The Effect of Information and Communication Technologies Penetration on Banking Intermediation Efficiency: Panel Study

Bilgi İşlem Teknolojileri Kullanımının Yaygınlaşmasının Bankaların Aracılık Etkinlikleri Üzerindeki Etkisi: Panel Çalışma

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Abstract

In this study, we analyze the impact of ICT penetration on banking intermediation efficiency, as measured by interest spreads and interest margins. We use unbalanced panel data to explore how ICT usage affects the efficiency of financial intermediation after controlling for other macroeconomic determinants of spreads and margins. Highly statistically significant negative correlations between three ICT penetration indicators and both interest spreads and interest margins are identified by using both univariate and multivariate time effect models. Our results suggest that ICT penetration enhance banking intermediation efficiency by reducing interest spreads and margins.

Keywords: ICT Penetration, Banking Intermediation Efficiency, Interest Spreads, Interest Margins

Öz

Bu çalışmada BİT kullanımının yaygınlaşmasının bankaların mevduat faizi ve kredi faizi arasındaki fark ve faiz marjı ile ölçülen bankaların aracılık etkinlikleri üzerindeki etkisi analiz edilmiştir. BİT kullanımının bankaların aracılık etkinlikleri nasıl etkilediği panel data kullanılmak ve faiz farkları ve faiz marjlarını etkileyen diğer makro faktörler kontrol altında tutulmak suretiyle araştırılmıştır. Tek değişkenli ve çok değişkenli zaman etkisi modelleri kullanılarak üç BİT penetrasyon göstergesi ve gerek faiz farkı gerekse de faiz marjı arasında yüksek derecede istatistiksel olarak anlamlı ve negatif korelasyon tespit edilmiştir. Araştırma bulgularımız BİT penetrasyonunun bankaların aracılık etkinliğini faiz farklarını ve faiz marjlarını azaltmak yoluyla artırdığını göstermektedir.

Anahtar Kelimeler: *BİT Kullanımının Yaygınlaşması, Banka Aracılık Etkinliği, Faiz Farkları, Faiz Marjları*

Introduction

Interest spreads and margins are often used as a measure of the cost of financial intermediation and indicate the level of efficiency in financial intermediation. The interest margin is defined as the difference between banks' interest income and interest expense expressed as a percentage of average interest-earning assets while the interest spread is defined as the difference between banks' lending rate and deposit rate.

The main factor of the wedge between the interest rate paid to savers and the interest rate charged to borrowers is operating costs (and transaction

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costs) of banks. Intermediation costs associated with screening and monitoring also drive a gap between lending and deposit rates. Information asymmetries and regulatory inefficiencies lead to further wedge in spreads and margins.

A wider spreads and margins discourage savings through low deposit rates, ration credit through high lending rates and reduce the demand for loans which leads to decrease in the level of consumption and investment in the economy. Thus wider spreads and margins lower economic growth and development. The impact of high spreads and margins is more severe in the context of developing countries where banks are the main source of external finance.

Empirical studies revealed bank specific, structural, macroeconomic and institutional factors as determinants of interest spreads and margins (Fofack, 2016; Dietrich et al., 2015; Horvath, 2009; Beck and Hesse, 2006; Geleos, 2006; Martinez Peria and Mody, 2004; Afanasieff et al., 2002; Demirguc-Kunt and Huizinga, 1999). In this study we explore whether penetration of ICTs increase the efficiency of financial intermediation, i.e. decrease the interest spreads and margins.

Starting early 1990's, banks started to use ICT technologies intensively. Banking becomes faster, easier and more efficient with ICT usage. Penetration of ICT (personal computers, mobile phones and the internet) lowers transaction, operating and interme-

diation costs of banks as well as reduces information asymmetries in the banking sector which leads to decrease in the bank spreads and margins. Moreover, Internet branches (virtual banking) enable banks to reduce their infrastructure and overhead costs, thus banks are able to offer (pay) higher interest rates on deposit accounts (savings), charge lower mortgage and loan rates and reduce service fees.

This article proceeds as follows. In the following section we introduce our data, model, and our empirical strategy. Estimation results are given in section 3. We offer concluding thoughts in the final section.

Empirical Framework

In this study, we use unbalanced panel data to explore how a country's ICT usage affects the efficiency of financial intermediation after controlling for other macroeconomic determinants of spreads and margins. Panel data for spreads includes the years between 1980 and 2014 and 145 countries while panel data for margins cover 153 countries over the period 1996-2014.

