Inefficiency Patterns in Family-Owned Banks in Bangladesh

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Abstract

This paper analyses the difference in the pattern of inefficiency between the family-dominated banks and the non-family-owned banks in Bangladesh using the Multi-directional Efficiency Analysis technology, which enables analysis of patterns within inefficiencies rather than only levels of (in)efficiency. The results show that whilst there are few significant differences in the levels of variable-specific efficiency scores between the two subgroups, there are clearer differences on the inefficiency contributions from particular outputs in most of the study period and on most variables in 2007-2009. This finding provides clues to differences in business models, and management practice between the two types of banks in Bangladesh.

Keywords: Bangladeshi Banking, Family Ownership, Global Financial Crisis (GFC), Multi-directional Efficiency Analysis (MEA), Inefficiency Contributions

JEL Codes : C44, G21, M11

1. Introduction[1]

The subject of banking efficiency has spawned a vast literature in the operational research, economics, and management journals. Inefficiency is linked to managerial underperformance, and rent-seeking behaviour that falls under the guise of X-inefficiency. As in Bogetoft and Hougaard (2003), it could be consistent with rational behaviour that allows for optimal inefficiency through slacks in production. Typically, the literature separates the methodology of efficiency measurement between the parametric approach (dominated by Stochastic Frontier Analysis (SFA)) and the non-parametric approach (dominated using Data Envelopment Analysis (DEA)). Recent surveys of bank efficiency include Aiello and Bonanno (2015), Paradi and Zhu (2013), and Fethi and Pasourias (2010). In the case of DEA, a multi-input multi-output framework produces a single efficiency score relative to a benchmark frontier. There are many advantages to the use of DEA but one of the disadvantages is that it considers radial improvements of all variables (inputs or outputs) for increasing efficiency.

An alternative methodology is Multi-directional Efficiency Analysis (MEA) which was introduced by Bogetoft and Hougaard (1999) and operationalized by Asmild et al. (2003). In contrast to DEA, where improvements to efficiency are identified jointly for all either input- or output variables, MEA investigates the improvement potentials in each input and output dimension and identifies a benchmark proportional to these potential improvements. This results in a more nuanced picture of the sources of the inefficiency which provides opportunities for additional conclusions about which variables the inefficiency is mainly located on. MEA, therefore, provides insights into the *level* of the inefficiency, and the *patterns* within the inefficiency, i.e., its sources and location. This paper applies this methodology to Bangladeshi banks, to understand the differences in the inefficiency patterns between different subgroups of banks.

Banking in Bangladesh is a good case for study using this methodology. While there have been numerous studies of bank efficiency in Bangladesh, there has not been any that has examined the inefficiency patterns of banks within the private sector. Why should this matter? Similar institutions may have similar *levels* of inefficiency but display quite different *patterns* of inefficiency. These differences indicate different operating practices that reveal differences in business objectives. In the case of Bangladesh, the private commercial banking sector has two distinct ownership structures – family-dominated ownership and non-family ownership. It turns out that ownership in private commercial banks in Bangladesh reveals differences in inefficiency patterns that point to differences in business objectives.

Our contribution here is twofold. First, we examine the inefficiency *levels* and *patterns* of family dominated banks and non-family-dominated banks in Bangladesh. The performance of family-owned firms generally is a well-established area of scholarship (Muttakin et al, 2015), but the study of the performance of family-dominated banks is relative scarce. Secondly, we identify the sources of inefficiency which differs between the two types of banks even if there is no difference in inefficiency levels. Here, we examine a complete data set of conventional banks in Bangladesh from 2001 to 2015 divided into two groups based on family-dominance. In this case, it turns out that there are few (significant) differences between the groups in terms of the inefficiency levels,

[1] We thank the Editor and an anonymous referee for helpful and constructive comments. All remaining errors are ours.

whereas clear patterns emerge in terms of differences in inefficiency contributions between family-dominated and non-family-owned banks, especially during the Global Financial Crisis (GFC).

The rest of this paper is structured as follows: The next section provides a brief overview of banking in Bangladesh. Section 3 outlines the literature review concerning efficiency studies of Bangladeshi banks. Section 4 describes the data. Section 5 defines the methodology applied in the analysis, specifically the MEA approach. In section 6 we present the results of MEA and the analysis of inefficiency contributions. Finally, section 7 contains a conclusion and discussion.

2. Banks in Bangladesh

Banking in Bangladesh evolved with the establishment of its Central Bank in 1972. All domestic banks were nationalized and merged into 6 operating banks. Following a decade of modest economic growth, the government embarked on a process of de-nationalizing the banks and the setting up of Private Commercial Banks (PCBs).

The 1st generation PCBs were incorporated in 1982, transferring control from the public to the private sector. Some banks remained under state control, but five more private commercial banks were established in 1983. Along with two specialized Islamic banks, this was the basis of the private banking sector in Bangladesh at the beginning of the 1980s. With the State-Owned Commercial Banks (SOCBs), this concentrated banking cluster saw a rapid growth in branches. The objective of the SOCBs were to finance the government deficit and subsidize loss-making state-owned enterprises, and with the PCBs, to enable bank credit to the emerging economy beyond the priority sectors. Other objectives included the policy of branch expansion to provide financial services, and to mobilize the domestic savings of the rural population. In total, 8 banks constitute the 1st generation PCBs of which 6 are conventional and 2 are Islamic Shariah based.

