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THE IMPORTANCE OF EFFICIENCY FOR LIFE INSURER PROFIT REGARDING CANADIAN LIFE INSURERS

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ABSTRACT

Purpose- This study examines 1) how the efficiency of life insurers influences their profits, 2) the influence of exogenous variables such as debt ratio on profits and 3) the critical phenomenon of how feasible it is for a life company to improve its profits via efficiency improvements versus changing other characteristics of its business.
Methodology- This study uses stochastic frontier analysis along with data from Canadian life insurers to calculate the required efficiency values along with the above effects and possibilitie
Findings- The results are that it is much easier for life insurers to increase profit via efficiency improvements versus improving other business aspects that it can control such as debt ratio or percent of new business written.
Conclusion- The results point to the key conclusion that to increase profit, or regain the profit lost due to inefficiency, for the most part and conceivably totally the best, easiest and quite possibly only way for life insurance companies to influence their profit is through improving their efficiency, especially in the vital long-term

Keywords: Life ınsurance, efficiency, profit, stochastic frontier analysis, exogenous variables
JEL Codes: G22, H21, G28

1. INTRODUCTION

An effective and productive insurance sector is crucially important to and contributes to a nation's economic growth (Das et al., 2003; USAID, 2005). Consequently life insurance is a very important segment of the economy of most countries. Hence it is paramount to determine accurately how well life insurance companies (LICs) perform and how viable they are for the benefit of other industries and indeed national economies.Only fifteen of the more than three hundred and eighty studies concerning LIC efficiency observed truly examine how efficiency affects profits. Fourteen of these do not explore aspects of life insurers improving their profits. Therefore this paper goes beyond what has been previously accomplished and investigates the essential concept of the feasibility of a LIC improving its profits via efficiency versus changing other characteristics such as debt ratio. The conclusion reached is that, for the most part and conceivably totally, the best, easiest and possibly only process for LICs to influence their profit is through improving efficiency.

This paper continues with Section 2 briefly describing the Canadian life insurance industry. Section 3 provides a review of the relevant literature. Section 4 gives a portrayal of the method applied to calculate 1) efficiency and 2) the profit versus efficiency and exogenous variables. Section 5 depicts the data utilized and Section 6 gives the evaluations regarding how to change profit. Section 7 concludes.

2. A BRIEF DESCRIPTION OF THE CANADIAN LIFE INSURANCE INDUSTRY

The Canadian life and health insurance industry has more than one hundred and fifty active companies providing life and health insurance and annuities (Canadian Life and Health Insurance Association (CLHIA), 2022). It is approximately the world's eleventh largest by premiums (Swiss Reinsurance Company (SRC), 2022) with two Canadian life and health companies ranking, by asset size, in the top twenty-two of the world's largest insurance companies of any kind (A. M. Best Company, 2022) and three in the top thirty-three by market capitalization (Infinite Market Cap, 2023). Additionally it has approximately the world's seventh (twelfth) largest per capita volume of life insurance premiums when taking into account countries of any reasonable size, namely with a population of more than six (five) million (SRC 2022). The products are issued to greater than twenty-nine million Canadians along with seventy million people in more than twenty countries and territories outside of Canada (CLHIA, 2022). They include individual and group life insurance, disability insurance, individual and group annuities,

retirement savings plans, individual and group health insurance, long-term care, critical illness and travel insurance. Twenty-two million Canadians have life insurance, twenty-seven million have supplementary health insurance, twelve million have disability insurance, twenty million have accident and other health coverage and over eight million Canadians have their retirement savings managed by Canadian life and health insurers (CLHIA, 2022). The industry has manufactured substantial premiums in Canada including a total of $138 billion in 2021 and in 2021 the industry paid out over $113 billion in benefits (CLHIA, 2022).

3. LITERATURE REVIEW

Only fifteen articles truly examine how efficiency affects LIC profits and only Wise (2018) undertakes such an analysis for Canada. Of the fifteen, Greene and Segal (2004), Karim and Jhantasana (2005), Liu (2007), Alhassan and Addison (2013), Al-Amri et al. (2014), Alhassan et al. (2015), Wise (2018), Eling and Jia (2019), Camino-Mogro and Bermudez-Barrezueta (2019) and Tuffour et al. (2021) show that the inefficiency of life companies can affect their (financial) outcome and ultimately their survivorship. The others, Zhong (2009), Biener et al. (2014), Jiang and Chen (2015), Parida and Acharya (2017) and Jaloudi and Bakir (2019) decide that (pure) technical efficiency has no effect on profit. However notwithstanding the foregoing the fifteen contain deficient aspects.

Considering the flaws; Greene and Segal (2004) and Karim and Jhantasana (2005) use stochastic frontier analysis (SFA) but use a second stage to evaluate how efficiency is influenced by exogenous variables. Such an approach is a weakness, the main reason being that in the first stage of the two-stage approach the inefficiency (u_i) variables are assumed to be independent and identically distributed whereas in the second stage they are not. The latter is as the u_i variables are assumed to have a functional relationship with the exogenous variables (Kumbhakar and Lovell, 2000; Zanghieri, 2009). Another chief reason that the one-stage approach is better is none of the variables are completely exogenous, i.e. they are correlated with elements of the functions applied in the first stage, which can lead to biased estimates in the second stage (Berger and Mester, 1997; Wang and Schmidt, 2002).Table 1 has a list of the problems of the papers and explanations:

Table 1: Problems in the Papers Investigating Efficiency Affecting Profits and Explanations as to Why They are Problematic

Paper	Problem	Explanation
Greene & Segal (2004)	Second stage regression with SFA	See text above
	Face Value as output	See text below
	Investments as output	See note (1) below
Karim & Jhantasana (2005)	Second stage regression with SFA	See text above
	Assets as output	See note (1) below
	Claims as output	See text below
	Reserves as output	See text below
Liu (2007)	Uses DEA	See text below
	Small number of inputs	See text below
	Common input prices	See note (2) below
Zhong (2009)	Uses DEA	See text below
	Not enough DMUs	See note (3) below
Alhassan & Addison (2013)	Uses DEA	See text below
	After tax profit as output	See text below
	Claims to premiums ratio as regressor vs ROA	See text below
Al-Amri, Cummins & Weiss (2014)	Uses DEA	See text below
	Uses second stage regression	See note (4) below
	Assess LI & GI as one	See note (5) below
	Input price of equity is common by country	See note (2) below
	Input price of reserves is common by country	See note (2) below
Biener, Eling & Wirfs (2014)	Uses DEA	See text below
	Uses second stage regression	See note (4) below
	Common input prices	See note (2) below
	Claims as output	See text below
	Reserves as output	See text below
	Investments as output	See note (1) below
Alhassan, Addison & Asamoah (2015)	Uses DEA	See text below
	After tax profit as output	See text below
	Claims to premiums ratio as regressor vs ROA	See text below
Jiang & Chen (2015)	Uses DEA	See text below

Parida & Acharya (2017)	Uses DEA	See text below
	Not enough DMUs	See note (3) below
	Claims as output	See text below
Camino-Mogro & Bermudez-Barrezueta (2019)	Uses DEA	See text below
	Appears to assess LI & GI as one	See note (5) below
	After tax profit as output	See text below
Eling & Jia (2019)	Appears to assess LI & GI as one	See note (5) below
	Investments as output	See note (1) below
	Before tax profit as output	Double counting as written premium is an input
Jaloudi & Bakir (2019)	Uses DEA	See text below
	Assess LI & GI as one	See note (5) below
Tuffour, Ofori-Boateng, Ohemeng & Akuaku (2021)	Investments/Reserves as output	See note (1) and text below
	Net II as OP	Double counting as Investments is an output

DEA = Data Envelopment Analysis; DMU = Decision Making Unit; GI = General Insurance

(1) LICs generate investment income (II) as an output from their assets hence to proxy output it is better to utilize the flow value (II) rather than the static value (assets) because the former gives a better idea of current ability and activity. Another difficulty with specifying assets is that they can fluctuate in value leading to an false apparent change in output.

(2) A shortcoming because insurers pay different prices for inputs such as wages, materials and capital.

(3) Zhong (2009) does not use enough decision making units (DMUs) (three) versus three inputs and one output. Parida and Acharya (2017) does not use enough DMUs (thirteen) versus four inputs and two outputs (Cooper et al., 2001; Dyson et al., 2001).

(4) The results from the second-stage regression designed to analyze the determinants of efficiency (after calculating efficiency values using DEA) are problematic because the required assumptions are not met (Golden and Yang, 2019).

(5) Treating life insurance and general insurance as one is a problem as the two industries are inherently distinct, for example a) general insurance (GI) claims are repeatable whereas with LI this is mostly not true, b) a substantial part of LI business is annuities which involves payment without the occurrence of a contingent event while this type of payment is much smaller for GI, c) LI business tends to be long-term whereas GI business tends to be short term and d) the regulations, capital requirements, etcetera of the two are (vastly) different.

Premiums appears to be a better proxy for output than either policy count or face value (FV). The superiority of premiums is demonstrated by starting with the fact that there are different premiums 1) per FV for different products and 2) as different policies have different sums insured per policy for the same product. By using three cases it is illustrated how premiums are a better output proxy than either FV or policy count.

The first case involves a comparison within the same company at the same time. As a policy generating $100 in premium gives rise to more profit it is more output than a policy generating $50 in premium. Therefore the $100 policy is more desirable and the company will not look at the two policies as the same.

The second case regards the same firm at different times where the situation might not be totally straightforward. For instance a policy yielding $50 in premium in the past may lead to more profit for the firm than a policy yielding $70 in premium now, perhaps due to expense or mortality differences. Consequently the former is greater output. However the same problem exists when employing either FV or policy count as a proxy, e.g. less FV issued previously might be perceived as more output for the same reasons. Therefore in this case premiums is as least as good a proxy for output as is either FV or policy count. For the third case, a comparison regarding diverse companies, the explanation for the second case applies. The outcome of taking the three cases into account, premiums seems to be a better proxy for output than either FV or policy count.

Reserves are not a good output proxy chiefly because they 1) represent the future not the present, 2) exhibit method and pattern differences between products, 3) have method and assumption differences between companies, 4) can be altered by company method and assumption changes and 5) can be varied by ad hoc changes. In addition reserves are not a good proxy for intermediation output. Similarly claims are not a good output proxy as 1) they are not a good measure of funds pooled and redistributed (i.e. for losses) by insurers, 2) most "real services" performed by LICs are not correlated with claim volumes, 3) claims represent past activity much more than present activity, 4) claims lead to losses of future profits and 5) they potentially increase giving the false appearance of more productivity.

Data envelopment analysis (DEA) is inappropriate for LIC efficiency research primarily because of the reasons that it 1) assumes no random error (Berger and& Mester, 1997; Cummins and Weiss, 2000), 2) assumes available inputs are similar across all DMUs (Dyson et al., 2001), 3) is designed for DMUs that do not have the usual economic goals such as profit maximization or cost minimization (Charnes et al., 1978; Sun & Zhong, 2011), 4) suffers due to exogenous constraints greatly influencing the results (Berger and Humphrey, 1991; De Luca Cardillo and Fortuna, 2000), and 5) DMUs can have very high efficiency scores simply because few others have analogous inputs, outputs or related features (Bauer et al., 1998).

LIC inputs can include items such as salaries, office costs, commission and associated costs, underwriting, marketing, systems costs, human resources, management fees, administration of investments, client service, premium collection costs, claims processing, general overhead, development costs and a plethora of others (Carr, 2004). So adopting a narrow set of input proxies versus this list results in a lack of precision decreasing outcome validity. Wise (2017) has more details, examples and explanations regarding reserves, claims, DEA and inputs.

Specifically for Alhassan and Addison (2013), Alhassan et al. (2015) and Camino-Mogro and Bermudez-Barrezueta (2019) the output proxy of net profit after tax 1) includes premiums and expenses (which the authors exploit as an input proxy) therefore results in double counting and 2) assumes that companies can control the tax they pay which generally is not true. Moreover for their measurement of how efficiency affects ROA in both Alhassan and Addison (2013) and Alhassan et al. (2015) one of the regressors is defined as the ratio of claims to premiums which 1) involves values defined as output proxies and 2) appears to be part of ROA by definition.

Another facet of LIC efficiency articles is that only five have dealt exclusively with Canada and few others have regarded Canada at all. The five have problems; 1) Kellner and Mathewson (1983) only defines a sort of pseudo-efficiency and has a sole output of the number of policies/lives, 2) Paradi (2002) only draws on data from 1998, has some common input prices (note (2) above) and includes reserves in its outputs (text above), 3) Bernier and Sedzro (2003) specifies common input prices (note (2) above) and has reserves as its output (text above), 4) Yang (2006) only exploits data from 1998 and does not incorporate prices for its inputs or outputs (so cannot calculate allocative efficiency) and 5) Wu et al. (2007) does not use any prices for its inputs or outputs (so cannot calculate allocative efficiency). Five other items are cross-country including Canada; 1) Donni and Fecher (1997) which examines fifteen OECD countries applies DEA (text above) and has the number of employees as its only input (text above) , 2) Eling and Luhnen (2010) with thirty-six countries and territories assesses life insurance and general insurance as one (note (5) above), has some common input prices (note (2) above) and reserves as its output (text above), 3) Gaganis et al. (2013) utilizing fifty-two countries and territories appraises life insurance and general insurance as one (note (5) above), 4) Biener and Eling (2012) with twenty-one countries computes life insurance and general insurance as one (note (5) above), has common input prices (note (2) above) and reserves as its output (text above) and 5) Eling and Jia (2019) with ninety-one countries and territories contains the problems as seen in Table 1 above.

Therefore, this paper improves on what has been implemented to date by avoiding the aforementioned problems.

4. METHOD

4.1. The Cost Function

SFA is employed to calculate efficiency. SFA computes maximum output (i.e. the "frontier") that can be obtained with a given set of inputs. The frontier can also be evaluated as the minimum indispensable input to generate a given set of outputs.

When utilizing SFA it is most common to apply the logarithmic form

$$\ln M_i = \ln f(k_i; \beta) + v_i - u_i. \tag{1}$$

with $f(k_i; \beta)$ the functional form of the efficient frontier, M_i the measured value, k_i values the independent variables and β the parameters to be estimated. Noise is represented by v_i and u_i represents inefficiency.

The basic functional form specified in this research for the efficiency frontier is the translog function:

$$\beta_0 + \sum_1^N \beta_n \, lnk_n + \tfrac{1}{2} \sum_1^N \sum_1^M \beta_{nm} \, lnk_n \, lnk_m \tag{2}$$

Following Berger and Mester (1997), the cost function evaluated applying the translog functional form[1], with the time subscript suppressed for notational ease, is

$$\ln\left(\frac{C_i}{w_{Ni}A_i} - \theta_C + .001\right) =$$

[1] *The cost function used by Berger & Mester (1997) is actually a FF functional form with a translog kernel.*

$$\alpha_0 + \sum_{n=1}^{N} \beta_n \ln\left(\frac{w_{ni}}{w_{Ni}} - \theta_n + .001\right) + \sum_{m=1}^{M} \gamma_m \ln\left(\frac{y_{mi}}{A_i} - \theta_m + .001\right) +$$
$$\frac{1}{2}\sum_{j=1}^{N}\sum_{k=1}^{N} \delta_{jk} \ln\left(\frac{w_{ji}}{w_{Ni}} - \theta_j + .001\right)\ln\left(\frac{w_{ki}}{w_{Ni}} - \theta_k + .001\right) +$$
$$\frac{1}{2}\sum_{j=1}^{M}\sum_{k=1}^{M} \epsilon_{jk} \ln\left(\frac{y_{ji}}{A_i} - \theta_j + .001\right)\ln\left(\frac{y_{ki}}{A_i} - \theta_k + .001\right) +$$
$$\frac{1}{2}\sum_{j=1}^{N}\sum_{k=1}^{M} \zeta_{jk} \ln\left(\frac{w_{ji}}{w_{Ni}} - \theta_j + .001\right)\ln\left(\frac{y_{ki}}{A_i} - \theta_k + .001\right) +$$
$$+ v_i + u_i \tag{3}$$

for insurer *i* with C_i its cost incurred, A_i its asset value, w_i its input prices, y_i its output quantities, the ϑ values such that the lowest value to take the natural log of is .001 for each variable (set), and the α, β, γ, δ, ε and ζ parameters estimated. As insurers can control reinsurance, the cost, prices and quantities are all net of reinsurance. Analogously as insurers mostly cannot control income tax the cost, prices and quantities are all before income tax. Finally v_i represents noise and u_i represents inefficiency.

4.2. Efficiency Measurement

After the computation of the parameter estimates in the cost function the efficiency scores are assessed. Following Kumbhakar and Lovell (2000) the first step in appraising cost inefficiency is to calculate the average of the residuals u_i from Equation (3) for each insurer *i*.

$$u_i^* = \frac{1}{T_i}\{\sum_t ln\left(\frac{C_i}{w_{Ni}(A_i)} - \theta_C + .001\right) - \widehat{\alpha_0} - \sum_t \hat{\bullet}\ \ln(\xi)\ \} \tag{4}$$

for insurer *i*, with T_i the number of its panel data observations, $\hat{\alpha}_0$ and $\hat{\bullet}$ the parameter estimates and the $\sum_t \hat{\bullet}\ \ln(\xi)$ values representing all of the summation terms in Equation (3).

Then for each insurer *i*

$$\hat{u}_i = u_i^* - \min_i\{u_i^*\} \tag{5}$$

is evaluated and its cost efficiency is

$$CE_i = \exp\ (-\hat{u}_i). \tag{6}$$

The cost efficiency measure derived via equation (6) assumes that the most efficient insurer has the lowest cost residual, which is the idea incorporated by Berger and Mester (1997) found in equation (7):

$$\frac{C^{min}}{C^i} = \frac{\exp\ [f(w^i y^i)]u_i^{*min}}{\exp\ [f(w^i y^i)]u_i^*} = \frac{u_i^{*min}}{u_i^*} \tag{7}$$

with *C* being the $\ln\left(\frac{C_i}{w_{Ni}A_i} - \theta_C + .001\right)$ values of the LHS of equation (3); *f* the functional form (here the translog function); *w*, and the input prices and output quantities; and *min* referring to the most efficient company.

The inspiration underpinning equation (7) is that the cost efficiency of company *i* is compared to the most efficient company if both draw on the same sets, namely of company *i,* of input prices, outputs quantities and exogenous variables.

4.3. The Profit Functions and Efficiency Measurement

When writing the cost function (3) as

$$C_i = f(w_i, y_i, u_i, v_i) \tag{8}$$

for the alternate and standard profit functions, respectively, the equivalents to (8) are

$$\Pi_i = f(w_i, y_i, u_i, v_i) \tag{9}$$

and

$$\Pi_i = f(w_i, p_i, u_i, v_i) \tag{10}$$

with Π_i the profit generated by insurer *i* and the p_i its output prices.

For profit efficiency the most efficient insurer is assumed to have the highest profit residuals so (incorporating the profit function equivalent of equation (5))

$$\hat{u}_i = \max_i\{u_i^*\} - u_i^* \tag{11}$$

is calculated; hence the profit efficiency of insurer *i* is

$$PE_i = \exp(-\hat{u}_i). \tag{12}$$

The alternate profit efficiency equivalent of equation (7) is

$$\frac{\Pi^i}{\Pi^{max}} = \frac{\exp\,[f(w^i y^i)]u_i^*}{\exp\,[f(w^i y^i)]u_i^{*max}} = \frac{u_i^*}{u_i^{*max}} \tag{13}$$

with Π being the $\ln\left(\frac{\Pi_i}{w_{Ni}A_i} - \theta_\Pi + .001\right)$ values corresponding to the $\ln\left(\frac{C_i}{w_{Ni}A_i} - \theta_C + .001\right)$ values of the LHS of equation (3); *f* the functional form; *w* and *y* the input prices and output quantities; and *max* referring to the most efficient company. The standard profit efficiency equivalent of equation (13) is the same except that p^i values replace the y^i values.

4.4. Profit versus Efficiency

Having determined the cost and profit efficiency scores for each LIC; this paper investigates the crucial concept of how efficiency impacts their profitability. Two profit values, measured as excess returns over Canadian Government bond yields, are utilized. These are

1) ROE which is defined for each year as profit/equity less the average ten-year Canadian Government bond yields and
2) ROA which is defined for each year as profit/assets less the average ten-year Canadian Government bond yields.

For ease of expression the standard terms of ROE and ROA are specified to refer to the profit values. Moreover the impact on Average ROE and Average ROA is analyzed as these 1) account for lags, e.g. giving new business a chance to be profitable, 2) eliminates aberrations and 3) "resist[s] the common - but unrealistic - assumption that profits are maximized in each and every year" (Humphrey and Pulley, 1997:74).

To establish the influence efficiency has on profit model (14) is drawn on. It includes the impact factors on profit of 1) the year of operation, 2) (natural log of) asset size, 3) the debt ratio (DR), 4) the percent of new business written (PNB) by the company, 5) the Minimum Continuing Capital and Surplus Requirement (MCCSR) ratio and 6) whether a company is domestic.

For ROE

$$ROE_i = \beta_0 + \beta_{effy}CE_i + \sum_{x=2000}^{2015}\beta_x D_{xi} + \beta_{lnasize}lnA_i + \beta_{drat}DebtRatio_i +$$

$$\beta_{pnew}PercNew_i + \beta_{mrat}MCCSRRatio_i + \beta_{dom}D_{dom\,i} \tag{14}$$

is applied for insurer *i* with $DebtRatio_i$ its DR, $PercNew_i$ its PNB, $MCCSRRatio_i$ its MCCSR ratio, D_{xi} dummy variables for its years of operation, $D_{dom\ i}$ a dummy variable for its domesticity, the β parameters estimated and time subscripts suppressed for notational ease. Equivalent regressions are used for ROA and profit efficiency.

For Average ROE and efficiency

$$\overline{ROE_i} = \beta_0 + \beta_{effy}CE_i + \beta_x\overline{D}_i + \beta_{lnasize}ln\bar{A}_\iota + \beta_{drat}\overline{DebtRatio}_i +$$

$$\beta_{pnew}\overline{PercNew}_i + \beta_{mrat}\overline{MCCSRRatio}_i + \beta_{dom}D_{dom\,i} \tag{15}$$

is incorporated for insurer *i* with $\overline{ROE}_i$ its Average ROE, $\bar{A}_i$ its average asset size, $\overline{DebtRatio}_i$ its average DR, $\overline{PercNew}_i$ its average PNB, $\overline{MCCSRRatio}_i$ its average MCCSR ratio, $D_{dom\,i}$ a dummy variable for its domesticity, the β parameters estimated and time subscripts suppressed for notational ease. Equivalent regressions are used for ROA and profit efficiency.

4.5. Profit versus Exogenous Variables

In addition to appraising how efficiency impacts LIC profitability this study determines the possibility of their improving profit via the exogenous variables. Evaluating how easy it is for a LIC to change its profit using each exogenous variable involves comparisons. The first is between 1) the change necessary in the exogenous variable to change profit and 2) the average current situation, concerning the exogenous variable, of the companies involved. For example, as depicted in Table 7 for

PNB/Average ROE, the current average is 34.76. The change necessary to increase Average ROE by one hundred basis points (bps) is then quantified, using the parameter estimate of 0.3032, as 3.30 which is 9.49% of the current 34.76.

The second comparison is between 1) the change necessary in each exogenous variable to change profit and 2) the situation of each company, with respect to the exogenous variable, in the individual company/years specified in this article. For example, concerning PNB/ROE, the largest company/year observation is 699.5. Therefore the change necessary to increase ROE by one hundred bps (776.4) is more than 110.9% of the current amount for all individual company/year observations.

Whether it is possible, difficult or impossible for an insurer to increase its profit utilizing each exogenous variable (except domesticity) is then determined employing specific criteria. These outcomes are then compared to how easily a LIC can improve its profit via efficiency to conclude whether to increase profit LICs should try to improve efficiency or should try to change the value of an exogenous variable.

5. DATA

The cost and profit functions along with the profit versus efficiency parameters are estimated incorporating unbalanced panel data and generalized least squares. Nineteen years of return data submitted to the Canadian life insurance regulator, the Office of the Superintendent of Financial Institutions (OSFI) data, 2000-2018, are drawn on. The OSFI-linked website http://data.beyond2020.com/osfi/osfi_en.htm has the data. The data used are restricted to LICs licensed by OSFI to issue life insurance and do so. Companies that are only allowed to service policies or only issue reinsurance are excluded. LICs included total forty-three domestic companies and thirty-seven foreign owned companies. On average about 11.5 years are used for each company. The measurements were implemented applying Stata as distributed by StataCorp LP.

For input proxies as detailed a list as feasible is incorporated. Hence six are utilized; claim payments; surrender values & other payments; dividends & experience rating refunds (ERRs); expenses of acquiring new business; expenses of operations with respect to existing business; and assets & interest on policyholder amounts on deposit (IPHA). Four output proxies are utilized; insurance premiums, annuity premiums, accident and sickness (A&S) premiums and investment income.

For each of the cost, alternate profit and standard profit efficiency investigations a few company/year observations were excluded from the original total of 922. Furthermore a number of the input and output prices and output quantities were adjusted to correct for unduly large fluctuations and other anomalies. Contact the author for the Alternate and Standard Profit summary statistics.

Table 2: Summary Statistics -Cost Efficiency

Company Characteristic	**All Companies**	**Domestic Companies**	**Foreign Companies**
Companies (N=)	80	43	37
Company/Years (N=)	916	495	421

Variable (Type)	**Minimum**	**Maximum**	**Average**	**Standard Deviation**
Primary variables ($000)				
Cost *(C)*	-1675535	12613542	360632	1069642
Asset Size *(A)*	2466	69739664	2365629	6972719
Input Prices				
Claims *(w_1)*	-6.465	3355.000	40.497	122.606
SVs & OPs *(w_2)*	-0.619	305.000	2.183	12.337
Dividends & ERRs *(w_3)*	-1.094	73.023	0.228	2.473
Acquiring New Business *(w_4)*	-0.741	19.646	0.394	1.070
Operations wrt Existing Business *(w_5)*	-2.742	25.968	0.471	1.600
Assets & IPHA *(w_6)*	-0.001	0.260	0.004	0.011
Outputs ($000)				
LI Premiums *(y_1)*	-1156206	5094239	114461	378129
Annuity Premiums *(y_2)*	-62012	2143309	67531	231432
A&S Premiums *(y_3)*	-598066	2368589	80289	234189
Investment Income *(y_4)*	-397334	3907407	111805	366217

Profit vs Efficiency variables[2]				
Debt Ratio *(DebtRatio)*	0.000	0.798	0.023	0.078
Percent of New Business Written *(PercNew)*	-135.895	6.995	0.159	4.522
MCCSR Ratio (*MCCSRRatio*)	0.957	144.974	3.194	6.397
ROE (Excess Return)	-14.828	23.752	0.085	0.967
ROA (Excess Return)	-0.640	1.964	0.021	0.129

Notes: Some data from potential companies and company/years not included are used in some capacity.

w_1 = value of claim payments divided by their number

w_2 = value of SVs & OPs divided by their number

w_3 = value of dividends & ERRs divided by their number

w_4 = expenses on a per premium basis

w_5 = total expenses attributable to existing business per non-new business policy/certificate

w_6 = value of investment expenses & IPHA divided by the value of the company's assets

DR = Debt/(Debt + Equity)

PNB = (net First Year and Single Premiums)/(net First Year and Single Premiums plus net Renewal Premiums)

MCCSRRatio for domestic (foreign-owned) companies = total capital ((net) assets available/total capital ((net) assets) required

6. Results and Discussion

Four cases are analyzed for each efficiency measurement namely ROE, ROA, Average ROE and Average ROA. The importance of efficiency on LIC profit becomes evident upon exploring the possibility of changing profit via the exogenous variables. The conclusion reached is that to increase profit, or regain the profit lost due to inefficiency, for the most part and plausibly entirely, efficiency may be the best, easiest and possibly only way to influence LIC profit.

6.1. Parameter Estimates and Changing Profit

This section exhibits the effect of cost and profit efficiency and the other variables on LIC profit and the degree to which each independent variable (that a life insurer can control) needs to be altered to attain a one hundred bp improvement in the profit measures. Whether it is possible, difficult or impossible for an insurer to increase profit using each exogenous variable (except domesticity) is also determined. These outcomes are then compared to how easily a LIC can improve profit through efficiency to conclude whether they should 1) use efficiency to increase profit or 2) change one of the exogenous variables.

