CEO compensation and bank efficiency: An application of conditional nonparametric frontiers

By

Roman Matousek\textsuperscript{1}, Nickolaos G. Tzeremes\textsuperscript{2}

\textsuperscript{1}Kent Business School, The University of Kent, Canterbury, Kent, CT2 7PE, UK.

Corresponding author’s e-mail address: R.Matousek@kent.ac.uk

\textsuperscript{2}Laboratory of Operations Research, Department of Economics, University of Thessaly, Korai 43, 38333, Volos, Greece.

Abstract

The paper, by incorporating the latest developments on the probabilistic approach of efficiency measurement, (Bădin et al., 2012) investigates in a dynamic context the effect of Chief Executive Officer (CEO) bonus and salary payments on banks’ technical efficiency levels. We apply time-dependent conditional efficiency estimates to analyze a sample of 37 US banks for the period from 2003 to 2012. The empirical evidence reveals a non-linear relationship between CEO bonus and salary payments and banks’ efficiency levels. More specifically it is reported that salary and bonus payments affect differently banks’ technological change and technological catch-up levels. Finally, the empirical evidence suggests that higher salary and bonus payments are not always aligned with higher technical efficiency levels.

Keywords: Bank efficiency; CEO compensation; Conditional efficiency measures; Data Envelopment Analysis.
1. Introduction

Over the past decades several influential papers have explored empirically the link between Chief Executive Officer (CEO) compensation levels and firms’ performance (known as pay-for-performance relationship). These studies examine the pay-for-performance relationship mainly for industrial US firms. They explored how firms’ performance determines CEO compensation levels. The majority of the empirical evidence suggest that the relationship is positive, however, there are also a few studies providing evidence of a weak relationship (Conyon and Murphy, 2000; Zhou, 2000; Buck et al., 2003). On the other hand, some other studies report that there is even a negative relationship between excess CEO compensation and firms’ performance (Core et al., 1999; Brick et al., 2006). Arguments in the literature (Finkelstein and Boyd, 1998; Bertrand and Schoar, 2003; Crossland and Hambrick, 2007, 2011; Hambrick and Quigley, 2014) suggest that when managerial discretion and CEO compensation are aligned then firm performance should be higher. Furthermore, earlier studies suggest that cash compensation should be structured in such a way that will enable high rewards to be associated with high performance (Jensen and Murphy, 1990a, 1990b; Mehran, 1995; Hall and Leibman, 1997).

Despite the importance of such a relationship in the banking industry, surprisingly a few empirical studies have been exploring the link between CEO compensation and bank performance. This study contributes to current empirical evidence.

---


2The extant research uses stock prices and financial and accounting based ratios as a measure of firms’ performance.

3For an extensive literature review see Murphy (1999) and Core et al. (2003).

4Managerial discretion is the ability of a CEO (or a top manager) to make strategic decisions that have both direct and indirect impact on firms’ performance (Finkelstein and Boyd, 1998; Bertrand and Schoar, 2003)
research on CEO compensation in general and banking in particular. The paper differs from other recent studies in several ways.

Firstly, we explore for the first time the effect of CEO bonus and salary payments on banks’ efficiency levels. We use a sample of 37 US bank holding companies over the period from 2003 to 2012. We examine in a nonparametric context the CEO payment-bank performance relationship. Secondly, we apply the latest developments of data envelopment analysis (DEA), as have been introduced by Bădin et al. (2012) and Mastromarco and Simar (2014). Specifically, we model bank technical efficiency by taking into consideration time effects and the effects imposed by CEO compensation levels without imposing the restrictive separability assumption. This is done by treating time and CEO compensation levels as external/environmental factors which in turn influence banks' production process. A number of recent studies, e.g. Holmstrom and Kaplan, 2003; Bizjak, Lemmon and Naveen, 2008; Hayes and Shaefer, 2009; Bizjak, Lemmon and Nguyen, 2011; among others, provide empirical support for the view that there is a common practice of competitive benchmarking to determine CEO compensation. Bizjak et al. (2008) point out that the practice is questionable since it can increase executive pay without taking into account a firm’s performance. On the other hand, competitive benchmarking can be used as an efficient tool to retain valuable CEOs. In other words, CEO compensation is not necessarily determined by the firm itself but reflects compensation packages across the sector.

Moreover, we apply full and partial time-dependent conditional efficiency measures that enable us to explore separately the effect of time and CEO bonus and

---

5 Recently Chen et al. (2013) have illustrated the usefulness of DEA methodology for the top management level due its ability to measure firms’ performance by identifying the firms’ imposing competitive advantage.

6 For details see the studies by Simar and Wilson (2007, 2011).

7 In a competitive environment, there is a high degree of discretion of how CEOs are compensated, see, for example, Finkelstein and Boynd (1998) for a further discussion.
salary payments on banks’ technological change (shifting of the frontier) and technological catch-up (distribution of efficiency). Thirdly, we deploy banks’ technical efficiency estimates instead of financial and accounting based ratios that are commonly used. Such an approach circumvents all the disadvantages related to those performance measures. The advantages of using relative rather than absolute measures for the analysis of the pay-for-performance relationship are discussed in detail by Antle and Smith (1986) and Gibbons and Murphy (1990). Steigenberger (2014) then discusses the limitation of financial and accounting ratios as a measure of firms’ performance. Fourthly, our model does not impose any assumptions related to the functional form of the examined relationship that allows us to reveal any nonlinearities. This is an important contribution to current research in the banking industry. The previous studies have assumed a linear relationship between CEO remuneration and bank performance.

The structure of the paper is as follows: Section 2 reviews the related literature of the pay-for-performance relationship with a particular emphasis on the banking sector. Section 3 provides a description of the variables used and presents the proposed methodological framework. Finally, Section 4 discusses the empirical findings. Section 5 provides a summary of our findings.

2. Review of the literature

The prevailing empirical research on the CEO compensation-firm performance relationship has mostly been conducted for industrial firms. Coughlan and Schmidt (1985), for example, examine how the changes in compensation affect stock price

