Statistical Analysis

Role of AVM in Reducing Systemic Risk in HDB Resale Property Market and Achieving HDB Stability Objectives

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Summary

In March 2014, Housing and Development Board (HDB) enacted rules to strengthen the long-term stability of its resale property market and prevent future asset bubbles.

As part of this effort, HDB has implemented steps to create a market of transparent pricing and rigorous mortgage valuations and underwriting.

This study uses statistical analysis of past HDB valuations to make the case for using Automated Valuation Model (AVM) in strengthening the long-term stability of the resale market and preventing future asset bubbles.

This study will show that AVMs have the veracity to provide accurate, timely, relevant, objective, neutral, measurable and documented valuations for price negotiation, mortgage underwriting, and market governance.

As a result, an AVM is a powerful and inexpensive tool to reduce Systemic risk in its resale property market and achieve HDB stability objectives.

Background

In March 2014, HDB changed its rules for buying and selling HDB resale flats.

According to [Ministry of National Development (MND)](#) website, the rules implemented include:

1. Only buyers or their salesperson can request a valuation from the HDB Panel of Valuers after the seller has granted them an Option to Purchase (OTP).

   In accordance with MAS', HDB's and CPF Board's requirements, only the valuation conducted by *a valuer from the HDB's panel* can be used by resale flat buyers to obtain a housing loan or use their CPF monies to pay for the flat purchase.

2. The Option period will be extended from 14 calendar days to 21 calendar days, to allow buyers *more time to get a valuation* during this period.

3. HDB will publish prices of *resale transactions daily*, instead of fortnightly, as soon as they are registered. This will enable buyers and sellers to reference to the latest information during price negotiations.

Previously, "most sellers would request a valuation (either from HDB or private) and use it as a base to negotiate with prospective buyers. This (was) done ahead of granting an OTP".

According to MND, HDB changed the rules in order to achieve the following objectives:

1. Encourage resale flat buyers and sellers to negotiate based on recent transaction prices;

2. Reduce the focus on Cash-Over-Valuation (COV) in negotiations;

3. Restore the original intent of valuation, which is to help buyers obtain a housing loan (from HDB or a bank) or use CPF savings to pay for their flat purchase; and

4. Improve the long-term stability of the resale market.

In other words, HDB has set goals for transparent pricing and rigorous mortgage underwriting with the ultimate objective of preventing an asset bubble from forming and destabilizing the financial system.

Central Question

By definition, an asset bubble is when the prices of an asset (i.e., homes) rise so sharply and at such a sustained rate that they exceed valuations justified by fundamentals, making a sudden collapse likely - at which point the bubble "bursts", wreaking havoc on the financial system at large.

Therefore, in order for HDB to achieve its goals, the market must be able to price and value resale flats efficiently, accurately, and at minimal cost (in order to ensure maximum adoption).

Central Question for this case study is what is the best valuation method[1] - an Automated Valuation Model (AVM) or a Panel of Valuers or both – for HDB to achieve its goals and prevent another asset bubble?

Ideal Prerequisites

Before using statistical analysis to assess the best valuation method for accomplishing HDB stability goals, it is helpful to discuss the *ideal* prerequisites that must be in place for "buyers and sellers to negotiate based on recent transaction prices" and a rigorous mortgage underwriting.

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[1] This paper uses the classic definition of "method", meaning a particular procedure for accomplishing or approaching something, especially a Systemic or established one. "Valuation Method" refers to the procedures and components (i.e., data, software applications, valuers, etc.) that, collectively, go into performing a property valuation. This definition is not to be confused with "approaches to value" (i.e., Sales Comparison Approach, Income Approach, Cost Approach, etc.). For the purposes of this case study, "method" includes Sales Comparison Approach, but it also includes a framework for checklists, field inspection software applications, computer-generated values, performance measurement, and valuer interaction with information, technology, and market participants. In other words, "method" encompasses all aspects of determining the value of a home for the purposes of price negotiations, mortgage underwriting, and other forms of risk analysis.

