidised unit: - Non-subsidised unit: 30%	Subsidised unit: - Non-subsidised unit: 35%
Unit sales year 2	Subsidised unit: - Non-subsidised unit: 40%	Subsidised unit: - Non-subsidised unit: 40%	Subsidised unit: - Non-subsidised unit: 15%	Subsidised unit: - Non-subsidised unit: 40%
Unit sales year 3	Subsidised unit: 50% Non-subsidised unit: 15%	Subsidised unit: 50% Non-subsidised unit: 10%	Subsidised unit: 40% Non-subsidised unit: 15%	Subsidised unit: 50% Non-subsidised unit: 15%
Unit sales year 4	Subsidised unit: 50% Non-subsidised unit: 10%	Subsidised unit: 50% Non-subsidised unit: -	Subsidised unit: 40% Non-subsidised unit: 15%	Subsidised unit: 50% Non-subsidised unit: 10%
Unit sales year 5	Subsidised unit: - Non-subsidised unit: -	Subsidised unit: - Non-subsidised unit: -	Subsidised unit: 20% Non-subsidised unit: 15%	Subsidised unit: - Non-subsidised unit: -
Unit sales year 6	Subsidised unit: - Non-subsidised unit: -	Subsidised unit: - Non-subsidised unit: -	Subsidised unit: - Non-subsidised unit: 10%	Subsidised unit: - Non-subsidised unit: -
Price escalation	Studio: 30% 1 BR: 30% 2 BR: 30%	Studio: 60% 1 BR: 50% 2 BR: 50%	Studio: 30% 1 BR: 20% 2 BR: 20%	Studio: 30% 1 BR: 30% 2 BR: 30%
Vacancy on commercial area (shops)	30%	20%	40%	30%
Required return	12%	10%	15%	12%
Repayment period of capital loan	3 years	3 years	6 years	3 years

selling tax for subsidised unit	1%	1%	1%	2.5%
Operation and maintenance cost	100%	100%	increases 10%	100%

Table 6.23 Output of four scenarios of investment analysis (after tax and finance)

	Base (most likely)	Optimistic	Pessimistic	Without subsidy
NPV (million IDR)	40,561.64	74,797.97	-13,875	40,001.03
IRR	19.54%	237.18%	9.13%	19.33%
Maximum number of subsidised units (1 BR)	45%	50%	15%	45%
Maximum number of subsidised units (1 BR & Studio)	40% 1 BR 25% Studio	50% 1 BR 30% Studio	10% 1 BR 90% Studio	45% 1 BR 20% Studio

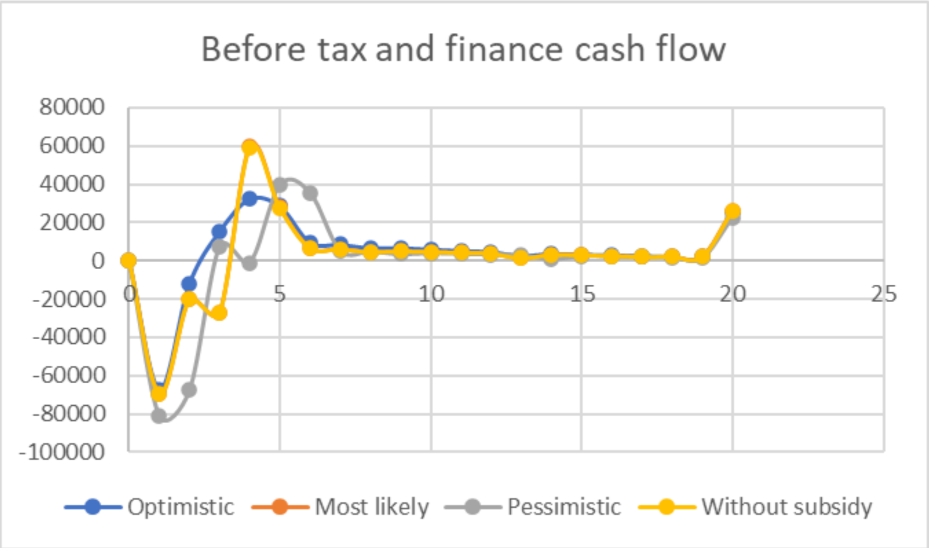


Figure 6.6 Cash flow of three scenarios

Note: NPV in million IDR

Under the pessimistic scenario, the study also assumed that the coronavirus conditions would hurt the demand for private rental housing over the short term. To allow for this, the sales schedule was extended to six years. However, the investment suffered from increases in operation and maintenance costs while the escalation of sales price could not be determined higher. The results from the analysis show that in the pessimistic scenario, the investment yielded a negative NPV of IDR -13,875 million and IRR of approximately 9.13% over a 20-year investment period. However, based on sensitivity analysis by changing number of subsidised units, the NPV is getting better.

The scenario without subsidy resulted in insignificant differences to the most likely scenario, as the difference only occurred in relation to selling costs. The selling tax for subsidised units was 1%, while for non-subsidised units it was 2.5%. The other costs and expenditures remained the same. This result shows that a government subsidy for this project would not be significant and could be improved to attract more housing developers.

6.4 FINANCIAL MODEL FOR LOW-COST APARTMENT AND DISCUSSION

As stated in Chapter 4 and in the introduction to this chapter, participants in the semi-structured interviews considered that transit-oriented developments (TOD) could also be a suitable approach for resolving location selection for new urban designs if these developments provide suitable transport options and if the housing is integrated with transportation planning and transportation features to allow tenants to easily and cheaply travel to their workplaces.

This study examined investment feasibility for mixed-income housing using the TOD concept. As reported by Oikarinen et al. (2014), land prices could be higher as well as property prices. However, as this study focused on public housing, where prices cannot be set at high levels, the challenge was how to make the project feasible for housing developers and affordable for home buyers. The financial analysis flow for a low-cost apartment is described in Figure 6.7, while the financial model is represented in Figure 6.8.

In response to the problem of high land prices, land could be rented from private concerns to reduce sales prices, as buying land is more expensive. The best scheme would be to have a long lease, which would provide tenants with affordable housing in the desired walkable neighbourhoods – neighbourhoods in which land use is pedestrian-oriented and there is good access to services and transport (Talen, 2013). This is a kind of government involvement, as described in Figure 6.8. As the transportation sector land is state-owned, the housing developer would pay an annual land rental fee, which would be much cheaper than buying the land and would allow for a greater number of subsidised units to be built.

