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The Adoption of Digital Technology and Labor Demand in Indonesia's Banking Sector

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This study investigates the effect of the adoption of digital technology on the labor demand in the Indonesian banking sector for the period of 2010-2017 using the semiannual data. This research uses a bank-level survey data obtained from the Indonesia Financial Service Authority. The results show that the technology adoption affects the labor demand significantly in all Commercial Bank Based on Business Activities (BUKU) levels of the banks. The technology adoption tends to be a substitution for the labor in the banks with BUKU I, BUKU II and BUKU III in the supporting and business units. In addition, the technology adoption becomes the complement for the labor only in the business units and banks with the BUKU IV level.

JEL Codes: G21, J23, O33.
Keywords: Technology adoption, indonesian banking sector, labor demand, digital Technology.

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1. Introduction

The banking sector contributes significantly to the Indonesian economy. Indonesian banks distributed the funds approximately amounting to 5,556 trillion Rupiah in 2014 (Effendi *et al*., 2018). The distribution of funds approximately increased to 7.299 Trillion Rupiah in 2017. Also, the average growth of the banking credit was about 20% for the 2002-2017 period. Despite its importance, Effendi *et al*. (2018) found that Indonesian banking was not efficient. The inefficiency of the banks can be transferred into the higher cost of the intermediation to the bank customers. Therefore, the inefficiency of the banks can cause welfare losses to the Indonesian economy.

To increase their efficiency, banks adopt technology, mainly digital technology, as one of the solutions in their operation. The technology can also widen the market of the bank without having too many branches and inputs. Thus, the technology adoption can change the way banks use the inputs, especially with respect to the labor demand. Data from the Indonesian Financial Services Authority (OJK) reveal that the numbers of banks and branches have decreased in the 2013-2017 period. The number of commercial banks was about 120 in 2013, and it decreased to 115 in 2017. Moreover, the number of branches also decreased for the commercial banks, especially during the 2015-2017 period. The number of branches of the commercial banks was 32949 in 2015, and it decreased to 32285 in 2017. The decreasing number of banks and branches may affect the labor demand in the banking sector.

Regarding the effect of the technology adoption on the labor demand, previous studies had various conclusions. Craig (1997) and Evangelista and Savona (2003) found that technology can be a substitute for labor, especially in the large banks. Dintrans *et al.* (2016) projected that the front-office and low-middle back office positions will be replaced by technology in the future. Contrarily, Ibrahim *et al.* (2015) found that the technology adoption is not substitution for the labor, but complement for the labor. Regarding the inconclusive results about the relationship between technology adoption and the labor demand, it is relevant to investigate such relationship in the banking sector.

Furthermore, there is also hardly any research investigating the effect of the technology adoption on the labor demand in the Indonesian economy. To fill the gap in the literature, a research investigating the effect of the technology adoption on labor demand in the Indonesian banking sector is needed.

The research investigating the impact of the technology adoption on the labor demand also has policy implications. The significant effect of the technology adoption on the labor demand in the banking sector may suggest OJK and other related policy makers to respond related to the demand and supply of labor. Therefore, a study about the effect of the technology on the labor use is important in the Indonesian economy.

The paper is organized as follows. Section II provides the literature review. Next, the relation between technology adoption and labor use is modelled. This is followed by the description of data in section III and the presentation of the empirical model and results in Section IV. The last section summarizes the results and draws conclusion from the research.

2. Technology adoption and labor demand

A theoretical underpinning and empirical findings can explain the relationship between technology adoption and labor demand. A model corresponding the technology adoption with the labor demand can simply be derived by using the Cobb-Douglas production function at the condition where marginal revenue product of labor (MPl) is equal to wage. The derivation ends up with a model where the labor demand is affected by the technology adoption, capital, and wage-to-price ratio. The detailed derivation is presented in the Appendix.

