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On the Valuation of Large Systemic U.S. Banks

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Abstract

We extend Gordon's growth model of stock valuation, allowing both dividend and cost of equity to be variable over time. We establish a dynamic relationship between the price – to – book ratio of equity and measures of the cost of equity, the expected growth of net income and modified dividend payout ratio. We examine the stock market valuation of large, systemic banks in the U.S. over the period 2003Q4 – 2014Q1. We find that the price – to – book ratio of equity is a valid valuation model. We also find large heterogeneity in the degree to which price – to – book ratios of these banks are temporarily above or below their long – run equilibrium valuation. These divergences are persistent over time but temporary with only about a quarter of the gap closing each quarter. We form trading strategies based on the model that lead to predominantly positive returns.

JEL classification: C32; C33; C58; E32; G12; G21

Keywords: Dividend discount model; Panel error correction; Pooled mean group estimation; Price to book valuation; Systemic U.S. banks

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1. Introduction

The valuation by market participants of U.S. banks' stock has fluctuated considerably over the last decade. As regards the price – to – book ratio of equity we have also observed large, secular movements during and after the financial crisis that erupted in 2007. To what extent are these movements compatible with a fundamental model of valuation? We address this question for the group of large, systemic U.S. banks. These are the banks that participated in a series of capital assessment tests conducted by the Federal Reserve starting in 2009.

We propose a novel model of equity valuation for banks. It is a dynamic model of valuation linking the price – to – book ratio of equity and measures of fundamentals such as the cost of equity, the expected growth of net income and the modified dividend payout ratio. This model is an extension of Gordon's growth model of stock valuation and allows both dividend and the cost of equity to be variable over time. We use the pooled mean group (PMG) method of dynamic heterogeneous panels estimation proposed by Pesaran et al. (1999) in order to estimate the long – run equilibrium relationship, if one exists. This method can be viewed as a panel error correction model.

Our results for large, systemic U.S. banks show that there is an economically meaningful and stable long – run equilibrium relationship between the price – to – book ratio of equity and the aforementioned fundamental variables. An increase in the expected growth of net income by one standard deviation is associated with an increase in the price – to – book ratio by 0.481. The corresponding magnitudes for the cost of equity and the modified dividend payout ratio are lower at -0.084 and 0.224, respectively. At any given point in time, however, there is a large heterogeneity in the degree to which current price – to – book ratios of these banks are temporarily above or below their long – run equilibrium valuation. Furthermore, these divergences are rather persistent over time. On average, only about a quarter of the gap closes each quarter.

Our model is agnostic about the reasons for the existence of persistent but temporary deviations of stock market valuation from a long – run equilibrium value.[3] However, this existence points to the possibility of predictable trading profits. We sort the bank stocks by the degree of over – or undervaluation implied by our model relative to the long – run relationship. Then, we form costless portfolios with long positions on the most undervalued stocks and short ones on the most overvalued stocks. Indeed, we find that the out – of – sample returns to such portfolios are predominantly positive.

In the next section, we briefly overview papers related to ours. In section three, we develop the theoretical model for fundamental valuation of banks' equity based on their price – to – book ratios. In section four, we describe the data we use and how the variables are constructed. In section five, we describe the econometric methodology and in section six we discuss our findings. Finally, we offer some concluding remarks on issues for future research.

2. Related papers

Gordon's growth model, as developed by Gordon and Shapiro (1956) and Gordon (1959), is the stepping stone of equity valuation techniques. It calculates the price of a common share as the sum of the expected dividend per share (DPS) discounted at the cost of equity, *r*, (hereafter COE). This model assumes that dividends grow at a constant rate forever and that COE remains the same forever:

[3] Williams (2013) contains a review of economic models that attempt to explain such deviations.

$$P = \sum_{t=1}^{\infty} \frac{DPS\left(1+g\right)^{t}}{\left(1+r\right)^{t}} = \frac{DPS\left(1+g\right)}{r-g} \tag{1}$$

given that $\left|\frac{1+g}{1+r}\right| < 1$ and $r > g$.

Campbell and Shiller (1988) derived what has been termed the Dynamic Gordon model; a simple and useful model relating the dividend yield to expected future returns and dividend growth. A crucial assumption is that both the dividend yield and dividend – adjusted returns are stationary, something that has to be tested before this model is employed. The Dynamic Gordon model has been used by various researchers. For instance, Crowder and Wohar (1998) exploit the concept of long – run equilibrium to identify the dynamic model that governs stock price behavior. Also, Kaliva and Koskinen (2014) derive a two – regime dynamic model used for stock market risk evaluation.

An alternative model to the one by Campbell and Shiller has been suggested by Vuolteenaho (2000, 2002). His model is based on the residual income model (RIM) developed by Edwards and Bell (1961), Peasnell (1982) and Ohlson (1995). Briefly, Vuolteenaho replaces dividend yield with book – to – market ratio and dividend-adjusted returns with accounting earnings less dividends. Even though Vuolteenaho's model is free of a stationarity assumption on the dividend yield, it collapses if the book value of equity (hereafter BVE) and market value of equity are not cointegrated, and/or earnings minus dividends are non – stationary.

Jiang and Lee (2007) propose a loglinear cointegration model (LLCI) that does not assume stationarity of the dividend yield and book – to – market ratio. LLCI is an extension of the Campbell – Shiller and Vuolteenaho models, and relates the spread between the book – to – market ratio and the dividend yield to market returns minus accounting returns.

Damodaran (2009) relates the price – to – book (hereafter PB) ratio with the return on equity (hereafter ROE) and the standard deviation of stock yields using cross – sectional data on small commercial banks. He suggests a positive relationship between PB and ROE and a negative one between PB and the volatility of stock yields. Damodaran presents as well at his website annual cross – sectional regressions of PB and its fundamentals. Benninga (2008), Copeland et al. (2000) and Damodaran (2012) formulate various proposals of valuation models.

Jordan et al. (2011) relate banks' market PB ratio to several fundamental ratios and whether the bank took funds from the U.S. Treasury under the Troubled Asset Relief Program (TARP). They use the method of random – effects (GLS regression). Calomiris and Nissim (2007) try to explain adjusted market to book (MB) ratio with balance sheet items. They estimate separate regressions for each group and average the coefficients over groups. This method provides consistent estimates if T is large enough. Calomiris and Nissim (2014) use a similar model in order to investigate how the adjusted MB ratio changed during the recent financial crisis with the explanatory variables being again balance sheet items.

In this paper, we develop a new approach using data on price – to – book ratio of banks' equity, and a variant of the Dynamic Gordon model. We use the PMG method of dynamic heterogeneous panels estimation proposed by Pesaran et al. (1999) in order to estimate the long – run equilibrium relationship, if one exists. This method can be viewed as a panel error correction model and allows for panel dynamics, long – run and short – run adjustments to an equilibrium relationship. We call this model the Dynamic Dividend Discount Model, or 3DM.

3. A model of fundamental valuation

Building on Gordon's growth model (or 1 – stage growth model), many intrinsic valuation models have been created using either free cash flows to the firm (FCFF) or free cash flows to the equity (FCFE) or dividends. The initial assumptions for constant dividend growth and COE are relaxed and thus, models with two, three or even *n* stages are developed including the terminal value as well. These stages reflect different regimes for growth.

In this paper, we follow Damodaran (2009), who argues that financial service firms are best valued using equity valuation models rather than enterprise valuation models.[4] Taking for granted that for equity valuation, the most popular technique used is the dividend discount model (DDM), we stick to DDM. In addition, we transform DDM from a model of intrinsic valuation to one of relative valuation as will be shown below.[5] According to DDM, the value of equity is calculated as the present value of expected dividends discounted by the present COE:

$$E_0 = \sum_{t=1}^{\infty} \frac{DIV_0 \left(1+g_{DIV}\right)^t}{\left(1+r\right)^t} \tag{2}$$

where E_0 is the value of equity at period $t=0$ estimated by DDM, DIV_0 is the dividend at current period $t=0$, g_{DIV} is the expected growth of dividends and r is the COE. When r is expected to change in the future, discounting is done with the accumulated COE. For t=T the

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[4] Common stock of non financial firms can be valued either with enterprise models after debt equivalents are subtracted or with equity models.

[5] Intrinsic and relative valuations are both based on cash flow, growth and risk characteristics. For intrinsic valuation, assumptions about these factors are explicit, while for relative valuation, assumptions are implicit. Intrinsic valuation estimates the value of an asset as the present value of its cash flows, whereas in relative valuation, the value of an asset is derived from comparable assets using market multiples.

cumulative COE is defined as $(1+r_1)(1+r_2)...(1+r_{T-1})(1+r_T)=\prod_{i=1}^{T}(1+r_i)$. Similarly for expected growth of dividends, if growth is expected to change in the future, cumulative growth should be considered.

The dividend payout ratio should be defined as a share of net income:

$$DIV_t = DPR_t \cdot NI_t \tag{3a}$$

where *DPR* is the dividend payout ratio and *NI* is the net income. However, in order to overcome the difficulties in interpretation when net income becomes negative, we consider *DPR* as the ratio of dividends to the book value of equity (hereafter BVE), or:

$$DIV_t = DPR_t \cdot BV(E)_t \tag{3b}$$

where $BV(E)$ is the BVE.

Beyond substituting *DIV* from the last equation into (2), we can also replace dividend's expected growth with net income's or earnings per share (EPS) growth. This change can be understood better if one thinks of expected growth as the part of ROE, which is not distributed to the shareholders. Defining ROE as the ratio of net income to the BVE,

$$ROE_t = \frac{NI_t}{BV(E)_t} \tag{4}$$

we have that expected growth in net income is given by:

$$Expected\ Growth_{NI} = (1-DPR)\cdot ROE \tag{5}$$

We should mention that the above equation holds when next periods' ROE is expected to be equal to current ROE. Further details for the definition and calculation of expected growth through fundamentals may be found in Damodaran (2012) or at his website.

Taking into account equations (3b) and (5), DDM turns into:

$$E_0 = \sum_{t=1}^{\infty} \frac{DPR_0 \cdot BV(E)_0 \cdot (1+g_{NI})^t}{(1+r)^t} \tag{6a}$$

where DPR_0 is the current DPR and $BV(E)_0$ is the current BVE.

Equation (6a) can be generalized as:

$$E_0 = \lim_{x \to \infty} \left[\sum_{t=1}^{x} \left(\frac{DPR_0 \cdot BV(E)_0 \cdot \prod_{i=1}^{t} (1+g_{NI,\mathrm{i}})}{\prod_{j=1}^{t} (1+r_j)} \right) \right] \tag{6b}$$

where at period $t=i$, $g_{NI,\, i}$ is the expected growth of net income for period $t=i+1$, and r_j is the COE for period $t=j$.

Equation (6a) gives us:

$$PB_0 = \sum_{t=1}^{\infty} \frac{DPR_0 \cdot (1+g_{NI})^t}{(1+r)^t} \tag{7a}$$

where PB_0 is the estimated price – to – book ratio at period $t=0$. Similarly, equation (6b) gives us:

$$PB_0 = \lim_{x \to \infty} \left[\sum_{t=1}^{x} \left(\frac{DPR_0 \cdot \prod_{i=1}^{t} (1+g_{NI,i})}{\prod_{j=1}^{t} (1+r_j)} \right) \right] \tag{7b}$$

Since it is difficult to estimate the values of every single determinant of PB arbitrarily into the future, it is common to assume that after a specific number of periods the variables are constant. At that point, a terminal value is calculated. So, equation (7b) becomes:

$$PB_0 = \sum_{t=1}^{N} \left(\frac{DPR_0 \cdot \prod_{i=1}^{t} \left(1 + g_{NI,i}\right)}{\prod_{j=1}^{t} \left(1 + r_j\right)} \right) + \frac{DPR_0 \cdot \left(1 + g_{NI,sg}\right) \cdot \prod_{i=1}^{N} \left(1 + g_{NI,i}\right)}{\left(r_{sg} - g_{NI,sg}\right) \cdot \prod_{j=1}^{N} \left(1 + r_j\right)} \tag{7c}$$

where $g_{NI, sg}$ and r_{sg} are the expected growth of net income and the COE during the stable – growth period, respectively. The numerator of the last term is the terminal value. Also, one can modify the first term depending on the desired number of stages.

