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# The Impact of Cloud Adoption on The SMB Profit: Evidence from Panel Data analysis

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## Abstract

Cloud computing is among the most recent advanced techniques that can play a critical role in small and medium-sized organizations, especially because it allows small businesses to access ICT resources without incurring big upfront expenditures or investing in specialized personnel. The backbone of any country's economy is small and medium businesses (SMBs). They generate employment and serve as a catalyst for innovation and entrepreneurship. Businesses are leveraging the benefits of cloud computing to gain a competitive advantage, cooperate, connect, and grow. This research hypothesizes that small companies that deploy cloud computing outperform those that do not deploy it in terms of profit growth. The purpose of this study is to examine this hypothesis. The data originated from small and medium enterprises in the Middle East. The data represents balanced panel data of 55 small and medium enterprises over 3 years, from 2015 to 2017 (n=55, t=3). This research employed panel data regression models, namely the fixed-effect and the robust M-estimation methods. The empirical findings appear to confirm the hypothesis that adopting cloud computing favorably affects the profit growth of SMEs. The conclusions of this research might be valuable for business owners in the Middle Eastern countries who seek profit maximization with emerging technologies.

**Keyword**: *Cloud computing, Profit maximization, SMB, Technology*

# Introduction

Prior to the advent of cloud computing, personal data used to be kept on local disks and memory cards. However, laptops and mobile phones are readily damaged or misplaced, and accessing saved data may require physical contact to the device (Arutyunov, 2012). Businesses formerly stored data on massive servers housed in specialized data centers. Data may be viewed only by a user who is logged into the business network; it may not be available through the Internet or when the person is traveling (Qian *et al.*, 2009).

A cloud provider or cloud hosting firm offers customers with a fixed-size web servers for data storage. While the customer retains ownership of the data saved, the hosting business acquires and maintains the necessary hardware (Amanatullah *et al.*, 2013). The cloud host provides continuous access to client data while maintaining the level of security specified by the customers (Che *et al.*, 2011). The data is then stored on one or more servers that the cloud hosting business configures in its data centers.

Although this idea traces all the way back to the 1960s, it has recently become very popular as Internet infrastructure has improved, enabling speedier access to distantly housed data (Arutyunov, 2012; Quddusi, 2014). Businesses are quickly migrating to cloud hosting because it eliminates the headaches involved with maintaining local servers, related expenses, and some security issues.

*benefits*

Cloud computing offers several benefits to small and medium-sized organizations (Strickland, 2008; Karadsheh and Alhawari, 2011). The first benefit is the adaptability and scalability. With infinite storage, organizations are no longer constrained by the limitations of conventional documentation systems. Cloud computing provides the capacity to expand as a business expands and new needs arise. If departments make effective use of their cloud storage capacity, they may easily improve their storage plan (Tan and Lin, 2012). Typically, when a small firm expands its operations, it must acquire extra IT gear to accommodate the increased workers. If a downsizing occurs, any capital expenditures made to acquire new gear will be declared ineffective. On the contrary, scaling up or down a cloud solution is far faster and more cost effective (Alhaddad, 2017; Vafin, 2017; A. Vafin, 2018). The IT staff will simply add new users via the cloud network to scale up. Likewise, when an employee quits the business, the user's data is securely erased or wiped from the cloud. If the cloud service is assigned to a cloud provider, the only expense associated with scaling is a per-user charge. Likewise, if a small firm wishes to acquire new software applications from a cloud provider, it may be activated in a matter of minutes for a low use cost. Similarly, corporations may scale down on their subscription if they no longer want certain data. This degree of adaptability helps businesses to respond to changing consumer and market

needs without having to worry about lagging systems (Talia, 2013). Cloud computing improves operational efficiency via growth and consolidation.

Another advantage is data recovery. Losing crucial data may endanger a business's brand and operations substantially. While a tarnished image is one thing, the corporation must also commit money and effort to repair the harm. During the recovery phase, the organization's internal activities may have to be suspended. According to studies, network outage a large amount of money. Businesses may develop a solid data retrieval solution that does not need any downtime by investment in cloud computing. The greater security of stored data is one of the most significant advantages of cloud computing for small organizations (Yeboah-Boateng and Essandoh, 2014). When small organizations connect with a reputable, experienced cloud provider, they have access to sophisticated cybersecurity analysis, monitoring, prevention, and elimination technologies. The small firm does not have to do the tasks of upgrading equipment and software, encrypting data, and monitoring traffic. The cloud provider executes these crucial duties expertly and precisely, ensuring that corporate operations continue uninterrupted.

