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# **PROBLEMS OF WORLD AGRICULTURE**

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**Mirosław Wasilewski<sup>1</sup>**

Department of Economics and Organization of Enterprises,  
Warsaw University of Life Sciences

**Olena Oliynyk<sup>2</sup>**

Department of Banking,  
National University of Life and Environmental Sciences of Ukraine

**Viktor Adamenko<sup>3</sup>**

Department of Economy and Finance Company,  
Kyiv National University of Trade and Economics

## **Financial System and Agricultural Growth: Evidence from Poland and Ukraine**

**Abstract.** We built simplified models of integral indicators for the level of development of the financial system and for agricultural growth using the principles of "moderate middle way". We then used these models to compare the levels of financial system development, economic and agricultural growth, and trends of financial development and agricultural growth, in Poland and Ukraine. We used the integral indicators and econometric methodologies to assess the relationship between financial development and agricultural growth in both countries. The results of the study revealed the absence of a statistical relationship between integral indicators of financial system development and agricultural growth in Poland and Ukraine. We can ascertain the presence of arguments regarding the existence of the impact of the banking component of the financial system on agriculture in these countries. The regression models showed significant directly proportional relationships between certain aspects of agriculture and some components of the banking sector (resources and effectiveness).

**Key words:** financial system, agricultural growth, integral indicator of agricultural growth, integral indicator of financial system development, Ukraine, Poland

## **Introduction**

The link between financial development and economic growth has been explored seriously by scholars only in the last 10-15 years. Some contributions investigating the finance-growth nexus are theoretically oriented, while others have an empirical focus.

The first attempt to define the relationship between financial development and economic growth was made by Goldsmith in 1969. Using cross-country data, Goldsmith found evidence of a positive trend in the ratio of financial institution assets to GDP for 35 countries from 1860-1963 [Goldsmith 1969]. Later, many authors extended this line of inquiry and confirmed Goldsmith's findings. They have provided additional information on the finance-growth nexus and have offered a much bolder assessment: firm-level, industry-level, and cross-country studies. Cross-country studies suggest that the level of financial development exerts a positive effect on economic growth [Beck et al. 2000; Levine et al 1998; Levine 2002; Rajan 2003].

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<sup>1</sup> Professor, Doctor habilitated, e-mail: mirosław\_wasilewski@sggw.pl

<sup>2</sup> Associate professor, Doctor habilitated, e-mail: olenaooliynyk@gmail.com

<sup>3</sup> Assistant of professor, e-mail: v\_adamenko@ukr.net

The existing literature on the finance-growth nexus uses three approaches: cross sectional analysis, a time-series approach, and panel data methods (a combination of both techniques). Each of these approaches has made useful contributions to the investigation of the relationship between finance and growth. However, Schmidt emphasized [Schmidt et al 2006] that all approaches suffer from some important limitations which do not allow us to take all results at face value. The general problem of all empirical studies is that, to examine the relationship between financial development and growth, one has to define appropriate measures of financial development. Researchers come up with various definitions and measures. Some studies use the size of the banking sector typically measured by the deposit liabilities to GDP or bank claims on the private sector to GDP. Others use the size of the stock markets, defined as market capitalization to GDP or total value of domestic equities traded on the stock exchanges to GDP. However, these measures have been criticized by some [Schmidt et al 2006].

In our opinion, the best option for solving methodological problems of evaluation of the finance-growth nexus is compliance with the concept of "moderate middle way", which includes<sup>1</sup>:

- using publicly available statistical data – quantitative objective indicators calculated using generally accepted methods and openly published on the Internet;
- maximum avoidance of subjective assessments and indicators that are characterized by uncertainty regarding the methods of collection or calculation;
- using mathematical approaches of the average level of complexity and using average dimension data sets. However, data sets must be sufficient to identify the main statistical regularities on the basis of regression analysis;
- visualization of assessment results.