Empirical studies have also investigated the effect of the technology adoption on the labor demand, but the results were still inconclusive. For example, Craig (1997) investigated the impact of the technology or technical change on the labor demand in US banks. The research used a time trend as the proxy of the technological change. The research found that technology might substitute for the labor in the large banks. On the other hand, Evangelista and Savona (2003) investigated the effect of the innovation on employment in the service sectors in Italy, including the banking sector. The technological progress affected positively the employment absorption in some service sectors with strong basis of technology, and the impact was stronger for the small size firms. Nevertheless, the impact of the technological progress was negative on the labor absorption in the banking sector. Moreover, Bessen (2015) investigated the effect of the ATMs on the labor demand in the US banks. The research found that the ATMs reduced labor demand, but this was offset by the large expansion in the number of branches. Most of the previous research did not comprehensively observe the impact of the technological adoption, especially in the measures of the technological adoption. Thus, a research comprehensively measuring the technology adoption and investigating its impact on the labor demand is needed.

Indonesian banking system applies a bank categorization based on the business activities (BUKU) classifying the banks into 4 groups. The 4 groups include banks of BUKU I, BUKU II, BUKU III and BUKU IV classified by bank's core asset. Banks are classified into BUKU 1 if the core asset is less than 1 trillion rupiah. Banks are grouped into BUKU II and BUKU III if the core assets are between 1 trillion and 5 trillion rupiah and between 5 trillion and 30 trillion, respectively. The BUKU IV includes the banks that have core asset more than 30 trillion rupiah. This categorization also affects the use of technology in the banks. The banks with higher BUKU level have higher investment in the banking technology compared to the banks with lower BUKU level (see Furst et al., 2000). Thus, the impact of the technology adoption on the labor demand in the banking sectors will be different among the BUKU levels.

Summarizing the theoretical background, by modifying the derived model in the Appendix[1], it is hypothesized that the mathematical relationship between technology adoption, capital, wage-to-price ratio and BUKU can be written in the following equation:

Lab=f(Tech, Cap, w/p, BUKU) (1)

Where $\frac{dLab}{dtech} > 0$ or $\frac{dLab}{dtech} < 0$, $\frac{dLab}{dCap} > 0$, $\frac{dLab}{dw/p} > 0$ and $\frac{dLab}{dBuku} > 0$ or $\frac{dLab}{dBuku} < 0$, Lab is a labor demand, Tech is technology adoption, Cap is capital expenditure of technology, w/p is wage-to-price ratio and BUKU is bank categorization. Furthermore, Berger (2003) also suggests that the technology adoption might change the performance in the supporting and business units. Therefore, the labor in (1) will also be divided into the business (LBuss) and supporting unit (Lsupp).

3. Modelling

This research applies two indicators of the technology adoption including the investment in the technology and the use of technology by banking customers from the demand side. The investment in technology is represented by the capital expenditure in technology. The use of the technology by banking customer is measured by the use of digital technology including the number of users, frequency of the use and the value of the transaction using the digital technology. Moreover, the use of the digital technology is represented by the uses of internet banking, mobile banking, SMS banking, mobile post banking, video banking and digital branch.

Based on the theoretical considerations and previous empirical findings presented in the previous section, equation (1) is proposed to reflect the relationship between the technology adoption and labor demand. The BUKU levels are interacted with the technology adoption to cover the different effects of the technology adoption on the labor demand among the BUKU levels. Linearizing the mathematical relationships in the (1) ends up with:

$$LSupp_{it} = \alpha_i + \lambda_1 Tech_{it} + \lambda_2 Cap_{it} + \lambda_3 (w/P)_{it} + \sum_{j=1}^{3} \gamma_j BUKU_{jt} + \sum_{j=1}^{3} \rho_j Tech_{it} * BUKU_{jt} + \varepsilon_{it} \quad (2)$$

$$LBuss_{it} = \sigma_i + \phi_1 Tech_{it} + \phi_2 Cap_{it} + \phi_3 (w/P)_{it} + \sum_{j=1}^{3} \delta_j BUKU_{jt} + \sum_{j=1}^{3} \eta_j Tech_{it} * BUKU_{jt} + \nu_{it} \quad (3)$$

where *i, j* and *t* are index banks, BUKU and period, respectively. The BUKU categorization is measured by the BUKU dummy with the dummy of BUKU I is used as a base. LSupp and LBuss are labor demand of supporting unit and labor demand of business unit, respectively.