Prior to Big Data technology, some of these *ideal* prerequisites were not possible. Now, however, information and software applications have made it possible to achieve these ideals so they are worth spelling out.

Prerequisites to negotiate purchase price based on recent transaction prices.

HDB introduced daily resale transaction data on its website and changed the methodologies to its price indices in an effort to provide market participants with more transparency in which to negotiate an HDB resale transaction. These two actions are important prerequisites to achieving its goals.

While these actions are clearly a step in the right direction, they, by themselves, do not tackle all the risks in the market that can lead to asset bubbles and market instability. While these two steps in transparency are critical, they do not provide a mechanism that helps untrained or unsuspecting market participants employ transaction data in a way that guards against error, omission, and conflicts-of-interest.

In order to guard against these risks, the ideal solution is to adopt a pricing mechanism that incorporates data and methods that meet the following criteria:

1. Relevant. Characteristics of the recent transactions should match the unit under negotiation. They should be similar in size, floor, view, property type, etc. There should be a documented and unimpeachable method (i.e., methodology, data collection, built-in checks-and-balances, etc.) for adjusting variations;

2. Timely. Data should reflect the latest transaction data. If the unit comparables are insufficiently timely, there should be a documented and unimpeachable methodology for incorporating price indices to make allowances for time disparities;

3. Consistent. Valuation should apply same method and corresponding relevant pricing data in every instance. Consistent methods, including data standards, facilitate fair and transparent negotiations. (Also, they provide mortgage underwriters and analysts with standardized big data sets for evaluating risk in various segments of the housing market.);

4. Objective. Neither data nor method for supporting comparable transactions should be susceptible to manipulation, distortion or omission;

5. Documented. An independent organization should be able to audit the data and methodology that went into presenting the transacted prices for negotiations;

6. Accessible. Pricing mechanism should be available to all market participants.

Standard and rigorous method and relevant, timely, consistent, objective, and documented transaction prices provide the veracity needed for any market participant, regardless of their training, to facilitate a fair negotiation and achieve a positive outcome between a willing buyer and willing seller.

Prerequisites for using a valuation to help buyers obtain a housing loan (from HDB or a bank) or use CPF savings to pay for their flat purchase.

Mortgage underwriters use valuations to assess their risk in lending to buyers. Specifically, underwriters analyze a home's market value, forced sale value, and building replacement costs. A transacted price is neither necessarily the market value of a home nor its forced sale value.

In order to use a valuation in underwriting, the underwriter must be confident in the integrity of the valuation method and opinions.

Underwriters are not usually present at field inspections. They do not participate in the construction of the valuation. It is difficult to measure the veracity of a human valuation in real-time unless the human valuation is benchmarked against an AVM.

As a result, heretofore, mortgage underwriters have relied on regulators and legal system to ensure the veracity of a human valuation.

In addition, banks, in particular, have established panels of valuers to distribute jobs to firms that promise to comply with guidelines and procedures. Implicit in this method is the concept of diversification[2] in an effort to guard against faulty valuations and reduce concentration risk.

While regulation and diversification have been effective, they come with significant costs in terms of efficiency, productivity, and monetary expenditures. Around the world, banks and other organizations use AVMs to benchmark valuation performance.[3] When there is a disparity between a specific valuation and the AVM, it does not necessarily mean either is wrong. What it means is that the valuer should justify the difference and the underwriter should assess the veracity of the difference from the perspective of risk. When it comes to portfolio management, an AVM is an outstanding tool for mark-to-market analysis and risk assessment.[4]

In other words, an AVM is an excellent tool for helping both the underwriter and regulator be more efficient and productive. And, the good news is that it can save significant money on infrastructure expenditures and consumer valuation costs.