In this paper, we build simplified models of integral indicators of the level of financial system development and agricultural growth by using the principles of "moderate middle way". We use the simplified models of integral indicators to compare the level of financial system development, economic and agricultural growth and trends of financial development and agricultural growth in Poland and Ukraine. Finally, we use the integral indicator and econometric methodologies to assess the relationship between financial development and agricultural growth in both countries.

## Methodology and Data

We suggest using the principles of "moderate middle way", as mentioned above, to build a simplified model of integral indicators of level development, which is associated with generalization of three types of indicators: 1) scale (extent of development); 2) resources; 3) efficiency. The composition of these indicators is illustrated in Table 1.

We divide the financial system into two components – the banking sector and financial markets. We propose to call the model of the integral indicator of the relative level of financial system development as «3+3»<sup>2</sup>.

<sup>1</sup> A more detailed explanation of the concept of "moderate middle way" is found in Wasilewski et al [2015].

<sup>2</sup> A more detailed explanation of the model "3+3" found in Oliynyk et al [2015].

Table 1. The indicators of the simplified model of the integral indicator

The integral indicator	Components of integral indicator		
	Scale (extent of development)	Resources	Efficiency
1. Financial system development:			
banking sector	Commercial bank branches (per 100,000 adults)	Deposit liabilities (% of GDP)	Domestic credit to private sector by banks (% of GDP)
financial markets	Listed domestic companies (per 1,000,000 adults)	Market capitalization of listed companies (% of GDP)	Stocks traded, total value (% of GDP)
2. Economic growth	Employment to population ratio, 15+, total (%) (modeled ILO estimate)	Gross capital formation (% of GDP)	GDP per capita (current US\$)
3. Agricultural growth	Arable land (hectares per person)	Agriculture, value added (% of GDP)	Agriculture value added per worker (constant 2005 US\$)

Source: authors' analyses based on data [World Bank 2015a, 2015b].

We offer to consider the significance of each indicator as being equal. This allows us to avoid result distortion, which is associated with subjective judgments, regarding the ranking of each indicator.

The integral indicator of level development is calculated as an area of a geometric figure (triangle is for economic and agricultural growth, hexagon – for financial system), with the tops in a coordinate system of 3 or 6 axes. Each axis corresponds to one of the indicators listed in Table 1. On each of the three or six axes, we plot the relative values, which are defined as a share of the maximum (or reference) value of the indicator.

The integral indicator of the financial system development level as an area of the hexagon can be calculated by the formula:

$$II_{FS} = \frac{1}{2} \times [(I_1 \times I_2) + (I_2 \times I_3) + \dots + (I_6 \times I_1)] \times \sin 60^\circ, \quad (1)$$

where  $II_{FS}$  – the integral indicator of the financial system development level;

$I_1, I_2, \dots, I_6$  – relative values of indicators used in the model "3 + 3" (6 indicators):  $I_1, I_2, I_3$  – relative values of banking sector indicators,  $I_4, I_5, I_6$  – relative values of the financial market indicators (see Table 1).

The integral indicator of the economic growth level as an area of the triangle can be calculated by the formula:

$$II_{EG} = \frac{1}{2} \times [(I_1 \times I_2) + (I_2 \times I_3) + (I_3 \times I_1)] \times \sin 120^\circ, \quad (2)$$

where  $II_{EG}$  – the integral indicator of the economic growth level;

$I_1, I_2, I_3$  – relative values of indicators of scale, resources and efficiency.

The integral indicator of agricultural growth, as well as the integral indicator of the economic growth level, is calculated by Formula 2, using three indicators according to Table 1.

The integral indicator describes the relative development level and it cannot be calculated only for one country for one year without comparison with another country or establishing reference values or time-series data<sup>1</sup>.

## Results

If the level of the financial system significantly affects the agricultural growth, then, obviously, we should observe a significant statistical relationship between the relevant integral indicators. Nevertheless, the conducted research has revealed that the relationships between the integral indicators of the financial system and agriculture in Poland and Ukraine for 2004-2012 are not observed (see Fig. 1).

