

# ICT and the Performance of Lebanese Banks: A Panel Data Analysis



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**Abstract** This study explores the impact of information and communication technology (ICT) on the performance of 25 Lebanese commercial banks for the period between 2000 and 2014. Unlike previous studies, this study uses a panel data analysis to assess the effect of the number of Internet users and domain registrations in Lebanon on the performance of the banks. Results reveal that there is a positive statistical significant relationship between ICT and the performance of the banks. Moreover, the capital adequacy ratio, the size of the bank, the growth rate of the gross domestic product and the lending interest rates were found to have a positive impact on the performance. We conclude that a higher level of ICT use is an important factor that determines commercial banks' profitability as it supports the commercial work of the banks and enables them to achieve a better performance.

**Keywords** ICT · Bank performance · Lebanon

## 1 Introduction

The banking sector is considered one of the main sectors where technological improvement is closely monitored and widely adopted. Information and communication technology (ICT) presents the possibility for banks to create new systems and innovative products that satisfy a broad range of customer needs. Moreover, technology based financial products and applications such as Internet and mobile banking bring tremendous advantages to both customers and financial institutions. Technological innovation is reshaping the banking industry through offering most of the banking services and products at lower operational costs for 24 h and 7 days, which decreases the dependency rate on physical branches and raises the bank profitability. In light of the importance of ICT in the banking industry, previous literature presented a wide range of studies that tackle the positive relation between the use of ICT and the banks' performance (Binuyo and Rafiu Adewale [1], Onay and Ozsoz

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Y. Baghdadi et al. (eds.), *ICT for an Inclusive World*,  
Lecture Notes in Information Systems and Organisation 35,  
[https://doi.org/10.1007/978-3-030-34269-2\\_25](https://doi.org/10.1007/978-3-030-34269-2_25)

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[2], Hernando and Nieto [3], DeYoung et al. [4], among others). Banks adopt ICT in an attempt to increase the efficiency of the services they offer and to enhance their business processes, particularly with the high level of competition which drove banks to search for innovations and development that will increase their customers' loyalty. As a result, ICT is considered a major enabler for improving the banking sector performance in today's rapid pace of change and highly competitive environments.

Lebanese banks are not an exception. Despite the fact that the Lebanese banking industry was greatly affected by the civil war during the years 1975–1990, the Lebanese banking industry is now considered among the 87 banking systems with a “low level of potential vulnerability” according to Fitch rating agency in its semi-annual report that assesses the risk of 115 banking systems operating in advanced and emerging economies [5]. This is considered the highest category on Fitch Macro Prudential Indicator (MPI). In fact, the Lebanese banking industry applies and uses new technologies at different levels: managerial, transactional and executive. The majority of commercial banks operating in Lebanon consider ICT as the main tool to succeed in this new dynamic world where institutions must strive to lower their transactional costs and to provide innovative activities that ensure their competitiveness. Hence, ICT has an impact on all processes that shape the modern banking industry from daily routines to strategic decisions.

All these features encouraged Lebanese banks to offer electronic-based services for their customers and to make for themselves high standard of excellence in terms of technology use and adoption. Lebanon was the first country in the Levant that used Internet for commercial purposes since 1995 [6]. The number of Internet users reached 3.6 million by July 2015, which accounts for an 86% penetration rate compared to 40% in 2010 [6]. Moreover, in 2015, Lebanon ranked fourth in the Arab region after Bahrain, United Arab Emirates (UAE) and Qatar [6]. These technological changes helped the Lebanese banks to maintain their position as top operating institutions and to enhance their performance.

The Lebanese banking system is considered one of the strongest in the Middle East and North African (MENA) region with consolidated total assets of commercial banks reaching 310,176 billion Lebanese pounds (USD 205.8 billion) at the end of March 2017, hence increasing by 0.7% from end December 2016 according to the Lebanese Association of Banks in Lebanon March 2017 report [7]. Moreover, 10 Lebanese commercial banks are considered among the top 1000 banks in the world according to the 2017 survey of the best 1000 banks in the world [8]. The survey is conducted by the Banker magazine and the ranking is based on the level of the bank's Tier One capital in US dollars by the end of the previous year.