The parameter estimates obtained from models (14) and (15) for efficiency, the (natural log of) asset size, DR, PNB, MCCSR ratio and domesticity are mostly consistent in sign and statistical significance as Table 3 shows:

Table 3: Parameter Estimates and Statistical Significance Values

Model/Parameter	Cost Efficiency	Alternate Profit Efficiency	Standard Profit Efficiency
Efficiency			
ROE	0.2115**	0.8470***	1.0426***
Average ROE	1.9443***	0.8929***	0.8485***
ROA	0.1099***	0.4417***	0.7739***
Average ROA	0.3018***	0.5529***	0.8430***
Ln(Asset Size)			
ROE	0.0079**	0.0094***	0.0102***
Average ROE	0.1182***	0.0949***	0.1116***
ROA	-0.0052***	-0.0061***	-0.0067***
Average ROA	0.0070***	0.0028*	0.0022*
Debt Ratio			
ROE	-0.2699***	-0.2198**	-0.2129**
Average ROE	-1.6419***	-1.1803***	-1.0638***
ROA	-0.0214	-0.167	-0.0226
Average ROA	-0.2137***	-0.2144***	-0.2123***
%New Business			
ROE	0.0013	0.0013	0.0012
Average ROE	0.3032***	0.1757***	0.2588***

[2] Both DR and PNB are expressed as values equal to 100 times the relevant percentage (as opposed to percentages) throughout this paper.

ROA	0.0002	0.0002	0.0001
Average ROA	0.0045	-0.0308***	-0.0149***
MCCSR Ratio			
ROE	0.0009	0.00003	-0.0003
Average ROE	0.0926***	0.0706***	0.0751***
ROA	-0.0001	-0.0002	-0.0002
Average ROA	0.0173***	0.0097***	0.0081***
Domesticity			
ROE	0.0521***	0.0557***	0.0303***
Average ROE	-0.2256***	-0.0994***	-0.1795***
ROA	0.0121***	0.0218***	0.0084***
Average ROA	-0.0245***	0.0110**	0.0088**

*** = significant to a 1% level
** = significant to a 5% level
* = significant to a 10% level

The consistency of the sign and significance of the parameter estimates found in Table 3 tends to demonstrate that the models (14) and (15) are valid. The Average ROE and Average ROA assessments represent the company/year observations spread over eighty companies and thus an average of about eleven and one-half and up to nineteen observations per company. This means that the Average ROE and Average ROA appraisals probe longer-term traits of profit versus the exogenous variables than do those of ROE and ROA. Hence the parameter estimates and statistical significance values for Average ROE and Average ROA may be better indicators of reality because life insurance is a long-term proposition. Consequently as the efficiency parameter estimates in Table 3 are mostly higher for the average profit computations; efficiency is even more vital to LICs in the more critical long-term versus the short-term.

The conclusion from the preceding combined with Tables 4 through 9 is that for the most part and potentially entirely the best, easiest and possibly only way for a LIC to influence profit is by changing its efficiency. The only cases where it seems possible to change profit via a characteristic other than efficiency have one or more caveats attached.

6.1.1. Changing Profits Using Efficiency

To illustrate, using the parameter estimates first consider how easy it is for a LIC to change profit using cost efficiency. Table 4 displays the relevant values regarding efficiency and life insurer profit:

Table 4: Parameter Estimates and Changes Necessary to Increase Profit Measures by 100 Basis Points – Cost Efficiency

Profit Measure	Value		Notes
ROE	Parameter Estimate	0.2115**	
	Change Necessary	4.73%	4 of 80 companies have inefficiency < 4.73%
	Average Inefficiency	14.07%	
Average ROE	Parameter Estimate	1.9443***	
	Change Necessary	0.52%	1 of 80 companies has inefficiency < 0.52%
	Average Inefficiency	13.97%	
ROA	Parameter Estimate	0.1099***	
	Change Necessary	9.10%	9 of 80 companies have inefficiency < 9.10%
Average ROA	Parameter Estimate	0.3018***	
	Change Necessary	3.32%	4 of 80 companies have inefficiency < 3.32%

*** = significant to a 1% level
** = significant to a 5% level

As per equations (7) and (13) of Section 4.2 this efficiency study calculates the efficiency of each LIC assuming it does not change its input prices, outputs, output prices and exogenous variables. Accordingly as shown in Table 4, decreasing inefficiency by the amount necessary to increase a profit measure by one hundred bps is clearly possible. For the worst case, ROA, the average inefficiency is 14.07% and the change necessary to increase ROA by one hundred bps is 9.10%. As only nine of the eighty companies have an inefficiency of less than 9.10%, it seems possible to increase ROA using efficiency. For each profit efficiency measure either one or two of the eighty companies have an inefficiency less than the change necessary to increase profit by 100 bps. Hence the analogous for alternate and standard profit efficiency are even more indicative of the ability of LICs to change profit through efficiency.

Contrasted to easily being able to change profit via efficiency, the results below exhibit that LICs cannot easily change profit via one of the other business aspects that it can control.

6.1.2. Changing Profit Using Asset Size

The first such aspect analyzed concerns how easily a LIC can change profit using asset size. Table 5 shows the relevant values for cost efficiency with respect to asset size and LIC profit:

Table 5: Parameter Estimates and Changes Necessary to Increase Profit Measures by 100 Basis Points Natural Log of Asset Size - Cost Efficiency

Profit Measure	Value	
ROE	Parameter Estimate	0.0079**
	Change Necessary	1.273
	Necessary Asset Size Change	≥356%
Average ROE	Parameter Estimate	0.1182***
	Change Necessary	0.0846
	Necessary Asset Size Change	≥108%
ROA	Parameter Estimate	-0.0052***
	Change Necessary	-1.905
	Necessary Asset Size Change	≥85%[a]
Average ROA	Parameter Estimate	0.0070***
	Change Necessary	1.432
	Necessary Asset Size Change	≥418%

*a: Decrease in asset size, *** = significant to a 1% level, ** = significant to a 5% level*

As to changing profit Table 5 demonstrates that, when taking into account the parameter estimates, to change one of the profit measures by one hundred bps necessitates an insurer changing its natural log of asset size by a positive quantity of at least 1.088 or a negative quantity of at most -1.905. This equates to an insurer increasing its asset size by at least 108% or decreasing it by at least 85%, both of which are clearly impossible.[3] For each profit efficiency measure an insurer must either increase its asset size by at least 109% or decrease it by at least 77%, so the analogous for alternate and standard profit efficiency are as telling of the inability of LICs to change profit through changing its asset size.

6.1.3. Changing Profit Using Debt Ratio (DR)

DR is a special case in that only 123 company/year observations are greater than zero leading to the investigation being further carried out confined only to those. Table 6 illustrates the relevant values regarding DR and LIC profit:

Table 6: Parameter Estimates and Necessary Debt Ratios (DRs) to Increase Profit Measures by 100 Basis Points Debt Ratio All Companies and Only Companies with Positive Debt Ratio - Cost Efficiency

Profit Measure	Value		% Required Change is of Current Average DR Cost (Alternate / Standard)
ROE	Parameter Estimate	-0.2699***	
	Necessary DR: All Companies	-1.39	
	Necessary DR: DR >0 Only	13.53	21.5% (26.4% / 27.2%)
	Current Average (All)	2.31	
	Current Average (DR>0)	17.24	
Average ROE	Parameter Estimate	-1.6419***	
	Necessary DR: All Companies	2.89	17.4% (24.2% / 26.9%)
	Necessary DR: DR >0 Only	12.11	4.8% (6.7% / 7.4%)
	Current Average (All)	3.50	
	Current Average (DR>0)	12.72	
ROA	Parameter Estimate	-0.0214	
	Necessary DR: All Companies	-44.42	
	Necessary DR: DR >0 Only	-29.50	
Average	Parameter Estimate	-0.2317***	

[3] Contact the author for values and details corresponding to the profit measures not referred to in the text for each of Asset Size, DR, PNB and MCCSR ratio for both profit reductions due to average inefficiency and specific company/years and companies.

ROA	Necessary DR: All Companies	-1.18	
	Necessary DR: DR >0 Only	8.04	36.8% (36.7% / 37.0%)

*** = significant to a 1% level

Note: For positive necessary DRs the numbers in the right-most column are the percent, that the required change is, of the current average to achieve said necessary DR. For example, for ROE/CE/>0 the current average is 17.24 so achieving the necessary DR of 13.53 requires a change of 3.71 which is 21.5% of the current 17.24. The values in parentheses are the equivalent percentages for APE and SPE.

For changing profit, Table 6 exhibits that, when considering the parameter estimates and both 1) all companies and 2) only companies with positive DR, to change one of the profit measures by one hundred bps necessitates an insurer changing its DR either to 1) a negative amount which is impossible or 2) except for Average ROE/DR>0 a positive amount that is difficult or impossible for the insurer to obtain. It can be noted that for Average ROE/CE/DR>0 the required change is 4.8% of the current average DR which is not difficult, but the required change for Average ROA/CE/DR>0 is 36.8% of the current average DR which is impossible for a LIC. Tables 6 also shows that the required change for the profit efficiency measures are more than for cost efficiency.

6.1.4. Changing Profit Using Percent of New Business Written (PNB)

Table 7 shows the relevant values with respect to PNB and LIC profit. Looking at changing profit Table 7 illustrates that, when investigating the parameter estimates, to change one of the profit measures by one hundred bps necessitates an insurer changing its PNB either to 1) such a high amount as to be impossible, 2) a negative amount which is impossible or 3) except for Average ROE a positive amount that is difficult or impossible for the insurer to obtain. It can be noted that for Average ROE/CE the required change is 9.5% of the current average PNB which is not difficult, but the required change for Average ROA/CE is 634% of the current average PNB which is impossible for a LIC. Tables 7 additionally shows that, except for Average ROA, the required change for the profit efficiency measures are more than for cost efficiency. For Average ROA/APE the required change is also impossible while for SPE the necessary PNB is negative, hence impossible.

Table 7: Parameter Estimates and Necessary PNBs to Increase Profit Measures by 100 Basis Points Percent of New Business Written (PNB) - Cost Efficiency

Profit Measure	Value		% Required Change is of Current Average PNB Cost (Alternate / Standard)
ROE	Parameter Estimate	0.0013	
	Necessary PNB	792.3	4876% (5035% / 5052%)
	Current Average	15.9	
Average ROE	Parameter Estimate	0.3032***	
	Necessary PNB	38.06	9.49% (16.2% / 11.0%)
	Current Average	34.76	
ROA	Parameter Estimate	0.0002	
	Necessary PNB	6036	37814% (31645% / 95047%)
Average ROA	Parameter Estimate	0.0045	
	Necessary PNB	255.1	634% (-92.6% / N/A)

*** = significant to a 1% level

Note: For positive necessary PNBs the numbers in the right-most column are the percent, that the required change is, of the current average to achieve said necessary PNB. For example, for CE/ROE the current average is 15.92 so achieving the necessary PNB of 792.32 requires a change of 158.72 which is 4876.4% of the current 15.92. The values in parentheses are the equivalent percentages for APE and SPE.

6.1.5. Changing Profit Using MCCSR Ratio

Table 8 exhibits the relevant values for MCCSR ratio and life insurer profit. As to changing profit Table 8 displays that to change either ROE or ROA by one hundred bps necessitates an insurer changing its MCCSR either to 1) such a high amount as to be impossible or 2) a negative amount which is also impossible. For Average ROE/CE the required change is 4.67% of the current average MCCSR which is not difficult, but the required change for Average ROA/CE is 24.9% of the current average PNB which may be difficult for a LIC. Furthermore Tables 8 shows that the required change for the profit efficiency measures are more than for cost efficiency. For ROE/SPE the necessary MCCSR is negative, hence impossible.

Table 8: Parameter Estimates and Necessary MCCSR Ratios to Increase Profit Measures by 100 Basis Points - Cost Efficiency

Profit Measure	Value		% Required Change is of Current Average MCCSR Cost (Alternate / Standard)
ROE	Parameter Estimate	0.0009	
	Necessary MCCSR	14.947	368% (10505% / N/A)
	Current Average	3.194	
Average ROE	Parameter Estimate	0.0926***	
	Necessary MCCSR	2.422	4.67% (6.13% / 5.76%)
	Current Average	2.314	
ROA	Parameter Estimate	-0.0001	
	Necessary MCCSR	-105.9777	
Average ROA	Parameter Estimate	0.0173***	
	Necessary MCCSR	2.891	24.9% (44.5% / 49.2%)

*** = significant to a 1% level

Note: For positive necessary MCCSRs the numbers in the right-most column are the percent, that the required change is, of the current average to achieve said necessary MCCSR. For example, for ROE the current average is 3.194 so achieving the necessary MCCSR of 14.947 requires a change of 11.754 which is 368.0% of the current 3.194. The values in parentheses are the equivalent percentages for APE and SPE.

6.1.6. Additional Considerations

Average cost inefficiency has reduced insurer ROE by 29.0%; to regain this by changing a company's 1) DR necessitates decreasing it by 107.4; 2) PNB necessitates increasing it by 225.0 or 3) MCCSR necessitates decreasing it by 340.695, each of which is clearly impossible. The results are much the same for Average ROE, ROA and Average ROA and are generally more extreme for the profit efficiency calculations.

The above calculations scrutinize averages only. The same conclusions apply for the specific company/year observations. For example, for cost efficiency to change ROE by one hundred bps the company has to sell more than 10.0% of current debt for all except ten of 916 company/year observations; has to decrease the amount of PNB by greater than 111.0% of the current value for all 916 or has to increase its MCCSR ratio by more than 30% of the current amount for all but three of the 916. So these are either difficult or impossible for virtually all company/years. The results are much the same for Average ROE, ROA and Average ROA and for the profit efficiency calculations. Tables 9 and 10 depict the feasibility of LICs changing profit a s to specific company/year observations.

As life insurance is a long-term proposition it is more realistic to consider the long-term than the short-term. In the short-term cases average cost inefficiency has reduced insurer ROE by 29.0% and insurer ROA by 33.3% of their potential. For the long-term cases average inefficiency has reduced insurer Average ROE by 73.7% and insurer Average ROA by 48.4% of their potential. Thus the long-term effect is greater than the short-term effect. For APE the trend is the same. Even though for SPE the trend is the opposite the two results are (very) close.

For the company/year observations an average of 28.2 (32.4)% of potential short-term ROE (ROA) is lost due to cost inefficiency for the applicable observations. For the long-term cases the average loss in potential profit is 71.3 (46.2)% for Average ROE (ROA). For APE the short-term values are 68.6 (67.1)% while the long-term numbers are 71.7 (68.4)%. As above for SPE the trend is the opposite but again the two results are close.

Furthermore for the short-term (long-term) cases, 22.6% and 22.4% (94.1% and 76.9%) of the individual company/year observations (companies) with a negative profit would have a positive profit if cost inefficiency were removed. For both APE and SPE the trend is the same. Hence overall for almost all cases in the discussion the long-term effect is greater than the short-term effect.

6.2. Feasibility of Increasing Profit

The results of Tables 3 through 8 are used to determine the feasibility of a LIC realizing a one hundred bp improvement in the profit measures by altering each independent variable that a life insurer can control, in (14) and (15). Table 9 summarizes:

Table 9: Feasibility of Increasing Profit by 100 Basis Points Via the Independent Variables Cost, Alternate Profit and Standard Profit Efficiency

Variable & Profit Measure	Cost	Alternate Profit	Standard Profit
Efficiency			
ROE	Possible	Possible	Possible
Average ROE	Possible	Possible	Possible

ROA	Possible	Possible	Possible
Average ROA	Possible	Possible	Possible
Ln(Asset Size)			
ROE	Impossible	Impossible	Impossible
Average ROE	Impossible	Impossible	Impossible
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
Debt Ratio (DR)			
ROE	Impossible	Impossible	Impossible
Average ROE	Difficult/Impossible	Impossible	Impossible
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
DR >0 Only			
ROE	Impossible	Impossible	Impossible
Average ROE	Possible	Possible	Possible
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
DR Co/Years			
ROE	Possible/Difficult/Impossible	Possible/Difficult/Impossible	Possible/Difficult/Impossible
Average ROE	Possible/Difficult/Impossible	Possible/Difficult/Impossible	Possible/Difficult/Impossible
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
% New Business			
ROE	Impossible	Impossible	Impossible
Average ROE	Possible	Difficult	Difficult
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
PNB Co/Years			
ROE	Impossible	Impossible	Impossible
Average ROE	Possible/Difficult/Impossible	Possible/Difficult/Impossible	Possible/Difficult/Impossible
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
MCCSR Ratio			
ROE	Impossible	Impossible	Impossible
Average ROE	Possible	Possible	Possible
ROA	Impossible	Impossible	Impossible
Average ROA	Impossible	Impossible	Impossible
MCCSR Co/Yrs			
ROE	Difficult/Impossible	Impossible	Impossible
Average ROE	Possible	Possible/Difficult	Possible/Difficult
ROA	Impossible	Impossible	Impossible
Average ROA	Difficult/Impossible	Difficult/Impossible	Difficult/Impossible

Note: Co/years refers to analyzing individual company/year observations as opposed to averages. For example for CE/DR/ROA, for all nine hundred and sixteen specific company/year observations the necessary change is more than 75% of the current amount so is deemed as impossible.

The main conclusion to draw from Table 9 is that in almost all cases it is either difficult or impossible for a LIC to improve its profit by changing a business characteristic that it can control (other than efficiency). There are some cases where it seems possible to change profit via such a characteristic however they all have one or more caveats attached as described in Table 10.

Table 10: Caveats Regarding Possibility of Changing Profit Measures

Characteristic	Profit Measure Seemingly Possible to Change	Caveats
DR>0 only	Average ROE	Impossible for both ROE and Average ROA
DR company/years	ROE	Possible for only 3 of >900 observations for all efficiency calculations
DR company/years	Average ROE	1) Possible for only 12/11/11 of 80 companies for CE/APE/SPE efficiency calculations. 2) Impossible for Average ROA for all companies
PNB	Average ROE	Possible for CE only where it is impossible for both ROE and Average ROA
PNB company/years	Average ROE	1) Possible for only 31/16/25 of 80 companies for CE/APE/SPE efficiency calculations 2) Impossible for both ROE and Average ROA for all companies
MCCSR	Average ROE	Impossible for both ROE and Average ROA
MCCSR company/years	Average ROE for most companies	Difficult or impossible for both ROE and Average ROA for all companies

Considering the results of Table 9 along with the associated caveats the conclusion is for the most part and conceivably totally the best, easiest and possibly only way for LICs to influence profit is through improving efficiency.

7. CONCLUSIONS

The key conclusion reached from the outcomes in Tables 5 through 9 is that to increase profit, or regain the profit lost due to inefficiency, for the most part and believably completely a LIC must change a business aspect that it can control (other than efficiency) enough to be difficult or finds it impossible. On the other hand Tables 4 and 9 illustrate that to increase profit using efficiency is definitely possible. This means that, especially in the vital long-term, for the most part and feasibly wholly the best, easiest and possibly only way for life insurance companies to influence their profit is through improving their efficiency.

Other important conclusions that can be taken include that the sign and significance of the parameter estimates of Table 3 being consistent tends to demonstrate that the models (14) and (15) are valid. Secondly, as the efficiency parameter estimates in Tables 3 and 4 are mostly higher for the average profit measures, it seems that efficiency is a critically greater determinant of LIC profit in the more realistic long-term than in the short-term. The latter indicates that a LIC should pay strict attention to efficiency as it is a central element of the life insurance business.

Life insurance is a long-term proposition so the long-term results of Section 6.1.6 are more crucial than the short-term results. In almost all features examined the influence of efficiency is greater in the long-term than in short-term. As well the greater long-term influence shows that, concerning the effect of efficiency and other variables on profit, for the most part and conceivably totally the best, easiest and possibly only way for LICs to influence profit is through improving efficiency, especially in the vital long-term.

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THE EFFECT OF MONETARY POLICY SHOCKS ON INDUSTRIAL OUTPUT IN AFGHANISTAN

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ABSTRACT

Purpose- This study examines the impact of monetary policy shocks on industrial output in Afghanistan. Quarterly secondary data were collected for the period from 2003 to 2021 from various official sources such as the Statistical Bulletin of the Central Bank of Afghanistan, the International Monetary Fund, and the World Bank.

Methodology- This study used a three-stage procedure. The first stage involved testing the stability of the variables to be included in the model. The second stage involves selecting the optimal lag length using various lag length criteria. Finally, the Vector Error Correction (VECM) model was used to determine if there were any short-run correlations or dynamics among the variables. The study also conducted some post-tests to confirm the validity and robustness of the regression model.

Findings- The results of the long-run vector error correction model show that there is a long-run causality running from monetary policy rate, broad money supply, inflation, exchange rate, and a commercial bank loan to the industrial sector. So, there was a speed of adjustment from the short-run to the long-run equilibrium. However, the Wald test confirmed that the short-run causality runs from the explanatory variables to the dependent variable. Commercial bank credit to the industrial sector was found to cause a change in industrial production in all six lag periods. The results were further supported by the Granger causality test. Shocks in commercial bank lending to the industrial sector were found to have no significant effect on industrial output. However, the performance of the industrial sector was the main cause of the flow of commercial banks' credit to the industrial sector.

Conclusion- The study recommends that monetary policy should proceed with extreme caution in managing the exchange rate. The study also recommends that the Central Bank of Afghanistan should encourage commercial banks to offer credit to the industrial sector at low-interest rates.

Keywords: Monetary policy shocks, industrial output, Vector Error Correction Model (VECM), Granger Causality Test, Afghanistan.
JEL Codes: E52, E32, L60

1. INTRODUCTION

We begin our discussion with the question, what is monetary policy? The policy pursued by a country's central bank to control and manipulate the supply of money and credit is called monetary policy. According to Prof. Spencer, *"Monetary policy is the deliberate exercise of the monetary authority's power to induce expansion or contraction in the money supply"*. The objectives of monetary policy vary from country to country and depend on economic conditions. The basic objectives of monetary policy are to promote a high level of employment, steady economic growth, a stable price level as a goal, interest rate stability, and a more stable financial market. Monetary policy is used to achieve these goals.

Another debate is whether monetary policy has an impact on the actual economy or economic activity in general. If so, what is the transmission mechanism that causes these effects? These are two of the most important and controversial questions in macroeconomics (Bernanke and Blinder 1992). Empirical estimation of the effects of monetary policy is another area of controversy among economists. Monetary economics has generated several controversies. Although there is now a consensus among economists that only prices are affected in the long run, the effects of monetary policy stimulus on real variables in the short run are still controversial (Walsh 2003).

An efficient monetary policy requires a thorough investigation of the short-run interaction between real and monetary variables. A frequently discussed issue is the divergence between the sticky price Keynesian models and flexible-price models of the real business cycle. Both monetarists and New Keynesians accept that monetary policy affects output in the short run,

while New Classical economists argue that prices are fully flexible and adjust quickly to clear the market; real variables are not affected by monetary policy (Mankiw and Romer 1991). The central bank policymaker asks about the impact of a one percentage point (basis point) change in the monetary policy instrument (interest rate) on output, prices, and other macroeconomic variables. The influence of monetary policy on real economic activity is a contentious area of macroeconomic debate. In recent decades, numerous studies have been conducted to determine the importance of money and monetary policy in the economy. Some of them are: Friedman and Schwartz, 1963; Romer and Romer, 1989; Sims, 1972, 1980a, 1980b; Stock and Watson, 1989; Masih and Masih, 1996; Ibrahim, 1998; Tan and Baharumshah, 1999; Ramachadran, 2004; Gamber and Hakes, 2005. According to Friedman (1968), *"Monetary Policy was a string. You could pull it to stop inflation but you push it to halt recession"*.

Da Afghanistan Bank (Central Bank of Afghanistan) is responsible for implementing monetary policy. This responsibility is explicitly stated in the 2003 Law on the Central Bank of Afghanistan. Article 62 of the Da Afghanistan Bank Law states : "*Da Afghanistan Bank shall be responsible for the formulation, adoption, and execution of the monetary policy*". The monetary policy encompasses the policy pursued by Da Afghanistan Bank (DAB) with regard to the use of monetary policy tools under its authority in order to achieve the objectives specified in the law.

In Afghanistan, monetary policy employs a variety of mechanisms to control the money supply in the economy in order to maintain general prices and financial system stability. Low and consistent inflation promotes long-term growth and job creation. It decreases uncertainty about the future pricing of goods and services and enables people and companies to make more confident economic decisions like consumption, saving, and investing. This, in turn, promotes higher growth and job creation in the medium term, contributing to the overall economic success of the country. So far, there have been no such studies on the impact of monetary policy shocks on industrial output in Afghanistan. Thus, this is initiative research.

The basic objective of this study is to examine the influence of monetary policy shocks on industrial output in Afghanistan. Quarterly secondary data were collected for the period from 2003 to 2021 from various official sources such as the Statistical Bulletin of the Central Bank of Afghanistan, the International Monetary Fund, and the World Bank. The paper contributes by filling the knowledge gap in the literature and providing policymakers with an evidence-based policy alternative to promote industrial expansion. To achieve the aforementioned research objective, the following research question was answered; Do monetary policy shocks affect industrial output?

This study is organized into the following five sections. Following the introduction, section 2 deals with the related literature review, section 3 explains the research methodology and dataset, section 4 focuses on research findings, section 5 explores discussion, and the last section presents the main conclusions and policy implications.

2. LITERATURE REVIEW

"Monetary policy was a string. You could pull on it to stop inflation but you could not push on it to halt the recession. You could lead a horse to water but you could not make him drink." (Friedman, 1968, pg. 1).

Central bank authorities influence real and nominal variables in the economy and initiate monetary policy actions by changing either short-term interest rates or the money supply. There is still much controversy in macroeconomics about the role of money in the short and long run. Although there is now a consensus among economists that the long-run effects of money are confined solely to prices, i.e., the long-run supernaturality of money, the effects of monetary stimulus on real variables in the short run are still controversial (Walsh 2010). A frequently discussed issue is the divergence between the sticky price Keynesian models and flexible-price models of the real business cycle. Both monetarists and New Keynesians accept that monetary policy affects output in the short run, while New Classical economists argue that prices are flexible and adjust quickly to clear the market (Mankiw and Romer, 1991).

From the debate among the four most influential schools of thought in macroeconomics, i.e., the Keynesians, the monetarists, the New Classical, and the real business cycle school, different opinions and views have emerged on the effectiveness of monetary policy in both the short and long run. Monetary policy is concerned with the discretionary regulation and control of the money supply by the monetary authority or central bank to achieve intended or desired economic goals (Nuhu, 2015). Monetary policy is known as an effective "economic stabilizer" that is usually used to determine, regulate, control, cost availability, and influence the direction of money and lending within an economy in order to achieve a specific macroeconomic policy goal such as increased employment, the balance of payments equilibrium, and long-term economic growth.

Monetary policy is divided into two types: expansionary and contractionary. Expansionary monetary policy is used when monetary authorities decide to expand the supply of money or reduce the cost of money in the economy in order to stimulate economic activity and combat depressions, recessions, and deflationary gaps (Uju and Ugochukwu, 2021). This can be achieved by purchasing securities on the open market, lowering interest and discount rates, reducing reserve requirements, and easing credit regulations, among other measures. In general, an expansionary monetary policy ensures that more money

is in the hands of the public. With a contractionary or tight monetary policy, monetary authorities take steps to reduce the money supply or increase the cost of money in the economy to cause a decline in economic activity.

Contractionary policies reduce the general price level and restrain inflation, resulting in lower levels of investment, employment, production, and economic growth. Depending on the economic objectives, regulatory authorities may shift from contractionary to expansionary measures as needed.

Sound monetary policy is essential for the growth and development of the industry. Monetary authority policy should focus on providing private-sector enterprises with access to financial resources. Banks should be encouraged to offer concessions to promote saving. Combined with a positive real interest rate, this will enable the banking sector to mobilize savings that can be transferred to the industrial sector. According to Busari et al. (2002), ''monetary policy stabilizes the economy better in a flexible exchange rate regime than in a fixed exchange rate regime, and it stimulates growth better in a flexible exchange rate regime, but is accompanied by a large depreciation that could destabilize the economy, implying that monetary policy stabilizes the economy better when it directly targets inflation rather than directly stimulating growth''.

Edoumiekumo and Karimo (2013) used the VAR model to examine the response of Nigerian real sector output to monetary policy shocks. The study found that credit and private-sector investment had a larger impact on output. In the long run, real GDP was more responsive to monetary policy shocks (MPR) and CPI, as well as to own innovations. In addition, the study found that while the interest rate or MPR had a direct and immediate impact on the real sector, it did so indirectly through the investment and credit channels. Chuku (2009) examined the ''impact of monetary policy innovations in Nigeria. The study used structural vector autoregression (SVAR) to track the impact of monetary policy shocks on Nigerian output and prices from 1986 to 2008. Monetary policy appears to have a large impact on output at times, but little or no impact at other times''.

