On post-crisis banks' fair value measurement disclosure

Purpose We investigate the newly disclosed investment banks' accounting information. Our primary goal is to use the accounting information available in the annual financial statements disclosed between 2012 and 2015 and examine the interplay between the popularity of valuation techniques among the banks, the banks' perception of the broader risk environment, and their relative performance. In examining this interplay, we rely on the performativity theory as it applies to the field of economic sociology

Design/methodology/approach We use regression techniques to investigate the interplay between the selection of valuation techniques, risk assessment and performance. To do so, we rely on the banks'10-K and 20-F reports from 2012 to 2015. We use three key ingredients in our model: (1) the banks' return on equity (ROE) as a proxy for performance; (2) the range of unobservable inputs as a proxy of the banks' risk assessment; (3) the intensity of use of the valuation techniques, as a proxy for the extent to which a technique has undergone a performative process.

Findings The regression results reveal two key findings. The first is an inverse relationship between the intensity of use of valuation techniques and the banks' profitability. This inverse relationship suggests that more popular techniques lead to more competition between banks, and thus narrows the profitability gap among them. The second is the inverse relationship between the banks' risk assessment and the intensity of use; i.e.: a wider range of unobservable inputs is typically associated with a less frequently used technique, and vice versa. Taken together, both of these results suggest that the intensity of use mediates the performative process between valuation techniques and ROE.

Research limitations/implications A major research limitation is the relatively small size of our sample, at both the cross-sectional and time series levels.

Practical implications From a policy perspective, our findings imply that policymakers now have some tools to monitor banks' risky positions and performance determinants in order to avoid the "too big to fail". For instance, we show that the disclosed range of unobservable inputs is a strong indicator of investment banks' performance.

Originality/value The contribution of this paper is twofold: 1. We empirically exploit the accounting information available in the investment banks 'annual financial statements, disclosed between 2012 and 2015. 2. We apply the theory of performativity to shed light on the interplay between performance, intensity of use of valuation techniques and risk assessment.

Keywords: accounting disclosure, theory of performativity, valuation techniques, investment banking, great recession, unobservable inputs, ROE, risk assessment.

JEL Codes : C21, C22, D21, G01. G24, K23, Z13, M41, M48

1. Introduction

The 2008 global financial crisis and the subsequent near-collapse of the banking system prompted regulatory bodies to demand more transparency from banks with regards to the pricing of financial instruments, particularly derivatives. In March 2008, the U.S. Security Exchange Commission (SEC) recommended an amendment to the fair value disclosure requirements that make it mandatory for publicly listed banks to disclose more specific information. A few years later, in April 2011, the Financial Accounting Standards Board (FASB) issued an Accounting Standards Update titled "Fair value Measurement", also known as ASU 2011-04 Topic 820 (FASB, 2011). This amendment was created to achieve common fair value measurement and disclosure requirements across the U.S. Generally Accepted Accounting Principles (GAAP) and the International Financial Reporting Standards (IFRS). The FASB was very specific with the purpose of the update, emphasizing that its primary goal was to explain how fair value should be measured.[1] The update did not require additional fair value measurements established standards for valuation practices. Rather, it required public companies to disclose both quantitative and qualitative information regarding the valuation techniques used to price financial instruments (FASB, 2011).

For investment banks and other financial institutions that actively engage in financial market making activities, the 2011 update was of paramount importance. With this new requirement, the valuation of investment banks' assets and liabilities essentially became subject to greater transparency and scrutiny, at least for a few years. Indeed, the FASB reversed course recently by relaxing some of the requirements introduced in 2011. In January 2016, it issued another Accounting Standards Update 2016-01, titled "Financial Instruments–Overall: Recognition and Measurement of Financial Assets and Financial Liabilities" (FASB, 2016). This update eliminates the requirement to disclose valuation methods and key assumptions used to estimate fair values.

Despite the 2016 relaxation of the disclosure requirements, annual financial statement data available from 2012 to 2015 do contain valuable quantitative and qualitative information with respect to investment banks' valuation techniques. This includes not only the valuation techniques employed by banks to price financial instruments, but also the various unobservable inputs as well

[1] More details about the definition of the concept of fair value are provided in (Majercakova and Skoda, 2015) and Palea (2014).

as information on the statistical distribution of these inputs, such as the minimum, maximum, average and median values (this dataset was first collected by (Annabi and Reuben, 2017)).[2]

With this backdrop in mind, our primary goal in this paper is to use the accounting information available in the annual financial statements disclosed between 2012 and 2015 and examine the interplay between the popularity of valuation techniques among the banks, the banks' perception of the broader risk environment, and their relative performance. In examining this interplay, we rely on the performativity theory as it applies to the field of economic sociology (Callon, 2007; MacKenzie and Millo, 2003; Callon and Muniesa, 2005; Callon *et al.,* 2007). The concept was first introduced in the field of linguistics by (Austin, 1962). In his seminal book, *How to Do Things with Words*, Austin (1962) discusses the concept of "performative utterance" and advances that "The name is derived, of course, from 'perform', the usual verb with the noun 'action': it indicates that the issuing of the utterance is the performing of an action -it is not normally thought of as just saying something". Adopted by economic sociology, performativity is the notion that economic theory is not just a mere approximate description of the real world, it very often shapes it or "performs" it. Put another way, a concept or model can be thought of as a device that stimulates the genesis and the development of a market or an economic environment. In finance, the market device reconfigures or enacts its own environment, i.e.: the market.