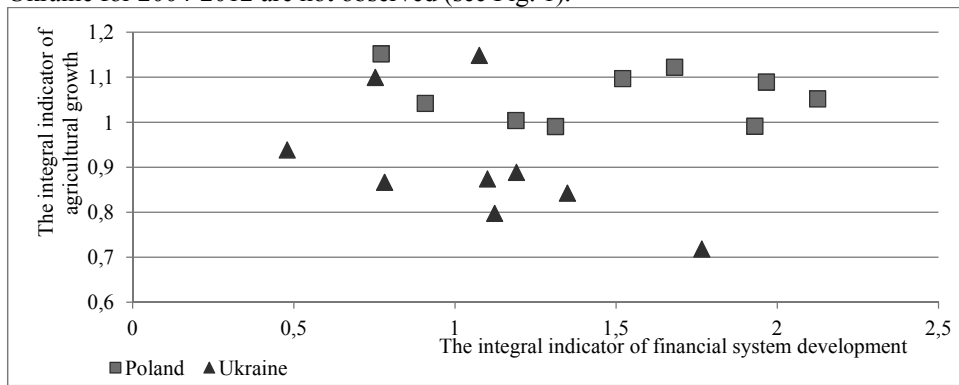


Fig. 1. The interdependence between the integral indicators of financial system development and agricultural growth in Poland and Ukraine, 2004 – 2012

Source: authors' calculations based on data [World Bank 2015a, 2015b; ECB 2015, NBU 2015].

Consistent statistical patterns between integral indicators of financial system development and agricultural growth are absent, but a strong relationship between the integral indicator of financial system development and economic growth is present. In this case, we can assume that agriculture should be viewed as one of those industries, for which the complex impact of the financial system does not have significant value. We may apply this assumption to Poland's agriculture, which developed steadily in 2004 - 2012, despite substantial transformational processes and crisis phenomena that occurred in the financial system, as well as significant changes in economic development (Fig. 2).

<sup>1</sup> A more detailed explanation of the concept of "moderate middle way" is found in Wasilewski et al (2015).

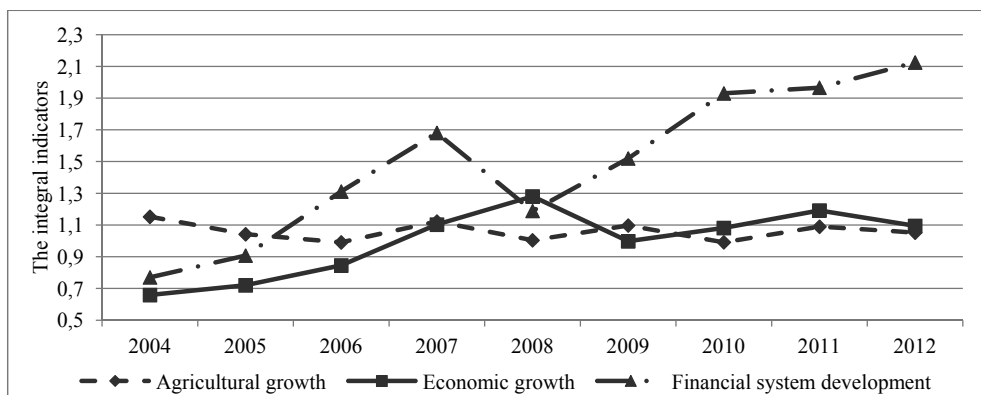


Fig. 2. The trend of integral indicators of financial system development, economic and agricultural growth in Poland, 2004 – 2012

Source: authors' calculations based on data [World Bank 2015a, 2015b; ECB 2015].

Poland's integral indicator of economic growth dynamics significantly differed from agriculture and was connected with the financial system development. Substantial correlation between the integral indicator of financial system development and the economic growth indicator is illustrated by the regression model (Fig. 3).