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[2] Diversification is a risk management technique that varies its assignments to different, non-connected experts. In the case of a valuation panel, the rationale behind this technique contends that a panel constructed of different firms will, on average, yield an overall portfolio of valuations of greater veracity than if just one firm were to do all the valuations. The intent is to smooth out inconsistencies in performance from one firm to another firm as well as reduce concentration risk in which lopsided exposure to a particular counterparty could potentially lead to an unacceptable loss. Implicit in this risk management technique is the knowledge that the risk manager cannot control the results of the experts in the portfolio. Just like an investment manager cannot control the performance of a portfolio of stocks, a mortgage underwriter cannot control (without technology) the performance of the valuers on the panel.

[3] "Moving Automated Valuation Models Out of the Box: Global Geography of AVMs," Paul E. Bidanset, International Association of Assessing Officers (IAAO), July 2014.
[4] Royal Institution of Chartered Surveyors (RICS) Standards & Guidance: Automated Valuation Models (AVM), RICS, 2010.

Therefore, this case study submits that an important prerequisite for using valuations in mortgage underwriting and other forms of risk analysis include the ability to measure and monitor the veracity of valuations.

Prerequisites for improving the long-term stability of the market.

This case study asserts that the prerequisite for improving long-term stability of the market is the development of a pricing mechanism that facilitates fair and transparent real estate negotiations, standardized mortgage underwriting, and timely and robust market analysis for the purpose of regulation and policy-making.

Summary of Valuation Prerequisites

1. Pricing mechanism for negotiating a real estate transaction by untrained buyers and sellers;

2. Measureable, and thus accountable, valuations that will contribute to a more rigorous mortgage underwriting process.

Possible Solutions for Establishing a Pricing Mechanism[5] and Providing a More Rigorous Underwriting Process

There are currently three possible solutions in Singapore for establishing a pricing mechanism while, at the same time, ensuring more rigorous mortgage underwriting:

1. One firm from HDB Panel of Valuers conducts valuation before negotiations while a second firm conducts an independent valuation for the purpose of mortgage underwriting;

2. Automated Valuation Model (AVM) provides valuation to establish listing price for negotiation and for mortgage underwriting;

3. AVM-Assisted Panel of Valuers provides valuation to establish listing price for negotiation and the same valuation is used for Mortgage Underwriting.

In the following section, this case study analyzes the performance of HDB Panel of Valuers and SRX Property's X-Value, the market's leading AVM. The intent of this statistical analysis is to determine the veracity of each method and, thus, assess which possible solution is the most efficient, productive and cost effective.

Statistical Analysis of Possible Solutions

This study is based on HDB valuations conducted between September 2011 and December 2016. It separates the valuations into two groups: (a). Prior to March 2014 Rule Change and (b). Since March 2014 Rule Change.

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[5] This paper uses "pricing mechanism" as an interchangeable noun for a "method that facilitates price discovery and negotiations based on recent transaction prices ".

Prior to the March 2104 Rule Change, HDB rules stipulated that HDB valuations be done before price negotiation. Since the change, it requires HDB valuations be done after price negotiation.

Study Methodology

This study simply reports raw data collected from estate agencies, HDB, and other government sources. Graphs in this paper are straight-forward representations of underlying data.

Upon request, SRX Property is happy to open its database to appropriate authorities for inspection and audit.

In addition, SRX Property has provided both its HDB and private property databases to an independent research team at National University of Singapore (NUS) that is studying the veracity and uses of AVM.

Formulas. This study uses the following formulas[6]:

TOX = Transaction-over-X_Value = Transacted Price – X_Value Price

TOV = Transaction-over-Valuation = Transacted Price – Valuation price

This study applies the following measurements:

Statistical mean. This measures the extent to which valuations in the study align with Sales Comparison Approach[7].

We expect a sample of valuations to approach zero if they reflect relevant, comparable transactions. Whether the mean is negative or positive is insignificant as long as it is near zero.

Standard Deviation. This measures the extent to which the market is over-paying or under-paying valuations based on Sales Comparison Approach.

Since property markets do not have a definitive pricing mechanism and, thus, negotiations are part of a real estate transaction[8], we expect transacted prices to deviate from valuations in many cases.