It has been argued that changes in the money supply lead to fluctuations in the general price level and consequently in nominal output, but not in real output in the long run (Lucas 1972). An increase in the cost of capital is likely to lead to a decline in investment and, consequently, lower output. Moreover, if the industry is highly unionized, the effect may be amplified to the point of being larger than if the level of unionization is low. From this point of view, it can be argued that the legal structure controlling labor disputes can be an important factor affecting industrial output. Alam and Waheed (2006) used the VAR approach to evaluate the sectoral impact of monetary policy in Pakistan. The results of the study show that different sectors respond differently to monetary policy tightening. In particular, it was observed that the performance of the financial and insurance sectors, retail and wholesale trade, and manufacturing deteriorated as a result of the interest rate shocks. In contrast, the mining and quarrying, and agricultural sectors showed little response to interest rate changes.

Gertler and Gilchrist (1994) found that monetary policy changes have a greater impact on small business variables when the sector as whole moves more slowly. Oliner and Rudebusch (1995) also observe nonlinearity and find that the impact of cash flow on investment is greater during periods of tight money. With respect to the Nigerian economy, a study was conducted by Saibu and Oladeji (2007) to examine the impact of asymmetric monetary policy shocks on fluctuations in real output using the modified GARCH. The study was based on the use of various measures of output such as GDP, and output in agriculture, industry, and service sectors. The analysis showed that monetary policy had a negative and small impact on most of the aggregate output measures studied. In particular, it was found that expansionary monetary policy led to a decline in output.

Ayodeji and Oluwole (2018) used simple regression to examine the impact of monetary policy on economic output in Nigeria. The study found a negative relationship between interest rates and GDP on the one hand and inflation and GDP on the other. The study did not disaggregate the impact of monetary policy on different sectors of the economy such as the industrial sector. According to Abeng (2006), monetary policy is only useful in a strongly monetized economy. If the economy is not highly monetized, the beneficial effect of monetary policy is limited. For example, in an underdeveloped economy where much of the output is produced in a subsistence sector, the availability of money is unimportant.

in other words, the large share of output produced in a subsistence sector of the economy would be independent of the money supply. As a result, monetary policy would not be a stronger tool for managing the economy. Kim (1999) examined the effects of postwar monetary policy shocks in the G-7 countries using the VAR approach. The study found that changes in output were correlated with monetary policy shocks in the short run, but only in an insignificant way. As a result, output fluctuations in the G-7 countries were not found to be significantly affected by monetary policy shocks in the postwar period. According to Olivei and Tenreyro (2007), in the United States of America, a monetary policy shock has a larger impact on output than on prices in the first half of the year, while the opposite is true in the second half. Using the structural vector error correction (SVEC) model with contemporaneous and long-run restrictions, we examined the relationship between monetary policy shocks and some key macroeconomic variables in Thailand from 2000q2 to 2017q2 during the inflation target period (Arwatchanakarn, 2018).

Arintoko and Kadarwati (2022) examine how monetary policy responds to macroeconomic shocks. As a result, the effects of GDP shocks, inflation shocks, and exchange rate shocks on policy rates are examined in the implementation of monetary

policy using a vector error correction model (VECM) analysis, as well as the responses of policy rates incorporating long-run relationships. The policy rate is used as the period of policy implementation from 2001Q1 to 2020Q1. The results of the study show that inflation and exchange rate shocks are the most important macroeconomic variables determining Indonesia's monetary policy stance in terms of size and contribution(Arintoko and Kadarwati, 2022).

Kuttner (2001) investigates the effects of monetary policy measures or actions on bills, notes, and debentures, using Federal Reserve futures rates as a measure of the expected component of policy changes to distinguish between expected and unexpected changes in target funds. Kuttner finds that the response of the interest rate market to expected monetary policy adjustments is small, but its response to unexpected surprises is enormous and highly significant. He contends that previous studies have failed to demonstrate the strong relationship between monetary policy actions and market reactions because they were unable to separate the expected component of the monetary policy action from the unanticipated component. Tolulope and Ajilore (2013) used an ARDL model to analyze the effect of monetary policy on prices and output in Nigeria. The analysis found a significant positive relationship between projected or anticipated monetary policy changes and Nigeria's output and prices. Mumtaz and Theodoridis (2020) propose a VAR that estimates the influence of monetary policy shocks on volatility (Mumtaz and Theodoridis, 2020).

In contrast, unexpected changes in monetary policy did not significantly affect the variables (Omini and Ogbeba, 2017). Cambazolu and Karaalp (20 12) used the VAR model to examine the impact of monetary policy shocks on output and employment in Turkey. The study found that shocks in the broad money supply affect employment and output through the stock of credit (Karim and Lee, 2011). Ganley and Salmon (1997) and Hayo and Uhlenbrock (2000) investigated the industry effect and found that the cross-industry distribution of policy effects is similar across countries and that these patterns are systematically related to measures of output durability and industry investment intensity, as well as borrowing capacity, size, and interest burden. In the latter model, more firms find it more difficult to increase their short-term productive capacity when the economy is growing. As a result, inflation becomes more vulnerable to changes in aggregate demand when capacity utilization is higher. Chuku examined the impact of monetary policy shocks in Nigeria using the SVAR technique. Cloyne and Hürtgen (2016) investigate the *''impact of monetary policy shocks on macroeconomic variables in the United Kingdom, while* Champagne and Sekkel (2018) *discover comparable findings in Canada''*(Murgia, 2020).

According to the results, broad monetary shocks had little impact on output and prices at a fast adjustment rate. Monetary policy and real exchange rate shocks, on the other hand, had a neutral and short-run impact on output. It was concluded that the broad money supply is the strongest monetary policy instrument in Nigeria. Olorunfemi and Dotun (2008) used simple regression to investigate the effect of monetary policy on Nigeria's economic performance. The study discovered a negative relationship between interest rates and GDP on the one hand and inflation and GDP on the other. The study did not break down the impact of monetary policy on other sectors of the economy, such as the industrial sector.

Using a vector error correction model and an impulse response function, Peter and Okotori (2022) examined the impact of monetary policy innovations on exchange rate volatility in Nigeria. The results show that in the long run, all monetary policy variables show a significant correlation with exchange rate volatility; however, while money supply and the exchange rate appear to have a significant short-run impact on exchange rate volatility, other variables such as the liquidity ratio or the monetary policy interest rate did not show a significant short-run relationship with exchange rate volatility. Further results on the impulse response function to volatility and on the variance decomposition of the prediction error suggest a significant relationship between the volatility of the exchange rate and the volatility of the money supply, but the correlation was much stronger (Peter and Okotori, 2022).

CSÁPAI (2020) develops a structural vector autoregressive model of the Hungarian economy and shows the responses of selected macroeconomic variables to an exogenous monetary policy shock. As a result of a one-standard deviation monetary policy shock, interest rates rise and the exchange rate appreciates. Industrial production, on the other hand, rises one month before the predicted decline. Although the price problem exists, the effects of the shocks are statistically small. We also show the variance decompositions of the forecast errors and test the robustness of our results by modifying the identification technique (CSÁPAI, 2020)

Da Afghanistan Bank has responsibility for implementing monetary policy. The responsibility is stated explicitly in the Da Afghanistan Bank Law of 2003. According to Article 62 of the Da Afghanistan Bank Law: *"Da Afghanistan Bank shall be responsible for the formulation, adoption, and execution of the monetary policy of Afghanistan.* Monetary policy refers to the policy of Da Afghanistan Bank (DAB), the central bank of Afghanistan, with respect to the use of monetary policy instruments under its authority to achieve the objectives stated in the law. Monetary policy in Afghanistan means that Da Afghanistan Bank uses instruments to influence the money supply in the economy with the aim of maintaining general prices and the stability of the financial system low and steady inflation fosters long-term growth and job creation. It eliminates uncertainty about future pricing of products and services, allowing people and companies to make more confident economic decisions including consuming, saving, and investing''. In turn, this supports longer-term growth and job creation, incorporating to the country's overall prosperity. How does monetary policy work? Fluctuations in the money supply signal DAB's monetary policy position to the market. Money supply changes have an impact on economic demand (DAB, 2023).

To preserve its primary goal of stability of domestic price, Afghanistan's central bank has devised a structure known as the Monetary Aggregate Targeting framework. Managing and controlling liquidity is critical in the economy; hence, variations in liquidity rates have a direct impact on the country's total economic activity. The DAB's aims are defined in Article 2 of the Preamble to the Da Afghanistan Bank Law: Da Afghanistan Bank's major goal is to achieve while preserving domestic price stability. Afghanistan Bank's supplementary objectives are to enhance the liquidity, solvency, and effective operation of a secure and stable market-based financial system, as well as to promote a safe, sound, and efficient national payments system. Regardless of its primary goals, Afghanistan Bank will assist the state's overall economic policies and promote long-term economic success. DAB seeks monetary stability by concentrating on the monetary aggregate - the reserve currency. Simultaneously, DAB strives to promote financial stability, including the efficient operation of Afghanistan's banking industry and financial system (DAB LAW, 2010). Since 1389, DAB has utilized the monetary reserve (MR) as the primary liquidity indicator within its monetary policy framework, with the precise amount expected based on the anticipated growth rate, average annual inflation rate, and changes in aggregate demand for Afghani over the year. DAB primarily employs open market operations (OMOs) to control liquidity in the money market to meet its operating goal. DAB conducts twice-weekly foreign exchange auctions to sell foreign exchange to approved money service providers (MSPs) and once-weekly auctions of capital notes (CNs) to sell CNs to commercial banks, often with a commitment to repurchase them on the maturity date of the transaction. In the event of a liquidity crisis, DAB injects Afghani into the system through OMOs (DAB, 2023). The Afghani industrial sector is based on small-scale production of textiles, woven carpets, and fertilizers. This sector employs about 10% of the country's labor force. The industrial sector generates 26% of the country's total GDP. Value-added processing of minerals and agricultural goods employs a significant portion of the Afghan population. Dried fruits, wood, leather, natural gas, coal, copper, cement, semi-precious stones, soap, furniture, footwear, granite, and marble are among the other products that contribute significantly to the country's industrial sector.

To alleviate unemployment, Afghanistan is trying to build a low-cost, labor-intensive manufacturing industry along the lines of India and China. There has been no such study on this subject in Afghanistan. Consequently, this is the first time such a study has been conducted (MOCI, 2023).

3. DATA AND METHODOLOGY

3.1. Data Collection

The study design was basically qualitative in nature. A set of quarterly time series data covering the period from 2003 to 2021 was used for the empirical analysis. The data were obtained from different official sources such as the World Development Indicators (WDI), the International Monetary Fund (IMF), the Central Statistics Office (CSO) of Afghanistan, the Ministry of Economy of Afghanistan, the Ministry of Commerce and Industry (MOIC) of Afghanistan, Da Afghanistan Bank (DAB), and the Statistical Bulletin of the Central Bank of Afghanistan. To achieve the research objective, the following variables were used: the industrial index (proxied by manufacturing output) as the dependent variable and the exchange rate, inflation, interest rate (monetary policy rate), broad money supply, and credit to the industrial sector as independent variables.

3.2. Econometrics Models

This study examines the short-run and long-run effects of monetary policy shocks on industrial output in Afghanistan using a restricted VAR (VECM) model. The Granger causality test is also used to test the causal relationship between the selected variables. The general functional model for the study is specified as follows:

$$COMS = f(MPR, M2, INF, EXC, BLTS) \quad (1)$$

Variables that are used in the model above are listed as follows:
COMS = Contribution of Manufacturing Sector to GDP.
MPR = Monetary Policy Rate or Interest Rate.
M_2 = Broad Money Supply.
INF = Inflation.
EXC = Exchange Rate.
BLTS = Bank Loan to Industrial Sector.

Since the values for the majority of the explanatory variables in the model had a large magnitude, to overcome this problem, all variables except the monetary policy rate/interest rate and inflation were converted to logarithmic form before being included in the model. This study used a three-stage procedure. The first stage tested the stability of the variables to be included in the model. This required a preliminary test for stationarity because of spurious regression, high R2, and low Durbin-Watson statistics when using nonstationary data. The Augmented-Dickey Fuller (ADF) test is used to test for unit roots. The Johansen cointegration test is used to examine cointegration between variables.

The second step involves selecting the optimal lag length among the variables in the system using various lag length criteria such as the Akaike information criterion (AIC), the Schwarz information criterion (SC), the final prediction error (FPE), and

the Hannan-Quinn (HQ) information criterion before performing the Johansen long-run cointegration test using the maximum eigenvalue and trace statistics to determine the number of cointegration vectors in the model. Finally, the Vector Error Correction (VECM) Model was employed to determine if there were any short-run correlations or dynamics between the variables, as shown in Equation 2:

$$\Delta lnCOMS_i = \alpha_0 + \beta_1 lnCOMS_{t-1} + \sum_{i=1}^{p}\beta_2 \Delta MPR_{t-i} + \sum_{i=1}^{p}\beta_3 \Delta lnM2_t + \sum_{i=1}^{p}\beta_4 \Delta INF_{t-i} + \sum_{i=1}^{p}\beta_5 \Delta lnEXR_{t-i} + \sum_{i=1}^{p}\beta_6 \Delta lnBLTS_{t-i} + \alpha ECM_{t-1} + \varepsilon_t \quad (2)$$

In equation 2 Δ is the first difference, α_0, β_1, β_2, β_3, β_4, β_5, β_6 are the coefficients to be estimated . The ECM mechanism tells us how much the variance is corrected in the long term. The Granger Causality test is also used to investigate the existence of causal relationships among the variables involved. The study also conducted some post-testing to confirm the validity and robustness of the regression model. The tests that were performed include the Breusch-Godfrey serial correlation LM test, the Breusch-Pegan-Godfrey heteroskedasticity test, and the Jarque-Bera normality test.

4. EMPIRICAL RESULTS

4.1. Unit Root Tests

A unit root test in statistics examines if a time series variable is non-stationary and has a unit root. Depending on the test, the null hypothesis is commonly defined as the presence of a unit root, and the alternative hypothesis is either stationarity, trend stationarity, or explosive root.

4.1.1. Augmented DICKEY-Fuller Test

An augmented Dickey-Fuller (ADF) test the ''null hypothesis that a time series sample has a unit root''. The alternative hypothesis varies based on the version of the test employed, although it is frequently stationarity or trend stationarity. This is an upgraded version of the Dickey-Fuller test for a larger and more complicated set of time series models. The augmented Dickey-Fuller (ADF) statistic employed in this test is a negative value. The more negative it is, the more confidently the theory of a unit root is rejected. To avoid false regression, the study employed time series data and needed a preliminary stationarity test for all variables used in the model. In this study, the ADF unit root test was performed, and the results are shown in Table 1. The results of the ADF test show that all variables are nonstationary at their levels, but stationary at their first differences, since they are integrated with order one, I(1).

Table 1: Augmented Dickey-Fuller (ADF) Unit Root Test

	At Levels			At First Difference		
Variable	**Intercept**	**Trends & Constan**	**None**	**Intercept**	**Trends &Constan**	**None**
lnCOMS	-0.30	-2.45	-0.51	-7.47***	-7. 37***	-6.23***
MRP	-0.33	-4.69	-3.23	-8.87**	-8.62***	-8.17*
LnM_2	-0.26	-3.39	-2.12	-3,63***	-5.43***	-4.31**
INF	-0.96	-3,28	-0.71	-4.95***	-6.75***	-6.41**
lnExc	-0.46	-2.81	-1.23	-9.76**	-9.61**	-8.74***
lnBLTS	-0.97	-1.87	-0.60	-6.72*	-1.06**	-4.56***

Note: ***/**/* indicates that the null hypothesis (H_0) is rejected at 1%, 5%, and 10% significant level.

4.1.2. Lag Order Seclectıon Crıterıa

This is the second stage, where we select the optimal length among the variables of the model. For this purpose, we used different lag length criteria such as the likelihood ratio (LR), the Akaike information criterion (AIC), the Schwarz information criterion (SC), the final prediction error (FPE), and the Hannan-Quinn information criterion (HQ).

Table: 2 Lag Length Selection

LAG	LL	LR	FPE	AIC	SC	HQ
1	-1743.993	23.89251	6.2e-62	91.0764	91.5532	91.5545
2	-1423.838	2647.656*	1.2e+15	78.3162	77.8744	77.6432
3	- 1164.544	3210.921	3.4e+35	78.2531	78.1421*	76.0231*
4	- 1198.273	64.52602	4.6e+62	58.4761	59.2603	57.1025
5	-1196.8 77	38.31659	7.2e+94	58.2571	55.3375	52.1264
6	-1546.567	61.52013	4.6e+62*	54.4417*	62.9738	54.6301

Note: * Represents lag order selection by criterion.

İn Table 2, the results of the Schwarz information criterion and the Hannan-Quinn information criterion show a lag order length of three (3), while the Akaike information criterion and the Final prediction error show a lag order length of six (6) for the selected model. Thus, the model for which we selected the optimal lag length using the AIC was six (6).

4.2. Co-Integration Test

The Johansen cointegration test was used to determine whether or not there is a long-trun relationship between the variables in the industrial output models. The reason for this test lies in the result of the unit root test presented in Table 1; all variables in the model are integrated into order one, which influences the choice of a Johansen cointegration test.

Table 3: Long Run Johansen Co-Integration Test

Null Hypothesis(H_0)	Alternative Hypothesis (H_1)	Eigenvalue	Trace Statistic	Critical Value (5%=0.05)	Decision Criteria
r=0	r>0		58.5905	47.21	Reject the H_0
r≤1	r>1	0.78286	26.5194*	29.68	Fail to reject the H_0
r≤2	r>2	0.55617	9.4606	15.41	Fail to reject the H_0
r≤3	r>3	0.28783	2.3325	3.76	Fail to reject the H_0
r≤4	r>4	0.10512	4.4562	5.56	Fail to reject the H_0
r≤5	r>5	0.62717	10.891	12.53	Fail to reject the H_0
r≤6	r>6	0.02574			

Null Hypothesis(H_0)	Alternative Hypothesis (H_1)	Eigenvalue	Max Statistic	Critical Value (5%=0.05)	Decision Criteria
r=0	r=1		48.3252	21.52	Reject the H_0
r=1	r=2	0.78286	26.8068	35.09	Fail to reject the H_0
r=2	r=3	0.55617	17.9175	18.17	Fail to reject the H_0
r=3	r=4	0.28783	33.1734	23.06	Fail to reject the H_0
r=4	r=5	0.10512	13.1631	9.93	Fail to reject the H_0
r=5	r=6	0.62717	8.6921	10.76	Fail to reject the H_0
r=6	r=7	0.02574			

H_0: There is the existence of cointegration.
H_1: There is no cointegration.

The results of the Johansen cointegration test, as presented in Table 3, show that the independent variables correlate in the long run with the dependent variable based on the fulfillment of the decision criteria. The trace test criterion confirmed the presence of one cointegrating equation (r≤ 1) in the model (P < 0.05%), but the Maximum Eigen value criterion showed the presence of at most one cointegrating equation (P < 0.05%).

In other words: If the trace statistic is greater than the critical value, we can reject H0. If the trace statistic is less than the critical value, H0 cannot be rejected. in our model above, r=0 (no cointegration). İn this case, the trace statistic=58.59 > critical value=47.21. so we can reject H0. İn r=1, the statistical value=26.51 < critical value=29.68. so we cannot reject the H0, but accept it. Consequently, there is one cointegration equation or cointegration. All variables included in the system are cointegrated and have a long-run relationship. When we consider the maximum Eigen value criterion, the same procedure is used. İn r=1, We concluded that all variables are cointegrated and have a long-run relationship. After determining that the long-run relationships exist the study then used the VECM model to capture both the long run and the short run dynamics in the model.

4.2.1. Vector Error Correction Model (VECM)

The vector error correction model (VECM) was estimated after the estimated model showed a long-term relationship; the results are shown in Table 4.

Table 4: Vector Error Correction Model (VECM) Results

Dependent variable: D(lnCOMS)				
Variable	**Coefficient**	**Std. Error**	**t- Statistic**	**Prob.**
ECT(-1)	-0.355155	0.049225	-7.21	0.000
D(lnCOMS(-1))	3.983385	2.288905	1.74	0.082
D(lnCOMS(-2))	2.388587	1.12345	2.13	0.033
D(lnCOMS(-3))	1.116806	0.590561	1.89	0.059

D(lnCOMS(-4))	2.132295	14.38407	0.15	0.882
D(lnCOMS(-5))	4.542783	13.51992	0.34	0.737
D(lnCOMS(-6))	0.0648622	0.0342672	-1.89	0.058
D(MRP(-1))	-0.0512232	0.0046698	-10.97	0.000
D(MRP(-2))	-0.0501563	0.0232211	-2.16	0.031
D(MRP(-3))	-0.2419482	0.0351325	-6.89	0.000
D(MRP(-4))	-0.1465539	0.0693167	-2.11	0.034
D(MRP(-5))	-0.7226421	0.0683759	-10.57	0.000
D(MRP(-6))	-0.0181945	0.0135896	-1.34	0.181
D(lnM_2(-1))	0.4754941	0.0926375	5.13	0.000
D(lnM_2(-2))	0.2319361	0.0464852	4.99	0.000
D(lnM_2(-3))	0.0604867	0.0101573	5.95	0.000
D(lnM_2(-4))	0.062569	0.0797558	0.78	0.433
D(lnM_2(-5))	2.018727	1.582177	1.28	0.202
D(lnM_2(-6))	1.498127	0.7939309	1.89	0.059
D(INF(-1))	0.111421	0.0090884	12.26	0.000
D(INF(-2))	3.123321	0.1802938	17.32	0.000
D(INF(-3))	0.7754851	0.0904708	8.57	0.000
D(INF(-4))	-0.1795064	0.1734789	-1.03	0.301
D(INF(-5))	0.2302592	0.396598	0.58	0.562
D(INF(-6))	1.082274	0.6000362	1.80	0.071
D(lnExc(-1))	0.2740417	0.0451935	6.06	0.000
D(lnExc(-2))	0.095573	0.0197684	4.83	0.000
D(lnExc(-3))	0.080683	0.8279521	0.10	0.922
D(lnExc(-4))	-0.0379117	0.3202604	-0.12	0.906
D(lnExc(-5))	0.1030018	0.2674115	0.39	0.700
D(lnExc(-6))	-0.7226421	0.0683759	-10.57	0.000
D(lnBLTS(-1))	0.4349998	0.0264485	16.45	0.000
D(lnBLTS(-2))	0.6116555	0.0077047	79.39	0.000
D(lnBLTS(-3))	0.1488298	0.0588255	2.53	0.011
D(lnBLTS(-4))	4.966156	1.633555	3.04	0.002
D(lnBLTS(-5))	0.8500856	0.1349062	6.30	0.000
D(lnBLTS(-6))	0.0728073	.0252998	2.88	0.004
C	15.30515	7.503034	2.04	0.041
F-statistic				67.055
Prob(F-statistic)				0.0000
R-squared				0.9137

R^2 From the model estimated above, it can be concluded that there is a strong relationship between the dependent and independent variables. The R-squared value measures the proportion of variance in the dependent variable that is explained by the independent variables. In this case, the R-squared value of about 91% means that about 91% of the changes in the dependent variable are caused by changes in the independent variables. Thus, the overall model explains 91% of the variance in the response variable, which is very good and quite efficient in practice. Moreover, a Prob(F-statistic) of 0.000 indicates that the F-statistic is significant at the one percent level and that the overall model is statistically significant.

The results of the long-run vector error correction model (VECM) are shown in Table 4. The result shows that there is a long-run causality running from the independent variables (MRP, M2, INF,Exc, and BLTS) to the dependent variable (COMS). This is evidenced by the negative coefficient of ECM (-1), which is also statistically significant at the 1% level. This implies there is a speed of adjustment of 35.51%from the short-run to long-run equilibrium. However, to determine if there is a short-term causality from the independent variables to the dependent variable, a Wald test was performed for each of the independent variables. The results of the Wald test are reported in Tables 5, 6 ,7, 8, and 9 respectively and indicates that short-term causality is running from MPR, M2, INF, Exc, and BLTS to COMS.

Table 5: Wald Test for C(8) = C(9) = C(10) = C(11) = C(12) = C(13) = 0

Test Statistic	Value	df	Probability
F-statistic	4.247734	(6,13)	0.0449
Chi-square	4.257309	6	0.0339

Table 6: Wald Test for C(14) = C(15) = C(16) = C(17) = C(18) = C(19) = 0

Test Statistic	Value	df	Probability
F-statistic	89.01805	(6,13)	0.000
Chi-square	178.0361	6	0.000

Table 7: Wald Test for C(20) = C(21) = C(22) = C(23) = C(24) = C(25) = 0

Test Statistic	Value	df	Probability
F-statistic	12.90714	(6,13)	0.000
Chi-square	2581428	6	0.000

Table 8: Wald Test for C(26) = C(27) = C(28) = C(29) = C(30) = C(31) = 0

Test Statistic	Value	df	Probability
F-statistic	25.20496	(6,13)	0.000
Chi-square	5.020454	6	0.000

Table 9: Wald Test for C(23) = C(33) = C(34) = C(35) = C(36) = C(37) = 0

Test Statistic	Value	df	Probability
F-statistic	507.4462	(6,13)	0.000
Chi-square	1522.339	6	0.000

4.3. Diagnostic Tests

The estimated VECM result was subjected to some diagnostic tests, such as the Breusch-Godfrey serial correlation LM test, the Breusch-Pagan-Godfrey heteroskedasticity test, and the Jarque-Bera normality test, as shown in Tables 10, 11, and 12. The results of the first two tests show that the estimated model is free of serial correlation and heteroskedasticity, as the probability of chi-square for both tests are greater than 5% singnificance level, and we therefore do not rejct the null hypothesis. Consequently, the model estimates are statistically reliable. Moreover, the results indicate that the residuals of the model are normally distributed, as the Jarque-Bera test has a p-value of 0.517%, so we could not reject the null hypothesis of normal distribution.

Table 10: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.035268	**Prob. F(2,89)**	0.9654
Obs*R-squared	0.079192	**Prob. Chi-Square(2)**	0.9612

Table 11: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.438587	**Prob. F(2,95)**	0.7804
Obs*R-squared	1.813199	**Prob. Chi-Square(4)**	0.7701
Scaled explained SS	6.666435	**Prob. Chi-Square(4)**	0.1546

Table 12: Jarque-Bera Test

Test	Chi-Squared	Prob
Jarque-Bera normality test	1.318	0.517

4.4. Pairwise Granger Causality Test

Granger causality is a method for studying causality between two variables in a time series. The method is a probabilistic representation of causality; it uses empirical data sets to find correlation patterns. The results of the Piarwise-Granger causality test are shown in Table 13.

Table 13: Pairwise Granger Causality Test

Null Hypothesis	Obs	F-Statistic	Prob	Decision Criteria (5%)
MPR does not Granger Cause COMS	67	2.98877	0.0183	Reject H_0
COMS does not Granger Cause MPR		0.49995	0.7750	Fail to Reject H_0
M2 does not Granger Cause COMS	67	0.39148	0.030	Reject H_0
COMS does not Granger Cause M2		1.28993	0,2810	Fail to Reject H_0
INF does not Granger Cause COMS	67	3.12202	0.0106	Reject H_0
COMS does not Granger Cause INF		1.88946	0.0994	Fail to Reject H_0
EXC does not Granger Cause COMS	67	4.08607	0.0031	Reject H_0

COMS does not Granger Cause EXC		1.18347	0.3287	Fail to Reject H_0
BLTS does not Granger Cause COMS	67	1.18629	0.3275	Fail to Reject H_0
COMS does not Granger Cause BLTS		2.59745	0.0348	Reject H_0
M2 does not Granger Cause MPR	67	3.69856	0.0162	Reject H_0
MPR does not Granger Cause M2		3.15847	0.0307	Reject H_0
INF does not Granger Cause MPR	67	0.87991	0.5159	Fail to Reject H_0
MPR does not Granger Cause INF		3.07727	0.0338	Reject H_0
EXC does not Granger Cause MPR	67	2.38977	0.0404	Reject H_0
MPR does not Granger Cause EXC		1.27300	0.2852	Fail to Reject H_0
BLTS does not Granger Cause MPR	67	2.80799	0.0467	Reject H_0
MPR does not Granger Cause BLTS		2.68696	0.0235	Reject H_0
INF does not Granger Cause M2	67	3.09958	0.0152	Reject H_0
M2 does not Granger Cause INF		3.06382	0.0344	Reject H_0
EXC does not Granger Cause M2	67	5.53424	0.0002	Reject H_0
M2 does not Granger Cause EXC		2.74093	0.0275	Reject H_0
BLTS does not Granger Cause M2	67	3.50027	0.0054	Reject H_0
M2 does not Granger Cause BLTS		1.38470	0.2376	Fail to Reject H_0
EXC does not Granger Cause INF	67	5.15208	0.0003	Reject H_0
INF does not Granger Cause EXC		5.89085	0.0002	Reject H_0
BLTS does not Granger Cause INF	67	4.15110	0.0028	Reject H_0
BLTS does not Granger Cause INF		2.52514	0.0392	Reject H_0
BLTS does not Granger Cause EXC	67	2.58863	0.0607	Fail to Reject H_0
EXC does not Granger Cause BLTS		4.65237	0.0012	Reject H_0

5. DISCUSSION

The policy pursued by a country's central bank to control and manipulate the supply of money and credit is called monetary policy. The objectives of monetary policy vary from country to country and depend on economic conditions. The basic objectives of monetary policy are to promote a high level of employment, steady economic growth, a stable price level as a goal, interest rate stability, and a more stable financial market. Edoumiekumo and Karimo (2013) used the VAR model to examine the response of Nigerian real sector output to monetary policy shocks. The study found that credit and private-sector investment had a larger impact on output. In the long run, real GDP was more responsive to monetary policy shocks (MPR) and CPI, as well as to own innovations. In addition, the study found that while the interest rate or MPR had a direct and immediate impact on the real sector, it did so indirectly through the investment and credit channels.