Unlike big organizations, which have vast resources and the ability to withstand shocks, SMBs are very vulnerable to variables that might impair their smooth operation. Cloud computing enables SMBs to achieve unmatched Business Continuity (BC) for a fraction of the expense of establishing similar mechanisms on-premises (Bajgoric, 2014; Hiles, 2014). Whether the interruption is affected by any accidents, small company is highly likely to stay unaffected, owing in large part to Cloud Computing. With Disaster Recovery (DR) embedded into the cloud service, any small or medium company will benefit from a robust business continuity plan in the event of a crisis (Prakash *et al.*, 2012; Alshammari *et al.*, 2017).

Additionally, software upgrades are an advantage. Legacy systems and other on-premise solutions need IT staff to do regular software updates to address issues (Alhaddad, 2018b). For major organizations, upgrading is a more involved procedure than merely restarting the computer. It may take a whole day to properly configure everything. On the other side, cloud computing companies host the software off-site, which eliminates the need for enterprises to worry about upgrades. By eliminating on-site upgrades, businesses may save funds on IT maintenance (Aljabre, 2012). Owners may reinvest these dollars in other areas, such as adding more automated technologies.

Additionally, conventional legacy systems need a variety of hardware components to function, which adds to the installation and maintenance expenses (Rosado *et al.*, 2012). This may drastically raise a small business's operating expenditures over time, suffocating cash flow (Aidar Vafin, 2018). Businesses may free up cash flow by removing wasteful solutions using cloud computing technologies.

The majority of cloud solutions have cheap upfront costs and provide flexible subscription options to suit the demands of varied enterprises.

Cloud computing enables small and medium-sized organizations to do business remotely (Williams, 2010). Companies, more than ever, require the freedom to enable workers to work remotely on their own devices (Alhaddad, 2018a). Employees are not bound to their office desktops or even to regular work hours with cloud solutions. Workers may access the program as long as they have a safe internet access and a device. This enables businesses to continue operating without physically opening their doors.

Collaboration among employees is getting easier for SMBs as a result of cloud computing (Baghdadi, 2013; Tashkandi and Al-Jabri, 2015). Teams may increase their cooperation and acquire a comprehensive picture by facilitating data exchange across departments. Numerous capabilities allow team workers to upload, distribute, and modify data in real time via cloud-based apps. Eliminating the wait time between modifications increases insight into the scope and progress of the project. Cloud computing enables new levels of cooperation and openness. Team members may monitor document processes in real time and even follow the history of document development. Between team members, information may be transferred securely. Cloud computing enables a better degree of quality control since it enables data consistency to be maintained.

Adopting this cutting-edge technology not only increases operational efficiency, but also strengthens a company's competitive advantage (Truong, 2010). Firms do not want to fall behind rivals that are using cloud computing to increase productivity (Tehrani and Shirazi, 2014). Additionally, new technology enhances the customer experience, enabling businesses to increase client acquisition and retention. When data is converted to a digital format, organizations become concerned about cybersecurity and regulatory compliance. However, modern cloud-based systems have integrated firewalls that protect data and monitor for suspicious activities. When the system detects developing dangers, it notifies IT administrators, enabling them to take prompt action. Some suppliers even give 24/7 customer help in the event that consumers encounter technological difficulties. Businesses may avoid purchasing and sorting through reams of actual paper by adopting software. They may save data electronically and print forms as required, significantly reducing paper waste. Additionally, businesses may dynamically scale their cloud storage space in response to changing demands, avoiding needless expenses.