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[6] X-Value Price is the AVM price. TOV uses the same definition as COV but for purposes of this study, it is more specific to use the term *Transaction* rather than *Cash*.

[7] Sales Comparison Approach compares recently sold, similar properties to the subject property. Price adjustments are made for differences in the comparable and subject property. The sales comparison approach is the foundation for the real estate professional's Comparative Market Analysis (CMA).

[8] Utility function (i.e., a ranking of usefulness) of a property varies from individual. As a result, a buyer and seller may or may not agree that a fundamental pricing mechanism (i.e., AVM, full valuation, auction, etc.) represents the value home in their minds. As a result, they must negotiate to arrive at an agreed purchase price.

However, given the large number of transactions in this study and the law of large numbers[9], we expect to see a normal distribution curve[10].

In real estate, width of the normal distribution curve (or its standard deviation) at various time intervals reflects the state of the market. The smaller the standard deviation, the more the market is trading close to its mean. Several factors influence standard deviation, including market trends, Cooling Measures, and pricing signals from pricing mechanisms.

As a result, standard deviation will change as factors influencing negotiations change. For example, during Cooling Measures we would expect to see a different standard deviation because the measures change the dynamics of real estate negotiations. Under normal conditions, negotiations consider pricing signals based on Sales Comparison Approach and market trends. Cooling Measures introduce two more considerations: stamp duty taxes and financing requirements. These considerations alter supply and demand and, thus, change the dynamics of negotiation.

Proportion of Valuations Matching Transacted Prices. This measures the percentage of valuations that match actual purchase prices. In real estate, since negotiation determines transaction price[11], we expect this number to be small.

In cases where the negotiation considers a valuation, there is still a Goodwill[12] component, which can be positive or negative or zero. It is rare in any type of negotiated deal, whether it is the buying and selling of a business or a property, that there is not some factor, above and beyond the valuation, that goes into the final negotiated price between a willing buyer and a willing seller.

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[9] Law of Large Numbers is a principle of probability according to which the frequencies of events with the same likelihood of occurrence even out, given enough trials or instances. As the number of experiments increases, the actual ratio of outcomes will converge on the theoretical, or expected, ratio of outcomes.

[10] Normal distribution, also known as Gaussian or standard normal distribution, is the probability distribution that plots all of its values in a symmetrical fashion, and most of the results situate around the probability's mean. Values are equally likely to plot either above or below the mean.

[11] Utility function (i.e., a ranking of usefulness) of a property varies from individual. As a result, a buyer and seller may or may not agree that a fundamental pricing mechanism (i.e., AVM, full valuation, auction, etc.) represents the value home in their minds. As a result, they must negotiate to arrive at an agreed purchase price.

[12] Goodwill arises when a buyer acquires an existing property at a price that differs from the fundamental, fair market valuation. Goodwill is usually either zero or positive. However, it can be negative when seller is willing to sell below fair market value. Examples of positive Goodwill: buyer considers property unique, in comparison to comparables, and is willing to pay more; high demand for property in which offers from several buyers bid up price paid; market is hot and buyer fears he must overpay to secure property; relationship between buyer and seller is such that buyer pays Goodwill; buyer believes price will appreciate sufficiently and is willing to pay above valuation to capture future appreciation; buyer is ignorant of fundamental, fair market value or chooses to ignore it. Examples of negative Goodwill: market is slow and seller fears that he will not find another buyer and settles for price below valuation; buyer and seller anticipate depreciation or property will not exceed inflation and buyer pays below valuation; in hot market, seller wants to price property to sell quickly; property in need of repairs or renovation not captured in valuation; relationship between buyer and seller results in negative Goodwill; seller is ignorant of fundamental, fair market value, or chooses to ignore it.

In cases where the valuation comes after the agreed transaction price, a high proportion of valuations matching transaction raises a red flag as to why this is the case and warrants further investigation into the veracity of these valuations.