Chuku (2009) examined the impact of monetary policy innovations in Nigeria. The study used structural vector autoregression (SVAR) to track the impact of monetary policy shocks on Nigerian output and prices from 1986 to 2008. Monetary policy appears to have a large impact on output at times, but little or no impact at other times. With respect to the Nigerian economy, a study was conducted by Saibu and Oladeji (2007) to examine the impact of asymmetric monetary policy shocks on fluctuations in real output using the modified GARCH. The study was based on the use of various measures of output such as GDP, and output in agriculture, industry, and service sectors.

According to Busari et al. (2002), monetary policy stabilizes the economy better in a flexible exchange rate regime than in a fixed exchange rate regime, and it stimulates growth better in a flexible exchange rate regime, but is accompanied by a large depreciation that could destabilize the economy, implying that monetary policy stabilizes the economy better when it directly targets inflation rather than directly stimulating growth. Alam and Waheed (2006) used the VAR approach to evaluate the sectoral impact of monetary policy in Pakistan. The results of the study show that different sectors respond differently to monetary policy tightening. In particular, it was observed that the performance of the financial and insurance sectors, retail and wholesale trade, and manufacturing deteriorated as a result of the interest rate shocks. In contrast, the mining and quarrying, and agricultural sectors showed little response to interest rate changes.

Kim (1999) examined the effects of postwar monetary policy shocks in the G-7 countries using the VAR approach. The study found that changes in output were correlated with monetary policy shocks in the short run, but only in an insignificant way. As a result, output fluctuations in the G-7 countries were not found to be significantly affected by monetary policy shocks in the postwar period. According to Olivei and Tenreyro (2007), in the United States of America, a monetary policy shock has a larger impact on output than on prices in the first half of the year, while the opposite is true in the second half. Cambazolu and Karaalp (20 12) used the VAR model to examine the impact of monetary policy shocks on output and employment in Turkey. The study found that shocks in the broad money supply affect employment and output through the stock of credit.

The Central Bank of Afghanistan (Da Afghanistan Bank) has established a framework known as Monetary Aggregate Targeting in order to preserve the primary goal of domestic price stability. Because liquidity management is crucial to the economy,

fluctuations in liquidity rates have a direct influence on the country's macroeconomic activities. The DAB's aims are defined in Article 2 of the Preamble to the Da Afghanistan Bank Law: ''The primary goal of Da Afghanistan Bank is to maintain domestic price stability''. Da Afghanistan Bank's additional objectives are to promote the liquidity, solvency, and effective functioning of a stable, market-based financial system and to promote a safe, sound, and efficient national payments system subordinate to this core objective. Da Afghanistan Bank will assist the overall economic policies of the state while achieving long-term economic success, without regard for its primary aims. DAB seeks monetary stability by concentrating on the monetary aggregate - the monetary reserve. Simultaneously, DAB aspires to guarantee financial stability, including the smooth operation of Afghanistan's banking industry and financial system (DAB LAW, 2010). Afghanistan's industrial sector thrives on the small-scale production of textiles, woven carpets, and fertilizers. About 10 % of the country's population is employed in this sector. The industrial sector contributes 26% of the country's GDP revenue. A significant portion of the Afghan population relies on the value-added processing of minerals and agricultural products. Some other products that contribute significantly to the country's manufacturing sector are dried fruits, timber, leather, natural gas, coal, copper, cement, semi-precious minerals, soap, furniture, shoes, granite, and marble. Afghanistan is seeking to build a low-cost, labor-intensive manufacturing sector along the lines of India and China to reduce unemployment. There is no such research on this issue in Afghanistan. So this is the first time such a study has been conducted (MOCI, 2023).

6. CONCLUDING REMARKS

The main objective of this study was to investigate the impact of monetary policy shocks on industrial output in Afghanistan. To achieve this objective, the study used a three-stage procedure. The first stage tested the stability of the variables to be included in the model. This required a preliminary test for stationarity, because spurious regression, high R^2, and low Durbin-Watson statistics can occur when using non-stationary data. The Augmented-Dickey Fuller (ADF) test is used to test for unit roots. The Johansen cointegration test is used to test for cointegration between variables.

The second step involves selecting the optimal lag length among the variables in the system using various lag length criteria such as the Akaike information criterion (AIC), the Schwarz information criterion (SC), the final prediction error (FPE), and the Hannan-Quinn (HQ) information criterion before performing the Johansen long-run cointegration test using the maximum eigenvalue and trace statistics to determine the number of cointegration vectors in the model. Finally, the Vector Error Correction (VECM) model was used to determine if there are any short-run correlations or dynamics among the variables. In addition, the Granger causality test is used to investigate the existence of causal relationships between the variables involved. In the study, some post-tests were also performed to confirm the validity and robustness of the regression model. The tests performed include the Breusch-Godfrey serial correlation LM test, the Breusch-Pegan-Godfrey heteroskedasticity test, and the Jarque-Bera test for normality. A set of quarterly time series data covering the period from 2003 to 2021 was used for the empirical analysis.

The data were obtained from various official sources such as the World Development Indicators (WDI), the International Monetary Fund (IMF), the Central Statistics Office (CSO) of Afghanistan, the Ministry of Economy of Afghanistan, the Ministry of Commerce and Industry (MOIC) of Afghanistan, Da Afghanistan Bank (DAB), and the Statistical Bulletin of the Central Bank of Afghanistan. The empirical results of the long-run vector error correction model (VECM) show that there is a long-run causality running from the independent variables (MRP, M2, INF, Exc, and BLTS) to the dependent variable (COMS). This is evidenced by the negative coefficient of ECM (-1), which is also statistically significant at the 1% level. This implies there is a speed of adjustment of 35.51%from the short-run to long-run equilibrium. However, to determine if there is a short-term causality from the independent variables to the dependent variable, a Wald test was performed for each of the independent variables. The result in the appendix indicates that short-term causality is running from MPR, M2, INF, Exc, and BLTS to COMS.

The results of the study also showed that the monetary policy rate (MPR) or interest rate, broad money supply (M_2), inflation (INF), the exchange rate (EXC), and commercial bank loans to the industrial sector (BLTS) caused significant changes in industrial output (COMS). MPR has a negative and significant impact on industrial production in five lag periods. The coefficients of M2 and inflation have a significant and positive impact on COMS in three lag periods. EXC has a positive and significant impact on COMS in two lag periods, but a negative impact on COMS in six lag periods. Commercial bank loans to the industrial sector (BLTS) were found to exert a change on COMS in all six lag periods. These results were further supported by the Granger Causality test, which showed the existence of causality running from MPR, M2, INF, EXC, and BLTS to the contribution of the Manufacturing Sector to GDP (COMS).

Conversely, shocks in commercial bank lending to the industrial sector were found to have no significant impact on the manufacturing sector's contribution to GDP. The Granger causality test also revealed that the performance of the manufacturing sector was the main cause of the flow of commercial bank loans to the industrial sector. Consequently, there was a one-way causal relationship between COMS and BLTS. In addition, the Granger causality test showed that there were bidirectional causal relationships between M2 and MPR, BLTS and MPR, INF and M2, EXC and M2, EXC and INF, and BLTS and INF. The results of this study are significant. For example, they make it clear that monetary policy and exchange rates are the

most effective tools to promote the improvement of manufacturing performance. Any change in exchange rates, such as the devaluation of the AFG, will therefore have a serious impact on the sector.

Based on the results, the study recommends that extreme caution be exercised in managing the exchange rate, which can help the industrial sector overall. In addition, it was found that improvements in the performance of the manufacturing sector are necessary to attract credit from commercial banks to this sector. This is not surprising given the unwillingness of commercial banks in Afghanistan to lend to the manufacturing sector at low-interest rates. This is a widespread problem faced by all large, medium, and small enterprises. The study also recommends that the Afghan government or especially the Central Bank of Afghanistan should reduce interest rates and encourage commercial banks to offer loans to the industrial sector at low interest rates.

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DOES PUBLIC DEBT IMPEDE FINANCIAL DEVELOPMENT IN JORDAN? SOME MACRO AND MICRO ANALYSES

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ABSTRACT

Purpose- It is acknowledged that banks offer their respective economies a number of services, including the encouragement of savings and allocation of capital to the private and public sectors. Within this context, and given that public debt in Jordan has been increasing at an alarming rate, this paper sets out to answer two questions: First, what is the impact of local public debt on aggregate credit to the private sector? Second, what is the impact of local public debt on bank-level credit to the private sector?
Methodology- To provide an answer to the first question, the paper uses annual data (1982 – 2021) on aggregate bank credit to the private sector, aggregate bank credit to the government, and the discount rate. The applied techniques include stationarity test, optimal lag structure, co-integration, and vector error-correction (VECM) estimation. To answer the second question, the paper uses annual bank level data (2010 – 2021) for all 13 listed Jordanian banks. The fact that this data includes both time series and cross-section elements, panel data analysis is used to measure the impact of bank-level credit to the government on bank-level credit to the private sector.
Findings- At the macro level, the results show that bank credit to the government (bank holdings of government securities) has a significant and negative impact of bank credit to the private sector. At the micro level, the results also show that bank-level lending to the government does affect (negatively) their credit to the private sector.
Conclusion- The results of this paper are not encouraging. Indeed, they indicate that public debt impedes credit to the private sector. The government should look at the status of its public finance and work on reducing its borrowing. In addition, the government should look at the viability of establishing a secondary market for its issued securities.

Keywords: Jordan, public debt, bank credit, diversification, time-series analysis, co-integration.
JEL Codes: E50, E51, E52

1. INTRODUCTION

On 12 July 2023, The United Nations Secretary-General (António Guterres) presented the report "A World of Debt: A Growing Burden to Global Prosperity". In this Report, the Secretary-General issued a "grave warning as global public debt reached an all-time high of $92 trillion in 2022".

From this Report, it is worth noting the following few quotations. First, "global public debt has increased more than fivefold since the year 2000, clearly outpacing global GDP, which tripled over the same time". Second, "the number of countries facing high levels of debt has increased sharply from only 22 countries in 2011 to 59 countries in 2022". Third, "3.3 billion people live in countries that spend more on interest than health or education".

Relative to the UN's 2023 Report, one can also argue that the state of public finance in Jordan is also alarming. Indeed, public debt to GDP ratio has increased from 67.1 percent in 2010 to 106.4 percent in 2021. Such an increase in public debt, one can argue, might have several implications including its impact (negative) on bank credit to the private sector.

The Author thanks the University of Jordan for his 2022/23 sabbatical year. This paper is part of his effort during this year.

This paper provides answers to two questions:

1. What is the impact of local public debt on aggregate (macro) credit to the private sector?

2. What is the impact of local public debt on bank-level (micro) credit to the private sector?

The rest of the paper has three more sections. In section2, we outline a brief review of the crowding-out literature. In section 3, the data and methodology is outlined. In section 4, the results are presented and discussed. Finally, section 5 summarizes and concludes the paper.

2. THE INTERPLAY BETWEEN PUBLIC DEBT AND PRIVATE SECTOR CREDIT

The concept of the crowding-out effect is probably one of the most hotly debated policy issues in economic theory (Buiter, 1977). Indeed, according to the Classical view, when public spending increases or taxes are reduced, public debt increases, and as a result, interest rates increase, and private credit and investments decrease (Palley, 2013). The Keynesian view, on the other hand, argues for a positive relationship between public spending and private investments. In other words, there is no crowding-out effect. This difference, one must state, is due to how these arguments look at various dynamics including the short term and long term, economy being in full employment or underemployment, and whether or not market prices are flexible or rigid.

The Classical argument rests on the claim that due to flexible prices and wage and interest mechanisms, the economy automatically reaches full employment. When public spending increases or taxes are reduced, public borrowing increases, and as a result, interest rates increase, and private credit and investments decrease. In other words, private investment is crowded out of the market due to fiscal policy (Palley, 2013).

The Keynesian argument rests on the claim that due to rigid prices, wages and interests, the economy does not automatically reach full employment. When public spending increases, aggregate demand increases, and as a result, total production accelerates. The increase in demand accelerates economic growth and total revenues, and as a result, more investments are stimulated. In other words, private investment is not crowded out of the market due to fiscal policy (Balcerzak and Rogalska, 2014).

The contrasting views of the Classical and Keynesian economists notwithstanding, it is also interesting to note that while Monetarists and New Classical economists follow the classical view, New Keynesian and Post Keynesian economists argue that the crowding out effect will occur only in the long term (Snowdon and Vane, 2005).

As one might expect, the different and contrasting views on the crowding-out effect have resulted in the publication of numerous empirical papers. This literature includes papers which use single-country data, and cross-country data. As a result, while some papers apply time series models, others use panel data estimation models. On average, the results of this literature vary according to time period and country. In other words, while some papers report the presence of a crowding-out effect, others do not.

Some of the research papers include Nieh and Ho (2006), Basar and Temurlenk (2007), Furceri and Sousa (2011), Cavallo and Daude (2011), Afonso and Sousa (2012), Gjini and Kukeli (2012), Xu and Yan (2014), Anyanwu, et al. (2017), Akpansung (2018), Lidiema (2018), Manda (2019), Lee and Goh, (2019), and many others. For example, Anyanwu, et al. (2017) examined the impact of local public borrowing on private credit in oil-dependent countries (1990 – 2012). Based on their panel data analysis (fixed effects and dynamic OLS-based models), the results indicate that public debt negatively affects private loans, and hence, there is a crowding-out effect.

Some further papers are published by the International Monetary Fund / IMF (2015 and 2017), Manda (2019), Kabir and Flath (2020), Miyajima (2020), Nguyen and Dang (2020), Zhang et al. (2022), Aghughu et al. (2022), Liu et al. (2023), and Ozili (2023). From these papers, it is worth noting the following observations.

1. In Egypt, "low credit reflects crowding out from public sector borrowing, which pushes interest rates up and reduces incentives to lend to the private sector." (IMF 2015).
2. In Nigeria, "lending to the private sector (in 2016-17) was largely crowded out by government borrowing" (IMF, 2017).
3. In China, "both central government debt and local government debt are negatively related to corporate debt" (Zhang et al. (2022).
4. "Based on data from Chinese prefecture-level cities, this paper empirically examines the impact of local government debt on corporate financing from 2006-2018. The results show that government debt financing reduces total corporate debt financing, increases the cost of corporate debt financing, and has a crowding-out effect on corporate debt financing" Liu et al. (2023).

3. THE DATA, METHODOLOGY AND ESTIMATED RESULTS

As mentioned in section 1, this paper attempts to answer two main questions: First, what is the impact of local public debt on aggregate (macro) credit to the private sector? Second, what is the impact of local public debt on bank-level (micro) credit to the private sector?

To examine the impact of public debt on aggregate credit to the private sector, we estimate the following model:

$$\ln(\text{Credit to Private Sector}_t) = \lambda + \beta_1 \ln(\text{Local Public Debt}_t) + \beta_2 \ln(\text{Discount Rate}_t) + \varepsilon_t \quad (1)$$

where, ε is the error term, and t is the time period (1982 – 2021). All variables are measured in their logarithm forms (ln).

The fact that we have time series data, we first examine the stationarity properties of the three variables (dependent and independent). We then determine the optimal lag structure of the model and test for co-integration using the Johansen-Masulius procedures (maximum eigenvalue / λ_{max} and the trace test / λ_{trace}).

λ_{max} is equal to: $-T \log(1 - \lambda_{r+1})$

The null is r = g co-integrating vectors with (g = 0, 1, 2, 3, …) against the alternative which is r ≤ g + 1.

λ_{trace} is equal to: $-T \sum_{i=r+1}^{k} ln(1 - \lambda_i)$

The null is r = g opposite the general specification r ≤ 1.

If there is co-integration, a vector error-correction (VECM) model is estimated to understand the short run and long run relationships between the variables.

$$\Delta\text{Credit to Private Sector}_t = \alpha + \lambda e_{t-1} + \sum_{i=1}^{n} bi\Delta\text{Local Public Debt}_{t-i} + \sum_{i=1}^{n} bi\Delta\text{Discount Rate}_{t-i} + \varepsilon_t$$

Based on the above model, we can conclude that a long-run relationship (convergence) does exist between the variables if the error correction term (λ) is negative and statistically significant.

In addition to the above-mentioned techniques, we finally test the model for serial correlation and stability in the residual terms. The serial correlation test is done using the Breusch-Godfrey Serial Correlation LM test. The stability in the residual terms is done using the CUSUM test ("cumulative sum of the recursive residuals".

As we stated in the introduction, we also examine the impact of local public debt on bank-level credit to the private sector. In this analysis, we use all Jordanian conventional banks (13) and cover the period 2010-2021. In other word, we estimate two basic models:

$$\Delta\text{Credit}_{i,t} = \beta_1\Delta\text{Deposits}_{i,t-1} + \beta_2\text{Bonds}_{i,t-1} + \beta_3\text{Diversification}_{i,t-1} + \beta_4\text{Equity}_{i,t-1-} + \beta_5\text{Size}_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$\Delta\text{Credit}_{i,t} = \beta_1\Delta\text{Deposits}_{i,t-1} + \beta_2\text{Bonds}_{i,t-1} + \beta_3\text{Diversification}_{i,t-1} + \beta_4\text{Equity}_{i,t-1-} + \beta_5\text{Size}_{i,t-1} + \beta6\text{GDP}_{t-1} + \beta6\text{Inflation}_{t-1} + \varepsilon_{i,t} \quad (3)$$

where, i refers to the 13 banks and t the period 2010-2021.

All seven variables are defined as follows: ΔCredit is the annual change in bank credit to the private sector, ΔDeposits is the annual change in total bank deposits, Bonds are the holdings of each bank of government securities divided by total assets, Diversification is net commission income divided by total income, Equity is equity capital (book value) divided by total assets, Size is the natural logarithm of total assets (proxy measure of size), GDP is the annual growth rate in real GDP, Inflation is the annual inflation rate.

The Period Seemingly Unrelated Regression / pooled EGLS technique is used in the estimation of models 1 and 2. This method accounts for serial correlation and heteroskedasticity (period) between the residual terms. This is necessary because the data contains a large number of years / the time series element (12 years) relative to the cross-section number (13 banks). In such cases, it is more likely than not, regressions would suffer from serial correlation in their residual terms.

4. THE ESTIMATED RESULTS

Before we present and discuss the estimation results (models 1-3), we first outline few observations about public debt in Jordan in recent years.

First, between 1982 and 1990, total public debt increased at an alarming rate (from 55.2 percent to 222.8 percent of GDP). In fact, the Jordanian government defaulted on its foreign debt in 1989, approached the IMF, and devalued the currency (Dinar) by 50 percent. Between 1990 and 2010, public debt decreased consistently. Finally, since 2010, total public debt has been

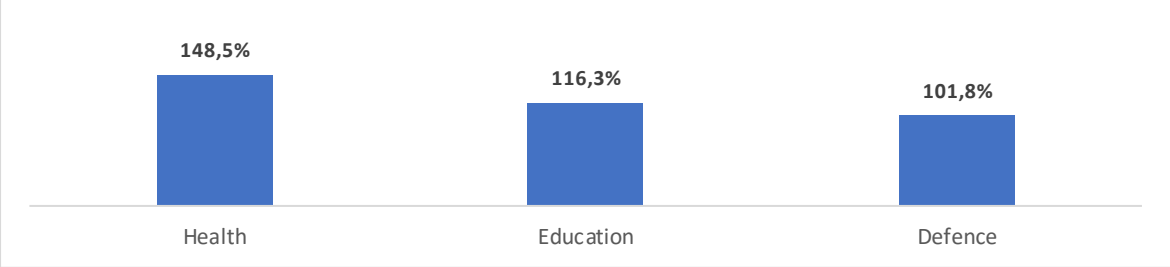
increasing and by the end of 2021, hit 106.2 percent of GDP. It is also relevant to note that the ratio of local public debt to total debt has increased from 19.4 percent in 2000 to 41.4 percent in 2010, and to 62.4 percent in 2021.

Table 1: Total Public Debt to GDP Ratio & its Composition

Year	Total	Local	Foreign
1982	55.2%	16.7%	38.5%
1990	222.8%	37.3%	185.5%
2000	104.7%	19.4%	85.3%
2005	84.3%	26.5%	57.8%
2010	67.1%	41.4%	25.7%
2018	92.9%	52.6%	40.3%
2021	106.2%	62.4%	43.8%
Source: Ministry of Finance Monthly Bulletins.			

Second, the recent increases in public debt are becoming costly. In 2021, for example, interest payments on public debt were more than what was spent on each of health (148.5 percent), education (116.3 percent), and defence (101.8 percent).

Figure 1: Interest Payments to Some Spending Items (2021)



As far as the impact of local public debt on aggregate (macro) credit to the private sector, we report below several observations.

First, the estimation results indicate that all three variables (total credit to private sector, local public debt, and the discount rate) are not stationary in their levels form. Once differenced, however, all three variables become stationary (Table 2).

Table 2: Augmented Dickey-Fuller Unit Root Test

	None	Constant	Constant & Trend	None	Constant	Constant & Trend
Total Credit to Private Sector	-1.419	-2.375	-3.496	-4.315*	-4.932*	-4.836*
Local Public Debt	-1.397	-1.394	-1.328	-2.925*	-3.083**	-3.083**
Discount Rate	0.325	-2.484	-3.126	-4.716*	-4.673*	-4.646*
* and ** imply significance at the 99 and 95 percent levels respectively.						

Second, the optimal lag length for the variables is 1. (Table 3).

Table 3: VAR Lag Order Criteria

Endogenous Variables: Credit to Private Sector, Public Debt, & Discount Rate						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	90.112	NA	3.32e-05	-4.637	-4.551	-4.606
1	103.220	24.145*	2.06e-05*	-5.116*	-4.858*	-5.025*
2	105.423	3.825	2.27e-05	-5.022	-4.591	-4.869
3	108.614	5.207	2.38e-05	-4.979	-4.376	-4.765

Third, the estimation results (trace statistic and maximum eigenvalue) indicate that there are at least two co-integrating relationships (Table 4).

Table 4: Johansen Multivariate Co-Integration Test

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	5 percent CV	P-Value	Eigen Value	Max-Eigen Statistic	5 percent CV	P-Value
Credit to Private Sector, Public Debt, & Discount Rate								
None*	0.496	26.782	14.265	0.001	0.497	26.782	14.264	0.001
At most 1*	0.246	11.008	3.841	0.001	0.260	11.007	3.841	0.001
At most 2	0.027	1.067	3.841	0.302	0.028	1.067	3.841	0.302

Fourth, the results indicate that there is a long-term relationship between credit to the private sector and local public debt and the discount rate. The error correction term is negative (Table 5) and statistically significant (-0.188).

Table 5: Results of the Vector Error Correction Models (VECM)

Variables	ΔIn(Total Credit to Private Sector)
ECT(-1)	-0.188*
D(Total Credit to Private Sector)-1	0.206**
D(Local Public Debt)-1	-0.036
D(Discount Rate)-1	0.103*
C	0.011
* and ** imply significance at the 99 and 95 percent levels.	

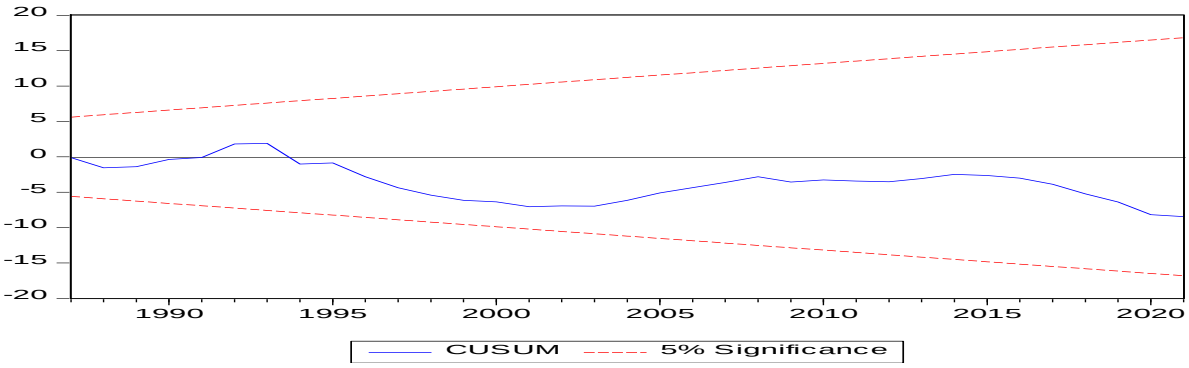
Fifth, in the long run, the impact of local public debt on total bank credit to the private sector is equal to -0.14 and significant. This is an indication of a crowding out effect at the macro level. In the long run, the impact of the discount rate on total bank credit to the private sector is equal to -0.587.

Finally, the model does not suffer from serial correlation (Table 6), and dynamically stable (Figure 2).

Table 6: Breusch-Godfrey Serial Correlation LM Test

Total Credit to Private Sector, Local Public Debt, & Discount Rate			
F-statistic	0.007	Prob. F(1,32)	0.936
Obs*R-squared	0.008	Prob. Chi-Square(1)	0.929

Figure 2: Credit to Private Sector, Public Debt, & Discount Rate



As stated in the first section of this paper, we also examine the impact of local public debt on bank-level (micro) credit to the private sector. In actual fact, and to examine if bank-level data supports the main conclusion about the impact of local public debt on aggregate credit the private sector, we update the data used by Tarawneh et al (2021) to examine the crowding out effect in Jordan. Below, we outline a few observations.

First, bank holding of government securities (treasury bills and government bonds) divided by total assets (bonds) is the most interesting variable. While the overall mean of this measure is equal to 20.9 percent, its maximum value is equal to 36.6 percent. These values reflect that licensed banks in Jordan invest heavily in the issued government financial securities.

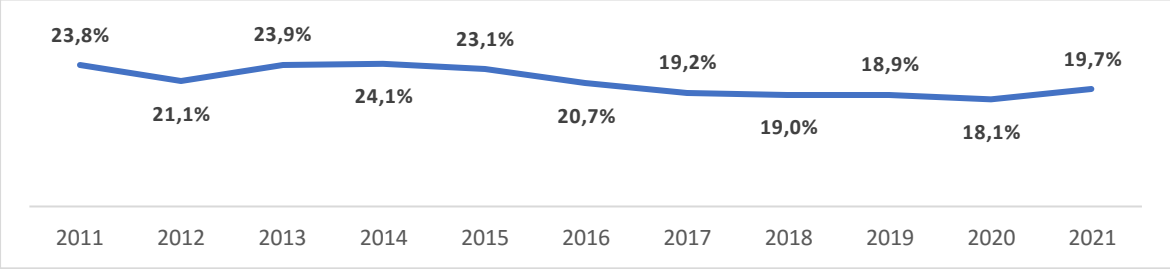
Table 7: Descriptive Statistics of Bank-Level Variables

	Mean	Median	Maximum	Minimum	Std. Deviation
ΔCredit	0.075	0.055	0.559	-0.111	0.108
ΔDeposits	0.063	0.036	0.570	-0.208	0.114
Bonds	0.209	0.203	0.366	0.016	0.073
Diversification	0.138	0.137	0.398	0.047	0.056
Size	21.619	21.511	24.041	19.704	0.911
Equity	0.070	0.071	0.208	0.022	0.031
GDP	0.020	0.022	0.034	-0.019	0.013
Inflation	0.023	0.029	0.048	-0.009	0.021

Within this context, it is informative to note that in Jordan, there is no secondary market for government securities. Whenever the government seeks local debt, it calls on the Jordanian Social Security Corporation and all licensed banks to subscribe to the issued securities and keep them until maturity.