---

8See, for example, Kumar and Russell (2002) and Henderson and Russell (2005).
9 This was mainly related to data availability issues.
performance. They provide supporting evidence that compensation affects both firms’ stock price and sales growth levels. Murphy (1985) analyzes the same relationship by adopting, as a dependent variable, the compensation level and as an independent variable, shareholder returns (rather than accounting profits) and growth of firms sales on the sample of 500 executives from the 73 largest manufacturing companies over the period from 1964 to 1981. The study shows that the performance measures that were adopted are strongly related to CEO compensation. Jensen and Murphy (1990a) also argue that CEOs’ financial rewards affect directly firms’ performance levels. They conclude that CEOs’ remuneration incentives are very important determinants of firms’ performance levels. In addition, they provide evidence that CEOs’ performance incentives come from stock ownership. Jensen and Murphy (1990b) then emphasise that cash compensation should be structured in such a way that enables high rewards to be associated with high performance. There is, however, evidence that cash compensation and corporate performance are weakly interrelated. Thus, it means that the ‘efficient’ structure of cash compensation should reflect upon firms’ performance levels. In the same spirit, Kaplan (1994) regresses the annual compensation changes on several accounting and share price performance metrics for 119 Japanese companies over the period from 1982 to 1984. He provides evidence of a positive relationship between compensation and firm performance. Mehran (1995) further examines CEO compensation and firm performance. The model uses as dependent variables two performance measures: Return on Assets (ROA) and Tobin’s Q. The tested sample includes 153 manufacturing firms during the period from 1979 to 1980. The findings of this study shows that CEO compensation explains significantly firms’ performance variations. In other words, the structure of compensation is a crucial determinant for firm performance. Hall and Leibman (1997) provide empirical evidence of a positive
relationship between CEO compensation and firms’ financial performance. Finkelstein and Boynd (1998) use as a measure of performance Return on Equity (ROE) and ROA. They find that prior firm performance is not linked to CEO compensation but firm size is a key determinant. Aggarwal and Samwick (1999a) show that relative performance evaluations are not linked with CEOs compensation contracts. Aggarwal and Samwick (1999b) provide convincing evidence that there is a link between sensitivity of compensation with the performance of rival firms. They also suggest that relative performance evaluation is very important for our understanding of executive compensation.

On the other hand, there are a number of studies that confirm the relationship between CEO rewards and firms’ performance. Brunello et al. (2001), who use a sample of 107 Italian firms, point out the positive relationship between CEO compensation and firms’ profit levels. Mitsudome et al. (2008) compare Japanese and US companies and their results indicate that there is a significantly positive relationship between CEO compensation and short-term performance. However, they could not confirm such a relationship for the Japanese firms when they use sales growth levels as a proxy for firm performance.

Barro and Barro’s (1990) study was among the first studies to investigate pay-for-performance contracts in the banking industry. They explore the relationship using a sample that includes US commercial banks during the period from 1982 to 1987. They find that the growth of compensation is positively related to accounting earnings and stock returns. That means the compensation growth depends on relative and aggregate performance. Later Hubbard and Palia (1995) provide evidence of a stronger relationship of compensation–performance during the 1980s, i.e., the period of interstate banking permission. They show that bank size also determines the level of
compensation. Crawford et al. (1995) examined the sensitivity of CEO performance after the deregulation period for a sample of 37 commercial banks over the period from 1976 to 1982. They provide evidence that during the deregulation period there was an increase in pay-performance sensitivities. Houston and James (1995) analyze a sample of 134 banks over the period from 1980 to 1990 and examine the determinants of CEO cash compensation (salary plus bonus) and CEO stock and option holdings. They find that there is a positive relationship between stockholder wealth with both types of compensation. They also provide evidence that bank CEOs’ cash compensation is sensitive to stock market performance. Furthermore, their findings suggest that for larger banks the pay for performance relationship is relatively weak. In contrast, Bliss and Rosen (2001) provide evidence that bank mergers and acquisitions contributed to a significant increase in CEO compensation, despite the fact that shareholder values declined through the lower value of bank shares. Their findings support several other studies suggesting that the size has a positive influence on CEO compensation. Ang et al. (2002), by using a sample of 166 US banks, provide evidence that the compensation of top bank executives is determined by bank performance and the size of the bank. They also show that the payment is higher when it is linked to long-term performance achievements. John and Qian (2003) examine the pay for performance sensitivity for a sample of 120 commercial banks and a sample of 997 manufacturing firms over the period from 1992 to 2000. Their results suggest that pay for performance sensitivity is lower for regulated firms and decreases with firm size and their debt ratio. In addition, they show that banks have lower pay for performance sensitivity than manufacturing firms. Anderson et al. (2004) show on the sample of 97 US bank mergers over the period from 1990 to 1997, that CEO compensation is related to the potential gains obtained from the bank merger.
A recent study by Cuñat and Guadalupe (2009), who analyze the sample of commercial banks and financial services firms from Standard and Poor’s 1500 index, show that total shareholder values that are used as a proxy for performance is positively linked with CEO compensation levels. John et al. (2010) examine a sample of bank holding companies during the period from 1993 to 2007. They find that the pay for performance sensitivity of bank CEO compensation decreases with the leverage ratio (defined as one minus the ratio of equity over assets) and it is positively related to the monitoring intensity (measured by subordinated debt rating, non-performing loan ratio and BOPEC rating). Livne et al. (2011) find a positive link between banks’ CEO pay and fair value valuation of available for sales assets. Finally, Livne et al. (2013) provide evidence that executive cash bonuses are linked with a simultaneously CEO risk-taking incentives, and a decrease of banks’ accounting performance.

The above brief review of the literature indicates that there are some pay-for-performance studies that explore how banks’ performance determines CEO compensation levels. However, we find a gap in current research that analyses how CEO compensation affects bank performance. Furthermore, it is also evident that the relative literature applies mostly the parametric approaches to investigate the pay-for-performance relationship. In other words, the model assumes a linear relationship between bank performance and CEO compensation. To this end our paper contributes to the literature by incorporating into our analysis a fully non-parametric framework enabling us to reveal any non-linear links. This can be accomplished by applying the latest developments of the probabilistic approach of efficiency measurement which are presented in the next section.

3. Data and methodology
3.1 Description of variables

We collect data for CEO compensation from Compustat Execucomp Database during the period from 2003 to 2012. The excessive compensation rewards of CEOs in the USA were criticised for a long time. In July 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act was introduced as a reaction to the Global Financial Crisis, when a large number of financial institutions collapsed. The Dodd-Frank Act is a complex Act dealing with different aspects of financial regulation that should prevent the repetition of the financial crisis in 2008. It embeds, among other regulatory changes, a systemic change of CEO compensation. In particular, the Dodd-Frank Wall Street Reform and Consumer Protection Act proposes provisions that affect executive compensation (Cotter et al (2013) and Kaplan (2012)). These provisions include: i) Advisory votes of shareholders about executive compensation and golden parachutes, including specific disclosure of golden parachutes in merger proxies; ii) disclosure about the role of, and potential conflicts involving, compensation consultants; iii) additional disclosure about certain compensation matters, including pay-for-performance and the ratio between the CEO’s total compensation and the median total compensation for all other company employees; iv) the Commission to direct the exchanges to prohibit the listing of securities of issuers that have not developed and implemented compensation claw-back policies; and v) a disclosure about whether directors and employees are permitted to hedge any decrease in market value of the company’s stock.

All those changes have been gradually implemented by the US Securities and Exchange Commission (SEC). In the period from 2010–2012, the SEC implemented the rules that require institutional investment managers to report their votes on executive compensation and "golden parachute" arrangements. The SEC also adopted
rules concerning shareholder approval of executive compensation and "golden parachute" compensation arrangements. Finally in July 2012, the SEC adopted rules regarding the disclosure about the role of, and potential conflicts involving, compensation consultants. In 2013, the SEC then adopted rules regarding pay ratios. In 2015, the Commission proposed rules regarding disclosure about whether directors and employees are permitted to hedge any decrease in market value of the company’s stock and finally the Commission proposed rules regarding pay for performance disclosure.

