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# The impairment costs of traditional non-quantitative retail banking practices during residential real estate foreclosure sales and their effect on National, Central & Reserve bank(s) policy<sup>1</sup>

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<sup>1</sup> This presentation was prepared for the Workshop. The views expressed are those of the authors and do not necessarily reflect the views of the Bank of Italy, the BIS, the IFC or the central banks and other institutions represented at the event.

# The impairment costs of traditional non-quantitative retail banking practices during residential real estate foreclosure sales and their effect on National, Central & Reserve bank(s) policy

...with focus on improved supervised machine learning applications in micro-prudential processes within the product life cycle of residential mortgages.

James N. Nicol  
Emmanuel Blonkowski

## Quantifying a qualitative micro-prudential process during residential real estate foreclosures

Residential real estate is the world's most commonly transacted financial asset.

To facilitate this transaction, every country has its own unique sovereign prudential guidelines and requirements governing retail banking standards on residential mortgage lending.

Since the global financial crisis of mid-2007 to early 2009, many countries' Central/National/Reserve banks and monetary authorities have increased supervisory measures to ensure responsible lending standards, and amplified consumer protection advocacy to defend against improper lending practices and improve market stability within their retail banking systems.

And while the retail lenders' requirements for mortgage loan approval and servicing are backed by standardised regulatory processes and approved prudential procedures, there is an opportunity for quantitative improvement within the product lifecycle of residential mortgages, specifically when non-performance necessitates repossession, and a foreclosure sale.

With the creation of the Statistical Data and Metadata eXchange (SDMX) and ongoing updates to data analytics platforms and tools, there is an inference that Central/National/Reserve banks and Monetary Authorities can improve guidance and governance by incorporating quantitative data analytics tools, platforms and applications within qualitative risk management frameworks for better data-driven outcomes in their retail banking systems.

To aid in that transition, we have built a micro-prudential application that improves transactional optimisation by benchmarking and indexing a retail bank's choice of selling agent (market participant), facilitating a foreclosure sale.

The application utilises a supervised, machine-learning, geo-spatial, geo-specific, market-augmented, time series regression algorithm, with predictive and prescriptive attributes, that eliminates the qualitative selection bias that impairs sale prices of bank-owned, repossessed and foreclosed residential real estate assets.

JEL classification: C5 C81 D23 D46 D63 D91 R3

Keywords: #micro-prudential #residential #mortgage #foreclosure #repossession #quantitative #modelling #forecasting #transactioncosts #impairmentcosts #organizationbehaviour

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## Introduction

Since the first version of the SDMX technical standard (1.0) was finalised in 2004 and approved in 2005 by the International Organization for Standardization (ISO), use of and interest in the SDMX by Central, National, Reserve banks and monetary authorities within the BIS membership has grown dramatically<sup>1</sup>.

Though the use of the SDMX standards is concentrated in a few statistical areas<sup>2</sup>, it has improved the regulatory reporting capabilities of Central, National and Reserve banks. However, as prudential supervisors of their retail banking systems, they face issues in the implementation of the SDMX standards and use of analytical applications to overcome the qualitative status quo<sup>3</sup>. This is due to the different interests of various stakeholders, and the challenge of replacing legacy reporting systems, processes, procedures, and practices<sup>4</sup> that utilize information at the level of granular, operational data.

For example, retail banking practices, procedures and processes guiding the product life cycle of residential real estate mortgages – specifically the qualitative processes and legacy procedures retail banks follow when mortgages become non-performing and default – have been slow to adopt, integrate or evolve alongside the SDMX or data analytic platforms. This has led to an ongoing impairment of prices and realised values when retail banks sell bank-owned, mortgage default, foreclosed and repossessed real estate<sup>5</sup>.

## Establishing reference points and benchmarks

The residential real estate sector plays an important role in financial and macroeconomic stability given its tight links with both the real economy and the financial system.<sup>6</sup>

A review of working papers and policy statements from global organizations, as well as guides and guidelines from sovereign prudential and supervisory bodies, establishes a common reference point for benchmarking residential mortgage underwriting standards and for management practices of immovable property within retail banking systems.

<sup>1</sup> Tissot B (2018) Journal for Mathematics and Statistical Science Volume 2018, Issue 1 SDMX, a Key Standard for Central Banks' Statistics

<sup>2</sup> Ehrmann H, Tissot B, Başır E and Hülagü T (2015) IFC Report No 4 Central banks' use of the SDMX Standard - 2015 Survey, conducted by the SDMX Global Conference Organising Committee

<sup>3</sup> Cristiano J, Kienecker K, Prenio J and Tan E (2020) FSI Insights on policy implementation No 29

<sup>4</sup> *Ibid*

<sup>5</sup> Allen F and E Carletti (2011a), 'Systemic Risk from Real Estate and Macro-Prudential Regulation', Paper presented at the Federal Reserve Board and *Journal of Money, Credit and Banking* Conference 'The Regulation of Systemic Risk', Washington DC, September 15–16, 2013

<sup>6</sup> European Systemic Risk Board (2021) European A Review of Macroprudential Policy in the EU in 2020

Analysing and tracing these reference points to their point of origin establishes the framework of the principles and standards within retail banking systems, and allows scope to empirically review, compare and test those principles and standards.

Overview of countries, supervisory bodies, financial authorities, working papers, policy statements, guides and guidelines for retail residential mortgage lending covered in this paper

Table1

Country	Financial Authority	Document	Date
Australia	Australian Prudential Regulatory Authority	Prudential Practice Guide APG 223 Residential Mortgage Lending	July 2019
Canada	Office of the Superintendent of Financial Institutions	Residential Mortgage Underwriting Practices and Procedures B-20	October 2017
England	The Prudential Regulatory Authority The Financial Conduct Authority	The PRA Rule Book The FCA Handbook	April 2013 April 2014
France	The French Prudential Supervision and Resolution Authority High Council for Financial Stability	Compendium of regulations relating to the exercise of banking and financial activities R-2021 - 1	October 2020 December 2019
Germany	The Federal Financial Supervisory Authority	Section 48u – the Banking Act	June 2017
Ireland	Central Bank of Ireland	The Irish Statute Book	February 2015
Spain	Bank of Spain	Regulatory Changes in Prudential Supervision	May 2013
United States of America	Consumer Financial Protection Bureau	The 2016 Mortgage Servicing Rule	August 2016
International Supervisory Body	Financial Stability Board	Thematic Review on Mortgage Underwriting and Origination Practices Principles for Sound Residential Mortgage Underwriting Practices	March 2011 April 2012
European Supervisory Body	European Central Bank	Trends and risks in credit underwriting standards of significant institutions in the Single Supervisory Mechanism	June 2020
European Supervisory Body	European Systemic Risk Board	Recommendation of the European Systemic Risk Board of 31 October 2016 on closing real estate data gaps as amended by Recommendation ESRB/2019/3 (ESRB/2016/14)	June 2021

In Australia, lending secured by mortgages over residential property constitutes the largest credit exposure in the Australian banking system<sup>7</sup>. Prudential practice guides, (PPG) provide guidance on the Australian Prudential Regulatory Authority's (APRA) view of sound practice in particular areas. The PPG APG 223 focus is Residential Mortgage Lending (July 2019) which in turns sites the Financial Stability Board's (FSB) Principles for Sound Residential Mortgage Underwriting Practices (April 2012) as a Rosetta Stone of sorts which sets out minimum underwriting standards

<sup>7</sup> APRA Prudential Practice Guide APG 223 Residential Mortgage Lending

that the FSB encourages supervisors of authorised deposit-taking institutions (ADI), like APRA, to implement.