The 1st generation PCBs inherited a state-run banking system, that had prioritised economic development at the expense of profitability, efficiency, and customer service. The banking system faced an ineffective regulatory framework and inherited poor risk management processes. The PCBs experienced a high default rate and NPLs. In the case of the SOCBs, lending was often dictated by political rather than economic precept. The incentive system for the banks stressed disbursements rather than loan recovery. Financial repression and low-cost borrowing to the priority sectors spawned a banking system which encouraged family dominance and weak corporate governance (Uddin and Suzuki, 2011).

However, denationalization failed to generate the expected results, partly because of the absence of effective regulatory supervision, poor credit management, and the consequence of political and vested interests, corruption, and unethical activities. Because of the poor performance of the 1st generation banks, the international donor agencies (World Bank and IMF) pressurized the government to strengthen internal bank management and credit discipline culminating in the Bank Company Act 1991.

2nd generation PCBs were established after 1991 with the object of diversifying control of ownership and fostering efficiency in the banking sector. From 1991 to 1998, a total of 10 PCBs

were set up, of which 8 were conventional and 2 Islamic Shariah based. The 2nd generation banks started life under an improved regulatory regime and therefore operated under a tighter risk management and more transparent reporting system. A further 12 banks were established after 1998 and these are labelled 3rd generation PCBs of which 9 are conventional, and 3 are Islamic Shariah based. 3rd generation banks adopted more technology-driven products and services and mimicked Western bank methods that saw a larger portion of income generation from off-balance sheet business.[2]

In 2015, a total of 39 PCBs (including 8 Islamic Shariah based banks) comprising 4226 branches, with BDT 6,652.9 billion of assets had 64.5% of the share of total bank assets in Bangladesh (Bangladesh Bank, 2017). The SOCBs and other government owned development banks controlled 30.3%, and foreign banks controlled 5.2% of the market.

3. Literature Review on Efficiency of Bangladeshi Banks

Studies of efficiency in Bangladesh banking have typically been of three kinds; the evolution of efficiency/inefficiency of commercial banks generally (or subset *viz* Islamic banks); comparison of efficiency performance between Islamic and non-Islamic banks; and comparison of government-owned and private commercial banks. These studies have utilised Stochastic Frontier Analysis (SFA) or DEA supplemented with a two-step procedure to explain the efficiency using Tobit type regressions.

Using accounting ratios, Safiullah (2010), Rashid and Nishat (2009) and Sarker (1999) examine commercial bank performance but do not provide a benchmarking type ranking. The picture of the trends in efficiency is mixed. Sufian and Kamarudin (2014a, 2014b) use DEA to examine bank profit efficiency in the period covering the GFC. The year 2008 was the peak for average profit efficiency but performance drops sharply in 2009 in response to the GFC. Akther et al (2013) use network-DEA to examine the bias in black-box DEA for the period 2005-2008 and find that average inefficiency declined in 2008. However, the finding that the trend of a declining average level of efficiency since the GFC was confirmed by Kamarudin et al (2016), and Fatema et al (2019).

Parametric methods have been employed by Robin et al (2018), Hassan and Hassan (2018) and Hossain Raju (2017) to model cost efficiency and cost and profit efficiency, respectively. Robin et al (2018) model an inefficiency function as part of the cost function to examine the effect of financial reforms over three stages in the period 1983-2012, using 12 commercial banks. The post-reform (1996-2012) and transition (1991-1995) periods exhibit a faster improvement in cost efficiency compared with the pre-reform period (1983-1990). The two latter studies SOCBs with PCBs for the period 2011-2015 and conclude that PCBs are more profit and cost efficient than SOCBs.

[2] A further 9 banks were established in Bangladesh after 2012. As these are relatively recently established, complete data for these banks are not fully available.

Using both SFA and DEA, the efficiency of Islamic banks is found to be lower by Haque and Sohel (2019). However, Asmild et al. (2019) caution against the simple comparison of Islamic with non-Islamic banks. They study the variable-specific efficiency (differences) of Bangladesh PCBs in a sample including Islamic Shariah banks and argue that comparison must be careful to compare like-for-like outputs. While both banks engage in the same market, Islamic banks are precluded from certain types of lending, and off-balance sheet type activities. Simply using the outputs of the balance sheet as typified by the Intermediation approach of Sealey and Lindley (1977) fails to allow for the differences in the balance sheet and exclusions on off-balance sheet operations dictated by Sharia law. Avoiding this problem, Asmild et al. (2019) use income flows, recognizing that interest is forbidden by Sharia where the loans made are in the form of an equity share.

The existing literature concerns the levels of the (in)efficiencies when comparing PCBs with other banks types (for example Islamic banks or SOCBs). None have examined the efficiency differences between family-dominated banks and other PCBs. Additionally, banks that have indistinguishable levels of (in)efficiency may exhibit differences in the patterns of (in)efficiency which reveals differences in business models. In this paper we identify a gap in the literature. First, we examine the efficiency differences between family-dominated banks and other PCBs. Second, we dig deeper and identify differences between the two ownership types. In this paper, we examine the efficiency patterns within the conventional PCBs alone (excluding Islamic, foreign, and government owned banks). These represent a more homogeneous group of banks in terms of banking activity and target market, making it possible to dig deeper into the underlying patterns within the inefficiencies. Furthermore, the literature has generally revealed that there might also be differences in the efficiencies over time, especially in connection with the Global Financial Crisis (GFC). We therefore investigate whether the inefficiency contribution patterns are consistent over the study period, which includes the GFC.