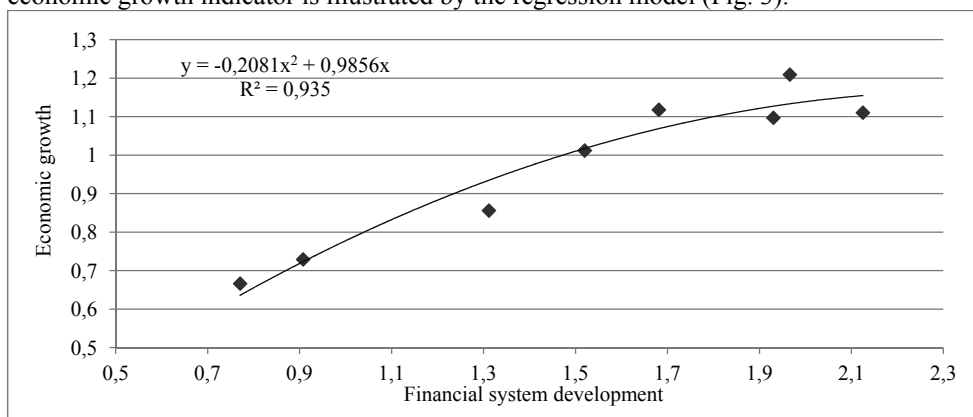


Fig. 3. The regression model describing the interdependence between integral indicators of financial system development and economic growth in Poland, 2004 – 2012 (data of 2008 is excluded)

Source: authors' calculations based on data [World Bank 2015b; ECB 2015].

The situation in Ukraine is slightly different from Poland. However, it is reasonable to assume that the complex influence of financial system development on agriculture is not substantial. This statement is based on the fact that relatively stable development of agriculture took place within a turbulent financial system and economic development processes in the background (Fig. 4).

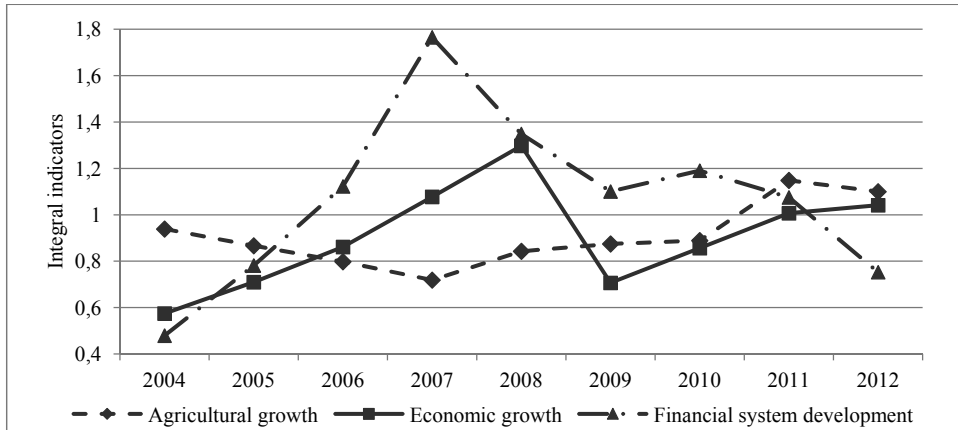


Fig. 4. The trend of integral indicators of financial system development, economic and agricultural growth in Ukraine, 2004 – 2012

Source: authors' calculations based on data [World Bank 2015a, 2015b; NBU 2015].

The study reveals a strong statistical relationship between the integral indicator of financial system development (taken with 1 year in advance) and the integral indicator of economic growth of Ukraine (Fig. 5), despite the fact that any similar interdependencies with the integral indicator of agricultural growth were not observed (Fig. 6).