It is evident that these rules do not impose any significant restrictions on CEO compensation but require disclosure of information about CEO compensation. In other words, our sample that covers the period from 2003–2012 is not biased due to the systematic changes in CEO remuneration. The main changes were introduced after 2012 that includes also pay performance related compensation disclosure.

We select financial institutions with Standard Industry Classification (SIC) codes between 6000 and 6300. We then exclude manually financial institutions with SIC code 6282 (Investment Advice); SIC codes 6111 (federal credit agency); SIC code 6199 (Finance Services); and SIC code 6211 (Security Brokers and Dealers). The final sample includes 37 US bank holding companies that were active during the period from 2003 to 2012. The Compustat Execucomp Database allows us to extract and divide CEO compensation into several categories. In our analysis, we use for CEO payment the total current compensation values that are directly extracted from the database and include salary and bonuses. As for financial statement data, these data are obtained from Bankscope, which is the most widely used database for financial institutions. We collected defined variables from consolidated financial statements for bank holding companies.
Furthermore, for our DEA context we need to specify banks’ production function. Hugh and Mester (2008) argue that bank production is unique to the production of other types of lenders. They show that banks have a special capital structure, i.e. the bank production process is based on the intermediation of deposits into informationally opaque assets. This argument is further supported by Berlin and Mester (2000), who provide empirical evidence of an explicit link between banks’ liability structure and banks’ lending behaviour. Such findings correspond with the role of banks in the economic system. Banks can reduce the problem of asymmetric information that is reflected consequently by reducing bank risk during its production process. Hugh and Mester (2008) further argue that this leads to efficient and prudent production of financial services.

Thus we apply the intermediation approach as proposed by Sealey and Lindley (1977) and has been followed by empirical research on bank efficiency, (eg. Curi, Lozano-Vivas, Zelenyuk, 2015; Fujii et al., 2014; Fethi and Pasiouras, 2010; Hugh and Mester , 1998)

Under the intermediation approach the inputs used are property, plant and equipment (a proxy for bank capital), deposits and number of employees. Bank outputs are defined as securities and loans. Furthermore, we use CEO salary and bonus payments in our model. Tables 1 & 2 present analytically (per year and per bank) the descriptive statistics of the variables used in our analysis.

[Table 1 and Table 2 about here]

3.2 Time-dependent conditional efficiency measures
Following Koopmans (1951) and Debreu (1951) the production technology is characterized by a set of inputs \( x \in \mathbb{R}_+^p \) that can produce a set of outputs \( y \in \mathbb{R}_+^q \). Then the technically feasible combinations of \((x, y)\) can characterize the production set as:

\[
\Psi = \{(x, y) \in \mathbb{R}_+^{p+q} \mid x \text{ can produce } y\},
\]

(1)

Then the Farrell (1957) measure of input oriented efficiency score for a unit operating at the level \((x, y)\) can be defined as:

\[
\theta(x, y) = \inf \{\theta \mid (\theta x, y) \in \Psi\}.
\]

(2)

According to Daraio and Simar (2005, 2007a) the production set can also be characterized as:

\[
\Psi = \{(x, y) \mid H_{x,y}(x, y) > 0\},
\]

(3)

where

\[
H_{x,y}(x, y) = \text{Prob} \left( X \leq x \mid Y \geq y \right) \text{Prob} \left( Y \geq y \right) = F_{x|x}(y) S_y(y).
\]

(4)

Therefore, the production process can be described by the joint probability of \((X, Y)\) on \( \mathbb{R}_+^p \times \mathbb{R}_+^q \). Then the Farrell-Debreu measure of input oriented efficiency can also be characterized as:

\[
\theta(x, y) = \inf \{\theta \mid F_{x|x}(\theta x, y) > 0\} = \inf \{\theta \mid H_{x,y}(\theta x, y) > 0\}.
\]

(5)

Mastromarco and Simar (2014) introduce, for the first time, the time-dependent conditional efficiency measures based on the probabilistic approach by Daraio and Simar (2005, 2007a) and the latest developments by Bădin et al. (2012). Similarly, let the time \( T \) be an additional conditional variable with those examined in our case (bonus and salary payments). Then for each time period \( t \) the attainable set \( \Psi_t^c \subseteq \mathbb{R}_+^{p+q} \) can be defined as the support of the conditional probability:
\[ H'_{x,y|z} (x, y|z) = \text{Prob}(X \leq x, Y \geq y|Z = z, T = t) \]
\[ = F'_{x,y,z} (x|y, z) S'_{y|z} (y|z) \] (6)

where \[ F'_{x,y,z} (x|y, z) = \text{Prob}(X \leq x|Y \geq y, Z = z, T = t) \] (7)

and \[ S'_{y|z} (y|z) = \text{Prob}(Y \geq y|Z = z, T = t) \] (8)

Then the full frontier case input oriented technical efficiency of a bank \((x, y) \in \Psi^\iota_\tau\), at time \(t\) facing the conditions \(z\) can be defined as:

\[ \theta_\iota (x, y|z) = \inf \{ \theta | F'_{x,y,z} (\theta x|y,z) > 0 \}. \] (9)

For the full frontier estimation we have used the assumption of variable returns to scale (VRS). This assumption is commonly used in banking efficiency literature by incorporating directly banks' scale effects. However, it must be noted that there is also support from several authors for the constant returns to scale (CRS) assumption (Kumar and Russell, 2002; Henderson and Russell, 2005; Henderson and Zelenyuk, 2007; Mastromarco and Simar, 2014) since it can provide us with a greater discriminative power compared to the VRS assumption (Zelenyuk and Zheka, 2006).

Furthermore, the order-\(\alpha\) quantile efficiency measure (also called robust or partial frontiers) for the input oriented case as introduced by Daouia and Simar (2007) can be defined for \(\alpha \in (0,1)\) as:

\[ \theta_\alpha (x, y) = \inf \{ \theta | F'_{x,y,z} (\theta x|y) > 1 - \alpha \}. \] (10)

Therefore, the order-\(\alpha\) quantile efficiency measure of a bank \((x, y) \in \Psi^\iota_\tau\), at time \(t\) facing the conditions \(z\) can be defined as:\(^{10}\)

\[ \theta_\iota,\alpha (x, y|z) = \inf \{ \theta | F'_{x,y,z} (\theta x|y,z) > 1 - \alpha \}. \] (11)

\(^{10}\)For the asymptotic properties of conditional measures see Jeong et al. (2010).
For the partial frontiers (conditional and unconditional) we have used $\alpha = 0.5$ which according to Bădin et al. (2012) correspond to the median frontiers and thus enable us to explore the potential shift of the distribution of the efficiencies as a function of time, bonus and salary payments. However, as suggested also by Bădin et al. (2014) we need to apply also $\alpha$ values close to 1 in order to check the robustness of the results obtained from the full frontier when interpret the results from the full frontiers. For that reason also an $\alpha = 0.95$ has been applied.