Finally, one has to mention that the ICT sector in Lebanon is also currently considered as one of the fastest growing sectors in the Lebanese economy. According to a report published by the Investment Development Authority of Lebanon [9], the ICT sector is expected to reach a compound annual growth rate (CAGR) of 9.7% by 2019 compared to 7% in 2016 and it contributed to 3% of Lebanon's GDP in the year 2013.

The main purpose of this study is to ascertain the level of use of ICT on the banking sector performance in Lebanon. Considering ICT as a key factor for higher banking

performance, this study uses an unbalanced panel of 25 commercial banks operating in Lebanon for the period between 2000 and 2014 to investigate the impact of ICT use on the banks' performance measured by the return on assets (ROA). Unfortunately, data for the use of ICT and for ICT expenditures and adoption on the bank level was not available for the Lebanese commercial banks. Hence, we modeled the level of ICT use in Lebanon using two proxies, the number of Internet users per 100 people and the number of Lebanese domain registrations. In fact, Internet users per 100 people is a very well established indicator for the level of ICT use in the literature. Moreover, in 1993, the .lb domain name was first allocated by the operator of the Internet Assigned Number Authority (IANA) to the American University of Beirut (AUB). AUB was the first institution that acquired a .lb domain name. By the end of year 2015, the Lebanese domain name registry had approximately 4000 registered .lb domains [6]. The author believes that the adoption of online channel both by users and institutions, will eventually save time and costs in processing administrative and financial transactions. As a result, this operating costs reductions will increase the efficiency of the financial system, leading to a better financial performance. In fact [3], argue that the most important benefit that arises from the use of ICT by banks is the reduction in overhead expenses. ICT use can reduce the costs related to the maintenance of physical branches and can also decrease the marketing and labor costs. Moreover [1], conclude that the contribution of ICT to a bank performance comes essentially from information and communication technology cost efficiency compared to investment in ICT.

This study makes several contributions to the literature. First unlike previous studies this is the first study that conducts a quantitative analysis using secondary data to investigate the impact of ICT use on the performance of Lebanese banks. Second, to the best of our knowledge this is the first paper that addresses this issue in Lebanon using a panel data analysis. Previous studies conducted in Lebanon, Hilal [10], Sarji [11] among others, used primary data collected through the use of survey questions.

The remainder of this study is organized as follows: Sect. 2 presents the literature review, Sect. 3 explains the methodology and data, Sect. 4 discusses the empirical results and Sect. 5 concludes.

## **2 Literature Review**

### ***2.1 ICT and Bank Performance***

Internet use and online presence of companies and banks is undoubtedly considered as one of the most important driving factors affecting the banking industry and changing banks' performance and activities. This study assesses the impact of Internet use and domain registration presence on the performance of commercial banks operating

in Lebanon. Numerous studies in the literature investigate the impact of Information and communication technology (ICT) on the banking sector performance and efficiency. The first strand in the literature confirms that Internet adoption as an additional distribution channel has a positive impact on the profitability. DeYoung et al. [4] find that Internet adoption as a delivery channel improved US community bank profitability. This enhancement is mainly driven by increases in non-interest income from service charges on deposit accounts. Hernando and Nieto [3] assess the effect of adopting a transactional Website on the financial performance of commercial banks operating in Spain. Results show that the adoption of the Internet offers gradual reduction in overhead expenses. This cost reduction will eventually lead to an improvement in the banks' profitability and turns to be highly significant after one and a half years in terms of ROA. Ciciretti et al. [12] find a significant positive relation between offerings of Internet banking products and bank performance in Italy. Onay and Ozsoz [2] use a panel of 18 retail banks operating in Turkey for the period of 1990–2008 to assess the impact of internet adoption on the banks' profitability. Results indicate that Internet banking adoption has a positive effect on per-branch profitability. However, this impact becomes negative after 2 years of adoption as Internet banking increases competition, hence yielding lower interest income.

In the context of Lebanon [10], uses a survey to investigate the opportunities, motivations and effects of the implementation of NICTs for Lebanese commercial banks. She concludes that NICTs are playing an increasing role in the evolution of banking businesses and that the use of this NICTs improves the productivity of banks. Sarji [11] uses a questionnaire survey to assess the banking customers' perception in Lebanon regarding the provided banking service. His study shows that most Lebanese banks have benefited from ICT to improve their operations and that IT has a significant impact on Lebanese banks.