Database queries. SRX Property Business Intelligence analysts used the following database queries to create the graphs used in this study:

(1). Distribution diagram of TOX:

```
SELECT ID AS crunch_research_corporate_transaction_ID,
   FLOOR_LAND_AREA,
   CD_RESEARCH_SUBTYPE,
   TYPE_OF_SALE,
   TRANSACTED_PRICE,
   VALUATION,
   CRUNCH_RESEARCH_STREET_ID,
   CONTRACT_DATE,
   concat(YEAR(contract_date),'M',MONTH(contract_date)) AS MONTH_OF_TRANSACTION
FROM searchhouse.crunch_research_corporate_transaction where transaction_type='S' and
cobroke_ind='O' and cd_research_subtype<5 and valuation > 100000;

SELECT crunch_research_corporate_transaction_ID,
   X_VALUE AS X_Value,
   date(date_upd) as date_update
FROM  sve_xvalue_transaction where x_value>0;

SELECT LOOKUP_HDB_TOWN_ID,
   ID AS CRUNCH_RESEARCH_STREET_ID
FROM crunch_research_street;

SELECT ID AS LOOKUP_HDB_TOWN_ID,
   NAME AS HDB_TOWN
FROM lookup_hdb_town;
```

(2). Distribution diagram of TOV

```
select
ceil((transacted_price - valuation) / valuation * 100),
count(t.id)
from
crunch_research_corporate_transaction t
where
t.transaction_type=  's' and t.cobroke_ind = 'o' and t.cd_research_subtype < 5 and
t.valuation > 100000 and
t.contract_date between <start date> and <end date>
group by
ceil((transacted_price - valuation) / valuation * 100)
```
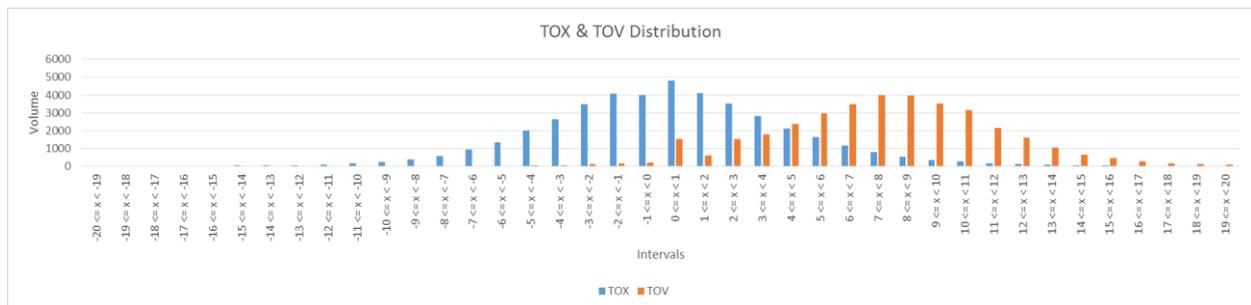
Statistical Results

Prior to 2014 HDB Rule Change.

TOX Sample Size[13] = 43,166
TOV Sample Size[14] = 36,684
Transaction period: September 2011 – February 2014

	Mean	**Standard Deviation**	**Proportion of Valuations Matching Transacted Prices**
TOX	0.4%	4.6%	1.9%
TOV	6.7%	4.4%	3.7%

Observations:

1. Both X-Value (TOX) and HDB Panel of Valuers (TOV) exhibit a normal distribution with similar Standard Deviations;

2. X-Value has Mean close to 0%;

3. HDB Panel has Mean of 6.7%;

4. Proportion of Valuations Matching Transacted Prices is low in both cases.   However, HDB Panel has a noticeably higher percentage.

After 2014 HDB Rule Change.

TOX Sample Size[15] = 44,497
TOV Sample Size[16] = 22,000

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[13] Sample size represents X-Value calculations for 98.0% of all HDB transactions during this period. There was insufficient data to conduct an X-Value on 2% of HDB transactions for this period.