The most relevant example of the application of the theory of performativity to economic sociology, and perhaps one closer to our analysis, is the Black-Scholes-Merton options pricing formula (hereafter BSM) (Mackenzie and Millo (2003)). The BSM formula was derived in 1973 and gained a great deal of attention in the academic world. It then quickly became the standard tool for pricing financial derivatives as practitioners relaxed many of its restrictive assumptions such as the absence of dividends and the use of a constant volatility parameter. In this example, the BSM model, i.e.: the device, performed financial markets, i.e.: the environment. Moreover, the performativity cycle allowed the BSM model to create the "phenomenon "of an asset with a known value (or at least so it was assumed) and subsequently enact the environment, i.e.: derivative markets, in which it is used. The performativity theory assumes that market devices engage their

[2] In their Dec 2013-10K reports, Morgan Stanley defines the unobservable inputs as "… inputs that reflect the Company's assumptions about the assumptions other market participants would use in pricing the asset or liability that were developed based on the best information available in the circumstances." (Morgan Stanley, 2013, p. 146).

environment by creating individual reproduction of themselves (Callon and Muniesa, 2005).[3] More recently, Abrahamson *et al.* (2016) defined market devices as business techniques, or linguistic prescriptions created to improve the operations of business organizations. The way in which the business techniques enact the business world make them more useful in that environment.[4]

In this paper, we argue that the process through which banks price financial instruments using valuation techniques is performative. We define valuation techniques as, not only methods selected by investment banks to optimally price financial instruments in order to maximize profit, but also market devices. In order to showcase this performative process, we depict a feedback loop (see Figure 1). First, valuation techniques are inanimate objects, written and created for an unexercised purpose. They can be therefore qualified as market devices, which marks the beginning of their existence. As banks begin to disclose their choice of valuation techniques, i.e.: they interact with the market devices and allow them to enact the environment, the performative process starts shaping up. Three key variables drive this performative process: 1. the popularity of the valuation techniques which determines their ability to attract a critical mass of participants; 2. the banks assessment of the broader risk environment; and 3. the banks' performance relative to their peers.

[Figure 1 here]

We proxy the popularity of the valuation techniques using *the intensity of use of valuation techniques*, a frequency measure of how often banks use a certain valuation technique for a certain traded asset or liability. As a measure for the banks' perception of the broader risk environment, we use a risk index that ranks the banks according to their risk perception or assessment (Annabi and Reuben, 2017). This risk index is inversely proportional to the range of unobservable inputs: the wider the range, the higher the bank's risk assessment, and vice versa. Our basic prior is that the choice of a given valuation technique and the corresponding inputs is partly informed by the bank's perception of the riskiness of its operating environment. For example, a wide range of unobservable inputs disclosed for a given technique likely reflects more uncertainty over the future value of the priced instruments, the broader operating environment and therefore the bank's own

[3] A stock ticker is another example of market device. In a detailed analysis of the agential features of financial technologies, Preda (2006) explores the idea that the ticker is a technological market device that performs what trading, and traders, constitute in financial markets.

[4] For more reference on the application of the theory of performativity to accounting see (Mouritsen, 1999), (Vosselman, 2014) and (Revellino and Mouritsen, 2015).

profitability outlook. Conversely, a tight range likely indicates greater confidence over the forward outlook.[5] Finally, and consistent with the banks' publicly disclosed shareholder policies, we use the Return on Equity (ROE) as a measure of investment banks' performance. As an additional robustness check, we also use the Return on Assets (ROA) as an alternative measure of banks' performance.

We empirically investigate the interplay between the popularity of the valuation techniques, the banks assessment of the broader risk environment, and the banks' performance relative to their peers. To do so, we estimate regression models with fixed effects on unobservable inputs. Our findings are twofold. First, the banks' performance exhibits an inverse relationship with the intensity of use. Put differently, the higher the intensity of use or the more popular the valuation technique is, the lower the banks' relative performance. This inverse relationship suggests that more popular techniques lead to more competition between banks, and thus narrows the profitability gap among them. Second, the higher the risk assessment, i.e.: the higher is the perception with regard to the riskiness of the operating environment, the lower is the intensity of use. In other words, a wider range of unobservable inputs is typically associated with a less frequently used technique, and vice versa. Taken together, these results suggest that the intensity of use mediates the performative process between valuation techniques and ROE.

The rest of the paper proceeds as follows. In section 2, we present the annual financial statement data covering the period from 2012 to 2015. Our sample includes the majority of US primary dealers. In section 3, we discuss the intensity of use of valuation techniques, the risk assessment index, and the ROE and ROA ratios. In section 4, we discuss the regression models and the key results. Section 5 provides concluding remarks.

2. The Data

We collect data on the unobservable inputs as well as the valuation techniques adopted by different banks. This data collection was made possible by the regulatory changes that required greater transparency and information disclosure. More specifically, the ASU 2011-04 requires companies

[5] The risk-taking literature generally associates the construct of risk with the extent to which a decision's expected outcomes are uncertain, decision goals are difficult to achieve, or the potential outcome set includes some extreme consequences (Gray and Cannelle, 1997; Sitkin and Pablo, 1992; Weber and Milliman, 1997; Wiseman and Gomez-Mejia, 1998). Our risk index captures these features.

to disclose quantitative information on unobservable inputs used in determining Level 3 measurements, a description of the valuation processes a company has in place for its Level 3 measurements and a description of the sensitivity of Level 3 fair-value measurements to changes in the unobservable inputs. Aside from the above three requirements, the ASU 2011-04 does not provide specific guidance on what quantitative information should be disclosed to meet the requirement described in the first item above. Instead, it includes an example of the type of information companies may disclose (FASB ,2011).

We examine 10Ks and 20Fs reports for the fiscal years spanning the 2012-2015 period. We first start by selecting the entire population of US primary dealers as of 2012, (21 dealers in total) and then retain dealers for which data on valuation techniques used to price the different assets and liabilities are available.[6] Table 1 shows the eight different banks in our sample, as well as the different categories of traded assets and liabilities, valuation techniques as well as unobservable inputs.