In March 2011, the Financial Stability Board (FSB) published a thematic review of residential mortgage underwriting and origination practices<sup>8</sup>. One of the recommendations was that the FSB set out to develop a principles-based framework for sound underwriting practices. Of the seven principles identified in the FSB Principles for Sound Residential Mortgage Underwriting Practices (April 2012), principle four; Effective collateral management, has several sub points of process requirements on the professionalism, diligence and independence of the appraisers and valuers of residential real estate.<sup>9</sup>

Understandably, the Principles refer to consumer protection issues that contribute to efforts to improve financial stability and prudential standards, the Principles are not intended to be a statement of consumer protection standards<sup>10</sup>. Allowing jurisdictions to adopt consumer protection standards that are appropriate to them.

Absent is guidance and guidelines on the selection process of market participants should non-performance of the mortgage necessitate the involuntary liquidation and foreclosure sale of the collateral by retail banks.

Likewise, while PPG APG 223 Residential Mortgage Lending (July 2019) offers ADI's guidance and guidelines in several key areas of the residential mortgage product life cycle, i.e. risk management framework, loan origination, stress testing, reliance on automated valuation models (AVMs) in security valuation as well as requirements on the professionalism, diligence and independence of the appraisers and valuers of residential real estate, absent is guidance and guidelines on the selection of market participants, should non-performance of the mortgage necessitate the involuntary liquidation and foreclosure sale of the collateral by retail banks.

As real estate and financial markets are differential and dynamic, we reviewed the documents in table 1 to confirm homogenous absences in guidance and guidelines on the selection process of market participants should non-performance of the mortgage necessitate the involuntary liquidation and foreclosure sale of the collateral by retail banks.

There were absences.

In that absence, we analysed a random sample group of mortgagee residential real estate sale transactions from Australia, Canada, England, France, Germany, Ireland, Spain, and the United States of America applying quantitative processes to predict and prescriptively index the retail banks choice of market participant's sale result against their markets average (arithmetic mean) sale result as a guide.

<sup>8</sup> [http://www.financialstabilityboard.org/publications/r\\_11031a.pdf](http://www.financialstabilityboard.org/publications/r_11031a.pdf)

<sup>9</sup> FSB (2012) Principles for Sound Residential Mortgage Underwriting Practices

<sup>10</sup> FSB (2012) Principles for Sound Residential Mortgage Underwriting Practices

## Research, Observations and Comparisons

Our research was done in three parts:

### Part One

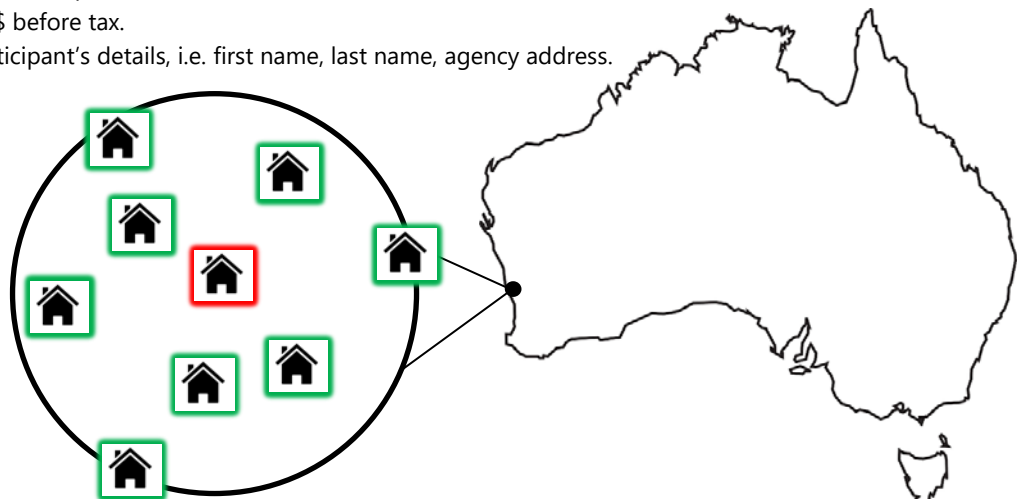
A random sample group of 500 Australian mortgagee residential real estate sales transacted between June 2018 and March 2020 (21 months) was analysed using newly developed analytical software. This analysis aggregated metrics which had previously not been analysed together – unique key result indicators of market participants – using API feeds from multiple data suppliers to ensure data accuracy and veracity.

In this way we predicted and prescriptively indexed the transaction metrics of the sale results of a retail bank's choice of market participants to be either above or below their market's average sale result.

Rather than over indexing, the observations of the key result indicators used to evaluate the transaction econometrics of the 'market average' were basic:

Box 1

- Property attributes, such as land size, number of bedrooms, bathrooms, car spaces correlating with the repossessed/foreclosed residential real estate sale.
- Property location, within 1,000 meters of a bank managed/bank owned/mortgage default residential real estate sale.
- Time series, within 180 days, 90 days prior and post bank managed/bank owned/mortgage default residential real estate sale transaction.
- Sale Price, \$ Per Square Meter (Land Size).
- Sale Price, \$ before tax.
- Market participant's details, i.e. first name, last name, agency address.



Of the 500 properties sold, within 3 months of being transacted, 94.3% were correctly predicted in having sold above or below their market average.

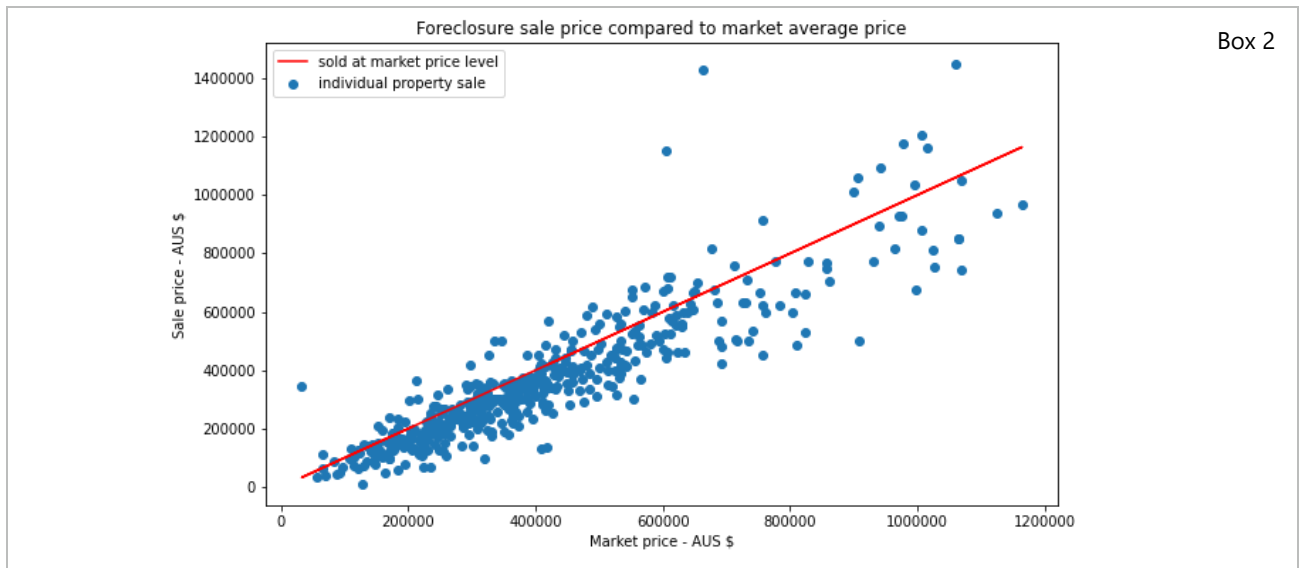
Within 6 months of being transacted, 91.1% were correctly predicted in having sold above or below their market average and 89.9% were correctly predicted in having sold above or below their market average within 12 months of being transacted.