[14] This sample size represents HDB Panel Valuations for 83.2% of all HDB transactions during this period. The other 16.8% of valuation data was unavailable to SRX Property.

[15] This sample size represents X-Value calculations for 97.7% of all HDB transactions during this period. There was insufficient data to conduct an X-Value on 2.3% of HDB transitions for this period.

Time period: April 2014 – December 2016
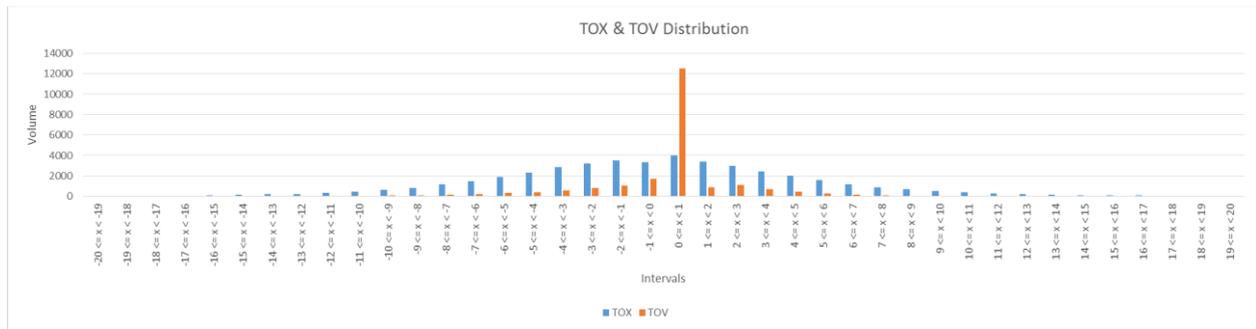
	Mean	Standard Deviation	Proportion of Valuations Matching Transaction Prices
TOX	0.4%	6.1%	1.0%
TOV	-0.6%	3.4%	48.4%

Observations:

1. X-Value (TOX) exhibits a normal distribution with and appropriate Standard Deviation;

2. HDB Panel of Valuers (TOV) valuations does not exhibit a normal distribution and its Standard Deviation raises some questions about its veracity;

3. Mean of both X-Value and HDB Panel approach zero;

4. Proportion of Valuations Matching Transaction Prices is in an acceptable range for X-Value;

5. In contrast, number of exact matching in HDB Panel valuations increased over 1,208%, from 3.7% prior to rule change to 48.4% after it.

Interpretation of Statistical Results

In both cases – prior and after HDB Rule change – AVM exhibits the characteristics of a robust valuation method. Its Means approach zero, indicating that valuations adhere to the Sales Comparison Approach and are reflective of properly-adjusted comparable transacted prices. It exhibits a normal distribution curve with a Standard Deviation representative of a negotiating market.

In contrast, data on HDB Panel raises red flags about the veracity of its valuation method.

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[16] This sample size represents HDB Panel Valuations for 48.3% of all HDB during this period. The other 51.7% of valuation data was unavailable to SRX Property due to fact that its members represent sellers in 75% of HDB transactions and buyers in 48.3% of the transactions. Under old HDB rules, sellers purchase valuations. Under new HDB rules, buyers purchase valuations. Regardless, the sample size is significantly sufficient to show the increasing trend in valuation equaling purchase price.

Prior to the HDB Rule change, HDB Panel correctly exhibits a normal distribution curve with a Standard Deviation reflecting a negotiating market. However, there are two red flags in the statistics.

First, HDB Panel has a Mean of 6.7%. This indicates that HDB Panel valuations are not adhering to Sales Comparison Approach and reflecting properly-adjusted comparable transacted prices. Buyers and sellers are negotiating based on valuations understating the value of the market. (Buyers and sellers recognized this and bid up prices above valuation. This behavior contributed to the high cash-over-valuation prior to HDB Rule Change.)

In other words, starting point for negotiation (i.e., HDB Panel valuations) is skewed since valuations are not reflecting Sales Comparison Approach and properly-adjusted comparable transacted prices.