[Table 1 here]

While regulators do require financial institutions to disclose the techniques used to value financial instruments, the data collected in our sample suggest that financial institutions are generally reluctant to provide detailed information. The pattern is consistent with the findings of Ernst and Young (2012), which document similarities and differences in the way public companies disclose their fair value measurement. To account for the variations in the degree of disclosure, we bucket the eight banks in our sample into three buckets according to the granularity of their disclosure.

- The first bucket includes *Citibank* and *Goldman Sachs*. These two banks discussed methods of fair-value measurement in their 2011 annual reports but disclosed a formal schedule with key unobservable inputs only in 2012. Taking Goldman Sachs as an example, the fair-value footnote of its 2011 10K contains a schedule that presents the valuation techniques and the nature of significant inputs generally used to determine the fair values of each class of level 3 cash-instruments. The schedule also explains that for Goldman Sachs' cash instruments, the

[6] The list is provided by the Federal Reserve Bank of New York through the following link https://www.newyorkfed.org/markets/primarydealers.html. This dataset extends the one used in (Annabi and Reuben, 2017), which only covered the 2013 and 2014 fiscal years. Here, we add accounting information for two additional years: 2012 and 2015.

valuation techniques vary by instrument, but are generally based on discounted cash flow techniques. However, in 2012, the schedule provides more detail, disclosing the range of significant unobservable inputs as of December 2012 and the value of the assets in each cash instrument category.

- The second bucket includes *Morgan Stanley* and *JP Morgan Chase*, both of which do not disclose any valuation techniques in 2011. In the 2012 annual report, they disclose the full fair-value schedule.
- The third bucket includes *Bank of* America, *Credit Suisse, Jefferies* and *Nomura*. These banks mention their valuation methods in their 2011 and 2012 annual reports but do not include a formal schedule.

We would also note that aside from the Discounted Cash Flows (hereafter DCF) method, financial institutions provide little information about cash flow forecasting techniques or the discount-rate estimation methods. The 10K and 20F filings typically contain rather generic terms, such as "internally developed forecasts," "bespoke models," "observable proxy," "comparable," etc. Other models, such as comparable pricing, price-based, and the market approach, are even more vaguely defined. In addition, the scenario analysis used to estimate value of an asset is usually defined as stress-testing for abnormal activity in financial markets.

3. The Drivers of the Performative Process

We now turn to the construction of the three variables that drive the performative process: the intensity of use of valuation techniques, the banks' risk assessment, and the banks' performance as measured by the return on equity (ROE).

3.1 The intensity of use

In order to measure the frequency with which each valuation technique is used to price the various assets and liabilities traded by investment banks, we introduce a measure of frequency of use that we call *Intensity of Use*. We define it as the number of times a technique is used to price a financial instrument over the number of times it is used for all the other financial instruments. The intensity of use of a valuation technique is therefore defined as I_a, where:

$$IU_a = \sum_{b=1}^{4} \frac{VT_{a,b}}{\sum_{a=1}^{7} VT_{a,b}} \qquad (1)$$

where $VT_{a,b}$ is the valuation technique a, where $a = \{1,\ldots,8\}$, for financial instrument b, where $b = \{1,\ldots,4\}$ (see Table 1). Table 2 shows the various levels of intensity attributable to the different classes of assets and valuation techniques

[Table 2 here]

Among the different valuation techniques used by the banks in our sample, the Discounted Cash Flow (DCF) method is the most commonly used and best defined. Banks commonly define this valuation method as computing net present value or fair value of estimated/forecasted future cash flows and appropriate terminal value by discounting them with the appropriate discount rate. A similar definition of DCF model can be found in financial literature (Williams, 1938; 1997 reprint; Gordon and Shapiro, 1956; Modigliani and Miller, 1958). Table 2 shows that, on average, the discounted cash flow approach is the most popular to price corporate debt, derivatives and structured products.

For the valuation of derivatives, we also find that banks tend to be extremely protective of their models. Other than a few instances mentioning the well-known BSM, for example, banks simply describe their over the counter (a.k.a. OTC) derivative valuation process based on closed-form analytic formulas, simulations models, or a combination of the two. Another takeaway from Table 2 is that for the pricing approach for corporate equity, comparable price models seem to be the most widely used. We also notice that models that face a larger range of uncertainty and judgment, such as internal model, have a lower intensity of use across the four categories of assets and liabilities.

[Table 3 here]

Table 3 complements Table 2 and shows various summary statistics for the intensity of use.

3.2 Risk Assessment

We measure the banks' risk assessment using the Risk Index (RI) introduced by (Annabi and Reuben, 2017). The RI is defined as the standard deviation of the unobservable input observations for each valuation technique, $j = \{1, \ldots, 8\}$, such that

$$RI_j = \sum_{n=1}^{4} \sum_{i=1}^{8} \sum_{k=1}^{4} \sqrt{\frac{(H_{i,j,k,n} - A_{i,j,k,n})^2 + (L_{i,j,k,n} - A_{i,j,k,n})^2}{2}} \qquad (2)$$

where n represents the year with $n = \{2012, 2013, 2014, 2015\}$, i refers to the banks with $i = \{1, \ldots, 8\}$, k refers to the financial instrument and $k = \{1, \ldots, 4\}$. H and L represent respectively the highest and lowest range value for the unobservable inputs. A represents the average range values for the unobservable input.

[Table 4 here]

Table 4 shows the average risk assessment per valuation technique for each year in our sample. We notice that, in 2012, the valuation with the highest risk assessment is the options model (OM), followed by the discounted cash flows (DCF). We also find that, on average, the 2012 risk assessments for the different valuation techniques were the highest out of the 4 years' observations in our sample.

