THE AVM CASCADE INDUSTRY

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INTRODUCTION

Given the high costs and possibilities for fraud in the residential real estate appraisal market, the Automated Valuation Model (AVM) industry continues to play an essential role in the housing and housing finance markets. There are by now a large number of distinct AVMs available, and it can be very hard to identify and to choose the most suitable AVMs for a particular valuation challenge. While the very largest AVM users dedicate significant resources to this selection process, the vast majority rely on providers of commercial AVM "cascades" to aid in their choice among AVMs. The current discussion paper focuses on the technical underpinnings of available cascades, and provides a guide for users as to which technique is best-suited to particular valuation tasks. It also proposes simple next steps for cascade producers, regulators, and users looking to seed further improvements in valuation technology.

Production of a typical cascade begins when the end user specifies a set of property transactions that are of particular interest (e.g. very recent transactions in a given geographic area and price tier). A sample of such transactions is then identified. The cascade producer has access to a set of AVMs each of which predicts the price at which some or all of the sample transactions will take place based on its proprietary techniques (a valuation provided by a given AVM is considered as qualifying for consideration by the cascade producer only if the associated "confidence score" is sufficiently high: see section 2). The producer compares these valuations with the actual transaction prices, and the accuracy of these predictions is then used to "rank order" the available AVMs in terms of quality. It is this ordering that underlies an overall "Cascade Valuation Model" (CVM) that is then constructed for the valuation task at hand.

To illustrate construction of a CVM, consider a cascade producer ranking 4 distinct AVM models labeled A through D for valuations in Orange County California and Queens County, New York, within price ranges deemed particularly relevant to the task at hand. One possible final cascade order is identified in the table below: it specifies models A through C in order in Orange County, and models D through B in reverse order in Queens. In Orange County, model D is not in the order, while model A is excluded in Queens County.

County	**Price Tier**	**First AVM**	**Second AVM**	**Third AVM**
Orange, CA	\$400,000 - \$899,999	Model A	Model B	Model C
Queens, NY	\$300,000 - \$799,999	Model D	Model C	Model B

In terms of how the ordering is used to produce the CVM, the name cascade is well-chosen. The top AVM in the order is first in line, and those for which it provides qualifying valuations are treated as valued by this AVM and incorporated in the CVM. The remaining properties are passed down to the second AVM in the cascade, and those that it provides a qualifying valuation for are likewise incorporated into the CVM; and so on through the remaining AVM's in the rank order.

The technical question that we address in this report concerns the algorithm used to identify and rank the relative performance of available AVMs. It turns out that different cascade producers use distinct approaches to order available AVMs from best to worst. Unfortunately, this is not widely appreciated, which both makes it hard for cascade users to identify the cascade that is best suited to their particular valuation challenge and lowers incentives for technical advance. One goal of this report is to indicate how cascade users can choose among available options in a principled manner, thereby to help spur increased innovation and ever more accurate valuation models.

We focus on comparing a "standard" CVM with a "use-based" CVM. By definition, a standard CVM rank orders available AVMs in terms of their performance on a fixed set of properties. In contrast, a use-based CVM orders AVMs using the structure of the cascade itself. Both techniques have the same opening step, in which AVM performance is compared on the entire set of transactions of interest. For a standard CVM, this first step is also the last: AVMs are ranked in order once and for all according to how they perform on the entire batch of properties. For a use-based CVM, the first comparison identifies only the top-ranked AVM: the second ranked AVM is identified by undertaking a fresh comparison of remaining AVMs after removing properties for which qualifying valuations are available from the first AVM. The use-based CVM continues iteratively in this manner to rank remaining AVMs based only on the properties for which no higher ranked AVMs provide qualifying valuations, foreshadowing in this respect the operation of the cascade in its ultimate use.

In section 2 of the report we cover the basic features of the cascade industry. Section 3 compares standard and use-based CVMs. It shows that use-based CVMs are superior when the AVMs differ from one another in fundamental ways, and therefore have distinct "areas of expertise" (e.g. Orange County as opposed to Queens County). In contrast, standard CVMs have the edge when the various AVM models can be globally ranked in terms of relative quality and when there are few available transactions. In such circumstances, the fact that the use-based CVM removes some observations necessarily weakens its statistical power in identifying the underlying quality of the available AVMs. We close the section by proposing methods whereby cascade producers could guide users in choosing between the two forms of CVM.