The Bangladesh economy was not immune to the GFC and like many emerging economies it was indirectly affected by the slowdown in the world economy (Rahman et al., 2009). Economic growth fell sharply from a peak of 7% in 2007 to 5% in 2009. Growth in exports fell from a three-year average of 14% per year in 2007, to 7% in 2008 and 9.8% in 2009. For an economy with an average level of "openness" (exports plus imports as % of GDP) of 40%, this will have exerted a significant negative shock, contributing to a sharp decrease in net trade, and a growth slowdown. It is expected that the growth slowdown will have had differential effects on efficiency patterns in the banks, depending on the exposure of their respective loan books to the traded sector. The older family-dominated banks have a more diversified branch network covering both rural and urban areas and will be less impacted by a traded-sector slowdown. The newer non-family-owned banks have a stronger concentration in the urban areas where the traded sector is largely located.

In this paper, we explore a distinguishing feature of the 1st generation banks that has a family dominated corporate governance structure. This difference in corporate governance incentivizes a different risk management and lending practice from other conventional banks (Mahbub et al, 2019). We therefore specifically focus on differences in the efficiency levels and efficiency patterns between the family-dominated 1st generation banks (denoted FAM) and the non-family-dominated PCBs (denoted NF)[3].

[3] Mahbub et al (2019) show that family-ownership is a determinant of performance differences.

The Key Performance Indicators (KPIs) in Table 1 shows that the FAM banks held on to their market share between 2001 and 2015, but the NF banks were able to increase their share substantially (largely at the expense of the SOCBs). As a group, the NF banks increased their branch network from 258 in 2001 to overtake the FAM banks in 2015. The inheritance of bad loans from the period of privatization and weak risk management methods saw the FAM banks with a high NPL ratio in 2001 but by 2015 this was comparable with NF banks which saw an increase in NPL from 2.6% in 2001 to 5.0% in 2015. A similar picture is seen for provisions. In terms of overall cost, the two types of banks are comparable.

Table 1: KPIs for Family-dominated (FAM) and Non-Family dominated (NF) banks in 2001 and 2015

	Bank group	2001	2015
Share of Total Bank Assets %	FAM	13.5	13.0
	NF	13.6	33.2
Total Number of Branches	FAM	841	1229
	NF	258	1730
NPL Ratio %	FAM	22.3	5.9
	NF	2.6	5.0
Cost Income Ratio %	FAM	45.9	47.8
	NF	51.7	49.3
Provisions as % of loans	FAM	2.3	1.1
	NF	0.8	1.2

So, besides age and generation and the corresponding differences in terms of ownership and governance structure, there also seem to be differences between the two groups in terms of their performance in the market, making this an interesting case for the analysis of inefficiency contributions.

4. The Data

The data set consists of 23 conventional banks, thus excluding Islamic as well as governmental banks, both of which are known to employ very different business models than the conventional banks.[4] The banks are separated into two groups, based on age and thus ownership and governance structure, such that the data set consists of a balanced panel of 6 family-dominated banks (FAM) and 17 non-family-owned banks (NF) over the common period 2001-2015.[5]

[4] Because foreign banks continue to operate as branches of their home institutions, data for these are unavailable.

[5] We have also evaluated all three generations of banks as separate groups and find similar results to the ones presented here, with only significant differences in the inefficiency patterns between the groups in the one-time window from 2007-2009.

The data comprises annual observations for each year 2001-2015. Due to the limited sample size, rather than considering each year separately, the data are pooled into 3-year windows, from 2001-2003, 2004-2006, 2007-2009, 2010-2012, and 2013-2015 respectively, and the analyses performed within each of these time windows.[6] Pooling of data across several years assumes that little technological change has occurred during the period and creates a risk of serial correlation. Therefore, a balance must be found between limiting the potential problems from pooling across different years (by using narrower windows) and boosting the sample size (by using wider windows).

Our study is based on archived data, entirely hand-collected from printed annual reports of respective banks and cross-checked with the online published reports. The input and output variables were deflated by the consumer price index. While many banking efficiency models exist in the literature (cf. e.g., the surveys in Berger and Humphrey, 1997, and Paradi and Zhu, 2013), mainly due to the limited sample size, we employ a very simple banking model with Salary costs and Other Costs as the two inputs, and Non-Interest Revenue (Non-IR) and Net Interest Revenue (Net-IR) as the two outputs. The inputs being cost flows and outputs being revenue flows suggest that the exercise in this paper relates to revenue efficiency or a close approximation to profit efficiency.

Descriptive statistics of the variables, across all the years in the data set (2001-2015) are shown for the family-dominated (FAM) banks and the non-family-owned banks (NF) in Table 2.