3.3 ROE and ROA

In our paper, we use the return on equity ratio, ROE, as our proxy for the profitability of the banks as dictated by their choice of valuation techniques. ROE for all the banks in our sample is collected from Ycharts, a financial data research platform. As a robustness check, we also use the return on assets ratio, ROA, as an additional proxy for profitability.

[Table 5 here]

Table 5 shows basic descriptive statistics on ROE and ROA. One can see that the average ROE in Table 5 increased from 2012 to 2013, then slightly decreased in 2014 to remain almost constant in 2015. Within our sample of banks, Goldman Sachs and JP Morgan were the best performers over the period 2012-2015. Relative to the pre-crisis period, banks ROE has substantially decreased due to tougher regulatory environment.

4. Empirical Results

4.1 Characterizing the Performativity Cycle

We argue that the process through which banks price financial instruments using valuation techniques is performative. We define valuation techniques as, not only methods selected by

investment banks to optimally price financial instruments in order to maximize profit, but also market devices. The following two propositions define the interplay between the three key drivers of the performativity cycle: 1. Intensity of use; 2. the risk assessment index; and 3. ROE and ROA. What is important to note is that the intensity of use mediates the performative process between valuation techniques and ROE.

Proposition 1: The intensity of use of valuation techniques is inversely correlated with ROE

Proposition 2: The intensity of use of valuation techniques is inversely correlated with Risk Assessment

The first proposition states that the banks' performance exhibits an inverse relationship with the intensity of use, i.e.: the popularity of techniques. Put differently, the higher the intensity of use or the more popular the valuation technique is, the lower the banks' relative performance. The second proposition states that the higher the risk assessment, i.e.: the higher is the perception with regard to the riskiness of the operating environment, the lower is the intensity of use. In other words, a wider range of unobservable inputs is typically associated with a less frequently used technique, and vice versa.

These two relationships explain the process that valuation techniques undergo through the mediating role of the intensity of use. The process is similar with ROE and risk assessment in that both allow the valuation techniques to be transformed in order to enact the environment, be it that of the market for ROE or that of bank's approach for risk assessment.

4.2 Regression Results

To empirically investigate the relationships between the banks' performance, the intensity of use, and the banks' risk assessment and the intensity of use described in the above two propositions, we estimate the following regression models:

$$Y_{it}(ROE) = \beta_0 + \beta_1 Intensity_{it} + \beta_2 Size_{it} + \beta_3 U.S.Domicile_{it} + \beta_4 GDP_t + \varepsilon_{it} \quad (3)$$

and

$$Y_{it}(Risk\ Assessment) = \beta_0 + \beta_1 Intensity_{it} + \beta_2 Size_{it} + \beta_3 U.S.Domicile_{it} + \gamma_i + \varepsilon_{it}, \quad (4)$$

where the ROE is based on twelve-month trailing figures (TTM), Risks Assessment refers to the risk assessment index as defined in equation (2), Intensity refers to the intensity of use as defined

in equation (1), Size refers to the size of the balance sheet size in billions of dollars, Domicile is a dummy variable that equates 1 if the bank is domiciled in the US, and 0 otherwise, and GDP refers to the country of domicile's GDP per capita.

The regression models shown in equations (3) and (4) essentially relate the bank's performance and risk assessment to the intensity of use of the valuation techniques, after controlling for the banks' balance sheet size and domicile, and GDP per capita.

The regression shown in equation (3) relates each bank's ROE to our measure of the intensity of use of the various valuation techniques disclosed. The dependent variable, ROE, can be thought as a categorical variable while the independent variable, the intensity of use, is a continuous variable. We estimate the model using a standard maximum likelihood technique. Table 6 provides the coefficient estimates for various versions of the regression model shown in equation (3).

[Table 6 here]

The key takeaway from Table 6 is the negative cross-sectional correlation between the ROE and the intensity of use. This inverse relationship suggests that more popular techniques lead to more competition between banks, and thus narrows the profitability gap among the banks. Table 6 also shows that the response of the ROE to the intensity of use decreases slightly when we control for the size of the balance sheet. This decline likely reflects the positive, albeit weak, correlation between size and ROE, i.e. larger banks have higher ROE, and vice versa, which explains the ameliorating effect that balance sheet size has on ROE. Similarly, we also note that the response of the ROE to the intensity of use further modestly declines when we control for the investment banks' domicile. This modest decline likely reflects the stronger profitability of US banks vs. their foreign peers. All in all, the regression results shown in Table 6 suggest that the more popular the valuation technique, the lower the banks' relative performance.

As a robustness check, we also substitute ROE with ROA as an alternative measure of banks' performance. The results remain unchanged as can be seen in Exhibit 7, i.e.: the intensity of use and the banks' profitability exhibit a negative cross-section correlation.

[Table 7 here]

Turning to the relationship between risk assessment and intensity of use shown in equation (4). Results in Table 8 suggest a negative and significant relationship between the intensity of use and

the risk assessment. The higher the intensity of use of a valuation technique, the lower is the perceived riskiness of the banks' operating environment and vice versa.

[Table 8 here]

As a final robustness check and in order to account for potential time variation in the relationship between ROE and intensity of use, we run panel regressions of equation (3). The regression results are displayed in Table 9.

[Table 9 here]

With the exception of 2012, the regression coefficient on the intensity of use is negative and significant during all the subsequent years. Again, the key takeaway is the negative correlation between the valuation techniques' performative process and the ROE. And as show by Table 10, a similar pattern prevails for ROA.