Second, HDB Panel has a higher Proportion of Valuations Matching Transaction Prices than that of X-Value. In any comparison, variance at least raises the question: why? In this particular case, we know from empirical evidence that under the old rules, some HDB sellers opted to agree on the selling price with the buyer before calling for a valuation. This could one reason that explains the difference in matching statistics between HDB Panel and X-Value.

After HDB Rule Change, HDB Panel does not exhibit a normal distribution representative that is representative of a robust valuation method. While its Mean approaches zero, its Standard Deviation is not reflective of a proper negotiating market.

The reason for the distortion of HDB Panel's curve is obvious. 48.4% of its valuations match the corresponding transacted prices[17]. This should not occur because transacted prices are set by

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[17] There are three reasons a valuation can match transacted price. First, buyer and seller were privy to valuation and agreed that it was the price at which they were willing to transact. Second, coincidence. Third, valuer matched his or her opinion to the transacted price.

A risk in a valuer conducting a valuation after negotiation is that there is now a conflict-of-interest surrounding the valuation. All parties to a transaction want to close the deal. The buyer wants to finance his home and the seller, banker, lawyer, valuer, and insurer want to get paid. Furthermore, valuers on HDB Panel of Valuations make little money on a valuation job. In order to make a living they must earn income from other sources.

Average Valuer Income Estimate[17]

2016 Transactions (a)	$ Fee per Valuation (b)	2016 Total HDB Valuation $ Fee (c)	HDB Panel Firms (d)	$ Revenue per Firm (e)	Min. Required Licensed Valuers per Firm (f)	Annual Income per HDB Valuer (g)	Monthly $ Income per Valuer (h)
20,813	175	3,642,275	70	52,033	3	17,344	1,445

As the previous table shows, buyers paid approximately $3.6 million in HDB valuation fees in 2016.

There are 70 firms on HDB Panel of Valuers, which means the average annual revenue per firm was only $52,033.

HDB requires a panel firm to have at least three licenses valuers. This means the maximum average monthly income for an HDB valuer is $1,445, which is below a living wage.

negotiation and negotiation has a Goodwill (both positive and negative) that accounts for factors outside of Sales Comparison Approach and properly-adjusted comparables, including the utility function of each individual as described in footnotes eight and eleven.

Given Goodwill component of any negotiation, it would be incorrect for mortgage underwriters and risk analysts to conclude that just because a willing buyer agreed to pay price Z that price Z is the appropriate value to apply to mortgage underwriting and risk analysis.

The fact is that bad valuations can lead to bad risk analysis and mortgage underwriting, which, in turn, can contribute to asset bubbles and, thus, financial system instability.

Evaluation of Possible Solutions for Establishing a Pricing Mechanism while Most Rigorous Underwriting

Based on the above observations and interpretations of this paper's statistical comparison of HDB Panel and X-Value valuation methods, it is possible to compare and contrast the three possible solutions for achieving HDB stability objectives.

Evaluation of Options (i.e., Possible Solutions)

Option	Method	Pricing Mechanism for Real Estate Negotiations		Use of Method in Rigorous Underwriting		Long-Term Stability Ranking	
		Veracity[18]	Accessibility[19]	Veracity	Accessibility	Veracity	Accessibility
a	Panel	No	No	No	No	3	3
b	AVM	Yes	Yes	Yes	Yes	2	1
c	AVM + Panel	Yes	Yes	Yes	Yes	1	2

It is possible to express HDB's stability objectives in the following formula:

Income derived from HDB valuations in 2016 would sustain neither an HDB valuation firm nor a valuer by itself. This means that a firm and its valuers must earn income outside of HDB. As a result, HDB firms and valuations have the incentive to spend as little time on HDB valuations and maximize their focus on other income channels.

Clearly not all valuers and firms will succumb to the above temptations. However, a high Proportion of Valuations Matching Transacted Prices raises concerns about the ability of tPanel Method to control the integrity of its valuations on a large scale.