From all equations (7a, b and c), one can realize that PB is a positive function of the dividend payout ratio and expected growth of net income, and a negative function of cost of equity. Clearly, the PB equation is non – linear in r, g_{NI} and DPR. In short:

$$PB = f\left(\overset{-}{r}, \overset{+}{g}_{NI}, \overset{+}{DPR} \right) \tag{8}$$

and this is the relationship with which we work in this paper.

Equation (6b) in either aggregate or per share form is a variant of DDM and provides a form of intrinsic valuation. From this equation, we derive equation (7b), which establishes the fundamental determinants of the PB ratio. Equation (7b) establishes the PB ratio as a measure of relative valuation. With relative valuation we can determine whether a particular common stock is under – or overvalued, relative to a comparable group of stocks. Econometric estimation can quantify the sensitivities of the PB ratio to these fundamental factors.

The common practice in the literature is to run regressions for every single period or sub – periods to allow for an update of the possibly unstable coefficients of the fundamentals. Our approach is different. We formulate a fully dynamic model that captures short – run dynamics around a long – run equilibrium relationship that links PB ratio with its fundamental determinants. We employ the pooled mean group (PMG) estimator proposed by Pesaran et al. (1999).

We call our novel model Dynamic Dividend Discount Model or 3DM. It is a dynamic variant of DDM. The dynamics come from two sources. First, equation (7c) allows for heterogeneity in growth and risk characteristics over time. Second, PMG allows for long – run and short – run slope coefficients that generate a steady – state equilibrium relationship, which is in accordance with the definition of terminal value. Due to the dynamic nature of PMG, 3DM indicates whether any particular common stock is undervalued or overvalued, relative to its long – run equilibrium valuation.

4. Data and sample description

Our sample includes large U.S. banks that participated in 2008 Trouble Asset Relief Program (TARP), 2009 Supervisory Capital Assessment Program (SCAP), 2011, 2012, 2013 and 2014 Comprehensive Capital Analysis Review (CCAR), and 2013 and 2014 Dodd – Frank Act Stress Tests (DFAST) exercises conducted by the Fed.[6] Before we present our dataset and some descriptive statistics, we provide a brief review of recent events for these large, systemic U.S. banks.

[6] The names of the banks that participated in TARP, SCAP and CCAR are given in Appendix A.

4.1 . Recent events for large, systemic U.S. banks

In 2008, the U.S. government instituted various bailout programs in response to heavy losses suffered by banks. TARP established on October 3rd 2008, was a plan to purchase financial institutions' assets and equity in order to strengthen the financial sector. Initially, the U.S. Treasury's plan was to purchase banks' toxic assets but that form of the bailout bill was finally dropped and TARP was established. Finally, only a few banks managed to fulfill their preferred stock obligations to the U.S. Treasury. For the rest of the banks, which did not meet their obligations, U.S. Treasury could either sell the warrants back to these banks or sell them to investors.

On February 25th 2009, the Fed announced that banks with year – end 2008 assets greater than $100 bn would have their capital needs assessed over a two year horizon, i.e. 2009Q1 until 2010Q4. Under SCAP, a forward looking analysis, the Fed reviewed capital of the 19 largest U.S. banks, which collectively held two – thirds of assets and more than one – half of loans in U.S. banking system. The assessments were conducted under two scenarios: the baseline scenario with consensus expectations in February 2009 and the more adverse one designed as a "what if" scenario with severe expectations. On May 7th 2009, the Fed released the results where 10 banks were in need to raise their capital, while aggregate capital needed under the more adverse scenario was $185 bn.

On November 17th 2010, the Fed announced that the banks that participated in the 2009 SCAP exercise would have their internal capital planning processes (i.e. dividend payments, share repurchase, stock redemption) and capital adequacy evaluated. This exercise, called CCAR, would be conducted on an annual basis. What would be assessed in the so called 2011 CCAR, was the bank's ability to absorb losses and maintain its lending activity over a nine – quarter period from 2010Q4 to 2012Q4 under three different scenarios. The baseline scenario and a stress scenario generated by each bank with expectations of the most likely and severe path of economy respectively, and an adverse scenario designed by the Fed for all participating banks. The adverse scenario included four additional quarters through the end of 2013. The Fed did not disclose the 2011 CCAR results.

The 2012 CCAR exercise was conducted for the same 19 banks. However, on November 22nd 2011, the Fed announced that all banks with total consolidated assets greater than $50 bn would be required to submit capital plans for examination. These new and, somewhat, smaller banks into were not examined together with the other 19 banks right away due to phase – in provisions. Assessment was done for the period from 2011Q4 to 2013Q4. This time, the Fed released the results under its severely adverse hypothetical scenario on March 13th 2012. The FED had objections about the capital plans of four banks. The following years, 2013 and 2014, the Fed performed two exercises per year: Dodd – Frank Act Stress Test (DFAST) and CCAR.

In 2013, the same 19 banks except for MetLife participated in DFAST and CCAR. Both DFAST and CCAR were run under the severely adverse hypothetical scenario but there was a difference. Capital action assumptions in DFAST were common for all participating banks, while in CCAR each bank's planned capital actions were considered. On March 14th 2013, the Fed objected to two banks' capital plans, while those of two other banks were only conditionally accepted.

In the fourth round of stress tests, there were 30 banks participating (applying the $50 bn rule announced on November 22nd 2011). The 2014 DFAST and CCAR included results from both adverse and severely adverse hypothetical scenario. Moreover, on March 26th 2014, the Fed announced that five banks did not manage to pass 2014 CCAR exercise. Four failed at qualitative assessment and one at quantitative assessment. A brief review of SCAP, CCAR and DFAST exercises can be found in Clark and Ryu (2013).

4.2 . Data review and variable construction

Data used is quarterly, from 2003Q4 to 2014Q1, i.e. $T = 42$, and refers to values at the end of each quarter. We collected data from Datastream mainly and secondarily from banks' SEC filings (10-K and 10-Q) when this was necessary. The aggregate number of banks that participated in the 2008 TARP, 2009 SCAP and the consecutive CCARs is 31. Since six of them are either unlisted (Ally Financial Inc., RBS Citizens Financial Group Inc. and UnionBanCal Corp.) or holding companies (BBVA Compass, Inc., HSBC North America Holdings Inc. and Santander Holdings USA), our sample is reduced to 25 banks.[7] We should note that MetLife, Inc. did not participate in the 2013 and 2014 DFAST and CCAR exercises because it completed its deregistration on 14/2/2013 as a bank. For this reason, we remove MetLife's data for the last five quarters. Furthermore, data for Discover starts on 2012Q2 due to issues involved in the calculation of betas as will be explained below. The list of banks included in our sample is in Appendix A. Next, we describe how we construct our variables.

We define **PB ratio** as the market value of equity over its book value at the end of each quarter. There are two problems with this definition that we must overcome. First, that valuation models reflect the price of a common share. Therefore, all non – common equity should be excluded and only common equity should be used. Second, that at each quarter's end, investors do not know the true value of PB because the quarter – end's book value of common equity (hereafter BVCE) is going to be published one or two months later. We

[7] Ally Financial Inc. announced its IPO on April 9th 2014, and RBS Group plc announced the IPO of its subsidiary, Citizens Financial Group Inc., on September 8th 2014.

assume that, in order to calculate PB at quarter – end, investors use in the denominator either the last quarter's (known) BVCE or a forecast of this quarter – end BVCE. We call the PB ratio constructed under the first assumption PBL, and under the second assumption PBF. Conceptually, PBF is the preferred construction method.

PBF, i.e. the estimated PB ratio with the forecast of BVCE is constructed as follows: We make this forecast by multiplying the last quarter's (known) BVCE with $\left(1+g\right)$, where g is the average of the last five BVCE growth rates, i.e.:

$$g_t = \frac{\sum_{i=1}^{5}\left(\frac{BV\left(CE\right)_{t-i} - BV\left(CE\right)_{t-i-1}}{BV\left(CE\right)_{t-i-1}}\right)}{5} \tag{9}$$

where $BV\left(CE\right)_{t-i}$ is the BVCE at the *t-i* quarter. Furthermore, we calculate market value of common equity as the product of quarter – end's close price and number of outstanding shares. The number of outstanding shares is adjusted for splits and reverse splits.

We construct **COE**, the cost of equity, assuming that CAPM holds, as the sum of the risk – free rate and beta times equity risk premium (ERP):

$$r = r_f + b\left[E\left(R_M\right) - r_f\right] = r_f + b \cdot ERP \tag{10}$$

where r_f is the risk free rate, b is the beta coefficient and $E\left(R_M\right)$ is the expected market return.[8,9] We use ten – year Treasury bond yields as the risk – free rate. These values, taken from U.S. Treasury website, are month – end values. Betas are calculated based on S&P500

[8] The Fed has used CAPM as its sole methodology for calculating the COE of U.S. banks since October 2005. See Barnes and Lopez (2005).

[9] King (2009) reports that the cost of equity estimations for U.S. banks using the multifactor Fama – French (1993) model generates similar results with CAPM.

total return index. The source is Datastream and we use month – end observations. They are equal to the ratio of the covariance of market returns and banks returns to the market returns variance. We calculate each bank's returns from the return index prices.[10] The source is again Datastream and we use month – end observations. Moreover, we use the last 60 monthly observations (each one at the end of the respective month) in order to create these betas. We find ERP at Damodaran's website (based on S&P500 at the end of each year as well), and because it is for the last quarter of each year, we adjust it for the other quarters as well. The procedure is as follows: After adding the year – end's risk – free rate to the respective ERP, we get the expected market return for that year. Furthermore, we assume that the expected market return is the same for all quarters of the year. Finally, we subtract the corresponding end of quarter risk – free rate from the expected market return so as to get the desired ERP.

We prefer return on common equity (**ROCE**) to ROE for the calculation of expected growth, because valuation models refer to common shareholders. Following the same logic, we use net income available to common shareholders instead of "general" net income, and because it is last period's equity that generates current period's net income, ROCE is given by:

$$ROCE_t = \frac{\left(NI\ \ available\ to\ common\right)_t}{BV\left(CE\right)_{t-1}} \tag{11}$$

Finally, we calculate **DPR**, the dividend payout ratio, as the ratio of dividends to the BVCE. However, for consistency in the model, we use dividends and net income to common shareholders, and BVCE. Further adjustment is made for the amounts spent for share repurchases, for which we assume that they are equally distributed across the quarters of a year (as stated in SEC 10-K filings). Additionally, because it is the event of dividend

[10] See Datastream definitions for further details about return index prices.

declaration that affects the price of a common share rather than the event of dividend payment, we use dividends declared instead of dividends paid. We find declaration dates at the NASDAQ website and banks websites. Hence, we have:

$$Mod\_DPR = \frac{Dividends\ declared\ + SR/4}{BV(CE)} \tag{12}$$

where Mod_DPR is the modified DPR and SR is the amount spent for share repurchases. For 2014Q1, the last quarter in our sample, the amount spent for stock buybacks is taken from SEC 10-Q filings and is not divided by four, because it is a quarterly value already.

Furthermore, taking into account equations (11) and (12) and substituting them into equation (5), we calculate the expected growth of net income or ***Exp_Growth***.

As explained earlier, we have two potential measures of the dependent variable. One is the forecasted PB ratio, PBF, and this will be our core model. We consider PBF the preferred measure because in the theoretical model, both the numerator and the denominator of PB ratio are measured in values of the same period. The secondary model uses the lagged PB ratio as the dependent variable. In Appendix D, we provide results using PBL for comparison and to check robustness.

Descriptive statistics for the full sample and for separate periods (2003Q4 – 2007Q2: BC, 2007Q3 – 2009Q4: DC, 2010Q1 – 2014Q1: AC) for our dataset are given in the next tables. These sub – periods correspond to the “before – crisis” period (BC), the “during – crisis” period (DC), and the “after – crisis” period (AC).

Table 1

Full sample statistics.

