“Test by the SVECM model of the impact of the exchange rates and foreign direct investment on the economic growth of the Maghreb region”

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TEST BY THE SVECM MODEL OF THE IMPACT OF THE EXCHANGE RATES AND FOREIGN DIRECT INVESTMENT ON THE ECONOMIC GROWTH OF THE MAGHREB REGION

Abstract

The purpose of this article is to identify the main sources of cyclical fluctuations affecting the five Maghreb countries in a general analysis framework through the impact of the exchange rates and foreign direct investment. Besides, will consider in this study a set of variables taking into account the real monetary and fi ancial dimensions of the economies. Therefore, authors have adopted an approach in terms of the VECM Structural model and analyzed the robustness of the response functions. Indeed, the estimation results showed the existence of a regional dynamics where the respective sensitivity to change of the real exchange rate is the same. In addition, FDI and REER stimulate economic growth of the Maghreb economies in exchange for regime transmutations. In addition, the participation of FDI in the socio-economic development seems to be weak without the implementation of a policy of support and guidance aimed at reducing the catastrophic effects on the economy and reorienting its investments towards sectors with a high added value.

Keywords structural VECM, demand and supply shocks, economic convergence, Maghreb countries

JEL Classification F15, F42, F43, C32

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АНАЛІЗ ВПЛИВУ ОБМІННОГО КУРСУ ТА ІНОЗЕМНИХ ПРЯМИХ ІНВЕСТИЦІЙ НА ЕКОНОМІЧНЕ ЗРОСТАННЯ КРАЇН МАГРИБУ З ВИКОРИСТАННЯМ СТРУКТУРНОЇ ВЕКТОРНОЇ МОДЕЛІ КОРЕКЦІЇ ПОХИБОК

Анотація

Мета статті – визначити основні джерела циклічних коливань, які впливають на розвиток п'яти країн Магрибу, шляхом аналізу впливу обмінних курсів і прямих іноземних інвестицій. Крім того, проаналізовано набір змінних з урахуванням реальних грошових і фінансових вимірів економічних систем. Для аналізу надійності функції віддачі використано структурну векторну модель корекції похибок. Результати вказали на наявність регіональної динаміки, коли відповідна чутливість до зміни реального обмінного курсу є однаковою. Виявлено, що прямі іноземні інвестиції та реальний ефективний валютний курс стимулюють економічне зростання економіки Магрибу в обмін на режимні зміни. Крім того, роль ПІІ в соціально-економічному розвитку виявляється слабкою через відсутність політики підтримки та наставництва, спрямованої на зменшення катастрофічних наслідків для економіки та переорієнтацію інвестицій на сектори з високою доданою вартістю.

Ключові слова структурна модель векторної корекції похибок, попит і пропозиція, економічна конвергенція, країни Магрибу

Класифікація JEL F15, F42, F43, C32

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INTRODUCTION

The purpose of this study is to focus on two types of determinants of macroeconomic stability as captured by some fundamentals of the host economy (economic growth, stability, business climate, political stability, country risk, sustainability of the public debt, inflation, ...) but similarly by the episodes of foreign exchange crisis that can be explained more by speculative attacks, reversals of capital flows, massive losses of foreign reserves and foreign exchange reserves and/or the deterioration of current accounts and which reflect external instability.

These debts to foreign countries cannot be settled in national currency (which does not exist abroad), but in foreign currency (paid in cash, by cheque, by bank drafts and especially transfers in foreign currency) that the debtor must obtain in his country by exchanging it for a certain amount of the national currency (Burda et al., 1993). This process of transfer is made possible through a tool known as the exchange rate.

Moreover, the exchange rates are at the heart of the international economic relationships and an integral part of the daily landscape of the economic agents. In fact, the rise of the international trade and financial relationships as well as the independence that results from it, are a first element explaining the strategic importance of this variable (exchange rate). Beyond its economic and financial dimension, the exchange rate plays a fundamental role as an instrument or an objective of the economic policy, or even as a symbol of political power.

Therefore, it was noted that there are two macroeconomic dimensions of country risk, which concern, on the one hand, internal factors, such as the characteristics of inflation, debt and the reduction of public deficits when they worsen, which can negatively influence the firms' decisions to invest by creating conditions of uncertainty about asset values or future taxation and, on the other hand, they concern external factors, such as external asymmetric shocks (imported crises), current account deterioration or exchange rate instability, which bring about similar levels of contingency.

