



## USING EXPONENTIAL SMOOTHING METHOD IN FORECASTING DOMESTIC CREDIT TO PRIVATE SECTOR OF GHANA

Usando o método de suavização exponencial na previsão de crédito doméstico para o setor privado de Gana

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**Abstract:** The private sector of Ghana faces many problems with respect to raising capital for their operations; this is largely due to government relying heavily on the local credit market for funds for developmental projects. This study uses exponential smoothing method (ESM) in EVIEWS to build a single sample model to forecast future domestic credit to private sector (DCPS) values in Ghana. Secondary annual data on DCPS spanning the period from 1982 to 2016 is used. The findings show that an exponential smoothing model with multiplicative error, additive trend and no seasonality fits the data best. The model had very small residual measures, which demonstrates a good model for forecasting. The estimated model is used to forecast the DCPS values for Ghana from the year 2017 to 2020. The results of this study will help private business people plan for the future. The results will also help policy makers to make informed decisions and formulate policies to improve the DCPS figures, since the private sector is the engine of growth, and crowding out would not be in the best interest of the government and the nation as a whole.

**Key words:** Domestic credit forecast; Regression forecasting; Ghana private sector; Bank credit

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## USANDO O MÉTODO DE SUA VIZAÇÃO EXPONENCIAL NA PREVISÃO DE CRÉDITO DOMÉSTICO PARA O SETOR PRIVADO DE GANA

Using exponential smoothing method in forecasting domestic credit to private sector of ghana

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**Resumo:** O setor privado de Gana enfrenta muitos problemas com relação à captação de capital para suas operações; isso se deve em grande parte ao fato de o governo depender fortemente do mercado de crédito local para obter recursos para projetos de desenvolvimento. Este estudo usa o método de suavização exponencial (ESM) no EVIEWS para criar um modelo de amostra única para prever futuros valores de crédito interno ao setor privado (DCPS) no Gana. São utilizados dados anuais secundários sobre o DCPS no período de 1982 a 2016. Os resultados mostram que um modelo de suavização exponencial com erro multiplicativo, tendência aditiva e sem sazonalidade se ajusta melhor aos dados. O modelo possuía medidas residuais muito pequenas, o que demonstra um bom modelo para previsão. O modelo estimado é usado para prever os valores do DCPS para Gana do ano de 2017 a 2020. Os resultados deste estudo ajudarão as empresas privadas a planejar o futuro. Os resultados também ajudarão os formuladores de políticas a tomar decisões informadas e a formular políticas para melhorar os números do DCPS, já que o setor privado é o motor do crescimento, e a exclusão não seria do melhor interesse do governo e do país como um todo.

**Palavras chave:** Previsão de crédito doméstico; Previsão de regressão; Setor privado de Gana; crédito bancário

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## 1 Introduction

The private sector is the focus for the current government of Ghana who took office after winning the December 2016 general elections. Most of the promises made to the electorates to compel them to vote massively in favor of this government are private sector driven. The big ones that will resonate in the ears of the electorates for a long time, and may be the yardstick to measure the performance of this government after the four years tenure are the —one village, one dam and —one district, one factory. Therefore, for this government to remain appealing to the voters in the next election, it has no choice, but to strengthen the private sector to help in fulfilling their promises.

According to (Hauner, 2008), there is a huge negative impact of domestic credit to government on bank deepening in developing countries, but no effect in advanced economies. The study also found that, though, credit to government increases profitability, it decreases efficiency drastically in developing countries, meanwhile, in advanced economies, there is no significant impact on profitability, but there is a positive impact on efficiency. (Hauner, 2008) concluded that, though the practice shows no effect on developed economies, it has long-term negative repercussions on financial development in developing countries and might eventually cause crowding out of the private sector. In another study, (Kumhof & Tanner, 2005) opined that domestic banks are very much exposed to government debt because private lending is more risky under the existing legal and institutional imperfections. This exposure puts banks and their borrowers at the mercy of governments' debt policies.