[1] This research does not apply the model in the natural logarithm as suggested by the model in the Appendix, since this research uses capital expenditure as one of the measures of the technology adoption which can be zero in some of the periods.

Equations (2) and (3) are estimated using pooled regression model imposing unobserved heterogeneity in the BUKU levels. Applying the common fixed-effects model using unobserved heterogeneity in banks cannot be possible since this model includes BUKU dummies which are constant across respective banks during the periods. The heteroscedasticity and autocorrelation are also tested using White test and Durbin-Watson test, respectively. To address the problem of heteroscedasticity and autocorrelation, this paper applies the Newey-West correction on standard error.

4. Data

This research uses bank-level data obtained from the survey conducted by Indonesian Financial Services Authority (OJK). The data set covers a semiannual data of the period 2010-2017, for which the data are provided by the surveys. Because of the limited data, this research uses only 40 banks covering 11 banks of BUKU I, 17 banks of BUKU II, 9 banks of BUKU III and 3 banks of BUKU IV. Although the research does not cover the 119 banks as the full sample of the commercial banks, the samples of 40 banks already represent the asset of banks. The 40 banks cover more than 80% of the Indonesian banks' asset.

Regarding the technology adoption, the capital expenditure (capex) is measured by capital expenditure for banking technology in value (rupiah). The use of technology is measured by the number of users in the digital banking (person), the frequency of use of the digital banking (unit) and the transaction value of the digital banking (rupiah). The business unit labor (Lbuss) is measured by the number of the workers in business unit. The supporting unit labor (LSupp) is measured by the number of the workers in supporting unit.

Table 1. Descriptive Statistics of the Variables

Variable	**Mean**	**Std. Dev.**	**Coeff.of Var**
Business unit employee (person)	4,389	11,875	2.71
Supporting unit employee (person)	958	1,826	1.91
Wage-to-price ratio (unit)	6	31	5.17
Total asset (billion rupiah)	83	180	2.17
Total Capital Expenditure (million rupiah)	387	2,738	7.07
The user number of digital technology (person)	211385	1888679	8.93
The frequency of use of digital technology (unit)	14978	124185	8.29
The transaction value of digital technology (unit)	331861	2281864	6.88
N = 580			

Source: authors' calculation

Table 1 shows the descriptive statistics of the variables in the model across banks and periods. All the variables have the high variation with the coefficient of variation larger than 1. The three variables with the highest variation include the user number of digital technology, the frequency of the use of the digital technology and the total capital expenditure, with the coefficients of variation of 8.93, 8.29 and 7.07, respectively. The high variation of the variables can be caused by the high variation among the banks in size.

5. Results

Table 2 shows the trend of the labor demand in the Indonesian banking sector. From the Table 2 it is shown that the average labor demand of the supporting unit increased significantly in semester 2 of 2010 and semester 1 of 2011, but it experienced a decline in semester 1 of 2012. The average labor demand had a positive trend from semester 2 of 2012 to semester 1 of 2015, except in semester 2 of 2013 when the labor demand experienced a negative downturn. However, the labor demand of supporting unit declined in semester 2 of 2016. Based on the data, we can see that the decline of the labor demand occurred not only in the supporting unit, but also in the business unit. Furthermore, the labor demand of the supporting unit declined relatively faster than the business unit. Also, the labor demand of the business unit had a similar trend with the total labor demand.

Table 2. Trend of the average labor demand

Period	Labor Business Unit	% Δ in Business Unit	Labor Support Unit	% Δ in Support Unit	Labors All Unit	% Δ in All Unit
2010.01	3,020		282		3,302	
2010.02	3,798	26%	618	119%	4,416	34%
2011.01	4,215	11%	732	18%	4,947	12%
2011.02	4,145	-2%	693	-5%	4,838	-2%
2012.01	3,056	-26%	670	-3%	3,727	-23%
2012.02	3,302	8%	770	15%	4,072	9%
2013.01	3,398	3%	706	-8%	4,104	1%
2013.02	3,015	-11%	747	6%	3,762	-8%
2014.01	3,175	5%	1,063	42%	4,238	13%
2014.02	3,604	14%	772	-27%	4,375	3%
2015.01	3,762	4%	773	0%	4,535	4%
2015.02	3,687	-2%	791	2%	4,478	-1%
2016.01	3,561	-3%	755	-5%	4,316	-4%
2016.02	3,468	-3%	768	2%	4,237	-2%
2017.01	3,414	-2%	800	4%	4,214	-1%