Second, on average, the overall mean of bank holding of government securities divided by total assets reflects a marginal decrease (from 23.8 percent in 2011 to 19.7 percent in 2021).

Figure 3: Bonds to Total Assets



Third, as far as the determinants of bank-level credit to the private sector is concerned, the most interesting observation is the consistently negative and significant impact of bank holding of government securities (bonds) on the dependent variable (annual change in bank credit to the private sector).

Table 8: Determinants of the Change in Bank-Level Credit to Private Sector

	ROA	t-Statistic	NIM	t-Statistic
Variable	**Coefficient**		**Coefficient**	
C	0.223	2.839*	0.187	2.425*
ΔDeposits	0.668	4.913*	0.661	4.132*
Bonds	-0.115	-3.902*	-0.119	-4.824*
Diversification	-0.104	-2.254**	-0.099	-2.609**
Size	-0.007	-2.108**	-0.006	-1.700***
Equity	0.062	0.634	0.145	1.625
GDP	---	---	0.371	4.763*
Inflation	---	---	-0.544	-4.961*
Adj. R^2	0.854		0.863	
D-W Statistic	2.064		2.000	
*, **, and *** imply significance at the 99 percent, 95 percent, and 90 percent levels respectively.				

Fourth, as far as the other factors are concerned, and on average, their impacts on the annual change in bank credit to the private sector are expected. The annual change in bank deposits, real economic growth (GDP), and the inflation rate significantly impact the change in bank credit positively, positively, and negatively respectively. The remaining variables (diversification and size) are significant at the 95 percent level. Equity capital is the only insignificant variable in its impact on the change in bank credit to the private sector.

To sum up, the negative coefficient of bank holding of government securities (-0.115 without GDP and inflation and -0.119 including GDP and inflation), indicates that the micro analysis supports the finding of the macro analysis. In other words, at the macro and micro levels, local public debt crowds out the private sector from the credit market.

5. SUMMARY AND CONCLUSIONS

The state of public finance in Jordan has always been weak and poor. Indeed, and for decades, no government in Jordan has ever realized a surplus in its budget. This is an unfortunate observation for two several reasons.

First, as a result of the rising public debt during the 1980s, the Jordanian government defaulted on its foreign debt back in 1989, approached the IMF, and devalued the local currency (Dinar) by 50 percent in October 1989.

Second, recently, public debt has also been rising. Indeed, total public debt to GDP ratio has increased from 67.1 in 2010 to 106.2 percent in 2021. Indeed, if this recently realized increase in public debt maintains its upward trajectory, it might well reach unsustainable level, and the1989 experience might well be repeated.

Within the context of the unwarranted state of public finance in Jordan, this paper has examined the impact of local public debt on aggregate (macro) credit to the private sector and on bank-level (micro) credit to the private sector.

Based on the results, we can conclude that public debt in Jordan, while might have several other negative implications, negatively impacts bank credit to the private sector at both the macro and micro levels. This is why several recommendations can be highlighted.

First, the government should look at its public finances and ask why all past (and present) budgets suffer from deficits. Based on such an analysis, the government should take all the necessary steps to solve this issue. While several policy recommendations can be suggested, the establishment of an independent and non-partisan fiscal council whose objective is to promote sustainable public finances should be one of the recommendations.

Second, the government should look at the way it borrows from the local market. In other words, the government must adopt a long-term policy whose objective is to establish a local secondary market for its issued debt instruments. It does not make sense to always sell the issued securities to licensed bank and to the Jordan Social Security Corporation. As one might expect, such a policy recommendation might prove to be a challenging one. Indeed, any successful implementation rests on several conditions. For example, such a market must have macroeconomic stability. In addition, the government must be a credible issuer of securities, and prepared to pay market interest rates. Finally, such a market should be backed by an appropriate technical and regulatory framework.

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COMPARISON OF THE ACCURACY OF MODELS IN FORECASTING VAR AND ES THROUGH TIME

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ABSTRACT

Purpose- Identify the best model/method to accurately forecast the Value-at-Risk (VaR) and the Expected Shortfall (ES) of position.
Methodology- The dynamic of each retained return series was estimated with one of retained GARCH-type model combined with one of retained probability distributions (normal, fat-tailed, and skewed) in each retained sub-periods (window). In each window (sub-period), the 1-day ahead VaR and ES were forecasted by using the best selected GARCH-type model. More than 4000 1-day ahead VaR and ES were forecasted with each retained model/method. Based on 252-day rolling-window, forecasted VaR and ES with each retained model/method were backtested around 3750 times.
Findings- Our results revealed that the best fitting GARCH-specifications combined with skewed Student or GED distribution enable to accurately forecast VaR more often. However, the best methods based on the best fitting GARCH-specifications combined with the best fitting probability distribution do not improve the frequency of acceptance of the null hypothesis stating the accuracy of the method. The accuracy of models tends to deteriorate during crises periods.
Conclusion- Modeling and forecasting the dynamic of retained series with skewed probability distributions (skwed student or wked GED) improve the forecasting accuracy of a parametric or semi parametric model. A performan model in sample may not perform well o ut sample. Forecasted VaR should be complemented with Stressed VaR or ES.

Keywords: VaR, ES, parametric, semi-parametric, backtesting, probability distribution, rolling-window.
JEL Codes: G11, C10, C51

1. INTRODUCTION

It is very important for a financial institution to determine (forecast) the risks it faces. In the specific case of market risk, a possible method of measurement is the evaluation of losses likely to be incurred when the price of portfolio assets falls. The important growth of trading activity and the trading loss of well-known financial institutions during the first part of the 90s have led financial regulators and supervisory committee of banks to prescribe rules and methods for quantifying market risk and determining the regulatory capital necessary to cover this risk.

The most well-known method often used to determine market risk is the Value-at-Risk (VaR) measure. Initially proposed by Till Guldimann, in the late 1980s1, the VaR method gained importance since the Basel committee required the calculation of regulatory capital for market risk based on VaR. The Basel committee proposed a standard approach as well as an internal method in determining market risk. In Basel 2 and 3, the proposed internal method is based on the VaR at 99% over 10 days. The VaR enables to determine the worst loss of a position or portfolio over a given period for a given confidence level.

The VaR is also used to determine the trading limit, the risk-adjusted performance, the optimum portfolio as well as the optimum hedge ratio.

According to Artzner et al. (1997, 1999) a coherent risk measure should verify some axioms: 1) Translation invariance, 2) Subadditivity, 3) Positivity, 4) Homogeneity, 5) Relevance, and 6) Conservatism. These axioms are not verified by the VaR. Artzner et al. (1999) proposed a new measure of risk satisfying these axioms: the Expected Shortfall (ES) (also called conditional value at risk (CVaR), average value at risk (AVaR), and expected tail loss (ETL)). The ES measures the average loss in case the VaR is violated. The last regulation on market risk prescribed by the Basel Committee (Fundamental Review of Banking Book, FRTB) consists of determining market risk and then the required regulatory capital by using the ES and the VaR as well as the profit and loss attribution (P/L) as a mean of backtesting.

Since the 1996 Basel Amendment, several models/methods for forecasting the VaR have been proposed. These models are parametric, semi-parametric or non-parametric. Most existing studies based on parametric models in forecasted VaR and ES showed higher performance of asymmetric GARCH-type specifications (such as gjrGARCH, APARCH, TGARCH) as well as of skewed probability distributions (such as skewed Student-t, skewed GED...). Furthermore, it was also shown that the choice of the volatility model appears to be less relevant than the choice of the probability distribution. These findings were also found in studies based on semi-parametric methods using GARCH-type specification and probability distribution, such as Filtered Historical simulation, and conditional extreme value methods.

The purpose of this article is to compare the performance of some parametric and semi-parametric models in forecasting the VaR and ES of a single position in three types of assets (SP500, EURUSD and Gold) over a long period ranging from January 2000 to June 2018 covering stable and unstable economic and financial periods. The retained parametric methods are the AR-GARCH-type models. Four semi-parametric methods were also used: the AR-GARCH model combined with Monte-Carlo (AR-GARCH-MC), the Filtered Historical Simulation method (FHS), the FHS method combined with Bootstrapping (FHS-B) and the conditional EVT method (SEVT). For each retained return series, the 1-day ahead VaR and ES were forecasted by using a 500 days rolling window method. More than 4000 windows were considered and more than 4000 1-day ahead VaR and ES were forecasted for each retained return and for each model/method.

Existing studies using the rolling-window method retained the same GARCH-type specification and the same probability distribution in each window. The performance of a model may change over time. We accounted for this fact by using two approaches: Approach 1: In each window the dynamic of each retained series was evaluated with the best fitting GARCH specification for each retained probability distribution and the 1-day ahead VaR and ES were forecasted. Approach 2: For each series and each estimation window, the best fitting model was selected among all GARCH specifications combined with all retained probability distributions and the 1-day ahead VaR and ES were forecasted.

The performance of models in forecasting the VaR and ES should be checked. Most existing studies compared the performance of some models in forecasting the VaR/ES. However, in a large part of these studies the VaR and ES were forecasted over one period or a few periods. Furthermore, some did not backtest these forecasts and few backtested them only one time by using different lengths of forecasted VaR. The BCBS recommends backtesting a model by using 1 year (252 days) forecasted VaR. Furthermore, the performance of a model can change through time. A model can perform well in forecasting the VaR over a certain period and perform badly over another period. Owing that, our forecasted VaR were backtested more than 3750 times by using 252-days rolling-window approach with the conditional coverage (CC) test of Christoffersen (1998) and the Dynamic Quantile (DQ) test of Engle and Managanelli (2004). In the same way, the forecasted ESs were backtested by using the residual exceedance over the VaR test proposed by McNeil and Frey (2000). By forecasting and backtesting the VaR and ES over a long period, it is possible to check the performance of retained models during stable as well as unstable periods.

The methods used in forecasting the VaR and ES are presented in the second part of this paper. Backtesting methods are presented in section 3. A presentation and descriptive analysis of retained return series are done in the fourth section. This section presents and discusses also results obtained.

2. REVIEW OF MODELS

Value-at-Risk (VaR) is a quantitative tool used to measure the maximum potential loss in value (or in percentage) of a portfolio of assets over a defined period at a given level. Specifically, VaR construction requires a quantile estimate of the left tail (right tail) of the return's distribution (or profit/loss distribution) of a long position (or short position). The h-period ahead VaR and ES are determined as follows:

$$VaR_{t+h}(100-\alpha) = G^{-1}(\alpha) \quad (1)$$

$$VaR_{t+h}(100-\alpha) = \hat{\mu}_{t+h} + \hat{\sigma}_{t+h} F^{-1}(\alpha). \quad (2)$$

$$ES_{t+h}(\alpha) \frac{1}{\alpha} \int_0^{\alpha} VaR_{t+h}(100-\alpha). \quad (3)$$

Forecasting the h-period ahead VaR and ES at level α can be done by using parametric methods (eq. 2-3), non-parametric methods (eq. 1), and semi-parametric methods. The parametric method requires the specification of the cumulative probability distribution F as well as the h-period expected mean return $\hat{\mu}_{t+h}$ and the h-period expected volatility $\hat{\sigma}_{t+h}$. As for the non-parametric method, it is based on the empirical probability distribution G.

2.1. Parametric Methods

Parametric methods consist of modelling and estimating the dynamic of risk factors by using the appropriate volatility model and the appropriate probability distribution (F). Based on these estimations and on the relation between these risk factors and the considered financial instrument prices (or returns), profits and losses in value (or in return) of the position is determined and then the VaR and ES can be forecasted (equations 2-3).

Initially, RiskMetrics proposed the delta-normal model, consisting of forecasting the VaR by estimating the standard deviation of the portfolio or position by means of the sample estimate of variance appropriately augmented by the quantile of a normal distribution. In this approach, the conditional mean and volatility are modelled with an AutoRegressive and Exponentially Weighted Moving Average (AR-EWMA) model. Since the 1980s several models belonging mainly to the AR/ARMA - GARCH family were proposed in modelling the volatility. These GARCH-type models can be classified as classical, asymmetric and non-linear GARCH models. Empirical studies found that the EWMA model performs the worst in forecasting VaR compared to GARCH-type models (Gonzalez-Rivera et al., 2004; Huang and Lin, 2004; Niguez, 2008; Chen et al., 2011; Abad et al. 2014). Most of the existing empirical studies modelled the dynamic of financial securities and forecasted the VaR by using GARCH-type models (Mittnik and Paolella, 2000; Giot and Laurent, 2004; Haas et al., 2004; Angelidis et al., 2007; Bali and Theodossiou, 2007). Although there is no evidence of an overpowering model, the results obtained in these studies seem to indicate that asymmetric GARCH models produce better outcomes.

Regarding the probability distribution F, initially it was specified as a normal distribution. However, in the literature it is widely recognized that return distributions of financial assets are skewed and fat tailed. The excess kurtosis can be taken into account by probability distributions, such as t-Student (std) and GED (ged). As for the skewness, it is accounted by skewed probability distributions. Different probability distributions were proposed to account for both features (excess kurtosis and skewness); such as skewed t-Student (sstd); skewed GED (sged).

In the empirical literature different GARCH-type models with different distributions were retained in existing empirical studies (Giot and Laurent, 2003; Bali and Theodossiou, 2007; Bali et al., 2008). Most existing studies forecasting the VaR and ES by using different GARCH type models combined with classical and skewed probability distributions showed the higher performance of asymmetric GARCH models (such as gjrGARCH, APARCH, TGARCH) as well as of skewed probability distributions (such as skewed Student-t, skewed GED...). Moreover, it was also shown that the choice of the volatility model appears to be less relevant than the choice of the probability distribution (Giot and Laurent, 2003; Angelidis et al., 2004).

2.2. Non-Parametric and Semi-Parametric Methods

The Historical Simulation (HS) method is the simplest non-parametric approach. This method consists of approximating G (equation 1) with the empirical distribution of financial returns. The forecasted VaR corresponds to the α quantile of this empirical distribution. Although this method is very simple, it presents several drawbacks due mainly to the size of the considered window and the main assumption on which is it based; returns are iid (Down, 2002). Some solutions to these drawbacks were proposed. The main important solutions are: 1) forecasting the VaR and ES with the HS method by using the standardized return (Filtering returns) instead of raw returns (Filtered Historical Simulation (FHS)), and 2) forecasting the VaR and ES by applying the HS method to bootstrapped raw returns or standardized returns (HS-B and FHS-B).

2.2.1. Filtered Historical Simulation (FHS)

The Filtered Historical Simulation (FHS) method consists of standardizing returns ($r_{t,s} = (r_t - \mu_t)/\sigma_t$), where μ_t and σ_t are the mean and the standard deviation) and then forecasting the VaR as the α quantile of the empirical distribution of those standardized returns G($r_{t,s}$). FHS method requires the determination of the mean and variance (μ_t and σ_t) of the raw data in the first stage in order to filter those data. Unconditional or conditional mean and variance can be used. The unconditional method consists of determining the mean and variance of the raw data over the retained window. Regarding the conditional

method, it consists of determining the mean and variance of the raw data by choosing first the appropriate model describing the best the dynamic of these data. Empirical studies employing this method modelled the conditional volatility with AR-GARCH-type models. These researchers considered different probability distributions, such as normal distribution, student distribution, skewed distributions, ... The importance of the choice of the probability distribution was empirically shown (Adcock et al., 2012). These authors showed that FHS models with skewed distributions produce more accurate VaR forecasts.

Another drawback of the HS approach is that the estimation of a quantile in the tails, as in the HS and FHS method, can be subject to important variance, mainly in case of reduced number of used observations in this estimation. In case of a sample composed with one-year daily observations, the quantile at confidence level 99% (corresponding to the forecasted VaR at 99%) will be the second or the third largest losses. This forecasted VaR depends on the realizations of the risk factors rather than on their probability distribution. Given this fact, the forecasted VaR with the quantile of the empirical distribution can be highly unstable, especially when the VaR is forecasted with a high confidence level by using only few available data. To overcome this instability problem bootstrapping can be combined with HS and with FHS.

2.2.2. Extreme Value Theory (EVT)

Another widely used semi-parametric method in forecasting the VaR and ES is the methods based on Extreme Value Theory (EVT). These methods deal with the study of extreme events, which are characterized by extreme deviations from the normal median of their probability distributions. More precisely, the EVT studies and models the behaviour of distributions in their extreme tails, therefore, could potentially give better estimates and forecasts on risk.

Among the methods based on EVT, the exceedances or peaks over threshold (POT) model is the most used in forecasting the VaR and the ES (Smith, 1989; Embrechts et al., 1997; McNeil and Frey, 2000; McNeil et al., 2005; Gilli and Këllezi, 2006). This method concentrates on returns (r_i) in the series that exceed a certain high threshold (u) and model these returns separately from the rest of the unknown distribution. Balkema and De Haan (1974) and Pickands (1975) showed that the generalized Pareto distribution (GPD) is the limiting distribution of the probability distribution of returns exceeding the threshold u by at most an amount y given that r exceeds the threshold u. Given this fact (this probability distribution) and the expression of the conditional probability distribution of returns exceeding the threshold u, the VaR and ES of a long position are determined as:

$$VaR_{t+h}(100-\alpha) = u + \frac{\beta}{\xi}\left(\left(\frac{n}{n_u}\alpha\right)^{-\xi} - 1\right), \tag{3}$$

$$ES_{t+h}(\alpha) = E(E|X > VaR_{t+h}(100-\alpha) = \frac{\widehat{VaR}_{\alpha}}{1-\hat{\xi}} + \frac{\hat{\beta}-\hat{\xi}_u}{1-\hat{\xi}}, \tag{4}$$

where ξ and β represent the shape parameter of the distribution and the scaling parameter, respectively. n and nu denote the total number of observations and the number of observations exceeding the threshold u. The choice of the threshold u is important for the performance of the GPD modelling. This threshold (u) value can be put directly at the lower 5% and 10% quantile of the distribution for the retained series. The optimal threshold can be determined with the graph of the sample mean excess (MEF), the Hill estimator, the Q − Q graph, the graphical bootstrap method (Embrechts et al., 1997), and the sample percentile approach (DuMouchel, 1983).

This presented GPD approach put emphasis on the tail of the distribution but does not recognize the fact that returns are no-i.i.d. One way to overcome this drawback is to combine the classical GPD approach with time-varying volatility models, such as ARCH and GARCH models, as suggested by McNeil and Frey (2000). These authors proposed to take into account the conditional heteroscedasticity in the data through the GARCH models and model the extreme tail behaviour through the EVT method. This method, first, filters different financial time series with GARCH-type models and then deduces the residuals. In the second step, the POT method is applied to these residuals.

In this conditional POT model, the h-period forecasted conditional VaR and conditional ES at level α are determined as:

$$\widehat{VaR}_{t+h}(100-\alpha) = \hat{\mu}_{t+h} + \sqrt{\hat{\sigma}_{t+h}}\widehat{VaR}(Z)_{t+h}(100-\alpha), \tag{5}$$

$$\widehat{ES}_{t+h}(\alpha) = \hat{\mu}_{t+h} + \sqrt{\hat{\sigma}_{t+h}}\widehat{ES}(Z)_{t+h}(\alpha), \tag{6}$$

where $\hat{\mu}_{t+h}$ and $\hat{\sigma}_{t+h}$ are the h-step forecasts for the conditional mean and variance, respectively. Regarding $\widehat{VaR}(Z)_{t+h}(100-\alpha)$ and $\widehat{ES}(Z)_{t+h}(\alpha)$, they are determined with POT model applied to standardized residuals (see equations 4 and 5).

Several authors forecasted the VaR and ES with EVT and conditional EVT models. Most of these authors showed that conditional EVT models produce more accurate VaR and ES forecasts. It was also revealed that the choice of the probability distribution in the conditional EVT models was more relevant than the choice of the GARCH-type models. Precisely, existing studies emphasized the higher accuracy of skewed distribution in forecasting the VaR and ES (Bali and Weinbaum, 2007; Bali and Theodossiou, 2007, 2008; Bali et al., 2008).

3. BACKTESTING

It is important to backtest the accuracy of the retained model in forecasting the VaR and ES. Backtesting VaR consists of comparing the forecasted/predicted losses (or returns) to the realized losses (or returns) and then testing the accuracy and effectiveness of the model. According to the Basel agreement, a model is acceptable when the proportion of exceptions/violations (losses greater than the VaR) is lower than α%, where α% denotes the level used to measure the 1-day ahead VaR and ES. Furthermore, exceptions should be independent: an exception today should not depend on whether an exception occurred on the previous day. Results of backtesting methods enable to select accurate models for VaR forecasting but also have an impact on the market risk capital requirement.

In the literature, different backtesting methods were proposed. Reviews of backtesting are provided by Campbell (2005) and Zhang and Nadarajah (2018). Among these methods, the most often used are the conditional coverage test introduced by Christoffersen (1998) and the Dynamic Quantile (DQ) test proposed by Engle and Managanelli (2004).

Based on the proportion of failure (POT) (Kupiec test) and the independence test of Christoffersen (1998), Christoffersen (1998) proposed the conditional coverage test enabling to test the correct failure rate as well as the independence of violations. The null hypothesis states the accuracy of the failure rate and the independence of exceptions. An exception occurs if the forecasted VaR is violated, meaning that the realized return (or losses) is lower than the VaR in return (or in value) (long position).

Engle and Managanelli (2004) proposed the Dynamic Quantile statistic (DQ) enabling to test the null hypothesis that the current VaR exceptions are uncorrelated with past exceptions (null hypothesis).

Although several backtesting methods for VaR were proposed, methods for backtesting ES are rare. One possible reason for this fact is that VaR has often been used more frequently compared to ES. Furthermore, backtesting ES is more difficult than that of the VaR. The earliest and the most used statistic is the residual exceedances over the VaR series r (representing the violations) which was proposed by McNeil and Frey (2000). McNeil and Frey (2000) proposed to test ES by directly using the residual exceedances over the VaR series r or by using standardized residuals (r_s)). McNeil and Frey (2000) proposed to test the null hypothesis stipulating that r (or r_s) has a zero mean, against the alternative that the mean of r (or r_s) is negative. This alternative hypothesis corresponds to the underestimation of the risk. Overestimation of the ES is limited to the difference between the ES and VaR. In this case, there is no violation and r (or r_s) assumes value zero. On the other hand, underestimation is theoretically unbounded.

4. EMPIRICAL ANALYSIS

4.1. Methodology

The purpose of this paper is to forecast the VaR and ES of position in different type of assets by using parametric and semi-parametric models over a long period. The retained assets are EURUSD currency exchange, Gold and SP500 stock index. The retained daily returns cover the period ranging from 4 January 2000 to 26 June 2018. This period covers periods of financial instability (IT crisis (2001-2003), subprime crisis (2007-2009) ...), economic recession, and of stability. By considering a long period it is then possible to check whether the retained models enable to correctly forecast the VaR and ES over different periods. A 500-day rolling window was employed to estimate the retained model and forecast 1-day ahead VaR and ES. Precisely, the first window covered the period ranging from 4 January 2000 to 3 December 2001 and the VaR as well as the ES for 4 December 2001 were forecasted. The last window included daily data from 26 July 2016 to 25 June 2018 and enabled to forecast the VaR and ES for the 26 June 2018. More than 4000 windows were considered and more than 4000 1-day ahead VaR and ES were forecasted for each retained return.

Retained parametric methods are classical AR-GARCH-type models (AR-GARCH-type). The conditional volatility of retained returns' series was modelled with different GARCH-type models: the classical GARCH model, the exponential GARCH model.

(eGARCH, Nelson (1991)), the Threshold GJR-GARCH model (gjrGARCH, Glosten et al. (1993)), and the Threshold GARCH (TGARCH, Zakoian (1994)). These models are presented in table 1. These models were estimated by assuming that the innovations follow a normal distribution, distribution accounting for the excess of kurtosis (Student T (std) and GED (ged)) as well as the skewed version of these probability distributions (skewed normal (snorm), skewed Student T (sstd) and skewed GED (sged)) which account to the skewness of financial returns' distributions. All these specifications were also used in the retained semi-parametric methods, which are the AR-GARCH type models combined with Monte-Carlo simulation (AR-GARCH-type-MC), the Filtered Historical simulation (FHS), the FHS combined with bootstrapping (FHS-B) and the conditional POT (SEVT). For this later method, threshold values are put directly at the lower 10% quantile of the distribution for the retained series.

Existing studies using rolling-window approach retained the same GARCH-type specification and the same probability distribution in each window. For a given series, the best-fitting GARCH specification and/or the best-fitting probability distribution can differ from one period to another period and mainly during stable and unstable periods. In order to account for these facts, two approaches were used in this article.

Table 1: Retained GARCH Type Models

Model	Formulations	Model	Formulations
GARCH	$\sigma_t^2 = w + \alpha.\varepsilon_{t-1}^2 + \beta.\sigma_{t-1}^2$	**gjrGARCH**	$\sigma_t^2 = w + \alpha.\varepsilon_{t-1}^2 + \gamma.\varepsilon_{t-1}^2 I(\varepsilon_{t-1} > 0) + \beta.\sigma_{t-1}^2$
eGARCH	$\ln(\sigma_t^2)=(1-\alpha_1)\alpha_0 + \alpha_1 \ln(\sigma_{t-1}^2) + g(\varepsilon_{t-1})$ $g(\varepsilon_{t-1}) = \theta.\varepsilon_{t-1} + \gamma(\lvert\varepsilon_{t-1}\rvert - \sqrt{\frac{2}{\pi}})$	**TGARCH**	$\sigma_t^2 = w + \alpha.\varepsilon_{t-1} + \gamma.\varepsilon_{t-1} I(\varepsilon_{t-1} > 0) + \beta.\sigma_{t-1}^2$

Approach 1: For each return series and each probability distribution, the best fitting GARCH specification in each window was selected based on AIC criterion. For each retained method (parametric and semi-parametric), the dynamic of each retained series was evaluated in each window with the best fitting GARCH specification for each retained probability distribution and the 1-day ahead VaR and ES were forecasted. As we retained 5 methods (1 parametric and 4 semi-parametric) and 6 probability distributions, in total 30 (5*6) series of around 4000 VaR and ES were forecasted for each retained returns' series.

Approach 2: For each series and each estimation window, the best fitting model was selected and estimated based on AIC among all GARCH specifications combined with all retained probability distributions and the 1-day ahead VaR and ES were

forecasted. For each return series more than 5 series (5=1 parametric + 4 semi-parametric methods) of around 4000 VaR and ES were forecasted.

The accuracy of the retained models should be backtested. The Basel committee recommends backtesting a model by using 252-day forecasted VaR and ES. As more than 4000 1-day VaR and ES were forecasted for each series by using a specific model with a specific probability distribution, forecasted VaR and ES were backtested by using 252-days rolling-window approach. In sum, for each series each model was backtested around 3750 times. This method enables to determine the performance of retained models through time.

Table 2: Descriptive Statistics

	Gold				EURUSD				SP500			
	mean	std	skew	kurtosis	mean	std	skew	kurtosis	mean	std	skew	kurtosis
mean	0.0003	0.0111	-0.281	4.2493	0.0000	0.0060	0.0477	1.3067	0.0001	0.0110	-0.202	2.5417
std	0.0004	0.0023	0.7634	3.1793	0.0003	0.0011	0.2597	1.0358	0.0005	0.0046	0.3138	1.9580

std: standard deviation

4.2. Empirical Results

4.2.1. Descriptive Statistics

The summary of the descriptive statistics of each 500-day rolling window is represented in table 2. The average returns of retained series are very slightly positive. The returns of the Gold and of the SP500 index are slightly negatively skewed. As for the return of the currency exchange rates, it is slightly positively skewed. As displayed in this table, most of the time, the skewness of Gold returns are negative and the kurtosis is higher than 3.

Table 3: Best Fitting GARCH (Bfg) Specification per Distribution (In-Sample) (Percent %)

	norm	snorm	std	sstd	ged	sged	norm	snorm	std	sstd	ged	sged
	SP500						EURUSD					
egarch	**76.2**	**77**	**77.1**	**77.8**	**77.8**	**78.8**	**49.6**	**49.7**	**46.4**	**47.7**	**46.8**	**46.8**
sgarch	0.7	0.7	0.4	0.3	0.9	0.9	27	17.9	33	4.6	2.6	2.6
gjrgarch	4	2.7	3.3	3.4	2.5	2.7	3.8	3.4	4.6	15	17.7	17.7
tgarch	19.2	19.6	19.3	18.4	18.8	17.7	19.7	18.9	16	32.9	32.9	32.9
	Gold											
egarch	**60.7**	**53.7**	**44.5**	**45.2**	**49**	**47.1**						
sgarch	5.9	9.1	27.1	27.4	23.2	24.8						
gjrgarch	5.2	8.3	9.9	9	4.5	6.4						
tgarch	28.2	28.9	18.4	18.4	23.2	21.8						

4.2.2. Empirical Results Related to Approach 1

For each retained probability distribution and each return series the best fitting GARCHtype specification is determined for each retained 500-day window based on AIC. Table 3 depicts a summary of the best-fitting GARCH specification for each probability distribution. According to our results, asymmetric GARCH-type models (eGARCH, gjrGARCH and TGARCH) fit better retained series whatever the probability distribution. For instance, the EGARCH model combined with the normal probability distribution was the best fitting model for the SP500 series on 76,2% of retained windows. Among the retained asymmetric model, the EGARCH dominates the gjrGARCH and TGARCH model whatever the retained series and the probability distribution. The classical GARCH model fits better only on a few windows.