Table 2: Descriptive Statistics of Model Variables

		Mean (St.Dev)			
Ownership	Period	Salary	Other Costs	Non-IR	Net-IR
Family (FAM)	2001- 15	997.1 (387.6)	811.3 (490.6)	1167 (433.0)	2767 (1618)
	2001-03	564.5 (192.5)	420.0 (199.9)	910.0 (419.4)	1034 (303.1)
	2004-06	715.2 (214.3)	550.6 (308.3)	959.2 (317.2)	1379 (417.5)
	2007-09	962.6 (191.1)	670.7 (238.6)	1205 (365.6)	2687 (789.6)
	2010-12	1285.4 (158.7)	1204.7 (568.8)	1493 (471.1)	4398 (1149)
	2013-15	1457.6 (213.4)	1210.3 (396.3)	1269 (339.8)	4335 (917.8)
Non-Family (NF)	2001-15	498.9 (408.7)	527.3 (497.6)	754.3 (524.0)	1675 (1332)
	2001-03	133.1 (114.9)	148.4 (94.9)	269.6 (212.3)	419.0 (291.3)
	2004-06	241.2 (142.0)	246.3 (123.8)	507.2 (278.2)	790.9 (353.1)
	2007-09	450.3 (248.5)	465.7 (288.7)	815.8 (410.3)	1614 (873.6)
	2010-12	745.1 (376.4)	819.7 (497.1)	1162 (543.3)	2663 (1250)
	2013-15	924.7 (397.8)	956.6 (630.3)	1017 (513.1)	2889 (1252)

From the mean values in Table 2, it is seen that the family-dominated banks on average are larger than the non-family-owned banks. This, of course, is due to the general growth of banks over time, such that the oldest banks, which here are the family-dominated 1st generation banks, also are the largest. Considering averages within each period reveals that the banks generally increase in size

[6] The dataset is available upon request.

on all variables during the study period. We also note that the NF banks have grown substantially more than the FAM banks during the study period, especially on Non-IR where growth rates from the 2001-2003 window and to the 2013-2015 window are 39% and 277% for the FAM and the NF banks, respectively.

5. Methodology

Numerous studies have utilized the non-parametric Data Envelopment Analysis (DEA) approach (cf. Charnes, Cooper and Rhodes, 1978) to analyse the relative performance of different organizational units. Many of these have been about the performance of banks, cf. e.g., the surveys in Berger and Humphrey (1997) and Paradi and Zhu (2013). However, DEA only considers radial improvements of inputs and/or outputs, whereas the MEA approach, provides additional information about variable-specific improvement potentials.

Recently, Asmild, et al (2016) introduced the notion of inefficiency contributions, which enables comparisons of whether individual variables contribute more to the overall inefficiency in one group than in another. This analysis is possible when considering the variable-specific (in)efficiency scores of MEA, rather than the radial efficiency scores from DEA. Thus, the analysis of inefficiency contributions provides additional insights into the composition of the inefficiency, which goes beyond simply considering the levels of the (potentially variable-specific) inefficiency.

In this paper, we utilize MEA as well as inefficiency contributions to analyse differences between both the inefficiency levels on the different variables (using MEA scores) and the inefficiency contributions from the different variables, between the family-dominated and the non-family-owned banks.

5.1 Multi-directional Efficiency Analysis (MEA)

Consider a set of *n* observed Decision Making Units (DMUs), where for each DMU *m* inputs, $X \in \mathbb{R}_+^m$, are used to produce *s* outputs, $Y \in \mathbb{R}_+^s$. For ease of notation in the following denote by Z the vector of throughputs (or netputs), $Z = (-X, Y) \in \mathbb{R}_+^m \times \mathbb{R}_+^s$.

Let $\left(x_k^j, y_r^j\right), k = 1, \dots, m, r = 1, \dots, s$ denote the observed input and output values and $z_i^j, i = 1, \dots, m + s(= p)$ the corresponding throughputs for DMU j, j = 1,...,n. An advantage of the notation using throughputs, and of the MEA methodology generally, is that it is straightforward to consider improvements in both inputs and outputs simultaneously, rather than the traditional narrow focus in e.g., DEA (Charnes, Cooper and Rhodes, 1978, Banker, Charnes and Cooper, 1984) on either input contractions or output expansions.

In the empirical analysis in the following, we utilize this property by defining an ideal point which identifies the improvement potentials in all inputs and outputs simultaneously.

The production possibility set used in MEA, is the same as the one used in the more commonly known DEA approach, with the standard assumptions of convexity and free disposability. Using this estimation of the production possibility set, MEA first identifies the coordinates of the ideal

reference point, z^{0I}, for $z^0 = (-x^0, y^0)$, by solving the following linear programming problem for each of the p dimensions, $I = 1,...,p$:

$$z_i^{0I} = max\delta_i$$
$$s.t.$$
$$\sum_{j=1}^{n} \lambda^j z_i^j \geq \delta_i$$
$$\sum_{j=1}^{n} \lambda^j z_{-i}^j \geq z_{-i}^0$$
$$-i = 1, \dots, i-1, i+1, \dots, m+s(=p), j = 1, \dots, n$$

Next, the selection of a benchmark for z^0 on the efficient frontier in the direction of the ideal point is found by solving the following program:

$$\beta^0 = \max \beta$$
$$s.t.$$
$$\sum_{j=1}^{n} \lambda^j z_i^j \geq z_i^0 + \beta\left(z_i^{0I} - z_i^0\right)$$
$$\lambda^j \geq 0; i = 1, \dots, m+s(=p); j = 1, \dots, n$$

And subsequently the benchmark is given as $\boldsymbol{z}^{0B} = \boldsymbol{z}^0 + \beta^0(\boldsymbol{z}^{0I} - \boldsymbol{z}^0)$

The dimension specific relative MEA inefficiencies for $\boldsymbol{z}^0 = (-\boldsymbol{x}^0, y^0)$ can now be calculated as:

$$RI_i^0 = \frac{z_i^{0B} - z_i^0}{z_i^0} \qquad (1)$$

Note, that the direction of the projection onto the efficient frontier is different from the radial contractions of inputs or expansions of outputs used in DEA. Consequently, different relative inefficiencies are identified for the different variables, resulting in a vector of variable specific MEA inefficiency scores for each observation rather than the overall radial efficiency measure from DEA. This, in turn, means that it is relevant, and interesting, to further analyse which variables the inefficiency is mainly located on. This is done by considering the so-called inefficiency contributions described below.