In relation to what has been previously said, the question that arises is to what extent the main sources of cyclical fluctuations in the real effective exchange rate and foreign direct investment can influence the behavior of economic growth in the Maghreb countries?

To address this issue, our work is organized as follows: the second section consists in a presentation of the status of empirical research studies which help identify the causal relationships between economic growth, the exchange rate and foreign direct investment on panel data. Next, an overview of the data, the variables and the estimation techniques is presented in the third section. The fourth section introduces an econometric application based on the Structural Vector Auto-Regression (SVAR). Finally, the last section concludes this research paper.

1. THEORETICAL ANALYSIS

Given the theoretical development mentioned above, it can be noticed that the consequences of applying the exchange rate regimes are various and sometimes opposite, while the final effect is not obvious to be determined a priori.

1.1. Economic growth and exchange rate

The majority of the conducted empirical studies are based on the IMF's certified hierarchy of the exchange rate regimes. However, these studies did not generate strong claims about the effect of the exchange rate nature on the economic development, which encouraged researchers to use new classifications. For this reason, Bailliu et al. (2001) used their own scale to study a sample of 25 emerging economies between 1973 and 1998, through which they noted that floating exchange rate regimes lead to a faster economic development, but only for countries that are highly correlated with international capital flows or affected by well-developed financial markets.

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Based on the methodology of Reinhart and Rogoff (2004), Husain et al. (2004) found, on a sample of 158 countries between 1970 and 1999, that the chosen exchange rate regime results mainly from the level of economic development. Subsequently, for the developing countries, a rigid exchange rate regime is often accompanied with a low inflation rate but without an impact on economic growth while the adoption of a flexible exchange rate regime by the same countries will raise the inflation rate without any improvement of economic growth. On the other hand, for the developed countries, estimates showed that a greater exchange rate flexibility leads to a low inflation rate and a significant economic growth.

In order to address these deficiencies, researchers, including Levy-Yeyati and Sturzenegger (2002) and Reinhart and Rogoff (2004), presented new classifications of foreign direct investment (FDI) based primarily on the exchange rate flexibility. In fact, the change of the exchange rate calculated as the standard deviation of the monthly rates of the change of the nominal exchange rate and finally, the fluctuation of the foreign exchange reserves calculated by the average of the monthly exchange rate of the ratio of the world reserves compared to the monetary base of the previous month.

From another angle, researchers Dehejia and Rowe (1999) and Dehejia (2003) agree on the division of the traditional methodology into three aspects, which makes it possible to distinguish between fixed, intermediate and floating exchange rates where the last two simply define the exchange rate regime, while the first characterizes both the exchange rate regime and the monetary policy framework. In fact, omitting this characteristic may alter the estimation of the impacts of the different exchange rate regimes on macroeconomic observations.

1.2. Economic growth and foreign direct investment

In fact, according to the endogenous growth theory, several factors, such as human capital, capital accumulation, international trade, public policy, and technology transfer, which explain a long-term growth, can be conveyed by FDI, which can stimulate economic growth through the creation of dynamic comparative advantages leading to technology transfer, human capital accumulation and increased international trade (Bende-Nabende et al., 2003; Bende-Nabende, 2002). These dynamic benefits, which are linked to one another, are complementary and therefore do not need to be studied separately. Actually, the gain generated by the EDI on one growth factor is likely to stimulate the development of the other factors, thus forming some kind of synergy.

On the other hand, trade flows and FDI are well known as very important factors in the process of economic growth. In fact, trade plays the role of upgrading skills through the importation and adoption of a superior production and innovation technology. If exporters use the innovation and production technology developed either by acting as sub-contractors for foreign companies or by competing on international markets, import producers face competition from foreign companies. They are pushed to adopt capital-intensive production facilities to face stiff competition from the developing countries where products are generally capital-intensive (Frankel and Romer, 1999). Therefore, the impact of trade openness on economic growth can be positive and significant mainly due to the physical capital accumulation and technology transfer.