In section 4 we make proposals in relation to future development of the cascade industry, focusing in particular on the appropriate role for the regulators. This is a particularly opportune time for considering this question, since the "Dodd-Frank Wall Street Reform and Consumer Protection Act" (http://docs.house.gov/rules/finserv/111_hr4173_finsrvcr.pdf) refers explicitly to AVM usage in Title XIV, Section 1473, on page 2239. The future of the industry depends a great deal on how the new rules are implemented, and we make explicit recommendations in this regard. The key is to ensure that the new regulations do not inadvertently slow progress in valuation technology. To this end, we propose heightened focus be placed on transparency and performance.

One reason for focusing on transparency is that, with notable exceptions, the information available to end users on CVM construction is inadequate, and performance assessment can be opaque. If the regulators take a lead in ensuring transparency, there is much potential for valuation methods to advance. Methodologies for combining models to make predictions have been revolutionized in recent years in computer science and in many fields of economic analysis. Some of these techniques may have value for the cascade industry. By focusing on transparent information provision and on clear and verifiable presentation of performance statistics, regulators would liberate production of ever more accurate property valuation estimates. We see this as a necessary step in the reconstruction of the U.S. housing finance market.

II. THE CASCADE INDUSTRY

A. A Step-by-Step Guide to the Cascade Industry

There are six key steps involved in producing a commercial AVM cascade. There are additional factors that end users may consider when making use of the cascade (e.g. AVM costs), but our focus is exclusively on the generation of the ordering of AVMs by quality.

1. **Transactions of Interest:** The first step is to identify property types and transaction types that are of interest in a particular valuation task. AVMs differ in many dimensions. For example, they may be based on distinct sources of underlying data, use different modeling techniques, and differ in the computational and analytic resources that they bring to bear. As a result of these differences, the relative performance of distinct AVMs may differ across market segments, making it crucial to specify an appropriate set of transactions. The transactions of interest may be defined based on geography, property type, price tier, and mode of housing finance. There is a trade off: the more restrictive are the criteria defining the transactions of interest, the smaller will be the available sample for AVM comparisons.

2. **The Comparison Sample:** The second step is to identify sample transactions on whose accuracy the various AVMs can be tested. This step can be highly challenging. In principle, one would want to use recent transactions to which the AVMs themselves were blind. Unfortunately, constructing a test that inhibits the various competing AVM developers from using data from the transactions that they are being asked to predict has become increasingly challenging. As a result, users may be tempted to seek values for loans in pipeline on properties that have not yet sold. But this too is fraught with difficulty since transactions in pipeline often fall through prior to completion, potentially due to mispricing. In the end, there is little choice but to select a sample of properties that are of interest and for which there is a recent transaction that is plausibly invisible to the AVM producers. But the relevant sample may be small, particularly for parties interested in a small market segment. One reasonable response to the challenge of small sample sizes is for the cascade producer to expand the definition of "similar" qualifying transactions on which to test AVM performance and potentially to down-weight findings for less similar transactions.

3. **Qualified Valuations:** AVM producers generally compute "confidence scores" together with their property valuations. These are intended to provide some measure of the accuracy of the AVM- estimated value. Unfortunately there is no standardization in the definition of AVM confidence scores. Moreover each AVM has specific exclusion rules identifying properties that it is unable to value with sufficient confidence, and therefore for which no value whatever is provided. The fact that not all properties are valued by all AVMs and that those that are valued have varying confidence scores presents cascade producers with a challenge: how can they identify properties that are adequately valued by each AVM they test, when these valuations are assessed as being of variable accuracy? A typical procedure is for the cascade producer to treat as qualifying only those valuations for which the confidence score assessed by the AVM producer is sufficiently high.

4. **Performance Standards:** AVMs need to be compared according to some fixed measure of performance. A common criterion in the industry is the proportion of AVM valuations that predict within 10% of the realized price in a transaction that is completed within the time

window for which the AVM valuation is intended to apply. This measure has the advantage of simplicity. But it is very limiting, and a better measure would involve weighting errors according to their importance. In particular, it is far more dangerous to overvalue a house than it is to undervalue a house, and this asymmetry should be reflected in the measure of performance.