We adopt smoothing techniques in order to condition the external variables and compute the conditional efficiency estimators. Therefore, we apply the approach proposed by Bădin et al. (2010) for bandwidth selection $(h)$.\textsuperscript{11} Furthermore, our model requires to calculate a nonparametric estimator $F_{X|Y,Z}^T(x|y,z)$, where we condition on $Y \geq y$, time $T = t$ and a particular value of $Z = z$. This can be estimated as:

$$
\hat{F}_{X|Y,Z}^T(x|y,z) = \frac{\sum_{j=(i,o)} I(x_j \leq x, y_j \geq y)K_{h_y}(z_j - z)K_{h_t}(\nu - t)}{\sum_{j=(i,o)} I(y_j \geq y)K_{h_y}(z_j - z)K_{h_t}(\nu - t)}. \tag{12}
$$

We also have to note that $h_y$ and $h_t$ are the bandwidths of optimal size. Whereas $K(.)$ is the kernel function with compact support. However, since we examine two exogenous factors (bonus and salary payments), we use a product kernel with a vector of bandwidths.\textsuperscript{12}

Finally, in order to examine the effect of time and CEO salary and bonus payments on banks’ performance levels, we adopt the approach introduced by Bădin et

\textsuperscript{11}Bădin et al. (2010) describe in detail the procedure and provide the Matlab codes for the calculation of optimal bandwidth $h$ (also called smoothing parameter).

\textsuperscript{12}For more details regarding computational issues of the Data Envelopment Analysis (DEA) estimators and bandwidth selection see the studies by Bădin et al. (2010, 2012) and Mastromarco and Simar, (2014).
al. (2012) by creating the ratios of conditional to unconditional efficiency estimates from the full and partial frontier measures:

\[ R_j(x, y|z, t) = \frac{\partial_j(x, y|z)}{\partial(x, y)}, \quad R_{j,\alpha}(x, y|z, t) = \frac{\partial_{j,\alpha}(x, y|z)}{\partial_{\alpha}(x, y)}. \]  \hfill (13)

Next, we apply nonparametric regressions and we explore the effect of \( T \) and \( Z \) by examining the behaviour of \( \hat{R}_j(x, y|z, t) \) and \( \hat{R}_{j,\alpha}(x, y|z, t) \) as a function of \( T \) and \( Z \). Thus, we are able to investigate the dynamic effects of CEO bonus and salary payments on banks’ technological change (shift of the frontier) and technological catch-up (distribution of efficiency). Based on Kumar and Russell (2002) and Henderson and Russell (2005), banks’ technological changes is represented by the ‘shifts in banks’ production frontier’ whereas banks’ technological catch-up are represented by the ‘movements toward or away from their production frontier’.

We apply a local linear estimator and optimal bandwidths using the least squares cross-validation (LSCV) criterion in the same way as presented by Hall et al., 2004; Li and Racine, 2004, 2007; Hayfield and Racine, 2008 among others.. Since we are using input oriented measures, Bădin et al. (2012) suggest that a tendency of the ratio \( \hat{R}_j(x, y|z, t) \) to increase alongside the conditioning variables indicates an unfavorable effect on banks’ technological change (shift of the frontier). In contrast a tendency of the ratio \( \hat{R}_j(x, y|z, t) \) to decrease alongside with the conditioning variables indicates a favorable effect. Similarly, a tendency of the ratio \( \hat{R}_{j,\alpha}(x, y|z, t) \) to increase with conditioning variables indicates again an unfavorable effect on banks’ technological catch-up (distribution of efficiency) and unfavorable in the opposite case.

\^For our calculation of the efficiency estimates we have used the ‘FEAR’ package which is an integrated program in ‘R’ language (Wilson, 2008).
4. Empirical findings

Tables 1 and 2 provide a basic information about our sample. As we can see there are large differences within time periods which indicate the presence of potential outliers and dimensionality problems that can significantly distort the precision of our estimates. Therefore we have to reduce the dimension in the input-output space and thus to gain precision and reliability in our analysis. As proposed by Bădin et al. (2012) and Daraio et al. (2015), we apply a variable reduction procedure and we replace the inputs and outputs by their best (non-centered) linear combinations (see for details Daraio and Simar, 2007b, pp. 148–150). As a result of that, we reduce the problem of dimensionality without losing any information, since the resulting univariate input (IF) and output (OF) factors are highly correlated with the original inputs and outputs used. The results from the input/output reduction are:

\[
IF = 0.567X_1 + 0.581X_2 + 0.584X_3
\]
\[
OF = 0.707Y_1 + 0.717Y_2
\]

Furthermore, we obtain the following correlations for inputs

\[
\hat{\rho}_{IF,x_k} = (0.926, 0.954, 0.946) \text{ for } k = 1, 2, 3. \]

It means that the obtained IF explains over 90% of total inertia of our original inputs. For the case of the outputs, we obtain

\[
\hat{\rho}_{OF,y_k} = (0.949, 0.925) \text{ for } k = 1, 2. \]

In other words, the obtained OF explains again over 90% of total inertia of our original outputs. Thus, we have one input and one output that minimize the problem of dimensionality.\(^{14}\)

\(^{14}\) For a discussion on the subject matter see Dyson et al. (2001).
Following the methodology described previously, Table 3 presents banks’ mean efficiency estimates and their standard deviation values over the period from 2003 to 2012, both for full and robust measures. The results reveal that there are differences between the mean efficiencies values between the VRS and the Order-α estimates (with $\alpha = 0.5$). Specifically, for Hudson City Bancorp Inc, Bank of New York Mellon Corp, Astoria Financial Corp, New York Cmnty Bancorp Inc, Washington Federal Inc, Cathay General Bancorp, First Bancorp P R, Bank of Hawaii Corp, Westamerica Bancorporation and United Bankshares Inc/WV the results between the robust and full frontiers indicate high efficiency differences (on average terms). Moreover, in the case of full frontiers 12 banks report the standard deviation efficiency values greater than 0.1. Similarly, when we examine the results of the robust frontiers also 12 banks report the standard deviation efficiency values greater than 0.1. That suggests that in both cases we have higher efficiency fluctuations over the examined period.

[Table 3 about here]

Figure 1 presents diachronically the number of banks with efficiency values above the sample’s mean efficiency value, both for the full and robust frontiers. As we observe for the case of full frontiers (solid line), the number of banks that have technical efficiency scores above the sample’s average value increases till 2007. This result changes after 2007, when the US banks were affected by the global financial crisis. We can observe that the number of banks with the technical efficiency scores over the average value decreases. We can also see that in the case of the robust frontiers (dashed line)

---

$^{15}$The analytical results of the estimated efficiencies both for the conditional and unconditional measures for the full and robust frontiers are available upon request.
line), this phenomenon is even more pronounced. We can further observe a decrease in the number of banks that have technical efficiency scores above the sample’s average value from 2005 and as we move towards the initiation period of the global financial crisis this number reduces considerably. However, after 2008 the results reveal that the number of banks having technical efficiency score above the sample average value increases but with some fluctuations (especially during the period from 2008 to 2011). In both cases, the results emphasize the negative effect of the global financial crisis on bank performance levels.