Most of the previous empirical studies have dealt either with the effect of the interaction between trade and FDI on economic growth (Selmi et al., 2016) or with the relationship between FDI and economic growth (Lipsey, 2000) and/or between trade and economic growth (Pahlavani et al., 2005). All these studies concluded that both FDI flows and trade promote economic growth. However, they could not provide a conclusive result on the relationship in general and on the meaning of causality in particular in many developing countries. In fact, the increased effects of FDI and trade flows may vary from one country to another and over time. In some countries, FDI and trade can even negatively affect economic growth (Xu, 2000).

According to an IMF study, Dabla-Norris and Lahreche (2010) studied the effect on economic growth for a heterogeneous group of countries. In fact, for the intermediate and poor but non-oil economies, FDI recorded a significant impact between 0.5% and 0.7% of growth following an increase of the FDI/GDP ratio of 1%. However, oil-producing countries have had little or no effect of FDI on growth, regardless of their inflow. This shows a strong acceleration of FDI for several years, followed by a stronger impact on growth, as if, because of the entry into a new period.

2. EMPIRICAL METHODOLOGY: MODEL, VARIABLES AND ESTIMATION TECHNIQUES

Authors purpose here is to see whether the real effective exchange rate (REER) and FDI could have a significant effect on the economic growth of the countries of the Maghreb region during the recent period, characterized by a floating exchange rate regime. While the exchange rate may be considered exogenous at the firm level, this assumption is questionable at the macroeconomic level. Since authors are interested in macroeconomic relations, the exchange rate and investment should be treated as interactive variables. In addition, given the prospective nature of investment decisions, it is important to use a framework that allows for a more detailed dynamic analysis.

To account for both feedback effects and dynamic effects, for our analysis chose a structural Vector Auto-Regression (SVAR) model. In the context of VAR models, all variables are considered endogenous, and the analysis of dynamic structures can take many different forms. An autoregressive representation makes it possible to apply Granger causality tests, while a moving average representation is used to estimate dynamic responses to shocks. Although these two types of effects are related, their review provides separate and complementary information. In fact, the structural VAR methodology allows in addition to simulate structural shocks.

2.1. Model specification

After a brief overview of the empirical literature and the theoretical and adaptation foundations of a structural linear dynamic model, will now focus on the appropriate empirical specification of this model in order to resolve our problem.

In Solow's model, the increase of the production factors (labor and capital) accounts for some of the growth. Since there is an increase of the labor force (labor factor) and domestic investments (capital factor) there is growth. Hover, most of the growth is not explained by these two factors, but is due to a residual factor. This is technical progress the origin of which is not really known (some say it is a factor "fallen from the sky").

Other than labor (salaried employment, POP) and capital (Gross Fixed Capital Formation, GFCF as a percentage of GDP), the other explanatory variables can be presented in three groups. Our approach consists the, in using three groups of variables in which the estimation, which was carried out between 1980 and 2016, has become efficient through the use of the criteria of absence of residuals autocorrelation and individual and temporal heteroskedasticity. Indeed, the first group of explanatory variables includes the variables relating to economic policy, namely:

- first, public spending relative to the real GDP (G);
- second, foreign direct investment relative to the real GDP (FDI);
- then, trade openness in relation to real the GDP (TRADE);
- finally, the consumer price index (CPI).

It was shown that the bidirectional causality report between investment and growth is very important for an open economy. Therefore, investing in a country rather than abroad generates prospects for investment returns, which refers to domestic opportunities opened up by growth.

The second group of explanatory variables forms monetary variables related to GDP, namely:

- on the one hand, the monetary aggregate (M3);
- on the other hand, private credit (CREDIT), which represents the degree of development of the financial sector, whose expected positive effects on growth.

The third group of explanatory variables forms exchange rate variables, namely:

- the real effective exchange rate (REER).

In the existing literature, a distinction is made between the short- and long-term effects of shocks. Indeed, real supply shocks are defined as exogenous changes in commodity prices or energy prices, production shocks or wage prices. Real demand shocks collect unanticipated changes in consumption, investments or public spending.

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2.2. Presentation of the countries studied and descriptive analysis of the variables

The purpose of this section is to describe the sample and provide a descriptive analysis of the variables per country. In fact, our Panel comprises N=5 Maghreb countries, namely Algeria, Morocco, Mauritania, Libya and Tunisia between 1980 and 2016, see 37 observations per country. Indeed, and based on the statistics presented in Table 1, authors will describe the main characteristics of the main variables used in this study.