This study aims at building a time series model that can be used to forecast future domestic credit figures to create awareness in the private business community, which will help them to plan. It will also inform policy makers to make informed decisions, which will help in national development. The results of this study will also enrich further, the already good literature that exists in forecasting.

The rest of the paper is organized as follows: Section 2 reviews existing literature relating to this study, section 3 discusses the methods used in data collection and analysis. Section 4 enumerates all the findings of the study and it contains the discussions. Finally, section 5 concludes the study and lists some recommendations.

## 2 Literature Review

Domestic credit to the private sector (DCPS) has been in focus in recent times, with most of the studies establishing relationships between DCPS and economic growth. (Osman, 2014) applied autoregressive distributed lag (ARDL) as an approach to cointegration to show that there is a positive long-run and short-run relationship between private sector credit and economic growth. (Lane & McQuade, 2014) established that domestic credit growth in European countries is strongly related to net debt inflows but not to net equity inflows. (Perez, 2017) studied the long run determinants and short dynamics that impact credit growth performance and found that there is a long run relationship between credit growth, domestic banks' equity and non-performing loans. (Shijaku & Kalluci, 2013) evaluated the long-run determinants of bank credit to the private sector and established that there exist an adjustment mechanism that brings bank credit back to equilibrium. Their work further found that lending is positively linked to economic growth. In addition, they proved that banking and financial intermediation, coupled with financial liberalization stimulate higher lending demand.

Other studies have been done on fitting appropriate models to predict relationships between domestic credit and other variables in the context of Africa. In Nigeria, (Emecheta & Ibe, 2014) applied reduced vector autoregressive (VAR) and established a significant positive relationship between bank credit and economic growth. In a similar work, still on Nigerian, (Emenike, 2016) used cointegration method to establish a long-run relationship between monetary policy and private sector credit. (Olowofeso, Adeleke & Udoji, 2015), however, used cointegration to show the existence of a significant positive relationship between private sector credit and output.

Existing literature has shown that little research has been done on Africa in the area of DCPS, and there is no evidence of any study that talks about the DCPS data of Ghana. Another gap in the literature is the lack of the usage of exponential smoothing method (ESM), though several studies including (Kim & Jung, 2018) have praised ESM for its optimal results in the framework of innovative space model. ESM has been used extensively in the sciences, example, (Shao-Hsien & Tsai, 2018) used ESM for prediction and analysis of thermal diffusion for understanding the influence and change brought by electric current on nickel base materials. Also, (Duan&Niu, 2018) applied ESM to forecast lake area changes in Wuhan (Makridakis et al., 1979) investigated the relative accuracy of different time series forecasting methods, and concluded that the exponential smoothing method gives more accurate forecast figures than the many other complicated methods. Meanwhile,(Makridakis and Winkler, 1983) investigated the accuracy of average forecast results obtained from the use of different methods, and found that forecast accuracy improves, and variability of the accuracy among different combinations decreases as the number of methods in the average increases. Furthermore, (Winkler and Makridakis, 1983) concluded from their study that combined forecast obtained through weighted averages were more accurate than the individual forecasts, and even outperforms forecasts obtained from simple unweighted average of the same methods.

Though, there are many approaches proposed by existing literature, the researchers chose ESM because of the popularity it has gained for its simplicity, accuracy in forecasting and having gained the praise of many astute researchers including(Makridakis et al., 1979), for being the best single sample forecasting model.

### 3 Research Methodology

After a detailed analysis of the pattern in the DCPS data, time series analysis is proposed for forecasting future DCPS values. The method used is the exponential smoothing method with linear trend.

#### 3.1 Data collection method

The data used in this study is a secondary data retrieved from the database of the International Monetary Fund (IMF). It comprises of annual DCPS figures of Ghana as a percentage of gross domestic product (GDP) from 1982 to 2016. This period is chosen since 1981 marks the end of coup d'états in Ghana, hence data from this period is bound to capture the right effects.