[Figure 1 about here]

Figure 2 then illustrates graphically the effect of CEO compensation on banks’ performance levels. More analytically, sub-figures 2a, 2c and 2e present the effect of time and CEO salaries on banks’ technological change (shift of the frontier) and technological catch-up (distribution of efficiencies). In addition sub-figures 2b, 2d and 2f present the effect of time and CEO bonus payments on banks’ technological change and technological catch-up. As we have already explained, we use input oriented efficiency measures and an increasing nonparametric regression line indicates a negative effect of the external variables (time, salary and bonus). A decreasing line indicates a positive effect. When analyzing the effect of time and salary on banks’ technological change (sub-figure 2a), we observe that for lower CEO salary levels the effect is negative. On the other hand, for higher salary values, we observe that the effect is positive.

If we examine the effect of CEO bonuses and time on banks’ technological change (sub-figure 2b), we observe a different effect. For lower bonus levels the effect
is positive that is represented as a decreasing nonparametric regression line, up to a
certain bonus level. However, as we move towards the end of the period the effect from
neutral turns to negative, which is indicated by an increasing nonparametric line.

Furthermore, when we examine the dynamic effect of CEO salary and bonus
levels on banks’ technological catch–up (subfigures 2c and 2d), we observe a similar
behaviour. As we have already mentioned, we set $\alpha = 0.5$ in order to observe the effect
of time, bonus and salary payments on the middle of the distribution of banks’
efficiencies. Our 3-dimensional picture reveals that for lower salary levels the effect is
negative – an increasing nonparametric line. We observe that after a certain threshold
salary level the effect becomes then positive, a decreasing nonparametric line. When
we examine the behaviour of salary on banks’ efficiency levels, we observe that as we
move towards and away from the global financial crisis period, the effect described
previously becomes more emphatic. Similarly, when we examine the effect of bonus
on banks' distribution of efficiencies again we observe that for small levels of bonus
payments the effect on banks' efficiency levels is positive but for higher bonuses the
effect becomes negative. When we move towards the end of the period this effect
becomes more pronounced.

The 3-dimensional pictures 2e and 2f provide us with the same information of
the effect of bonuses and payments on banks' technological change as in sub-figures 2a
and 2b. However, as has been suggested by Bădin et al. (2012) when we apply the
Order-$\alpha$ frontiers and we set $\alpha$ near to 1 (in our case $\alpha = 0.95$), then we can have a
robust visualization of the examined effects since in some cases some extreme data
points can mask over some effect of bonus, salaries and time. If we compare our four
3-dimensional pictures (i.e. 2a with 2e and 2b with 2f), we can observe differences in
the effect on banks' technological change levels. These differences are attributed to the
extreme data points. Specifically, when we examine the effect of salary and time on banks' technological change levels (sub-figure 2e), we observe that for lower salary levels the effect is negative up to a certain salary level. After that level, and for the largest part of salary levels, the effect becomes positive. Furthermore, when we compare the 3-dimensional picture from the partial frontier in subfigure 2e with the one for the full frontier (subfigure 2a), we can conclude that the effect of salary on banks’ technological change is the same throughout the examined period and does not change. Thus it is evident that extreme data point can mask over the examined effect and therefore the need to apply robust frontiers with $\alpha$ values near to 1 proven to be essential for our case. In the same way subfigure 2f presents the effect of bonus payment and time on countries’ technological change levels using robust frontiers. In contrast to subfigure 2b, the 3-dimensional picture presented on subfigure 2f provides us with a robust view of the effect avoiding the influence of extreme data points. The results reveal a clear positive effect on banks’ technological change levels for lower levels of bonus payments, however, for larger levels of bonus payments the effect become negative. It is also evident that this effect is observed throughout the entire period. However, this was not the case when we examine the same effect under the full frontiers (subfigure 2b), suggesting that the extreme data points mask over the examined effect.

The overall results suggest that higher levels of CEO salaries affect positively banks’ technological change and technological catch-up, whereas higher levels of CEO bonuses affect them negatively. According to Crawford et al. (1995) the deregulation of banks provides the framework for riskier investments. In our setting risk-taking involves the over-investment in risky loans and securities (Kupiec and O'Brien, 1997). As a result shareholders use performance-pay schemes to encourage risk-taking by CEOs. The positive correlation between CEO compensation and corporate risk is well
documented in the relative literature (Aggarwal and Samwick, 1999a; Gormley et al., 2013), this in turn justifies our findings regarding the negative effect of higher levels of CEO bonus payments. Since the CEO bonus payments are associated with risk investments, this in turn reflects negatively on banks’ technological change and technological catch-up levels. On the other hand, since technological change investments are regarded as a source of systematic risk (Papanikolaou, 2008), the positive effect of higher levels of CEO salary payments on banks’ technology change and technological catch-up can be attributed to the positive correlation between riskier investments and CEO incentives.

5. Conclusions

In our study, we apply an innovative methodological framework to explore the effect of CEO salary and bonus payments on banks’ efficiency levels. We find that the effect of CEO cash compensation on bank performance has a nonlinear form. These results challenge the findings presented by studies that apply the traditional pay-for-performance relationship investigated in a parametric setup, eg. Ang et al., 2002; John and Qian, 2003; Anderson et al. 2004; Cuñat and Guadalupe, 2009; among other studies that assume ex-ante a linear relation. We also argue that higher CEO compensation levels do not necessarily improve bank efficiency. Our results indicate that CEO salary and bonus payments affect differently bank technological change and technological catch-up levels. We show that lower salaries have a negative effect on bank technological change and technological catch-up levels. That means CEOs have to be

16 Additionally, Brissimis et al. (2008) suggest that capital and credit risk have a negative relationship on banks’ efficiency levels.
paid above a certain threshold level in order to affect bank performance positively. We also show that higher bonuses as a performance related part of the total CEO remuneration package do not have the expected effect on bank technological change and technological catch-up levels. These results correspond to previous research studies that explore the CEO payment incentives and risk investments, eg. Aggarwal and Samwick, 1999a; Gormley et al., 2013; among others. Riskier investments have a negative effect on bank efficiency levels (Brissimis et al., 2008), and therefore CEO payment incentives that are interrelated with such investments (loans and securities) also have a negative effect. This is supported by our empirical findings that indicate that higher levels of CEO bonus payments can lead to risk taking involving the over-investment in risky loans and securities (Kupiec and O'Brien, 1997). This consequently negatively affects bank technological change and technological catch-up levels.

A logical extension of this study might be to further explore the effect of time and CEO compensation on bank performance levels in other geographical locations, and in particular in Europe. In terms of methodological framework it would be worth investigating the probabilistic characterization of directional distance functions, as proposed by Simar and Vanhems, 2012 and the new developments involved in the conditional directional distances, as discussed by Daraio and Simar, 2014. However, the proposed research extensions are beyond the scope of our paper and are left for future research.