Table 1. Overall descriptive analysis of basic variables

Source: Author's calculations.

Designation	GDPC	POP	GFCF	FDI	REER	CPI	TRADE	M3	G	CREDIT
Average	35,269.74	4,190.976	29.05	2.13	124.75	74.11	78.41	58.74	70.42	35.60
Median	6,514.48	2,334.780	27.48	0.94	104.07	77.74	64.72	51.94	75.38	29.03
Maximum	179,193.80	12,541.810	70.48	37.17	447.53	182.84	224.69	253.91	149.00	81.16
Minimum	966.47	425.676	9.48	0.00	30.01	8.98	25.63	18.36	26.64	3.91
Standard Deviation	56,978.17	3,888.350	11.37	4.26	70.83	37.78	38.94	34.77	16.36	21.04
Skewness	1.52	0.88	1.16	5.16	2.30	0.23	1.49	2.11	0.16	0.47
Kurtosis	3.49	2.20	5.04	35.56	9.32	2.48	5.20	10.15	6.68	1.93
Jarque-Bera (JB)	73.35	29.02	73.44	8,991.21	471.66	3.72	105.82	531.16	105.18	15.60
JB Probability	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00
Observations	185	185	185	185	185	185	185	185	185	185

According to the Figure 1 shows a significant increase of FDI from the mid-2000s to the end of the sample period. During the 1980/2016 period, the evolution of FDI in this country was assessed at an average of 5.39 with a standard deviation of 8.34. The set of logarithmic values was between 0.01 and 37.17. Therefore, the sample distribution of FDI is asymmetrically spread on the right (Skewness=2.38) and strongly leptokurtic (Kurtosis=5.88). Based on the probability of the Jarque-Bera's normality test, authors reject the null hypothesis of normality at 5%. Overall, this variable shows a significant overall growth of 49.72% with an annual growth of 1.13%.

For the real effective exchange rate (REER), the evolution of the 5 countries in the Figure 2 shows a clear difference until the beginning of the 1990s and thereafter observe the stability of the rates around 100%. For the case of Tunisia, the evolution of the REER is characterized by an average of 133.5 with a standard deviation of 41. The set of values is between 94.8 and 220.2. The sample distribution of the TCER is asymmetric spread on the right