Source: authors' calculation

Table 3 and Table 4 shows the average trend of the technology adoption in Indonesian banks both from the demand side of the digital banking and the level of technology adoption. The demand side of digital banking is measured by the number of users of digital banking, the

frequency of use of digital banking, and the transaction value of digital banking. The level of the technology adoption is reflected by total capital expenditure in technology. Due to the data limitation, the measure of the technology adoption from the demand side only started from semester 1 of 2013 to semester 1 of 2017. The data of capital expenditure started from semester 1 of 2010 to semester 1 of 2017 which is sourced from secondary data, provided by OJK.

Table 3. Trend of the average technology adoption from the demand for digital banking

Period	Digital Banking Users	% ΔDigital Banking User	Transaction Frequency (Million)	% ΔFrequency (Million)	Transaction Value (Billion Rp)	% ΔTransaction Value (Billion Rp)
2013.2	522,265		17.9		473,862	
2014.1	931,084	78%	36.3	103%	561,768	19%
2014.2	1,111,443	19%	41.4	14%	549,517	-2%
2015.1	1,411,511	27%	33.6	-19%	497,700	-9%
2015.2	1,636,844	16%	45.9	37%	447,176	-10%
2016.1	2,006,070	23%	53.1	16%	458,793	3%
2016.2	2,317,779	16%	56.5	6%	451,070	-2%
2017.1	2,513,819	8%	57.5	2%	542,088	20%

Source: authors' calculation

From Table 3 it is shown that the number of users of digital banking and the frequency of use of digital banking showed a positive trend during the 2013-2016 period. The frequency of use slightly decreased in semester 1 of 2015, but the trend was positive. Although the average of the percentage changes of the transaction value using digital technology was positive, the percentage changes were negative in most of the periods. The value of transaction using digital technology decreased in semester 1 of 2015 to semester 2 of 2015, but it increased again in semester 1 of 2016. The value of the transaction also increased in semester 1 of 2017 after the decrease in the previous period.

Table 4 shows that the capital expenditure of technology adoption tended to fluctuate with an increasing trend at the end of book period. The trend indicates that there was an annual investment cycle in the technology. Therefore, both demand side and capital expenditure indicated positive trends at the end of the book period. If we relate the trend of the labor demand with the trend of the technology adoption, there is an indication of opposite directions of the trends between the two variables. For example, labor supporting unit decreased continually after semester 1 of 2015 while the capital expenditure of technology and the technology adoption from the demand side for digital banking increased in the same period, on average.

Tabel 4. Trend of the average level of technology adoption

Period	Capital Expenditure (Billion Rp)	% ΔCapital Expenditure
2010.1	56	
2010.2	310	454%
2011.1	94	-70%
Period	Capital Expenditure (Billion Rp)	% ΔCapital Expenditure
2011.2	238	153%
2012.1	26	-89%
2012.2	104	300%
2013.1	15	-86%
2013.2	104	593%
2014.1	36	-65%
2014.2	300	733%
2015.1	25	-92%
2015.2	187	648%
2016.1	10	-95%
2016.2	360	3500%
2017.1	13	-96%