## Research Hypothesis

This study will examine the following null and alternative hypotheses:

**a) Null hypothesis**

**H0:** Cloud adoption does not lead to profit growth for small and medium sized business

**b) Alternative hypothesis**

**H0:** Cloud adoption leads to profit growth for small and medium sized business

# Methodology

The study's objective is attained by employing panel data techniques. There are several advantages to fully utilizing this complex structure, assuming we have availability of a panel data. To begin, and probably most crucially, panel data enables us to address a broader range of concerns and solve more complicated problems than time - series data or cross-sectional data alone. Second, analyzing continuous changes in factors or their relationships is often intriguing (over time). To accomplish this with simple time series data, it is occasionally necessary to run the data for an extended period of time in order to accumulate sufficient observations to conduct effective testing of hypotheses (Lee, 2002). However, by integrating cross sectional and time series data, one may improve the degree of freedom (df) and hence the robustness of the test by simultaneously including information on the dynamic characteristics of a large number of entities. Additionally, the added variance produced by this technique may alleviate concerns about multicollinearity that may develop when time series dataset is modeled individually. Third, as seen below, by appropriately designing the model, one may eliminate the impact of certain types of missing data on regression findings.

In empirical research, panel estimator approaches are classified into two basic categories: Fixed Effects (FE) models and panel Robust regression model, namely M-estimation method (Machado, 1993; Ma and Kosorok, 2005). Fixed effects models in their simplest version allow for cross-sectional but not longitudinal change in the intercept, but all slope values are fixed cross-sectionally and longitudinally. While this method is undoubtedly more efficient than SUR models (which need estimation of (N + k) parameters), it still involves estimation of (N + k) parameters (Matyas and Sevestre, 2016) (Baltagi, 2010).

The fixed-effects paradigm presupposes that the true magnitude of the impact is consistent across studies and that the only source of effect size variation is random error (error in estimating the effect size). As a result, while assessing the various research, we may effectively exclude data from smaller studies if larger studies provide more data on the same impact size (Park, 2010).

In contrast, the purpose of the random-effects model is to predict the average of a distribution of impacts, not a single observable effect. Because each study reports a unique impact size, it is vital to ensure that the summary approximation includes all of these measured factors.

We used the following regression model to estimate the influence of cloud computing on profit growth of SMBs. We also included other control independent variables. The description of the all variables can be found in table 1.

$$PR_{it} = \alpha + \beta_1 Cloud_{it} + \beta_2 Comp_{it} + \beta_3 Time_{it} + \beta_4 Edu_{it} + \beta_5 Exp_{it} + \beta_6 Fin_{it} + \beta_7 Place_{it} + \beta_8 Age_{it} + \beta_9 BG_{it} + \beta_{10} Sex_{it} + \epsilon_{it}$$

Were, i denotes the sample small business and t indicates time, in this case, year. α indicates intercept and all the betas from $\beta_1$ to $\beta_{10}$ are the indicators of slope coefficients in the regression equations.

*Table 1. Descriptions of the variables*

| SL | Symbols | Variables | Measurements |
|---|---|---|---|
| 1 | *PR* | Total profit | Total profit measured as the total sales volume minus total costs, in a year t, for business i |
| 2 | *Cloud* | Cloud deployment | 0= not selling on Amazon, 1=Selling on amazon |
| 3 | *comp* | Competition intensity | 0=low competition, 1=high competition |
| 4 | *time* | Duration of the business | Age of the business in years |
| 5 | *edu* | Education level of business owner | Education level of business owners measured in years of education |
| 6 | *exp* | Experience of business owner | Experience of business owners measured in years |
| 7 | *fin* | Finance source of the business | 0= own, 1=credit institution |

| | | | |
|---|---|---|---|
| 8 | *Place* | Place of the business | 0= not near the main road, 1= near the main road |
| 9 | *Age* | Age of the business owner | Age of the business owner measured in years |
| 10 | *BG* | Business background of family | Family business background; 0=no , 1= yes |
| 11 | *Sex* | Gender of the business owner | Gender of the business owners, 0= female, 1= male |

## Results

This section summarizes the findings of this research. The figure 1 shows that in most cases, when a business employ cloud computing, the profit rate increases. The table 2 presents the N-way tabulation of cloud deployment and profit growth. It can be seen from the table that the frequency for businesses with cloud computing have the large profit rates. The table 3 and 4 summarizes the results of the main aim of this study. We used fixed effect and the robust regression model to investigate our hypotheses. They both show that the cloud computing deployment has positive and significant impact on the profit rates of SMBs. This supports our hypothesis.