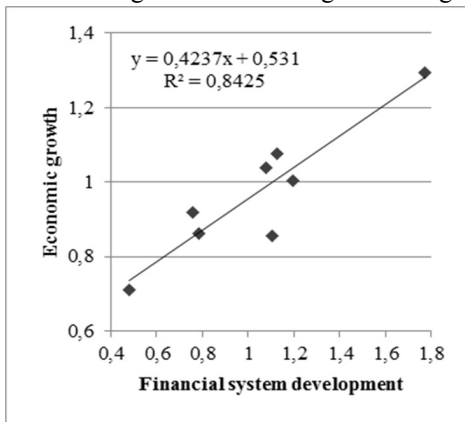


Fig. 5. The regression model describing the interdependence between integral indicators of financial system development (for the previous year) and economic growth in Ukraine (the values of integral indicators of the financial system development are for 2004-2011, data of 2008 is excluded; the values of integral indicators of economic growth are for 2005-2012, data of 2009 is excluded).

Source: authors' calculations based on data [World Bank 2015b; NBU 2015].

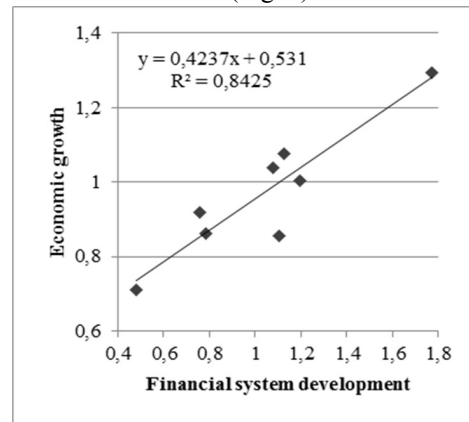


Fig. 6. The regression model describing the interdependence between integral indicators of financial system development (for the previous year) and agricultural growth in Ukraine (the values of integral indicators of financial system development are for 2004-2011; the values of integral indicators of agricultural growth are for 2005-2012).

Source: authors' calculations based on data [World Bank 2015a, 2015b; NBU 2015].



Although an absence of the complex influence of financial system development on agricultural growth was observed in Poland and Ukraine during the studied period (according to the integral indicators analysis), this does not give any reasons to conclude that the development of the financial system does not influence the development of agriculture in these countries. Important relations may exist between indicators characterizing separate aspects of the financial system and agricultural growth.

Taking into consideration only the development of the banking component of the financial system as being the most significant one (as many researchers assume) for small and medium agricultural producers, and analyzing the correlation between its integral indicator and separate indicators of agricultural growth, we can identify certain statistical dependencies (Table 2).

Most notably, in Table 2 we can observe that: in the case of Poland, there is a strong positive correlation between the development of the banking component of the financial system and value added per worker in agriculture (in constant 2005 US \$); in the case of Ukraine, there is a strong negative correlation between the development of the banking component of the financial system and value added in agriculture (% of GDP). Regression models (Fig. 7 and Fig. 8) illustrate the identified dependencies.

Table 2. Correlation coefficients between the integral indicator of the banking component of the financial system and separate indicators of agricultural growth in Poland and Ukraine, 2004-2012

The indicator of agricultural growth	Correlation coefficients with integral indicator of the banking component of financial system	
	Poland	Ukraine
Arable land (hectares per person)	-0.817	0.583
Agriculture, value added (% of GDP)	-0.377	<b>-0.899</b>
Agriculture value added per worker (constant 2005 US\$)	<b>0.914</b>	0.310

Source: authors' calculations based on data [World Bank 2015a, 2015b; ECB 2015; NBU 2015].

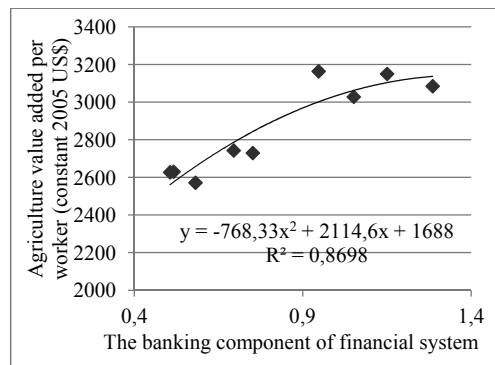


Fig. 7. Regression model that describes the relationship between the integral indicator of banking component of financial system and agriculture value added per worker (constant 2005 US\$) in Poland, 2004 – 2012.