5. **Method of Ranking:** The final stage of cascade production involves ordering the performance of the various AVMs on the sample transactions using the given performance standards. It is in this final stage that the ranking methodology comes into play. As noted above, standard CVMs use one and only one comparison, ranking all AVMs based on their performance on the fixed valuation sample. In contrast, use-based CVMs create the ranking based on multiple comparisons conducted in a sequential manner, with the performance of lower ranked AVMs being judged only on the basis of properties for which higher ranked AVMs do not provide qualifying values.

6. **Assessing CVM Performance:** CVMs exhibit their own performance characteristics, just as any individual AVM does. Indeed, in technical terms a CVM is a form of AVM. Hence it is desirable from the user viewpoint for the cascade producer to provide an estimate of the performance in practice of the CVM produced by following the first five steps outlined above. This step is easier to undertake for the use-based than for the standard cascade, since what matters is precisely performance in use. In a standard cascade, it is not possible to infer CVM performance based on the overall performance characteristics of the AVMs, since they will not be used on all properties, but rather on designated subsets. This also makes it hard to assess the increase in accuracy that the marginal additional AVM adds to performance of the CVM.

B. Cascade Providers

It is not easy to get information either on the precise set of available CVMs or on the competitive structure of the cascade industry. A search of the Web shows that, in addition to CoreLogic, there are a wide variety of different firms that advertise themselves as supplying various cascade services. However it is often not easy to tell what role they play. There are strong complementarities between production of AVMs and of CVMs, and there can be something of a blurred line between AVM and CVM methodologies. Moreover some of those who advertise CVM services may be more "platform providers" than algorithm developers. Once a CVM has been designed, it must be put into operation, a service that can be provided by the CVM designer or a third party, called a platform provider, which integrates the CVM with other products and services to support an institution's workflow.

To clarify industry structure, we now list various suppliers advertising themselves on the Web as offering cascade services. We begin with CoreLogic, which is the most explicit in describing its offerings, thereafter continuing in alphabetic order. While CoreLogic offers information on the technical underpinnings of its offerings, it is all but impossible to find valid information on the technical foundations of the various competing CVMs.

- CoreLogic: CoreLogic is explicit in identifying that it has separate branded CVM offerings in addition to a wide variety of AVMs. Moreover CoreLogic also supplies technical specifications to its clients (see the CoreLogic White Paper of March 2009 on Cascade Model Methodology, www.corelogic.com/cascade). This White Paper also contains important details on how CoreLogic ensures that property valuations are blind. The White Paper is also explicit in noting that it offers use-based CVMs in addition to standard CVMs. CoreLogic refers to the former as "Conditional" cascades since the performance of lower ranked AVMs is conditioned on the removal of properties valued by higher performing AVMse: see the White Paper of November 2009, "The Role of Conditional Logic in AVM Cascade Creation", http://www.corelogic.com/About-Us/Research-and-Trends.aspx.

- AVMetrics: When technical expertise is needed, consultants often appear and the AVM-CVM industry is no exception. A leading provider of consulting services is AVMetrics which offers both to test the accuracy of AVMs and to test the effect of particular orderings of AVMs in cascades. AVMetrics does not offer prepackaged CVMs, however it has offered consulting services that build cascades.

- ISGN: ISGN offers mortgage technology and services, and recently acquired FiServe's fulfillment business. As such, it provides AVMs and claims also to provide CVMs. There is no information available on how cascade order is identified.

- LPS Valuation Solutions: Lender Processing Services is a large integrated supplier of valuation services, and uses what it calls "geo-preferencing" that is claimed to ensure that the most reliable AVM is used in a given area. It is not clear precisely how this is identified.

- PLATINUMdata: PLATINUMdata offers AVMs produced by others and "investor compliant cascades," with little additional information being readily available.

- Pro-Teck: Pro-Teck offers AVMs produced by others as well as a CVM. The description of their cascade is that it offers "configurable AVM sequences"—not specifying how the sequences are determined.