Acknowledgements

We would like to thank Professor Robert G. Dyson and three anonymous reviewers for their helpful and constructive comments on an earlier version of our manuscript. Any remaining errors are solely the authors’ responsibility.
References


Curi, C., Lozano-Vivas, A., Zelenyuk, V., 2015. Foreign bank diversification and efficiency prior to and during the financial crisis: Does one business model fit all?


Table 1: Descriptive statistics of the variables

<table>
<thead>
<tr>
<th></th>
<th>Property Plant and Equipment (USD (000' s))</th>
<th>Deposits (USD (000' s))</th>
<th>Number of Employees (000' s)</th>
<th>Securities (USD (000' s))</th>
<th>Loans (USD (000' s))</th>
<th>Salary (USD (000' s))</th>
<th>Bonus (USD (000' s))</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003 Mean</td>
<td>276.784</td>
<td>31926.882</td>
<td>12.679</td>
<td>9765.726</td>
<td>25606.215</td>
<td>531.370</td>
<td>775.988</td>
</tr>
<tr>
<td>Std</td>
<td>859.676</td>
<td>66985.126</td>
<td>27.734</td>
<td>18509.018</td>
<td>51543.541</td>
<td>214.180</td>
<td>1445.749</td>
</tr>
<tr>
<td>Year</td>
<td>Min</td>
<td>Mean</td>
<td>Std</td>
<td>Max</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>------</td>
<td>-----</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>2.463</td>
<td>306.669</td>
<td>964.719</td>
<td>3835.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>0.332</td>
<td>270.422</td>
<td>140.000</td>
<td>1108.654</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>0.000</td>
<td>832.522</td>
<td>772.927</td>
<td>1000.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>0.000</td>
<td>1.898</td>
<td>140.000</td>
<td>7498.232</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>1.898</td>
<td>431.213</td>
<td>13173.926</td>
<td>129.808</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>0.395</td>
<td>1239.532</td>
<td>390.512</td>
<td>1490.028</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>0.397</td>
<td>95081.974</td>
<td>140.000</td>
<td>7458.232</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>0.395</td>
<td>1239.532</td>
<td>390.512</td>
<td>1490.028</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>0.397</td>
<td>95081.974</td>
<td>140.000</td>
<td>7458.232</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Diachronic representation of the number of banks with efficiency scores above samples’ average efficiency value.
Figure 2: The effect of time and CEO’s compensation on banks’ performance levels

2a
The effect of CEO’s salary and time on the ratio R(x,y,t)

2b
The effect of CEO’s bonus and time on the ratio R(x,y,t)

2c
The effect of CEO’s salary and time on the ratio R(x,y,t) with \( \omega = 0.5 \)

2d
The effect of CEO’s bonus and time on the ratio R(x,y,t) with \( \omega = 0.5 \)

2e
The effect of CEO’s salary and time on the ratio R(x,y,t) with \( \omega = 0.95 \)

2f
The effect of CEO’s bonus and time on the ratio R(x,y,t) with \( \omega = 0.95 \)
Table 2: Descriptive statistics of the variables per bank

<table>
<thead>
<tr>
<th>Bank Name</th>
<th>Property Plant and Equipment</th>
<th>Deposits USD (000' s)</th>
<th>Number of Employees (000' s)</th>
<th>Securities USD (000' s)</th>
<th>Loans USD (000' s)</th>
<th>Salary USD (000' s)</th>
<th>Bonus USD (000' s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Std</td>
<td>Mean Std</td>
<td>Mean Std</td>
<td>Mean Std</td>
<td>Mean Std</td>
<td>Mean Std</td>
<td>Mean Std</td>
</tr>
<tr>
<td>ASTORIA FINANCIAL CORP</td>
<td>14.633 1.772</td>
<td>12217.450 1030.143</td>
<td>1.701 0.124</td>
<td>4945.381 2444.113</td>
<td>1346.086 1394.315</td>
<td>713.587 148.690</td>
<td>67.088 142.095</td>
</tr>
<tr>
<td>BANK OF HAWAII CORP</td>
<td>16.848 4.822</td>
<td>8848.355 1424.777</td>
<td>2.512 0.136</td>
<td>4422.476 1957.832</td>
<td>5466.727 406.691</td>
<td>486.510 183.469</td>
<td>204.500 415.942</td>
</tr>
<tr>
<td>BANK OF NEW YORK MELLON CORP</td>
<td>700.500 248.083</td>
<td>0 68294.493 36.608</td>
<td>11.860 49080.800 27619.673</td>
<td>37813.500 5647.043</td>
<td>818.128 76.218</td>
<td>2311.347 2833.392</td>
<td></td>
</tr>
<tr>
<td>BBX CAPITAL CORP</td>
<td>14.961 0.000</td>
<td>3582.476 451.175</td>
<td>1.994 1.012</td>
<td>846.951 350.338</td>
<td>3578.606 1374.419</td>
<td>535.686 47.670</td>
<td>461.380 793.865</td>
</tr>
<tr>
<td>CATHAY GENERAL BANCORP</td>
<td>10.304 2.964</td>
<td>6183.922 1194.274</td>
<td>1.011 0.086</td>
<td>2303.554 758.892</td>
<td>5655.593 1486.230</td>
<td>973.100 233.012</td>
<td>247.500 402.528</td>
</tr>
<tr>
<td>COMERICA INC</td>
<td>101.361 11.117</td>
<td>43608.300 3865.653</td>
<td>10.307 1.051</td>
<td>6720.800 2581.179</td>
<td>42533.100 4038.636</td>
<td>1 567.055 353.810</td>
<td>592.425</td>
</tr>
<tr>
<td>COMMUNITY BANK SYSTEM INC</td>
<td>15.956 1.790</td>
<td>3701.862 917.896</td>
<td>1.562 0.302</td>
<td>1643.247 493.000</td>
<td>2864.473 526.844</td>
<td>390.462 137.084</td>
<td>21.843 36.223</td>
</tr>
<tr>
<td>CULLEN/FROST BANERS INC DIME COMMUNITY BANSHARES</td>
<td>31.413 5.928</td>
<td>12179.421 3802.801</td>
<td>3.655 0.259</td>
<td>4697.616 2257.020</td>
<td>7050.826 1500.542</td>
<td>729.500 102.265</td>
<td>3968.116 2177.108</td>
</tr>
<tr>
<td>EAST WEST BANCORP INC</td>
<td>36.327 31.901</td>
<td>10314.091 5652.229</td>
<td>1.639 0.672</td>
<td>1987.836 1032.675</td>
<td>9571.999 4081.668</td>
<td>1 567.055 353.810</td>
<td>592.425</td>
</tr>
<tr>
<td>FIFTH THIRD BANCORP</td>
<td>211.542 140.256</td>
<td>74737.300 11350.834</td>
<td>20.950 0.943</td>
<td>17742.800 5992.474</td>
<td>66701.200 10970.438</td>
<td>7 994.658 445.071</td>
<td>716.663</td>
</tr>
<tr>
<td>FIRST BANCORP P R</td>
<td>22.163 4.935</td>
<td>10673.788 2086.209</td>
<td>2.621 0.345</td>
<td>4177.913 1379.604</td>
<td>10853.198 1910.456</td>
<td>673.528 161.739</td>
<td>261.240 295.010</td>
</tr>
<tr>
<td>FIRST MIDWEST BANCORP INC</td>
<td>13.257 2.521</td>
<td>5794.833 675.951</td>
<td>1.751 0.098</td>
<td>1890.972 582.700</td>
<td>4833.472 523.592</td>
<td>531.229 296.100</td>
<td>83.317 94.835</td>
</tr>
<tr>
<td>GLACIER BANCORP INC</td>
<td>10.453 3.404</td>
<td>3432.426 1269.596</td>
<td>1.409 0.374</td>
<td>1654.237 1077.487</td>
<td>3024.959 901.144</td>
<td>309.661 48.712</td>
<td>75.000 81.650</td>
</tr>
<tr>
<td>HUDSON CITY BANCORP INC</td>
<td>6.677 2.803</td>
<td>17909.024 6268.871</td>
<td>1.407 0.242</td>
<td>17021.537 7537.830</td>
<td>22635.720 8488.961</td>
<td>5 353.118 363.529</td>
<td>637.208</td>
</tr>
<tr>
<td>INDEPENDENT BANK CORP/MI</td>
<td>6.288 1.906</td>
<td>2237.848 337.859</td>
<td>1.268 0.136</td>
<td>330.653 162.904</td>
<td>2059.814 443.217</td>
<td>372.462 123.957</td>
<td>24.568 45.469</td>
</tr>
<tr>
<td>JPMORGAN CHASE &amp; CO</td>
<td>4210.800 696.319</td>
<td>0 198.453 52.342</td>
<td>0 5 24 0 6 7</td>
<td>194.246 5690.000</td>
<td>5148.344</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M &amp; T BANK CORP</td>
<td>187.699 10.211</td>
<td>45166.357 10550.391</td>
<td>13.994 0.769</td>
<td>7694.580 821.780</td>
<td>46239.191 9461.579</td>
<td>954.289 575.406</td>
<td>247.000 237.711</td>
</tr>
</tbody>
</table>