[Table 10 here]

5. Discussion and Conclusions

We use annual financial statement data available from 2012 to 2015 and extract quantitative and qualitative information with respect to investment banks' valuation techniques. We then rely on the performativity theory to examine the interplay between the popularity of valuation techniques among the banks, the banks' perception of the broader risk environment, and their relative performance. We do so by estimating regression models with fixed effects on unobservable inputs. The regression results reveal two key findings. The first is an inverse relationship between the intensity of use of valuation techniques and the banks' profitability. This inverse relationship suggests that more popular techniques lead to more competition between banks, and thus narrows the profitability gap among them. The second is the inverse relationship between the banks' risk assessment and the intensity of use; i.e.: a wider range of unobservable inputs is typically associated with a less frequently used technique, and vice versa. Taken together, both of these results suggest that the intensity of use mediates the performative process between valuation techniques and ROE.

Granted, the 2016 relaxation of the disclosure requirements clearly puts a constraint on a potential extension of this work to include future annual financial statements. But one way to overcome this

constraint is to use survey data. Conducting a well-designed survey among investment banks would allow for a better understanding of the decision-making processes behind valuation techniques, and more specifically, the relationship between the intensity of use, risk assessment, and performance. The use of survey data would therefore allow us to further assess the robustness of our constructs on the intensity of use and the risk assessment.

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Figures and Tables List

Figure 1: Performative Process for Valuation Techniques

This figure shows the performative process for the intensity of use and its correlation with investment banking objectives. Particularly, it shows how valuation techniques operate as market devices that perform through the intensity of use to affect not only ROE in some instantiations, but also Risk assessment in others. We apply a construct for intensity of use and create a novel construct for risk assessment. It is important to notice that the performative process is cyclical, by allowing the market devices to first enact the environment and then allowing the environment to re-affect the market device by acting through the process itself.

FIGURE 1
Performative Process for Valuation Techniques

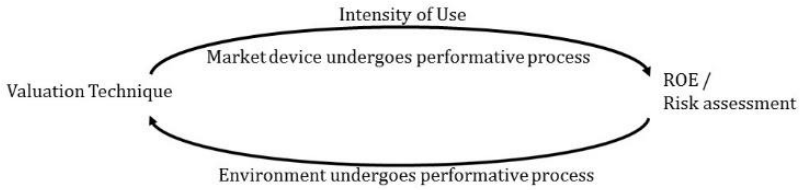

Table 1: Data Description

This table describes the data collected from 10K and 20F between December 31st, 2012 until December 31st, 2015. Using the same screening methodology as in (Annabi and Reuben, 2017)), we retain eight banks in our sample, then we bucket the traded assets and liabilities into four categories, and we label them *financial instrument*. We also identify 30 unobservable inputs that we bucket into seven groups: Correlation, price, rate, severity, spread, volatility and yield. We also retain the following eight valuation techniques: comparable bond price, discounted cash flow, corporate loan model, correlation model, internal model, net asset value, market approach and option model. Moreover, we bucket the 30 unobservable inputs collected into seven categories: *Correlation* (e.g. commodity correlation, credit correlation, cross-commodity correlation, equity-equity correlation, equity-FX correlation, equity-interest rate correlation, interest rate curve correlation, interest rate-FX correlation, interest rate-interest rate correlation), *price* (e.g. comparable bond price, comparable equity price, comparable loan price, comparable price, price per barrel of oil, price per megawatt hour of power), *rate* (e.g. recovery rate, capitalization rate, conditional default rate, cumulative loss rate, default rate, discount rate, prepayment rate,), *severity* (loss severity), *spread* (e.g. credit spread, spread per Million British Thermal Units (MMBTU) of natural gas), *volatility* (e.g. at-the-money volatility, commodity volatility, equity volatility, FX volatility, inflation volatility) and *yield*.

Investment Banks	**Financial Instruments**	**Valuation Techniques**	**Unobservable Inputs**
Bank of America	Corporate debt	Comparable price model	Correlation
Citibank	Corporate equity	Corporate loan model	Price
Credit Suisse	Derivatives	Correlation model	Rate
Goldman Sachs	Structured product	Discounted cash flow	Severity
Jefferies		Internal model	Spread
JP Morgan Chase		Market approach	Volatility
Morgan Stanley		Net asset value	Yield
Nomura Group		Option model	

Table 2:Average intensity of Use per Financial Instrument and Valuation Technique

The table reports the average intensity of use of each financial technique by category of trading assets and liabilities. This intensity of use is defined in equation (1). These averages are calculated for all the 8 banks in our sample over the period 2012-2015. The valuation techniques reported in this table are; CP (Comparable Price model), CLM (Corporate Loan Model), CM (Correlation Model), DCF (Discounted Cash Flow), IM (Internal Model), MA (Market Approach), NAV (Net Asset Value) and OM (Option Model). Missing values indicate that banks in our sample do not use these valuation techniques to price the corresponding assets or liabilities.

	CP	CLM	CM	DCF	IM	MA	NAV	OM
Corporate Debt	34.77%	18.39%	7.07%	42.07%	26.41%	40.14%	-	8.80%
Corporate Equity	37.32%	-	3.51%	32.52%	33.33%	33.73%	23.65%	-
Derivatives	18.47%	-	25.24%	53.82%	14.38%	26.30%	-	80.00%
Structured Products	25.29%	27.54%	35.35%	70.09%	8.77%	28.37%	-	11.20%

Table 3: Descriptive Statistics on Intensity of Use

We start with a sample of 14 companies. In 2012, six companies failed to comply with ASU-2011 04, which requires disclosure of information about the valuation technique they are using to price trading assets and liabilities. This brings the number of observations for the Balance in 2012 to eight companies. Moreover, Leukadia acquired Jefferies in 2014, which brings the total sample size for balance to seven in 2015. We present 4 tables, each describing descriptive statistics for the intensity of use (see equation (1)) as well as the balance as of December 31st of the corresponding year studied. Mean represents the average risk assessment, StDev the standard deviation of the observations, Min the minimum value, Max the maximum value.