At the time of sale, the indexing revealed 76.8% of the bank selected market participants sold the foreclosed property below their market's average sale price.

Month by month, over the 21 months, the banks choice of market participant, under-performed when compared against their market's average.

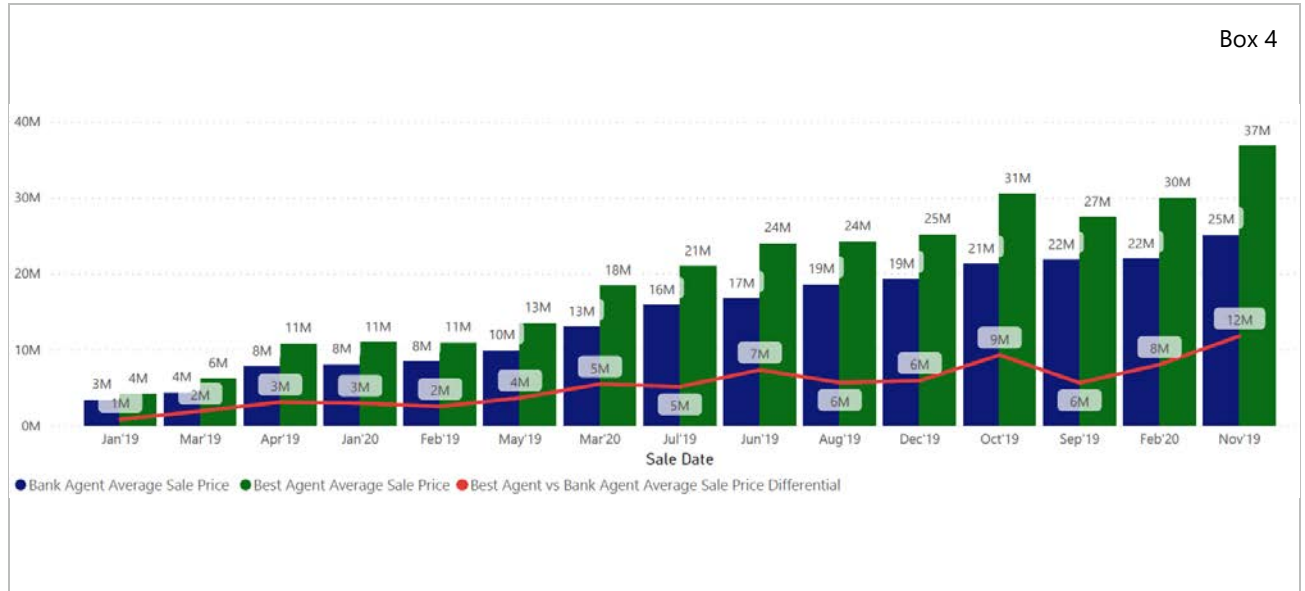
The average difference between the bank selected market participant's foreclosure result and their market's average sale price, per the sample group, was -\$46,607 at the time of sale.



## Part Two

When benchmarking the performance of the bank selected market participant of the foreclosed property against their market's average sale price results, we indexed market participants who would have been a more ideal or 'BestAgent' to ensure transactional optimisation of the foreclosed property.

The gap between the bank selected market participant's sale price result and the 'BestAgent' market participant's average sale price result is even more significant when compared with their market's average sale price result, \$157,907.



### Part Three

Repeating the process outlined in Part One to include bank owned, mortgage default, repossessed and foreclosed real estate sales in Canada, England, France, Germany, Ireland, Spain, and the United States of America, we prescriptively indexed the bank's selected market participants results to be either above or below their market averages and against other market participants.

Table 2

Country	Residential real estate foreclosure sales	% of foreclosure sales below market average	Differential average foreclosure sale price to market average sale price	Differential bank selected agent average sale price to BestAgent average sale price
Australia	500 <sup>1</sup>	77	-\$46,607	\$157,907
Canada	750 <sup>2</sup>	78	-\$43,899	\$87,455
England	1120 <sup>3</sup>	68	-£28,540	£79,887
France	1340 <sup>4</sup>	71	-€42,115	€87,766
Germany	1660 <sup>5</sup>	71	-€29,009	€67,882
Ireland	98 <sup>6</sup>	66	-€33,150	€64,078
Spain	940 <sup>7</sup>	69	-€47,441	€82,369
The United States of America	6560 <sup>8</sup>	79	-\$52,572	\$104,741

<sup>1</sup>Corelogic, Domain and SQM <sup>2</sup>Realtor.ca and ForeclosureSearch.ca <sup>3</sup>UKAuctionList, Rightmove and Zoopla <sup>4</sup>LeBonCoin.fr, SeLoger.com and Pap.fr <sup>5</sup>ImmobilienScout24.de, Immowelt.de and Govesta.co <sup>6</sup>Daft.ie and MyHome.ie <sup>7</sup>Fotocasa.es and BankBargainsSpain.com <sup>8</sup>RealtyTrac, Zillow and RedFin

## Algorithm and modelling

The regression algorithm used to index the market participants operates within a narrow band of temporal and spatial scales, nominated by the user.

The best fit, a binomial distribution model, allowed us to figure the probability of observing a specific number of 'best' outcomes when the process was repeated against the market participants with the outcome for a given market participant is either success (above market) or failure (below market) benchmark result against the market's average and other market participants.

Per below, "n" denotes the number of observations or agent performance metrics i.e. Days on Market, List Price to Sale Price Differential, \$ per SQM, and "x" denotes the number of "successes" or events of interest occurring during "n" observations. The probability of "success" or occurrence of the outcome of interest is indicated by "p".

With this notation in mind, the binomial distribution model is defined as:

$$P(X \text{ "successes"}) = \frac{n!}{x!(n-x)!} p^x (1-p)^{(n-x)}$$

This model allows for the proprietary indexing of market participants, geospatially on a property-by-property basis. In use and function as a micro-prudential tool, the software utilises supervised machine learning, attributes. Identifying and isolating outlier results, dimensionally reducing and classifying input variables with each software update.

As a time series, geospatial, geospecific, market augmented proprietary indexing system with predictive and prescriptive attributes to quantitatively improve upon legacy qualitative retail banking practices during the involuntary liquidation of residential real estate, The 'BestAgent' Index ensures greater risk transparency to facilitate better data driven decisions when selecting market participants during an involuntary liquidation event at a micro-prudential level.