Moreover, previous studies in the literature investigated the relationship between ICT investment and the bank performance. Berger [13] examines technological progress and its effects in the banking industry. Results show that ICT investment generate improvements in costs and that technological progress increases overall productivity. Kozak and Eyadat [14] suggest that increasing ICT investment is associated with an increase in the value of return on assets for the US banking sector. Binuyo and Rafiu Adewale [1] investigate the impact of ICT on bank performance of South African banking industry for the period 1990–2012. Findings reveal that the use of ICT increases return on capital employed as well as return on assets. However, the study reveals that most of the contribution to performance comes from ICT cost efficiency rather than being the result of ICT investment.

## ***2.2 Factors Affecting Bank Performance***

In addition to the impact of ICT use on the banking sector performance, other internal and macroeconomic factors have been depicted to have a significant effect on this performance. Determining the factors that affect banks' performance has been

widely tackled in the literature. Moreover, this has been a topic of interest for both developed and developing countries. Researchers investigated the effect of several candidate variables on bank performance. Previous empirical studies have related the bank performance to internal or microeconomic determinants as well as external factors that reflect the macroeconomic environment in which the bank operates. However, the literature reveals mixed results on the impact of these factors on the bank performance.

Among the internal factors, we use the size of the bank, the capital adequacy ratio and the ratio of operating expenses to total assets. The effect of the size on the bank performance is a subject of debate in the literature. Some advocate that size has a positive effect, others show that its impact on the performance is negative. Bikker and Hu [15], Pasiouras and Kosmidou [16] and Aladwan [17] among others, show a positive impact of size on performance. The second group suggests that a negative relation exists between the two variables [18–20]. Finally, some researchers did not find a statistically significant impact of size on the performance of banks [21, 22].

Regarding the level of capitalization, the Capital adequacy ratio (CAR) has been mostly used in the literature as an internal factor affecting the bank performance. A higher ratio reduces the risk incurred by banking activities and sends a positive signal to the market on the degree of the bank solvency, which improves the performance of the bank. Moreover, several empirical studies show the positive relation between CAR and the bank performance. Among others we cite [23–25]. However, some researchers such as [26] find that CAR has a negative impact on performance. In fact, a higher level of capital adequacy ratio will lead to an increase in the variable costs which might not generate a higher profitability. In addition, when capital levels are high, this result in a lower level of leverage and risk which do not really translate in a higher profitability as some argue that shareholders' profit is usually higher when equity level is reduced and risk raises.

The third internal factor used represents efficiency and it is measured by the ratio of operating costs to total assets. It is argued that higher expenses will generate lower profits. Previous studies show that banks that have lower expenses for a certain level of output are highly efficient, hence they have a higher profitability. Hong and John [24], in their study for Japanese banks find that there is a negative relation between the ratio of costs to income and the bank performance. Moreover [21, 27], establish a significant positive impact of efficiency on profitability.

For external variables, we use the Gross domestic product (GDP) annual growth rate and the lending interest rate. Economic theory suggests a positive impact of economic growth on bank profitability. In fact, when bad economic conditions persist the quality of the loan portfolio decreases, generating larger credit losses. As a result, banks increase the provisions for non-performing loans which decreases their profitability. A better economic situation will improve the solvency of borrowers, resulting in an increase in the demand for credits and improving the profitability of banks (Athanasoglou et al. [21], Calza et al. [28], Beckmann [29] among others).

In addition, lending rates is considered as an important external factor as it is associated with the macroeconomic instability which affects the profitability of the

banks. As argued by Njuguna and Ngugi [30], macroeconomic environment is considered as a cause and a consequence influencing lending interest rates. Higher level of macroeconomic instability and a decrease in economic growth, increase investors' uncertainty towards their returns on investments which in turn increases the lending interest rates. At the same time, we argue that banks usually prefer higher lending rates as higher rates yield more returns. In fact, an increase in lending rates will generate more revenues as interest rates on loans and other investments increase. Aydemir and Ovcu [31] investigate the effect of the short-term interest rate and the slope of the yield curve on banking profitability in an emerging market. Results reveal that while their impact on bank profits is negative in the short-run, the effects of these variables on the profitability turn out to be positive in the long run. Maigua and Mouni [32] assess the impact of interest rate determinants on the performance of commercial banks in Kenya. Results show that higher levels of discount rates, inflation rates and exchange rates lead to higher performance in commercial banks in Kenya. Khan and Sattar [33] examine the effect of interest rates changes on the profitability of commercial banks operating in Pakistan. They find a strong and positive correlation between interest rate and commercial banks' profitability.