	Mean (%)	Median (%)	StDev (%)	Min (%)	Max (%)
2012	45.70	41.70	27.24	1.00	100.00
2013	44.33	41.70	24.98	1.03	79.45
2014	37.50	42.59	27.72	1.30	100.00
2015	39.40	34.37	27.02	1.47	100.00

Table 4: Descriptive Statistics on Risk Assessment

This table reports descriptive statistics bank's risk assessment (defined in equation (2)) by year, and for each valuation technique. We report the Mean, Standard Deviation (StDev), minimum value (Min), maximum value (Max) and the total number of observations (N). The valuation techniques considered are; CP (Comparable Price model), CLM (Corporate Loan Model), CM (Correlation Model), DCF (Discounted Cash Flow), IM (Internal Model), MA (Market Approach) and NAV (Net Asset Value). Missing values indicate that banks in our sample do not use these valuation techniques to price the corresponding assets or liabilities.

	2012					2013					2014					2015				
	Mean	StDev	Min	Max	N	Mean	StDev	Min	Max	N	Mean	StDev	Min	Max	N	Mean	StDev	Min	Max	N
CP	2.12	2.09	.02	7.33	21	2.03	1.87	0	9	39	3.05	4.91	0.01	22.2	60	3.37	6.63	0	41.86	59
CLM	3.51	-	3.51	3.51	1	1.69	.94	.4	2.64	4	1.92	.95	1.03	3.37	5	1.33	.93	0	3.01	18
CM	3.52	3.87	1.29	10.36	5	4.77	9.86	.658	38.26	14	2.05	1.61	.22	6.77	22	2.04	1.63	0	7.89	29
DCF	8.92	46.49	0	334	51	6.12	24.69	0	266.6	128	3.77	6.68	0	47	58	5.03	12.9	0	109	91
IM	-	-	-	-	-	15.38	51.50	.4	208.3	16	-	-	-	-		-	-	-	-	-
MA	0	-	0	0	1	0.87	1.36	0	5.13	15	2.28	2.99	0	18.7	52	2.67	4.78	0	35.94	61
NAV	4.63	-	4.65	4.65	1	1.98	-	1.98	1.98	1	-	-	-	-	-	-	-	-	-	-
OM	27.38	92.16	.13	334	13	4.25	9.47	0	66.91	54	4.41	9.29	.12	47	26	4.84	16.5	0	109	44

Table 5: Descriptive Statistics for ROE, ROA, Size and GDP per Capita

The data sample comprise all investment banks identified as dealers by the Security and Exchange Commission (SEC). This Table contains descriptive statistics for the dependent variables ROE and ROA, as well as the control variables: Size and GDP per Capital. The ROE measure is based on Trailing Twelve Months (TTM). The ROA is measured as the trailing 12-month net income / average of the previous 5 quarters of total assets. All the ROE and ROA in this table are collected from ycharts.com, and effective on December 31st of their corresponding year. Size refers to the size of the balance sheet size in billions of dollars, and is collected from banks' balance sheets. We collect GDP per capita data from The World Bank Data, and more particularly World Development Indicators. GDP per capita is measured in current $US. We collect GDP per capital for 4 countries in which the banks in our sample are domiciled: Japan, Switzerland, United Kingdom and United States. Moreover, there are 8 banks in the sample for the time-period 2012-2014, then Leukadia acquired Jefferies in 2014, which brings the total sample size of banks to 7 in 2015.

	Year	Mean	Median	StDev	Min	Max
ROE (%)	2012	5.33	3.99	4.28	0.11	11.48
	2013	7.34	6.39	2.50	4.75	11.39
	2014	6.54	5.95	3.34	2.19	11.70
	2015	6.57	8.43	5.82	-6.27	11.28
ROA (%)	2012	0.37	0.19	0.36	0.01	0.92
	2013	0.58	0.58	0.20	0.25	0.86
	2014	0.51	0.42	0.29	0.20	0.96
	2015	0.62	0.75	0.44	-0.31	0.99
Size ($US Billion)	2012	3.07	0.15	5.15	-0.18	29.97
	2013	2.28	1.13	3.27	-1.59	15.21
	2014	6.05	0.66	16.83	-2.36	88.15
	2015	2.17	0.94	2.98	-2.03	24.81
GDP per Capita (Current $US)	2012	56,189	50,027	18,460	41,538	83,164
	2013	55,077	47,597	20,451	40,454	84,659
	2014	56,230	50,505	20,842	38,069	85,815
	2015	53,900	50,068	20,133	34,474	80,990

Table 6: Intensity of Use of Valuation Techniques and ROE

This table presents coefficients estimates of regression where intensity of use is the independent variable and the ROE is the dependent variable. ROE is a well-established financial indicator that measures the rate of return on the money invested by common stock owners and retained by the company thanks to previous profitable years. The key variables are intensity of use of valuation techniques, size and a dummy variable indicating whether the investment bank in question is from the United States or not. Intensity of use is defined in equation (1), size of the balance sheet is in billions of dollars, and effective as of December 31st of each year in our sample. We also use GDP per capita ($ millions) as a control variable. In this table, the primary control variables, namely size, a dummy specifying U.S. domicile as well as GDP per capita, are introduced sequentially in order to buttress the validity of the relationship between intensity and ROE. No. Obs. denotes the number of observations, and Adj. R^2 is the adjusted R^2. The total number of observations reflects the number of intensity of uses we calculate per financial technique and asset class for all the banks in our sample. The number of observations change each year as each banks decision to adopt certain valuation techniques for certain assets and liabilities change for one year to the other, and the number of banks in our sample decrease from 8 (2012-2014) to 7 in 2015. In parenthesis are the adjusted t-statistics. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Dependent variable: ROE