Variable name	*Mean*	*SD*	*Min*	*5%*	*25%*	*Median*	*75%*	*95%*	*Max*
PBF	1.601	0.949	0.12	0.538	0.924	1.412	2.093	3.242	7.288
PBL	1.645	0.95	0.116	0.539	0.941	1.48	2.146	3.302	6.929
COE	0.089	0.026	0.017	0.055	0.068	0.087	0.103	0.142	0.175
Exp_Growth	0.026	0.034	-0.473	-0.018	0.017	0.029	0.04	0.062	0.164
Mod_DPR	0.02	0.019	0	0.0004	0.005	0.017	0.029	0.061	0.115
Assets	461	614	28.6	50.6	89	156	565	2030	2480

Notes: We round to the 3rd decimal except for the 5% quantile of Mod_DPR, where we round to the 4th one and for assets, where we round to the 1st one. Number of observations for each variable is 1011 except for assets, which is 969. Assets are in USD bn. Because Bank of Montreal assets are in CAD, this bank is excluded from the calculations of assets. For the 42 Bank of Montreal observations, the mean, standard deviation, minimum value, median and maximum value of assets in CAD bn are: 397, 96, 256, 389 and 590, respectively.

Table 2

Sub – sample statistics.

Variable name	*2003Q4 – 2007Q2*		*2007Q3 – 2009Q4*		*2010Q1 – 2014Q1*	
	Mean	Median	Mean	Median	Mean	Median
PBF	2.28	2.15	1.314	1.146	1.173	1.012
PBL	2.345	2.196	1.352	1.17	1.204	1.036
COE	0.077	0.071	0.088	0.085	0.101	0.098
Exp_Growth	0.042	0.04	0.005	0.017	0.023	0.023
Mod_DPR	0.032	0.029	0.016	0.012	0.012	0.008
Assets	347	107	493	157	544	183

Notes: We round to the 3rd decimal. Assets are in USD bn. Because Bank of Montreal assets are in CAD, this bank is excluded from the calculations of assets. Bank of Montreal's corresponding numbers in CAD bn are: 297 and 294 in the first sub – period, 395 and 383 in the second sub – period, and 486 and 523 in the third sub – period, respectively.

We notice that PBF and PBL summary statistics are similar (with correlations 99.73%), their standard deviations are rather high, and there is a great dispersion in the panel between the upper 5th and the bottom 5th percentile. The highest values of both PBF and PBL belong to American Express due to its high intangible assets. COE values average around 9% over time and expected growth of net income varies a lot. The lowest values of assets belong to Zions, ranging from 28.6 to 56.1 bn USD. Moreover, we see that both in full sample and in the sub – periods, the variables are positively skewed, except for expected growth.

PBF and PBL values are larger before the crisis than after. Specifically, the DC values are approximately 55% of the respective BC ones, and the AC values are slightly lower than the DC ones. The cost of equity displays an upward trend over time starting from a mean value of 7.7% before the crisis to a mean value of 10.1% after the crisis. Similarly, total assets of large, systemic U.S. banks display a positive trend averaging 42% higher during the crisis and 57% after the crisis compared to the period before the crisis, respectively. On the contrary, modified DPR has experienced a downward trend over these sub – periods. Particularly, DC mean values are half of BC respective ones, and AC values are even lower. These trends in PB ratios, and modified DPR are in accordance with Calomiris and Nissim (2014). Lastly, expected growth was higher before the crisis. In the DC period the mean of expected growth is almost zero, whereas in the AC period, it is roughly 55% of the respective BC one.

Table 3 reports ordinary and Kendall’s correlation among the examined variables and total assets. We see that there is a strong, positive relationship between the PB ratios and expected growth or modified DPR, while COE is negatively correlated with PB. Finally, we have a remarkable positive relationship between assets and COE.

Table 3

Full sample correlation matrix.

	PBF	PBL	COE	Exp_Growth	Mod_DPR	Assets
PBF	1	0.961	-0.208	0.604	0.509	-0.137
PBL	0.997	1	-0.205	0.606	0.508	-0.134
COE	-0.195	-0.199	1	-0.101	-0.239	0.254
Exp_Growth	0.528	0.538	-0.067	1	0.431	-0.035
Mod_DPR	0.712	0.706	-0.246	0.407	1	-0.059
Assets	-0.231	-0.233	0.422	-0.07	-0.13	1

Notes: Ordinary correlation coefficients and Kendall's tau – b statistics are in the lower triangular matrix and in the upper one, respectively. We round to the 3rd decimal. In calculations of correlation statistics between assets and the rest of the variables, Bank of Montreal has been excluded due to the different currency denomination.

5. Econometric approach

We use the pooled mean group (PMG) method of dynamic heterogeneous panels estimation proposed by Pesaran et al. (1999) in order to estimate the long – run equilibrium relationship, if one exists. This method can be viewed as a panel error correction model, where long – run and short – run slope coefficients are estimated from an extension of the autoregressive distributed lag (ARDL) model proposed by Pesaran and Smith (1998).

It is now common to study panels in which both N, number of cross sections, and T, number of time periods, is quite large, also called "data fields" by Quah (1990). The PMG estimator is established on such data. It is an intermediate estimator between mean group (MG) and dynamic fixed effect (DFE) estimators. DFE, which imposes slope homogeneity allowing only the intercepts to differ across cross sections, is affected by the upward heterogeneity bias as pointed out by Pesaran and Smith (1995) and by the so – called "Nickel bias". On the other hand, MG proposed by Pesaran and Smith (1995), which first runs N different time series and then averages the estimates, imposes different long – run and short – run slope coefficients across cross sections. PMG exploits the techniques used in both MG and DFE. It pools and then it averages allowing in this way for dynamics with common long – run slope coefficients, and different short – run slope coefficients (including speed of adjustment), cross – section specific intercepts and error variances.

PMG imposes long – run restrictions and allows for short – run slope heterogeneity. Long – run slope homogeneity can easily be tested via the Hausman (1978) specification test based on the comparison between PMG and MG estimators. Under the null hypothesis of long – run slope homogeneity, PMG estimates are efficient and consistent. Otherwise, under the alternative hypothesis of slope heterogeneity, PMG estimates are inconsistent. MG estimates are in either case consistent if $\sqrt{N}/T \to 0$ when $N, T \to \infty$. When performing the Hausman test, we employ the covariance matrices based on the estimated disturbance variance from the efficient estimator, i.e. the PMG estimator in our case.

The following notation is used throughout: The Greek letter Δ denotes first difference, whereas *I*(*d*) signifies an integrated variable of order *d*.

We start with the theoretical relationship derived in equation (8). We postulate that a linearized version of that describes the long – run equilibrium relationship:

$$\begin{gathered} PB_{it} = \alpha_{0i} + \alpha_{1i} COE_{it} + \alpha_{2i} Exp\_Growth_{it} + \alpha_{3i} Mod\_DPR_{it} + \eta_{it} \\ i = 1, ..., N \ and \ t = 1, ..., T \end{gathered} \tag{13}$$

where $PB_{i,t}$ is either the *PBF* or the *PBL* ratio, a_{0i} is the bank – specific intercept, a_{1i}, a_{2i}, and a_{3i} are the common long – run coefficients of COE, expected growth of net income and modified DPR, respectively, and η_{it} is the error term. Furthermore, if variables are *I*(1) and cointegrated, $\eta_{i,t}$ is a *I*(0) process for all *i*.

The *ARDL* (p,q1,q2,q3) dynamic panel specification is given by:

$$\begin{aligned} PB_{it} &= \delta_{0i} + \sum_{j=1}^{p} \lambda_{j,i} PB_{i,t-j} + \sum_{j=0}^{q1} \delta_{1j,i} COE_{i,t-j} + \sum_{j=0}^{q2} \delta_{2j,i} Exp\_Growth_{i,t-j} \\ &+ \sum_{j=0}^{q3} \delta_{3j,i} Mod\_DPR_{i,t-j} + u_{it} \\ & i = 1,2,...,N \;\; and \;\; t = 1,2,...,T \end{aligned} \tag{14}$$

where δ_{0i} is the group specific effect and u_{it} is the error term. The disturbances u_{it} must be independently distributed across *i* and *t*, and independently distributed of the regressors. Also, we assume that the roots of characteristic equation $1 - \sum_{j=1}^{p} \lambda_{j,i} \cdot z^{j} = 0$ for $i = 1,2...,N$, lie strictly outside the unit circle, which guarantees that the speed of adjustment, ϕ_i, is negative, and thereby a long – run relationship exists. This ensures dynamic stability of the model used.

According to the previous equation and imposing one lag for each variable, we get the following unrestricted or unconstrained error correction model (ECM):

$$\begin{aligned} \Delta PB_{it} &= \phi_i \left(PB_{i,t-1} - \alpha_{0i} - \alpha_{1i} COE_{it} - \alpha_{2i} Exp\_Growth_{it} - \alpha_{3i} Mod\_DPR_{it} \right) \\ & - \delta_{11i} \Delta COE_{it} - \delta_{21i} \Delta Exp\_Growth_{it} - \delta_{3it} \Delta Mod\_DPR_{it} + u_{it} \end{aligned} \tag{15}$$

where $\phi_i = -\left(1 - \lambda_{1i}\right)$ is the speed of adjustment, $\alpha_{0i} = \frac{\delta_{0i}}{1-\lambda_{1i}}$, $\alpha_{1i} = \frac{\delta_{10i} + \delta_{11i}}{1-\lambda_{1i}}$, $\alpha_{2i} = \frac{\delta_{20i} + \delta_{21i}}{1-\lambda_{1i}}$, $\alpha_{3i} = \frac{\delta_{30i} + \delta_{31i}}{1-\lambda_{1i}}$ and u_{it} is the error term. One would expect ϕ_i to be negative and statistically significant if a long – run equilibrium relationship exists.

The unrestricted ECM generated by ARDL equation in levels (this is equation (14) with time indices only) and used for each bank for the choice of lag structure is the following equation:

$$\Delta PB_t = \theta_0 + \theta_1 PB_{t-1} + \theta_2 COE_t + \theta_3 Exp\_Growth_t + \theta_4 Mod\_DPR_t + \sum_{j=1}^{p-1} \lambda_j^* \Delta PB_{t-j} + \sum_{j=0}^{q1-1} \delta_{1j}^* \Delta COE_{t-j} + \sum_{j=0}^{q2-1} \delta_{2j}^* \Delta Exp\_Growth_{t-j} + \sum_{j=0}^{q3-1} \delta_{3j}^* \Delta Mod\_DPR_{t-j} + \varepsilon_t \quad (16)$$

where $\theta_1 = -1 + \sum_{j=1}^{p} \lambda_j$, ε_t are serially uncorrelated disturbances with zero means and constant variance – covariances, and the roots of $1 - \sum_{j=1}^{p} \lambda_j \cdot z^j = 0$ fall outside the unit circle. We note that "lambdas" are the autoregressive parameters of PB_t given by the ARDL levels equation from which equation (16) is created.

Given our data and sample, we run 24 ARDLs on the unrestricted ECM (see equation (16)), one for each bank but Discover (due to small number of observations, only 8). The order of each lag was chosen using the Schwarz Bayesian Information Criterion (SBIC, which has been shown to give consistent estimates for the lag lengths, i.e. p and q) subject to one lag of the dependent variable and to maximum lag of one for the exogenous regressors.

The PMG method and steady – state equilibrium relationship are plausible if only if the examined variables are interacting suitably so that $\eta_{i,t}$ in equation (13) is $I(0)$. Even though ARDL and PMG methods do not require pre – testing for the order of integration of the examined variables, the hypothetical existence of any $I(2)$ variable would make these methods inappropriate as long as variables in levels are used.

Therefore, we first test for non – stationarity and next for cointegration among the examined variables. We employ panel non – stationarity tests for common and individual unit root processes both in levels and in 1st differences. The first set includes tests of Levin et al. (2002), LLC, and Breitung (2000), while the second set includes the tests of Im et al. (2003), or IPS, the combined p – values tests of Choi (2001) and Maddala and Wu (1999), or MW.

We also employ the Hadri (2000) test, even though it has different null hypothesis and may yield results that contradict those of alternative tests (see Hlouskova and Wagner (2006)). Having tested for non – stationarity, we then test for panel cointegration according to Pedroni's (1999, 2004) test, since it has greater power in panels with large *T* than Kao's (1999) test, as Gutierrez (2003) mentions. Provided that there is evidence in favor of cointegration, PMG can be used to estimate the relationship in equation (13), if it exists.