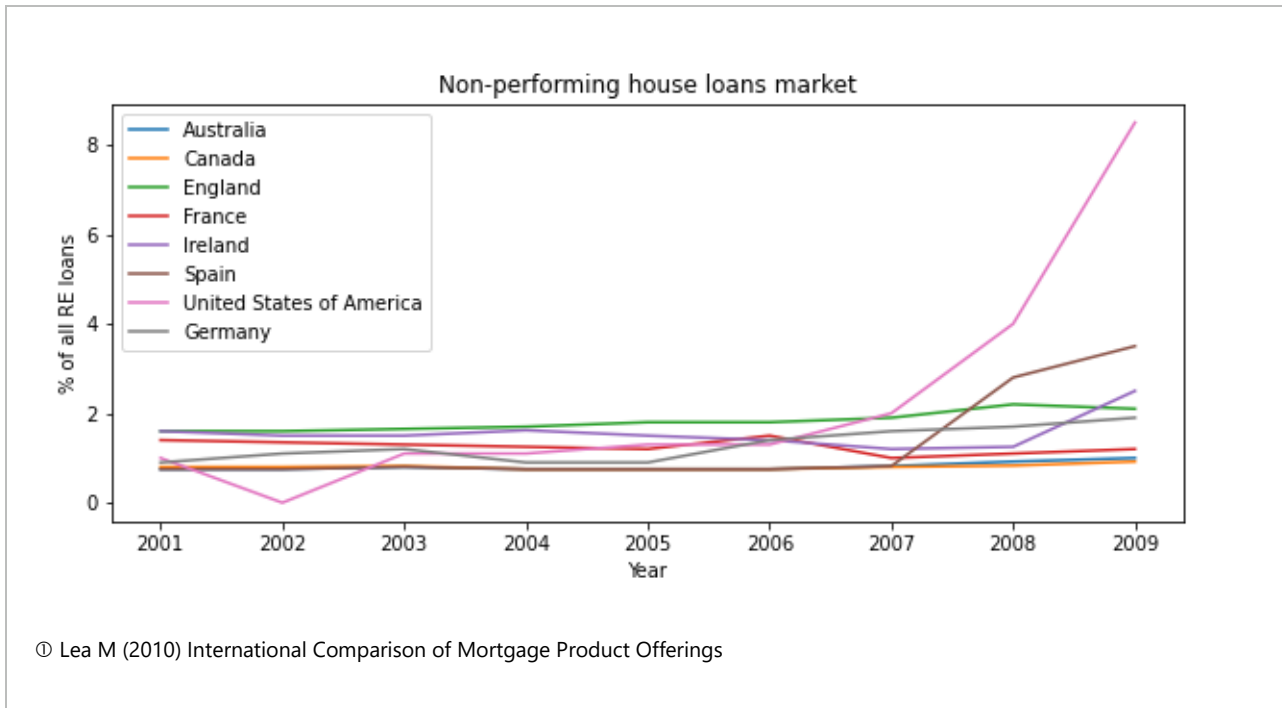
## Residential foreclosures and their effect on Central/National/ Reserve Bank(s) and Monetary Authorities Policies

In comparison, globally, losses during and after the global financial crisis were minimal in Australia<sup>11</sup> (Rogers D 2015).

The global financial crisis highlighted involuntary liquidation value vs market value of residential real estate from impatient creditors and cautionary markets. In healthy developed residential real estate markets; prior to 2007; foreclosure sales and non-performing housing loans annually represented less than 2%<sup>12</sup> of their respected markets.

<sup>11</sup> Rogers D Credit Losses at Australian Banks: 1980–2013

<sup>12</sup> Lea M (2010) International Comparison of Mortgage Product Offerings



Post global financial crisis, the increased regulation and oversight of residential mortgage underwriting practices by many Central/National/Reserve banks, monetary authorities, prudential regulatory authorities, and various global supervisory economic bodies focused on loan origination, lending documentation standards and definitions of best practices for residential valuers and appraisers.

Absent from the commentary, conclusions and recommendations was standards and best practices on the selection process(es) of the administrators for the mechanism of involuntary liquidation: the market participants.

And while it can be difficult to disentangle the triggers of a downturn event from its amplifiers, default, foreclosure and repossession sales of residential real estate were amplifier events of the global financial crisis.<sup>13</sup>

The future challenge for Central/National/Reserve banks, monetary and prudential regulatory authorities is setting quantitative standards within a qualitative principles-based framework to improve outcomes and reduce the gap between involuntary liquidation value vs market value.

Current frameworks contain flexibility for individual jurisdictions to adopt their own standards according to their own circumstances<sup>14</sup> as real estate markets are dynamic with underlying risk differing greatly across jurisdictions and within countries.<sup>15</sup>

<sup>13</sup> Calhoun M (2018) Lessons from the financial crisis: The central importance of a sustainable, affordable and inclusive housing market

<sup>14</sup> Financial Stability Board (2011) Thematic Review on Mortgage Underwriting and Origination Practices Peer Review Report

<sup>15</sup> *Ibid*

Appreciating those factors, the most universal of statistical and market metrics is the arithmetic mean of a market.

Outcomes are either above or below average when supplied temporal and spatial context.

The use of supervised machine learning software by Central/National/Reserve Banks and Monetary Authorities would aid in effective collateral management by lowering a threshold of action triggered by current frameworks and would advance consumer finance protection by identifying market participants that outperform their market's average.

During involuntary liquidation, a market's average can be used as a predictive benchmark to quantitatively index a market participant's past outcomes in that market as an indication of future results.

### In summary

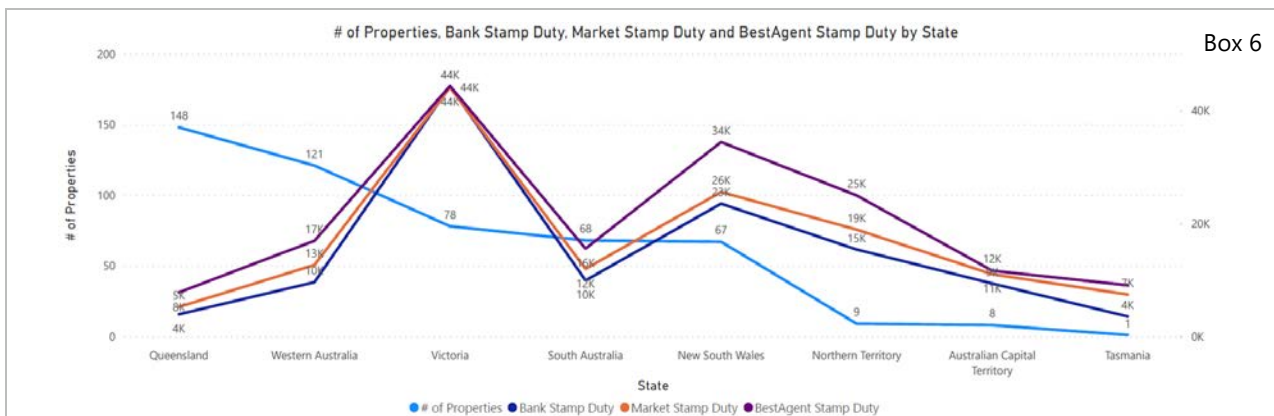
With Australia as point of reference, within the sample group, when retail banks sell bank owned property, 3 out of 4 transactions sell for below their market's average sale price while other market participants transact homes of identical basic hedonic attributes for above their market's average.

What has been identified is a quantitative opportunity for improvement in the guidance that Central, National, Reserve Banks, Monetary Authorities and their prudential bodies give to their retail banking sectors to lessen the impairment costs of traditional qualitative retail banking practices within the product lifecycle of residential mortgages when non-performance necessitates involuntary liquidation.

This is not a theoretical concept or an abstract financial exercise. It is a real-world data science solution use of a supervised machine learning algorithm that recognises the difference in unrealised funds not as a simple redistribution of wealth but as a net loss to a collective markets value.

The difference, in people terms: tens of thousands of dollars, pounds and euros in unrealised funds for the defaulted mortgager's repayment capacity to creditors.

Exponentially, again using Australia as a point of reference, the gain of hundreds of thousands, quarterly, in unrealised taxes and stamp duty, at state level, from the causal inference of impaired correlated sales.



## Next steps

As mentioned in the introduction, as prudential supervisors, introducing new quantitative SDMX standards and analytical applications to replace qualitative legacy, processes, procedures, and practices<sup>16</sup> within retail banking systems can be a challenge due to different interests of various stakeholders.

To overcome this challenge, we envision as a litmus test to ensure quantitative best practice the use of innovation labs and hubs within Central/National/Reserve banks and monetary, prudential, and financial supervisory authorities, to pool resources and to test new analytical software by running comparative testing parallel to the processes, procedures and practices currently used in their retail banking sectors.