Source: authors' calculations based on data [World Bank 2015a, 2015b; ECB 2015].

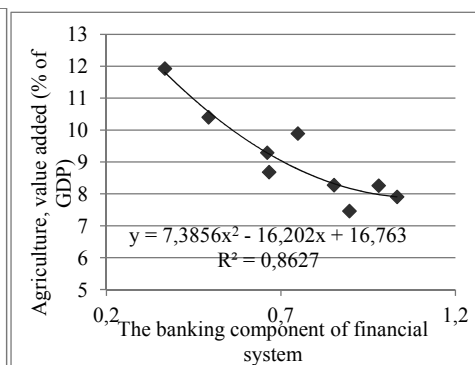


Fig. 8. Regression model that describes the relationship between the integral indicator of banking component of financial system and agriculture, value added (% of GDP) in Ukraine 2004 – 2012.

Source: authors' calculations based on data [World Bank 2015a, 2015b; NBU 2015].

The regression model in Fig. 7 confirms the significance of the banking component for the efficiency of the agricultural sector in Poland. The explanation to this may be the existence of significant demand for bank loans among small and medium-sized agricultural producers, due to relative scarcity of agricultural subsidies (compared with other EU countries). For example, in Germany, where the amount of subsidies per 1 hectare of land is several times higher than in Poland, such dependence was not observed – the coefficient of correlation between the integral indicator of banking component development and value added per worker in agriculture was 0.216.

We observe even tighter correlation ( $R^2=0.908$ ) in the case of building multiple linear regression models with the dependent variable (Y) being value added per worker in agriculture (constant 2005 US \$), and independent ones representing the resource base and the efficiency of the banking sector in Poland:

$$Y = 27,317 X_1 + 12,386 X_2 + 1208,5 \quad (3)$$

where  $X_1$  – Deposit liabilities (% of GDP);  
 $X_2$  – Domestic credit to private sector by banks (% of GDP).

In the case of Ukraine, the relationship between the development of the banking component of the financial system and value added per worker in agriculture is very weak in comparison to Poland. This fact, combined with the existence of inverse relationship between the development of the banking component of the financial system and value added in agriculture, can be evidence to the following. Firstly, in Ukraine and Poland the importance of the financial system for agriculture is fundamentally different, and secondly, agriculture in Ukraine should be viewed as one of those industries for which the complex influence of the banking component of the financial system development is insignificant or negative.

To confirm this preliminary conclusion about Ukraine we attempted to check two hypotheses based on statistical data of the National Bank of Ukraine.

The first hypothesis: the presence of the above-mentioned inverse correlation is the result of the fact that the development of Ukrainian agriculture is less dependent on bank credit compared to other sectors of the economy. According to this hypothesis, the development of the banking component in Ukraine has to lead to increase in value added of more credit-dependent sectors as a share of GDP with the decrease in the share of agriculture, which is a less credit-dependent branch of the economy.

According to the analysis, this hypothesis is not confirmed. In the result, comparison of the lending and economic activity volume dynamics at current prices revealed that the volume of agricultural production is more sensitive to changes in lending than to the activity of other industries and the economy as a whole (Table 3).

Table 3. Simple linear regression model parameters describing the relationship between the volume of lending and the volume of economic activity at current prices in Ukraine in 2004-2012 p.

Industry	The indicator of the economic activity	Parameters		R-squared values
		slope coefficient	constant	
Agriculture	Gross output	5.6442	42.406	0.8706
Trade	Retail turnover	1.5855	32.274	0.9484
Economy as a whole	GDP	1.209	279.2	0.8966

Source: authors' calculations based on data [World Bank 2015a, 2015b; NBU 2015].