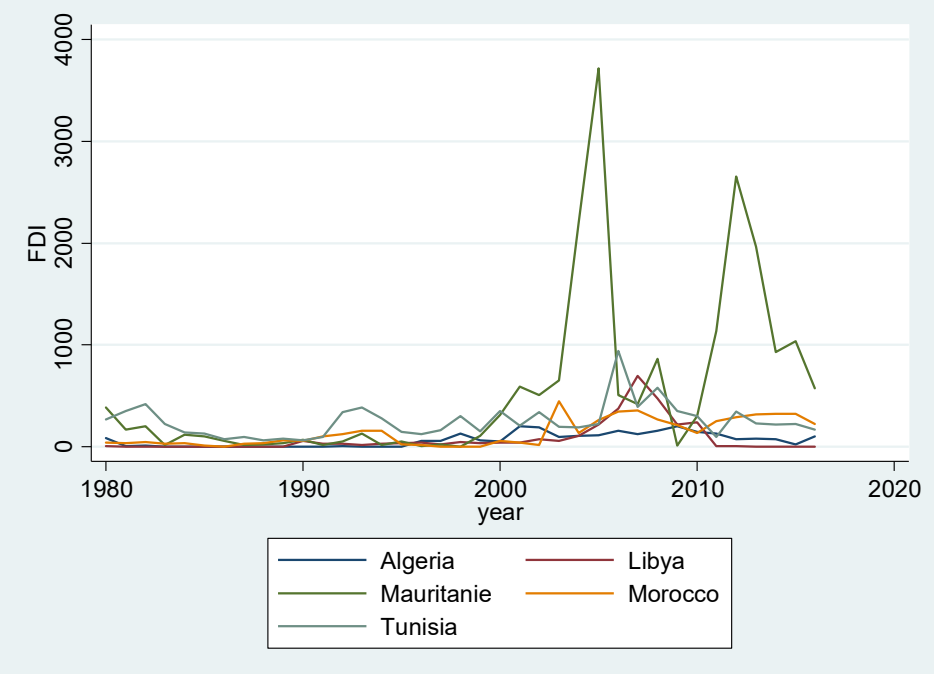

Figure 1. Trend evolution of FDI per country

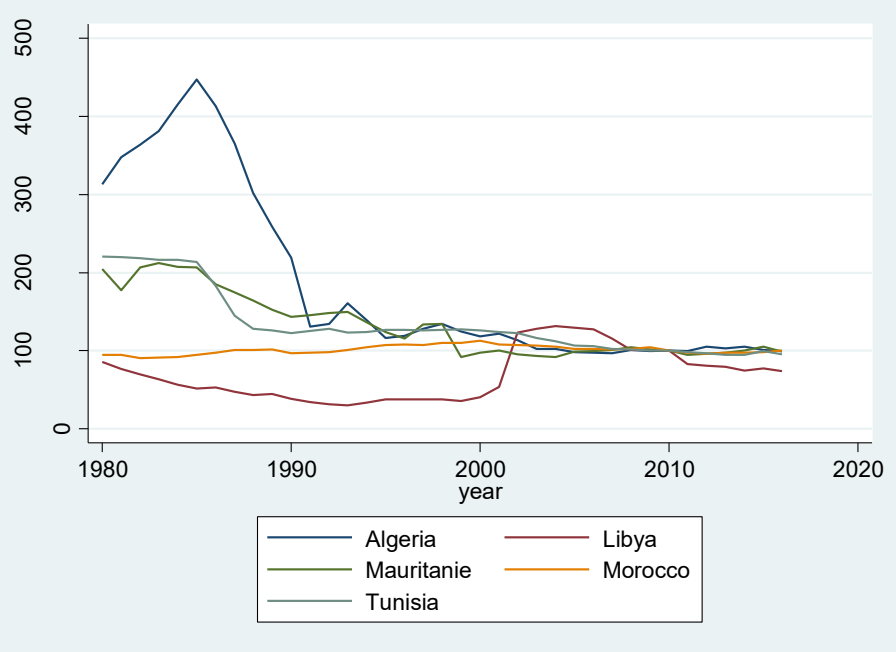

Figure 2. Trend evolution of the REER per country

(Skewness=1.35) and slightly leptokurtic (Kurtosis=0.47). Based on the probability of the Jarque-Bera normality test, authors reject the null hypothesis of normality at 5%. In total, this variable shows a significant overall decrease of –56.82% and an annual of –2.31%.

Overall, authors found that on average, the majority of the series are unstable or in variance, in addition, they show a strong divergence from one country to another, which proves once again the strong heterogeneity and dependence between them.

2.3. Integration analysis and cointegration test

The main problems of panel unit root tests are, on the one hand, the form of the heterogeneity of the model used to test stationarity, which is the simplest form as it consists only in postulating the existence of constants specific to each individual and, on the other hand, the possible correlations that may exist between individuals. In fact, taking into account or not these possible inter-individual dependencies opposes two types of generations. Thus, authors present in Table 2 the results Levin, Lin and Chu (2002, LLC), Im, Pesaran and Shin (2003, IPS) and Hadri (2000) panel unit root tests.

Table 2. Unit root tests of variables in logarithm

Source: Author's calculations.

Variables	In level			First difference		
	LLC	IPS	Hadri	LLC	IPS	Hadri
LGDPC	2.053	3.012	38.76***	–4.360***	–7.870***	–1.304
LPOP	–1.626	–7.121***	39.42***	–3.357**	–2.617**	3.333
LGFCF	0.625	0.064	21.42***	–8.772***	–8.293***	–0.859
LFDI	–0.694	–2.342***	19.39***	–5.798***	–9.234***	–1.418
LREER	–1.751**	0.170	34.45***	–5.147***	–5.818***	1.261
LCPI	–3.667***	–5.394***	48.27***	–3.728***	–3.165***	1.265
LTRADE	–0.034	0.888	32.71***	–6.767***	–7.284***	–0.467
LM3	0.164	1.011	21.22***	–4.881***	–6.909***	0.207
LG	–0.118	–0.794	34.85***	–5.018***	–7.867***	–0.771
LCREDIT	–0.828	–0.224	26.88***	–5.605***	–7.093***	0.855

Notes: *, ** and *** significant at 10%, 5% and 1%, respectively.