<sup>16</sup> Cristano J, Kienecker K, Prenio J and Tan E (2020) FSI Insights on policy implementation No 29

## References

Allen F and E Carletti (2011a), 'Systemic Risk from Real Estate and Macro-Prudential Regulation', Paper presented at the Federal Reserve Board and *Journal of Money, Credit and Banking* Conference 'The Regulation of Systemic Risk', Washington DC, September 15–16.

APRA Prudential Practice Guide APG 223 Residential Mortgage Lending

Calhoun M (2018) Lessons from the financial crisis: The central importance of a sustainable, affordable and inclusive housing market

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Ehrmann H, Tissot B, Başır E and Hülögü T (2015) IFC Report No 4 Central banks' use of the SDMX Standard - 2015 Survey, conducted by the SDMX Global Conference Organising Committee

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Lea M (2010) International Comparison of Mortgage Product Offerings

Rogers D (2015) Credit Losses at Australian Banks: 1980–2013

Tissot B (2018) *Journal for Mathematics and Statistical Science* Volume 2018, Issue 1 SDMX, a Key Standard for Central Banks' Statistics



## Who are we and what do we do?

We're a RegTech SaaS developer specialising in creating new and innovative micro-prudential tools for Central, National and Reserve Banks to aide their retail banking sectors in better data driven decisions around stress testing, risk management and transactional optimisation during the involuntary liquidation of distressed, repossessed and foreclosed residential real estate.



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## What's the problem?

What are the impairment costs of traditional non-quantitative retail banking practices during residential real estate foreclosure sales and what is their effect on Central bank policy?

And how could the use of supervised machine learning applications during micro-prudential processes within the product life cycle of residential mortgages, lessen that impairment.



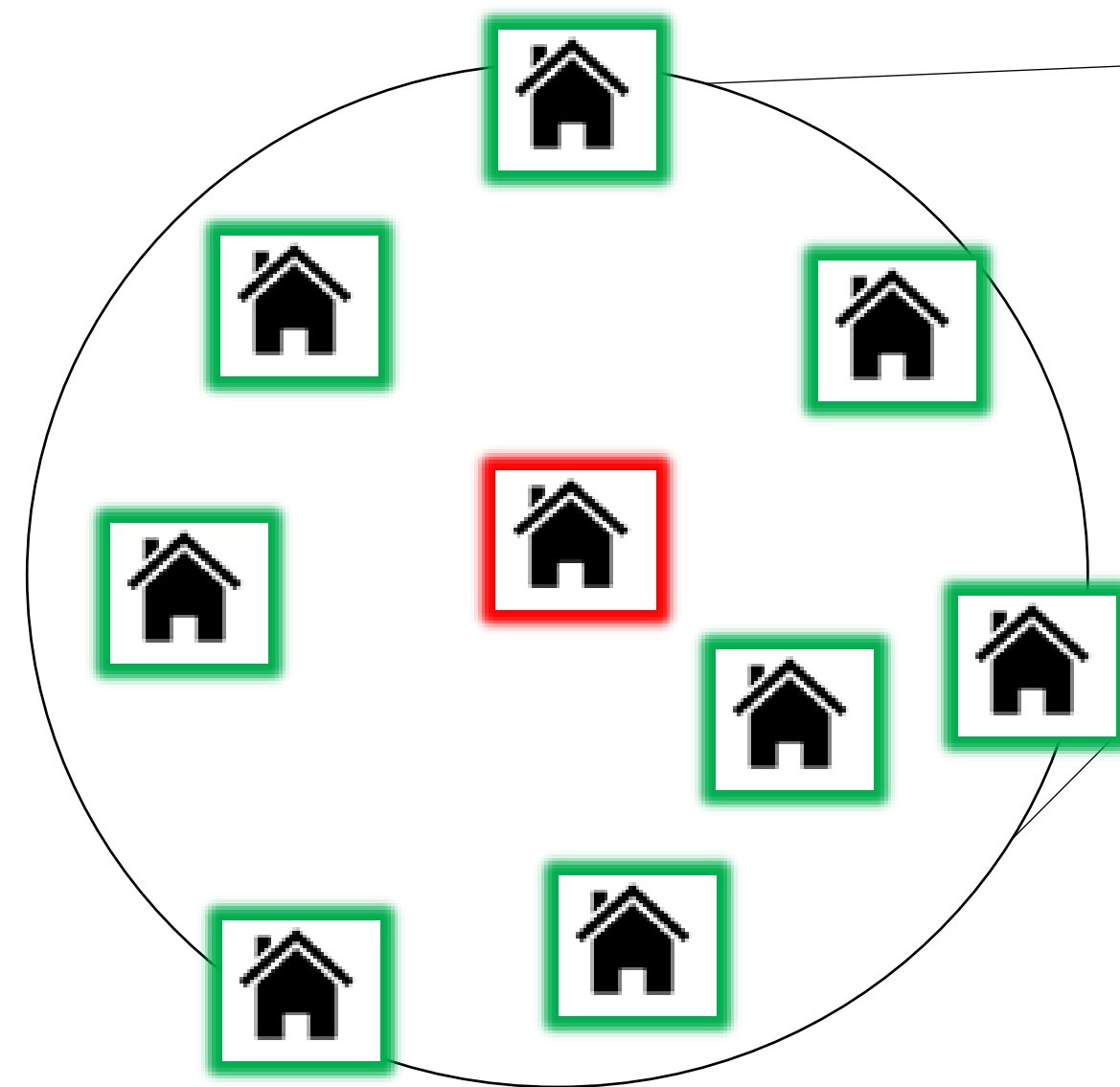
Overview of countries, supervisory bodies, financial authorities, working papers, policy statements, guides and guidelines for retail residential mortgage lending covered in this presentation