- Southwest Financial: Southwest Financial Services, Ltd. does not provide its own AVM but does provide "avmV" a cascade that uses undisclosed "customized business rule sets" in determining which AVM to use in a given geography.

In addition to the various institutions that offer cascade services to third parties, the largest lenders create their own cascades. Their AVM usage is monitored by regulators, and little is publicly announced about the CVM methodology employed by these companies. Most of these companies host their cascades through third party services – meaning that the CVM rules are created by the lender, but housed and managed by a service provider.

In order to judge cascade performance, it would be ideal to know how each cascade carried out the six steps alluded to above: identifying properties of interest; selecting sample transactions; defining qualifying valuations; setting performance standards; ranking relative performance of the AVMs; and assessing CVM performance. Unfortunately, definitive information is often hard to find, and may be entirely unavailable. Again, CoreLogic is something of an exception in this regard. Other suppliers provide little information about the safeguards they put in place against "peeking ahead" by the various competing AVM developers. This is part of a more general phenomenon, relating to the "secret sauce" nature of the industry, which in most cases profoundly limits the technical information available to cascade users.

Given that the documentation of available cascades is not completely transparent, it is not possible to provide definitive statements on the method of rank ordering AVMs that the various suppliers use. Again, CoreLogic is something of an exception in this regard. While competitors do not make explicit statements of methodology, standard CVMs were the rule in the early stages of the industry, since they are the simplest to produce. It is likely that they still dominate the industry: competitive pressures suggest that cascade producers other than CoreLogic would feel compelled to so indicate if they were producing use-based CVMs.

C. Regulation

Regulators set minimum standards for AVM and AVM cascade use. Members of the Federal Financial Institutions Examination Council (FFIEC), including the Office of the Comptroller of the Currency (OCC), regulate all commercial banks with national charters including many of the largest mortgage originators. OCC Bulletin 2000-16 specifies procedures for validating and operating valuation models, which include both AVMs and cascades. In the bulletin, which is entitled "Risk Modeling -- Model Evaluation," the OCC requires that AVMs (and later cascades) must be validated for use with particular mortgage products on an institution's own transaction data, taking into account the costs of estimated error rates. In the May 15, 2005 bulletin 2005-22 entitled "Credit Risk Management for Home Equity Lending," (http://www.occ.treas.gov/ftp/bulletin/2005-22a.pdf), the OCC discusses the use of AVMs and AVM cascading platforms. OCC recommends validating any internal or third-party collateral evaluation tools, specifically referencing bulletin 2000-16, for guidance on appropriate validation methods and techniques for these models. OCC relies on participants in the industry to compare and contrast AVMs and cascades. The appropriate usage of AVMs is also addressed in the Mortgage Reform and Anti-Predatory Lending Act, Title XIV of the Dodd-Frank Wall Street Reform and Consumer Protection Act:, as discussed in section 4.

While some mortgage originators have recognized expertise in ranking AVMs and exceed the required standards, other parties lack the necessary expertise. Conversations with industry participants suggest that size may contribute to this disparity, since larger institutions can justify staffing a team dedicated to AVMs, while smaller institutions must rely on a multi-tasking risk manager.

The standard-setting role of the regulator is a two-edged sword. On the one hand, the fact that the model validation bulletin specifically mentions the need to assure against theoretical error based on inappropriate application of statistical methods by untrained modelers encourages small mortgage lenders to outsource as they cannot afford the fixed costs of the validation work. On the other hand, there may be a "technology-freezing" effect of such regulations. They may remove the incentive to advance the technological frontier. Mortgage originators that use previously vetted AVMs or cascades face a well-understood and achievable burden of proof in justifying their usage.

Any new methodology, by contrast, will be subject to significant scrutiny, and regulators may have little incentive to approve given that they are blamed more for sins of commission than of omission. There is a risk that this technology-freezing effect of the regulators will grow more rather than less significant if the regulatory focus increasingly centers on incentives rather than performance. Another issue concerns the proposed guidance on AVM use that the regulators put out in 2008 (www.ncua.gov/Resources/RegulationsOpinionsLaws/proposed_regs/proposed%20gudelines.doc). Although it has not yet been adopted, it calls (on page 55) for an institution to establish an "independent model validation process." The caveat here is that independence does not ensure quality. We believe that a transparent process addressing in detail each of the 6 key steps in CVM production alluded to above is more of the essence. We return to these points in section 4.