Our dependent variable is the cost of financial intermediation as measured by both interest margin and interest spread. The interest spread and interest margin equations are estimated with the following multivariate fixed time effect models (FEM)

$$\text{SPREAD}_{it} = (\alpha + \tau_t) + \beta_1 \text{ICT}_{it} + \beta_2 \text{INFLATION}_{it} + \beta_3 \text{GDPGRO}_{it} + \beta_4 \text{RIR}_{it} + u_{it} \qquad (1)$$

$$\text{MARGIN}_{it} = (\alpha + \tau_t) + \beta_1 \text{ICT}_{it} + \beta_2 \text{INFLATION}_{it} + \beta_3 \text{GDPGRO}_{it} + \beta_4 \text{RIR}_{it} + u_{it} \qquad (2)$$

and the following multivariate random time effect models (REM);

$$\text{SPREAD}_{it} = \alpha + \beta_1 \text{ICT}_{it} + \beta_2 \text{INFLATION}_{it} + \beta_3 \text{GDPGRO}_{it} + \beta_4 \text{RIR}_{it} + (\tau_t + u_{it}) \qquad (3)$$

$$\text{MARGIN}_{it} = \alpha + \beta_1 \text{ICT}_{it} + \beta_2 \text{INFLATION}_{it} + \beta_3 \text{GDPGRO}_{it} + \beta_4 \text{RIR}_{it} + (\tau_t + u_{it}) \qquad (4)$$

where *it* subscript stands for the *i-th* country's observation value at time *t* for the particular variable. α is the intercept term and τ_t represents time-specific effects which affect all countries in the same way. u_{it} is idiosyncratic error term of the regression model.

Two measures of financial intermediation efficiency (the interest spread and the interest margin) are used as dependent variables to evaluate the sensitivity of our empirical results. Results may vary depending on which financial intermediation efficiency indicator is used. If the results hold across different financial intermediation efficiency indicators, it will be an indication of their robustness. The list of dependent variables, their definitions, and the data sources are given in Table 1 below.

Table 1. List of Dependent Variables

Variables	Definition	Source
Interest Margin	Accounting value of bank's net interest revenue as a share of its average interest-bearing (total earning) assets. Aggregated on the country level from underlying bank-by-bank unconsolidated data from Bankscope.	http://data.worldbank.org/data-catalog/global-financial-development
Interest Spread	Difference between lending rate and deposit rate. Lending rate is the rate charged by banks on loans to the private sector and deposit interest rate is the rate offered by commercial banks on three-month deposits. Raw data are from the electronic version of the IMF's International Financial Statistics. IFS line 60P - line 60L.	http://data.worldbank.org/data-catalog/global-financial-development

Our explanatory variables were chosen in the light of previous studies found in the literature and our main hypothesis (Demirguc-Kunt and Huizinga, 1999; Afanasieff et al., 2002; Horvath, 2009). ICT penetration in above models is represented by three variables. Definition and data source of ICT penetration variables are given in Table 2 below.

Table 2. List of ICT Variables

Variables	Definition	Source
INTERNET	Internet users per 100 people	World Bank, WDI
FXBROADBAND	Fixed broadband subscriptions per 100 people	World Bank, WDI
CELLPHONE	Mobile-cellular telephone subscriptions per 100 people.	World Bank, WDI

We also introduced three more determinants of interest spreads and margins into our analysis based on evidence from existing literature to see how robust our finding is. Definition and data source of other independent variables besides ICT variables are given in Table 3 below.

Table 3. List of Independent Variables

Variables	Definition	Source
GDPGRO	Manufacturing, value added (annual % growth)	World Bank, WDI
INFLATION	GDP deflator (annual %)	World Bank, WDI
RIR	Real Interest Rate	World Bank, WDI

The following further describes the independent variables and discusses their expected signs. INFLATION is the rate of growth of the GDP deflator. The coefficient of the INFLATION variable is expected to have positive sign in our model. Inflation can affect bank spreads/ margins through causing informational asymmetries and macroeconomic instability and affecting the flexibility of loan rates (Huybens and Smith, 1999; Dietrich et al., 2015). Inflation can also affect spreads/margins if inflation shocks are not transmitted through to both borrowing and lending rates equally fast or adjustment occurs at different speed (Martinez Peria and Mody, 2004; Beck and Hesse, 2006).

GDPGRO is the yearly volume of gross domestic product (GDP) growth (in %). A negative relationship between the GDP growth and spreads/margins is expected in our model. Changes in output affects interest spreads in a countercyclical way. Banks react output growth by lowering their interest spread since the growth of output improves the creditworthiness of borrowers, decreases their default risk and increases the deposits that bank can lend while they respond economic slowdowns through increasing spreads/margins because economic slowdown deteriorates creditworthiness of borrowers, increases their default risk and decreases the deposits that bank lend (Martinez Peria and Mody, 2004; Fofack, 2016).

RIR is the real interest rate which is the difference between money market rate and inflation. We expect a positive correlation between the real interest rate and spreads/ margins. As real interest rate rises, both the marginal cost of funds faced by banks and riskiness of borrowers are likely to increase which lead to a positive relationship between real interest rates and spreads/margins. On the other hand, real interest rate can also affect spreads/ margins if the changes in real interest rate are not passed to both borrowing and lending rates equally fast or adjustment occurs at different speed (Dabla-Norris and Floerkemeier, 2007: 13).