5.2 Inefficiency Contributions

For an inefficient observation, the inefficiency contribution for $z^0 = (-x^0, y^0)$ from variable I, is given by the dimension specific inefficiency in variable i $(z_i^{0B} - z_i^0)$ relative to the overall efficiency, which is the Euclidian distance of the inefficiencies across all dimensions $\left(\sqrt{\sum_{i=1}^{p}(z_i^{0B} - z_i^0)^2}\right)$, i.e. as

$$IEC_i = \frac{z_i^{0B} - z_i^0}{\sqrt{\sum_{i=1}^{p}(z_i^{0B} - z_i^0)^2}} \qquad (2)$$

By taking the inverse cosine to the ratio (2), it is transformed into an angle $\theta_i^0 = \arccos(IEC_i)$. Note, however, that since the inverse cosine is monotonically decreasing, the smaller the angle θ_i^0 the larger the inefficiency contribution from variable *I*, IEC_i. The distributions of these angles can be modelled using the so-called von Mises-Fisher distribution (Mardia, 1975; Mardia and Jupp, 2000), a well-known and frequently used model for describing directional statistics[7]. The von Mises-Fisher distribution is a two-parameter distribution, with one parameter, μ, describing the mean direction and the other parameter, κ, describing the concentration around the mean direction. For large κ the distribution is well-approximated by a normal distribution[8]. When considering input directions, the concentration parameters are generally very large, and for computational reasons the estimations are performed in the corresponding truncated normal distributions[9].

6. Results

6.1 Inefficiency Levels

Considering first the levels of the variable-specific MEA inefficiencies, as defined in equation (1), we examine whether there are significant differences in the levels of the inefficiency scores between the family-dominated and the non-family-owned banks. It is worth noting that the efficiencies for both family-dominated and non-family-owned banks (within each window) are measured relative to a common frontier. It can be argued that, since the banks all compete within the same market, they must be assessed relative to the best performing banks within that market, regardless of their age or ownership. Furthermore, comparisons of the levels of (in)efficiencies in the two groups require that they be measured relative to the same frontier. Comparisons of inefficiency scores are performed using the Kruskal-Wallis test.

For each group of banks in each time window, the average MEA inefficiency scores and standard deviations for each variable are shown in Table 3, along with the calculated test statistics and corresponding significance probabilities.

Table 3: Average relative MEA inefficiency scores and their standard deviations for family-dominated (FAM) and non-family owned (NF) banks

[7] Note that the angle is undefined for efficient units, and therefore those units are excluded from the estimations.

[8] Statistical inference (the appropriate von Mises-Fisher distribution is restricted to $[0,\pi/2]$) regarding differences in inefficiency contributions between groups is based on likelihood ratio test statistics, which are evaluated in the corresponding asymptotic χ^2-distributions.

[9] For further details see Asmild et al (2016).

Time window		Salary	Other Costs	Non-IR	Net-IR
2001-03	FAM	0.210 (0.085)	0.112 (0.105)	0.172 (0.135)	0.217 (0.147)
	NF	0.158 (0.114)	0.153 (0.107)	0.271 (0.242)	0.205 (0.157)
	χ^2 (p)	2.737 (0.098)	2.647 (0.104)	1.257 (0.262)	0.099 (0.753)
2004-06	FAM	0.252 (0.070)	0.150 (0.123)	0.248 (0.183)	0.236 (0.194)
	NF	0.148 (0.091)	0.117 (0.078)	0.221 (0.163)	0.141 (0.097)
	χ^2 (p)	19.87 (**0.0000**)	0.942 (0.332)	0.525 (0.469)	2.262 (0.133)
2007-09	FAM	0.264 (0.054)	0.154 (0.059)	0.278 (0.136)	0.200 (0.093)
	NF	0.184 (0.098)	0.176 (0.089)	0.227 (0.146)	0.231 (0.124)
	χ^2 (p)	11.67 (**0.0006**)	2.557 (0.110)	1.381 (0.240)	1.136 (0.286)
2010-12	FAM	0.246 (0.077)	0.210 (0.075)	0.338 (0.143)	0.268 (0.103)
	NF	0.195 (0.094)	0.185 (0.098)	0.227 (0.151)	0.254 (0.134)
	χ^2 (p)	3.558 (0.059)	1.982 (0.159)	7.031 (**0.008**)	0.242 (0.623)
2013-15	FAM	0.186 (0.063)	0.117 (0.069)	0.201 (0.091)	0.138 (0.088)
	NF	0.180 (0.085)	0.140 (0.099)	0.183 (0.119)	0.174 (0.119)
	χ^2 (p)	0.014 (0.907)	0.440 (0.507)	0.422 (0.516)	0.982 (0.322)

Kruskal Wallis χ^2 test statistics (df=1) and corresponding p-values for comparisons of the MEA-scores between the types of ownership are shown.

From Table 3, we observe that there are no significant differences between the groups of banks on the levels of the inefficiencies, except for Salary in the 2004-06 and the 2007-09 window and for Non-IR in the 2010-12 window. That there are (significantly) larger inefficiencies on Salary for the family-dominated banks than for the non-family-owned banks, is in line with previous research[10].