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From Table 2, all series failed to pass the three units root tests. It is clear then that the Hadri (2000) test is the most relevant because all series show the presence of a unit root in level, while the same series accept the null hypothesis of stationarity in first differences. Thus, it can be consider that all the series are integrated of order 1.

Since the majority of the variables are stationary in first difference, it is important to study the existence of a cointegration relationship between them. Thus, authors have chosen the following step to find out the maximum delay order in a VAR constructed by the 10 variables in question. With reference to the different criteria's, the maximum number of lags chosen is equal to p = 4.

Given the large number of variables in the model (10 variables), authors were able to apply only the Kao test (1999) where its ADF statistic (–1.681, probability = 0.046) rejects the null hypothesis of absence of cointegration for a risk of 5%.

From this descriptive diagnosis and the integration of the different variables of model, authors achieved the important results of the non stability of the variables and the existence of a strong heterogeneity and dependence between the five the Maghreb countries.

3. ESTIMATES AND INTERPRETATIONS OF THE RESULTS

In this section, authors test econometric model on the representation the SVECM. Therefore, authors construct a multi-variate vector error-correction model in which the dynamics of growth, the domestic and foreign investment, the exchange rate, the money supply and the price movements are the combined results of the supply and demand shocks.

3.1. VECM Modeling

Let a standard VAR be of the following reduced form:

$$X_{it} = H_1 X_{iT-1} + ... + H_k X_{it-k} + \mu + e_{it} \qquad (1)$$

with t = 1,…, T; i = 1,…, N; k is the model order (number of delays), X_{it} is the vector of the model variables. In case, X_{it} is of dimension (10; 1) and defined by

$X_{it}' = [\text{LGDPC, LCREDIT, LFDI, LREER, LGFCF, LCPI, LM3, LTRADE, LPOP, LG}]$. H is a matrix of coefficients, e_{it} is an error term $(0, \Sigma)$ and μ is a constant.

In accordance with the Engle and Granger representation theorem (1987), in the presence of a cointegration relation, the standard VAR in the reduced form can be reformulated in an error correction version (VECM):

$$\Delta X_{it} = \Gamma + \Delta X_{it-1} + ... + \Gamma_{k-1} + \Delta X_{it-k+1} + \Pi X_{it-1} + \mu + e_{it} \qquad (2)$$

The matrices Γ and Π contain equations. The first concerns short-term stationary relations, while the second deals with non-stationary long-term relationships. The VAR model representations and its VECM form correspond to the reduced form of the structural VAR presented below:

$$A(L)X_{it} = B\varepsilon_{it} \qquad (3)$$

where *A* is the polynomial matrix with the delay operator *L*, *B* is a diagonal matrix, ε_{it} is the vector of orthogonal structural shocks of variance-covariance matrix Ω. Following a series of treatments, come to the following report:

$$\varepsilon_{it} = C_0 e_{it} \qquad (4)$$

with $\varepsilon_0 = B^{-1} A_0$ and $\Omega = c_0^{-1} \sum \left(C_0^{-1} \right)$.

The determination of the structural form parameters is possible from the estimated VAR parameters of the reduced form, subject to the imposition of a sufficient number of identification restrictions. These identifying constraints are either long-term or short-term (contemporary relations).

According to the method of Blanchard and Quah (1989), require the imposition of 45 short-term restrictions on the number $\left[n(n-1)/2 \right]$ on the structural form or $n = 10$. Besides, the identification of the short-term variance-covariance matrix is based on the Choleski method, followed by the identification technique of Bernanke and Mihov (1995). The variance-covariance matrix Ω contains $\left[n(n+1)/2 \right]$ independent restrictions. In case, Ω provides 55 independent restrictions on the number $\left[n(n+1)/2 \right]$.