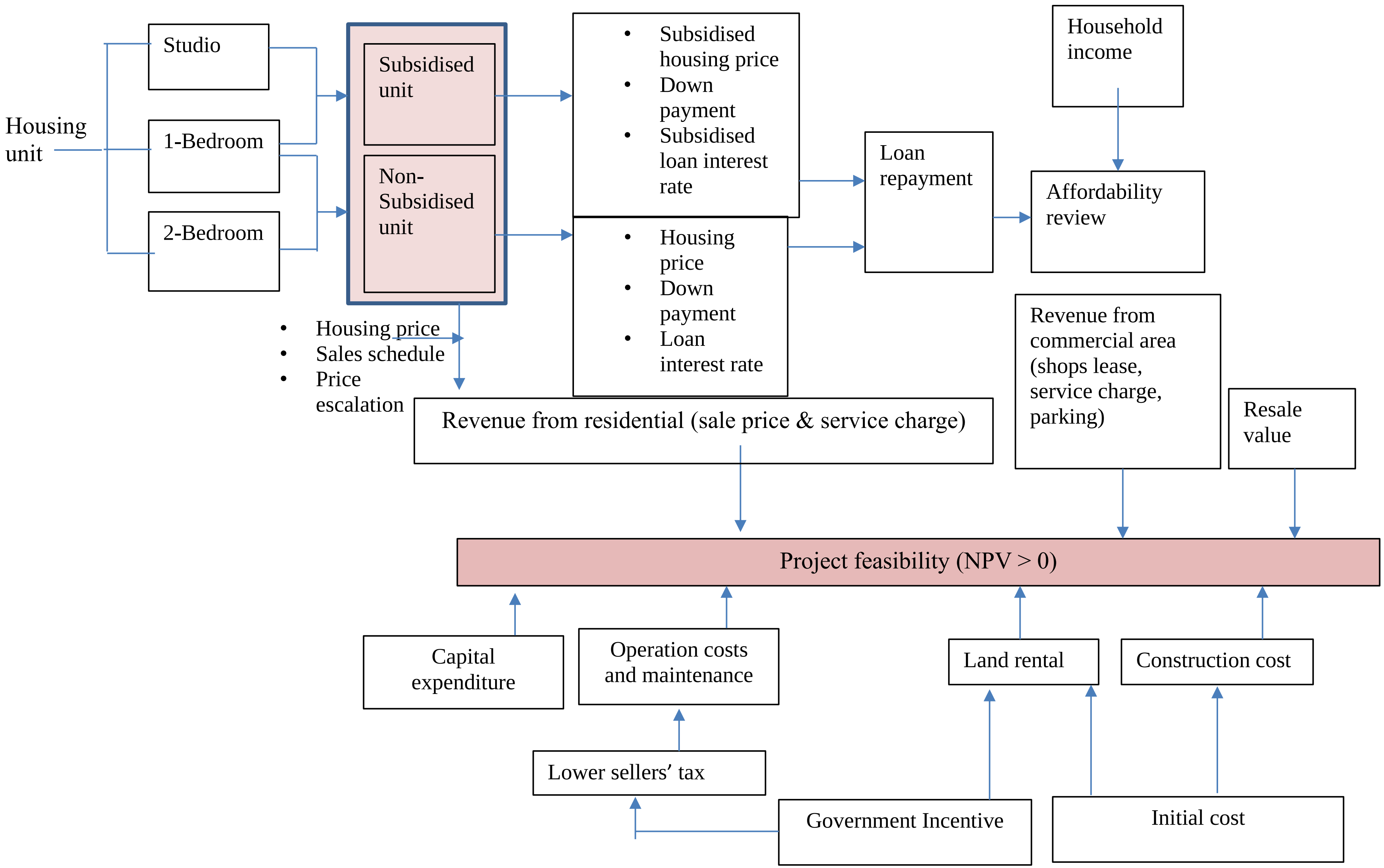


Figure 6.7 Flow of financial analysis for low-cost apartment

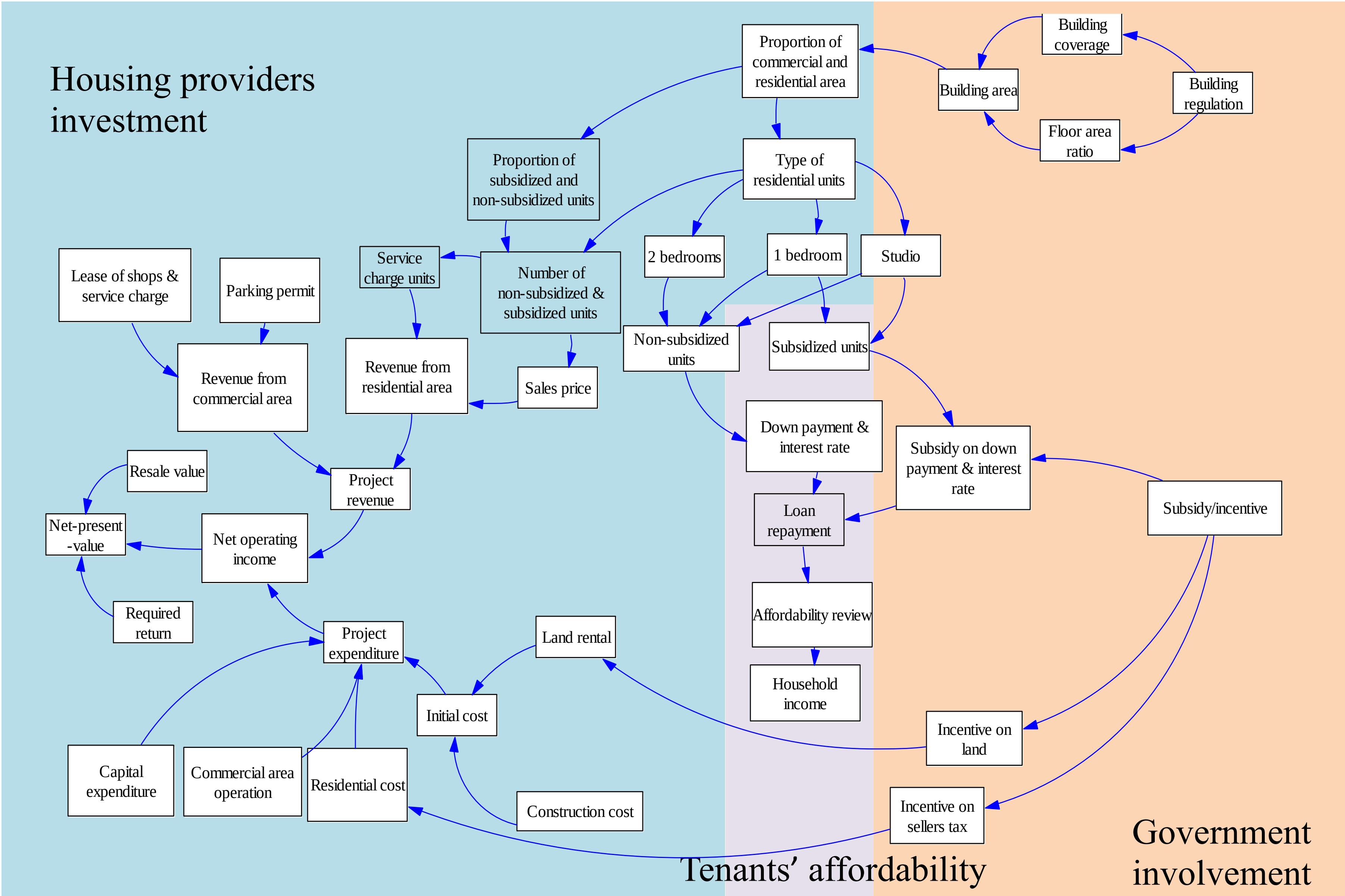


Figure 6.8 Financial model for low-cost apartment

The Phase 2 financial model had equations that reflected the relationship among factors. These equations are listed below.

A. Tenant's affordability

   1. Loan repayment = PMT (monthly year, period, (unit price-down payment)
   2. Required income = (loan repayment/30%) / (1-income tax)

B. Government's involvement

   2. Building coverage ratio: depends on local government regulation (i.e. 30%) maximum building coverage = land area * 30%
   3. Floor area ratio: depends on local government regulation (i.e. 30%) Maximum floor area = land area * 3
   4. Subsidy on interest rate = (normal interest rate – subsidised interest rate)
   5. Incentive on sellers tax = (2.5% - 1%)

C. Housing provider's investment

   1. Revenue
      a. Commercial area
         1. Shop lease = number of units * monthly lease price
         2. Service charge = number of units * service charge/sqm * unit area
      b. Residential area
         Unit sales = (sales price * number of units) – (sellers tax * number of units)
         Service charge = number of units * service charge/sqm * unit area
   2. Expenditures
      a. Initial cost
         1. Land acquisition = (land price * land area) + land preparation cost
            Or
         2. Land rental = monthly land rental
         3. Construction cost
         4. Building permit
      b. Commercial area operation = operating expenses = administration salary + electricity and water bills of public infrastructure + waste recycling retribution + building maintenance + property tax + capital expenditure

    c. Residential area operation = operating expenses = administration salary + electricity and water bills of public infrastructure + waste recycling retribution + building maintenance + property tax
3. Net operating income = Revenue – expenditures

   Resale value = (total net operating income year 21)/2.5%

   Net cash flow = net operating income + resale value

   Net present value = ∑ (net cash flow / required return)

6.5 CHAPTER SUMMARY

This chapter showed how parameters influence project viability from the developer's side, the effectiveness of government subsidies, and home buyer's affordability in homeownership. This chapter began by conducting semi-structured interviews with 18 participants from the public and semi-private housing development sector. The aim of the interviews was to identify key aspects and issues underlying public housing rental and ownership schemes. Four theme clusters emerged from the data collected from the interviews that reflected critical aspects of public housing development: land provision, design and construction, housing financing, and partnership schemes.

In their study in Nigeria, Mukhtar et al. (2017) suggested that effective housing financing is one critical success factor for public housing projects in developing countries. This aligns with the findings of this study, where most participants in the semi-structured interviews mentioned housing financing as a critical factor in successful public housing development. However, the major themes in the housing financing theme cluster related to subsidy and pricing, and these were the key points. There are significant constraints related to public housing financing as it involves low-income communities who have problems with housing finance accessibility and affordability. On the other hand, the public housing operator must ensure that the building is running well and maintaining its liveability. Therefore, the government should consider the most suitable subsidy schemes and pricing. Moreover, as the private sector is invited to be involved, the project should be feasible, yet affordable.

The home buyers' affordability analysis showed a comparison of the amount they must pay and their required income to meet affordability benchmark, that is, 30% of household income. Based on *Required income for eligible group for homeownership* *credit,* Minister of Public Works and Public Housing regulation 2020 s.242 (Indonesia), low-income home buyers are categorised as those who have a maximum monthly income of IDR seven million and could not afford to buy a house without government intervention, such as subsidised housing prices and subsidies on interest rates. With an interest rate of 4.25% for 15 years, which is 60% of the normal interest rate, home buyers can make monthly loan repayments. Home buyers who receive a government subsidy on the down payment or an interest rate of home ownership credit are able to buy studio (non-subsidised price) or 1-bedroom units (subsidised price). When the down payment is lower than 10% of the housing price, they cannot afford to pay monthly loan repayments, as this constitutes more than 30% of their household income. Government and housing providers provide subsidised units for low-income home buyers. Under the market price, the buyer needs a monthly income of at least IDR 10 million to be able to make the loan repayments.

Meanwhile, project feasibility from the supply side used some parameters including expenses, costs, initial investments, and required rates of return. The number of the subsidised units was set as a changing variable that influenced the project's viability, which determined the maximum number of acceptable subsidised units, and ensured that the project was still feasible. It showed that maximum subsidised units can be provided by housing providers. The more subsidised units, the lower the net present value, meaning the project becomes unfeasible. The base scenario assumed that subsidised units were 1 bedroom. However, based on sensitivity analysis, a subsidy on studio types would produce more subsidised units. Therefore, in order to raise the net present value, the number of subsidised units for all types should be combined.

Another sensitive variable is that of operation costs; therefore, innovative ways should be found to lower these costs. A government subsidy on operation costs can be taken into account as some units in the public housing development are occupied by low-income communities. As stated in Chapter 5, a low-income community cannot be charged the market-based price. One approach to rent price determination is the cost-based approach. Thus, there is a need to effectively manage the operational costs through five approaches: maintenance standards, budget constraints, control of improper use of property, energy costs, and policy (Li et al., 2016).

Scenario analysis showed most likely and pessimistic scenarios were more realistic than optimistic ones, as the current property market is in a stagnant cycle due to the global pandemic. Buyers are holding back on transactions, with many companies reconsidering any kind of expansion or relocation planning (REI, 2020b). In addition, price escalation cannot be determined similarly to the most likely or optimistic scenarios. Real property data showed that the growth of home ownership credit was only 0.62% (quarter on quarter) (Bank of Indonesia, 2020), while unit sales had also decreased compared to previous year (-30.93% year on year comparison). In response to this situation, the Indonesian Government may enlarge the home ownership credit facility and loan-to value flexibility to ease the stress on future buyers. This corresponds with a study conducted by Acheampong and Earl (2020), which described the pandemic impact on public housing investment by some forms of government allowances. However, this study maximised government subsidies to maintain the project feasibility by combining the subsidised and non-subsidised units.

Another aim of this chapter was to examine the effectiveness of government subsidies. The Indonesian Government offers some forms of subsidy, including an interest rate subsidy, whereby the monthly loan repayment is set as the indicator to examine the buyer's affordability. The changing variable is the down payment, as the more buyers pay upfront, the lower the loan repayment monthly. Overall, the subsidy price is reasonable for low-income buyers. The common constraint in housing finance is that the increasing housing prices do not align with increasing income, which results in failure in home ownership (Ministry of Public Works and Public Housing, 2014). Meanwhile, supply side government subsidies are offered by providing land, especially in major cities, where the land prices are high and land availability is scarce. Unlike public rental housing developments, the government does not need to extend any other forms to meet project viability, such as public infrastructure and utility. It could be concluded that it is essential to create occupancy segmentation and public housing pathways so that low-income community can rent in public rent housing before they are able to undertake home ownership. Low-cost apartments are suitable for those with higher income than public rental housing tenants. This will help the government to provide appropriate subsidies.

Chapter 7: Low-cost Apartment Financial Analysis Using System Dynamic

The aim of this chapter is to develop a dynamic simulation model for investment analysis. The model supports the discussion in Chapter 6 and was created using Microsoft Excel. The model was used to determine investment feasibility analysis, drawing a causal loop diagram of influencing factors to develop a dynamic simulation model, and verifying the model by means of a case study. The case study used the public housing project discussed in Chapter 6. Scenario analysis was also generated after base model development and validation. Secondary data were gathered from government and private developers, as discussed in Chapter 4.

This chapter consists of nine sections. Section 7.1 presents the data set. Section 7.2 discusses the modelling overview, including steps taken to build the model, while Section 7.3 focuses on problem articulation, including identifying the variables. Section 7.4 describes the base model development, while Section 7.5 supports the base model development by input formula to each variable. Section 7.6 focuses on running the base model, followed by model testing or validation in Section 7.7. The model scenario is explained in Section 7.8. Lastly, Section 7.9 provides discussion and summary in the form of policy formulation and evaluation.

7.1 MODELLING OVERVIEW

The basic calculation was based on planned maintenance costs and historical data related to maintenance costs. It was then calculated for long term projection using time value of money. One indicator to measure economic changes is that of inflation. Most costs are subject to inflation, therefore realistic forecasting is required to predict inflation variations over time. Revenue is also influenced by inflation, which reflect to the increasing of selling price, rent price and service charge. Therefore, some assumptions were applied.

Another form of quantitative analysis is financial model development. The model was underpinned by mathematical analysis in financial terms, the primary method used to express annual cost and revenue being discounted cash flow (DCF).

The fundamental concept of DCF analysis is the time value of money, which means cash flows occur at different times and will be adjusted to net present value (NPV) using discount rate quantification (Brown, 2016). In the context of price determination, the price was a part of revenue or cash inflow, and this was calculated to examine the feasibility of the project. This was done by calculating the present value of summation of future net operating income, divided by discount factor. When the calculated NPV is positive, the investment is economically viable.

The quantitative analysis was conducted in Phases 2 to 4. The financial model for low-cost apartments was developed using the system dynamics model delivered through a series of specific steps. In general, the financial model aimed to examine the NPV based on the revenue and the cost for minimum level building performance. The revenue included rent or selling price and certain government subsidy schemes. The rent or selling price was then determined based on real cost and the ability and willingness to pay.

While factors that influence cash flow are difficult to predict, system dynamics provide more advanced approach, includes (Suryani et., 2012; Lyneis, 2000):

- Formulation inputted in system dynamics covers expert knowledge into the model, and it enable to develop highly non-linear behaviour.
- The formula includes historical data, which is used to forecast future parameter. Therefore, it will produce accurate prediction or forecasts of short to mid-term trends.
- System dynamics can develop forecasting model, which is better than statistical model, as it accommodates sensitivity and scenario analysis using structure and parameter scenario and therefore lead to better decisions.

It can be expected the real cost, subsidy, and willingness and ability to pay will meet at a point of equilibrium in the analysis. In terms of boosting private sector involvement, when the government applies a subsidy policy, it is the optimal condition for the private sector to set the price at marginal cost. Based on modelling steps (Sterman, 2000), this model was built using the following steps, which is visualised on Figure 7.1:

- Problem articulation: this step identifies the goal, its key variables which describe real system, and determines the time horizon. It characterises the problem dynamically as the first step to understanding it and to designing policies to solve it.