That there are few significant differences in the inefficiencies between the two groups might lead to the conclusion that the structure of the inefficiency is similar in both types of banks. However, this conclusion is, only based on the ***levels*** of the inefficiencies[11]. There might still be ***differences*** in terms of which variables the inefficiency is mainly located in, which is exactly what can be analysed using the inefficiency contributions defined in equation (2). The inefficiency contributions do not concern the levels of efficiency. Rather, a larger inefficiency contribution on a variable in one group compared to the other group, means that relatively more of the overall

[10] Mahbub, et al (2019) find evidence of rent-seeking and featherbedding of personnel in family dominated banks in the form of over-manning and over-payments for family related staff.

[11] On the recommendation of an anonymous referee, we conduct a similar exercise using a combination of the input and output orientation in DEA for each time window and find no significant difference in the efficiency levels based on a Kruskal-Wallis rank sum test. The details are available on request.

inefficiency comes from the variable in question in the former group than in the latter. The results regarding the inefficiency contributions are presented in section 6.2 below.

6.2 Inefficiency Contributions

The estimated mean direction parameters (for the distributions of the angles) for each input and output dimension in each of the year time-windows are shown in Table 4. Note here that smaller angles correspond to larger inefficiency contributions. For example, we see that the estimated mean direction for Net-IR in the window 2007-09 for the family-dominated banks is 0.725 and for the non-family-owned banks is 0.505. This means that the part of the inefficiency contributed by Net-IR is larger for the NF banks than for the FAM banks. This difference for Net-IR in 2007-09 is seen to be highly significant.

From Table 4, we note that there are strong significant differences between the groups of banks on Non-IR in the time windows 2001-03, 2004-06 and 2010-12, and weak significance in 2007-09. So, there are differences between the FAM and the NF banks, in terms of the inefficiency contributions from Non-IR, with the FAM banks having higher inefficiency contributions from Non-IR in the beginning of the study period. But this changes in the window 2007-09 such that it is the NF banks having the larger inefficiency contribution from Non-IR in the latter part of the study period. It is also notable that there are additional significances between the bank groups in the window 2007-2009, with Other Costs and Net-IR also being significantly different.

Table 4: Estimated direction (μ) and standard deviations hereof in the truncated von Mises distribution (output directions) or truncated normal distribution (input directions).

Time window		Salary	Other Costs	Non-IR	Net-IR
2001-03	FAM	1.179 (0.056)	2.728 (5.158)	1.146 (0.053)	0.685 (0.044)
	NF	1.469 (0.056)	1.498 (0.104)	0.941 (0.038)	0.739 (0.037)
	χ^2 (p)	4.92 (0.027)	1.48 (0.224)	9.05 (**0.003**)	0.880 (0.348)
2004-06	FAM	1.524 (0.826)	1.504 (0.077)	1.053 (0.041)	0.866 (0.058)
	NF	2.366 (1.533)	1.428 (0.013)	0.848 (0.038)	0.853 (0.038)
	χ^2 (p)	0.178 (0.673)	2.75 (0.097)	11.4 (**0.0007**)	0.037 (0.847)
2007-09	FAM	1.237 (0.060)	1.454 (0.006)	1.020 (0.037)	0.725 (0.031)
	NF	1.474 (0.061)	1.425 (0.006)	1.145 (0.030)	0.505 (0.033)
	χ^2 (p)	3.347 (0.067)	10.65 (**0.001**)	6.453 (**0.011**)	19.41 (<**0.0000**)
2010-12	FAM	1.385 (0.012)	1.431 (0.009)	1.144 (0.025)	0.500 (0.025)
	NF	1.417 (0.021)	1.430 (0.017)	1.238 (0.020)	0.424 (0.023)
	χ^2 (p)	1.987 (0.159)	0.003 (0.959)	8.030 (**0.004**)	4.678 (0.031)

2013-15	FAM	1.191 (0.043)	1.400 (0.012)	1.145 (0.037)	0.647 (0.049)
	NF	1.262 (0.022)	1.382 (0.013)	1.228 (0.014)	0.538 (0.020)
	χ^2 (p)	1.742(0.187)	0.934 (0.334)	3.667 (0.056)	3.641 (0.056)

χ^2 test statistics and corresponding p-values from likelihood-ratio tests comparing angles between family-dominated (FAM) and non-family owned (NF) banks.