Finally, for the bank performance proxies, most of the empirical studies measure bank performance using return on assets (ROA), return on equity (ROE) or the net interest margin (NIM). ROA has been most widely used in the literature as a metric to measure bank performance and it was validated for its usefulness as a proxy for the bank profitability [34]. There are many reasons that make ROA a good proxy for the bank performance. ROA does not vary when the level of leverage changes as it is the case with ROE [35]. Moreover, as mentioned by Olson and Zoubi [36] assets can indicate the levels of income and expenses simultaneously. ROA is a financial ratio used to show how well a bank uses its assets to generate earnings. Among others, we cite [37, 38] who use ROA to estimate the profitability and performance of Indonesian and Nigerian banks respectively.

### 3 Methodology and Data

#### 3.1 Model and Estimation Technique

Our linear model aims to explore the impact of ICT use on the performance of 25 commercial banks operating in Lebanon for the period between 2000 and 2014. We follow previous studies in the literature and model the performance of the bank as a function of both internal or microeconomic variables and external or macroeconomic factors. In addition, we consider that the performance of the bank is also affected by the level of ICT use proxied by the number of Internet users (per 100 people) and the number of Lebanese domain registrations. Hence, the empirical panel data model for the bank performance is specified as follows:

$$\begin{aligned} \text{ROA}_{it} = & \beta_0 + \beta_1 \text{OP}_{it} + \beta_2 \text{CAR}_{it} + \beta_3 \text{Size}_{it} + \beta_4 \text{GDP}_{t-1} \\ & + \beta_5 \text{LI}_t + \beta_6 \text{INT}_t + \beta_7 \text{DR}_t + e_i \end{aligned} \quad (3.1)$$

where,  $i = 1, \dots, N$  shows the subscript for each bank in the panel,  $t = 1, \dots, T$  indicates the time period and  $e_{it}$  denotes the random error term which represents white noise characteristics.  $\text{ROA}_{it}$  the dependent variable, denotes the performance for the bank  $i$  in year  $t$ . It is measured by the return on assets.  $\text{OP}_{it}$  represents the operating costs ratio for the bank  $i$  in year  $t$ , as a proxy we use the ratio of the non-interest expenses to total assets.  $\text{CAR}_{it}$  refers to the capital adequacy ratio for the bank  $i$  in year  $t$ .  $\text{Size}_{it}$  indicates the size of the bank  $i$  in year  $t$  and as a proxy we use the logarithm of the total assets of the bank.  $\text{GDP}_{t-1}$  refers to the lag of the annual growth rate of the GDP in Lebanon. It is known in the literature that a growth in the GDP does not affect the performance contemporaneously, it usually takes time for the effects to show. Therefore, we use the lag of the growth rate of the GDP.  $\text{LI}_t$  is the lending interest rate in Lebanon. Finally, ICT use is proxied by the number of Internet users (per 100 people) in Lebanon denoted by  $\text{INT}_t$  and the number of Lebanese domain registrations represented by  $\text{DR}_t$ .

In this study, the model in Eq. 3.1 is estimated using the fixed effects (FE) estimator. This method along with the random effects (RE) estimator technique are widely used in panel data analysis. The FE model considers exogenous variables as non-random. Moreover, the FE model assumes that the slopes of the regression lines are the same across the banks. The RE model in contrast considers that explanatory variables are driven by random movements. In an attempt to select the appropriate model to use the Hausman test is performed. The Hausman test statistic obtained is  $H = 167.789$  with  $p\text{-value} = \text{prob}(\text{chi-square}(7) > 167.789) = 7.34042e - 033$ . This very low  $p\text{-value}$  counts against the null hypothesis that the RE model is consistent, in favor of the FE model. Thus this result shows that the FE model is the appropriate model to use. The FE model presents many advantageous, it fully captures the time constant omitted variables, hence removing any heterogeneity across the banks and avoiding misspecification error. The fixed effect model is represented as follows:

$$\begin{aligned} \text{ROA}_{it} = & \beta_0 + \beta_1 \text{OP}_{it} + \beta_2 \text{CAR}_{it} + \beta_3 \text{Size}_{it} + \beta_4 \text{GDP}_{t-1} \\ & + \beta_5 \text{LI}_t + \beta_6 \text{INT}_t + \beta_7 \text{DR}_t + \alpha_i + u_{it} \end{aligned} \quad (3.2)$$

where, the error term is decomposed into two error components, the individual specific component  $\alpha_i$  and the traditional disturbance term  $u_{it}$ .

### 3.2 Data Source and Descriptive Statistics

The main goal of this empirical research is to assess the impact of ICT use on the performance of commercial banks operating in Lebanon while including the largest possible number of banks and covering the longest time period. However, the number

**Table 1** Descriptive statistics

Variable	Mean	Std. dev.	Minimum	Maximum
ROA	1.05	1.35	−2.10	7.84
OP	2.15	2.83	0.77	33.19
CAR	7.48	2.73	0.68	18.58
Size	3.64	0.82	3.60	6.68
GDP	4.48	3.25	0.90	10.30
LI	10.59	3.43	7.25	18.15
INT	31.58	24.52	22.53	74.70
DR	144.53	28.32	142.50	205.00

of banks included in this study and the choice of the time period were dictated by the data availability. Annual data for ROA, non-interest expenses, total assets, capital adequacy ratio for the 25 Lebanese commercial banks included in this study, for the period between 2000 and 2014 were retrieved from the Bankscope database. Annual data on Internet users (per 100 people) and GDP growth rate were downloaded from the World Bank's World Development Indicators. In fact, Internet users (per 100 people) is the most widely used proxy for ICT in the literature. The data for the lending interest rate was obtained from the Global Financial Development Database. Finally, data for the number of Lebanese domain registrations was collected from the business handbook issued by InfoPro.SAL [6]. Due to lack of long time series for all the variables considered in this study, we ended up with an unbalanced panel and a total of 299 observations.

The descriptive statistics: the mean value, the standard deviation, the minimum and the maximum value for the different variables for the panel are presented in Table 1.

We notice that Internet users (per 100 people) and the number of Lebanese domain registrations have the highest standard deviations higher than 0.9 which reflects a high level of volatility over the years 2000–2014. These figures are expected particularly with the growing usage of ICT over these years. Other factors have almost the same volatility with a standard deviation ranging between 2.8 and 3.43. The performance indicator ROA have the lowest volatility with a standard deviation of 0.2. This result is expected particularly that commercial banks included in this sample have maintained a satisfying level of profitability over the course of the period 2000–2014.

## 4 Empirical Results

The results for the estimation of our fixed effects model presented in Eq. (3.2) are reported in Table 2.



**Table 2** Fixed-effects model estimation output

Variable	Coefficient	Std. error	t-ratio	p-value
const	- 0.27	0.23	- 1.189	0.23632
OP	0.05	0.03	1.54	0.1235
CAR	0.20	0.099	2.05	0.0409**
Size	0.23	0.13	1.78	0.0755*
GDP_1	0.13	0.03	4.18	0.0000***
LI	0.29	0.11	2.67	0.0079***
INT	0.14	0.05	2.74	0.0065***
DR	0.23	0.13	1.71	0.0887*

Dependent variable ROA

\*, \*\*, \*\*\* Indicate that the estimated coefficients are statistically significant at the 10%, 5% and 1% significant levels respectively

Furthermore, in order to check the validity of our model, the F-Test was carried out. The F-Test for individual effects statistic is  $F(24,267) = 89.9888$  and has a very low p-value, way less than 0.0001 which indicates that we reject the null hypothesis that individual effects are equal to 0 and confirms the fact that each bank has a different intercept. This result shows that the fixed effects model is the appropriate model to use as we need to model individual heterogeneity, we cannot simply pool the data.