- Dynamic hypothesis: modellers develop a theory of how the problem has arisen. In order to support theory development, a causal loop diagram is developed to explain cause and effect between variables and to transform the causal loop diagram into the stock flow diagram.
- Formulation: to run the model, the stock flow diagram, which includes levels, rates, and auxiliary, are inputted the accurate equations. Stock shows the quantity of study factors while flows demonstrate factors that come in and out, changing the stock level. Subsequently, the formula is inputted to each variable and linked them.
- Testing: the aim of testing is to compare the simulated behaviour of the model to the actual behaviour of the system. This is the validation process, the process of evaluating model simulation to determine whether it is an acceptable representation of the real system. In this study, it was conducted using case studies from previous quantitative analyses. The public rental housing scheme was taken as a representative case study as the rent price was determined to be more appropriate than that of any other public rental housing. A model will be valid if the error rate for the comparison between the model and the case study is smaller than 5%.
- Policy formulation and evaluation: once valid model has been developed and has been tested through simulation and scenario, the valid model can be used to design and assess policies for advancement. Output of the model could be used as basis of the policy. Different policies must be considered, because the real systems are extremely fluctuated.

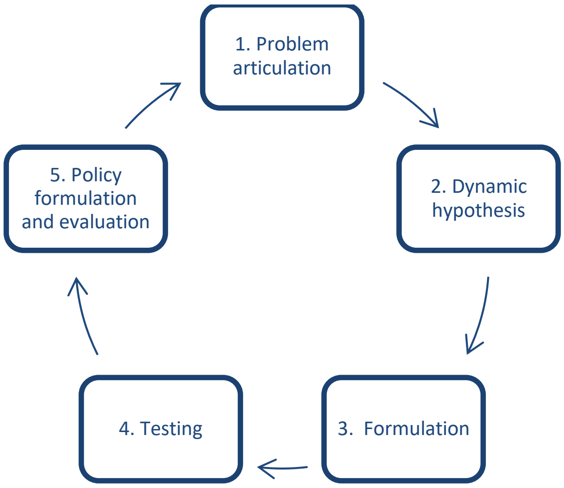
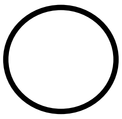


Figure 7.1 System dynamics modelling process

Table 7.1 Variables in System Dynamics

Variable	**Symbol**	**Description**
Level		A quantity that accumulates over time, changing its value by accumulating or integrating rates
Rate		Changes the values of levels
Auxiliary		Arises when the formulation of a level's influence on a rate involves one or more intermediate calculations, often useful in formulating complex rate equations, used for ease of communication and clarity

Source: Sterman (2000)

7.2 RESEARCH VARIABLES

The first step in developing the system dynamics model is to define the purpose of the model, which means consideration of the focus on a problem and shaping the model. The aim of this study was to develop a model for investment feasibility analysis for low-cost apartments. The second step involved defining the model's boundaries and identifying key variables to describe the behaviour of interest related to the purpose of the model. The third step was to create a causal loop and stock flow diagram to describe the system feedback loops.

Chapter 6 examined some economic parameters applied in this study, such as investment periods, inflation rates, tax rates, capital loans, and repayment periods.

Prior to investment feasibility analysis, affordability was checked to analyse whether a sales price is affordable for low-income buyers. In this model, key parameter would be the model variables as listed in Table 7.2. This sub-section of this chapter provides variables and data summary used for the input of the model.

Table 7.2 Research Variables

	Variables	**Sub variables**	**Source of data**
Income	Unit sales	Sales price	Developer
		Number of units	Developer
		Type of unit	Developer
		Service charge unit	Developer
	Shops	Leasable area	Developer
		Rentable area	Assumption/Analysis
		Lease fee	Developer
		Service charge commercial area	Developer
	Parking	Number of cars	Assumption/Analysis
		Number of motorcycles	Assumption/Analysis
		Car parking fee	
		Motorcycle parking fee	
Cost	Initial cost	Construction cost	
		Land rental	
	Capex	Elevator	Assumption/Analysis
		Escalator	Assumption/Analysis
		Electric generator	Assumption/Analysis
		Façade	Assumption/Analysis
	Operation expense	Electricity	Assumption/Analysis
		Water retribution	Assumption/Analysis
		Waste retribution	Assumption/Analysis
		Administrator salary	Assumption/Analysis
		Building maintenance	Assumption/Analysis
	Tax	Property tax	Assumption/Analysis
		Selling tax	Assumption/Analysis
		Income tax	Assumption/Analysis
	Depreciation		Assumption/Analysis
Expected return	Rate		Assumption/Analysis

7.3 PROBLEM ARTICULATION

The system dynamics model represents the relationships among factors influencing the financial cash flow in terms of both inflow and outflow. Furthermore, it was utilised to develop several scenarios for rental, ownership, and mixed low-cost apartments. The general process of discounted cash flow calculation is described below.

7.3.1 Determining cash outflow

The cost of low-cost apartment projects includes building construction cost, building operation and maintenance cost. The total cost was derived from the construction costs estimation. Operation costs refer to the regular (annual) expenses incurred in running low-cost apartment projects, such as water bills, electricity bills and wages, while maintenance costs include building repair and maintenance and also road access maintenance.

7.3.2 Determine Cash Inflow:

The revenue of low-cost rental apartments was determined by the residential and commercial area revenue. The revenue from a residential area was derived from unit sales, while revenue from a commercial area came from lease fees of shops and parking fees. The summary of variables and initial value is described in Table 7.3.

Table 7.3 Initial Value

	Variables	**Sub variables**	**Number**
Income	Unit sales	Sales price	Studio: 224,000,000 1 BR: 360,000,000 2 BR: 688,000,000 Subsidised unit: 306,000,000
		Number of units	Studio: 308 units 1 BR: 242 units 2 BR: 176 units Subsidised unit: 242 units
		Type of unit	Studio, 1 BR, 2 BR, subsidised unit
		Service charge unit	13000/sqm/month

	Shops	Leasable area	30460.95 sqm
		Rentable area	10661.33 sqm
		Lease fee	300,000/sqm/month
		Service charge commercial area	120,000/sqm/month
	Parking	Number of cars	208 cars
		Number of motorcycles	682 motorcycles
		Car parking fee	150,000/car/month
		Motorcycle parking fee	50,000/motorcycles/month
Cost	Initial cost	Construction cost	434,365,000,000
		Land rental	215,000,000/year
	Capex	Elevator	
		Escalator	
		Electric generator	
		Façade	
	Operation expense	Electricity	16,157,741,501
		Water retribution	311,310,909
		Waste retribution	386,859,600
		Administrator salary	2,700,000,000
		Building maintenance	2,171,825,000
	Tax	Property tax	0.5%
		Selling tax	Subsidised unit: 1% Non-subsidy unit: 5%
		Income tax	21%
	Depreciation		
Expected return	Rate		12%

7.4 DYNAMIC HYPOTHESIS

Based on the variables identified above, it was possible during this phase to predict relationships between the factors influencing the financial cash flow in terms of both inflow and outflow. Income, cost, and expected returns influenced each other with their own variables, and the whole inter-relationship was described in causal loops and stock flow diagrams.

Based on the system dynamics modelling steps as defined by Sterman (2007), the stages of this modelling development were: 1) problem articulation, to determine the focus problem, identify variables in the models, and set time horizon and dynamics characteristics; 2) dynamic hypothesis, the time available to develop the causal loop diagram that clarifies causal relations among variables and then convert the causal loop diagram into the stock flow diagram; and 3) the following phase of formulation, when the system description was transcribed into levels, rates and auxiliary equations.

7.4.1 Causal Loop Diagram

A causal loop diagram is used to transform the structure of systems into the diagram. Therefore, the diagram will link variables in the system, which the relationship is denoted by arrow (Sterman, 2000). In this study, this causal loop diagram represented the relationship between revenue, operation cost and required return. In general, the causal loop diagram consisted of three main loops: net operating income and required rate of return – net operating income including two major loops, income, and operation expenses; net operating income and required return will then determine net cash flow, which is the indicator of investment feasibility. Figure 7.2 represents the causal loop diagram of investment feasibility analysis. Certain factors can affect the project income and expenses, associated with the residential area, both subsidised and non-subsidised units, and the commercial area.

The number of units in the residential area and the number of rentable areas played an important role in determining the project's income, as did the proportion of subsidised and non-subsidised units, which affected the income. The revenue from commercial areas such as shops and parking space also increased the income variable, which contributed to the increasing of the net operating income. However, operation expenses, capex, and construction costs decreased the net operating income variable.

As in the model in Chapter 6, the revenue from residential areas in public ownership housing was derived from sales of units and monthly service charges. Revenue from commercial areas in public rental housing and public ownership housing were similar, including shop leases, monthly service charges and monthly registered parking permits. In this model, the revenue was also broken down into revenue from subsidised units and non-subsidised units. It was also then classified based on types of units: studio, 1 BR, and 2 BR.

Meanwhile operating expenses were similar to the operating expenses for public housing, as described in Chapter 6, consisting of administration salaries, waste retribution, building maintenance, electricity, and capital expenditure. Selling cost and construction cost were included. However, the expenditures were categorised as routine expenditures, referred to as operation expenses and non-routine expenditure, such as construction costs and capex.

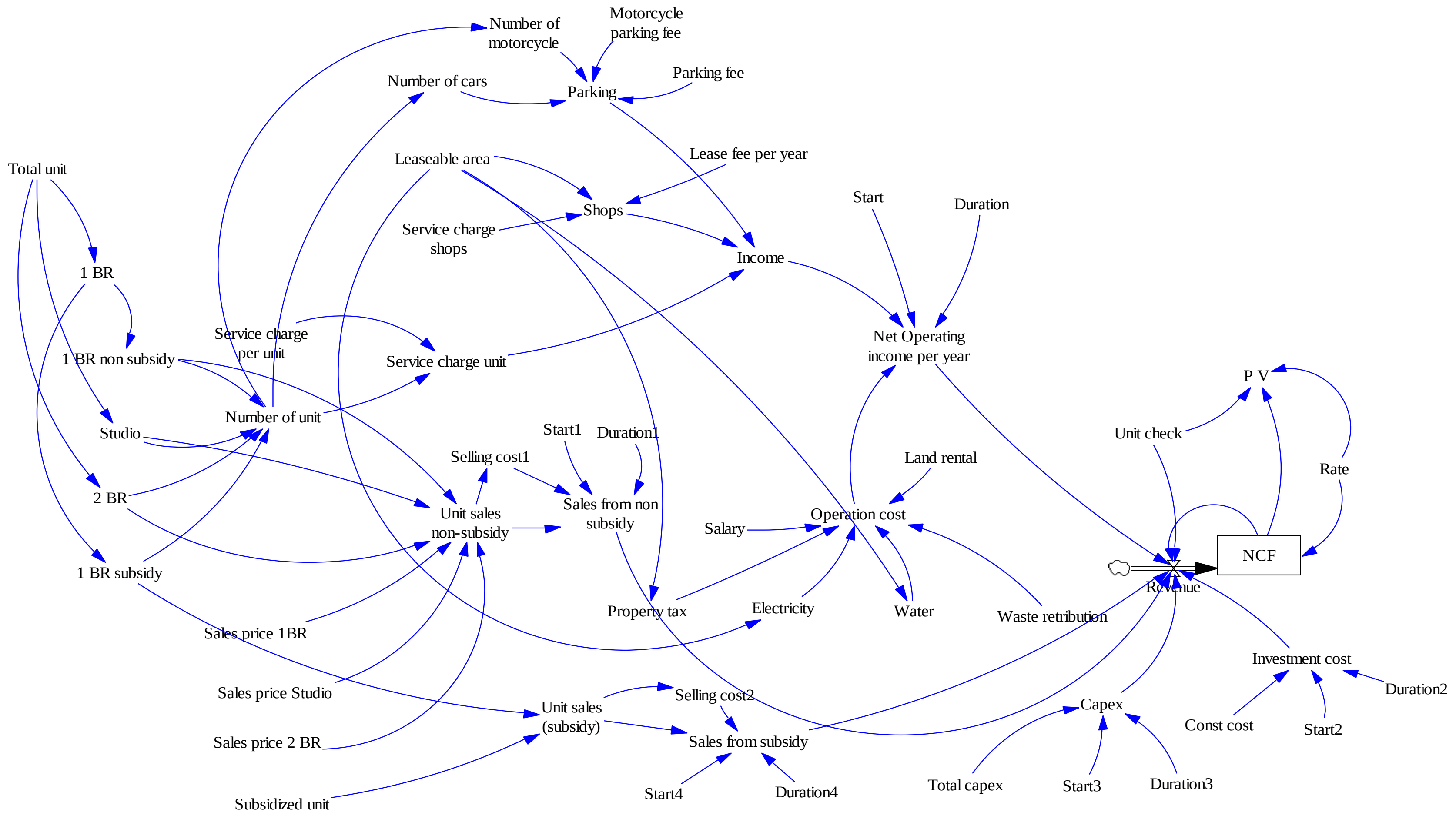


Figure 7.2 Causal loop diagram

7.4.2 Stock Flow Diagram

The stock flow diagram is the development of the causal loop diagram depicted in a diagram consisting of two types of variables, namely stock (level) and flow (rate) inside dynamic systems modelling. Stock flow diagram is more comprehensive than causal loop diagram, as causal loop diagrams only emphasise the feedback structure of the system. They need to be converted into a flow diagram, which is more detail in illustrating the physical structure of the model, to invite closer specific attention to the system structure (Lyneis, 2000).