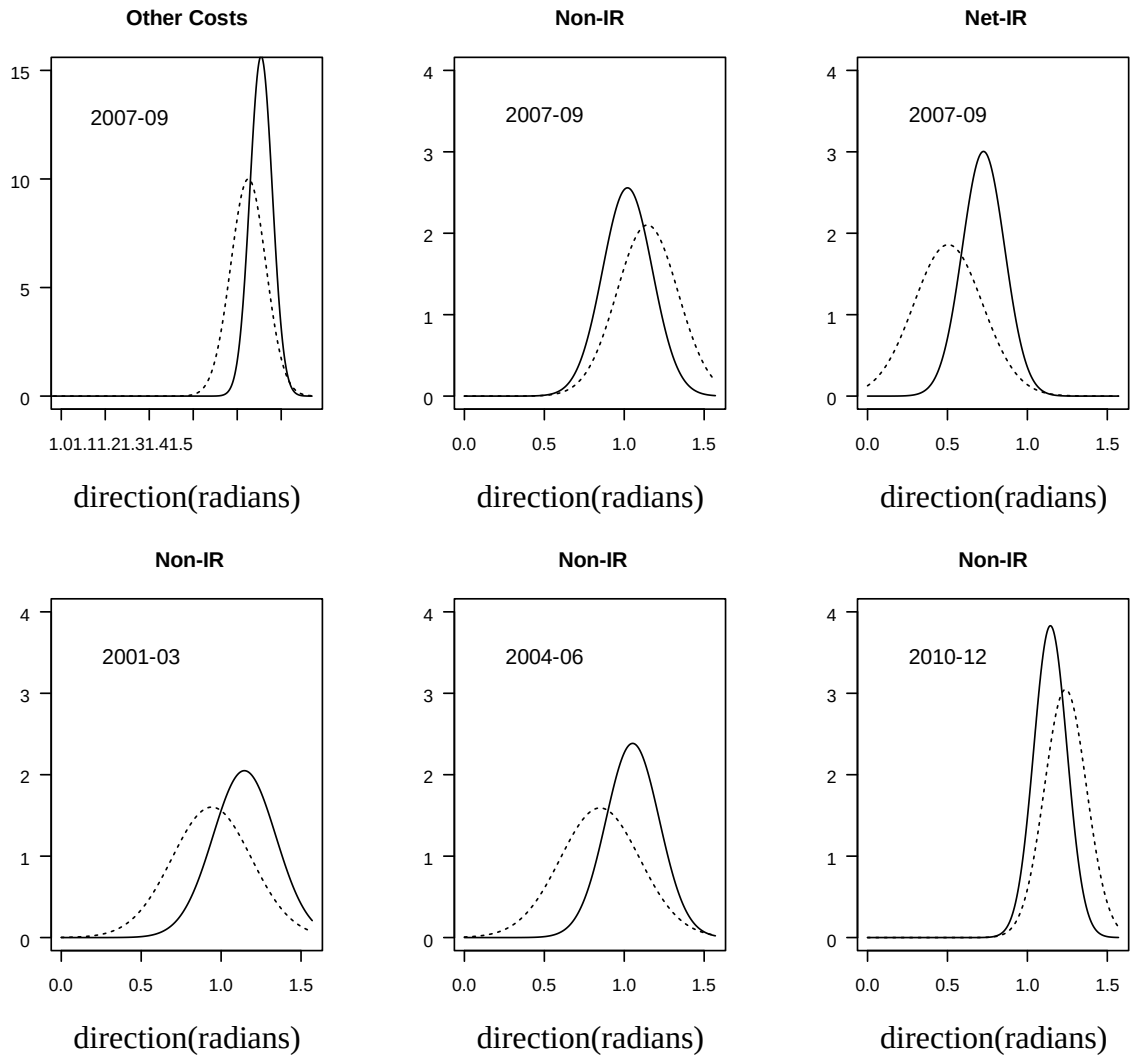
Overall, we observe there are differences on the *inefficiency contributions* from Non-IR in most time windows, but also in the time window of 2007-09 there were a significant difference in the *levels* of inefficiency of Salary, and also significant differences in the *inefficiency contribution* from the three other variables (Other Costs, Net-IR and (partly) Non-IR).

The estimated distributions (of the angles) for the cases where there are significant differences between the FAM and the NF banks are shown in Figure 1. The figure illustrates how the estimated distributions of the inefficiency contributions depending on ownership, are different between the FAM and the NF banks in the 2007-2009 window, i.e., during the period of the global financial crisis, for the three variables shown (Other Costs, Non-IR, and Net-IR). For Other Costs, the FAM banks generally have larger angles, corresponding to smaller inefficiency contributions, than the NF banks.

We noted from Table 3 that the levels of inefficiency on Other Costs are not significantly different between the FAM and NF banks in the GFC period. Yet, the results in Table 4 as illustrated in Figure 1, reveals that whilst the levels are not different, relatively more of the overall inefficiency for the NF banks in this window comes from Other Costs than it does for the FAM banks. Regarding the outputs, we see that the FAM banks have larger inefficiency contributions on Non-IR and smaller inefficiency contributions from Net-IR than the NF banks.

Thus, even though there are no significant differences between the two types of banks in the 2007-2009 window in terms of the levels of inefficiency on these three variables, we still see that the composition of the efficiency is different. Specifically, the FAM banks have relatively more of their inefficiency coming from Non-IR and less from Net-IR and Other Costs than the NF banks. This is different from the two previous time windows and suggests that the period of the GFC negatively affected off-balance sheet income for FAMs than NFs. This pattern continues into the 2010-12 window, but it is noticeable that there are no significant differences in the inefficiency contribution of both outputs and inputs for both types of banks. This suggests that the GFC may have acted as a turning point for the FAM banks and post-GFC see a convergence of inefficiency levels and contributions of both types of bank.

Figure 1: Estimated distributions for inefficiency contributions for selected windows and variables.



The solid curves show results for the family-dominated banks (FAM) and the dashed curves are for the non-family-owned banks (NF). Owned banks in the time window 2007-09.

In Figure 1, we also see the estimated distributions for Non-IR in four of the time windows (2001-03, 2004-06, 2007-09 and 2010-12). We note that the distributions are different between the FAM and NF banks, but also that the FAM banks in the beginning of the study period (2001-2003 and 2004-2006) have larger angles (smaller inefficiency contribution) than the NF banks, but then this changes such that the FAM banks for the period 2007-2009 and 2010-2012, have smaller angles and thus higher inefficiency contributions from Non-IR than the NF banks.