31
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Price</th>
<th>Change</th>
<th>P/E Ratio</th>
<th>EPS</th>
<th>Market Cap</th>
<th>ROE</th>
<th>Dividend Yield</th>
<th>PE Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW YORK CMNTY BANCORP INC</td>
<td>37.164</td>
<td>12.131</td>
<td>16418.203</td>
<td>5687.833</td>
<td>2.883</td>
<td>0.744</td>
<td>$6263.829</td>
<td>1375.776</td>
</tr>
<tr>
<td>NORTHERN TRUST CORP</td>
<td>104.270</td>
<td>6.507</td>
<td>53984.910</td>
<td>19473.290</td>
<td>11.143</td>
<td>2.343</td>
<td>$16833.520</td>
<td>8547.157</td>
</tr>
<tr>
<td>PNC FINANCIAL SVCS GROUP INC</td>
<td>127206.70</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$1000.00</td>
<td>0</td>
</tr>
<tr>
<td>POPULAR INC</td>
<td>97.904</td>
<td>36.397</td>
<td>24928.184</td>
<td>3450.359</td>
<td>1.337</td>
<td>0.549</td>
<td>$3279.954</td>
<td>2676.856</td>
</tr>
<tr>
<td>PROSPERITY BANCSHARES INC</td>
<td>12.947</td>
<td>5.694</td>
<td>5773.209</td>
<td>3083.762</td>
<td>1.337</td>
<td>0.549</td>
<td>$3279.954</td>
<td>2676.856</td>
</tr>
<tr>
<td>STERLING BANCORP/NY</td>
<td>6.367</td>
<td>1.669</td>
<td>1890.086</td>
<td>606.929</td>
<td>0.535</td>
<td>0.083</td>
<td>$858.096</td>
<td>219.778</td>
</tr>
<tr>
<td>SUSQUEHANNA BANCSHARES INC</td>
<td>22.253</td>
<td>3.601</td>
<td>7949.963</td>
<td>2698.096</td>
<td>2.835</td>
<td>0.516</td>
<td>$1819.003</td>
<td>7425.704</td>
</tr>
<tr>
<td>TCF FINANCIAL CORP</td>
<td>72.247</td>
<td>16.903</td>
<td>10368.001</td>
<td>1994.846</td>
<td>8.176</td>
<td>1.111</td>
<td>$1877.010</td>
<td>446.147</td>
</tr>
<tr>
<td>TRUSTCO BANK CORP/NY</td>
<td>3.574</td>
<td>1.142</td>
<td>3086.476</td>
<td>508.225</td>
<td>0.645</td>
<td>0.114</td>
<td>$1020.755</td>
<td>176.103</td>
</tr>
<tr>
<td>U S BANCORP</td>
<td>655.010</td>
<td>127.981</td>
<td>0</td>
<td>49172.426</td>
<td>55.632</td>
<td>5.778</td>
<td>$49042.500</td>
<td>13074.551</td>
</tr>
<tr>
<td>UNITED BANKSHARES INCAV</td>
<td>10.798</td>
<td>0.955</td>
<td>5417.991</td>
<td>940.846</td>
<td>1.479</td>
<td>0.100</td>
<td>$1180.033</td>
<td>3877.540</td>
</tr>
<tr>
<td>WASHINGTON FEDERAL INC</td>
<td>6.154</td>
<td>2.167</td>
<td>6641.302</td>
<td>1766.046</td>
<td>0.984</td>
<td>0.217</td>
<td>$2072.868</td>
<td>818.626</td>
</tr>
<tr>
<td>WEBSTER FINANCIAL CORP</td>
<td>68.183</td>
<td>19.114</td>
<td>12269.978</td>
<td>1806.106</td>
<td>3.052</td>
<td>0.222</td>
<td>$4333.308</td>
<td>1409.762</td>
</tr>
<tr>
<td>WELLS FARGO &amp; CO WESTAMERICA BANCORPORATION</td>
<td>2811.700</td>
<td>984.377</td>
<td>0</td>
<td>6</td>
<td>211.070</td>
<td>63.334</td>
<td>$84146.436</td>
<td>1722.26</td>
</tr>
<tr>
<td>WINTHURST FINANCIAL CORP</td>
<td>17.460</td>
<td>4.861</td>
<td>8688.478</td>
<td>3233.712</td>
<td>2.138</td>
<td>0.707</td>
<td>$1415.336</td>
<td>732.366</td>
</tr>
<tr>
<td>ZIONS BANCORPORATION</td>
<td>178.928</td>
<td>95.120</td>
<td>36183.663</td>
<td>8426.848</td>
<td>10.061</td>
<td>1.137</td>
<td>$4869.333</td>
<td>749.005</td>
</tr>
</tbody>
</table>
Table 3: Mean efficiency values and standard deviations (Std) for full and partial frontiers over 2003-2012.