Empirical results presented in Table 2 show that with the exception of operating costs to total assets ratio, all the exogenous variables have a statistical significant impact on the Lebanese Banks performance to a varying degree. The coefficient for Internet users is positive and statistically significant at the 5% significance level, showing that as the number of Internet users in Lebanon grows, the performance of the banks increases. Moreover, the coefficient for the number of domain registrations in Lebanon is also positive and statistically significant at the 10% significance level. Thus, as the number of domain registrations increases, the use of the Internet channel increases in Lebanon which positively influences the performance of the banks. These results highlight the fact that as the adoption of the Internet channel among Lebanese increases, the performance of the banks will be enhanced, particularly that almost all the banks included in our study are using the Internet channel. The results are in line with the studies conducted by Hilal [10] and Sarji [11] in the context of Lebanon that assess the impact of ICT and technological progress on the productivity and performance. Both studies conclude that ICT has a significant positive impact on the performance of the Lebanese banks.

In addition, the estimation results in Table 2 reveal that the coefficients for the capital adequacy ratio and the size of the bank are both positive and statistically significant at the 5 and 1% significance levels respectively. These results are in line with the strand of literature that established a positive relation between the size of the bank and its performance [15–17]. They also match the results of several empirical studies that show the positive relation between CAR and the bank performance

[23–25]. As for the macroeconomic factors, the coefficient for the lag of the GDP growth rate is positive and highly significant as expected since a better economic situation will improve the bank performance. This result is similar to the one obtained by Athanoglou et al. [21], Calza et al. [28], Beckmann [29], among others. The lending interest rate coefficient is also positive and significant at the 1 significance level confirming the results of Maigua and Mouni [32], Khan and Sattar [33] among others who find a positive impact of interest rate on the bank performance. Finally, the coefficient of the ratio of operating costs to total assets is positive and not statistically significant, this result is not expected as usually the CAR is considered as one of the internal factors that influence the performance of the bank.

## 5 Conclusion

This paper examines the impact of the progress in the use of Internet among Lebanese and the higher number of domain registrations on the performance of 25 commercial banks operating in Lebanon for the period between 2000–2014. We tried through this paper to assess the impact of the ICT on the banking business, particularly that the ICT sector is now one of the fastest growing sectors in Lebanon and that the Lebanese banking industry is considered as one of the main sectors where technological innovations are widely adopted.

Our objective is to empirically test the relationships between the level of use of Internet channel among Lebanese, the online presence of firms, banks and institutions operating in Lebanon and the commercial banks' performance. Towards this end we use two proxies for the level of ICT use in Lebanon, namely the number of Internet users (per 100 people) and the number of domain registrations per year. The model was estimated using the fixed effects method and the results confirm the presence of a positive and statistically significant relation between ICT use and the Lebanese banks' performance.

Our empirical results suggest that a higher level of ICT use supports the commercial work of the banks, enables them to develop new distribution channels particularly through the use of Internet which as a result will lead to a reduction in costs and an increase in profits. Internet has become an integral part of the banking business, as the number of Internet users and domain registrations increases, performing banking operations online will become easier and more convenient particularly since online users are now familiar with this channel. The Lebanese banking industry should profit from this fact to offer a wider range of services and to enhance its ability to integrate financial products. Such practices in the online environment will yield major advantages in terms of cost reductions, efficiency and better performance.

These results provided us with an empirical evidence that depicts the importance of ICT use in enhancing the performance for the Lebanese banking sector considered as the back bone of the Lebanese economy. The implication of these findings underscores the need for banks' owners and policy makers to promote policies that

enhance the optimal use of ICT without compromising information security, particularly that the rapid growth of ICT use by the banking system gave rise to a higher level of theft and fraud as more personal and financial information are becoming digitized.

Finally, one has to note that this study might suffer from some limitations regarding the number of banks included in the sample. Moreover, and due to data unavailability on the level of ICT investments or expenditures per bank, we were not able to model the level of ICT use and adoption as an internal factor, rather we considered the level of ICT use in Lebanon as an external factor affecting the performance of the banks. However, despite the fact that this research might suffer from some limitations, empirical results remain adequate and statistically significant and highlight the importance of the use of ICT on the profitability and performance of commercial banks operating in Lebanon. One possible extension of this study would be to perform it using ICT as an internal factor determining the bank performance as data for ICT on the bank level becomes gradually available. Another possible future work would be to conduct a similar study in the context of the MENA region.

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