<b>Country / Body</b>	<b>Financial Authority</b>	<b>Document</b>	<b>Date</b>
Australia	Australian Prudential Regulatory Authority	Prudential Practice Guide APG 223 Residential Mortgage Lending	July 2019
Canada	Office of the Superintendent of Financial Institutions	Residential Mortgage Underwriting Practices & Procedures B-20	October 2017
England	The Prudential Regulatory Authority The Financial Conduct Authority	The PRA Rule Book The FCA Handbook	April 2013 April 2014
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International Supervisory Body	Financial Stability Board	Thematic Review on Mortgage Underwriting & Origination Practices  Principles for Sound Residential Mortgage Underwriting Practices	March 2011 April 2012
European Supervisory Body	European Central Bank	Trends and risks in credit underwriting standards of significant institutions in the Single Supervisory Mechanism	June 2020
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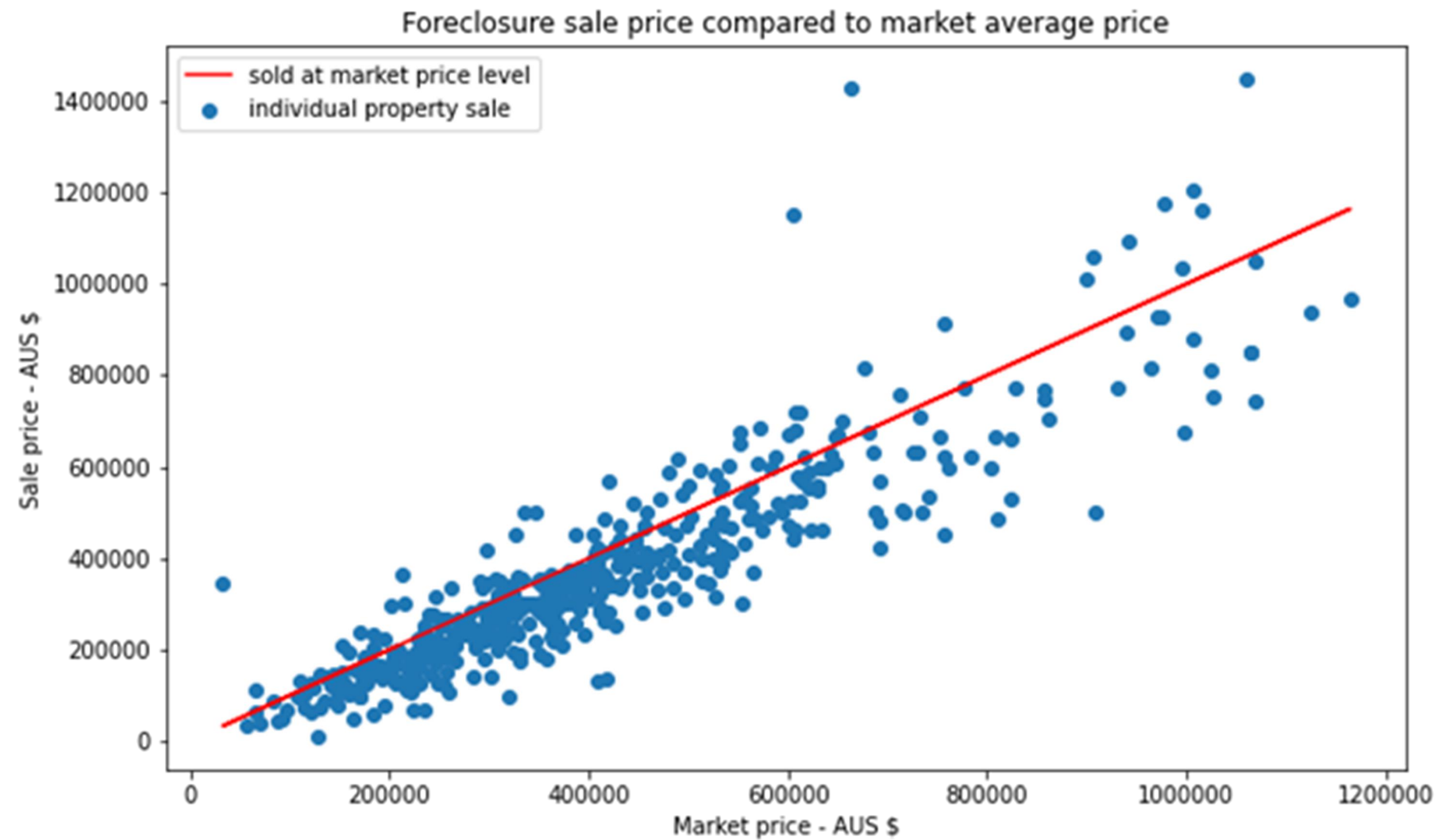


# Research, Observations and Comparisons

- A random sample group of 500 Australian mortgagee sales - June 2018 to March 2020
- Basic hedonic property attributes: # bedrooms, # bathrooms, # car spaces, land size
- Property location: within 1000 sqm
- Time series: 180 days, 90 days prior and post sale
- Sale Price: \$ Per Square Meter (Land Size).
- Sale Price: \$ before tax.
- Market participant's details



# Research, Observations and Comparisons



76.8% sold below market



### Search Property Details

Type of residence

Property Characteristics

# of bedrooms :  Studio 1 2 3 4 5+

# of bathrooms:  None 1 2 3 4 5+

# of car spaces:  None 1 2 3 4 5+

Search Radius:  100m 250m 500m 750m 1km 1.5km 5km 10km

Timeline:  3 months 6 months 12 months 18 months 2 years 3 years

### Current Market Averages

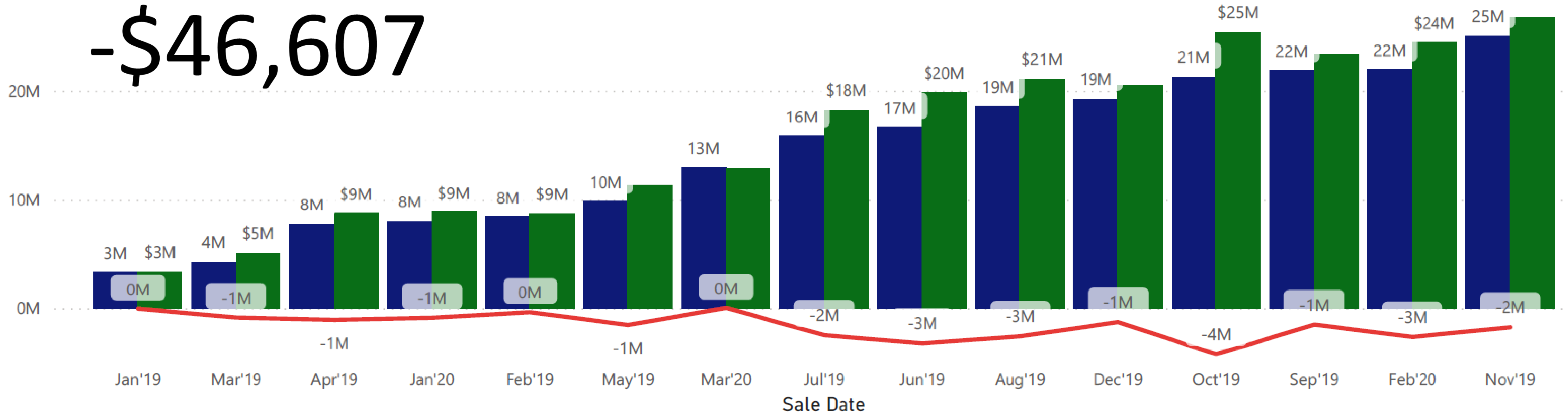
Property type	# Bedrooms	# Bathrooms	# Car Spaces	Search Radius	Timeline
House	3	1	3	1km	6 months

Average Sale Price	Average List / Sale Price Differential	Average Land Size	Average Price Per SQM	Average Days on Market
\$ 457,500	\$ 2,500	658 m <sup>2</sup>	\$ 695	43 days