In this model, the rate was used to describe the flow of variables, which were correlated one to another and terminated at this variable rate. The stock flow diagram was different to the causal loop diagram, which only described the links between variables, while the stock flow diagram not only described the links, but also made connections with any formulation. For this reason, some variables were moved, as they had their own time horizon. For example, subsidised units had a sales schedule for two years, from years three to four, while non-subsidised units were scheduled for sale from years 1 to 4. The sales schedule affected the seller's tax, which was part of the selling cost. Therefore, the selling cost was attached to unit sales, both subsidised and non-subsidised sales.

7.4.3 Net cash flow variable

Net cash flow was built to respond to gently accelerating sales from non-subsidy and subsidy net operating income.

Net Operating income per year= PULSE (Start, Duration)*(Income-Operation cost)

NCF= INTEG (Revenue-(Revenue/(1+Rate)); Initial Value= 0 (IDR)

Revenue = (Net Operating income per year + Sales from non-subsidy+Sales from subsidy-Capex-Investment cost) – (NCF/Unit check) (IDR)

The net cash flow rate was influenced by net cash flow and rate.

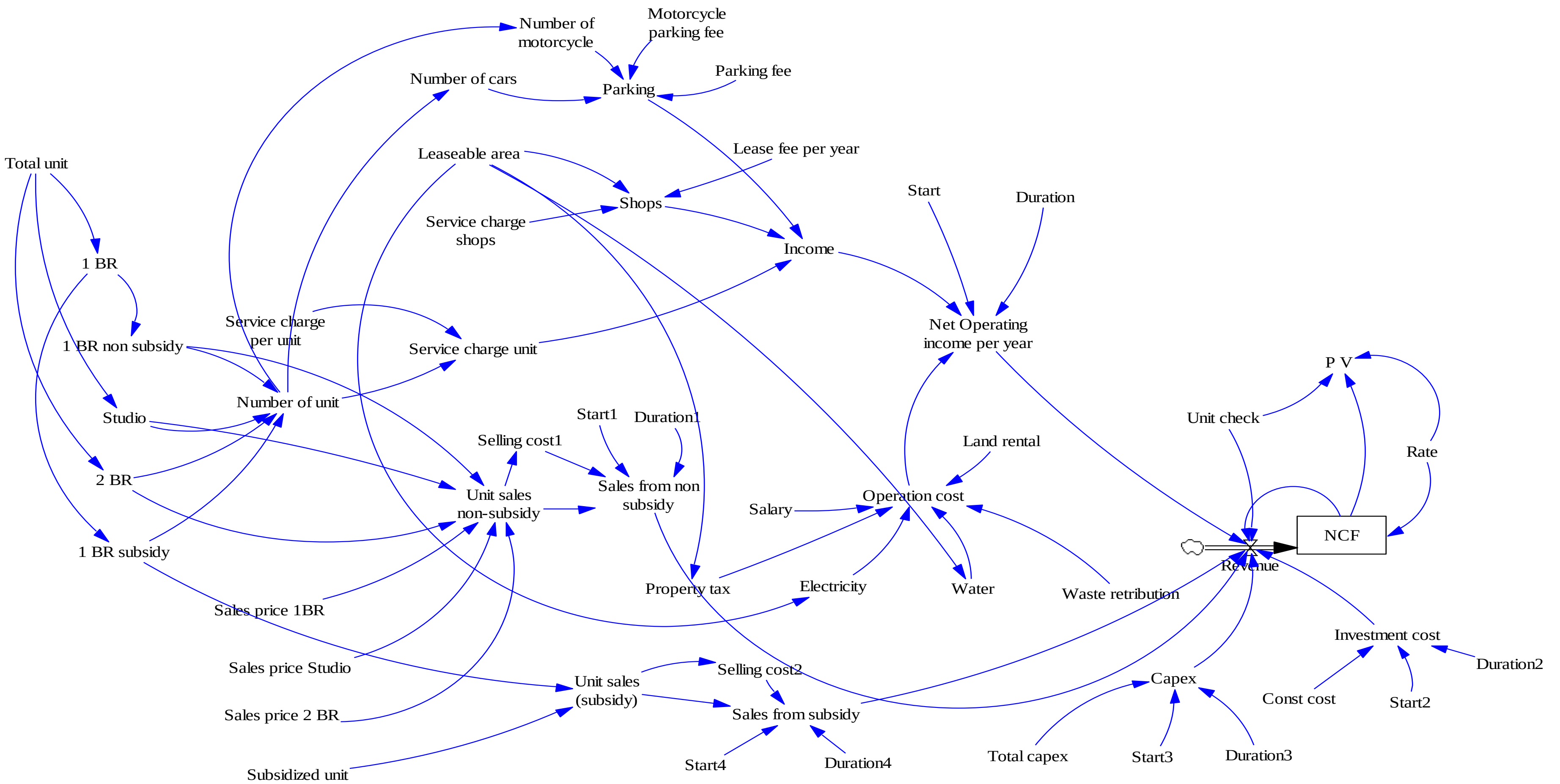


Figure 7.3 Stock flow diagram

7.5 INPUT FORMULA

Unit sales non-subsidy = (("1 BR non subsidy"*Sales price 1BR)+("2 BR"*Sales price 2 BR)+(Studio*Sales price Studio)) (IDR) (1)

Sales price 2BR= 688.000.000 (IDR) (2)

Sales price Studio = 224.000.000 (IDR) (3)

Sales price 1BR= 360.000.000(IDR) (4)

Sales from non-subsidy = PULSE (Start1, Duration1)*("Unit sales non-subsidy"-Selling cost1)*0.25 (5)

Selling cost 1= "Unit sales non-subsidy"*0.025 (6)

Start 1= 1 (year) (7)

Duration1= 1(year) (8)

Number of unit= "1 BR non subsidy"+"1 BR subsidy"+"2 BR"+Studio (9)

1 BR= 0.4*Total unit (10)

1 BR subsidy = 0.6*"1 BR" (Dmnl) (11)

1 BR non subsidy = 0.5*"1 BR" (Dmnl) (12)

2BR= 0.2*Total unit (Dmnl) (13)

Studio= 0.3*Total unit (Dmnl) (14)

Total unit= 968 (Dmnl) (15)

Unit sales (subsidy) = (Subsidised unit*"1 BR subsidy") (16)

Subsidised unit= 306.000.000 (IDR) (17)

Selling cost 2= "Unit sales (subsidy)"*0.01 (18)

Sales from subsidy = PULSE (Start4, Duration4)*("Unit sales (subsidy)"-Selling cost2)*0.5 (IDR) (19)

Start4 = 3 (year) (20)

Duration = 2 (year) (21)

Income= Shops+Service charge unit+Parking (IDR) (22)

Service charge unit = Number of unit * Service charge per unit*12 (IDR) (23)

Service charge per unit = 400000 (IDR) (24)

Shops = (Lease fee per year*Leasable area) + (Service charge shops*Leasable area) (IDR) (25)

Leasable area = 30461(sqm) (26)

Lease fee per year = 300000*12 (IDR) (27)

Service charge commercial area = 120000*12 (IDR) (28)

Parking= (Motorcycle parking fee*Number of motorcycles)+(Parking fee

*Number of cars)*12 (IDR) (29)

Number of cars = 0.5*Number of unit (30)

Number of motorcycles = 0.2*Number of unit (31)

Car parking fee = 200000 (IDR) (32)

Motorcycle parking fee = 100000 (IDR) (33)

Capex= PULSE TRAIN (Start3, Duration3, 3 , 15)*Total capex (34)

Total capex = 936.500.000 (IDR) (35)

Start3 = 5 (year) (36)

Duration3 = 1 (year) (37)

Elevator

Escalator

Electric generator

Façade

Operation cost= Electricity+Property tax+Salary+Waste retribution+Water

+Land rental (IDR) (38)

Electricity = Leasable area*1020*332 (IDR) (39)

Water retribution = Leasable area*0.01*8000*365 (IDR) (40)

Waste retribution= 580.800.000 (IDR) (41)

Salary = 580.800.000 (IDR) (42)

Land rental = 215.000.000 (IDR) (43)

Building maintenance

Tax

Property tax = ((Leasable area*4e+06*0.2)-8e+07)*0.005 (44)

Selling tax

Income tax

Depreciation

PV= (NCF*(1/Rate))*Unit check (IDR) (45)

NCF= INTEG (Revenue-(Revenue/(1+Rate))); Initial Value= 0 (IDR) (46)

Revenue = (Net Operating income per year+Sales from non-subsidy+Sales from subsidy-Capex-Investment cost)-(NCF/Unit check) (IDR) (47)

Rate= 0.1 (48)

Net Operating income per year= PULSE (Start, Duration)* (Income-Operation cost) (IDR) (49)

Start= 1 (year) (50)

Duration= 20 (year) (51)

Investment cost = PULSE (Start2, Duration2)*Const cost*0.33 (52)

Const cost = 434.365.000.000 (IDR) (53)

Start2 = 0(year) (54)

Duration2 = 3 (year) (55)

7.6 RUNNING BASE MODEL

Base model run results are needed to train system behaviour during the time horizon of simulation (Suryani et al., 2010). In this research, the time horizon was set for 20 years for the base model, starting from 2021 to 2041. The time horizon setting refers to the investment period. Running the base model began by model checking to make sure that the relationships between the variables in the model were valid.

The net operating income was influenced by revenue and by operating expenses. Figure 7.4 shows the diagram of each variable that influenced net operating income and net cash flow (NCF).