III. COMPARING STANDARD AND USE-BASED CVMs

Once a cascade has been developed, the typical application involves the user following the rules of the cascade to estimate values for an upcoming series of transactions, likely on an entirely different set of properties than those on which the cascade was produced. This approach is based on the presumption that past trades are more or less representative of these upcoming trades. Supposing this to be so, the key question is how a cascade user can know whether a use-based or standard cascade is likely to be superior for the particular valuation challenge that they face (all the user can hope to do is identify which is more likely to perform at a higher level, not which is sure to so perform). We use a simple example to address many of these issues.

EXAMPLE: There are three AVMs, labeled A, B, and C, and the performance criterion is that an "accurate" valuation is one that is within 10% either side of the actual recorded transactions price. There are four properties in the sample data set, with each AVM providing qualifying valuations (which may or may not be accurate) for three of the four properties. The table below captures the information in the example.

	AVM A	AVM B	AVM C
Property 1	1	1	0
Property 2	1	1	-
Property 3	1	-	0
Property 4	-	0	1
STANDARD CVM	1	2	3
USE-BASED CVM	1	3	2

- AVM A provides qualifying valuations for properties 1, 2, and 3. It is accurate in valuing all to within 10%, as indicated by the entry 1 in the corresponding rows.
- AVM B provides qualifying valuations for properties 1, 2, and 4. It accurately values properties 1 and 2, but inaccurately values property 4, as indicated by the entry 0.
- AVM C provides qualifying valuations for properties 1, 3, and 4. It accurately values property 4, but inaccurately values properties 1 and 3.

The final two rows record the ranking of AVMs respectively in the standard CVM and the use-based CVM. The standard CVM places AVM B ahead of C, since it is accurate on more properties. In contrast, the use-based CVM places AVM C ahead of AVM B, since it alone accurately values property 4, the property for which AVM A does not provide a qualifying valuation.

1. Variable Relative Quality Favors Standard CVMs

Example 1 above illustrates a case in which the three AVMs appear to be fundamentally different in terms of their underlying structure. This example has the property that AVM C produces an accurate valuation where both AVMs A and B perform poorly, and an inaccurate valuation where AVMs A and B perform well. This difference in relative performance is uncovered only by the use-based CVM, which in that sense appears to produce a more accurate ranking of the AVMs than does the standard procedure. If indeed the AVMs are genuinely different in terms of where they perform well, then information on relative performance on AVMs B and C on properties 1 to 3 is of little relevance, and the essential comparison relates only to their performance on property 4. In this case, the standard CVM is strictly less accurate than the use-based CVM due to its bias in favor of AVM B. Given its strongly superior performance on properties 1 through 3, the standard CVM evaluates AVM B as strictly superior to AVM C in all cases, regardless of their actual relative quality. In this case the use-based CVM is strictly more accurate since it looks only at relative performance on property 4, which is appropriate given the differences between models. Note also that the standard CVM produces a misleading picture of model accuracy: it treats model B as having a high accuracy rate, since it is accurate on 2 of 3 valuations. Unfortunately, it is inaccurate in the only valuation that matters: that of property 4.

2. Fixed Relative Quality Favors Standard CVMs

The variation in the relative quality of AVMs B and C is the key ingredient in making the use-based cascade more accurate. Consider now the polar opposite case, in which their relative quality is the same across all properties on a small sample. In this case, statistical reasoning argues in favor of the standard cascade over the use-based cascade. For example, in the four property cases above, it may be purely by chance that AVM C, while generally less accurate than AVM B, happened to produce a successful valuation for property 4, while AVM B did not. If this is indeed true, then the use-based cascade is incorrect in concluding that AVM C is superior on properties similar to property 4: it was purely by chance that AVM C performed better on property 4 than did AVM B. The advantage of the standard cascade in this case is that it includes the performance on properties 1 through 3 in the comparison, and on this basis identifies AVM B as superior to AVM C.