6. Estimation results

First, we conduct panel unit root tests. We use two sets of tests. The first set includes tests whose null hypothesis is that there exists unit root in the examined variable, while the second set includes a test whose null hypothesis is the stationarity of the examined variable. Although the first set of tests have the same null hypothesis, i.e. the variables contain a unit root, their alternative hypotheses differ. The tests of LLC and Breitung are based on homogeneous alternative where it is assumed that the autoregressive parameter is identical for every cross section (common unit root). The tests of IPS, Choi and MW have heterogeneous alternatives where cross sections are stationary with individual autoregressive parameters (individual unit root). The second set, which includes the Hadri test with the null hypothesis of stationarity, has the alternative hypothesis that some cross sections contain a unit root.

Because PMG involves homogeneity of long – run parameters and heterogeneity of intercepts, error variances and short – run parameters, we apply both sets of panel unit root tests, since the first one imposes pooling and the second one allows heterogeneity.

The Choi and MW tests are based on Fisher's (1932) panel unit root test that combine p – values from either Augmented Dickey – Fuller (ADF) or Phillips – Perron (PP) individual unit root testing. Results from all these tests are presented in the next table, specifically the p –values are given. The selection of lag length was made using SBIC.

Initially, we test for unit root in levels. Unanimous results from all these tests, except for LLC, for PBF and PBL suggest that both dependent variables contain a unit root at least at 1% significance level. In five of nine tests for COE, results show that COE contains a unit root as well. In seven of nine tests non – stationarity is not rejected for *Mod_DPR* and all tests for *Exp_Growth* but Hadri one suggest that the latter is definitely $I(0)$. Furthermore, the same tests conducted at 1^{st} differences imply that none of the variables contain a unit root. Clearly, neither variable in our dataset is $I(2)$ or of higher order of integration. This means that both ARDL and PMG models are applicable, since we have a mixture of $I(0)$ and $I(1)$ variables. Ultimately, since for the dependent variable and two of the exogenous regressors there is evidence against stationarity, cointegration between the examined variables is highly probable.

Table 4

Panel unit root tests.

Variables / *Tests*	PBF (ΔPBF)	PBL (ΔPBL)	COE (ΔCOE)	Exp_Growth (ΔExp_Growth)	Mod_DPR (ΔMod_DPR)
H_0: unit root in the examined variable					
LLC (2002)	0% (0%)	0% (0%)	0.19% (0%)	0% (0%)	7.19% (0%)
Breitung (2000)	12.32% (0%)	13.05% (0%)	0.01% (0%)	0% (0%)	3.28% (0%)
IPS (2003)	2.61% (0%)	5.97% (0%)	4.22% (0%)	0% (0%)	2.88% (0%)
MW (1999), ADF	8.8% (0%)	19.76% (0%)	3.35% (0%)	0% (0%)	14.58% (0%)
MW (1999), PP	8.9% (0%)	24.46% (0%)	9.26% (0%)	0% (0%)	0.28% (0%)
Choi (2001), ADF	2.38% (0%)	5.4% (0%)	4.46% (0%)	0% (0%)	3.93% (0%)
Choi (2001), PP	1.79% (0%)	4.62% (0%)	7.3% (0%)	0% (0%)	0.12% (0%)
H_0: stationarity of the examined variable					
Hadri (2000), homoskedastic	0% (63.19%)	0% (53.97%)	0% (60.6%)	0.01% (94.15%)	0% (96.94%)
Hadri (2000), heteroskedastic	0% (14.57%)	0% (8.57%)	0% (8%)	0% (27.36%)	0% (55.25%)

Notes: Individual intercept is included in all the above tests, except for the Breitung test that includes intercept and trend. We round to the 4^{th} decimal. These are the p – values of the tests. Hadri's test checks the null hypothesis of stationarity against the alternative that the series for some banks contain a unit root. The other tests examine the null hypothesis that the examined variable contains a unit root, while their alternative is that either all banks converge with the same rate (LLC and Breitung tests) or each bank converges with its own rate (IPS, Choi and MW tests).

Given the results for panel unit root tests, we test for panel cointegration. Pedroni's (1999, 2004) panel cointegration test allows for heterogeneous intercepts and slope coefficients. Null hypothesis is no cointegration, while the alternative is either homogeneous or heterogeneous. Pedroni's test reports 11 statistics, where eight of them are based on a within – dimension approach (panel tests), specifically half of them are average statistics and the other half are weighted ones. The remaining three statistics are based on a between – dimension approach (group tests). We note that "panel statistics" are subject to homogeneous alternative, whereas the "group" ones to heterogeneous alternative. Table 5 reports the p – values for each statistic. Group 1 contains the variables needed for the core model and group 2 for the secondary one. Except for panel v – statistics (simple and weighted), all other statistics reject the null of no cointegration at any convenient significance level.

Table 5

Panel cointegration results.

Group of variables / *Statistics*	Group 1 (PBF for dependent variable)	Group 2 (PBL for dependent variable)
Panel v – Statistic	13.17%	18.06%
(weighted)	(40.63%)	(39.04%)
Panel rho – Statistic	0%	0%
(weighted)	(0%)	(0%)
Panel PP – Statistic	0%	0%
(weighted)	(0%)	(0%)
Panel ADF – Statistic	0%	0%
(weighted)	(0%)	(0%)
Group rho – Statistic	0%	0%
Group PP – Statistic	0%	0%
Group ADF – Statistic	0%	0%

Notes: Dickey – Fuller corrected degrees of freedom are used. We round to the 4^{th} decimal. These are the p – values of the null hypothesis of no cointegration. Individual intercept but no trend is included in the test. Panel statistics have homogeneous alternative (common speed of convergence), whereas group statistics have heterogeneous alternative (different speeds of convergence).

Even though, Pedroni's test does not specify the direction of the cointegrating relationship, the results allow for the possibility that a steady – state equilibrium relationship indicated by equation (13) exists. So our next step is to employ the PMG estimation method and finally find out whether COE, expected growth and modified DPR drive the PB ratio.

Before turning to the PMG estimation of our core model, we need to determine the appropriate lag – length specification to use. To do so, we follow Pesaran et al. (1999), and run 24 separate ARDL regressions (see equation (16)) for the core model for each one of the 24 banks in the sample. We then use the SBIC to pick the optimal lag structure for each one of the 24 banks. Finally, we retain the lag – length specification that has been chosen the most and constrain the PMG estimation to use that. We find that in 9 of 24 banks *ARDL* (1,0,0,0) is chosen. This means that there is one lag for PBF and zero lags for the rest of the variables. Table 6 presents the *PMG* (1,0,0,0) estimates for the following equation:

$$\Delta PB_{it} = \phi_i \left(PB_{i,t-1} - \alpha_{01} - \alpha_{1i} COE_{it} - \alpha_{2i} Exp\_Growth_{it} - \alpha_{3i} Mod\_DPR_{it} \right) + \varepsilon_{it} \qquad (17)$$

where $\phi_i = -(1-\lambda_{1i})$, $\alpha_{0i} = \frac{\delta_{0i}}{1-\lambda_{1i}}$, $\alpha_{1i} = \frac{\delta_{10i}}{1-\lambda_{1i}}$, $\alpha_{2i} = \frac{\delta_{20i}}{1-\lambda_{1i}}$, $\alpha_{3i} = \frac{\delta_{30i}}{1-\lambda_{1i}}$, and ε_{it} is the error term.

Table 6

PMG (1,0,0,0) estimates.

Dependent variable: PBF	Slope coefficients (asymptotic std. errors)
Speed of adjustment (average): φ	-0.263*
	(0.034)
COE	-3.231**
	(1.466)
Exp_Growth	14.158*
	(1.457)
Mod_DPR	11.799*
	(1.912)
Constant (average)	1.163*
	(0.086)
Number of cross sections	25
Number of observations	986
Log Likelihood	22.074
Hausman test: p – value	81.78%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Consequently, the steady – state equilibrium relationship derived by 3DM is:

$$PBF = c - 3.231 \cdot COE + 14.158 \cdot Exp\_Growth + 11.799 \cdot Mod\_DPR$$

where c is the bank – specific intercept.

We notice that the speed of adjustment, φ, is negative and statistically significant, which means that a long – run equilibrium relationship dictated by equation (14) exists. The speed of adjustment is not a pooled estimate but the average of the equivalent coefficients across cross sections. The magnitude of φ implies that around 26% of deviation from the long run value is eliminated in the first period (one quarter). This suggests that a year after a shock almost 29.5% of any disequilibrium still remains, while after four years the PB ratio has closed 99.24% of the gap from long – run valuation. The estimated value of φ implies that PB values are away from steady – state equilibrium relationship for extended periods of time. The statistically significant values of bank – specific speeds of adjustment, φ_i, range from -0.694 (for Bank of America) to -0.088 (for Huntington Bancshares).[11]

The rest of the coefficients present the expected sign and are in accordance with equation (8). Therefore, the PB ratio model in equation (8) may be regarded as a valid stock market valuation model. The COE coefficient suggests that an increase of COE by its panel standard deviation reduces PB ratio by 0.084, which is a relative low effect. On the other hand, the PB ratio rises by 0.481 and 0.224 when expected growth in net income and modified DPR increase by their panel standard deviations, respectively. Arguably, the last two fundamental determinants seem to affect the PB ratio quantitatively more than does COE. So, hypothetically speaking, if a bank were to experience an increase in its COE, expected

[11] There are four banks with statistically insignificant speeds of adjustments (Comerica, MetLife, Morgan Stanley and Northern Trust) at 10% significance level. We also note that the short – run coefficient for PMG (including intercepts) are estimated as cross – sectional averages of the corresponding coefficients.

growth of net income and modified DPR by their corresponding panel standard deviations, then it would have its PB ratio augmented by 0.621.[12]

Moreover, a Hausman (1978) specification test indicates that long – run slope homogeneity is valid. The p – value of 81.78% presents strong evidence in favor of the null hypothesis of long – run homogeneity. Thus, PMG coefficients are efficient and consistent, and they should be preferred over the MG ones.

Given the results from table 3, we calculate the predicted PB ratios for the whole sample. These are the PB values that would prevail under the estimated model if bank values were at their long – run equilibrium relationship. Then, we create a new variable, which we call *valuation* that shows the degree of divergence of the market values of PB from their long – run equilibrium values. If *valuation* for a bank at a point in time is negative, it means that this bank is temporarily undervalued, according to the 3DM and given the information in our sample of large, systemic banks. The opposite holds if *valuation* is positive.[13] We define *valuation* as:

$$Valuation = \frac{market\ value\ of\ PB - predicted\ value\ of\ PB}{predicted\ value\ of\ PB} \tag{18}$$

We mitigate the impact of outliers following the next procedure. We drop the values outside the range: $\left[P5-0.5\left(P95-P5\right), P95+0.5\left(P95-P5\right)\right]$, where Pj is the j^{th} percentile.

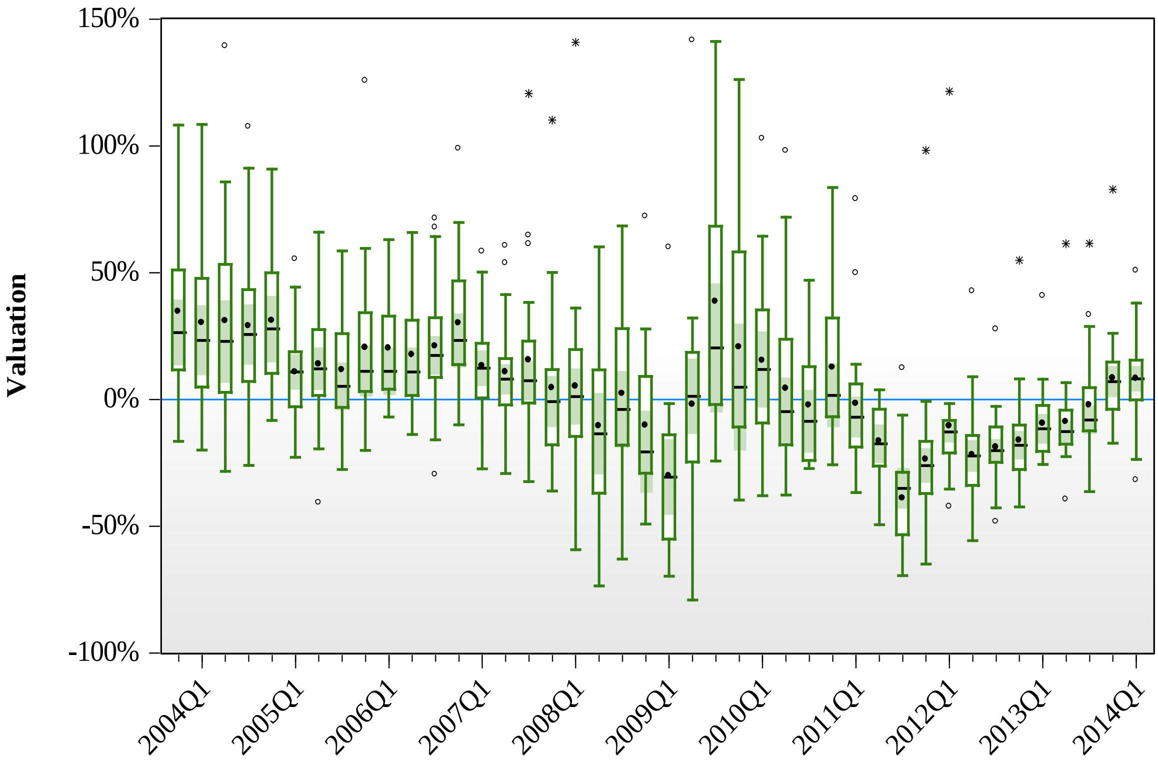
[12] Bank – specific intercepts are statistically significant and positive ranging from 0.842 for Goldman Sachs to 3.097 for American Express, except for two of them, which are not statistically significant (Morgan Stanley and Northern Trust). Significance level is 10%. The average of all intercepts is 1.163.