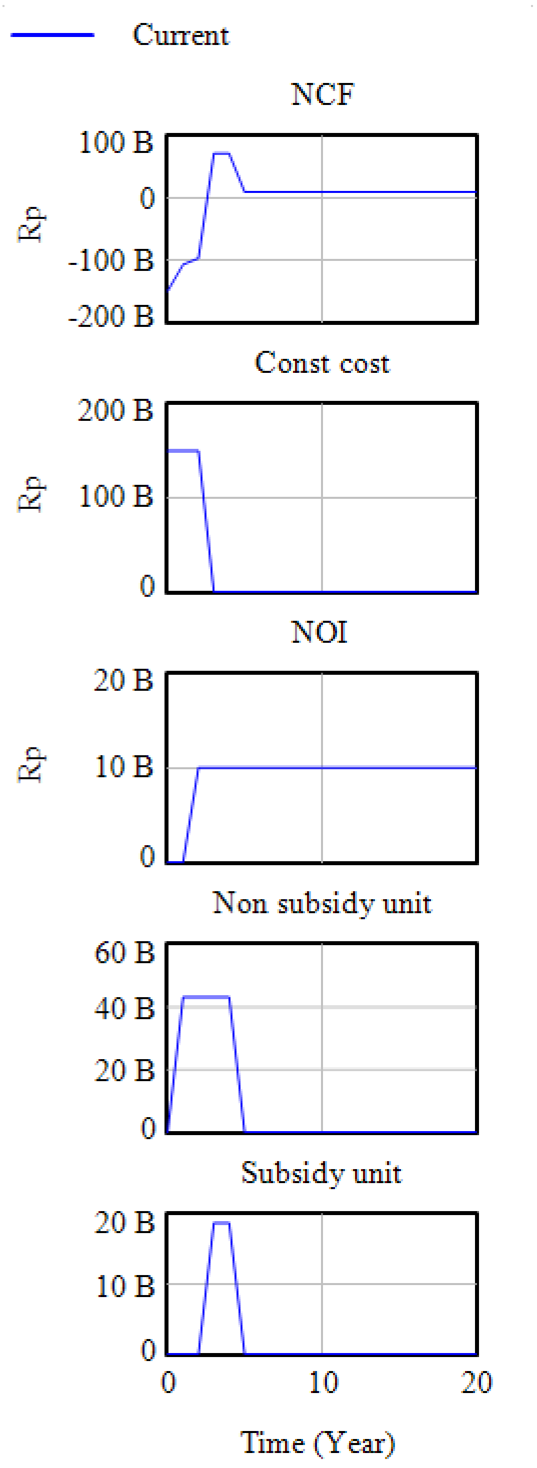


Figure 7.4 Output of running the base model

A strip graph was generated that showed the workbench variable (inventory) at the top, and all of the variables that directly caused the inventory to change below (production and sales). The two runs were the same, so the graph lines lie on top of one another. In this study, net cash flow (NCF) was generated by construction cost, net operating income, subsidy units and non-subsidy units. From Figure 7.4 it is evident that unit subsidy only occurred in years three and four, while non-subsidy occurred in years one to four. Years 5 to 20 had a regular net operating income derived from the operation of the building.

7.7 MODEL VALIDATION

The model validation phase is important as it ensures the accuracy and the performance of the base model based on past data (Lyneis, 2000). The process involves comparison of the output of the model simulation with historical data, although in this study, the output was compared with the previous calculation using Microsoft Excel (Chapter 6). According to Sterman (2000), validation model is indicated by error rate, which should be smaller than 5%, In the formula, S represents the average of the simulation result and A represents the average of the historical data.

Furthermore, in this study, sales from non-subsidised units, sales from subsidised units, and operation expenses were selected to check the model validity based on the consideration that sales and operation expenses are key parameters in the cash flow.

$$Error\ rate = \frac{|\bar{S} - \bar{A}|}{\bar{A}}$$

$$\bar{S} = \frac{1}{N}\sum_{i=1}^{N} S_i$$

$$\bar{A} = \frac{1}{N}\sum_{i=1}^{N} A_i$$

a. Sales from non-subsidy units:

   Average data = 66181.5 million

   Average simulation output = 65311 million

   Error rate = $\frac{65311-66181.5}{66181.5}$= 1.32%

b. Sales from subsidy units

   Average data = 36655.7 million

   Average simulation output = 37026 million

Error rate = $\frac{37026-36655.7}{36655.7}$= 1%

c. Operation cost

Average data = 14482 million

Average simulation output = 15002 million

Error rate = $\frac{15002-14482}{14482}$= 3.59%

According to the above results, the error rate was smaller than 5%, showing that the model is valid.

7.8 MODEL SCENARIO

A scenario is an approach that develops a set of predicted condition in the future (Lyneis, 2000). Basically, there are two types of scenarios: parameter and structure. According to the scenario employed in chapter 6, the structure scenario would be categorised as optimistic and pessimistic scenario. Some alternative scenarios were retrieved from a valid model by changing some feedback loops and adding new parameters. Meanwhile parameter scenario is applied by increasing or decreasing the value of the parameter to see the impact on output. In this study, parameter scenario was employed to support sensitivity analysis, while structure scenario was used to support scenario analysis. The scenario block diagram is given in Figure 7.5. The time horizon of the scenario model was set for 20 years based on planned investment period. This time span was used to provide comprehensive investment feasibility analysis that would have an impact on the outputs and policy formulation.

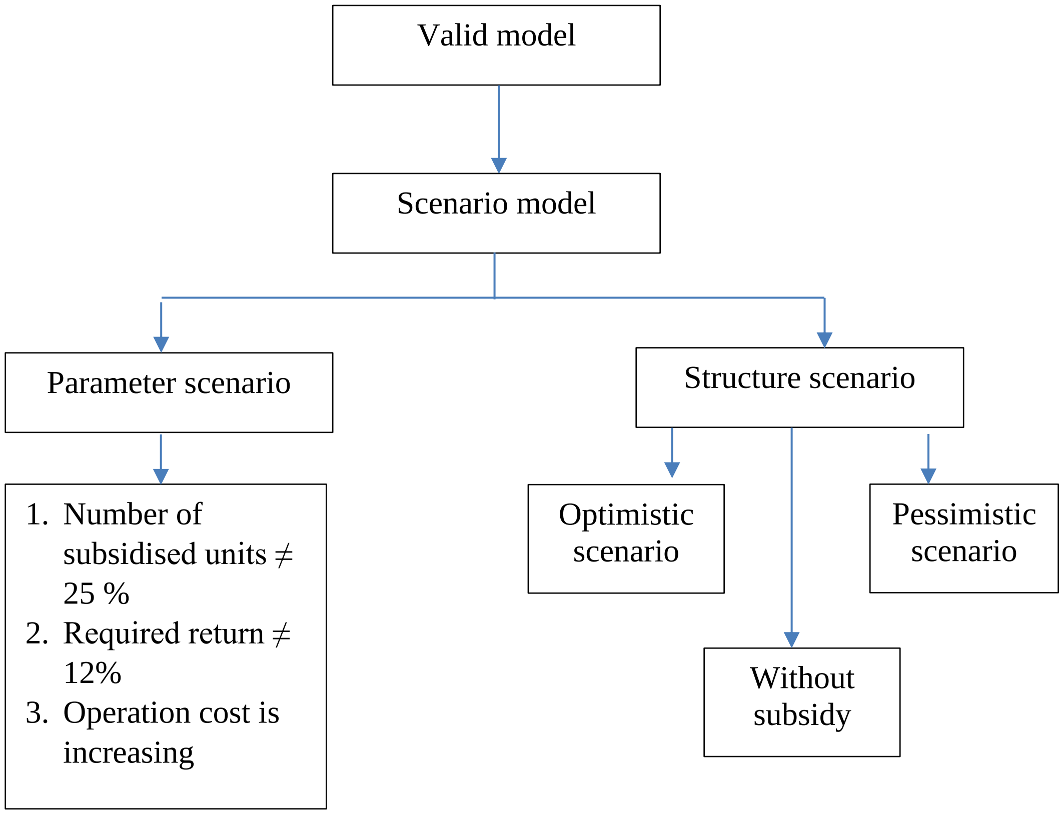


Figure 7.5 Model scenarios

7.8.1 Parameter scenario (sensitivity analysis)

In investment analysis, the parameter scenario is termed sensitivity analysis The aim of sensitivity analysis was to calculate what-if of the change of key variables as a result of changes in other variables through simulation. This is a means of predicting the outcome of a decision given a certain range of variables. This study examined the following changes of parameter, which is presented in Figure 7.6 to 7.9:

- Number of subsidised units
- Increase in operation cost

Number of subsidised units

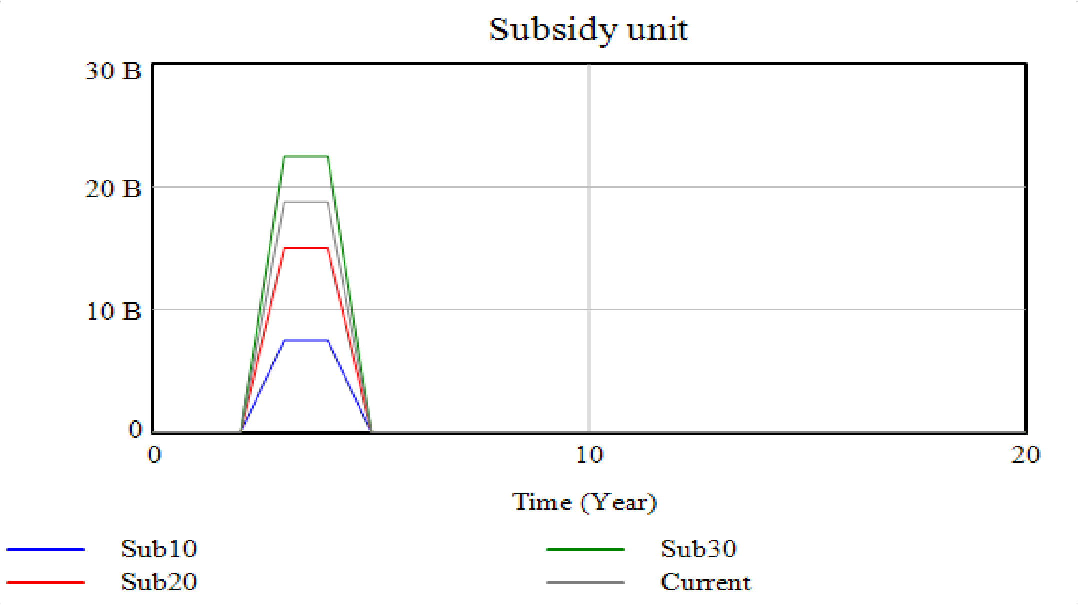


Figure 7.6 Revenue changes due to number of subsidised unit changes

Note: Sub 10 = Number of subsidised units = 10% of total units

Sub 20 = Number of subsidised units = 20% of total units

Sub 30 = Number of subsidised units = 30% of total units

Current = Number of subsidised units = 25% of total units

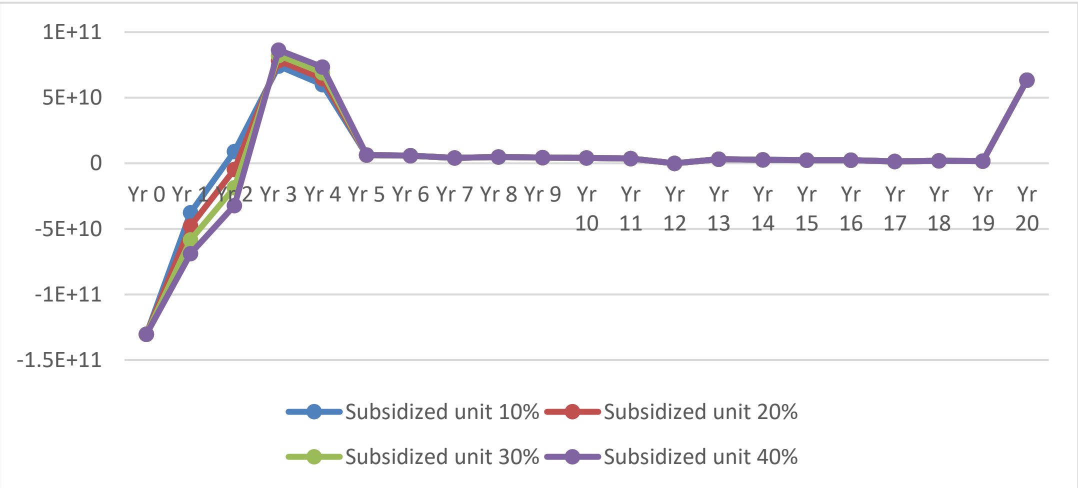


Figure 7.7 Net cash flow changes due to number of subsidised unit changes

Increase in operation costs

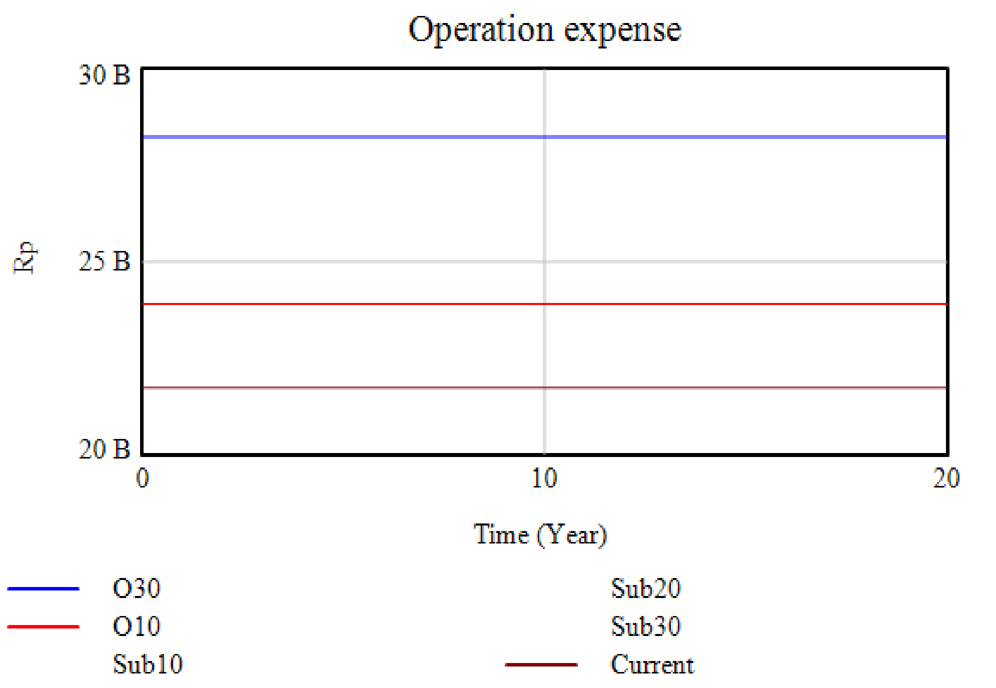


Figure 7.8 Operation cost changes due to the increasing of operation cost

Note: 030: Operation cost increased 30%; O10: Operation cost increased 10%

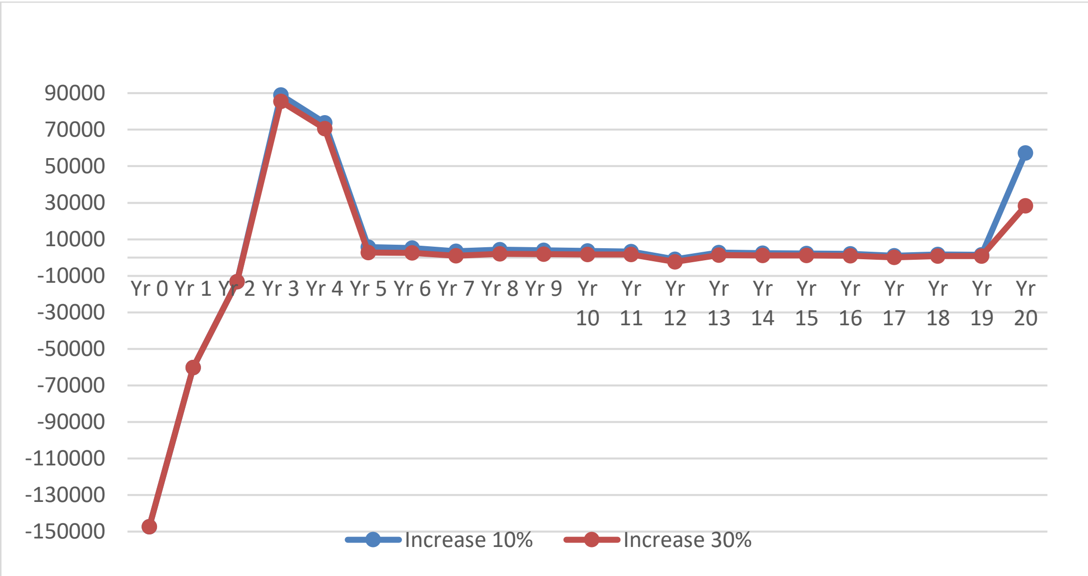


Figure 7.9 The net cash flow changes due to the increasing of operation cost

As seen from Figures 7.6–7.9, small changes in input values could affect the outcome of the analysis significantly. Sensitivity analysis in this model showed the changes through net cash flow.

7.8.2 Structure Scenario

In order to support structure scenario, optimistic and pessimistic scenarios were developed to predict the condition changing in the future. There are three scenarios as listed in Table 7.4, namely base scenario, optimistic scenario, and pessimistic scenario.

Table 7.4 Investment scenario

Scenario name	Base	Optimistic	Pessimistic
Probability of scenario	50%	25%	25%
Inputs:			
Unit sales year 1	Non-subsidised unit: 35%	Non-subsidised unit: 50%	Non-subsidised unit: 40%
Unit sales year 2	Non-subsidised unit: 40%	Non-subsidised unit: 40%	Non-subsidised unit: 15%
Unit sales year 3	Subsidised unit: 50% Non-subsidised unit: 15%	Subsidised unit: 50% Non-subsidised unit: 10%	Subsidised unit: 40% Non-subsidised unit: 15%
Unit sales year 4	Subsidised unit: 50% Non-subsidised unit: 10%	Subsidised unit: 50%	Subsidised unit: 40% Non-subsidised unit: 15%
Unit sales year 5			Subsidised unit: 20% Non-subsidised unit: 15%
Price escalation	Studio: 30% 1 BR: 30% 2 BR: 30%	Studio: 60% 1 BR: 50% 2 BR: 50%	Studio: 40% 1 BR: 20% 2 BR: 20%
Vacancy on commercial area (shops)	30%	20%	40%
Required return	12%	12%	10%
Repayment period of capital loan	3 years	3 years	5 years
Outputs:			
NPV	11904.3 million	62058.66 million	-29196 million
IRR	14.34%	35.84%	5.12%
Maximum number of subsidised units	30%	50%	-

The scenario grew by considering optimistic and pessimistic conditions. Structure scenario was applied by changing some variables as scenario changing. The comparison of net cash flow of three scenarios is presented in Figure 7.10 and 7.11.

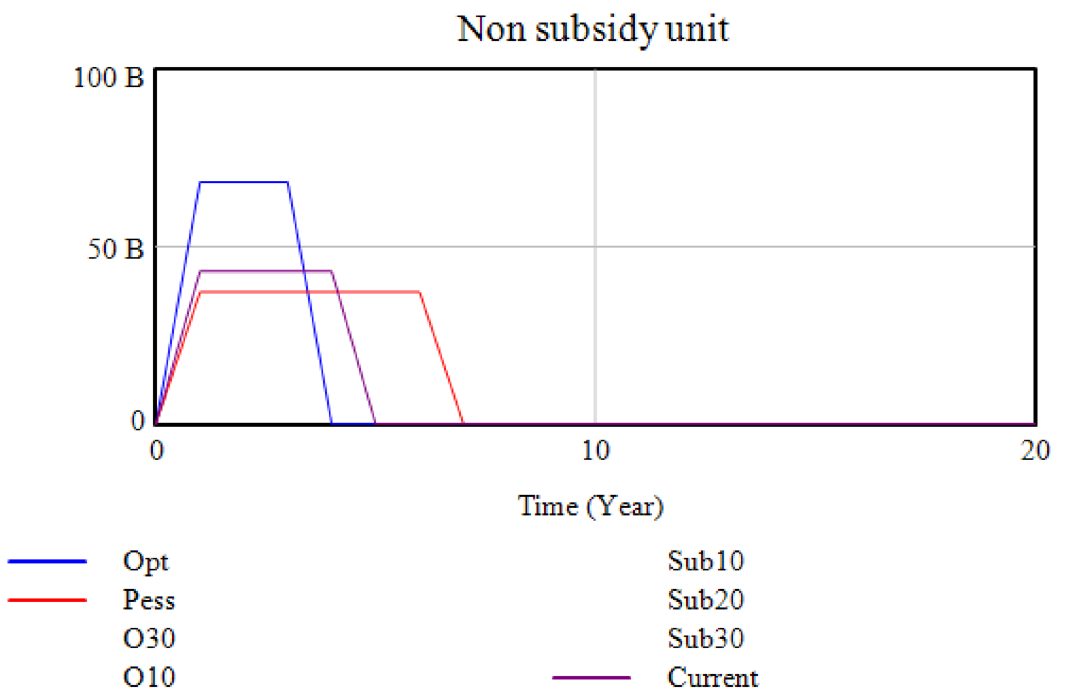


Figure 7.10 The revenue from non-subsidised unit changes based on most likely, optimistic, and pessimistic scenarios

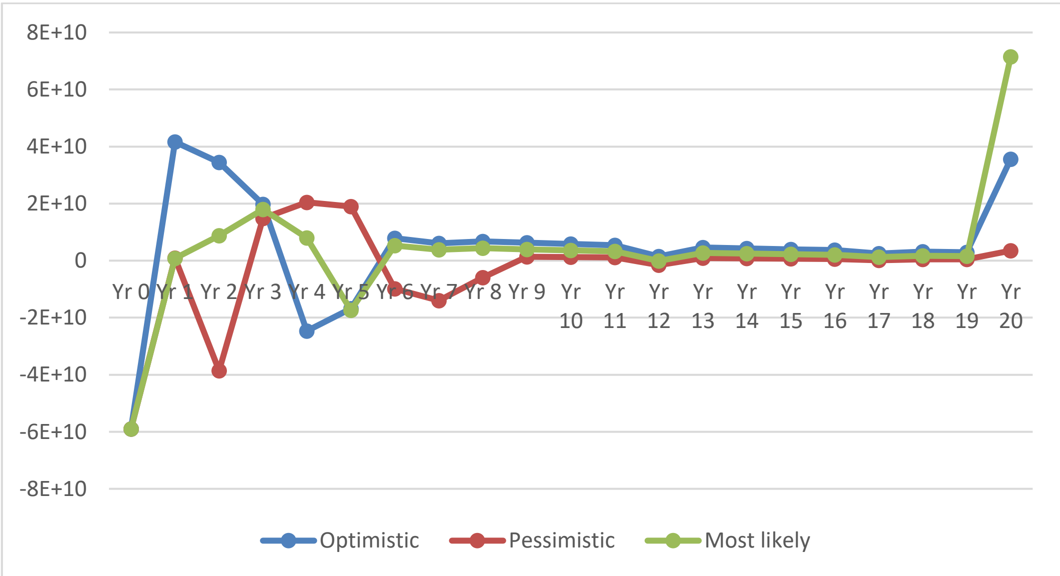


Figure 7.11 The net cash flow based on most likely, optimistic, and pessimistic scenarios

In pessimistic scenario, the economic conditions are at their worst, units were expected to be sold over five years. In Figure 7.11, the pessimistic scenario was symbolised by the red line. It shows that the cash flow is still high in year 5, which was longer than in other scenarios. The escalation price at which the developer sells the low-cost apartment units was also lower than most likely to adjust the condition in an effort to boost sales. However, based on data from the Indonesian Real Estate Association (2020), the sales of subsidised units remain constant as the government continues to subsidise low-income buyers. Furthermore, the market of first-home buyers is not influenced by the bad economic conditions. Therefore, price escalation varies between studios and 1 BR, and 2 BR apartments. The sales schedule of non-subsidised houses is longer than expected.