To summarize, the results of the analysis of the *inefficiency contributions* show that there are significant differences in the patterns within the inefficiencies on Non-IR and more general differences in the time window of 2007-09. This should, however, also be related to the results in Table 3 which show that the family-dominated banks had a significantly higher *level* of inefficiency on Salary than the NF. What this highlight are a difference between FAM and NF business practices. Before the GFC the source of inefficiency in the NF banks are greater from off-balance sheet business, compared with FAM banks. However, the GFC acts as a turning point. In

the 2007-09 and later periods the inefficiency contributions from non-interest earnings are greater for FAM banks than NF banks. Off-balance sheet business in the FAM banks is in the main, related to loan activity (letters of credit) whereas with NF banks it is trading activity (guarantees and other contingent liabilities), see Rahman (2013). It can be argued that the GFC was the catalyst that led to a convergence of inefficiency levels and patterns of both bank types.

7. Conclusion and Discussion of Results

We have applied MEA and the idea of inefficiency contributions to a data set comprising two types of private commercial banks in Bangladesh in the study period of 2001-2015.

The results first showed that there are few significant differences between the two groups of banks in terms of the levels of inefficiency on the different variables, as indicated by the MEA scores. This is, perhaps, not surprising, since all the banks are operating in a competitive market, where persistent differences in efficiency levels are unlikely to be sustainable. However, Mahbub et al (2019), suggest that FAM banks may have different objectives to NF banks revealed in comparatively higher cost and lower profit performance. The finding that FAM banks had higher inefficiency levels in Salary in the period up to the GFC, is consistent with their finding. The efficiency difference on salary is eliminated after the crisis. The crisis may have provided the catalyst for change in management practices. Regulatory changes (Bank Company Act, 2013) have established of a common professional certification and outsourcing of recruitment. This has weakened the potential for 'rent-seeking' and 'featherbedding' by the FAM banks.

However, the analysis of inefficiency contributions provides a more detailed look into the structure within the inefficiencies. We find strong significant differences between the two groups in terms of the inefficiency contributions from Non-IR in most time windows, and on three out of the four variables in the 2007-2009 GFC window. These differences in the inefficiency contributions highlight differences in business models that point to differences in the sources of the inefficiency. Common (in)efficiency levels do not imply common (in)efficiency sources.

That the FAM banks had smaller inefficiency contributions from Non-IR than the NF banks at the start of the study period is due to the smaller share of Non-IR income by the NF banks. FAM banks, having operated longer, were able to generate more off-balance sheet loan and deposit product business from their customers than the NFs at the beginning of the sample. However, we see a much larger growth in Non-IR for the NF banks (277% from 2001-03 to 2010-15 compared to 39% growth for the FAM banks). Coming later to the industry, the NF banks concentrated their off-balance sheet business on financial services to high net-worth clients, brokerage business, and guarantees on real and financial trading. The FAM banks started out with higher Non-IR income from fees and commissions from selling traditional bundled financial products. This explains why the NF banks change from a higher inefficiency contribution to a lower inefficiency contribution than the FAM banks on Non-IR during the study period.

The FAM banks, being established earlier, were much more wedded to the traditional banking model of balance sheet activity compared with NF banks that adopted a more diversified strategy of income generation from financial services. The issue of generating non-interest income earnings

as a diversification strategy has been questioned by Stiroh (2004), who argues that the two income flows are strongly positively correlated reducing the gains for diversification. However, Smith et al. (2003) show that non-interest income tends to be volatile relative to net interest income. In the case of Bangladesh, the median coefficient of variation of Non-IR income for the FAM banks is 53% and for the NF banks is 69%. The point being that Non-IR is a relatively more volatile source of income generation for NF banks. The NF banks were able to grow their non-IR income through an expansion of brokerage business which is both volatile and highly correlated with stock market activity of the Bangladesh bull run of 2009-11. The FAM banks have used fees and commissions to generate Non-IR income from loan and deposit products, which tends to be steady but closely correlated with Net-IR business. Our results suggest that the manager needs to dig deeper into the sources of Non-IR income generation and its correlation with the business cycle to identify best practice strategy.

Finally, the GFC produced a negative shock to the economy which may have brought to the surface underlying inefficiencies in risk management and lending practices that would have remained submerged under bull market conditions. The GFC therefore reveal differences between the two types of banks in their respective lending strategies and risk management practice. We note that the patterns within the inefficiencies became significantly different for most variables during the GFC (with the FAM banks having higher inefficiency contributions from Non-IR and the NF banks having higher inefficiency contributions from Other costs and Net-IR). The NFs expanded their branch network rapidly in the second part of the sample which would have left them exposed on non-labour costs in the crisis period. Their concentration on the urban areas where the traded sectors are located would have also exposed them to the slowdown in net trade during the GFC. Post-GFC, we see that the inefficiency differences and patterns of inefficiency differences are not significantly different between the two types of banks, suggesting a convergence that can only be confirmed with a longer date set, which is beyond the scope of this paper.

Understanding the patterns of inefficiency reveals differences in the business models in firms that operate in the same market. Banks are multi-product institutions that offer singular and bundled financial services. While the inefficiency differences between banks differentiated by ownership structure are not significant, there are significant differences in the patterns of inefficiency. These patterns are caused by complex forces but also provide clues to differences in business models and management practices. DEA is a conventional tool for benchmarking of management efficacy. However, conventional benchmarking exercises based on DEA do not reveal significant differences in the sources of inefficiency that show differences in business models.

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