3. Large Sample Size Favors Use-Based CVMs

With a large sample of transactions on which to compare AVMs B and C, it becomes increasingly unlikely that the use-based ranking will be in error. For example, suppose that there are 100 or more transactions that AVMs B and C provide qualifying valuations for, while AVM A does not. In this case, it is almost impossible for the use-based ranking to incorrectly identify the superior AVM. The law of large numbers ensures that any substantial difference in model performance on these properties will show up in the statistical sample.

4. A Wrinkle Related to AVM Coverage

The reason for building an AVM cascade in the first place is that different AVMs provide qualifying valuations for distinct properties. There are several possible reasons why AVMs may provide qualifying valuations for distinct properties. One is that they have different areas of expertise: this tends to favor use-based cascades. The second is that they are more or less selective, in which case the job of ranking AVMs is particularly difficult. A highly selective AVM can in principle artificially boost its ranking by providing few qualifying valuations. It is easy to construct examples in which this can lead both the use-based and the standard CVM to erroneously select the best AVM based more on the fact that it refuses to value hard-to-value properties rather than any overall superiority in performance.

5. A User Guide

The above indicates that the nature of the valuation task, of the competing AVMs, and of the comparison sample are all critical in determining whether a use-based or standard CVM is likely to be superior. Given the intricacies involved in selecting an appropriate cascade, we believe that cascade users would do well to ask cascade producers to provide a rationale as to which form of CVM is better matched to the given task. There would be two key aspects to such a rationale:

1. **Correlation in Errors:** A key issue is how similar the underlying errors are for the various AVMs. To evaluate this requires a measure of the correlation in model errors in areas of overlap. If this correlation is significantly below 1, then the underlying AVMs would appear to have different structures, heightening the need for the use-based CVM. However if the correlation is close to one, then the models are likely to be very similar in basic structure, lowering any advantage that the use-based CVM might have.

2. **Comparison of Sets for Which Qualifying Valuations are Provided:** The extent to which different AVMs provide qualifying valuations for distinct properties is a key factor in identifying how different the underlying AVM models are. If there are significant differences in the properties for which qualifying valuations are provided, this is indicative of model differences, and pushes in favor of the use-based CVM. It also serves to ensure that many properties will not be valued by the first AVM in the cascade order, yet will be valued by the remaining AVMs. On the other hand, if there is almost complete overlap, this suggests that the underlying AVMs are similar, and also shrinks the sample for comparing lower ranked AVMs. In that sense, it favors the standard over the use-based CVM.

In addition to these two factors, it is important for all CVM producers to complete step 6 of model creation alluded to in the last section, by evaluating CVM performance. This is more straight forward for the use-based cascade, since the model is constructed in precisely the same manner that it is applied. For the standard CVM, accurate estimation of the performance in practice is more intricate, and appears not to be the industry norm. This factor clearly favors the use-based CVM for risk management purposes. The job of a risk manager depends on having an accurate expectations concerning performance in practice of the valuation model. In that sense, having flawed expectations based on poorly measured CVM performance is a significant problem.

IV. REGULATIONS AND PROGRESS IN THE VALUATION INDUSTRY

The fact that use of an inappropriate cascade can negatively impact the expected and actual accuracy of valuations highlights the importance of technical advance in the cascade industry. There is room for improvement in this regard. In addition to use-based CVMs, computer scientists are developing powerful techniques for combining the opinions of distinct experts that may have potential for improving cascade performance. In fact, many of the individual AVMs incorporate such reconciliation techniques. But cascade technology remains limited to a selection methodology.

Each industry participant has an important role in helping the cascade industry achieve its potential. Providers must seek innovation from within and outside of the mortgage industry. Academic experts have much to offer in cascading and other risk management technologies. Lenders can become proponents of valuation-enhancing innovation: they could require lenders to task providers and regulators with creating new approaches. And although regulators neither create nor purchase cascades, they may be the most powerful advocates for innovation. While some of the largest mortgage originators have recognized expertise in ranking AVMs, most other parties lack the required expertise. For such parties it is the regulators who increasingly set the ground rules for use of AVM cascades in lending decisions. Regulatory priorities concerning use of AVMs "to estimate collateral valuation for mortgage lending purposes" are indicated in S.1473, p. 2239 of the "Dodd-Frank Wall Street Reform and Consumer Protection Act". Five quality control standards are listed:

> "Automated valuation models shall adhere to quality control standards designed to
>
> (1) ensure a high level of confidence in the estimates produced by automated valuation models;
>
> (2) protect against the manipulation of data;
>
> (3) seek to avoid conflicts of interest;
>
> (4) require random sample testing and reviews; and
>
> (5) account for any other such factor that the agencies listed in subsection (b) determine to be appropriate."