7.9 POLICY FORMULATION AND EVALUATION

Similar to the suggestion made in Chapter 6, government and housing developers should pay more attention to the most sensitive variables, which are the number of subsidised units and operation costs. There is a need for innovation in terms of finding ways to reduce operation costs. Government subsidy could be considered, as some units in public housing are occupied by low-income communities. There is a case for finding ways to manage these costs more effectively through five possible approaches, namely maintenance standards, budget constraints, controlling improper use of property, energy costs, and policy itself (Li et al., 2016).

Regarding the proportion of subsidised units, if the housing developer allocates more than 30% of all units as subsidised units, the feasibility project analysis will show the project to be not feasible, which will be indicated by a decrease in net cash flow. However, subsidised units can be combined with other types of units.

7.10 CHAPTER SUMMARY

This chapter aimed to develop a dynamic simulation model for investment analysis. The model supports the discussion in Chapter 6, which was calculated using Microsoft Excel. The model was built using the system dynamics model, which was used to determine investment feasibility analysis, drawing a causal loop diagram of influencing factors to develop a simulation model using system dynamics, and verifying the model by means of a case study. The case study used the public housing project discussed in Chapter 6. Scenario analysis was also generated after base model development and validation. Secondary data were gathered from the government and private developers, as discussed in Chapter 4.

In this study, the parameters included expenses, costs, initial investments and required rates of return. The model development began with a causal loop diagram, which described the relationship among factors. Subsequently, a stock flow diagram was developed using formulation.

Model validation was conducted using the case study in Chapter 6. According to the results, the error rate was 3.59%, which was smaller than 5%, showing that the model is valid. The sensitivity analysis was conducted as a part of parameter scenario analysis. The parameter scenario was applied to measure the change in the number of subsidised units and increases in operating costs.

Structure scenario analysis was applied in the scheme of optimistic and pessimistic scenarios and developed to predict future demand. The scenario grew by considering optimistic and pessimistic conditions. Similar to Chapter 6, the investment scenario was related to the sales schedule, number of subsidised units, and price escalation. Regarding the proportion of subsidised units, if the housing developer allocates more than 30% of all units as subsidised units, the feasibility project analysis will show the project to be unfeasible.

Chapter 8: Discussion and Conclusions

8.1 INTRODUCTION

Depending on the housing backlog, additional supplies of public housing may be offered by government or non-government sectors. However, in this study, public housing projects that receive government subsidies were evaluated to ensure viable financial models for developers and affordability for home buyers. Previous studies have provided evidence that housing finance is a major barrier for low-income communities. Consequently, this study identified the need for research related to public housing projects to ensure that projects are both viable for developers and affordable for homebuyers.

The main aim of this research was to develop a financial model around the two elements of affordability and project feasibility. Three main research questions were proposed to achieve the research aim. These questions centred upon the following aims:

1. The development of a financial model for public rental housing.
2. The development of a financial model for low-cost apartments (home ownership).
3. The development of a financial model for public housing development using system dynamics to depict and analyse changes in investment variables.

8.2 KEY FINDINGS

The clear establishment of research objectives guided the achievement of this research aim, which progressed and concluded according to the sequence of the study's objectives. The investment feasibility model, which employed a case study, illustrated financial calculation with government support in the form of subsidy. The research questions and aims of the research were addressed and accomplished, and a summary is provided below.

8.2.1 Findings related to the first research question

RQ1: How to develop a financial model for public rental housing?

The study aimed to develop a comprehensive financial model that not only considered the feasibility of projects for the developer but was also based on tenants' affordability and government subsidies. In developing a financial model for public rental housing, this chapter combined results from several steps. As previously mentioned in Chapter 5, based on the factors influencing rent price, which were determined through the tenants' survey, the findings show that most respondents selected the factors of willingness to pay, ability to pay, government subsidy, household income, location and running cost as those influencing public rental housing. Three additional factors: willingness to pay, ability to pay, and government subsidy were added to the previously identified factors influencing rent prices of mainstream commercial properties, factors such as location and accessibility, size and age, and property attributes. These factors were the calculation basis for the rent price determination described in Figure 5.2. The ability to pay and the willingness to pay factors were used to determine rent price using income-based and market-based methods, respectively; while running cost was used to determine rent price for cost-based approach.

The housing cost-to-income ratio was used to measure tenants' affordability through their willingness and ability to pay public housing rent prices. It shows the affordability gap between rent price determination approaches. From Figure 5.7 it is evident that the housing cost-to-income ratios in all cities were rising in the market-based price conditions. For tenants in all cities the ratio would be worse if they decided to rent a house.

Tenants' affordability profiles were addressed via the tenants' survey, which used monthly expenses as a proxy to calculate actual household income. Tenants' ability to pay was calculated by the affordability measurement, that is, 30% of household income. The findings showed that compared to current rent prices, tenants' ability was higher than current rent prices, as summarised in Table 5.4 and Figure 5.4. Meanwhile, tenants' willingness to pay was measured in two ways: actual rent price and substitute dwelling data. The willingness to pay adopted a substitute dwelling assumption as there was no comparable market with public rental housing. This study used two alternative substitute dwellings, assumed as alternative dwellings before tenants stayed in public rental housing: boarding houses and rental houses.

This study proposed the use of three rent price determination approaches: income-based, cost-based, and market-based, as existing rent price determination approaches did not integrate market rent, a cost approach, and tenants' affordability. Most existing rent price determination approaches have been income-based, and in this study, this was found to be very low, therefore it could not cover the cost of housing, which includes building operation and maintenance cost. Meanwhile, if the rent price was determined using a cost-based approach, not all low-income communities were able to pay. Private market rent was very high, and it was not affordable for low-income communities. The most suitable approach was indicated by housing cost-to-income ratio, with the 30% rule, where the housing cost should be less than 30% of household income. The maximum cost-based approach is ideally used to determine low-cost apartment rent prices, as the low-cost apartment operator will have sufficient resources from rent revenue to meet the operation and maintenance costs. Income-based approach was used as affordability indicator. Discounted market-based prices can also be applied in the boarding house scheme.

The aim of the analysis was to examine public rental housing feasibility using three rent prices inputted based on three rent price determination approaches (income-based, cost-based, and market-based). In order to raise housing supply, the government needs to assist both in supply and demand side. New demand side government subsidies for tenants who cannot afford the 30% of minimum wage income standard, for example: relocated tenants, is required. This subsidy provides a government guarantee regarding the minimum income received by developer. A public rental mixed-use housing project that offers affordable rent for tenants does not meet housing developers' required rate of return. Receiving a reduction in upfront cost (land rental did not purchase) and cross subsidy from commercial area was found to be insufficient to meet the viability of a project without government assistance. However, if the government extends the subsidy for partial building construction, such as infrastructure utility, the investment would be more attractive.

8.2.2 Findings related to the second research question

RQ2: How to develop a financial model for low-cost apartments?

The project aimed to develop a comprehensive financial model to include tenants' affordability when buying their first home, but also to consider developers' viability. To address this research question, semi-structured interviews were conducted with 18 participants from the public and semi-private housing development sector. The aim of the interviews was to identify key aspects and issues underlying public housing rental and ownership schemes. Four theme clusters emerged from the data collected from the interviews that reflected critical aspects of public housing development: land provision, design and construction, housing financing, and partnership schemes. Related to land provision, most participants suggested that public housing should be built on government asset land as the land price accounts for 15% of total housing cost. Another recommendation was about utilising land banking owned by semi-private companies. Design and construction of public rental housing should focus on minimising operational and maintenance costs, as the rent price cannot be determined high. In contrast, design and construction for public ownership housing should be planned to maximise revenue and to adjust the capped selling price, which is determined by the government.

In this study, in terms of mixed-housing projects, there were two types of units: subsidised and non-subsidised. The proportion of subsidised and non-subsidised units should be determined proportionally and enable the semi-private developer to make a profit. If all units are set as subsidised units, the project will not be feasible; it must be mixed use, subsidised and non-subsidised. However, the findings showed that the Indonesian Government needs to consider the most suitable schemes from various perspectives, such as financial and legal. Three possible schemes are mixed-income, mixed-tenure, and mixed-use. Each scheme has advantages and disadvantages. However, there are legal constraints related to rights of land. The most difficult part in initiating public and private collaboration is tenure when it relates to a government asset. Mixed housing, which is rental and ownership, is impossible. However, if required, land could be rented privately to reduce the selling price because land acquisition is more expensive. The most likely scheme would be a long lease (building rights title).

According to data collected from the semi-structured interviews, participants considered transit-oriented developments (TODs) as a suitable approach to resolving location selection for new urban designs. These developments provide suitable transport options and are integrated with transportation planning and transportation features to allow tenants to travel to their workplaces easily and cheaply. This requires the housing developer to build close to railway stations. Participants from the private sector and the ministry suggested that the issue of high land prices could be overcome by using under-utilised state-owned company land or land banking. Land could also be rented from private concerns to reduce the sales price, as buying land is more expensive. These findings offer empirical evidence regarding the potential financial viability and affordability of mixed-income housing as an innovation to address the housing backlog in Indonesia.

Subsequently, the financial model was developed with integration of three stakeholders (housing developer, government, and home buyers). The existing financial calculation was partial, as the government subsidy program and developer calculation did not match and did not consider tenants' affordability. The targeted market for low-cost apartment home buyers is low-income communities who have higher income than public rental housing tenants. Home buyers who receive a government subsidy on their down payment or interest rate for a home ownership credit are able to buy a studio (non-subsidised price) or 1-bedroom unit (subsidised price). Home buyers' affordability was measured by their ability to pay the monthly home ownership loan, which should be less than the affordability measurement, that is, 30% of household income.

Low-cost apartments are not viable without government involvement. Subsidised home buyers should be assisted through some forms of government subsidy, such as subsidy on down payment and interest rate, as described in Table 6.5 to 6.8, which is applied to make sure that the capped selling price is affordable for low-income buyers. Meanwhile, a supply side government subsidy is providing land, especially in major cities, where the land prices are high, and land availability is scarce. The government subsidy on land is more effective form than any other government subsidy. The government does not need to extent any other subsidies to meet project viability. However, low-cost apartment model should be mixed use and mixed-income housing as standalone project would not be viable. Mixed use consists of commercial and residential, where commercial area is expected for cross subsidy.

8.2.3 Findings related to the third research question

RQ3: How can system dynamics be used to develop an investment feasibility model for public housing development?

This study extended the use of system dynamics simulation for investment financial analysis. A case study of a low-cost apartment was used for validation, which evidenced how system dynamics are used to depict and analyse changes in investment variables and to assist policy formulation. The developed causal loop diagrams are a novel contribution as they provided feedback loops for low-cost apartment investment. The system dynamics simulation is a mathematical realisation of the developed interrelationship among system variables, which involved three stakeholders: the government, housing developers, and home buyers.

System dynamics is an advanced approach to developing an investment feasibility model. Sales income and project costs followed the calculation presented in Chapter 6. Using system dynamics, the simulation model easily and quickly calculated the variation range of changed variables, such as the number of subsidised and non-subsidised units and increasing operational and maintenance costs.

The model also produced the results of the scenario changing, as outlined in Chapter 6. The simulation and scenario results can be used to analyse the financial feasibility of the project as well as changed variable and to show the impact or behaviour on the project cash flow of the changing system.

8.3 RESEARCH CONTRIBUTION

Alajami (2020) listed different kinds of research originality, including originality of topic, problem-selecting, methods, and findings. This section demonstrates such originality and justifies the contribution of the research from two different perspectives: theoretical and policy. The contribution of this research project is significant in the context of public rental housing due to the ongoing need for and the important role of housing finance.

8.3.1 Theoretical Contribution

1. The original contribution of this study is the integration of multi-stakeholders' decisions into the financial model for public housing. In order to achieve public housing viability, this study determined the most suitable rent price determination approach for certain level of tenants' income, a form of government subsidy for tenants/home buyers and housing developers, and realistic return for public housing developer.