	(1)	(2)	(3)	(4)
Intensity	-0.016*** (0.007)	-0.014*** (0.004)	-0.012*** (0.004)	-0.013*** (0.005)
Size		0.3*** (0.004)	0.3*** (0.004)	0.3*** (0.003)
U.S. domicile			2.260*** (0.435)	0.846** (0.072)
GDP per Capita				0.002** (0.164)
Constant	0.465 (3.35)	0.765 (3.29)	-1.132 (3.37)	2.512 (2.63)
No. Obs.	1036	1036	1036	1036
Adj. R^2(%)	24.75	29.52	34.24	50.32

Table 7: Intensity of Use of Valuation Techniques and ROA

This table presents coefficients estimates of regression where intensity of use is the independent variable and the Return on Assets (ROA) is the dependent variable. We run this regression as a robustness check for regression (3) where another measure of performance, ROE, is used to proxy banks' performance. The key variables are intensity of use of valuation techniques, size and a dummy variable indicating whether the investment bank in question is from the United States or not. Intensity of use is defined in equation (1), size of the balance sheet is in billions of dollars, and effective as of December 31st of each year in our sample. We also use GDP per capita ($ millions) as a control variable. In this table, the primary control variables, namely size, a dummy specifying U.S. domicile as well as GDP per capita, are introduced sequentially in order to buttress the validity of the relationship between intensity and ROA. No. Obs. denotes the number of observations, and Adj. R^2 is the adjusted R^2. The total number of observations reflects the number of intensity of uses we calculate per financial technique and asset class for all the banks in our sample. The number of observations change each year as each banks decision to adopt certain valuation techniques for certain assets and liabilities change for one year to the other, and the number of banks in our sample decrease from 8 (2012-2014) to 7 in 2015. In parenthesis are the adjusted t-statistics. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Dependent variable: ROA

	(1)	(2)	(3)	(4)
Intensity	-0.041*** (0.012)	-0.0354*** (0.012)	-0.0354*** (0.012)	-0.0354*** (0.012)
Size		10e-03*** (7.2e-6)	15e-03*** (7.2e-6)	15e-03*** (7.5e-6)
U.S. domicile			2.56*** (0.009)	15e-03** (5.6e-6)
GDP per Capita				0.002** (0.164)
Constant	2.841 (2.52)	3.62 (2.45)	3.62 (2.50)	2.48 (3.94)
No. Obs.	821	821	821	821
Adj. R^2(%)	52.27	53.11	54.33	56.22

Table 8: Intensity of Use of Valuation Techniques and Risk Assessment

This table represents the performative pattern between valuation techniques and the assessment of risk by investment banking traders. Intensity is defined in equation (1), risk assessment is measured in equation (2). No. Obs. denotes the number of observations, and Adj. R^2 is the adjusted R^2. The total number of observations reflects the number of intensity of uses we calculate per financial technique and asset class for all the banks in our sample. The number of observations change each year as each banks decision to adopt certain valuation techniques for certain assets and liabilities change for one year to the other, and the number of banks in our sample decrease from 8 (2012-2014) to 7 in 2015. In parenthesis are the adjusted t-statistics. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Dependent variable: Risk assessment

	(1)	(2)	(3)
Intensity	-0.17* (0.11)	-0.24*** (0.07)	-0.28*** (0.14)
Size		-0.23 (0.24)	-0.55 (0.34)
U.S. domicile			17.38 (9.01)
Constant	1.24 (3.09)	1.06 (3.85)	-12.97* (7.85)
No. Obs.	110	110	110
Adj. R^2(%)	21.4	24.2	22.6

Table 9: Intensity of Use of Valuation Techniques and ROE Per Year

This table presents coefficients estimates of regression (3). In this regression, we estimate the correlation between ROE and intensity of use of valuation technique over a time period of 4 years, spanning from 2012 to 2015 (see equation (3)). The dependent variable is the Return on Equity, or ROE. The key variables are intensity of use of valuation techniques (%), size of the balance sheet ($ billions), bank's domicile (dummy variable) and GDP per capita (Current $US). The control variables are introduced sequentially in order to buttress the validity of the relationship between intensity of use and ROE. The total number of observations, No. Obs., reflects the number of intensity of uses we calculate per financial technique and asset class for all the banks in our sample. This number changes each year as each banks decision to adopt certain valuation techniques for certain assets and liabilities change for one year to the other, and the number of banks in our sample decrease from 8 (2012-2014) to 7 in 2015. In parenthesis are the adjusted t-statistics. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Dependent variable: ROE

	Panel A: 2012 ((1) – (4))				**Panel B: 2013 ((5) – (8))**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intensity	-2.3e-03 (3e-03)	-1.06e-03 (3.3e-03)	-0.11e-03 (3.3e-03)	-1.44e-03 (3.3e-0.3)	-23e-03*** (4.9e-03)	-21e-03*** (4.8e-03)	-21e-03*** (4.8e-03)	-20e-03*** (3.5e-03)
Size		6e-02*** (4.84e-02)	16e-02*** (3.08e-02)	6.79e-02*** (2.56e-02)		-27e-02*** (4.92e-02)	26e-02*** (4.99e-02)	24e-02*** (4.75e-02)
U.S. domicile			1.70*** (0.4214)	2.21*** (0.694)			0.566*** (0.46)	0.724*** (0.33)
GDP per capita				8.23e-06*** (1.4e-04)				3.96e-03*** (7.58e-06)
Constant	-0.48 (2.82)	-0.14 (2.73)	-1.56 (2.71)	-2.22 (2.32)	5.04 (3.46)	5.35 (3.40)	4.86 (3.42)	2.40 (1.24)
No. Obs.	730	730	730	730	1036	1036	1036	1036
Adj. R^2(%)	64.23	67.2	63.1	76.67	25.2	26.4	39.1	48.48