# Research, Observations and Comparisons

-\$46,607



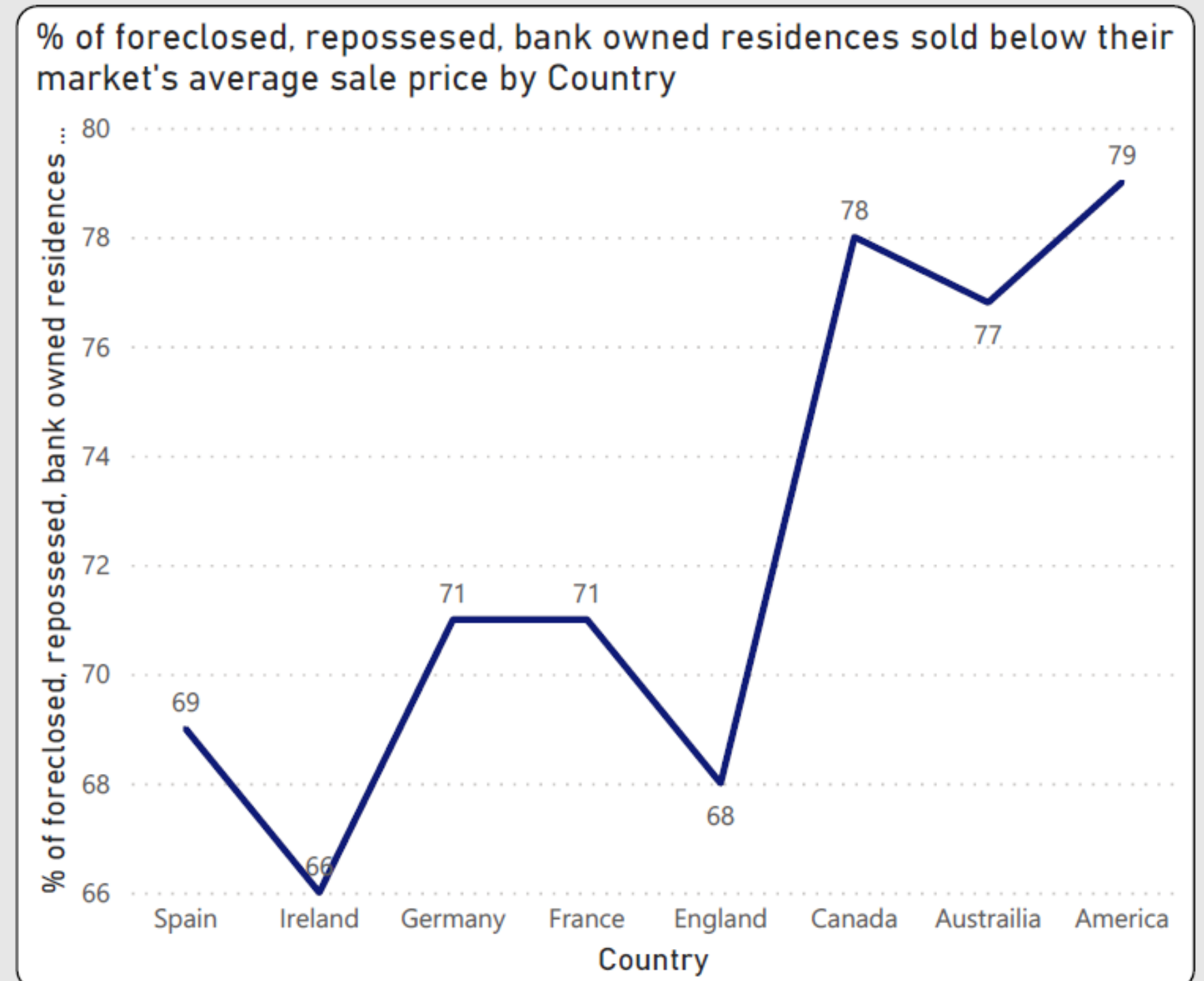
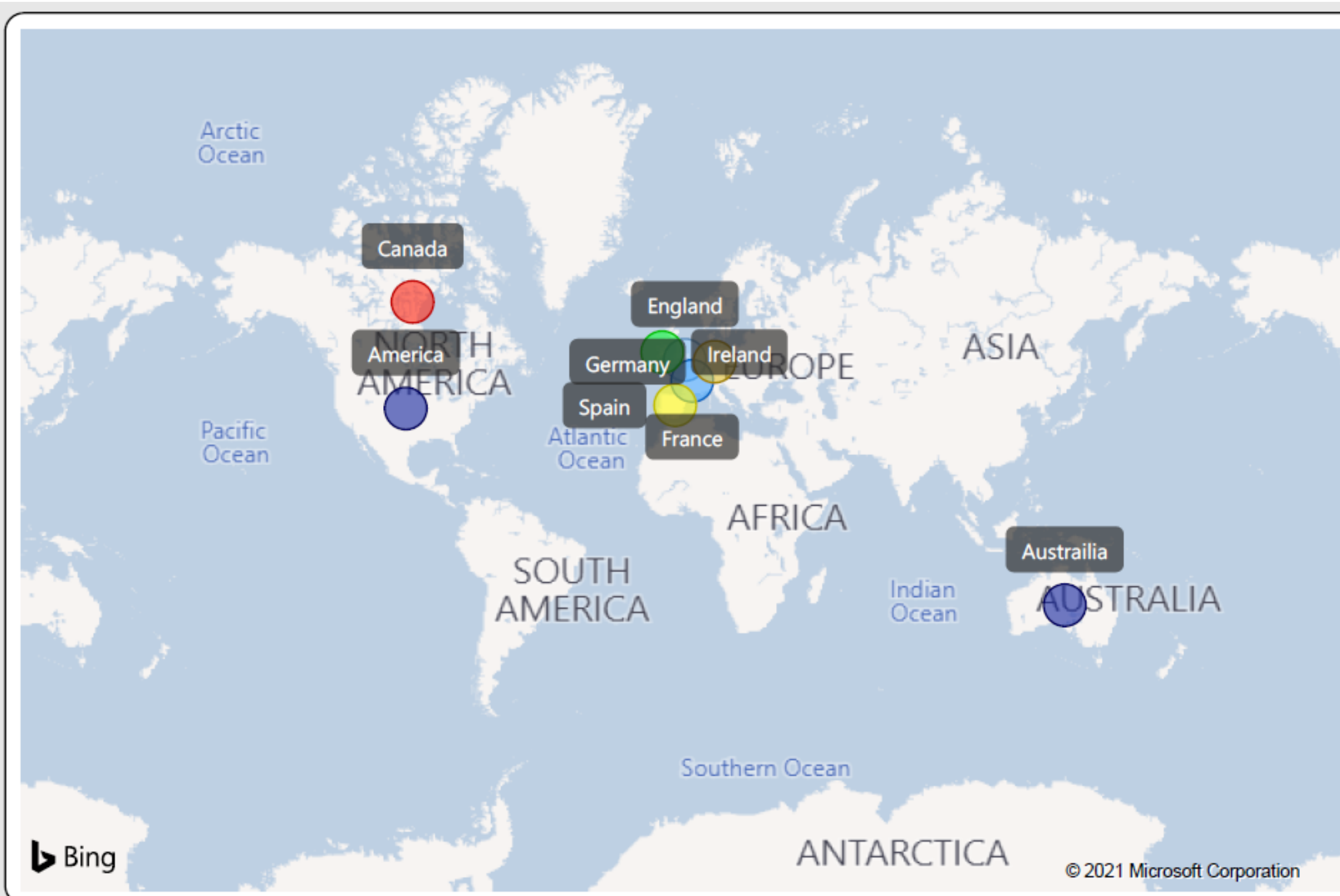
● Bank Agent Average Sale Price ● Market Average Sale Price ● Bank Agent vs Market Average Sale Price Differential



# Research, Observations and Comparisons



# Research, Observations and Comparisons



Country	Residential real estate foreclosure sales	Sold below their market's average %	Difference (Foreclosure price v market average price)	BestAgent vs Bank Agent Average Sale Price Differential
Spain	940	69	-€47,441	€82,369
Ireland	98	66	-€33,150	€64,078
Germany	1660	71	-€29,009	€67,882
France	1340	71	-€42,115	€87,766
England	1120	68	-£28,540	£79,887
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America	6560	79	-\$52,572	\$104,741



The best fit, a binomial distribution model, allowed us to figure the probability of observing a specific number of 'best' outcomes when the process was repeated against the selling agent with the outcome for a given selling agent is either success (above market) or failure (below market) benchmark result against the market's average and other market participants.