Source: authors' calculation

Table 5 shows the regression results of Eqs. (2) and (3) using the capital expenditure of technology as a measure of the technology adoption. The models suffered from the problem of the heteroscedasticity using the White test. Thus, the standard error of the model was corrected using the White-corrected standard error. From the Table 5 it is seen that the capital was significant affecting the labor demand only for supporting unit of labor at the 1% critical level. Also, the wage-to-price ratio had a negative effect on the labor demand at the 1% critical level for the supporting and business units, respectively. Furthermore, the technology adoption was significant affecting the labor demand for the banks with BUKU I. The coefficients of the technology adoption of the BUKU I were -0.0244 and -0.0592 for the labor demand models of supporting unit and business unit, respectively. The coefficients were both significant at the 1% critical level. Moreover, the coefficients for the technology adoption of BUKU II were -0.114 (=-0.0244-0.0899) and -0.267 (=-0.0592-0.208) for the respective labor demand models with supporting unit and business unit, and coefficients were significant at the 1% critical level. The coefficients for the technology adoption of BUKU III were -0.0244 (=-0.0244-$2.20*10^{-8}$) and -0.0592 (=-0.0592-$1.28*10^{-8}$) for the respective labor demand models with supporting unit and business unit. The coefficient was significant at the 10% critical level only for the labor demand with supporting unit. The coefficients for the technology adoption of BUKU IV were -1.434 (=-0.0244-1.410) and 19.031 (=- 0.0592+19.090) for the respective labor demand models with supporting unit and business unit. The coefficient was positive and significant at the 1% critical level only for the labor demand with business unit. This indicates that the

increase of the technology investment in the banking sector affected positively the labor demand only in the business unit.

Table 5. Regression results of labor demand model I

	LSupp	Lbuss
Constant	246.6***	412.7***
	(5.89)	(4.60)
W/P	-1.367***	-6.791***
	(-4.17)	(-4.21)
Cap	9.530***	17.82
	(3.52)	(1.20)
Tech	-0.0244***	-0.0592***
	(-2.92)	(-3.16)
Tech*BUKU2	-0.0899***	-0.208***
	(-5.78)	(-4.62)
Tech*BUKU3	$2.20*10^{-8}$**	$1.28*10^{-8}$
	(2.39)	(0.51)
Tech*BUKU4	-1.410	19.09***
	(-0.77)	(3.87)
BUKU2	-92.77*	34.46
	(-1.67)	(0.18)
BUKU3	31.44	1209.0
	(0.10)	(0.73)
BUKU4	-2783.7**	12265.8
	(-2.15)	(1.07)
N	580	580
R^2	0.374	0.599

Notes: t statistics in parentheses

** significant at the 10% critical level*

*** significant at the 5% critical level*

**** significant at the 1% critical level*

Source: Author's calculation

The results in the Tabel 5 suggest that there was a negative effect of the technology adoption on the labor demand of the supporting unit in the banks at all BUKU levels, although the effect was not significant at the BUKU IV level. Furthermore, there was also a negative effect of the technology adoption on the labor demand of the business unit in the bank at BUKU I, II and III levels. The effect of the technology adoption on the labor demand of the business unit was positive in the banks at BUKU IV level. This indicates that the technology adoption increased the labor demand only in the business unit of BUKU IV. Furthermore, most of the dummy variables were not significantly affecting the labor demand in both models of supporting unit and business unit, except the dummy variable of BUKU IV. The negative dummy coefficient of the BUKU IV suggested that the BUKU IV banks had lower number of labor in supporting

units compared to the BUKU I. The results suggest that the technology adoption substituted for the labor demand in the Banks with BUKU I, II and III in the both supporting and business units. The technology adoption complemented for the labor demand in the bank with BUKU IV only in the business unit.