[13] In calculating *valuation* we kept only observations with positive values of predicted PB ratios. Had we kept observations with negative predicted PB ratios, these would have been classified as outliers in our mitigation procedure. Specifically, figures 1, 2 and 3 would have remained roughly the same and results in 6.2 sub – section identical.

For normal distributions, this procedure corresponds to a range of values of ± 4 standard deviations from the mean. Figure 1 contains the box plots for every quarter in our sample.[14]

<u>Figure 1</u>

Divergence of market Price – to – Book ratios from their long – run values.



<u>Notes:</u> The box segment represents the first and third quartiles. Their difference is called interquartile range (IQR). Median is shown as a line through the center of the box, while the mean is a black dot inside the box. The staple is a line drawn at the last data point within or equal to each of the inner fences, whereas the whiskers are lines drawn from first and third quartile to the respective staple. Inner fences are equal to the first quartile minus $1.5IQR$ and the third quartile plus $1.5IQR$. Similarly, outer fences are constructed with $\pm 3IQR$. Data points beyond the inner fences are known as near outliers (circles), while those beyond outer fences are referred to as far outliers (asterisks). Finally, the shaded area denotes the confidence intervals for the median at 5% significance level.

[14] Appendices C and D present figures for *valuation* corresponding to the alternative core model that uses PBF and *PMG* (1,0,1,0), and the secondary model that uses PBL and *PMG* (1,0,0,0).

First, we notice that there is a large heterogeneity in the degree to which PB ratios are above or below their long – run equilibrium valuation. We see that from 2003Q4 until 2008Q1, the median of *valuation* is positive, except for 2007Q4. Namely, the median bank, if one existed, is overvalued, relative to its long – run equilibrium value, except for 2007Q4. From 2008Q2 until 2009Q1, the crisis affects negatively the financial sector. The median bank is undervalued, relative to its long – run equilibrium value. In the following four quarters, the financial sector seems to recover but after 2010Q2 until 2013Q3 the median banks are below their long – run valuation, except for 2010Q4. Specifically, in 2011Q3 *valuation* presents its lowest value in the sample. However, from 2012Q2 until 2014Q1 we notice that there is an upward trend where *valuation* rises. Specifically, in 2013Q4 and 2014Q1, the median of *valuation* becomes positive for the first time since 2010Q4. Furthermore, we notice that in every period of time, the range of *valuation* is large enough so that there are both under – and overvalued banks, relative to their long – run equilibrium values.

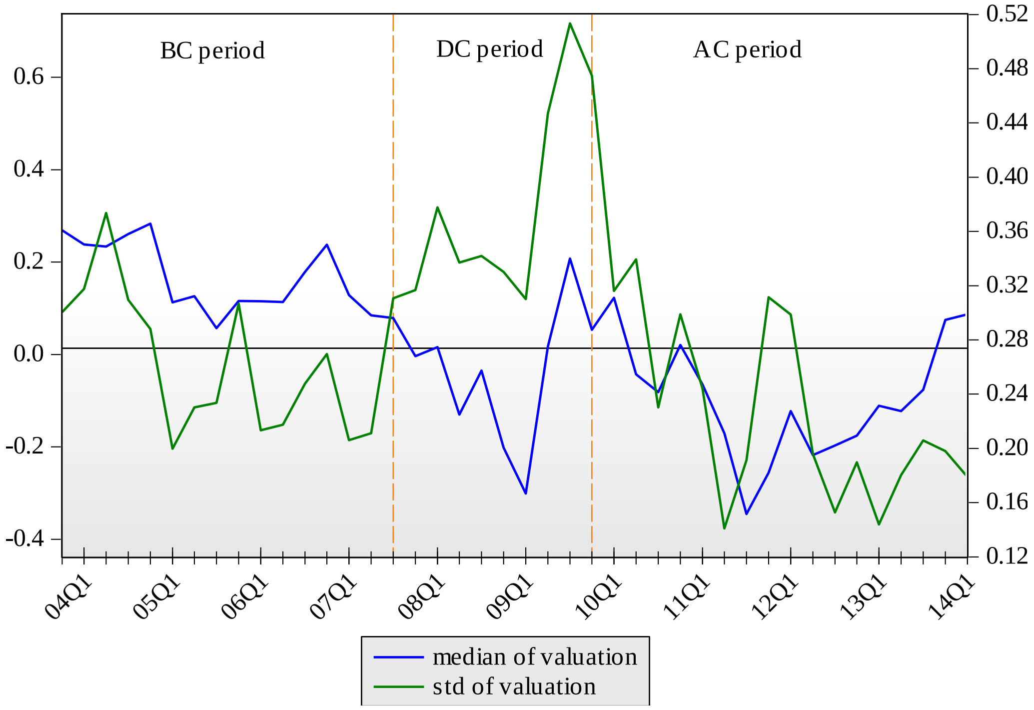
Valuation in the interval between 2009Q2 and 2010Q1 rose abruptly. Probably, this is due to the completion of the SCAP buffer needed under the more adverse or "what if" scenario. Banks had to raise additional capital in order to build the SCAP buffer until November 9th 2009. Clearly, banks' recapitalization seems to have operated well enough so that banks' PB ratios moved above their long – run valuation. On the contrary, TARP in 2008Q3 seems not to have had a positive association with the market valuation of the financial sector. In the next quarter, the median of *valuation* decreased to -20.14% from -3.47%.

The period from 2010Q2 to 2011Q3 displays a downward trend in *valuation*. This is a period in which the market was hit with several pieces of bad news for banks' profitability and a rise in the degree of uncertainty. On July 2010 the Dodd – Frank Act was enacted while leaving uncertain until much later how the Volcker rule would be implemented the banks in our sample. Additionally, the Federal Reserve on March 18th, 2011, announced that the 2011 CCAR exercise had been completed and that the results would be available to banks management only in one month. This secrecy may have worried investors in anticipation of likely bad news for the resilience of banks' capital. Specifically in 2011Q3, the median of *valuation* presents the lowest value in sample.

Next figure plots the median and standard deviation of *valuation* at each quarter in our sample. We distinguish three sub – periods: Before the crisis (BC: 03Q4 – 07Q2), During the crisis (DC: 07Q3 – 09Q4), and After the crisis (AC: 10Q1 – 14Q1). It seems that there is a positive relationship between the median and the standard deviation of *valuation*. That is verified by the almost 72.34%, 66.19% and 28.09% (ordinary) correlation statistics in each sub – period, respectively. Also, we see that during the crisis the fluctuations of both the median and the standard deviation of *valuation* increased. This trend continues until 2012Q2.

Figure 2

Dispersion of *valuation* over time.

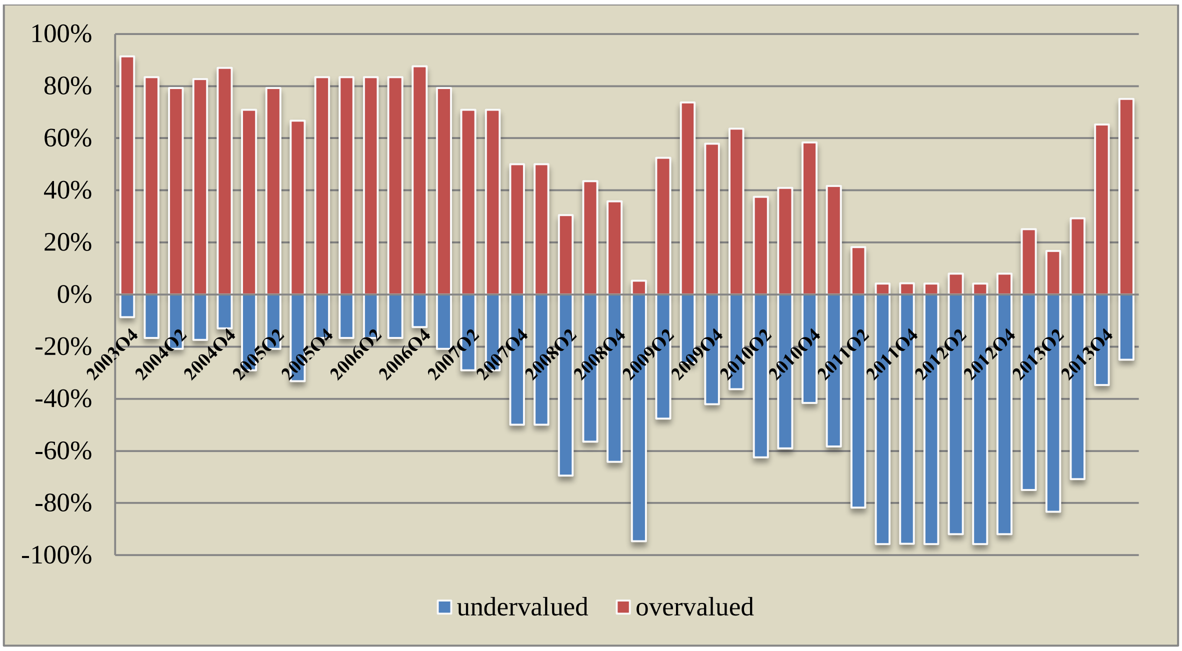


Notes: Outliers' impact has been reduced by the procedure stated in the main text. Median and standard deviation of *valuation* are centered on their means. Left axis is for median and right axis for standard deviation of valuation, respectively.

Figure 3 shows the percentage of undervalued and overvalued banks in sample based on our 3DM of long – run PB ratios and as reflected in the variable: *valuation*.

Figure 3

Percentage of Under – and Overvalued banks over time.



Notes: Numbers come from *valuation*, which is calculated using the *PMG* (1,0,0,0) core model.

We see more overvalued banks, relative to their long – run equilibrium values, from the beginning of the sample until 2007Q3, from 2009Q2 until 2010Q1, in 2010Q4 and in the last two quarters of our sample. Surprisingly, the percentage of undervalued banks before the crisis is larger than that of overvalued banks during the period starting from 2011Q3 until 2012Q4.

6.1 . Sensitivity and robustness checks

Besides *PMG* (1,0,0,0) with the full sample, we run three more models. One without American Express because of its being an extreme outlier, one without Discover because of small number of observations and another one without both of them. Thus, we verify that PMG is robust to outliers. Details are given in Appendix B.

The next most common choice after *ARDL* (1,0,0,0) is *ARDL* (1,0,1,0) in 8 banks, i.e. 1 lag for PBF and expected growth of net income, and zero for COE and modified DPR. Results from *PMG* (1,0,1,0) form with all four cases are in Appendix C. The same procedure is done with PBL as dependent variable and the respective results are presented in Appendix D. Also, the respective figures 1, 2 and 3 of the secondary model are in Appendix D. We verify again that PMG is robust to outliers.