Particularly in trade, which during the period of the study was the driver of economic growth in Ukraine, the UAH 1 increase in lending was accompanied by UAH 1.59 growth in retail turnover on average, while in agriculture – by UAH 5.64 growth in gross output. When comparing agriculture to the economy as a whole, it is possible to identify a 4.7 times excess sensitivity of this branch to changes in lending. It is observed that the gross output of agriculture increases exponentially in the case of bank lending growth in this sector and nominal GDP growth becomes slower if bank lending volumes in economy decrease (Fig. 9, Fig. 10). Similarly, slowdown can be seen in the retail trade turnover in the case of shrinking volumes of trade sector crediting.

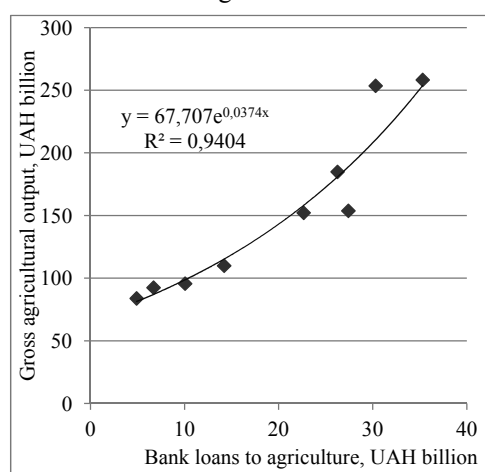


Fig. 9. Regression model that describes the relationship between the volume of bank loans to agriculture and the gross agricultural output in Ukraine, 2004 - 2012 (at current prices).

Source: authors' calculations based on data [World Bank 2015a; NBU 2015].

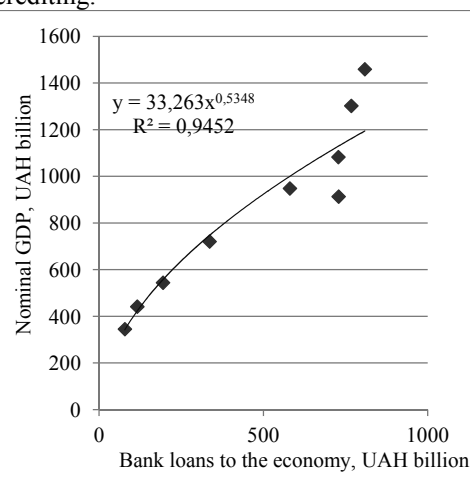


Fig. 10. Regression model that describes the relationship between the volume of bank loans to the economy and nominal GDP in Ukraine, 2004 - 2012 (at current prices).

Source: authors' calculations based on data [NBU 2015].

Revealed patterns not only deny the first hypothesis, but also illustrate the importance of bank financing for the development of Ukrainian agriculture, since it is of even higher significance than for most other sectors and for the economy as a whole.

The second hypothesis: the existence of an inversely proportional relationship between the development of the banking component of the financial system and value added in agriculture (% of GDP) in Ukraine is connected with the fact that the indicator that characterizes the performance of the banking sector – domestic credit to private sector by banks (% of GDP) – has inadequate dynamics if the bank loan elasticity to GDP is greater than one. In this case, the banking sector development, accompanied by growth in lending to the real sector, leads to relatively higher GDP growth. As a result, the domestic credit lent to the private sector by banks (% of GDP) is decreased.

The analysis of interdependence between the volume of bank credits at current prices and nominal GDP in Ukraine for the period from 2004 till 2012 provides an argument in favor of the second hypothesis – an increase in lending is accompanied by relatively higher GDP growth (as shown in Table 3, the UAH 1 increase in lending is accompanied by an

average UAH 1.2 GDP growth). Thus, the existence of an inversely proportional relationship between the integral indicator of the banking component of the financial system and agriculture, value added (% of GDP) in Ukraine is not evidence of a negative financial system development impact on agriculture.