Estimation Results

The results of multivariate estimations are reported in Table 4 and Table 5 below for spreads and margins respectively. Each Table has 3 models for 3 different ICT indicators. Hausman test is used for the selection between fixed time effect model and random time effect model and decision is made at 1% significance level.

Table 4 reports estimation results for the spread regressions. All coefficients of ICT variables are statistically significant and take the expected signs in all models, indicating that ICT penetration seem to decrease bank spreads. In regard to other variables in the model, the estimated coefficients of INFLATION and RIR variables take the theoretically expected positive sign and are statistically significant in all models in line with other studies (Horvath, 2009; Geleos, 2006; Afanasieff et al., 2002). The results suggest that spreads increase with rises either in the inflation rate or in the real interest rate. Banks seem to set higher spreads in a higher-inflation and a higher-real interest rate environment. By contrast, the coefficient of the GDPGRO variable is significantly negative in all models, suggesting that output growth may cause increased competition in the banking industry and macroeconomic stability both which may lead to decrease in spreads (Horvath, 2009: 134).

The estimation results for the margin regressions are reported in Table 5. All coefficients of ICT indicators are statistically significant and take the expected negative signs, suggesting that ICT penetration decrease margins by reducing transaction costs and increasing competition. Regarding the effects of macroeconomic indicators in the model, the estimated coefficients of INFLATION and RIR take the theoretically expected positive sign and are statistically significant in all models while that of GDPGRO is insignificant in all models. Thus, inflation and real interest rate are estimated to increase the net interest margin while GDP growth has no significant impact on interest margin in line with previous studies (Horvath, 2009; Demirguc-Kunt and Huizinga, 1999).

Overall, our results suggest that inflation rate, real interest rate and GDP growth are the significant macroeconomic factors determining spreads while inflation rate and real interest rate are the significant macro-economic factors determining margins. Our results also revealed that ICT penetration contributes to decrease in both spreads and margins.

Table 4. Multivariate Model Estimation Results (Spreads)

	(1)	(2)	(3)
C	6.9032	-0.1165	7.6924
Standard Error	0.2032	0.1839	0.2031
P-value	0.0000	0.5265	0.0000
INTERNET	-0.0857		
Standard Error	0.0061		
P-value	0.0000		
FXBROADBAND		-0.0228	
Standard Error		0.0104	
P-value		0.0283	
CELLPHONE			-0.0550
Standard Error			0.0038
P-value			0.0000
INFLATION	0.0370	0.4814	0.0348
Standard Error	0.0014	0.0120	0.0013
P-value	0.0000	0.0000	0.0000
GDPGRO	-0.0361	-0.0177	-0.0323
Standard Error	0.0132	0.0093	0.0108
P-value	0.0065	0.0569	0.0029
RIR	0.3457	0.7108	0.2726
Standard Error	0.0117	0.0111	0.0099
P-value	0.0000	0.0000	0.0000
Number of Observations	2349	1337	3009
Number of Countries	144	136	145
R-squared	0.4134	0.7848	0.3521
Estimated Model	FEM	FEM	FEM
Hausman-statistics	36.7990	30.399904	103.6178

Table 5. Multivariate Model Estimation Results (Margins)

	(1)	(2)	(3)
C	4.8689	3.6586	5.0318
Standard Error	0.1417	0.1470	0.1739
P-value	0.0000	0.0000	0.0000
INTERNET	-0.0457		
Standard Error	0.0030		
P-value	0.0000		
FXBROADBAND		-0.0902	
Standard Error		0.0078	
P-value		0.0000	
CELLPHONE			-0.0232
Standard Error			0.0019
P-value			0.0000
INFLATION	0.0785	0.1573	0.0866
Standard Error	0.0057	0.0096	0.0057
P-value	0.0000	0.0000	0.0000
GDPGRO	-0.0023	-0.0039	-0.0002
Standard Error	0.0074	0.0077	0.0073
P-value	0.7548	0.6087	0.9767
RIR	0.0977	0.1229	0.1047
Standard Error	0.0073	0.0088	0.0075
P-value	0.0000	0.0000	0.0000
Number of Observations	2029	1395	2050
Number of Countries	152	146	153
R-squared	0.2713	0.3485	0.2414
Estimated Model	FEM	FEM	FEM
Hausman-statistics	52.0691	28.2060	71.8913

Conclusion

In addition to other macro determinants of banking intermediation efficiency as measured by interest spreads and interest margins, this study explores the explanatory power of ICT penetration. We test the hypothesis that ICT penetration contributes to decrease in both interest spreads and interest margins by using panel data and three ICT penetration indicators. Our results revealed that ICT penetration contributes to decrease in both spreads and margins. This finding is statistically significant and valid for three ICT penetration indicators. Thus, the results indicate that ICT penetration enhances banking intermediation efficiency, controlling for other factors that may contribute to decrease in banking efficiency indicators. Our results suggest that governments aiming to increase ICT penetration contribute to better financial intermediation.

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