Furthermore, we also run different ARDLs generated by equation (14) as above with the only difference being the imposition of long run slope homogeneity (one lag for dependent variable and maximum of one lag for the exogenous regressors). The ARDL specification with the lowest SBIC is *ARDL* (1,1,1,1) (see equation (15)), which means that there exists one lag for each variable. Thereby, we confirm that what might be the optimal order for group specific estimates is not the optimal order when long – run slope homogeneity restriction is imposed, as first stated by Pesaran et al. (1999). Nonetheless, our analysis and main findings are based on the specifications derived from the separate ARDL's procedure, as Pesaran et al. (1999) do. Details for the *PMG* (1,1,1,1) are in Appendix E.

6.2 . Predictable trading profits

We have shown that 3DM is a valid dynamic valuation model for large, systemic U.S. banks. The existence of persistent but temporary deviations of stock market valuation from a long – run equilibrium value, points to the possibility of predictable trading profits. In this section we check whether an investor could profit by holding zero – cost portfolios of bank stocks dictated by the model. In particular, the model predicts that stocks with PB ratios that are at any point in time away from their long – run equilibrium value will eventually return to that. Thus, future stock returns of the banks in our sample are predictable.

To examine the predictability of trading profits we formulate the following costless strategy. We estimate our model (see equation 17) for the banks in our sample (except for Discover due to inadequate number of observations) up to a cutoff date, *T*. Then, we sort the banks by the degree of divergence of their PB ratios from their PB ratios from their long – run equilibrium, which we have named *valuation*.[15] We then form portfolios with short position in the *N* stocks with the most positive *valuation* that finance a long position in the *N* stocks with the most negative *valuation*. In particular, we form three portfolios corresponding to $N = 1$, 2 or 3. All stocks have equal weights (in absolute value) in the portfolio. Finally, we look at the portfolio total returns after *H* quarters, where *H* ranges from one to nine quarters, depending on the starting date.

We take as cutoff dates, *T*, 2012Q1, 2012Q2, 2012Q3, 2012Q4 and 2013Q1.[16] As mentioned above, the investing horizons are one to nine quarters. The 2013Q1 sample is tested with investing periods of up to five quarters, the 2012Q4 sample up to six, the 2012Q3 one up to seven, the 2012Q2 one up to eight and the 2012Q1 sample up to nine quarters.[17]

The banks in our sample are large accelerated filers and are subject to SEC 10-Q and 10-K fillings. The deadline for the first is 40 days and for the second 60.[18] Given that a year has

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[15] We exclude banks that are estimated to have statistically insignificant speeds of adjustment to the long – run equilibrium relationship at 10% significance level. These are Comerica, MetLife, Morgan Stanley and Northern Trust in all five samples. Also, Discover is excluded due to insufficient number of observations.

[16] The φs of each of these samples are -27.85%, -26.79%, -26.46%, -26.07% and -26.38% respectively. They are close to the φ of the core model, so the interpretation remains unchanged.

[17] For the sample 2003Q4 – 2012Q1 we run 24 different ARDLs and in 9 of 24 banks *ARDL* (1,0,0,0) is chosen according to SBIC. For the other four samples, we assume that *ARDL* (1,0,0,0) is the preferred specification.

[18] The SEC 10-K fillings are annual reports and must be submitted in the first 60 days of the year for the large accelerated fillers. These deadlines are according to amendments adopted by SEC in December 2005.

252 working days, the deadline of SEC 10-Q is 28 working days and the corresponding of 10-K is 42. Based on these numbers, we find the dates for each sample where all data is available, i.e. the starting date of the investing strategies in each sample. In each sample given the starting date, we find the critical dates corresponding to the end of each investing period. Consequently, using the return index prices in each of these critical dates we are able to compute the total returns. In Appendix F we provide more detail about the critical dates, the names of the banks included in every portfolio and their degree of under – or overvaluation.

Given the "small negative" values of φ in each sample, we anticipate that as the investing period increases so does the return in the sense that many periods later, the market PB ratio will close more of the gap from the long – run valuation. Table 7 shows the total returns of each portfolio across time in all samples.

We find that the overwhelming majority of total returns is positive, in particular 78 out of 105 cases. Specifically, in the longer investing periods the returns are greater than those in the shorter ones. The first sample presents the greatest return of 31.21% magnitude on 8/8/2014, while on 27/2/2014 the fourth sample presents the lowest return, -7.41%. Also, the negative returns in the last two samples confirm that the market PB ratios have yet to converge to their fundamental valuation.[19] Overall, we find that the out – of – sample returns of the constructed portfolios are predominantly positive.

[19] We repeated the same procedure with the secondary model, i.e. *PMG* (1,0,0,0) with PBL as the dependent variable. 23 of 30 stocks remain the same in both the core and secondary model. The returns are quite similar.

Table 7

Total returns of each investing strategy.

Sample / Inv. Per.	2012Q1			2012Q2			2012Q3			2012Q4			2013Q1		
	t.r.1	t.r.2	t.r.3	t.r.1	t.r.2	t.r.3	t.r.1	t.r.2	t.r.3	t.r.1	t.r.2	t.r.3	t.r.1	t.r.2	t.r.3
1 Q	*-0.52*	*-1.56*	*-0.95*	*2.06*	*7.52*	*7.19*	*0.8*	*-2.95*	*0.65*	*-3.19*	*-3.73*	*-2.68*	*0.02*	*-0.75*	*0.49*
2 Qs	*10.93*	*5.42*	*4.96*	*11.73*	*14.1*	*12.25*	*-0.42*	*-3.75*	*1.11*	*-5.32*	*-6.02*	*-3.09*	*0.4*	*0.65*	*2.57*
3 Qs	*13.51*	*8.2*	*6.5*	*11.05*	*18.14*	*16.06*	*1.92*	*-0.14*	*5.45*	*-1.56*	*-3.93*	*-0.92*	*-3.28*	*-3.59*	*-1.53*
4 Qs	*13.04*	*11.37*	*8.9*	*11.08*	*18.55*	*18.49*	*4.04*	*1.28*	*7.61*	*-6.51*	*-7.41*	*-3.08*	*-0.38*	*-2.96*	*0.36*
5 Qs	*13.94*	*12.46*	*12.56*	*15.3*	*18.24*	*20.59*	*0.26*	*0.05*	*4.66*	*1.82*	*-4.26*	*-0.58*	*1.26*	*0.88*	*2.69*
6 Qs	*21.35*	*15.15*	*16.32*	*11.37*	*14.78*	*16.34*	*6.41*	*5.22*	*6.62*	*8.33*	*1.9*	*3.05*	–	–	–
7 Qs	*14.19*	*9.09*	*11.27*	*15.31*	*15.16*	*18.34*	*17.4*	*8.98*	*11.6*	–	–	–	–	–	–
8 Qs	*20.56*	*11.91*	*15.16*	*23.55*	*21.1*	*21.95*	–	–	–	–	–	–	–	–	–
9 Qs	*31.21*	*18.08*	*18.99*	–	–	–	–	–	–	–	–	–	–	–	–

Notes: Numbers are in percentages. Total return of the portfolio with the two stocks (1+1) is “t.r.1”. Total return of the portfolio with the four stocks (2+2) is “t.r.2”. Total return of the portfolio with the six stocks (3+3) is “t.r.3”. In 2012Q1 and 2012Q2 samples, only one stock was found to be overvalued according to *valuation*. Hence, in the “2+2” and “3+3” portfolios we consider the two least undervalued stocks as the second and third most overvalued stocks. In 2012Q3 sample, only two stocks were found to be overvalued according to *valuation*. Hence, in the “3+3 portfolio” we consider the least undervalued stock as the third most overvalued stock. The stocks included in the returns calculation of these portfolios present negative and statistically significant speeds of adjustment.

7. Conclusions

Our main finding is that the stock market valuation of large, systemic U.S. banks has a stable long – run relationship to three fundamental variables: the cost of equity, the expected growth of net income and the modified dividend payout ratio. At any given point in time, however, there is a large heterogeneity in the degree to which current price – to – book ratios of equity of these banks are temporarily above or below their long – run equilibrium valuation. Furthermore, these divergences are rather persistent over time with only about a quarter of the gap closing each quarter. It is natural to ask what forces causing these temporary divergences are and whether they have been relatively stable throughout the last decade. The financial crisis and the ensuing regulatory response to the crisis are likely to have affected the relative importance of these shocks to the steady – state relationship.

Our approach in this paper towards finding a common long – run equilibrium relationship between PB ratios and fundamentals was to limit our sample sectorally and temporally. We looked at large systemic U.S. banks during a period when very large shocks buffeted their valuations. A natural extension of our work would be to use our approach over longer time periods, for a more inclusive group of U.S. banks, for international banks, as well as for other sectors.

APPENDIX A

Table A.1

List of banks participated in the TARP, SCAP and CCAR exercises.

Exercises / ***Names***	**TARP 2008**	**SCAP 2009**	**CCAR 2011**	**2012**	**2013**	**2014**
Ally*	X	X**	X	X**	X**	X
American Express	X	X	X	X	X	X
Bank of America	X	X**	X	X	X	X
Bank of NY Mellon	X	X	X	X	X	X
BB&T	X	X	X	X	X**	X
BBVA Compass						X
BMO						X
Capital One	X	X	X	X	X	X
Citigroup	X	X**	X	X**	X	X****
Comerica	X					X
Discover	X					X
Fifth Third	X	X**	X	X	X	X
Goldman Sachs	X	X	X	X	X***	X
HSBC						X****
Huntington	X					X
JPMorgan Chase	X	X	X	X	X***	X
Keycorp	X	X**	X	X	X	X
M&T	X					X
MetLife		X	X	X**		
Morgan Stanley	X	X**	X	X	X	X
Northern Trust	X					X
PNC	X	X**	X	X	X	X
RBS Citizens						X****
Regions	X	X**	X	X	X	X
Santander						X****
State Street	X	X	X	X	X	X
SunTrust	X	X**	X	X**	X	X
US Bancorp	X	X	X	X	X	X
UnionBanCal						X
Wells Fargo	X	X**	X	X	X	X
Zions	X					X*****
TOTAL	*24*	*19*	*19*	*19*	*18*	*30*

Notes: Names in bold are not included in the sample, *GMAC Inc. re – branded itself as Ally Financial Inc. on May 2010, X** denotes banks that failed at each year's exercise, X*** denotes conditional approval, X**** denotes fail at qualitative assessment, and X****** denotes fail at quantitative assessment.

Table A.2

List of acronyms.

Acronyms	*Explanation*
3DM	Dynamic dividend discount model
AC	After – crisis period
ADF	Augmented Dickey – Fuller test
ARDL	Autoregressive Distributed Lag
BC	Before – crisis period
BVCE	Book value of common equity
BVE	Book value of equity
CAPM	Capital asset pricing model
CCAR	Comprehensive Capital Analysis Review
COE	Cost of equity
DC	During – crisis period
DDM	Dividend discount model
DFAST	Dodd – Frank Act Stress Test
DFE	Dynamic fixed effects
DIV	Dividend
DPR	Dividend payout ratio
DPS	Dividend per share
$E(R_M)$	Expected market return
ECM	Error correction model
EPS	Earnings per share
ERP	Equity risk premium
Exp_Growth	Exprected growth of net income
FCFE	Free cash flow to the equity
FCFF	Free cash flow to the firm
GLS	Generalized least squares
IPS	Im, Pesaran, Shin test
LLC	Levin, Lin, Chu test
MG	Mean group
Mod_DPR	Modified dividend payout ratio
MW	Maddala, Wu
NI	Net income
PB	Price – to – book
PBF	Forecasted PB
PBL	Lagged PB
PMG	Pooled mean group
PP	Phillips – Perron test
RESET	Regression Specification Error Test
ROCE	Return on common equity
ROE	Return on equity
SCAP	Supervisory Capital Assessment Program
SEC	Security and Exchange Commission
SR	Amount of share repurchase
TARP	Trouble Asset Relief Program

APPENDIX B

Table B.1

PMG (1,0,0,0) – core model, where American Express and Discover are excluded.