<table>
<thead>
<tr>
<th>Bank Name</th>
<th>Mean (VRS)</th>
<th>Mean (Order-α)</th>
<th>Std (VRS)</th>
<th>Std (Order-α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTORIA FINANCIAL CORP</td>
<td>0.396</td>
<td>0.951</td>
<td>0.043</td>
<td>0.003</td>
</tr>
<tr>
<td>BANK OF HAWAII CORP</td>
<td>0.485</td>
<td>0.937</td>
<td>0.035</td>
<td>0.008</td>
</tr>
<tr>
<td>BANK OF NEW YORK MELLON CORP</td>
<td>0.190</td>
<td>0.759</td>
<td>0.190</td>
<td>0.612</td>
</tr>
<tr>
<td>BB&amp;T CORP</td>
<td>0.497</td>
<td>0.290</td>
<td>0.364</td>
<td>0.205</td>
</tr>
<tr>
<td>BBX CAPITAL CORP</td>
<td>0.547</td>
<td>0.856</td>
<td>0.006</td>
<td>0.197</td>
</tr>
<tr>
<td>CATHAY GENERAL BANCORP</td>
<td>0.495</td>
<td>0.978</td>
<td>0.020</td>
<td>0.005</td>
</tr>
<tr>
<td>CITY NATIONAL CORP</td>
<td>0.452</td>
<td>0.889</td>
<td>0.054</td>
<td>0.033</td>
</tr>
<tr>
<td>COMERICA INC</td>
<td>0.237</td>
<td>0.510</td>
<td>0.113</td>
<td>0.031</td>
</tr>
<tr>
<td>COMMUNITY BANK SYSTEM INC</td>
<td>0.535</td>
<td>0.961</td>
<td>0.007</td>
<td>0.006</td>
</tr>
<tr>
<td>CULLEN/FROST BANKERS INC</td>
<td>0.495</td>
<td>0.882</td>
<td>0.040</td>
<td>0.023</td>
</tr>
<tr>
<td>DIME COMMUNITY BANCSHARES</td>
<td>0.533</td>
<td>0.753</td>
<td>0.003</td>
<td>0.235</td>
</tr>
<tr>
<td>EAST WEST BANCORP INC</td>
<td>0.501</td>
<td>0.920</td>
<td>0.021</td>
<td>0.065</td>
</tr>
<tr>
<td>FIFTH THIRD BANCORP</td>
<td>0.091</td>
<td>0.197</td>
<td>0.177</td>
<td>0.113</td>
</tr>
<tr>
<td>FIRST BANCORP P R</td>
<td>0.450</td>
<td>0.927</td>
<td>0.034</td>
<td>0.018</td>
</tr>
<tr>
<td>FIRST MIDWEST BANCORP INC</td>
<td>0.520</td>
<td>0.960</td>
<td>0.011</td>
<td>0.009</td>
</tr>
<tr>
<td>GLACIER BANCORP INC</td>
<td>0.528</td>
<td>0.952</td>
<td>0.016</td>
<td>0.058</td>
</tr>
<tr>
<td>HUDSON CITY BANCORP INC</td>
<td>0.147</td>
<td>0.948</td>
<td>0.140</td>
<td>0.033</td>
</tr>
<tr>
<td>INDEPENDENT BANK CORP/MI</td>
<td>0.552</td>
<td>0.479</td>
<td>0.005</td>
<td>0.067</td>
</tr>
<tr>
<td>JPMORGAN CHASE &amp; CO</td>
<td>0.711</td>
<td>0.865</td>
<td>0.236</td>
<td>0.145</td>
</tr>
<tr>
<td>M &amp; T BANK CORP</td>
<td>0.224</td>
<td>0.327</td>
<td>0.137</td>
<td>0.080</td>
</tr>
<tr>
<td>NEW YORK CMNTY BANCORP INC</td>
<td>0.331</td>
<td>0.882</td>
<td>0.027</td>
<td>0.058</td>
</tr>
<tr>
<td>NORTHERN TRUST CORP</td>
<td>0.262</td>
<td>0.428</td>
<td>0.196</td>
<td>0.161</td>
</tr>
<tr>
<td>PNC FINANCIAL SVCS GROUP INC</td>
<td>0.558</td>
<td>0.196</td>
<td>0.342</td>
<td>0.114</td>
</tr>
<tr>
<td>POPULAR INC</td>
<td>0.372</td>
<td>0.610</td>
<td>0.081</td>
<td>0.070</td>
</tr>
<tr>
<td>PROSPERITY BANCSHARES INC</td>
<td>0.507</td>
<td>0.916</td>
<td>0.034</td>
<td>0.095</td>
</tr>
<tr>
<td>STERLING BANCORP/NY</td>
<td>0.539</td>
<td>0.615</td>
<td>0.004</td>
<td>0.167</td>
</tr>
<tr>
<td>SUSQUEHANNA BANCSHARES INC</td>
<td>0.522</td>
<td>0.920</td>
<td>0.020</td>
<td>0.019</td>
</tr>
<tr>
<td>TCF FINANCIAL CORP</td>
<td>0.589</td>
<td>0.756</td>
<td>0.031</td>
<td>0.023</td>
</tr>
<tr>
<td>TRUSTCO BANK CORP/NY</td>
<td>0.536</td>
<td>0.823</td>
<td>0.004</td>
<td>0.221</td>
</tr>
<tr>
<td>US BANCORP</td>
<td>0.699</td>
<td>0.208</td>
<td>0.175</td>
<td>0.030</td>
</tr>
<tr>
<td>UNITED BANCSHARES INC/WV</td>
<td>0.524</td>
<td>0.965</td>
<td>0.005</td>
<td>0.007</td>
</tr>
<tr>
<td>WASHINGTON FEDERAL INC</td>
<td>0.485</td>
<td>0.984</td>
<td>0.020</td>
<td>0.009</td>
</tr>
<tr>
<td>WEBSTER FINANCIAL CORP</td>
<td>0.478</td>
<td>0.860</td>
<td>0.016</td>
<td>0.027</td>
</tr>
<tr>
<td>WELLS FARGO &amp; CO</td>
<td>0.562</td>
<td>0.776</td>
<td>0.252</td>
<td>0.138</td>
</tr>
<tr>
<td>WESTAMERICA BANCORPORATION</td>
<td>0.527</td>
<td>0.979</td>
<td>0.006</td>
<td>0.005</td>
</tr>
<tr>
<td>WINTRUST FINANCIAL CORP</td>
<td>0.521</td>
<td>0.934</td>
<td>0.011</td>
<td>0.028</td>
</tr>
<tr>
<td>ZIONS BANCORPORATION</td>
<td>0.539</td>
<td>0.465</td>
<td>0.208</td>
<td>0.159</td>
</tr>
</tbody>
</table>