	Panel C: 2014 ((8) – (11))				**Panel D: 2015 ((12) – (15))**			
	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Intensity	-1e-05*** (4e-06)	-1e-05** (4e-06)	-1e-05** (4e-06)	-5.27e-06* (8.5e-07)	-4e-05*** (5e-06)	-3.49e-05*** (5e-06)	-2.17e-05*** (5e-06)	-1.08e-05*** (5e-06)
Size		2.40e-03*** (4.00e-04)	2.60e-03 *** (4.07e-04)	1.98e-03*** (2.89e-04)		1.16e-03** (4.68e-04)	9.08e-04*** (4.72e-04)	1.06e-03*** (6.37e-04)
U.S. domicile			-10.06e-03 (4.1e-03)	-13.32e-03 (4.5e-03)			16.25e-03*** (5.1e-03)	8.27e-03*** (3.1e-03)
GDP per capita				7.75e-07*** (1.19e-07)				2.68e-07*** (1.28e-07)
Constant	4.3e-02 (2.99e-02)	4.5e-02 (2.94e-02)	5.2e-02* (2.86e-02)	3.6e-02* (1.756e-02)	10.2e-02* (0.037)	10.3e-02** (3.7e-02)	9.14e-02*** (3.7e-02)	1.3e-02*** (1.8e-03)
No. Obs.	986	986	986	986	1017	1017	1017	10171017
Adj. R^2(%)	33.6	36.5	34.8	32.9	48.8	48.4	48.5	48.8

Table 10: Robustness Check - Intensity of Use of Valuation Technique and ROA, Per Year

This table presents coefficients estimates of regression (3), except that the dependent variable is Return on Assets, or ROA. In this regression, we estimate the correlation between ROA and intensity of use of valuation technique over a time period of 4 years, spanning from 2012 to 2015 (see equation (3)). The key variables are intensity of use of valuation techniques (%), size of the balance sheet ($ billions), bank's domicile (dummy variable) and GDP per capita (Current $US). The control variables are introduced sequentially in order to buttress the validity of the relationship between intensity of use and ROE. The total number of observations, No. Obs., reflects the number of intensity of uses we calculate per financial technique and asset class for all the banks in our sample. This number changes each year as each banks decision to adopt certain valuation techniques for certain assets and liabilities change for one year to the other, and the number of banks in our sample decrease from 8 (2012-2014) to 7 in 2015. In parenthesis are the adjusted t-statistics. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Dependent variable: ROA

	Panel A: 2012 ((1) – (4))				**Panel B: 2013 ((5) – (6))**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intensity	-8.4e-03 (9e-03)	-4.79e-03 (9.4e-03)	-5.88e-03 (9.1e-03)	-1.44e-03 (3.3e-0.3)	-1e-03*** (8.8e-04)	-1e-03*** (4.8e-04)	9.8e-02*** (4.7e-03)	-1e-03*** (4.8e-03)
Size		2e-02*** (4.9e-02)	1.5e-2*** (2.4e-03)	6.79e-02*** (2.56e-02)		-1e-02*** (4.9e-02)	4e-02*** (5.2e-02)	24e-02*** (4.2e-02)
U.S. domicile			0.686*** (05.5e-03)	2.21*** (0.694)			2.6e-03*** (4e-04)	1.6e-03*** (0.3337)
GDP per capita				8.23e-06*** (1.4e-04)				1.90e-03*** (5.83e-06)
Constant	-0.002 (0.017)	-0.004 (0.016)	-0.004 (0.016)	-0.021 (0.017)	0.002 (0.017)	0.002 (0.014)	0.002 (0.0014)	0.007 (0.008)
No. Obs.	646	646	646	646	821	821	821	821
Adj. R^2(%)	63.76	64.57	69.64	72.45	34.6	35.8	48.2	49.6

	Panel C: 2014 ((8) – (11))				**Panel D: 2015 ((12) – (15))**			
	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Intensity	-1e-05*** (6e-06)	-3e-05** (4e-06)	-3e-05** (5e-06)	-2e-06* (5.3e-07)	-2e-05*** (9e-06)	-2e-05*** (9e-06)	-2e-05*** (7e-06)	-1.08e-05*** (5e-06)
Size		4.85e-03*** (3.44e-04)	4.52e-03 *** (3.44e-04)	3.97e-03*** (2.55e-04)		3.42e-03** (5.64e-04)	3.76e-03*** (4.44e-04)	1.06e-03*** (6.37e-04)
U.S. domicile			3.52e-03 (5.4e-03)	-4e-03 (1.1e-03)			6.66e-03*** (4.34e-03)	8.27e-03*** (3.1e-03)
GDP per capita				3.21e-07*** (7.52e-07)				2.68e-07*** (1.28e-07)
Constant	4.14e-02 (1.15e-02)	4.5e-02 (2.94e-02)	4.2e-02* (1.07e-02)	2.4e-02* (1.12e-02)	5.5e-02* (0.020)	5.1e-02** (2e-02)	6.66e-02*** (4.3e-02)	1.3e-02*** (1.8e-03)
No. Obs.	546	546	546	546	808	808	808	1017
Adj. R^2(%)	56.1	63.6	65.7	69.2	52.8	55.6	65.3	48.8