2. This study proposed the use of public rent determination approaches that consider tenants' affordability and building quality using income-based and cost-based approach. The income-based approach uses household income

and ability as the basis for calculation, while the cost-based approach uses public rental housing operation and maintenance costs. These approaches can help governments and housing providers to determine rent prices that are affordable for low-income tenants where the price can cover the operational and maintenance costs of public rental housing to maintain the building's condition

3. This study also proposed the use of substitute dwellings on the submarket of discounted market-based approach, as there is no comparable market for public housing.

4. This study extends the use of system dynamics for investment financial analysis. It demonstrates how system dynamics can be used to depict and analyse changes in investment variables.

8.3.2 Contribution to Public Housing Practice

This research makes three contributions relevant to public housing practice, where the main output is to raise public housing supply, especially from the non-government side. First, the research proposed three rent price determination approaches that accommodate tenants' income and operation and maintenance costs. These three approaches will also satisfy tenant affordability. If public rental housing is only occupied by one type of tenant, then the categorisation can be organised using the income-based approach. The tenants will pay up to 30% of their income to meet the cost of housing which able to cover both, operational and maintenance costs. It means that if that cost of housing is higher than the tenants' ability to pay (more than 30% of income), the government will need to help management to cover the maintenance costs. Meanwhile, if operational and maintenance cost has been covered, the tenants will not be charged higher.

Furthermore, if the rent price is determined based on operational and maintenance costs, government subsidies can be arranged in this scheme in the form of availability payments or subsidies on operation and maintenance costs, as mentioned in the previous section. This recommendation is directed especially at local governments, as they primarily manage public rental housing. Meanwhile, a discounted market-based price will be feasible for investors, although tenants could not afford this. In this circumstance, the government would need to subsidise gaps to achieve an affordable level and discounted market rents. For this reason, there needs to be initial categorisation at the beginning of a tenancy. This study also studied financial feasibility based on three rent prices as an input. The result showed how government subsidies influence the net present value, which indicated project feasibility. Government subsidies will raise NPV, which is attractive to housing providers.

Secondly, this study examined the effectiveness of the government subsidies and forms of subsidies on low-cost apartments and public rental housing from demand and supply side. The basic principle is more private sector's involvement, less government subsidy will be. However, there should be an effort to attract private sector to invest in public housing project. Supply side government subsidies on low-cost apartment were land and tax deduction, while subsidies on public rental housing were land and part of construction, such as public utilities. Demand side subsidies were capped price, lower home ownership interest rate, and down payment.

Due to high land costs, the government needs to subsidise land provision from government's asset land or semi-private companies' asset land for public housing to reduce housing prices. In addition, some incentives could be granted for housing developers if they provide subsidised units. Meanwhile the government also needs to subsidise home buyers in the form of a discounted market price and other government subsidy schemes, such as those relating to down payments or interest rates. System dynamics simulation can also be used to assist decision making related to investment feasibility analysis, as the investment feasibility analysis in this study identified the most sensitive variables and showed the financial analysis results in pessimistic, most likely, and optimistic scenarios. Housing providers or housing developers could potentially pay more attention to these variables.

In public rental housing, the affordability criteria determine tenants' income and the most suitable rent price determination approach; while in low-cost apartments, the minimum income is required to match the housing price. Efficient government subsidies have been evaluated to attract private investment and to be allocated to tenants and home buyers who have an income below the affordability criteria.

Finally, system dynamics simulation could be adopted to develop public housing financial model. This method can describe the relationship (cause and effect) of the variables and quickly simulate the change of variables throughout the project.

8.3.3 Contribution to Public Housing Policy

This research formulates several suggestions for policy makers, where the main output is to raise public housing supply. Firstly, there should be tenants' classification based on their income (segmentation) by providing identified quantitative evidence of tenants' ability and willingness to pay and of home buyers' affordability. This information could inform future housing finance policy.

Secondly, the research proposed the evaluation of rent price determination approaches to accommodate tenants' affordability and building operation and maintenance costs. Income-based and cost-based approaches can be used interchangeably. These approaches also accommodate special case tenants, such as relocated communities. Housing policies may vary. The rent price should be capped price by the regulation, which is estimated using the real cost. Local and ministry governments then pay the gap between the tenants' ability to pay and the required price. Governments need to provide grant subsidies to tenants who have income below the affordability benchmark. Another important issue given the model proposes mixed-housing strategy, is that there should be segmented tenants who will occupy low-cost and commercial unit (low and middle income) based on their ability to pay.

Thirdly, this study examined the effectiveness of the government subsidies and forms of subsidies on low-cost apartments and public rental housing from the demand and supply side. Subsidies on land provision are mandatory, as land prices in urban areas are rising and land is becoming scarce. Therefore, land provision from the government could help to accelerate public housing programs. Land provision can utilise the land owned by semi-private companies. This study suggests the benefits of a land use policy for mixed-housing development using a TOD concept for both government and housing providers. This concept accommodates the needs of low-income communities to live close to a mass transportation facility to reduce their transportation costs.

8.4 RESEARCH LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This research, however, is subject to several limitations, which could be addressed in future studies. These are outlined below:

1. Data collection for semi-structured interviews could be expanded to include private housing developers as they are potential key players in low-cost apartment development. Data collection from the housing providers' survey could be extended to include this group and also other areas. Given the diversity of stakeholders to the provision of public housing across Indonesia, there are possible opportunities to build upon and improve this study by comparing practices in more area and more housing developers.
2. To a larger extent, the findings of this study could be adapted and applied to public housing development in rental and ownership scheme, for both, the relocated community and regular tenants in other countries both developed and developing countries
3. This study employed system dynamics to develop an investment feasibility analysis for home ownership. The model has witnessed that system dynamics can show dynamic behaviour of feasibility analysis through scenario planning. Given its benefit, the model can be applied in the further research, which would be used to analyse rental schemes, including revenue and expenditures.

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Appendices

Appendix A: Financial Model for Public Housing

QUT	PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT -INTERVIEW-
Multi-financial Modelling Framework for Public Housing QUT Ethics Approval Number 1900000284	

RESEARCH TEAM

Principal Researcher	Farida Rachmawati	PhD student School of Economics and Finance Faculty of Business and Law Queensland University of Technology (QUT) Email: farida.rahmawati@hdr.qut.edu.au
Associate Researchers	A/Prof Connie Susilawati Prof Ashantha Goonetilleke	Principal Supervisor Associate Supervisor

DESCRIPTION

This research aims to identify the key aspects and issues underlying the low-cost apartment rent and selling price determination. This information will be utilised to build a financial model for low-cost apartment.

Stakeholders:

The stakeholders are classified in two different groups:

1. Government: ministry, province and local
2. Non-government: state-owned company, private developer, affiliations

Confidentiality:

We respect your privacy and to ensure confidentiality, respondents' contact details will be kept strictly confidential. The outcome of these interviews will be analysed and published as part of my final thesis.

PARTICIPATION

Voluntary participation and time:

Your participation is voluntary. At this stage, the interview time is expected to be approximately 30 – 60 minutes.

RISKS

There are no major risks beyond normal day-to-day living associated with your participation in this project.

PRIVACY AND CONFIDENTIALITY

All comments and responses will be treated confidentially unless required by law. Any data collected as part of this project will be stored securely as per QUT's Management of research data policy. Anonymity and confidentiality of your response will be kept. Please note that non-identifiable data from this project may be used as comparative data in future projects.

QUESTIONS/FURTHER INFORMATION ABOUT THE PROJECT

If you have any questions or need further information please contact me (see above detail) or my Principal Supervisor Dr. Connie Susilawati on c.susilawati@qut.edu.au

CONCERNS/COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT

QUT is committed to research integrity and the ethical conduct of research projects. However, if you have any concerns or complaints about the ethical conduct of this research, you should contact the Research Ethics Advisory Team on +61 7 3138 5123 or email humanethics@qut.edu.au. The QUT Research Ethics Advisory Team is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Interview Participant Consent Form

I have read and understood the above information. I agree to participate in the interview.

Name: ________________________ Signature: ________________________

Date: _______

Position: ______________________ Organisation/Group: ______________________

SEMI STRUCTURED INTERVIEW CONTEXT

The very low rental price in the existing low-cost rental apartment in Indonesia becomes the obstacle for private sector to justify financial return for them to deliver low-cost apartment development project. The project is not profitable since the low-cost apartment is aimed to low-income community so that the selling and rental price are kept low. However, the rent determination for low cost rental apartment should cover at least the real operation and maintenance cost. In addition, the rent and selling price should consider the tenants' ability and willingness to pay.

1. Personal Information

    Please give me some basic information on:

    c. Your position in the organization
    d. Your personal interest
    e. Responsibility in low-cost apartments
    f. Professional interests
    g. Vision for future
2. Housing finance policy
    a. How will you evaluate current public sector efforts and practices for low-cost housing? (Mainly the strength and weaknesses if any. Your evaluation could relate to but not limited poverty alleviation, access to low-cost apartment, affordability etc.)
    b. Do you think that real estate developers can participate in low-cost apartment supply? To what extent they may involve (you may choose one or more):
        1. Land provision
        2. Building provision
        3. Low-cost apartment management
        4. Finance provide
        5. Others..
    c. What is your proposed policy regarding finance
    d. From your perspective, what are the most significant challenge of the low-cost apartment initiation and development, particularly in finance aspect
    e. From your perspective, what should be improved for these housing finance policy, so that low-income community is able to access the housing finance system:
        - Down payment of low-cost ownership apartment
        - Government subsidy for land and interest rate of loan
        - Mortgage loan
    f. From your perspective, what are the most suitable government subsidy in low-cost apartment management?
        1. Electricity in public area
        2. Water
        3. Land provision
        4. Others……………………….

g. What incentives could you nominate to attract more stakeholders (including your organisation) to become involved in the low-cost apartment development?

3. Low-cost apartment management
   From your perspective, should the low-cost apartment be classified into different segmentation?
   - Tenant's income
   - Type of tenure
   - Type of rent
4. Low-cost apartment rent price determination
   a. Technical

	Influence	Not Influence
Household income		
Location		
Neighbourhoods		
Total urban population		
Urban economy		
Urban amenities		
Demographic factors		
Mortgage features		
Government policy		
Household living standards		
Supply and demand		
Housing cost (land, cost recovery and construction cost)		
Architectural elements		
Neighbourhood features		
Indoor facilities		

Appendix B: Financial Model for Public Housing

QUT	PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT -INTERVIEW-
Multi-financial Modelling Framework for Public Housing QUT Ethics Approval Number 1900000284	

RESEARCH TEAM

Principal Researcher	Farida Rachmawati	PhD student School of Economics and Finance Faculty of Business and Law Queensland University of Technology (QUT) Email: farida.rahmawati@hdr.qut.edu.au
Associate Researchers	A/Prof Connie Susilawati Prof Ashantha Goonetilleke	Principal Supervisor Associate Supervisor

DESCRIPTION

This research aims to identify the key aspects and issues underlying the low-cost apartment rent and selling price determination. This information will be utilised to build a financial model for low-cost apartment.

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Interview Participant Consent Form

I have read and understood the above information. I agree to participate in the interview.

Name: ____________________Signature: ___________________Date: _______

Position:____________________Organisation/Group:______________________

QUESTIONNAIRE CONTEXT

Housing costs are defined as the sum of rent payments; rate payments (water and general); and mortgage or unsecured loan payments (if the initial purpose of the loan was primarily to buy, add, or alter the dwelling).

Tenant’s information:

Name	
Age	
Occupation	
Number of family members	

Household cost

Expenses	Cost
Daily needs	
Housing cost	
Education	
Bills	
Transportation	
Health	
Clothing	
Telecommunication	

Housing Preference

a. In which location would you prefer to live? (Please rank 1 to 4)

Location	Rank
Urban area	
Outer suburbs	
Close to industrial area	
Rural village	

b. In which housing type would you prefer to live? (Please rank 1 to 3)

Location	Rank
High rise apartment	
Detached housing in housing complex	
Detached housing (self-help housing)	

c. If you do not live in the low-cost apartment, where would you prefer to live?

Location	Rank
Boarding house	
Rent a house	
Self-help housing	

d. Would you consider living as a permanent renter as opposed to being a property owner?

Yes

No