Table 6. Regression results of labor demand model II

	Model 1		Model 2		Model 3	
	LSupp	LBuss	LSupp	LBuss	LSupp	LBuss
Constant	236.3***	364.9***	229.9***	356.1***	233.1***	361.3***
	(5.78)	(4.16)	(5.83)	(4.15)	(5.82)	(4.14)
W/P	-1.176***	-6.937***	-1.361***	-7.124***	-1.411***	-7.292***
	(-4.44)	(-4.44)	(-4.70)	(-4.51)	(-4.50)	(-4.52)
Cap	12.33***	28.64*	12.35***	29.08**	12.21***	28.91
	(5.53)	(1.94)	(5.46)	(1.96)	(5.28)	(1.92)
Tech	-0.258***	-0.340***	-0.00188***	-0.00377***	-0.530***	-0.962***
	(-3.46)	(-2.72)	(-2.76)	(-2.94)	(-3.20)	(-3.43)
Tech*BUKU2	0.263***	0.341***	-0.00494	-0.0200***	0.530***	0.962***
	(3.52)	(2.73)	(-1.28)	(-3.47)	(3.20)	(3.43)
Tech*BUKU3	0.263***	0.343***	0.00431***	0.00272*	0.530***	0.961***
	(3.52)	(2.75)	(5.82)	(1.91)	(3.20)	(3.43)
Tech*BUKU4	0.258***	0.340***	-36.96***	44.60**	0.496***	1.002***
	(3.45)	(2.73)	(-7.03)	(2.24)	(2.99)	(3.57)
BUKU2	-177.2***	-158.2	-147.0***	-138.5	-143.8***	-126.5
	(-3.36)	(-0.83)	(-2.81)	(-0.72)	(-2.68)	(-0.64)
BUKU3	-504.4**	-136.6	-419.1*	39.69	-225.5	186.9
	(-2.21)	(-0.09)	(-1.77)	(0.02)	(-0.87)	(0.11)
BUKU4	-3978.5***	9964.5	-4028.5***	9805.5	-4030.4***	10050.6
	(-3.19)	(0.84)	(-3.17)	(0.82)	(-3.10)	(0.83)
N	580	580	580	580	580	580
R^2	0.534	0.568	0.539	0.568	0.499	0.567

Notes: t statistics in parentheses

* *significant at the 10% critical level*

** *significant at the 5% critical level*

*** *significant at the 1% critical level*

Model 1 = Model with number of user of the digital technology as a proxy of technology

Model 2 = Model with frequency of use of the digital technology as a proxy of technology

Model 3 = Model with transaction value of the digital technology as a proxy of technology

Authors' calculation

Table 6 shows the labor demand models with different measures of the technology adoption i.e. the demand of digital banking. For the proxy of the technology adoption, the Model 1, Model 2 and Model 3 applied the number of users of digital banking, the frequency of use of digital bankingm and the transaction value of digital banking, respectively. From Table 6 it is apparent that the technology adoption affected negatively the labor demand in all models of the BUKU I level of the banks. Also, the effects were consistent and significant for the models in supporting and business units. For example, coefficients of the technology adoption on the Model 1, Model 2 and Model 3 were significant at the 1% critical, respectively. This indicates that the increase of the use of the banking technology by customer reduced the labor demand in the banks at BUKU I level.

In model 1, the effects of the technology (number of users of the banking technology) on the labor demand in BUKU 2, BUKU 3 and BUKU 4 were positive for both supporting and business units. The effects were significant at the 1% critical levels in the supporting and business units, respectively. This indicates that use of the technology adoption (mainly the digital banking) reduced the labor demand in BUKU I, but increased the labor demand in BUKU II, III and IV. In spite of this, the coefficient of the technology in BUKU IV that closed to zero for both supporting and business units might indicate that the labor demand in BUKU IV might be still neutral to technology.

In model 2, the effect of the technology adoption (frequency of use of the digital technology) on labor demand was not the same among the BUKU I, II, III and IV for both supporting and business units. The technology affected the labor demand of supporting unit negatively for the banks in BUKU I, BUKU II and BUKU IV with the respective coefficients of the technology being -0.0019, -0.007 and -36.962. The coefficients were significant at the 1% critical levels for only the BUKU I and BUKU IV, respectively. The technology affected the labor demand positively in the banks of BUKU III, and the coefficient was significant at the 1% critical level. In the business unit, the technology affected the labor demand negatively for the banks in BUKU I, BUKU II and BUKU III with the coefficients of technology were - 0.004, -0.024 and -0.001. The coefficients were significant at the 1% and 10% critical levels, respectively. The technology affected the labor demand of the business unit positively in the banks of BUKU IV with the coefficient of 44.596, and the coefficient was significant at the 5% critical level.