The variable being analyzed is DCPS by banks in Ghana; which refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable that establish a claim for repayment. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available.

#### 3.2 Data analysis

Exponential smoothing is a relatively simple but robust approach in practice. It is widely used to produce a smoothed time series (Gardner, 1985) and it performs well in empirical studies (Boudoukh, Richardson & Whitelaw, 1997). More importantly, previous studies show that all exponential smoothing methods are optimal forecasts in the framework of innovations state space (ISS).

The analysis is in three parts, firstly, the raw data is summarized to present the data in an intelligible format for the characteristics of the data to be easily seen, followed by the fitting of the time series model. Finally, residual analysis is done to measure the strength of the model with respect to forecasting. EViews is used to carry out the analysis to achieve the objective of this research.

The forecasting method used in this study is the exponential smoothing method (ESM). Extensive work has been done to study the theoretical properties of ESM, for example, (Gardner, 1985); McKenzie (1984, 1985).

The problem that arises in the fitting of an exponential smoothing method for forecasting is the choice of the most appropriate  $\alpha$ . (Gardner, 1985) discusses various theoretical and empirical arguments for selecting an appropriate smoothing parameter. The value of  $\alpha$  falls in the interval from zero to one, although, some researchers think that,  $0 \leq \alpha \leq 2$  is appropriate for an ARIMA model. (Gardner, 1985) reports that among practitioners, an  $\alpha$  smaller than 0.30 is usually recommended. However, in the study by (Makridakis et al., 1982),  $\alpha$  values above 0.30 frequently yielded the best forecasts. (Gardner, 1985) finally concludes that it is best to estimate an optimum  $\alpha$  from the data, rather than to "guess" and set an artificially low value.

The mathematical model for an exponential smoothing method with Trend is given by:

$$\widehat{DCPS}_t = \alpha DCPS_{t-1} + (1 - \alpha)\widehat{DCPS}_{t-1} + EstimatedTrend \quad (1)$$

Where,  $\widehat{DCPS}_t$  is the forecast at time  $t$   
 $DCPS_{t-1}$  is the forecast at time  $t-1$   $\alpha$  is the smoothing constant.

### 3.3 Residual analysis

The appropriateness of the model for forecasting purposes can be determined by residual analysis. The model is deemed good if it yields small residual values. The two measures normally used are the Mean Absolute Deviation (MAD), and the Root Mean Square Error (RMSE).

*Sum of forecasting errors*

$$MAD = \frac{\text{Number of forecasts}}{\text{Number of forecasts}}$$

Let  $Forecast_i$  = the forecast value for the period  $i$   
 $DCPS_i$  = the actual value for the period  $i$   
 and  $\epsilon_i$  = the error for time  $i$   
 then,  $\epsilon_i = DCPS_i - Forecast_i$  ,

$$MAD = \frac{\sum_{i=1}^n \epsilon_i}{n} \quad (2)$$

$$MSE = \frac{\text{Sum of squares of forecasting errors}}{\text{Number of forecasts}}$$

$$\therefore MSE = \frac{\sum_{i=1}^n \epsilon_i^2}{n} \quad (3)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^n \epsilon_i^2}{n}} \quad (4)$$

The model with the smallest MAD and/or the smallest RMSE is the best model. To forecast out of sample, the model is adjusted to accommodate as follows:

$$Forecast\ n\ periods\ away = \alpha(Last\ value) + (1 - \alpha)(Last\ forecast) + n(Trend) \quad (5)$$

## 4 Results and Analysis

4.1 Descriptive statistics and trend identification

Table 1 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
DCPS	35	1.5423	19.586	9.7640	5.6778

Table 1 above presents the raw data in an intelligible manner, bringing out all the characteristics and features in a summarized format. From the table, the minimum recording of DCPS from the year 1982 to 2016 is 1.5423, which was seen in 1983, and the maximum is 19.585, which occurred in 2016. The series has a mean value of 9.764 and a standard deviation of 5.678.