Dependent variable: PBF	Full sample without American Express	Full sample without Discover	Full sample without both of them
	slope coefficients (asymptotic std. errors)		
Speed of adjustment (average): φ	-0.263*	-0.26*	-0.26*
	(0.035)	(0.035)	(0.036)
COE	-3.381**	-3.34**	-3.489**
	(1.478)	(1.453)	(1.464)
Exp_Growth	14.301*	13.85*	13.993*
	(1.463)	(1.44)	(1.446)
Mod_DPR	11.172*	12.1*	11.479*
	(1.943)	(1.901)	(1.932)
Constant (average)	1.114*	1.157*	1.102*
	(0.051)	(0.09)	(0.048)
Number of cross sections	24	24	23
Number of observations	945	979	938
Log Likelihood	61.961	17.108	56.972
Hausman test: p – value	79.87%	95.58%	95.95%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Coefficients have the expected signs and still there is a steady – state equilibrium relationship, which drives PB ratio.

APPENDIX C

PMG (1,0,1,0) is given by:

$$\Delta PB_{it} = \phi_i \left(PB_{i,t-1} - \alpha_{0i} - \alpha_{1i} COE_{it} - \alpha_{2i} Exp\_Growth_{it} - \alpha_{3i} Mod\_DPR_{it} \right) - \delta_{11i} \Delta Exp\_Growth_{it} + \varepsilon_{it} \quad \text{(C.1)}$$

where $\phi_i = -\left(1-\lambda_{1i}\right)$, $\alpha_{0i} = \frac{\delta_{0i}}{1-\lambda_{1i}}$, $\alpha_{1i} = \frac{\delta_{10i}+\delta_{11i}}{1-\lambda_{1i}}$, $\alpha_{2i} = \frac{\delta_{20i}}{1-\lambda_{1i}}$, $\alpha_{3i} = \frac{\delta_{30i}}{1-\lambda_{1i}}$, and ε_{it} is the error term.

Table C.1

PMG (1,0,1,0) – Alternative core model.

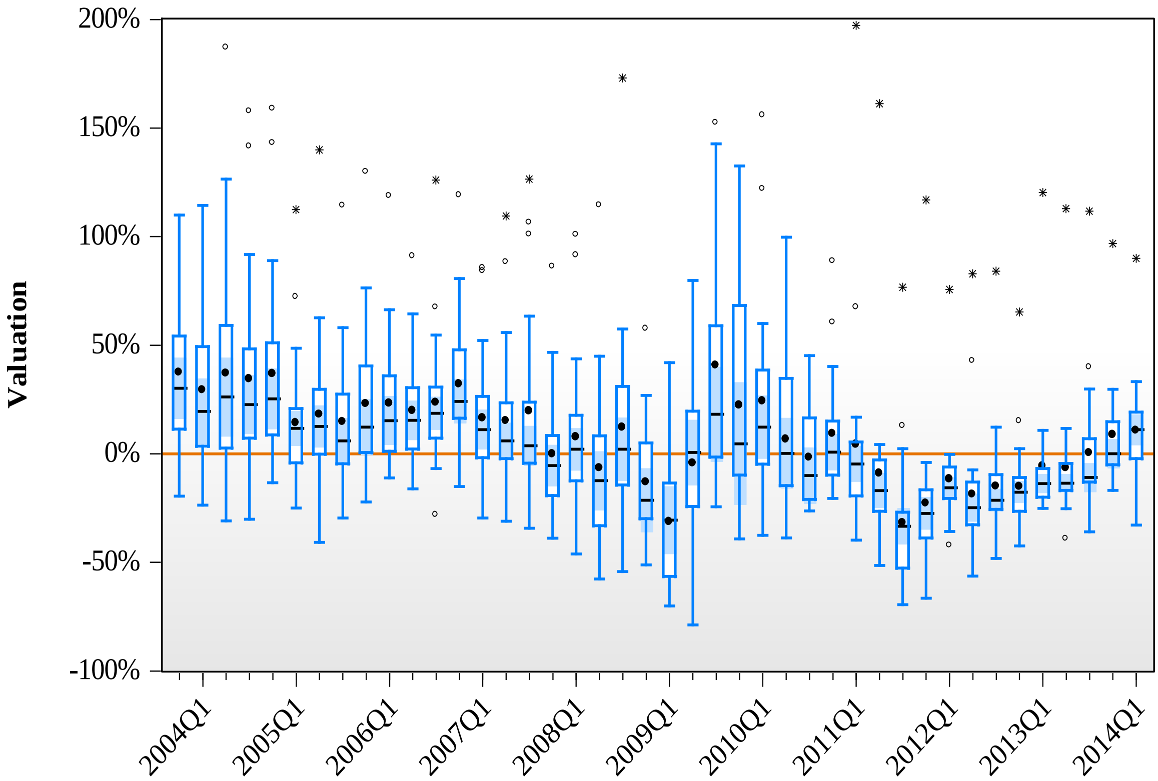
Dependent variable: PBF	Full sample	Full sample without American Express	Full sample without Discover	Full sample without both of them
	slope coefficients (asymptotic std. errors)			
Speed of adjustment (average): φ	-0.261* (0.039)	-0.262* (0.04)	-0.266* (0.04)	-0.267* (0.041)
COE	-3.644* (1.356)	-3.766* (1.369)	-3.734* (1.355)	-3.86* (1.368)
Exp_Growth	13.321* (1.609)	13.733* (1.635)	13.241* (1.601)	13.65* (1.627)
Mod_DPR	13.571* (1.988)	12.799* (2.028)	13.574* (1.987)	12.801* (2.027)
Constant (average)	1.195* (0.082)	1.146* (0.053)	1.189* (0.083)	1.138* (0.052)
ΔExp_Growth (average)	1.3 (1.214)	0.535 (1.037)	0.81 (1.153)	-0.007 (0.916)
Number of cross sections	25	24	24	23
Number of observations	986	945	979	938
Log Likelihood	66.752	102.003	58.651	93.9
Hausman test: p – value	90.47%	89.55%	99.15%	99.84%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Again, coefficients have the expected signs and display robustness to outliers. Below, *valuation* box plots are given for the full sample alternative core model.

Figure C.1

Divergence of market Price – to – Book ratios from their long – run values, full sample alternative core model.



Notes: The box segment represents the first and third quartiles. Their difference is called interquartile range (IQR). Median is shown as a line through the center of the box, while the mean is a black dot inside the box. The staple is a line drawn at the last data point within or equal to each of the inner fences, whereas the whiskers are lines drawn from first and third quartile to the respective staple. Inner fences are equal to the first quartile minus $1.5IQR$ and the third quartile plus $1.5IQR$. Similarly, outer fences are constructed with $\pm 3IQR$. Data points beyond the inner fences are known as near outliers (circles), while those beyond outer fences are referred to as far outliers (asterisks). Finally, the shaded area denotes the confidence intervals for the median at 5% significance level.

We see that estimates of the alternative core model are almost the same with those of the core model.

APPENDIX D

Running again 24 separate ARDLs, we find once more that the most common choice is the *ARDL* (1,0,0,0), as 9 of 24 banks prefer it. The second most common choice is *ARDL* (1,0,1,0), as it is chosen 6 times. Finally, we verify again that PMG's coefficients are robust to outliers. The following tables report the results from PMG estimates.

Table D.1

PMG (1,0,0,0) – secondary model.

Dependent variable: PBL	Full sample	Full sample without American Express	Full sample without Discover	Full sample without both of them
	slope coefficients (asymptotic std. errors)			
Speed of adjustment (average): φ	-0.244* (0.031)	-0.242* (0.032)	-0.239* (0.032)	-0.237* (0.033)
COE	-3.225** (1.566)	-3.428** (1.584)	-3.357** (1.548)	-3.557** (1.565)
Exp_Growth	15.784* (1.61)	15.963* (1.62)	15.444* (1.59)	15.622* (1.6)
Mod_DPR	11.257* (1.958)	10.412* (2.009)	11.552* (1.945)	10.72* (1.995)
Constant (average)	1.183* (0.094)	1.132* (0.053)	1.18* (0.098)	1.121* (0.05)
Number of cross sections	25	24	24	23
Number of observations	986	945	979	938
Log Likelihood	43.702	79.243	38.609	74.121
Hausman test: p – value	78.71%	63.5%	96.73%	85%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Table D.2

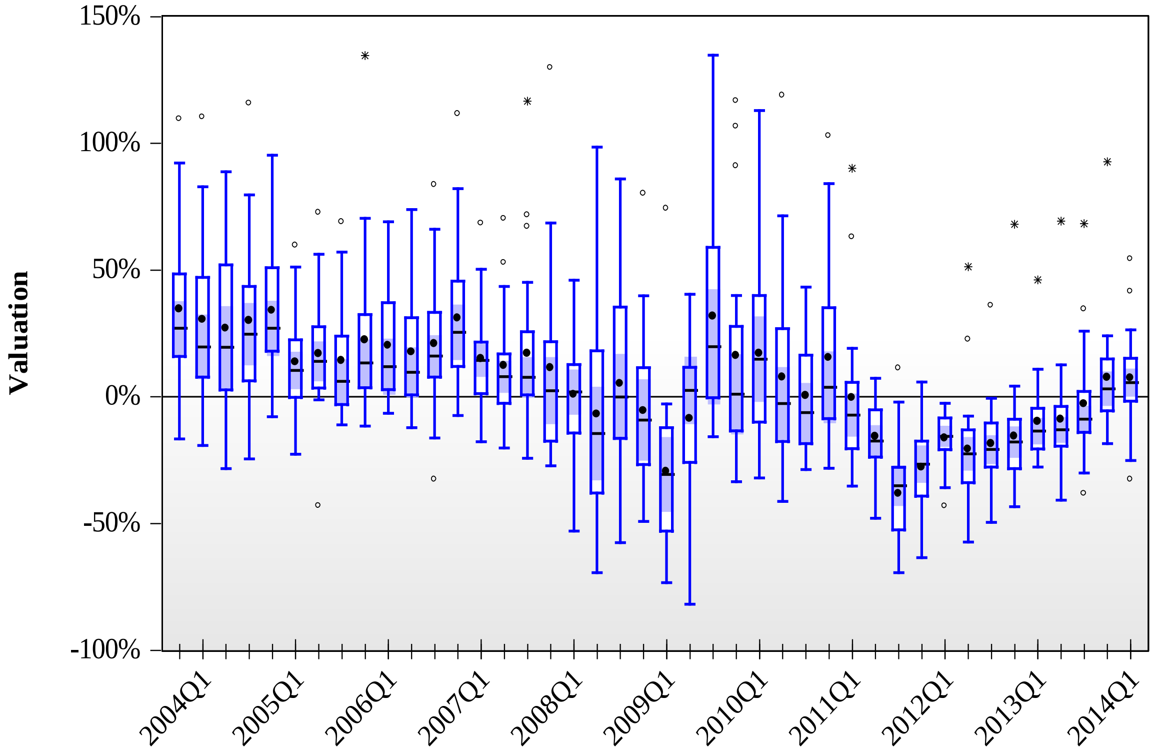
PMG (1,0,1,0) – alternative secondary model.