For each retained series and each retained probability distribution, the best fitting GARCH-type specification is used for forecasting 1-day ahead VaR and ES at each time (in each window) with each of the retained parametric and semi-parametric methods. The performing model is the one that is the most often accurate one; this means that the null hypothesis of model accuracy is the least rejected by backtesting methods. In this article the conditional coverage (CC) test of Christoffersen (1998) and the dynamic quantile (DQ) test of Engle and Managanelli (2004) are used.

For each method, the accuracy of VaR(99%) and VaR(95%) is checked at levels 1% and 5% for each series and each probability distribution combined with the best fitting GARCH type specification. Tables 4 - 6 represent the percent of time the null

hypothesis stating the accuracy of the retained model in forecasting the VaR is rejected. Due to the large number of results (30=6*5 series of around 4000 forecasted VaR), these tables contain for each method and for each series only the results of the model rejecting the least the null hypothesis of model accuracy based on the conditional coverage test and the DQ test. Both these tests may sometimes lead to different results. For instance, based on the conditional coverage test at 1% level the null hypothesis is the least rejected (4.84% times) for the AR-GARCH model combined with skewed Student (sstd) distribution.

In the forecasted VaR(99%) compared to AR-GARCH models combined with other retained probability distributions for the SP500 return series. And according to the DQ test, the null hypothesis is the least rejected (15.75% times) for the AR-GARCH model combined with skewed GED (sged) distribution for the SP500 return series compared to AR-GARCH models combined with other retained probability distributions. For this return series, the VaR(95%) forecasted with the AR-GARCH model combined with skewed GED (sged) distribution is the most accurate based according to both backtesting tests at 1% compared to other AR-GARCH model combined with the other retained probability distribution.

The percentages of rejection of the null hypothesis of model accuracy are different in both backtesting methods. The null hypothesis is more rejected by the DQ test than the conditional coverage test, except in a few cases such as backtesting the VaR(95%) at 5%. These percentages of rejection depend also on the level of VaR and the level of backtesting method.

Models producing forecasted VaR which are the most often accurate ones are represented in bold in tables 4 - 6 whatever the method and the probability distribution. These tables reveal that methods using skewed probability distributions (skewed Student (sstd) and skewed GED (sged)) enable accurately forecast VaR more often followed by methods based on heavy-tailed probability distributions (Student (std) and GED).

Table 4: Backtesting VaR-SP500 (%)

	VaR(99%)	BT	at 1%	VaR(95%)	BT	at 1%	VaR(99%)	BT	at 5%	VaR(95%)	BT	at 5%
		CC	DQ		CC	DQ		CC	DQ		CC	DQ
AR-GARCH	sged	5.19	15.75	sged	2.73	6.05	sged	11.82	16.07	sged	12.31	11.28
	sstd	4.84	21.63									
	bf	5.14	15.53	bf	2.73	6.39	bf	14.40	15.95	bf	12.41	11.87
AR-GARCH-MC	sged	6.24	19.73	sged	3.29	6.05	sged	9.39	19.93	sged	12.17	10.99
	sstd	4.89	21.41	sstd	2.16	6.27						
	bf	6.24	23.45				bf	14.01	23.69	bf	12.71	12.66
SEVT	**std**	**3.24**	**14.55**	ged	0.42	5.53	ged	9.98	21.33	**sged**	**6.29**	**9.29**
							std	**11.28**	**15.75**			
	bf	4.52	28.78	bf	0.42	6.02	bf	16.00	30.10	bf	6.07	10.37
FHS	sstd	5.55	17.25	ged	2.16	4.67	sged	9.78	20.13	norm	5.87	10.81
				sstd	0.00	6.22	sstd	14.52	18.14	sstd	5.06	13.39
	bf	5.73	30.18	bf	2.70	4.60	bf	14.40	15.95	bf	4.55	9.09
FHS-B	sged	3.86	17.35	**sstd**	**0.00**	**4.37**	**sged**	**8.70**	18.65	ged	5.16	10.47
										sstd	**4.18**	**11.55**
	bf	3.86	23.45	bf	2.7	4.08	bf	10.00	25.76	bf	4.55	9.02

bf: best fitting model among all retained GARCH specifications and retained probability distributions.

Figures in this table represent the percentage of rejection of Ho. BT: backtesting.

The conditional EVT (SEVT) and Bootstrapped FHS (FHS-B) methods produce forecasted VaR of SP500 which are the most often accurate ones. Indeed, the null hypothesis of accuracy is the least rejected for one of these methods dependent on the level of VaR and the level of the backtest test (Table 4). For instance, 3.24% of more than 3750 backtested forecasted VaR(99%) of SP500 determined with the SEVT model based on Student probability (std) distribution leads to the rejection of the null hypotheses at 1% according to the conditional coverage test. Similar findings are observed for the EURUSD currency exchange (Table 5). Regarding the Gold, the results in Table 6 do not lead to the conclusion of a dominant method. Our findings related to SP500 and EURUSD are in line with the summary of the review of literature done by Abad et al. (2014). In their paper these authors did a review of VaR methodologies and findings. They resumed the findings of 24 papers using classical parametric, semi-parametric and non-parametric methods in forecasting VaR. In 83.3% of these papers, the EVT was selected as the best method in forecasting the VaR, followed by FHS.

For each retained series the observed returns and the forecasted VaR(99%) with the selected models are displayed in graphs 1, 2 and 3.[1] These graphs show that realized returns are almost higher than the forecasted VaR(99%), except a few times. Regarding the backtesting results, the p-values related to the CC test and DQ test of the retained models for forecasting VaR(99%) are displayed in graphs 4,5, and 6. These graphs reveal that the null hypothesis of accuracy is mainly rejected during unstable periods, such as the beginning of the subprime crisis (2007-2008). These plots show the dependence between exceptions.

Figure 1: Realized Return and VAR (99%) of SP500 with SEVT-Std and FHS-B-Sged Models

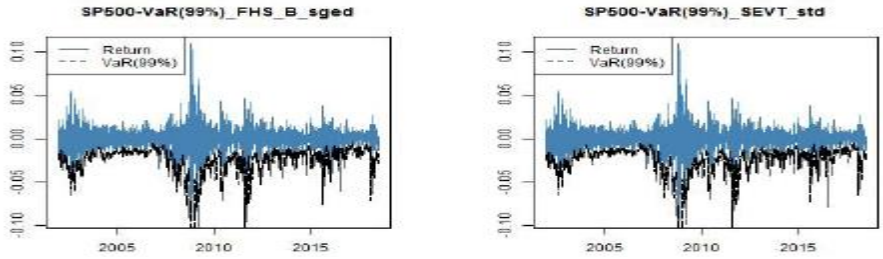


Table 5: Backtesting VaR-EURUSD (%)

	VaR(99%)	BT CC	at 1% DQ	VaR(95%)	BT CC	at 1% DQ	VaR(99%)	BT CC	at 5% DQ	VaR(95%)	BT CC	at 5% DQ
AR-GARCH	sged	**0.00**	18.44	norm	2.56	5.02	sged	1.65	18.51	norm	10.28	7.79
				snorm	2.19	5.66				snorm	8.24	10.43
	bf	0.30	18.54	bf	3.17	7.97	bf	2.31	19.03			
AR-GARCH-MC	**sged**	**0.00**	18.44	norm	2.16	4.84	sged	1.67	18.44	norm	9.32	7.55
	bf	0.30	18.54	bf	2.24	7.77	bf	2.31	19.03	bf	7.47	13.62
SEVT	ged	0.30	18.39	**ged**	0.20	**0.34**	sged	1.65	18.51	**ged**	5.97	**3.25**
										snorm	**3.29**	7.62
	bf	0.30	18.39	bf	0.20	0.32	bf	2.26	18.59	bf	5.97	3.07
FHS	**ged**	0.00	18.24	norm	0.52	4.33	norm	0.02	18.37	ged	7.89	6.42
	norm	0.00	18.24				sged	1.65	18.29	sstd	4.38	6.47
	bf	0.00	18.49	bf	1.03	5.14				bf	7.89	6.25
FHS-B	**ged**	0.00	**18.15**	**norm**	0.00	2.41	**sged**	**0.02**	**18.29**	ged	7.72	5.83
				snorm	0.00	2.24				snorm	4.30	7.72
	bf	0.00	18.37	bf	0.61	4.5	bf	0.02	18.29	bf	7.72	5.75

bf: best fitting model among all retained GARCH specifications and retained probability distributions.

Figures in this table represent the percentage of rejection of Ho. BT: backtesting.

Table 6: Backtesting VaR-Gold (%)

	VaR(99%)	BT CC	at 1% DQ	VaR(95%)	BT CC	at 1% DQ	VaR(99%)	BT CC	at 5% DQ	VaR(95%)	BT CC	at 5% DQ
AR-GARCH	std	0.00	23.81	sstd	0.00	6.88	std	2.24	31.33	sstd	1.79	15.48
	bf	6.19	37.77	bf	0.10	6.64	bf	6.27	39.54	bf	6.17	22.88
AR-GARCH-MC	sstd	0.05	39.89	sged	0.05	8.87	**std**	**2.04**	27.18	sstd	1.79	19.61
	std	**0.00**	**20.15**									
	bf	6.17	37.55	bf	1.38	9.90	bf	6.27	38.51	bf	6.34	28.70

[1] Due to space, only the p-value graphs and VaR(99%) graphs of the selected models are displayed. Others obtained graphs can be provided on demand.

SEVT	snorm	2.78	20.77	std	0.00	4.74	**snorm**	**5.51**	**21.33**	**ged**	**0.00**	**18.70**
	sstd	1.52	36.99				sstd	3.49	39.44	sstd	2.38	16.10
	bf	3.64	37.72	bf	0.00	8.04	bf	6.46	39.52	bf	0.05	19.69
FHS	snorm	2.38	20.59	ged	0.00	4.30	snorm	5.58	21.55	ged	0.71	15.21
	sstd	0.02	36.27				sstd	4.20	40.70	**sstd**	**1.35**	**12.02**
	bf	2.11	32.64	bf	0.00	3.76	bf	5.70	34.06	bf	0.71	14.33
FHS-B	norm	1.99	20.45	std	0.00	3.24	snorm	5.58	21.60	ged	0.29	14.60
	sstd	0.02	24.65				sstd	4.15	26.96	sstd	3.00	13.44
	bf	1.23	31.04	**bf**	**0.00**	**3.10**	bf	5.14	33.05	bf	0.00	13.64

bf: best fitting model among all retained GARCH specifications and retained probability distributions.

Figures in this table represent the percentage of rejection of Ho. BT: backtesting.

For the selected models, a summary of the results of backtesting ES are displayed in Table 7. For each series and for each selected model within each retained method, this table contains the percent of time the null hypothesis is rejected at 5% level with the 1-side and 2-side tests proposed by McNeil and Frey (2000). The null hypothesis states the nullity of the residuals between the observed losses (returns) and the predicted ES in case the VaR is exceeded. If a model accurately enables to forecast the ES then the average of the difference between the observed return and the predicted ES should be equal to 0. Compared to the percentages of rejection of the null hypothesis of accuracy in forecasting VaR, the percentages of rejection of the null hypothesis related to backtest of ES are higher. In all selected models, the percentages of rejection of the null hypothesis related to ES are between 0,3-0,4.

Figure 2: Realized Return and VaR (99%) of EURUSD with FHS-B-Sged Model

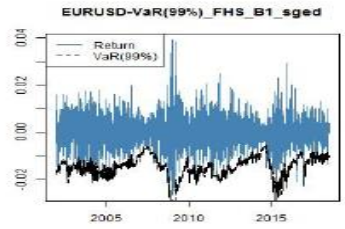


Figure 3: Realized Return and VaR (99%) of Gold with AR-GARCH-MC-Std And SEVT-Snorm Models

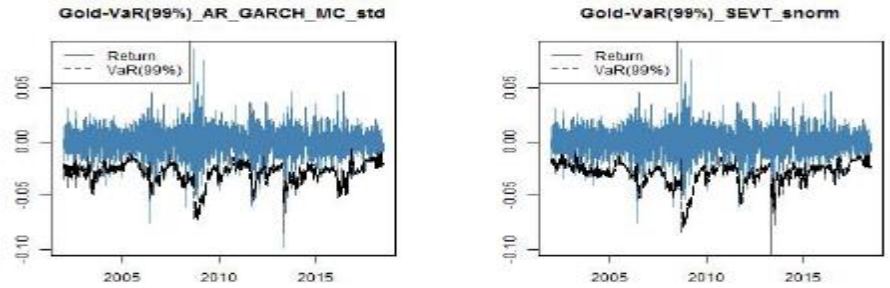


Table 7: Backtesting ES (%)

	SP500	**er-1side**	**er-2side**	**EURUSD**	**er-1side**	**er-2side**	**Gold**	**er-1side**	**er-2side**
AR-GARCH	sged	38.58	38.58	sged	39.64	39.64	std	39.30	37.18
	bf	42.54	42.54	bf	30.74	30.64	bf	39.54	38.61
AR-GARCH-MC	sged	39.74	38.29	sged	41.14	39.86	std	31.19	30.40
	bf	35.49	34.63	bf	33.19	33.10	bf	42.71	40.03
FHS	sged	43.60	43.60	norm	37.96	37.87	snorm	45.44	45.44
	sstd	37.33	36.27	sged	45	43.62	sstd	46.77	42.07

	bf	44.61	41.26	bf	37.72	36.22	bf	44.63	42.57
FHS-B	sged	45.56	45.56	sged	38.04	36.66	snorm	47.83	47.83
							sstd	46.77	40.89
	bf	40.08	40.08	bf	37.03	35.68	bf	44.8	38.76

bf: best fitting model among all retained GARCH specifications and retained probability distributions.

Figures in this table represent the percentage of rejection of Ho. er-1side: 1 side test and er-2side: 2 side test.

Figure 4: P-value of Conditional Coverage Test and DQ Test for VaR (99%) Tested at 5% for SP500 with SEVT-std and FHS-B-sged Models

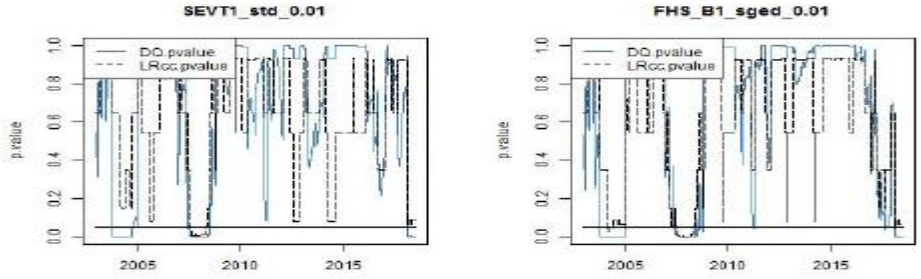


Figure 5: P-value of Conditional Coverage Test and DQ test for VaR(99%) Tested at 5% for Gold with SEVT-snorm and AR-GARCH-MC-std models

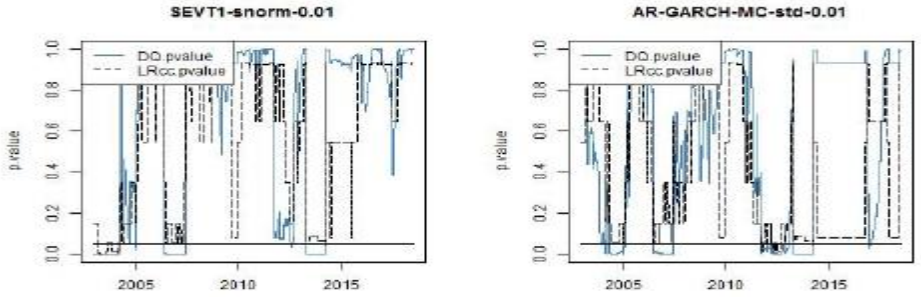
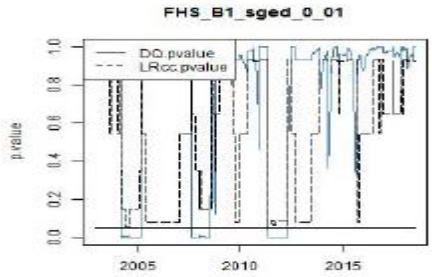


Figure 6: P-value of Conditional coverage test and DQ test for VaR(99%) tested at 5% for EURUSD with FHS-B-sged model



4.2.3. Empirical Results Related to Approach 2

The best way would be to forecast the VaR and the ES for each time with the GARCH type model combined with the probability distribution fitting the best retained series. Among the retained GARCH-type models and probability distribution, a summary of the best fitting specification for each series is presented in table 8. This table represents the percentages of each specification retained as the best fitting specification based on AIC criteria. According to our results, the GED probability distribution is the dominant distribution in case of the EURUSD and Gold series. As for the return of SP500, the skewed GED (sged) is the dominant distribution.

For each method, the dynamic of each retained series is evaluated with the retained best fitting model in each window and more than 4000 1-day ahead forecasted VaR and ES are determined. The percent of rejection of the null hypothesis among the 3750 backtests are represented with bf (bf=best fitting) in Tables 4 - 6. Surprisingly, the best-fitting models do not improve the frequency of the accuracy of forecasted VaR. Indeed, the percent of time the rejection of the null hypothesis of accuracy is not lower for best-fitting models compared to the best specification based on the probability distribution (approach 1).

In this article, for each probability distribution the best GARCH-type model was selected based on the AIC (in-sample). Similarly, the best-fitting model was also selected based on AIC determined in sample. The best-fitting model in-sample does not mean that this model is the best-fitting model out-sample. This fact can explain our backtesting results related to the best fitting model (approach 2) compared to the backtesting results related to the best model retained in approach 1.

Regarding the backtest of forecasted ES by using the best fitting model, the percent of time the null hypothesis of accuracy is rejected is important (see Table 7). However, these percentages are lower than the percentages of rejection of the null hypothesis of accuracy in forecasting ES with methods used in the first approach, except for a few methods.

5. CONCLUSION

The purpose of this article was to compare the performance of parametric and semiparametric models in forecasting the VaR and the ES through time. The performance of a model in modelling the dynamic of financial returns may change through time and then the accuracy of this model to forecast the VaR and ES may change too. To account for these facts, two approaches were considered.

Approach 1: For each return series and each probability distribution, the best fitting GARCH specification in each window was selected based on AIC criterion. For each retained method (parametric and semi-parametric), the dynamic of each retained series was evaluated in each window with the best fitting GARCH-specification for each retained probability distribution and the 1-day ahead VaR and ES were forecasted.

Approach 2: For each series and each estimation window, the best fitting model was selected and estimated based on AIC among all GARCH-specifications combined with all retained probability distributions and the 1-day ahead VaR and ES were forecasted.

Our results revealed that the best fitting GARCH-specifications combined with skewed Student or GED distribution enable to accurately forecast VaR more often. However, the best methods based on the best fitting GARCH-specifications combined with the best fitting probability distribution do not improve the frequency of acceptance of the null hypothesis stating the accuracy of the method. The accuracy of models tends to deteriorate during crises periods. This latter finding can be explained by the fact that the best fitting model in sample does not mean that this model is the best fitting model out-sample. Indeed, the best fitting GARCH-specification and the best fitting model were selected in-sample based on AC.

Our results revealed that the selected model among all retained methods/approaches enables to forecast accurately the realized loss most of the time but not all the time. Forecasted VaR with the selected model underestimates the realized losses over certain period mainly during unstable periods. This finding can explain the consideration of the Stressed VaR(99%) in addition of the VaR(99%) in the determination of the risk weighted assets (RWA) for market risk since Basel 2.5. In the Basel 2, the RWA is determined by using only the VaR(99%). The Stressed VaR (sVaR) should be determined by using the worst 1-year daily data occurred during the past 10 year.

Results related to backtesting ES with nostandardized version of McNeil and Frey (2000) test are not homogeneous. These results can also be due to the fact that backtesting ES is difficult compared to backtesting VaR. Due to this latter fact, in the FRTB approach the Basel committee did not prescribe a method enabling to directly backtest ES but this later is done by using Profit and Loss attribution test as well as backtesting VaR. Furthermore, these results can explain why the ES for the determination of the required capital for market risk in the FRTB is not determined as done in this article. In this article, the ES is determined as the average loss when the forecasted VaR is exceeded by using daily returns of the considered window. In the FRTB, different ES are determined and combined in the determination of the risk-weighted assets for market risk. One type of ES is determined by using current data as we did and one type by using data from the stressed periods.

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EARNINGS MANAGEMENT, CAPITAL MANAGEMENT, SIGNALLING AND THE COVID-19 PANDEMIC: THE CASE OF LISTED BANKS IN THE UNITED STATES

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ABSTRACT

Purpose- This paper investigates earnings management, capital management, the impact of the Covid-19 pandemic and signalling by United States listed banks of loan loss provisions. This study is particularly important because there is a relative dearth of research in banking on these topics and thus remain considerably under researched.
Methodology- The dataset comprises a pooled cross-sectional and time series data for a sample of 249 U.S. listed banks for the period 2015 to 2020 consisting of 1,494 observations. A panel data analysis is conducted.
Findings- Results overall show no evidence of systematic earnings management, capital management or signaling by the banks. Findings reveal the impact of the Covid-19 pandemic is not significant during this period of economic fragility for listed banks. The elasticity of loan loss provisions with regards to the annual growth in gross domestic product is negative and statistically significant overall. This is evidence that U.S. listed banks' loan loss provisioning exhibits a pro-cyclical nature. Overall, these results provide evidence of the success of restrictions due to tighter bank regulation and supervision that came into effect at the end of 2014. This required U.S. banks to maintain a minimum common equity tier 1 capital ratio of 4 percent, a minimum tier 1 capital ratio of 5.5 percent, a minimum total capital ratio of 8 percent, and a minimum leverage ratio of 4 percent.
Conclusion- This study adds to the literature as it provides evidence that restrictions on bank activities in the form of minimum capital and leverage ratios at the end of 2014, restrictions in the use of bank capital, and extension of financial support via government intervention funding during the Covid-19 pandemic crisis period have reduced incentives to smooth earnings in the United States banking system. It therefore represents a tried and tested model that can be adopted by banking systems in other countries.

Keywords: Banks, capital management, COVID-19 pandemic, earnings management, loan loss provision, signalling.
JEL Codes: M41, G21, C23, G28

1. INTRODUCTION

This study examines the impact of the Covid-19 pandemic on the earnings management and capital management practices of US listed banks and its interaction effects. Healy and Whalen (1999) define earnings management as the obfuscation of a firm's financial statements by insiders with the objective to mislead some stakeholders or to impact certain contractual outcomes that are contingent on numbers in the financial statements.

Roychowdhury (2006) determines that substantial evidence exists that executives engage in earnings management practices using two main methods. One means is to manage earnings by manipulating accruals with no direct cash flow consequences which is also known as accrual manipulation. In addition, managers can be incentivized to engage in the manipulation of real activities during a period to meet certain earnings targets. Thus, bank managers allow themselves the discretion to manage the loan loss provisioning. This has no direct effect on cash and represents a way to manage earnings.

Cohen et al. (2014) find that managers can opportunistically apply their discretion to utilize loan losses to "paint a desired picture of the firm;" (p. 181). The authors note that as losses accumulate over time and there is the eventual reconciliation of the loan loss provision, there would have to be a reversal of the discretionary choices that were previously made. They

conclude that firms engaging in aggressive earnings management are likely to experience a higher chance of going bust in a period of fragility and greatly underperform during the crisis.

The principle of loan loss provisioning is to adjust a bank's loan reserves to capture anticipated future loan portfolio losses. For commercial banks, loan loss provisions represent a relatively large accrual and thus have a significant impact on banks' earnings and regulatory capital according to Ahmed et al. (1999). It is widely documented in literature that bank managers are incentivized to utilize loan loss provisions for the management of earnings and regulatory capital as well as to convey or signal private information regarding future expectations.

In the United States (U.S.), risk-based capital ratios are used to assess the relative strength, security, and safety of lending institutions. As at the end of 2014, U.S. banks need to maintain a minimum common equity tier 1 capital ratio of 4 percent, a minimum tier 1 capital ratio of 5.5 percent, a minimum total capital ratio of 8 percent, and a minimum leverage ratio of 4 percent.

The Covid-19 pandemic hit U.S. listed banks hard for several reasons. First, the Covid-19 pandemic made it increasingly difficult for US listed banks to keep their distribution channels open due to social distancing restrictions. Second, U.S. listed banks are exposed to potential failures in supervisory and compliance processes and procedures that were not created for out-of-office remote work that has been prevalent. Third, the near-zero interests rates and growing pressures on customers placed huge demands on U.S. listed banks to meet revenue and profit targets. These factors are likely to increase the occurrence of banks' earnings management and capital management practices.

Earnings management and capital management in the guise of loan loss provisions (LLPs) are acknowledged problems that adversely impact the users of the financial statements of U.S. listed banks as accounting violations. The occurrence of events like the Covid-19 pandemic creates a period of financial crisis that is likely to exert pressure on a bank's management to manage earnings and capital. This study is therefore important and contributes to the body of knowledge as it is observed that there is a lack of recent relevant research pertaining to earnings management, capital management, signalling and the impact of the Covid-19 pandemic since the institution of the new banking capital requirements commencing at the end of 2014. This gives rise to the following research question – "What is the impact of the Covid-19 pandemic on the earnings management and capital management practices of U.S. listed banks, its interaction effects, and the signalling effects under the new capital regime requirements?"

The paper is structured as follows. After the introduction, section 2 provides the literature review. Section 3 discusses the data. Section 4 furnishes the methodology. Section 5 offers the results, while section 6 presents the findings and conclusions.

2. LITERATURE REVIEW

Banks book provisions for loan losses on the income statement which increases expenses. Using a sample of US commercial banks, Scheiner (1981) concludes that bank managers use loan loss provisions (LLPs) to manage earnings. Banks raise LLPs during periods of high profitability to enable them reduce volatility of reported earnings in the future (Ma, 1988; Greenawalt and Sinkey; 1988). There is a strong positive correlation between poor financial situation of banks and a high occurrence of earnings management (Bhat, 1996). Some U.S. banks utilize LLPs as mechanisms for earnings management for stock market transactions (Ahmed et al., 1999; Beaver and Engel, 1996; Collins et al., 1995; Healy and Wahlen; 1999; Liu et al., 1997; Liu and Ryan; 1995; and Scholes et al., 1990). Research using samples of non-United States banks also arrive at similar conclusions (Anandarajan et al., 2003; 2007; Pérez et al., 2008).

Banks are required to maintain minimum capital bases as defined by the regulations. Studies using samples of U.S. banks test whether LLPs are utilized to manage capital i.e., opportunistically manage the capital adequacy ratio and they confirm evidence of capital management using LLPs (Moyer, 1990; Scholes et al., 1990; Beatty et al., 1995; Collins et al., 1995). The breach of capital ratios can result in regulatory interventions which can be costly for bank managers and the shareholders (Anandarajan et al., 2003).

Curcio and Hasan (2013) examine the relationship between loan loss provisioning and earnings management in respect of the capital adequacy of Euro Area (EA) banks versus non-EA credit institutions. The authors have several findings. First, they find evidence to conclude that loan-loss provisions represent changes in the anticipated quality of a bank's loan portfolio. Second, in contrast to non-EU Banks, capital management is critical for EU banks. Third, earnings management is an important factor impacting both EU and non-EU banks. Fourth, signalling to outsiders is applicable to non-EU banks, but not for EU credit institutions. Fifth, bank LLPs show a pro-cyclical nature. Finally, the authors conclude that restrictions on bank activities, limit incentives to manage earnings in non-EU banking systems, unlike EU ones.

The signalling hypothesis states that there is a positive correlation between discretionary changes in loan-loss provisions and future changes in future earnings. Consequently, it is expected that the coefficient of the variable will have a positive sign. Kanagaretnam et al. (2004) perform joint tests of signalling and income smoothing via loan loss provisions and provide evidence that support the use of loan loss provisions to smooth earnings. Curcio and Hasan (2013) find that as opposed to what was observed during the non-financial crisis period, non-EA banks used LLPs to manage earnings during the financial

crisis period spanning 2007 to 2010, but not for the management of their capital ratios or the signalling of private information to outsiders.