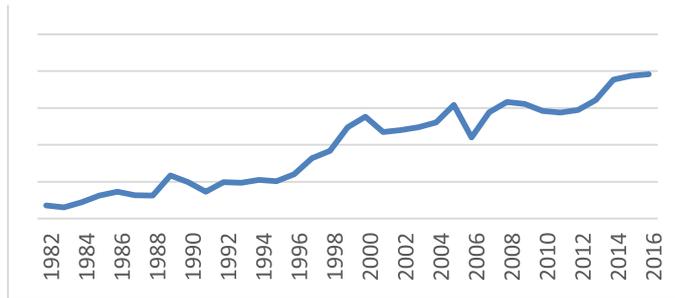


Figure 1 Time Series of Original Data

Figure 1 above shows that the series contains trend and has an intercept.

4.2 Exponential smoothing model for DCPS

Table 2 Estimated Exponential Smoothing Model

Parameters	
Alpha:	0.544242
Beta:	0.000000
Initial Parameters	
Initial level:	1.160855
Initial trend:	0.471277
Compact Log-likelihood	-73.30356
Log-likelihood	-60.74782
Akaike Information Criterion	154.6071
Schwarz Criterion	160.8285
Hannan-Quinn Criterion	156.7547
Sum of Squared Residuals	1.057703
Root Mean Squared Error	0.173839
Average Mean Squared Error	2.823497

Table 2 presents the best-estimated exponential smoothing model for the data to be a type with multiplicative error, additive trend and without seasonality. The model fitted has very low error values, thus, the root mean squared residuals is 0.17, the average mean squared error is 2.82 and sum of squared residuals is 1.06, which implies that the model will yield good estimates when used in forecasting future

DCPS values, which is evident in Figure 2 below. From the model output,  $\alpha = 0.5442$  and  $Trend = 0.4713$ , so, from equation (1), the fitted model is:

$$\widehat{DCPS}_t = 0.5442DCPS_{t-1} + 0.4558\widehat{DCPS}_{t-1} + 0.4713 \quad (6)$$

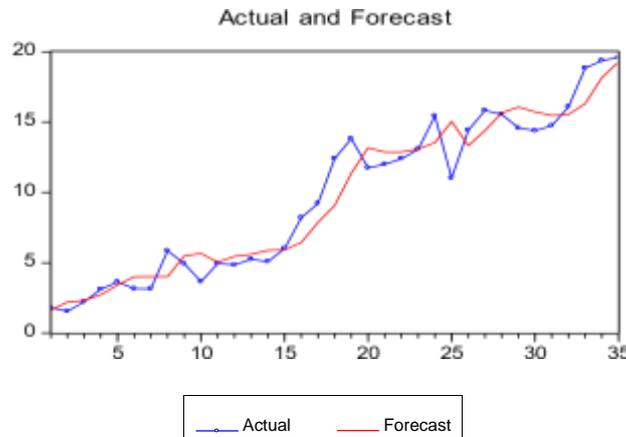


Figure 2 Graph of actual and forecast

### 4.3 Forecast

Using equation (5), forecast values for DCPS for the years 2017 to 2020 are obtained.

Table 3 Forecast Values

Year	Forecast
2017	19.90
2018	20.68
2019	21.50
2020	22.34

### 5 Conclusion

In this paper, we have fitted an exponential smoothing model to the domestic credit to the private sector data of Ghana. The fitted model has minimal forecast errors, which proves a good model and is consistent with findings from (Makridakis et al., 1979).

The DCPS forecast values churned out by the fitted model show that the four years that follow the sampling period would see only 13.98% improvement in DCPS (i.e., from 19.60 in 2016 to 22.34 in 2020), which is woefully inadequate, looking at the initial low figure. Meanwhile, government’s proposed developmental plan – which includes —one district one factory and —one village one daml - is so much private sector dependent, hence will require availability of serious funds to the private sector to fuel it. This is not promising for the future of the private sector of Ghana, and is not in support of the economic growth agenda planned by the government.