Dependent variable: PBL	Full sample	Full sample without American Express	Full sample without Discover	Full sample without both of them
	slope coefficients (asymptotic std. errors)			
Speed of adjustment (average): φ	-0.243* (0.036)	-0.242* (0.032)	-0.248* (0.037)	-0.247* (0.038)
COE	-3.857* (1.386)	-3.981* (1.405)	-3.934* (1.384)	-4.062* (1.402)
Exp_Growth	14.955* (1.748)	15.557* (1.789)	14.873* (1.74)	15.472* (1.782)
Mod_DPR	12.6* (2.007)	11.602* (2.064)	12.608* (2.006)	11.609* (2.063)
Constant (average)	1.24* (0.085)	1.186* (0.053)	1.233* (0.085)	1.177* (0.052)
ΔExp_Growth (average)	1.113 (1.214)	0.353 (1.057)	0.61 (1.147)	-0.203 (0.932)
Number of cross sections	25	24	24	23
Number of observations	986	945	979	938
Log Likelihood	89.943	120.213	81.751	112.018
Hausman test: p – value	83.91%	80.79%	98.06%	97.29%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Figure D.1

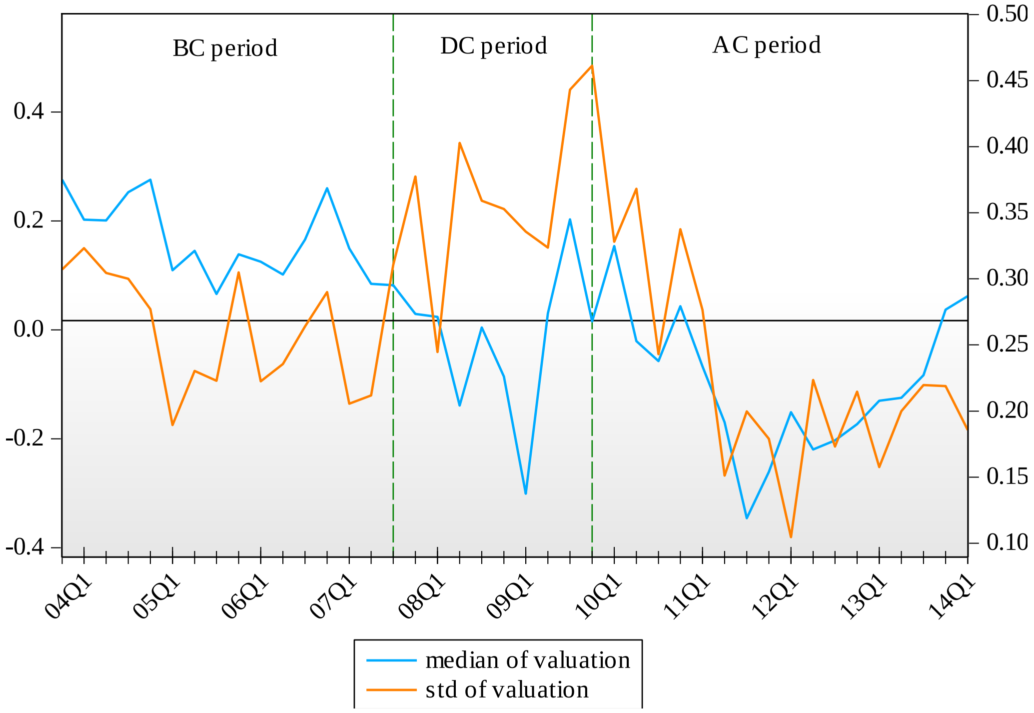
Divergence of market Price – to – Book ratios from their long – run values, secondary model.



Notes: The box segment represents the first and third quartiles. Their difference is called interquartile range (IQR). Median is shown as a line through the center of the box, while the mean is a black dot inside the box. The staple is a line drawn at the last data point within or equal to each of the inner fences, whereas the whiskers are lines drawn from first and third quartile to the respective staple. Inner fences are equal to the first quartile minus 1.5*IQR* and the third quartile plus 1.5*IQR*. Similarly, outer fences are constructed with $\pm 3IQR$. Data points beyond the inner fences are known as near outliers (circles), while those beyond outer fences are referred to as far outliers (asterisks). Finally, the shaded area denotes the confidence intervals for the median at 5% significance level.

Figure D.2

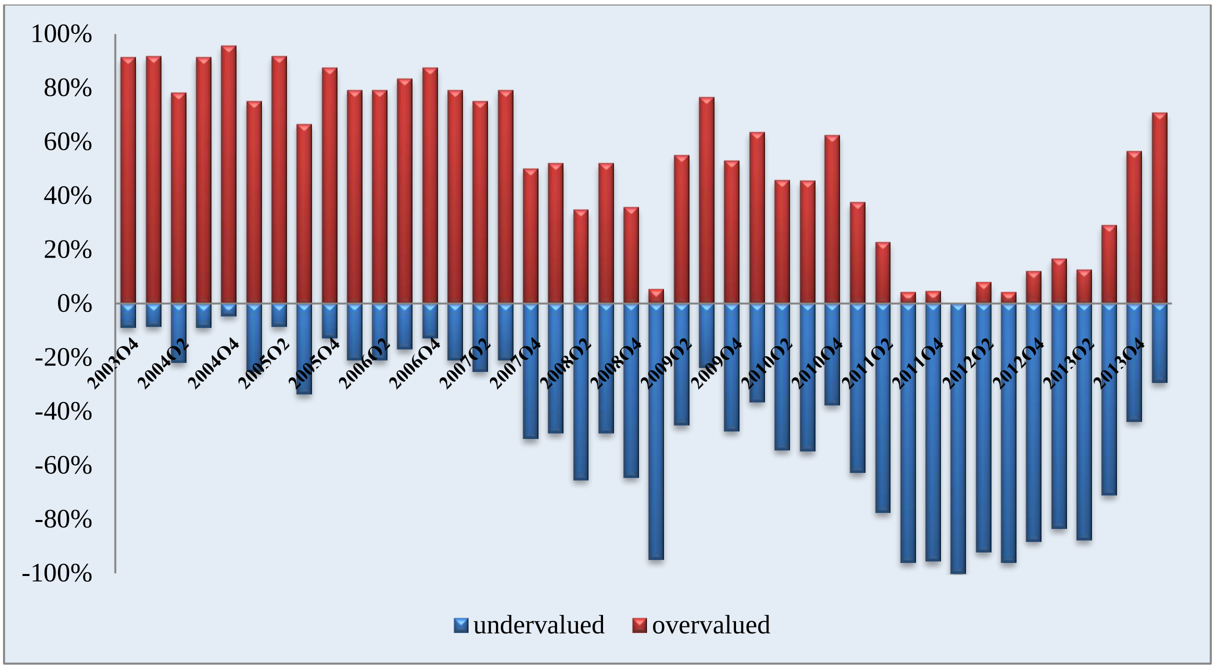
Dispersion of *valuation* over time, secondary model.



Notes: Outliers' impact has been reduced by the procedure stated in the main text. Median and standard deviation of *valuation* are centered to their means. Left axis is for median and right one for standard deviation of valuation, respectively.

<u>Figure D.3</u>

Percentage of Under – and Overvalued banks over time, secondary model.



<u>Notes:</u> Numbers come from *valuation*, which is calculated using the *PMG* (1,0,0,0) estimates.

We notice that the figures of secondary model share a common pattern of behavior with the corresponding ones of core model. Two differences lie on the dispersion of *valuation* over time in the DC and AC period. The correlation between the median of *valuation* and its standard deviation is 66.19% in the core model, while it is 16.8% in the secondary model during the crisis. The respective numbers after the crisis are 28.09% and 57.14%. However, the correlation of *valuation* and its standard deviation in the whole sample in the two models is 27.9% and 31.52% in the core and secondary model, respectively.

APPENDIX E

Table E.1

PMG (1,1,1,1) – core model.

Dependent variable: PBF	Full sample	Full sample without American Express	Full sample without Discover	Full sample without both of them
	slope coefficients (asymptotic std. errors)			
Speed of adjustment (average): φ	-0.259*	-0.26*	-0.269*	-0.27*
	(0.042)	(0.043)	(0.042)	(0.044)
COE	-0.263	-0.313	-0.266	-0.351
	(1.275)	(1.283)	(1.275)	(1.283)
Exp_Growth	10.53*	10.78*	10.541*	10.79*
	(1.506)	(1.523)	(1.507)	(1.523)
Mod_DPR	17.65*	17.217*	17.637*	17.205*
	(1.806)	(1.829)	(1.807)	(1.83)
Constant (average)	0.889*	0.837*	0.873*	0.82*
	(0.087)	(0.065)	(0.086)	(0.063)
ΔCOE (average)	-4.356**	-4.647**	-5.569*	-5.927*
	(1.98)	(2.037)	(1.63)	(1.654)
ΔExp_Growth (average)	1.918***	1.154	1.47	0.653
	(1.086)	(0.847)	(1.032)	(0.715)
ΔMod_DPR (average)	-1.829	-2.08	-2.661	-2.962
	(1.948)	(2.006)	(1.836)	(1.881)
Number of cross sections	25	24	24	23
Number of observations	986	945	979	938
Log Likelihood	127.976	162.318	117.36	151.704
Hausman test: p – value	76.57%	71.05%	86.94%	86.64%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Table E.2

PMG (1,1,1,1) – secondary model.

Dependent variable: PBL	Full sample	Full sample without American Express	Full sample without Discover	Full sample without both of them
	slope coefficients (asymptotic std. errors)			
Speed of adjustment (average): φ	-0.233* (0.038)	-0.232* (0.04)	-0.246* (0.038)	-0.246* (0.039)
COE	-0.768 (1.392)	-0.802 (1.405)	-0.761 (1.391)	-0.795 (1.405)
Exp_Growth	12.49* (1.665)	12.854* (1.693)	12.432* (1.661)	12.792* (1.689)
Mod_DPR	15.953* (1.87)	15.398* (1.902)	16.011* (1.867)	15.461* (1.899)
Constant (average)	0.966* (0.087)	0.909* (0.063)	0.95* (0.085)	0.893* (0.061)
ΔCOE (average)	-4.303** (2.008)	-4.557** (2.074)	-5.631* (1.574)	-5.961* (1.599)
ΔExp_Growth (average)	1.863 (1.14)	1.111 (0.942)	1.289 (1.021)	0.478 (0.719)
ΔMod_DPR (average)	-0.879 (1.942)	-1.123 (2.002)	-1.972 (1.677)	-2.279 (1.71)
Number of cross sections	25	24	24	23
Number of observations	986	945	979	938
Log Likelihood	149.936	178.921	139.341	168.319
Hausman test: p – value	64.29%	59.29%	81.92%	78.86%

Notes: We round to the 3rd decimal except for p – value of Hausman test. The Hausman test examines the validity of long – run slope homogeneity. *1% significance level, **5% significance level, ***10% significance level.

Appendix F

Table F.1

Critical dates of the investment strategies.

Sample / *Crit. Dates*	2012Q1	2012Q2	2012Q3	2012Q4	2013Q1
Starting date	*9/5/2012*	*8/8/2012*	*7/11/2012*	*27/2/2013*	*8/5/2013*
1 Q later	*9/8/2012*	*8/11/2012*	*7/2/2013*	*27/5/2013*	*8/8/2013*
2 Qs later	*9/11/2012*	*8/2/2013*	*7/5/2013*	*27/8/2013*	*8/11/2013*
3 Qs later	*8/2/2013*	*8/5/2013*	*7/8/2013*	*27/11/2013*	*7/2/2014*
4 Qs later	*9/5/2013*	*8/8/2013*	*7/11/2013*	*27/2/2014*	*8/5/2014*
5 Qs later	*9/8/2013*	*8/11/2013*	*7/2/2014*	*27/5/2014*	*8/8/2014*
6 Qs later	*8/11/2013*	*7/2/2014*	*7/5/2014*	*27/8/2014*	–
7 Qs later	*7/2/2014*	*8/5/2014*	*7/8/2014*	–	–
8 Qs later	*8/5/2014*	*8/8/2014*	–	–	–
9 Qs later	*8/8/2014*	–	–	–	–

Notes: These dates are calculated with the deadlines of 40 and 60 days adopted by SEC.

Table F.2

Banks names and the degree of under – or overvaluation.

			Sample: 2012Q1			
Names	Bank of NY Mellon	Citigroup	Keycorp	BB&T	Bank of America	Regions
Degree of *valuation*	*-47.88*	*-36.38*	*-31.55*	*0.07*	*-2.94*	*-3.63*
			Sample: 2012Q2			
Names	Bank of NY Mellon	Citigroup	Keycorp	Capital One	Fifth Third	BB&T
Degree of *valuation*	*-50.21*	*-49.07*	*-41.37*	*52.58*	*-4.93*	*-7.68*
			Sample: 2012Q3			
Names	Bank of NY Mellon	SunTrust	State Street	Fifth Third	Bank of America	BB&T
Degree of *valuation*	*-50.94*	*-38.58*	*-38.05*	*7.36*	*4*	*-0.65*
			Sample:2012Q4			
Names	Bank of NY Mellon	Goldman Sachs	Keycorp	Bank of America	SunTrust	Capital One
Degree of *valuation*	*-44.7*	*-35.71*	*-31.69*	*22.9*	*3.47*	*3.04*
			Sample: 2013Q1			
Names	JPMorgan Chase	Goldman Sachs	Keycorp	Bank of America	BB&T	SunTrust
Degree of *valuation*	*-24.55*	*-23.35*	*-22.65*	*17.37*	*11.49*	*10.99*

Notes: Numbers are in percentages. We round to the 4th decimal.

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