Gombola et al. (2016) investigate the impact of leverage and liquidity on the behaviour of earnings and capital management in US commercial banks for the period 1999 to 2013. They find that the measures of earnings and capital management consistently show a significantly positive correlation with capital ratios and a significant negative correlation with liquidity ratios. These findings indicate that regulators need to be alert to all forms of aggressive earnings and capital management practices by U.S. banks.

Tran (2022) notes that due to the Covid-19 pandemic that adversely affected the global economy, banks all over the world suffered significant reductions in loan growth and increased levels of distressed and non-performing assets that posed a systemic threat to banks' stability. The authors use a quarterly panel of international banks' data spanning the first quarter of 2020 to the first quarter of 2021 to empirically assess the accounting and market-related risks during the Covid-19 pandemic. They find that banks exhibit increased accounting risk and greater return volatility during the Covid-19 pandemic.

This study therefore contributes to the literature as there is an identified gap in the literature on the topics of earnings management, capital management, signalling and the impact of the Covid-19 pandemic with respect to US listed banks. This is because since the end of 2014, US banks are mandated to achieve a minimum common equity tier 1 capital ratio of 4 percent, a minimum tier 1 capital ratio of 5.5 percent, a minimum total capital ratio of 8 percent, and a minimum leverage ratio of 4 percent. And the impact of these capital ratio restrictions is significantly under researched. Hence, this study attempts to bridge this gap in order to help academics and practitioners, regulatory bodies and standard setters have a better understanding of the topic.

3. DATA

The dataset used in this study is annual data from published financial statements of US listed commercial banks. Data are sourced from published annual financial statements of all United States listed banks using the Bloomberg database for the period 2015 to 2020 and listed on the NASDAQ (327 banks) and NYSE (54 banks) stock exchanges as of June 30th, 2021 representing an initial total population of 381 listed banks. The exclusion of banks with missing data, incomplete data, and depositary receipts results in a final sample of 249 US listed banks.

The final sample comprises a balanced panel dataset of 249 US listed commercial banks for the six-year period spanning 2015 to 2020 and consisting of 1,494 observations. The specific timeframe is to achieve consistency because as of the end of 2014, banks need to maintain a minimum common equity tier 1 capital ratio of 4 percent, a minimum tier 1 capital ratio of 5.5 percent, a minimum total capital ratio of 8 percent, and a minimum leverage ratio of 4 percent.

4. METHODOLOGY

4.1. Testing for Capital Management and Earnings Management

For the testing of the capital and earnings management hypotheses, the Models 1 to 4 are used. Models 1 to 4 are based on an adaptation of the model utilized by Ahmed et al. (1999); Anandarajan et al. (2003, 2007); Leventis et al. (2011), and Curcio and Hasan (2013). This model illustrated in Models 1 to 4 tests for earnings management and capital management in the context of the common equity tier 1 capital ratio, tier 1 capital ratio, total capital ratio, and leverage ratio. The main underlying premise of the model is that it relates a bank's loan loss provisioning to the fundamental earnings information contained in published financial statements and to Tier 1 capital and other capital ratios.

Model 1 represented by equation (1) examines capital management and earnings management by modelling the relationship between loan loss provision as the dependent variable and the Common Equity Tier 1 Capital ratio and the other variables as the explanatory variables.

Model 1

$$\mathrm{LLPR_{it}} = \alpha_0 + \beta_1 \mathrm{COM\_CAP_{it}} + \beta_2 \mathrm{EBTP_{it}} + \beta_3 \mathrm{NPL\_CHNG_{it}} + \beta_4 \mathrm{LOAN\_CHNG_{it}} + \beta_5 \mathrm{CHARGE\_OFF\_CHNG_{it}} + \beta_6 \mathrm{COVID_{it}} + \beta_7 \mathrm{COVID_{it}} * \mathrm{EBTP_{it}} + \beta_8 \mathrm{LN\_ASSETS_{it}} + \beta_9 \mathrm{GDP\_GR_{it}} + \mathrm{e_{it}} \quad (1)$$

Model 2 represented by equation (2) examines capital management and earnings management by modelling the relationship between loan loss provision as the dependent variable and the Tier 1 Risk-Based Capital ratio and the other variables as the explanatory variables.

Model 2

$$\mathrm{LLPR_{it}} = \alpha_0 + \beta_1 \mathrm{TIER1\_CAP_{it}} + \beta_2 \mathrm{EBTP_{it}} + \beta_3 \mathrm{NPL\_CHNG_{it}} + \beta_4 \mathrm{LOAN\_CHNG_{it}} + \beta_5 \mathrm{CHARGE\_OFF\_CHNG_{it}} + \beta_6 \mathrm{COVID_{it}} + \beta_7 \mathrm{COVID_{it}} * \mathrm{EBTP_{it}} + \beta_8 \mathrm{LN\_ASSETS_{it}} + \beta_9 \mathrm{GDP\_GR_{it}} + \mathrm{e_{it}} \quad (2)$$

Model 3 represented by equation (3) examines capital management and earnings management by modelling the relationship between loan loss provision as the dependent variable and the Total Risk-Based Capital ratio and the other variables as the explanatory variables.

Model 3

$$\mathrm{LLPR_{it}} = \alpha_0 + \beta_1 \mathrm{TOTAL\_CAP_{it}} + \beta_2 \mathrm{EBTP_{it}} + \beta_3 \mathrm{NPL\_CHNG_{it}} + \beta_4 \mathrm{LOAN\_CHNG_{it}} + \beta_5 \mathrm{CHARGE\_OFF\_CHNG_{it}} + \beta_6 \mathrm{COVID_{it}} + \beta_7 \mathrm{COVID_{it}} * \mathrm{EBTP_{it}} + \beta_8 \mathrm{LN\_ASSETS_{it}} + \beta_9 \mathrm{GDP\_GR_{it}} + \mathrm{e_{it}} \quad (3)$$

Model 4 represented by equation (4) examines capital management and earnings management by modelling the relationship between loan loss provision as the dependent variable and the Leverage Capital ratio and the other variables as the explanatory variables.

Model 4

$$\mathrm{LLPR_{it}} = \alpha_0 + \beta_1 \mathrm{LEV\_CAP_{it}} + \beta_2 \mathrm{EBTP_{it}} + \beta_3 \mathrm{NPL\_CHNG_{it}} + \beta_4 \mathrm{LOAN\_CHNG_{it}} + \beta_5 \mathrm{CHARGE\_OFF\_CHNG_{it}} + \beta_6 \mathrm{COVID_{it}} + \beta_7 \mathrm{COVID_{it}} * \mathrm{EBTP_{it}} + \beta_8 \mathrm{LN\_ASSETS_{it}} + \beta_9 \mathrm{GDP\_GR_{it}} + \mathrm{e_{it}} \quad (4)$$

Where;

$\mathrm{LLPR_{i,t}}$ is the ratio of loan loss provisions to average loans outstanding of bank *i* at time *t*.

$\mathrm{COM\_CAP_{i,t}}$ is the common equity tier 1 capital ratio of bank *i* at time *t*,. As of the end of 2014, commercial banks need to maintain a minimum common equity tier 1 capital ratio of 4 percent.

$\mathrm{TIER1\_CAP_{i,t}}$ is the Tier 1 Risk-Based Capital Ratio of bank *i* at time *t*. The first tier is composed of capital is used to withstand loss without requiring a bank to cease operations. Tier 1 capital includes items such as common stock, disclosed reserves, retained earnings and certain types of preferred stock. As at the end of 2014, the required minimum tier 1 capital ratio is 5.5 percent.

$\mathrm{TOTAL\_CAP_{i,t}}$ is the Total Risk-Based Capital Ratio of bank *i* at time *t*. It adds both the first and second tiers, and the figure is divided by the bank's risk-weighted assets. As of the end of 2014, the required minimum total capital ratio is 8 percent. Tier 2 represents the second layer of a bank's capital and consists of items such as revaluation reserves, hybrid instruments, and subordinated term debt.

$\mathrm{LEV\_CAP_{i,t}}$ is the Leverage Capital Ratio of bank *i* at time *t*. As of the end of 2014, the minimum leverage ratio is 4 percent.

$\mathrm{EBTP_{i,t}}$ is the ratio of earnings before taxes and LLPs to total assets of bank *i* at time *t*.

$\mathrm{NPL\_CHNG_{i,t}}$ is the change in the ratio of non-performing loans to average loans that occurred at the bank *i* at time t with respect to *t-1*.

$\mathrm{LOAN\_CHNG_{i,t}}$ is the change in lending activity volumes of bank *i* at time *t*, measured by the change in total amounts relative to time *t-1*.

$\mathrm{CHARGE\_OFF\_CHNG_{i,t}}$ is the change in the ratio of annualized net charge-offs to average total loans of bank *i* at time *t*, measured by the change in total amounts relative to time *t-1*.

COVID is the dummy variable (1) for observations lying within the Covid regime (i.e., the 2020 calendar years) and (0) otherwise.

$\mathrm{LN\_ASSETS_{i,t}}$ is the natural logarithm of total assets of bank *i* at time *t*.

$\mathrm{GDP\_GR_{i,t}}$ is the annual growth in gross domestic product at constant prices at time *t* with respect to *t-1*.

$\mathrm{e_t}$ is the error term.

Loan loss provisions consist of two components: the first is the discretionary or the unexpected part which is subject to the manager's control. The second is the non-discretionary or expected component that is due to changes in default risk as a result of the ordinary growth of loan portfolios (Curcio and Hasan, 2013). To control for the non-discretionary component, the $\mathrm{NPL\_CHNG_{i,t}}$ variable (the change in the ratio of non-performing loans to average loans that occurred at the bank *i* at time *t* with respect to *t-1*) and the $\mathrm{LOAN\_CHNG_{i,t}}$ variable (the change in lending activity volumes of bank *i* at time *t*, measured by the change in total amounts relative to time *t-1*) variables are used.

With respect to the $\mathrm{NPL\_CHNG_{i,t}}$, it is expected that loan-loss provisions are positively associated with changes in non-performing loans. The non-performing loans model parameter has widely been regarded as an indicator of banking problems and financial stability as several studies emphasize the dynamic behavior of non-performing loans before banking or other period of instability (Hoggarth et al., 2002; and Domac and Peria., 2003). There was a persistent increase in non-performing loans of US and non-US banks during the Covid-19 pandemic that hit the global economy (Tran et al., 2022).

With regards to the $LOAN\_CHNG_{i,t}$ variable, this model parameter can be considered a proxy to reflect general provisions (Curcio and Hasan, 2013). However, the impact of this variable on loan loss provisions primarily depends on the quality of incremental loans. This is because although the change in total loans outstanding should influence the choice of LLPs by bank management. Beaver and Engle (1996) note that a lot of attention focused on non-performing assets after the mid-80s in the attempt to achieve more sustainable long-term stability of the banking system most likely led to bank managers being prevented from lending to less creditworthy customers (Lobo and Yang, 2001).

Following previous studies such as Moyer (1990); Beatty et al. (1995); Ahmed et al. (1999); Anandarajan et al. (2007), Curcio and Hasan (2013), the models 1, 2, 3 and 4 representing the Common equity tier 1, Tier 1 Risk-Based, Total Risk-Based, Leverage Capital Ratios support capital earnings management hypothesis if the signs of the capital ratios are negative. This is consistent with the notion that the banks with the lower capital ratios will reduce their loan loss provisions to enhance their capital ratios by increasing the numerators of the regulatory ratios. The existence of a negative association between primary quality capital and loan loss provisions is the main theory of the traditional capital management hypothesis. A negative sign is therefore expected for the Common equity tier 1 (COM_CAP), Tier 1 Risk-Based (TIER1_CAP), Total Risk-Based (TOTAL_CAP), Leverage Capital (LEV_CAP) regulatory ratio variables.

The $EBTP_{i,t}$ variable representing the ratio of earnings before taxes and loan loss provisions to total assets of bank *i* at time *t*, is the variable used to test for earnings management in the form of the income smoothing hypothesis. There is support for the existence of this hypothesis if the coefficient of the EBTP variable is positive. This means that banks with earnings lower (higher) than their target value will likely reduce (increase) loan loss provisions. As listed banks raise funds from the stock market, a positive sign is expected for the EBTP variable as US listed banks will have an incentive to manage earnings (Anandarajan et al., 2007; Curcio and Hasan, 2013).

The $CHARGE\_OFF\_CHNG_{i,t}$ variable representing the change in the ratio of annualized net charge-offs to average total loans of bank *i* at time *t*, measured by the change in total amounts relative to time *t-1* is modelled. This is because failure to do so yields excessive false rejections against the null of no earnings management in various settings (Basu et al. (2020). A positive sign is expected because a higher charge-off indicates a lower credit quality of the loan portfolio that will positively relate to a higher loan loss provision.

The dichotomous Covid variable is binary variable to control for the impact of the Covid-19 pandemic. The interaction variable COVID*EBTP is included to detect whether U.S. listed banks are likely to engage in opportunistic earnings management in the event of a period of fragility such as the Covid-19 pandemic that adversely impacted the earnings before taxes and loan-loss provisions of banks and their stock market share prices. A negative sign is expected since listed banks obtain financing from the stock market, the banks will have an increased incentive to smooth earnings (Anandarajan et al. (2007); Curcio and Hasan (2013) during the Covid-19 period when stock market prices are depressed. Additionally, this is supported by Cohen et al. (2014) who conclude that firms practising aggressive earnings management are likely to experience a higher probability of going under during a period of fragility such as the Covid-19 pandemic and exhibit dramatic degrees of poor performance during the crisis.

The LN_ASSETS variable representing the natural logarithm of total assets as a measure of bank size is included as a control variable. Consistent with Liu and Ryan (1995), Anandarajan et al. (2007), Curcio and Hasan (2013), it is expected that the coefficient of this variable will be positive. This is because it is expected that as a result of higher volume of lending business, big banks should have larger loan loss provision's relative to smaller banks. In addition, the "political cost" theory postulated by Watts and Zimmerman suggests a positive sign as well. Political Costs Theory states that large profitable firms are subject to relatively higher effective tax rates and regulatory costs. Thus, there is a positive relationship between firm size and the use of earnings management practices via income-reducing accounting methods. Additionally, Mansfield (1962) concludes that higher earnings and the resulting increased political visibility are likely to attract potential rivals, thus increasing competition.

The GDP_GR variable is included as another control variable to control for the pro-cyclical effect of loan loss provisions, in line with the risk management hypothesis (Fonseca and Gonzále, 2008). Consistent with Curcio and Hasan (2013), the 6-year cycle sample period of this study does not afford the authors to consider the full economic cycle, meaning that the results of the analysis need to be interpreted cautiously.

4.2. Testing for Signalling Theory

To test the signalling hypothesis, the one-year ahead change in earnings before loan-loss provisions and taxes to assets is included in the right side of the regression equation (5). Consistent with Curcio and Hasan (2013), the regression model represented by equation (5) is made more parsimonious by dropping the change in the ratio of non-performing loans to average loans (NPL_CHNG) and the change in volumes of lending activity (LOAN_CHNG) variables. The signalling hypothesis states that there is a positive association between discretionary changes in loan-loss provisions and future changes in future earnings. As a result, a positive sign for the coefficient of the variable is expected as in Wahlen (1994), Ahmed et al. (1999), Anandarajan et al. (2007) and in Curcio and Hasan (2013). The model used to test the signalling hypothesis which is Model 5:

Model 5

$$\mathrm{LLPR_{it}} = \alpha_0 + \beta_1 \mathrm{EBTP_{it}} + \beta_2 \mathrm{EBTP\_CHNG_{i,t+1}} + \beta_3 \mathrm{TIER1\_CAP_{it}} + \beta_4 \mathrm{GDP\_GR_{it}} + \mathrm{e_{it}} \quad (5)$$

Where;

$LLPR_{i,t}$ is the ratio of loan loss provisions to average loans outstanding of bank *i* at time *t*.

TIER1_CAPi,t is the Tier 1 Risk-Based Capital Ratio of bank i at time t. The first tier is composed of capital is used to withstand loss without requiring a bank to cease operations. Tier 1 capital includes items such as common stock, disclosed reserves, retained earnings and certain types of preferred stock. As at the end of 2014, the required minimum tier 1 capital ratio is 5.5 percent.$EBTP_{i,t}$ is the ratio of earnings before taxes and LLPs to total assets of bank *i* at time *t*.

$EBTP\_CHNG_{i,t+1}$ is the change in the ratio of earnings before taxes and LLPs to total assets of bank i at time t, measured by the change in total amounts relative to time t+1.

$GDP\_GR_{i,t}$ is the annual growth in gross domestic product at constant prices at time *t* with respect to *t-1*.

e_t is the error term.

The dataset consists of a pooled cross-sectional and time series data. As the t-statistics could be overstated, a panel data modelling estimation technique is utilized where the Hausman test is used to determine if fixed effects or a random effects model is appropriate. This methodology is used to estimate all the models.

5. RESULTS AND ANALYSIS

The descriptive statistics for the full sample estimation are presented in Table 1. The full sample estimation comprising 1,494 observations across 249 U.S. listed banks represent a balanced panel. The mean and median value of LLPR is 0.004 and ranges from a minimum of -0.013 to a maximum of 1.500 with a standard deviation of 0.040. This implies a wide variation that includes negative amounts representing instances where provisions are credits in the income statement and thus are reductions in provision. Likewise, wider dispersions are noted in the control size variable LN_ASSETS and the LOAN_CHNG to a lesser extent. The $CHARGE\_OFF\_CHNG_{i,t}$ variable exhibits highly significant variation with an average value of 0.075, a median value of -0.002 and ranges from a minimum of -41.330 to a maximum of 153.20 and with a standard deviation of 4.11 indicating that considerable randomness in the change in the ratio of annualized net charge-offs to average total loans of bank *i* at time *t*, measured by the change in total amounts relative to time *t-1*. These observed statistics indicate the sample characteristics to be distributed across US listed banks from small to medium to large firms in terms of relative size and lending volume activity.

Table 1: Descriptive Statistics

Variables/Statistics	Observations	Mean	Median	Maximum	Minimum	Std. Dev.
CHARGE_OFF_CHNG	1,494	0.075	-0.002	153.290	-41.330	4.111
COM_CAP	1,494	0.127	0.120	0.506	0.045	0.036
EBTP	1,494	0.014	0.014	0.052	-0.047	0.006
LEV_CAP	1,494	0.102	0.099	0.258	0.040	0.020
LLPR	1,494	0.004	0.002	1.500	-0.013	0.040
LN_ASSETS	1,494	8.610	8.422	15.035	5.862	1.677
LOAN_CHNG	1,494	0.136	0.089	1.250	-0.225	0.167
NPL__CHNG	1,494	0.004	-0.001	1.977	-0.010	0.056
TIER1_CAP	1,494	0.133	0.125	0.506	0.060	0.035
TOTAL_CAP	1,494	0.148	0.139	0.520	0.080	0.035

Table 2 provides pairwise Pearson correlation coefficients of the variables that are used in the regression models for the sample of U.S. listed banks. Among the independent variables, the natural logarithm of total assets (LN_ASSETS) is the only explanatory variable that is positively and statistically significantly associated with the loan loss provisions dependent variable at the 5% level of significance. This result is consistent with the finding of Curcio and Hasan (2013). The Total Risk-Based Capital Ratio (TOTAL_CAP), the change in the ratio of non-performing loans to average loans (NPL_CHNG), are positively, but not statistically significantly, associated with loan-loss provisions.

The GDP growth rate (GDP_GR) is the only independent variable that is negatively and somewhat statistically significantly associated with the loan loss provisions dependent variable albeit at the 10% level of significance. This result is consistent with the studies of Fonseca and González (2008), Laeven and Majnoni (2003),and Bikker and Metzemakers (2015) that find loan loss provisions and GDP growth to be negatively correlated using international samples of banks. This is also inconsistent

with Anandarajan et al. (2007) where the authors find a significant positive correlation coefficient and inconsistent with Curcio and Hasan (2013) that find an insignificant relationship. The ratio of earnings before taxes and LLPs to total assets (EBTP), the common equity tier 1 capital ratio (COM_CAP**),** the Tier 1 Risk-Based Capital Ratio (TIER1_CAP), the Leverage Capital Ratio (LEV_CAP), the change in the ratio of annualized net charge-offs to average total loans (CHARGE_OFF_CHNG), and the change in volumes of lending activity (LOAN_CHNG) variables are negatively, but not significantly associated with loan loss provisions. Even though, the Pearson correlation coefficients analysis has shown associations between the loss provisions and the other variables for U.S. listed banks, a more robust and rigorous econometric analysis is required for further investigation.

Table 2: Pearson Correlation Coefficients of Key Variables

		ln_assets	ebtp	com_cap	tier1_cap	total_cap	lev_cap	charge_off_chng	npl_,chng	loan_chng	llpr	gdp_gr
ln_assets	Pearson Correlation	1	.231**	-.258**	-.205**	-.153**	-.228**	-0.011	-0.040	-0.040	.140**	-.081**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.678	0.125	0.119	0.000	0.002
Ebtp	Pearson Correlation	.231**	1	-0.011	-0.016	0.005	.121**	-0.019	-0.001	-0.045	-0.009	0.023
	Sig. (2-tailed)	0.000		0.668	0.537	0.856	0.000	0.470	0.964	0.085	0.732	0.375
com_cap	Pearson Correlation	-.258**	-0.011	1	.945**	.890**	.685**	.052*	0.017	-.111**	-0.021	0.002
	Sig. (2-tailed)	0.000	0.668		0.000	0.000	0.000	0.043	0.524	0.000	0.411	0.923
tier1_cap	Pearson Correlation	-.205**	-0.016	.945**	1	.922**	.686**	0.048	-0.021	-.133**	-0.012	0.015
	Sig. (2-tailed)	0.000	0.537	0.000		0.000	0.000	0.064	0.417	0.000	0.641	0.568
total_cap	Pearson Correlation	-.153**	0.005	.890**	.922**	1	.656**	0.042	0.012	-.143**	0.007	-0.029
	Sig. (2-tailed)	0.000	0.856	0.000	0.000		0.000	0.107	0.632	0.000	0.799	0.259
lev_cap	Pearson Correlation	-.228**	.121**	.685**	.686**	.656**	1	0.041	-0.002	-0.016	-0.035	.118**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.116	0.925	0.537	0.171	0.000
charge_off_chng	Pearson Correlation	-0.011	-0.019	.052*	0.048	0.042	0.041	1	0.006	.055*	-0.001	0.013
	Sig. (2-tailed)	0.678	0.470	0.043	0.064	0.107	0.116		0.827	0.035	0.958	0.606
npl_,chng	Pearson Correlation	-0.040	-0.001	0.017	-0.021	0.012	-0.002	0.006	1	-0.007	0.002	-0.042
	Sig. (2-tailed)	0.125	0.964	0.524	0.417	0.632	0.925	0.827		0.795	0.953	0.104
loan_chng	Pearson Correlation	-0.040	-0.045	-.111**	-.133**	-.143**	-0.016	.055*	-0.007	1	-0.033	0.039
	Sig. (2-tailed)	0.119	0.085	0.000	0.000	0.000	0.537	0.035	0.795		0.200	0.134
Llpr	Pearson Correlation	.140**	-0.009	-0.021	-0.012	0.007	-0.035	-0.001	0.002	-0.033	1	-.062*
	Sig. (2-tailed)	0.000	0.732	0.411	0.641	0.799	0.171	0.958	0.953	0.200		0.016
gdp_gr	Pearson Correlation	-.081**	0.023	0.002	0.015	-0.029	.118**	0.013	-0.042	0.039	-.062*	1
	Sig. (2-tailed)	0.002	0.375	0.923	0.568	0.259	0.000	0.606	0.104	0.134	0.016	
	N	**1494**	**1494**	**1494**	**1494**	**1494**	**1494**	**1494**	**1494**	**1494**	**1494**	**1494**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The results of Models 1, 2, 3, 4 and 5 are illustrated in Tables 3, 4, 5, 6 and 7 respectively. The Hausman test is performed for each model to investigate if a fixed effects or a random effects model is appropriate. The Hausman test results show that p-value is not significant for all the models except model 5 in Table 7 which shows that the Hausman test is statistically significant at the 5% level. This means that a random effect model is selected for all the models 1, 2, 3 and 4 while a fixed effects model is determined to be appropriate for model 5. Overall, the results show that there is no evidence of systematic capital management as the Common equity tier 1 capital ratio; the minimum tier 1 capital ratio, the total capital ratio of 8 percent, and the leverage ratio are not significant. Thus, this study provides overall evidence that the restrictions on bank activities in form of minimum capital ratios, restrictions in the use of bank capital both official and private have reduced incentives to smooth earnings in the US banking system (Curcio and Hasan, 2013).

The tabulated results of Models 1, 2, 3 and 4 as detailed in Tables 3, 4, 5, and 6 respectively provide no evidence of systematic earnings management as the EBTP variable (the ratio of earnings before taxes and LLPs to total assets of bank *i* at time *t*) is statistically insignificant. This observation is contrary to the finding of Curcio and Hasan (2013) in their paper that earnings management is an important factor that affects provisioning decisions for both EU and non-EU banks such as U.S. listed banks.

Table 3: Model 1-Modelling Capital Management and Earnings Management with the Common Equity Tier 1 Capital Ratio for the Period 2015 to 2020- Random Effects (Dependent Variable: LLPR)

Variable	Coef.	Robust Std. Err.	z	P>z
COM_CAP	0.012	0.018	0.700	0.484
COVID19	0.005	0.007	0.690	0.490
COVID19_EBTP	-0.142	0.199	-0.720	0.474
EBTP	-0.254	0.356	-0.710	0.476
GDP_GR	-0.038*	0.020	-1.910	0.056
LOAN_CHNG	-0.005	0.006	-0.830	0.404
CHARGE_OFF_CHNG	0.000	0.000	1.230	0.219
NPL_CHNG	0.002	0.002	0.860	0.388
LN_ASSETS	0.003	0.003	1.210	0.228
CONSTANT	-0.023	0.021	-1.100	0.271

*Depicts 10% level of significance
Number of observations = 1,494
Hausman test statistic = 3.97 (0.783)

The tabulated results of Models 1, 2, 3 and 4 provide evidence that the dichotomous Covid-19 pandemic variable and its interaction effect with the ratio of earnings before taxes and LLPs to total assets variable are not statistically significant. A possible reason for this result is that the huge Covid-19 Economic Relief intervention funding provided by the U.S. government helped to limit the effects of Covid-19 pandemic on earnings management and capital management during the crisis period. The effect of the U.S. government's Covid's intervention funding is controlled by the GDP_GR variable that measures the annual growth of the gross domestic product of the U.S. economy.

Table 4: Model 2-Modelling Capital Management and Earnings Management with the Tier 1 Risk-Based Capital Ratio for the Period 2015 to 2020 – Random Effects (Dependent Variable: LLPR)

Variable	Coef.	Robust Std. Err.	Z	P>z
TIER1_CAP	0.015	0.021	0.690	0.489
COVID19	0.005	0.007	0.690	0.490
COVID19_EBTP	-0.145	0.201	-0.720	0.469
EBTP	-0.251	0.352	-0.710	0.476
GDP_GR	-0.038**	0.019	-2.060	0.039
LOAN_CHNG	-0.005	0.006	-0.840	0.402
CHARGE_OFF_CHNG	0.000	0.000	1.280	0.202
NPL_CHNG	0.002	0.002	0.860	0.389
LN_ASSETS	0.003	0.003	1.210	0.228
CONSTANT	-0.023	0.021	-1.090	0.277

** Depicts 5% level of significance
Number of observations = 1,494
Hausman test statistic = 4.00 (0.779)

The elasticity of loan loss provisions with respect to GDP_GR (the annual growth in gross domestic product) is negative for Models 1 2,3, and 4 and statistically significant at the 5% level for Models 2 and 3; whilst statistically significant at the 10% level for Models 1 and 4. This result is consistent overall with Curcio and Hasan (2015) that find the GDP growth rate to be negatively associated with the loan loss provisions for non-European banks and statistically significant at the 5% level only.

This result is also consistent with pro-cyclical behavior of banks (Fonseca and González, 2008; Bikker and Metzemakers, 2015; Laeven and Majnoni, 2003).