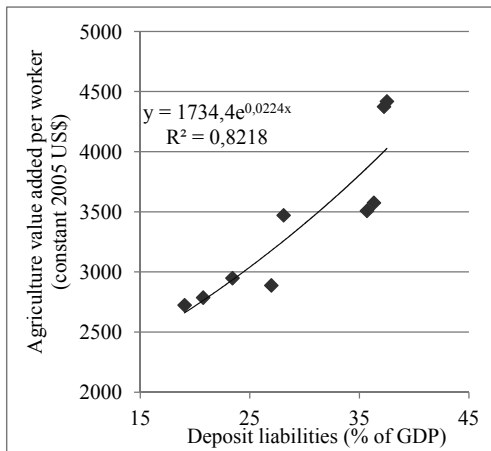


Fig. 11. Regression model that describes the relationship between deposit liabilities (% of GDP) and agriculture value added per worker (constant 2005 US\$) in Ukraine, 2004 - 2012.

Source: authors' calculations based on data [World Bank 2015a; NBU 2015].

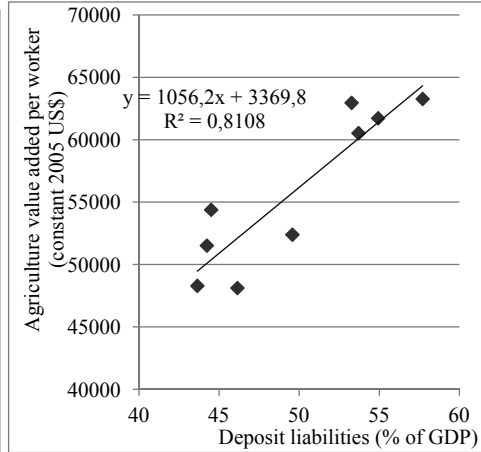


Fig. 12. Regression model that describes the relationship between deposit liabilities (% of GDP) and agriculture value added per worker (constant 2005 US\$) in USA, 2004 - 2012.

Source: authors' calculations based on data [World Bank 2015a; FRS 2015].

The importance of financial system development (particularly its banking component) for agriculture of Ukraine is confirmed by a regression model that describes the relationship between deposit liabilities (% of GDP) and value added per worker in agriculture (constant 2005 US \$) (Fig. 11). This model, unlike the case of Poland (Fig. 7), provides an exponential growth rate of value added per worker in agriculture, which may indicate the existence of substantial potential for productivity increase in agriculture, which can be reached with stimulation of financial system development through increase of its resource base. It should be noted that the positive relationship between deposit liabilities (% of GDP) and value added per worker in agriculture (constant 2005 US \$) for the period from 2004 to 2012 was observed also in the US (Fig. 12) and in many other countries with developed agriculture.

The market component of the financial system, unlike the banking component, is characterized by an absence of significant statistical dependence between certain aspects of agricultural growth, taking into consideration the integral indicator as well as its separate components, in Poland and Ukraine.

## Conclusions

This study provided that the financial system has positive impact on development in Poland and Ukraine, despite the lack of significant statistical dependency between the

relevant integral indicators in these countries. We proved that the banking component of the financial system has a significant impact on agricultural growth, as evidenced by regression models built on the basis of effectiveness and resource base indicators.

We found that the indicator “domestic credit to private sector by banks (% of GDP)”, which was used to characterize the performance of the banking sector as part of the integral indicator of financial system development, showed specific dynamics in the case of Ukraine. This means that when the number of loans was increased, the level of the indicator decreased over 2004-2012. The reason was a high dependence of the Ukrainian economy on bank lending, which was reflected in the high elasticity of GDP to changes in lending. The specific dynamics of indicator “domestic credit to private sector by banks (% of GDP)” may be considered as one of the reasons for the absence of statistical dependence between the integral indicators of financial system development and agricultural growth. As evidenced by the results of the study, agriculture is much more dependent on bank lending than the vast majority of other branches of the economy.

The results indicate the feasibility for further scientific search on the ways to increase the efficiency of agricultural activities in Poland and Ukraine through the creation of conditions for further development of the financial system, especially its banking component.

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