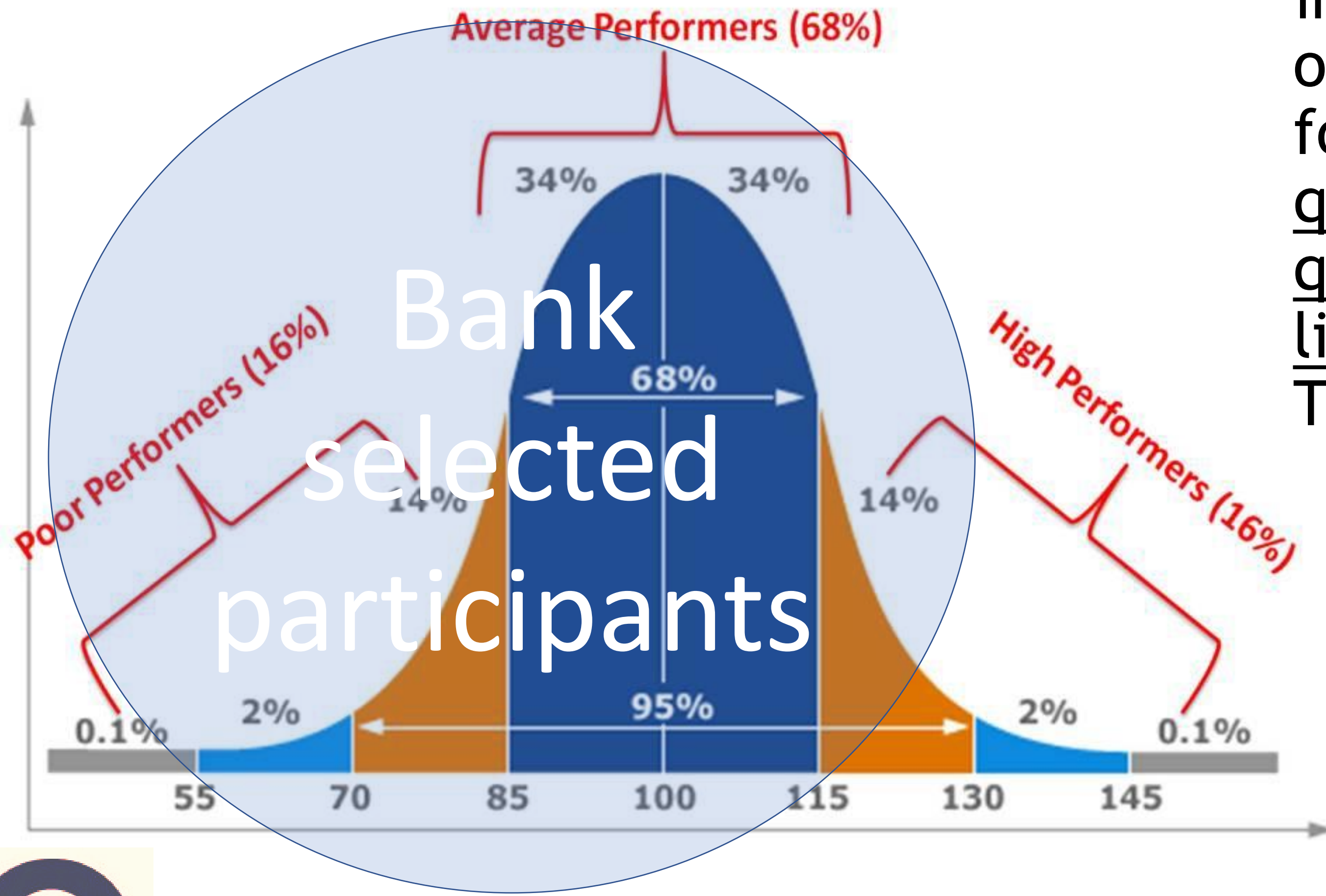
$$P (X \text{ "successes"}) = \frac{n!}{x! (n - x)!} p^x (1 - p)^{(n-x)}$$

"n" denotes the number of observations or agent performance econometrics, of which we discussed previously, Days on Market, List Price to Sale Price Differential, \$ per SQM, and "x" denotes the number of "successes" or events of interest occurring during "n" observations. The probability of "success" or occurrence of the outcome of interest is indicated by "p".





# Problem Identified, Isolated and Solved



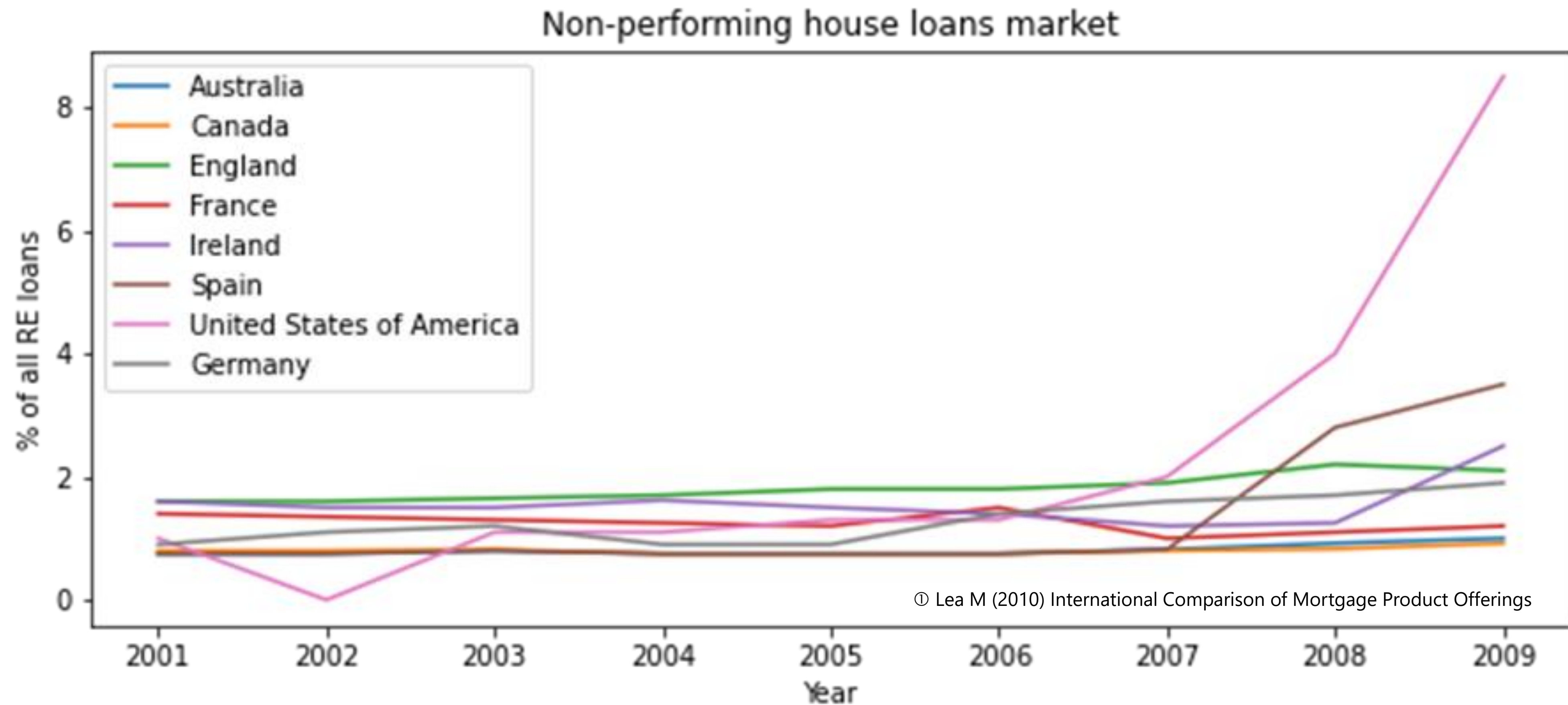
The opportunity for improvement is in the retail banks selection process of the market participant selling the foreclosed property. It is the only qualitative part of an entirely quantitative process in the product lifecycle of a residential mortgage. The selection process is:

Unsystematic.  
Biased.  
Nonreplicable.  
Inefficient.

Achieves results below market.



# Research, Observations and Comparisons



# Research, Observations and Comparisons

# of Properties, Bank Stamp Duty, Market Stamp Duty and BestAgent Stamp Duty by State