The background to these regulations relates to the structure of the AVM and CVM industries. On the one hand, production of AVMs and CVMs is highly complementary and depends on access to the best data: that is why there are integrated suppliers, such as CoreLogic. As data providers, the larger institutions are in many ways best placed to protect against manipulation of the data given their access to the largest data sets including the most recent transactions. This places them in the best position to monitor possible "peeking" at actual transactions that may bias performance statistics for less conscientious AVM providers. In contrast, independent producers lack direct access to primary data, which makes them less able to ensure that contributing AVMs are producing results without prior knowledge of the benchmark transaction. The integrated suppliers also have an advantage with respect to meeting standard (4): given their knowledge of the quality of data used for testing, they can in principle be transparent with end users. In contrast, independent providers may be subject to data-use constraints that preclude end users from validating the calculations.

To set against these technical advantages, integrated suppliers of AVMs and CVMs have a financial interest in which AVMs rank highest in the cascade. There is no such clear-cut incentive problem for the independent operators.

Against this backdrop, the key question is how the regulators interpret these rules. The critical issue for the future of housing finance is that the regulations positively impact the quality of valuations. This is by no means certain. With a narrow interpretation focusing on incentives and certification of modeling methods, the regulations may incentivize users to seek standardized and outdated models. This would remove the incentive to invest in technological improvements since existing cascade approaches would be more likely to achieve regulatory approval, while novel methods would not. If that were to occur, the regulations would have a negative impact on the evolution of the market.

Fortunately, there appears to be room for more progressive interpretation of the regulations. We propose explicit addition of quality and transparency of models by the "agencies listed in subsection (b)" under clause (5) above. Regulators would thereby nurture a transparent and competitive industry structure. Development of superior cascades is highly technical and requires significant resources: large transactional data sets; expertise in algorithm design and statistical modeling; large amounts of computational power; and domain specific expertise in the intricacies of real estate valuation. This can only be worthwhile if the resulting improvements in performance can be advertised and understood and hence monetized by those who develop them. The regulators have a unique opportunity to encourage accuracy-enhancing progress in the valuation industry.

One key to ensuring progress is for the regulators to focus explicitly on transparency. The regulators can play a role in breaking the industry free from its self-defeating "secret sauce" nature by ensuring that information on the quality of valuations is presented in an open and verifiable manner. This would benefit not only the banks, but also the regulators themselves. It is much easier to audit a bank when the performance of AVMs and CVMs is presented in a transparent manner. Regulators should use clause (5) to establish ground rules concerning cascade presentation and to include in this the insistence that cascade producers are transparent about their methodologies. They should ensure that AVM and CVM producers present valid analyses of their relative performance in various standardized valuation tasks, with possible auditing that these had been applied in a neutral manner. At present there is no standardized method for comparing AVM performance. For example, there is a profound lack of standardization around the definition of AVM confidence scores. Regulators could press for a common definition of AVM performance to be adopted.

As noted above, the regulations will succeed only if they spur improvements in the valuation industry. We believe that increased standardization and transparency in performance measurement would liberate just such improvements. It would enable those with the best methodologies to prove their competitive edge, and thereby spur competitors also to advance the technological frontiers of the valuation industry. Objective performance measurement would also aid user comprehension and enable competition to flourish. Business would flow to those who perform best and innovation would be spurred.[1]

[1] This research was sponsored by CoreLogic. CoreLogic's sponsorship consisted of AVM performance data, documents on CoreLogic cascades, access to CoreLogic industry experts and funding for AVAC's research. The opinions expressed herein are solely those of the authors, and are not the opinions of CoreLogic or any of its employees.