In Model 3, the technology adoption (transaction value of the digital technology) affected the labor demand of the supporting unit significantly at all BUKU levels of the banks at the 1% critical level. The technology affected negatively the labor demand of the supporting unit in BUKU I, BUKU III and BUKU IV with the coefficients of -0.530, -0.000 and -0.034. The technology affected positively the labor demand in the BUKU II with the coefficient of 0.000. In the business unit, the technology adoption also affected the labor demand significantly in all BUKU levels of the banks at the 1% critical level. The technology affected the labor demand of the business unit negatively only in the banks ath BUKU I, BUKU II and BUKU III levels with the coefficients of -0.962, -0.000 and -0.001, respectively. The

technology affected the labor demand of the business unit positively only in the BUKU IV with the coefficient of 0.040.

The effect of the wage-to-price ratio was negative on all the labor demand models, and the coefficients were significant at the 1% critical level. Furthermore, the capital had a positive effect on the labor demand of the supporting unit. The effect of the capital on the labor demand was not significant for the labor demand of the business unit. Moreover, most of the BUKU dummies were significantly affecting the labor demand of the supporting unit. The effects of the dummy variable were not significant affecting the labor demand for the business unit.

From the results of Model 1 - Model 3 it is apparent that the technology adoption by users measured by the number of users, frequency of use and transaction value of the digital banking affected significantly the labor demand in the banks in all BUKU levels, although the effects can be different among the BUKU levels. Summarizing the results, this research may suggest that the technology adoption mostly have positive effects on the labor demand of the business unit at the BUKU IV level. Moreover, the technology adoption is suggested to have negative effects on the labor demand in the most banks at BUKU level lower than BUKU IV for both supporting and business units.

6. Conclusion

This research investigates the effect of the technology adoption on the labor demand in the Indonesian banking sector. This research uses both secondary and survey data of the banks obtained from the Indonesian Financial Authority (OJK). The econometrics model is applied to estimate the effect of the technology adoption on the labor demand.

This study finds that the technology adoption affects the labor demand of the banks significantly in most of the BUKU levels. The technology adoption mostly affects negatively the labor demand of the banks in BUKU I, BUKU II and BUKU III in both supporting and business units. The technology adoption seems to affect positively the labor demand of the banks in the banks at BUKU IV level.

This research may suggest the policy maker to restructure the labor market to the condition where the market can provide the labor supply for the larger size of the labor demand in the business unit of the banks. This may also reduce the problem of the dual market condition in the Indonesian labor market. An affirmative action to face the reduction in labor market of the supporting unit of the banks should also be addressed.

Appendix

To derive the relation between technology adoption and labor demand, assume the production function follows the Cobb-Douglas production function where output is a function of capital, labor and technology:

$$Y = A^{\alpha}K^{\beta}L^{\gamma} \quad \text{(i))}$$

where Y is output, A is technology, K is capital and L is hired labor. Applying the assumption in the microeconomics theory where the optimal labor demand stays at the condition where *marginal revenue product of labor* (MRPL) is equal to wage (w), we can get the equation:

$$MRP_L = P.MPl = P * (\gamma A^{\alpha}K^{\beta}L^{\gamma-1}) = w \quad \text{(ii)}$$

where P is product price and MPl is marginal product of labor. MPl is the first derivative of the Y in the equation (i). Taking the natural logarithm to linearize the (ii), it ends up with:

$$ln\gamma + \alpha \ln A + \beta \ln K + \gamma LnL - \ln L = \ln w/P \quad \text{(iii)}$$

Expressing the (3) in LnL, we finally can get:

$$\ln L = \eta_1 + \eta_2 \ln A + \eta_3 \ln K + \eta_4 Ln(w/P) \quad \text{(iv)}$$

where η_1, η_2, η_3 and η_4 are ln γ/(1-γ), α/(1-γ), β/(1-γ) and 1/(1-γ), respectively. Assuming A is a variable that may included ATM, E-Banking (EB), debit/credit and the use of digital technology, the (4) can be written as:

$$\ln L = \alpha_1 + \sum_{i=1}^{n} \beta_i Tech_i + \lambda_1 \ln K + \lambda_2 (w/P) + \varepsilon \quad \text{(v)}$$

where Tech is the use technology.

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