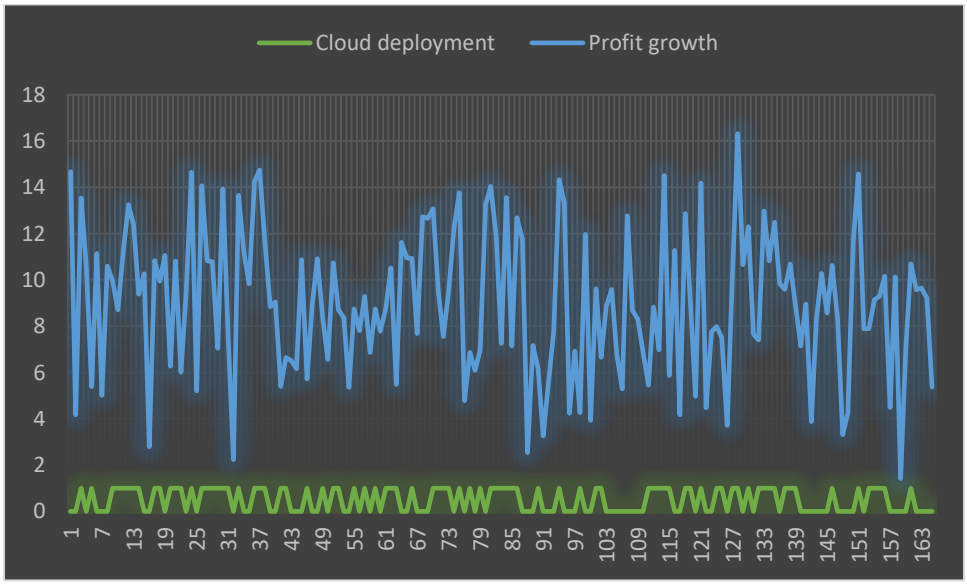


*Figure 1 Shows graphically that there is a positive relationship between cloud deployment and profit growth*

*Table 2 Tabulation of cloud and profit*

Sample: 2015 2017
Included observations: 165

Tabulation Summary

| Variable | Categories |
|---|---|
| CLOUD | 2 |
| PR | 4 |
| Product of Categories | 8 |

| Measures of Association | Value |
|---|---|
| Phi Coefficient | 0.186185 |
| Cramer's V | 0.186185 |
| Contingency Coefficient | 0.183039 |

| Test Statistics | df | Value | Prob |
|---|---|---|---|
| Pearson X2 | 3 | 5.719686 | 0.1261 |
| Likelihood Ratio G2 | 3 | 6.236114 | 0.1007 |

Note: Expected value is less than 5 in 25.00% of cells (2 of 8).

| Count | | PR [0, 5) | [5, 10) | [10, 15) | [15, 20) | Total |
|---|---|---|---|---|---|---|
| CLOUD | 0 | 17 | 42 | 24 | 0 | 83 |
| | 1 | 7 | 49 | 25 | 1 | 82 |
| | Total | 24 | 91 | 49 | 1 | 165 |

*Table 3 Panel least square results*

Dependent Variable: PR
Method: Panel Least Squares
Sample: 2015 2017
Periods included: 3
Cross-sections included: 55
Total panel (balanced) observations: 165

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| AGE | -0.002432 | 0.002945 | -0.825716 | 0.4109 |
| BG | -0.084352 | 0.055988 | -1.506610 | 0.1351 |
| CLOUD | 1.063421 | 0.059719 | 17.80714 | 0.0000 |
| COMP | -0.991651 | 0.059245 | -16.73824 | 0.0000 |
| EDU | 0.962160 | 0.037523 | 25.64183 | 0.0000 |
| EXPR | 1.041747 | 0.058391 | 17.84087 | 0.0000 |
| FIN | 0.928580 | 0.055750 | 16.65610 | 0.0000 |
| PLACE | 0.988596 | 0.060375 | 16.37426 | 0.0000 |
| SEX | -0.062749 | 0.057181 | -1.097390 | 0.2751 |
| TIME | 1.003779 | 0.009975 | 100.6302 | 0.0000 |
| C | 0.692112 | 0.147957 | 4.677795 | 0.0000 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.994343 | Mean dependent var | 8.504080 |
| Adjusted R-squared | 0.990723 | S.D. dependent var | 3.004598 |
| S.E. of regression | 0.289398 | Akaike info criterion | 0.645073 |
| Sum squared resid | 8.375100 | Schwarz criterion | 1.868628 |
| Log likelihood | 11.78145 | Hannan-Quinn criter. | 1.141757 |
| F-statistic | 274.6521 | Durbin-Watson stat | 2.916727 |
| Prob(F-statistic) | 0.000000 | | |