Table 5: Model 3-Modelling Capital Management and Earnings Management with the Total 1 Risk-Based Capital Ratio for the Period 2015 to 2020 – Random Effects (Dependent Variable: LLPR)

Variable	Coef.	Robust Std. Err.	z	P>z
TOTAL_CAP	0.022	0.025	0.850	0.395
COVID19	0.005	0.007	0.680	0.495
COVID19_EBTP	-0.150	0.202	-0.740	0.459
EBTP	-0.250	0.351	-0.710	0.476
GDP_GR	-0.041**	0.017	-2.420	0.016
LOAN_CHNG	-0.005	0.006	-0.820	0.410
CHARGE_OFF_CHNG	0.000	0.000	1.090	0.278
NPL_CHNG	0.002	0.002	0.860	0.390
LN_ASSETS	0.003	0.003	1.210	0.225
CONSTANT	-0.024	0.022	-1.100	0.269

** Depicts 5% level of significance
Number of observations = 1,494
Hausman test statistic = 4.39 (0.734)

Bank size measured by the natural logarithm of total assets (LN_ASSETS) is found not to be significant for any of the models. This finding is consistent with that of Curcio and Hasan (2013) who find bank size to be neither statistically nor economically significant for non-European banks.

Table 6: Model 4-Modelling Capital Management and Earnings Management with the Leverage Capital Ratio for the Period 2015 to 2020 – Random Effects (Dependent Variable: LLPR)

Variable	Coef.	Robust Std. Err.	z	P>z
LEV_CAP	0.009	0.018	0.480	0.632
COVID19	0.005	0.007	0.690	0.489
COVID19_EBTP	-0.137	0.194	-0.710	0.479
EBTP	-0.257	0.363	-0.710	0.478
GDP_GR	-0.036*	0.021	-1.750	0.080
LOAN_CHNG	-0.005	0.006	-0.830	0.406
CHARGE_OFF_CHNG	0.000	0.000	1.190	0.232
NPL_CHNG	0.002	0.002	0.850	0.393
LN_ASSETS	0.003	0.003	1.210	0.226
CONSTANT	-0.022	0.019	-1.110	0.269

* Depicts 10% level of significance
Number of observations = 1,494
Hausman test statistic = 4.04 (0.775)

In addition, the tabulated results of Model 5 in Table 7 show no evidence of signalling of private information to outsiders by US listed banks as the coefficient of the one-year ahead change in earnings before loan-loss provisions and taxes to assets (EBTP_CHNG) variable although statistically significant at the 1% level is negative and not positive. Again, this contrasts with the finding that non-EU banks such as U.S. listed banks use LLPs to signal private information of a bank's future profits to outsiders (Curcio and Hasan, 2013).

Table 7: Model 5-Modelling Testing for the Signalling Theory with the Tier 1 Risk-Based Capital Ratio for the Period 2015 to 2019 – Fixed Effects (Dependent Variable: LLPR)

Variable	Coef.	Robust Std. Err.	t	P>t
EBTP	0.064**	0.029	2.25	0.026
EBTP_CHNG	-0.001***	0.001	-2.73	0.007
GDP_GR	-0.029***	0.010	-2.99	0.003
TIER1_CAP	-0.007	0.005	-1.40	0.162
CONSTANT	0.002**	0.008	2.09	0.037

*** Depicts 1% level of significance
** Depicts 5% level of significance
Number of observations = 1,245[1]
Hausman test statistic = 8.90 (0.031)

Further, the dataset comprises a pooled cross-sectional and time series data. This means that the t-statistics could be overstated. A panel data modelling estimation technique is therefore implemented where the Hausman test is used to test if a fixed effects or a random effects model is appropriate. As a test for robustness, a pooled regression analysis was performed. As an additional test for robustness, a dynamic panel data analysis using the Arellano-Bond GMM technique was also performed to control for potential problems relating to possible endogeneity and panel data bias. The results for these tests (not shown) are robust and consistent with the results reported earlier. Another issue relates to survivorship bias. None of the sampled banks filed for bankruptcy during the sample period. It was not possible to identify from the data, cases of mergers and acquisitions during the sample period. Although this does not remove survivorship bias, consistent with Curcio and Hasan (2013), it is not expected that it will influence the results obtained.

6. FINDINGS AND CONCLUSIONS

This study examines earnings and capital management, the impact of the Covid pandemic and signalling by banks of loan loss provisions for U.S. listed banks for the 6-year period 2015 to 2020 consisting of 1,494 observations. As of the end of 2014, banks need to maintain a minimum required capital ratios. Consequently, there is the need to assess the impact of the Covid-19 pandemic on earnings management and capital management as well as to examine the existence of signalling by U.S. listed banks since the inception of these new banking regulatory capital ratios for U.S. banks. The study has several important findings and contributes in several ways.

First, there is no evidence of systematic capital management as there is no statistically significant relationship between loan loss provisions and the Common equity tier 1 capital ratio; the minimum tier 1 capital ratio, the total capital ratio of 8 percent, and the leverage ratio since the new banking regulatory capital ratios came into force the end of 2014.

Second, there is similarly no evidence of systematic earnings management using loan loss provisions by U.S. listed banks. These results provide evidence of the success of restrictions due to tighter bank regulation and supervision that came into effect at the end of 2014.

Third, the dichotomous Covid-19 pandemic variable and its interaction effect with the ratio of earnings before taxes and LLPs to total assets variable are not statistically significant. A plausible explanation for this result is that the massive Covid-19 Economic Relief intervention funding provided by the U.S. government helped to mitigate the effects of Covid-19 pandemic on earnings management and capital management during the crisis period.

Fourth, the elasticity of loan loss provisions with respect to the annual growth in gross domestic product is negative and statistically significant overall. This is evidence that U.S. listed banks loan loss provisions are characterized by a pro-cyclical nature which is consistent with previous empirical evidence that is well documented in the literature.

Finally, in contrast to the documented literature, there is no evidence to support the idea that U.S. listed banks use loan loss provisions to signal a bank's future profits to outsiders. This study will therefore assist regulatory bodies and standard setters not only in the U.S. but also globally. This is because the required maintenance of a minimum common equity tier 1 capital ratio of 4 percent, a minimum tier 1 capital ratio of 5.5 percent, a minimum total capital ratio of 8 percent, and a minimum leverage ratio of 4 percent by U.S. banks as of the end of 2014 presents a model that is recommended be adopted by other

[1] As the most recent data point collected is for the calendar year 2020, it is not possible to calculate the change in the ratio of earnings before taxes and loan loss provisions to total assets of bank *i* at time *t*, measured by the change in total amounts relative to time *t+1* for the 2020 data point. Hence, the total number of observations for the sample estimation reduces by one full year's observations from 1,494 to 1,245 observations to test the signalling hypothesis in Model 5 (Table 7).

bank supervisors and regulators worldwide to limit opportunistic practices of capital management, earnings management, and signalling.

A possible avenue for future research is to extend the analysis to unlisted U.S. banks. Another suggestion is to examine relationship between earnings management, capital management and available corporate governance characteristics for U.S. listed banks since the end of 2014 when US banks are required to maintain new minimum capital ratios.

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THE ROLE OF REAL EARNINGS MANAGEMENT IN THE VALUE RELEVANCE OF ACCOUNTING INFORMATION IN INDONESIA

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ABSTRACT

Purpose- One feature that should be integrated in financial statements to be relevant to decision-makers is the relevance of the information to the users. When the value and usefulness of accounting information used to gauge business financial performance are undermined by earnings management methods, problems arise. As a result, the information presented may deceive financial statement users about the corporation's financial performance. Because IFRS demands managerial judgment in the accounting process by definition, its adoption may even increase the chance for real earnings management (REM). This study aims to examine the impact of REM to the value relevance of accounting information before and after IFRS adoption.

Methodology- The population was manufacturing companies listed on the IDX, with samples 230 firm year observations consists of one hundred fifteen firms year before adoption of IFRS and one hundred fifteen firms year after IFRS adoption. this study used firms' abnormal levels of cash flows, production costs, and discretionary expenditures as proxies for real earnings management. Using a price model and panel data, the main result confirms that real-based earnings management has an impact on the value relevance of earnings and book value of equity before IFRS adoption, but has no effect after IFRS adoption.

Findings- The findings revealed that prior to the adoption of IFRS, real earnings management was employed by companies that had higher earnings value relevance and lower equity book value relevance than companies that did not apply earnings management. After the adoption of IFRS, there is no significant effect of real earnings management on the value relevance of earnings and equity book value.

Conclusion- The results show that investors believe that earnings are a signal from managers with the implementation of real earnings management prior to the adoption of IFRS, but after the adoption IFRS, they may not be able to do so.

Keywords: Real earnings management, value relevance, accounting information, earnings, equity book value,
JEL Codes: M40, M41, M49

1. INTRODUCTION

Financial reports serve the useful purpose of giving a general overview of an entity's financial position, overall performance, and changes for various users in making financial decisions with the necessary awareness to help, for example, the achievement of the company to come (IASB, 2018) and to propose the financial status of the current company to shareholders and the public (Krause & Tse, 2016). .

Accounting is employed in financial reports as a tool to recapitulate all company transactions for recognition, measurement, and dissemination, which is important since it incorporates relevance and reliability (Tahat & Alhadab, 2017). These are the features that underpin accounting numbers in the IASB Conceptual Framework (FASB) for Financial Reporting.

The capital market necessitates appropriate accounting data that may be used to make effective and efficient judgments (Chen et al., 2016). Increasing capital market investment has an impact on capital market strength and economic growth. Accounting figures are used by investors to determine stock prices, and firms that provide high-quality information benefit from cheaper capital expenditures (Balagobei, 2017). Numerous studies have been conducted to examine the value and

relevance of accounting information, including financial reports, which was carried out, among other things, by examining the correlation between accounting information and stock prices or stock returns (Sutopo et al., 2018). There are compelling arguments in the value relevance literature for adopting profit as the key measure of financial information (Mirza et al., 2020).

In order to be used as the main tool for making decisions, financial reports must be of high calibre (Ernawati & Aryani, 2019). The expansion of worldwide commerce involves the use of universal accounting standards. In response to the requirements of this standard, the International Accounting Standards Board (IASB) published International Financial Reporting Standards (IFRS). The total implementation of IFRS in Indonesia began in 2012. This attracted a large number of academics to conduct studies on the overall impact of IFRS adoption on the company's financial reporting process.

Many developing countries have inefficient and immature capital markets (Black & Nakao, 2017). The condition of the Indonesian Stock Exchange has not proven that there is the required level of efficiency in the capital market (Natapura, 2009), on the other hand there is concentrated ownership (Black & Nakao, 2017), weak institutions (Alshyoukh & Manaf, 2018), or a lack of compliance with implementing regulations (Outa, 2011) . The literature notes that there are differences between developing countries and developed countries in highlighting the effect of IFRS adoption. In developing countries, there are findings that high quality standards will help these countries improve the quality of their financial reporting (Ismail et al., 2013).

In general, widely accepted accounting rules provide managers some leeway in deciding which accounting technique to apply for their organization. Managers are presumed to want to make decisions on the best accounting technique for the firm, resulting in earnings management (Healy & Wahlen, 1999). Investors seldom use manipulated data when making judgments, therefore their reaction to the data is no longer reflected in the company's stock price (Chandrapala, 2013).

Earnings management may be accomplished in a variety of ways. According to the literature, one of the most prevalent techniques is to manage accruals using accounting judgments. This is referred to as accrual-based earning management. Companies frequently engage in real-earnings management to misappropriate earnings in addition to the accrual earnings management (Dechow & Skinner, 2000). Roychowdhury (2006) devised an empirical method for escribing actual earnings management. The findings show that managers avoid reporting losses by performing real-earnings management.

The earnings management phenomenon that occurs in Indonesia in the financial reports of Garuda Indonesia, PLN, and Pertamina has the same pattern, namely the recognition of earnings that is larger than it is. The Management manages earnings by recognizing unearned income on receivables from related parties from each of the company's transaction partners. The distinction is that the debtor in the case of Garuda Indonesia is a private corporation. Meanwhile, in the case of the PLN and Pertamina, the government is obligated to pay the loan.

Based on the many incidents of earnings management, it can be inferred that management frequently manipulates financial reports to make them seem good to outside parties. corporations with modest earnings are designed to be larger in order to appear larger to outside parties, whereas corporations with huge profits are designed to be smaller in order to reduce the tax burden. Earnings management efforts all have one goal: to make financial reports seem good in the eyes of the public, particularly investors.

Previous research has indicated that the combined outcomes of the earnings management and value relevance connection Earnings management has been identified as an issue that impacts earnings quality (e.g., Klann and Beuren 2018); value relevance (Callao, Cimini, and Jarne 2016; Shan 2015); and business value (Azaria & Muslichah, 2021). As a result, while evaluating organizations, market participants will move from earnings to book value (Marquardt & Wiedman, 2004). It has been established through prior research that earnings management decreases the relevance of earnings value (Mostafa 2017; Altintas, et al., 2017) laba, and the relevance of book value (Habib, 2004), but Oraby (2017) demonstrates that earnings management is irrelevant since it has no effect on stock prices.

By investigating the value and usefulness of accounting data under IFRS standards in Indonesia, a developing stock market, this study attempts to provide evidence of the unintended consequences of IFRS adoption, which is important, given the scarcity of information accessible to developing country investors, such an investigation is worth considering. Although there are many studies on the value relevance of accounting information in developed markets, value relevance studies in developing countries are rarely documented (Dosamantes, 2013). This research contributes to body of knowledge by providing empirical information regarding the usefulness and significance of accounting data in Indonesia as a developing country, both before and after the implementation of IFRS.

Based on the description above, research is needed on the effect of earnings management on the relevance of earnings and book value of equity before and after the implementation of IFRS in Indonesia. While the results of this study are as follows: first, prior to IFRS adoption, companies that applied real earnings management had higher earnings value relevance and a lower book value of equity value relevance compared after IFRS adoption. Second, There is no effect of real earnings management on the value relevance of earnings and the book value of equity.

2. LITERATURE REVIEW

2.1. Value Relevance of Accounting Information

The value of accounting information is relevant because of the net surplus hypothesis, which asserts that the company's worth is represented in the accounting figures in the financial statements (Feltham & Ohlson, 1995). Accounting data, which include financial reports, might influence user investment and credit decisions (Krause & Tse, 2016; Comiran, Fedyk, & Ha, 2018). Accounting information is significant when it can explain stock values, such as earnings or book value. According to the net surplus theory, the profit-equity connection can explain a company's market value. Profit, according to this so-called net surplus relationship, is the decisive element in changes in equity transactions such as dividend payments and equity investments. Stock prices may be assessed by earnings and decided by equity as a result of this connection. Furthermore, the theory generates a measuring technique that demonstrates that a company's market value may be stated using financial components such as balance sheets and income statements.

2.2. IFRS Adoption in Indonesia

IFRS convergence was the one of the outcomes reached by the Indonesian authorities at the G20 Forum meeting in Washington, DC on November 15, 2008. In Indonesia, the IFRS convergence process is complete adoption, selective adoption with interlude, and adoption with amandemen to accommodate for the country's unique characteristics. As a result, Indonesia eventually accepted IFRS as its nearest accounting standard and made minimal changes to Indonesian regulations and the corporate environment.

The terraced IFRS convergence technique has introduced different tiers to the IFRS convergence program. The first spans the extended period from 2007 to 2012. The primary goal of this part is to reconcile IFRS with Indonesian accounting requirements. In general, Indonesian accounting rules in 2012 were the same as those in effect on January 1, 2009. Meanwhile, from January 1, 2015, PSAK utilized in Indonesia will converge with IFRS in general, which went into force on January 1, 2014, minimizing the gap between the two standards from three years on January 1, 2012 to one year on January 1, 2015. This is Indonesia's pledge to serving as Southeast Asia's single G20 member.

Many studies have been conducted to determine if a transition from GAAP to IFRS would result in an increase in accounting quality by taking into account the normative, positive repercussions of IFRS. However, past research' findings have not proven conclusive. Although several studies have documented an increase in the value and relevance of accounting information (Suadiye 2012; Isaboke & Chen 2019; Erin, Olojede, & Ogundele 2017; Bhatia and Mulenga 2019), there are other findings that show a limited increase in value relevance (e.g., García et al. 2017; Kadri, Aziz, & Ibrahim 2010) while other studies show no increase (e.g., Filip and Raffournier 2013 or even negative results (Negakis, 2013). Many reasons have been proposed to explain the inconsistent results. According to Ball and Shivakumar (2006), there are too many different components in a corporation that lead IFRS to lack clarity and quality of information. According to Pelucio-Grecco et al. (2014), other crucial elements, such as country-specific characteristics, demonstrate that research on IFRS adoption is scarce, particularly throughout the convergence phase. In the accounting literature, the focus is mostly on accruals and earnings in terms of the impact of earnings management strategies on accounting numbers (Boujelben et al., 2020).

2.3. Opportunistic and Informational Real Earnings Management

One of the primary distinctions between accrual earnings management and real earnings management is that the former has no influence on cash-based accounting information, such as that of the CFO, because it happens as a result of accounting technique modifications that directly affect accrual-based data. Nonetheless, the latter has a significant impact on the CFO because, according to Roychowdhury (2006), real earnings management represents managerial efforts that are distinct from routine operational tasks. According to Zang (2012), Cohen & Zarowin (2010), and Andreas (2017), enterprises that choose to control their results through real earnings management are more likely to disclose negative cash flows from operations. According to Ho, et al. (2015), whereas accrual-based earnings management declined with IFRS adoption, businesses were

more likely to create real earnings management. As a result, it is predicted that real earnings management may increase the risk of changes in the relevance and trustworthiness of the CFO's current value as one of the most essential pieces of information for decision making by some of the most important consumers of financial statements.

Earnings has been implied as a primary measure in accounting and investigated as a "summary" of a firm's activities, capable of summarizing a firm's past and present accomplishments and serving as an input to forecasting future performance, primarily sought as a measure of value, a predictive tool, and a measure of assessing investment opportunities (Leal et al., 2017).. Previous empirical study on financial data for economic decision making has concentrated on earnings, book value of equity, dividends, accruals, and cash flows.

The empirical question is whether earnings or book value can be used to determine firm value. The main source of earnings dominance, according to the financial reporting conceptual framework developed by the IASB, is accrual-based income, which is the main financial data for estimating the future cash flows of a business, assisting investors in making sound economic decisions (IASB, 2018).

Earnings management causes a company's earnings rate to become substantially more unpredictable (Marquardt & Wiedman, 2004). The present literature highlights that the value of earnings becomes less relevant as investors become more reliant on the book value of equities and other financial information (Dedman, et al. 2017; Mirza, et al. 2018). As a result, for a better understanding of the value and relevance of financial information for making wise economic decisions about investments, taking into account the book value of equity and other financial information is crucial (Mirza et al., 2020).

Because earlier research on effect of earnings management on the quality of reported accounting numbers has generally focused on the influence of accrual earnings management strategies on earnings-based evidence, The main objective of this study is to close this gap by investigating whether real earnings management causes changes in investors' preferences in investing, shifting from earnings valuation to book value. According to the preceding debate, the company's involvement in profits manipulation has diminished its effectiveness in making economic judgments.

3. RESEARCH METHOD

3.1. Population and Sample

The population in this research comprises manufacturing companies that were registered on the Indonesia Stock Exchange (IDX) between 2007 and 2016. Manufacturing businesses were chosen because, being the largest category of enterprises on the IDX, they exhibit similar accrual characteristics. Because IFRS went into effect on January 1, 2012, the testing period began five years before and after that date, resulting in the 2007-2016 research period. The sample strategy utilized was basic random sampling because the population's members are homogeneous.

From 2007 to 2016, data was gathered from the Indonesian Stock Exchange (IDX) database. The end of each company's fiscal year was determined, and the data was divided into five-year periods before and after the implementation of IFRS. Because IFRS was fully implemented on January 1, 2012, the financial statements for the inaugural period of IFRS standard adoption are reports generated for the 12 fiscal months ending December 31, 2012.

For this study, financial reports from the IDX were combined with notes from the Indonesian Capital Market Directory (ICMD), while information on publication dates, financial reports, and stock prices were sourced from PT Indonesian Capital Market Electronic Library (ICaMEL). Using a random sample approach, the patterns acquired include 115 observations prior to IFRS implementation and 115 observations after IFRS adoption from manufacturing businesses listed on the Jakarta Stock Exchange (IDX).

3.2. Variable Measurement

3.2.1. Real Earnings Management

Following Roychowdhury (2006), this study used firms' abnormal levels of cash flows, production costs, and discretionary expenditures as proxies for real earnings management. Specifically, the normal level of cash flows, production costs, and discretionary expenditures are modeled as follows:

$$CFO_{it}/A_{it-1} = \alpha_0 + \alpha_1(1/A_{it-1}) + \beta_1(S_{it}/A_{it-1}) + \beta_2(\Delta S_{it}/A_{it-1}) + \epsilon_{it} \quad (1)$$

$$PROD_{it}/A_{it-1} = \alpha_0 + \alpha_1(1/A_{it-1}) + \beta_1(S_{it}/A_{it-1}) + \beta_2(\Delta S_{it}/A_{t-1}) + \beta_3(\Delta S_{it-1}/A_{it-1}) + \epsilon_{it} \quad (2)$$

$DISEXP_{it}/A_{it-1} = \alpha_0 + \alpha_1(1/A_{it-1}) + \beta(S_{it-1}/A_{it-1}) + \epsilon_{it}$ (3)

Where:

CFO_{it} : operating cash flows adjusted for extraordinary items and discontinued operations of firm i in year t
A_{it-1} : total assets of firm i in year t–1
S_{it} : total sales revenue of firm i in year t
ΔS_{it} : change in sales revenue of firm i in year t
$PROD_{it}$: production costs offirm i in year t, defined as the sum of cost of goods sold and the change in inventories
$DISXP_{it}$: discretionary expenditures of firm i in year t, defined as the sum of advertising expenses, research and development expenses, and selling, general, and administration expenses.
ε_{it} : other relevant information firm i during year t

For each firm-year, the cross-sectional regressions of models (1) to(3) were estimated. The abnormal CFO, abnormal PROD, and abnormal DISX were computed as the difference between the actual values and the normal levels estimated from models (1) to (3). There were three continuous variables created, i.e. AB_CFO, AB_PROD, and AB_DISX, to measure the extentof abnormal operating cash flows, abnormal production costs, and abnormal discretionary expenditures, respectively.

To obtain consistent estimations across different measures so that a higher value of each measure indicates the extent of the real earnings management, the abnormal CFO and abnormal DISX were multiplied by negative one (-1): AB_CFO = (–1)*abnormal CFO and AB_DISX = (–1)*abnormal DISX. AB_PROD is defined as the abnormal PROD. An aggregate measure, AB_REM, was also operated to capture the total effects of the real earnings management. AB_REM is defined as AB_CFO + AB_PROD + AB_DISX. Similar to the accrual-based earnings management, a value of 1 (one) was assigned to REM if AB_REM waspositive, and zero for otherwise.

3.2.2. Value Relevance

The model was frequently utilized in the literature (for example, Burgstahler & Dichev, 1997). In accordance with these research, the model is as follows:

$$P_i = \alpha_0 + a_1\ EPS_{it} + \alpha_2\ BV_{i,t} + \alpha_3\ REM_{it} + \alpha_4\ REM_{it} \times EPS_{it} + \alpha_5\ REM_{it} \times BV_{i,t} + \varepsilon_{it} \quad (4)$$

Where:

P_{it} : share price firm i during year t
EPS_{it} : earnings per share firm i during year t
$BVPS_{it}$: book value of equity firm i during year t
REM_{it} : real earnings management firm i during year t
ε_{it} : other relevant information firm i during year t

Ohlson's model was expanded to investigate the impact of real-based earnings management (REM) on the relevance of earnings and book values before and after the implementation of IFRS. The equation shows the regression model used to observe this impact. In the context of real-based earnings management, the slope coefficient a4 expresses the value relevance of earnings. Similarly, the slope coefficient a5 denotes the importance of book value in the context of real-based earnings management. It is projected that a4 is negative, suggesting that the value of earnings is less relevant in companies that practice real earnings management. On the other hand, a5 is expected to be positive, indicating greater value relevance to the book value of equity as the market shifts its confidence from earnings to the book value of equity.

3. FINDINGS AND DISCUSSION

Table 1 shows the sample distribution based on the manufacturing industry sub-sector classified in the Indonesia Capital Market Directory (ICMD), with a total sample of 230 samples.

Table 1: Sampling Framework

Sub Sektor	Jumlah Perusahaan	Jumlah Perusahaan- Tahun
Stone, clay, glass, concrete products	1	10
Electronic	1	20
Automotive & similar products	5	40
Apparel & other textile products	2	20

Adhesives	2	20
Pharmacy	3	30
Paper & similar products	1	10
Cement	1	10
Metals & similar products	3	30
Textiles & mills	1	10
Plastic	1	10
Consumer goods	1	10
Tobacco	1	10
Total	23	230

Table 2 presents the results of the descriptive statistical tests of the main research variables, which consist of stock log prices, earnings, book value of equity, and real earnings management.

Table 2: Descriptive Statistics

	Minimum		**Maxsimum**		**Mean**		**Standard Deviation**	
Variable	Pre IFRS	Post IFRS	Pre IFRS	Post IFRS	Pre IFRS	Post IFRS	Pre IFRS	Post IFRS
LOGPRICE	1.673	2.021	4.99	5.301	2.850	3	0.651	0.662
EPS	-253	-2394	10.320	8.019	505.38	409.94	1345	1264
BV	-2242	-2372	22.062	26.012	2119	2747.02	3537	5074
REM	0.00	0.000	1.000	1.000	0.574	0.513	0.497	0.502

Before and after IFRS adoption, the mean real earnings management (REM) values were 0.574 and 0.513, respectively, suggesting that 57.4% and 51.3% of firm-years produced positive real earnings (real earnings management by growing earnings). The average log stock price after IFRS implementation is 3.00, up from 2.850 before IFRS adoption, suggesting that the average stock price after IFRS adoption is higher than before IFRS adoption.. The average EPS was 505 before and 410 after IFRS introduction, showing that the typical business enjoyed greater positive profits per share before than after IFRS adoption. The average book value is 2119 and 2747, respectively, indicating that the average book value after IFRS implementation is larger than the average book value before IFRS adoption.

Table 3 shows the findings of several regressions which attempt to look at the influence of real earnings management on earnings relevance and book value of equity before and after IFRS implementation.

Table 3: Results of tests H1, H2, and H3

Variable	**Before IFRS Adoption**	**After IFRS Adoption**
C	2.57	2.8445
	(0.0000)	(0.0000)
EPS	-0,0003	1.2×10^{-4}
	(-2.18)	(2.0308)**
BV	0,00023	5.8×10^{-5}
	(4.22483)***	(3.7831)***
REM	0.02111	-0.1456
	(0.171632)	(-1.3797)
REM x EPS	5.59×10^{-4}	9.33×10^{-6}
	(1.82507)*	(0.50)
REM x BV	-1.79×10^{-4}	9.6×10^{-6}
	(-2.1511)**	(0.25)
F_stat	17.2116	22.15
	(0.0000)	(0.0000)
Adj R^2	0.4156	0.48
N	115	115

Prior to the implementation of IFRS, there was a positive and substantial interaction between REM and EPS on stock prices at a 10% level, with a coefficient of 5.59 x 10^{-4}, and a negative interaction between REM and BV on stock prices at a 5% level, with a coefficient of -1.79 x 10^{-4}. This suggests that prior to the implementation of IFRS, firms that used real earnings management had higher earnings value relevance and lower equity book value relevance than companies that did not use real earnings management. This demonstrates that prior to the adoption of IFRS, real earnings management led investors to believe that the measure of earnings was more reliable than the book value of equity or that earnings information was information or signals from managers.

After the adoption of IFRS, the relationship between REM x EPS and stock price is not significant as well as the relationship between REM x BV and stock price, with coefficients of 9.33 x 10^{-6} and 9.6 x 10^{-6}, respectively.This indicates that after adopting IFRS, organizations who practice real earnings management do not see a change in the relevance of the value of earnings, and the book value of equity as well. These findings suggest that, following the introduction of IFRS, the market may be unable to discern between opportunistic real earnings management and genuinely beneficial information.

4. CONCLUSION

This study focuses on whether real earnings management affects the relevance of the value of earnings and the book value of equity both before and after the implementation of IFRS. The data reveal that prior to IFRS adoption, companies that applied real earnings management had higher earnings value relevance and a lower book value of equity relevance compared after IFRS adoption. There is no effect of real earnings management on the significance of earnings and the book value of equity after the implementation of IFRS. This demonstrates that prior to the adoption of IFRS, with the implementation of real earnings management, investors assumed that earnings were a signal from managers; however, after the adoption period, with the implementation of real earnings management, investors may be unable to distinguish whether earnings are managed opportunistically or informationally. As a limitation of this study, only two forms of accounting information are are utilized namely earnings and book value of equity to evaluate stock prices, and only the price model is used in the valuation model. In the future, valuation models should employ the return model together with other accounting data like as cash flow and dividends .

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