[18] An affirmative Veracity means that the valuation method exhibits the statistical characteristics of an accurate and robust valuation method. Namely, its Mean approaches zero, its normal distribution curve and Standard Deviation represent actual negotiation behaviour given existing market conditions, and its Proportion of Valuations Matching validates the operational integrity of the method.

[19] An affirmative Accessibility means that the valuation method is readily accessible to both trained/experienced and untrained/inexperienced users. "Readily accessibility" implies several qualities, including ease-of-use, ubiquity, speed of delivery, documentation, transparency, measurability, and built-in checks-and-balances

(Fair Real Estate Negotiations) + (Rigorous Underwriting) = Long-Term HDB Resale Market Stability

Since valuations play an important role in negotiations and underwriting, it is possible to rank the contribution the three options make in strengthening long-term HDB resale market stability.

As the statistical analysis in this paper proves, X-Value outperformed HDB Panel in two market environments (i.e., upward trending and cooled) in terms of veracity and accessibility.   This ranks AVM ahead of Panel in terms of contributing to long-term stability of HDB resale market.

As for the best possible solution of the three, it depends on the valuation method's use.

In case of method acting as a pricing mechanism for real estate negotiations, AVM has better accessibility than AVM + Panel.

In Singapore, X-Value is instantaneous and available across multiple delivery systems including Internet and mobile technology.   As a result, negotiators can employ it anytime and anywhere. In contrast, for a negotiator to engage a valuer supported by an AVM, it takes some to schedule and conduct field inspection as well as write the valuation report.

In case of rigorous mortgage underwriting or complicated price negotiations, it is prudent to use a hybrid of Valuation and AVM methods. While the veracity of X-Value is exceptional, when it comes to risk assessment and liability protection, the hybrid system provides that extra checks-and-balance that gives all parties a higher comfort level.   This is possible because under the hybrid system, licensed valuers check the computer and computer checks licensed valuers and their support staff.

At the same time, though, data management technology allows the hybrid method to operate at higher levels of efficiency and productivity and pass those savings onto the consumer. To the normal HDB consumer, the current average cost of $175 for valuation is significant and there is no doubt, as it has proven to be true in the private market, that a hybrid system can deliver valuations for both price negotiations and rigorous underwriting at a meaningful discount to prevailing HDB and private valuation fees.

Given this discussion, this study gives AVM+Panel (hybrid) are ranking of one in veracity and a ranking of two in accessibility. It ranks AVM first in accessibility and second in veracity.

Statistical Analysis Conclusions

As statistical analysis in this study proves, Automated Valuation Model (AVM) is a robust, neutral, and objective valuation method that offers speed and transparency above and beyond a traditional valuation panel.

At the very minimum, AVM's veracity provides four technological solutions to help prevent asset bubbles and facilitate the long-term stability of HDB resale property market.

First, it provides a documented, instantaneous, robust pricing benchmark for buyers, sellers, and their agents to negotiate real estate deals.

Second, it provides a checks-and-balance for valuers. It ensures comprehensive collection of transaction data and provides a benchmark against which a valuer can check his or her opinion before <u>finalizing</u> the report. Investors benchmark investment managers against stock and bond indices and each other for the good of their markets and industries. Valuers should not be immune to this type of accountability.

Third, AVM provides a checks-and-balance for mortgage underwriters. It is inefficient and cost-prohibitive for underwriters to accompany valuers on field inspections or even spot-check their work. AVM provides underwriters with an inexpensive solution to measure and, thus, control the veracity of valuations that are being factored into their risk analysis.

Fourth, AVM provides property analysts with robust information in which to measure risk in property market. For example, TOX can be used to measure market movements and, thus, the potential for asset bubbles. X-Value can mark-to-market mortgage portfolios.

Already government and private organizations are using X-Value. Consumers and property agents are generating over 100,000 X-Values per month.

As the statistical analysis in this paper proves, AVM, like X-Value, represents a robust valuation method that is **Smart Technology for a Smart Nation**.