The tables 3 and 4 summarizes the regression results of panel data model. The model seems to be well-fit with an R-squared of greater than 0.80. The t-statistics and the associated P-values indicate that all variables, except age, business background and sex are significant. The table above highlights the Fixed effect model's results. Since R-squared is greater than 0.80, the model appears to be well-fit. All variables are significant, as shown by the t-statistics and associated values. Furthermore, the Random effect model yields equivalent results. The results of the Random effect model are given in the table above. The model seems to be well-fit with an R-squared of 0.99. The t-statistics and accompanying values suggest that all factors are significant except for Age, Background, and Sex. The overall findings suggest that the profit rate depends on the cloud computing adoption such that if SMB adopt cloud computing, their profit rates increase.

*Table 4 Panel robust least square*

Dependent Variable: PR
Method: Robust Least Squares
Sample: 2015 2017
Included observations: 165
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|---|---|---|---|---|
| AGE | -0.000917 | 0.002677 | -0.342670 | 0.7318 |
| BG | -0.079185 | 0.049501 | -1.599655 | 0.1097 |
| CLOUD | 1.032022 | 0.049340 | 20.91643 | 0.0000 |
| COMP | -0.958730 | 0.051619 | -18.57316 | 0.0000 |
| EDU | 0.977567 | 0.031384 | 31.14852 | 0.0000 |
| EXPR | 1.015783 | 0.049643 | 20.46160 | 0.0000 |
| FIN | 0.959921 | 0.049683 | 19.32080 | 0.0000 |
| PLACE | 0.980875 | 0.049888 | 19.66149 | 0.0000 |
| SEX | 0.025202 | 0.049461 | 0.509533 | 0.6104 |
| TIME | 1.000323 | 0.009015 | 110.9613 | 0.0000 |
| C | 0.600869 | 0.137854 | 4.358737 | 0.0000 |

Robust Statistics

| | | | |
|---|---|---|---|
| R-squared | 0.899582 | Adjusted R-squared | 0.893062 |
| Rw-squared | 0.991769 | Adjust Rw-squared | 0.991769 |
| Akaike info criterion | 111.5365 | Schwarz criterion | 154.3579 |
| Deviance | 12.22623 | Scale | 0.352864 |
| Rn-squared statistic | 15118.63 | Prob(Rn-squared stat.) | 0.000000 |

Non-robust Statistics

| | | | |
|---|---|---|---|
| Mean dependent var | 8.504080 | S.D. dependent var | 3.004598 |
| S.E. of regression | 0.289383 | Sum squared resid | 12.89634 |



## Conclusion

Small companies want virtual access to data without incurring storage or device maintenance fees. Cloud storage is a cost-effective alternative that is gaining popularity fast. It has been shown in the

literature that SMBs encounter several challenges both inside and internationally. For example, although demand for technology-based services continues to grow, funding for SMBs continues to decline. While advancements in technology have enabled company owners and managers to utilize it, many find it difficult to do so due to the high cost of installation and maintenance and their lack of simple access to capital. However, if SMBs install and utilize technology collaboratively, the cost of employing technology may be minimized and the quality of IT-based services can be greatly improved. SMBs' information, technology, and infrastructures must be transformed via effective support for virtualization and incorporation of operational operations, which may be accomplished through the Cloud business plan.

Additionally, many consumers lack a thorough grasp of Cloud Computing, that is another reason for the industry's slow adoption. Accurate knowledge about emerging technologies is necessary to improve users' awareness and ensure that they, particularly SME leaders and employees, fully comprehend the advantages. The majority of prior study in this field has been on industrialized and/or European nations, with relatively little attention paid to emerging countries. Further research is thus required to thoroughly explore and identify hurdles to Adoption of cloud computing in developing nations, while also taking into account the unique adoption processes of each country.

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