For more accurate and reliable forecasting values, we recommend a further research to employ a couple of forecasting methods from the list in (Makridakis and Winkler, 1983), and compute the weighted average of the figures from the individual methods.

Government and regulatory authorities must take a cue from the forecast values churned out by this study and formulate policies that will improve future DCPS values to aid in nation building.

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## References

- [1] Hauner D. Credit to government and banking sector performance [J]. *Journal of Banking & Finance*, 2008.32(8):1499-1507
- [2] Kumhof M. M. and Tanner M. E. Government debt: A key role in financial intermediation [J]. 2005: International Monetary Fund, Working paper
- [3] Osman E. G. A. The impact of private sector credit on Saudi Arabia Economic Growth (GDP): An Econometrics model using (ARDL) Approach to Cointegration [J]. *Am Int J Soc Sci*, 2014.3(6):109-117
- [4] Lane P. R. and McQuade P. Domestic credit growth and international capital flows [J]. *The Scandinavian Journal of Economics*, 2014.116(1):218-252
- [5] Perez P. An Analysis of Private Sector Credit Growth in Belize: A VECM Approach. in 49th Annual Monetary Studies Conference. 2017. Radisson Fort George Hotel& Marina, Belize City, Belize
- [6] Shijaku G. and Kalluci I. Determinants of bank credit to the private sector: The case of Albania. 2013. [Online]. Available from: <https://mpira.ub.uni-muenchen.de/79092/> [Accessed 30th July 2018]
- [7] Emecheta B. and Ibe R. Impact of bank credit on economic growth in Nigeria: application of reduced vector autoregressive (VAR) technique [J]. *European Journal of Accounting Auditing and Finance Research*, 2014.2(9):11-21
- [8] Emenike K. O. How does monetary policy and private sector credit interact in a developing economy [J]? *Intellectual Economics*, 2016.10(2):92-100

- [9] Olowofeso E. O., Adeleke O. A. and Udoji A. O. Impact of private sector credit on economic growth in Nigeria [J]. *CBN Journal of Applied Statistics*, 2015. 6(2):81-101
- [10] Kim J.-M. and Jung H. Time series forecasting using functional partial least square regression with stochastic volatility, GARCH, and exponential smoothing [J]. *Journal of Forecasting*, 2018.37(3):269-280
- [11] Shao-Hsien C. and Tsai K.-T. Predictive Analysis for the Thermal Diffusion of the Plasma-Assisted Machining of Superalloy Inconel-718 Based on Exponential Smoothing [J]. *Advances in Materials Science and Engineering*, 2018
- [12] Duan G. and Niu R. Lake Area Analysis Using Exponential Smoothing Model and Long Time-Series Landsat Images in Wuhan, China [J]. *Sustainability*, 2018.10(1)
- [13] Makridakis S., Hibon M. and Moser C. Accuracy of forecasting: An empirical investigation. *Journal of the Royal Statistical Society [J]. Series A (General)*, 1979:97-145
- [14] Winkler R. L. and Makridakis S. The combination of forecasts [J]. *Journal of the Royal Statistical Society. Series A (General)*, 1983:150-157
- [15] Makridakis S., et al. The accuracy of extrapolation (time series) methods: Results of a forecasting competition [J]. *Journal of forecasting*, 1982.1(2):111-153
- [16] Gardner E. S. Exponential smoothing: The state of the art [J]. *Journal of forecasting*, 1985.4(1):1-28
- [17] Boudoukh J., Richardson M. and Whitelaw R. F. Investigation of a class of volatility estimators [J]. *Journal of Derivatives*, 1997.4(3),63–71
- [18] Gardner E. S. Exponential smoothing: The state of the art [J]. *Journal of Forecasting*, 1985.4(1),1– 28
- [19] Makridakis S. and Winkler R. L. Averages of forecasts: Some empirical results [J]. *Management Science*, 1983.29(9):987-996