ε is the vector of structural innovation that responds to system of which $\varepsilon' = \left[\varepsilon_t^{GDPC}, \varepsilon_t^{CREDIT}, \varepsilon_t^{FDI}, \varepsilon_t^{REER}, \varepsilon_t^{GFCF}, \varepsilon_t^{CPI}, \varepsilon_t^{M3}, \varepsilon_t^{TRADE}, \varepsilon_t^{POP}, \varepsilon_t^{G} \right]$ are respectively the real supply shock, the credit supply shock, the foreign investment supply shock, the exchange shock, the domestic investment supply shock , the money demand and supply shock, the trade opening supply shock, the labor demand shock and the public expenditure shock. e_{it} is the vector of residues in the reduced form: $e_t^{GDPC}, e_t^{CREDIT}, e_t^{FDI}, e_t^{REER}, e_t^{GFCF}, e_t^{CPI}, e_t^{M3}, e_t^{TRADE}, e_t^{POP}, e_t^{G}$, with $C_0 = B^{-1} A_0$.

In reference to the work of Kim (2001), and according to Goux (2006), no over-identification was possible at the B-matrix level, which remains simply diagonal. As a consequence, the shock identification scheme based on the equation of the relationship between structural shocks and reduced-form disturbances is insufficient, i.e. $B\varepsilon_{it} = A_0 e_{it}$.

With reference to the lower triangular shape of the matrix A_0 , competitiveness should respond in the short term to the real supply shock e_{it}^{GDPC}. However, authors have considered that, unlike production for domestic consumption, which is immediately affected by a real supply shock (Blanchard & Quah, 1989), production for foreign markets is not instantaneously influenced by a variation not anticipated from domestic production.

As a result, the external supply of domestic goods and services, and therefore GDPC, does not respond to the real domestic supply shock in the short term, but rather in the long term. In other words, this type of growth shock has no permanent effect on the competitiveness of foreign or domestic investment in the short term. As a result, the growth shock is identified as the only shock that can have a long-term effect on itself. This restriction is justified by the fact that study focuses on small economies the market power of which in the world market is quite limited.

The credit shock has an instantaneous influence on both the external (FDI, REER) and domestic variables (CPI, M3 and G) while the credit reaction function on per capita output is zero, which implies the absence of a credit effect on real domestic production (Citu & Twanddle, 2003). This manipulation of the theoretical consideration therefore imposes an additional restriction on the non-significant coefficient: $a_{21}=a_{23}=a_{25}=0$.

The FDI shock has a significant impact on the labor force, the exchange rate and the price level. On the other hand, there is no direct relationship with domestic production, which implies the absence of the effect of FDI shocks on real domestic production. This operation of the theoretical consideration therefore imposes the following restrictions: $a_{31}=a_{32}=a_{34}=a_{35}=a_{36}=a_{37}=a_{38}=a_{39}=a_{310}=0$.

The exchange rate shock has an immediate influence on the external variables (FDI, TRADE) as well as the domestic ones, such as GFCF and CPI while the real exchange rate response function on the domestic production index is zero, which implies the absence of the effect of exchange rate shocks on the real domestic production (Citu & Twanddle, 2003). This leads us to impose additional restrictions on the non-significant coefficient: $a_{41}=a_{42}=a_{43}=a_{45}=a_{46}=a_{48}=a_{49}=a_{410}=0$. A domestic investment shock (GFCF) affects only the domestic variables

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(GDPH, M3 and POP), but has no effect on the external ones, which leads us to impose additional restrictions on the non-significant coefficient $a_{53}=a_{54}=a_{510}=0$.

However, according to the contribution of Kim and Roubini (2000), the monetary policy is conducted on the basis of the money supply and the nominal short-term exchange rate. This function implies that the monetary authorities determine the short-term consumer price index based on the values of these two variables (money supply and nominal exchange rate).

Elsewhere, Sims and Zha (1998) argue that monetary policy does not respond instantly to shocks affecting real output or prices. This underlying assumption is authenticated by Peersman and Smets (2001) using the same principle. In fact, the argument lies in the absence of contemporary data on prices and actual output when monetary policy decisions are made. In addition, the lack of immediate short-term CPI response to structural shocks in real supply and demand is particularly relevant for the monetary policy of the Maghreb countries, due to short-term CPI smoothing by the TCB to preserve financial stability. In the context of work, this argument reflects the burden of a constraint of the short-term nullity of the insignificant coefficients: $a_{62}=a_{63}=a_{64}=a_{65}=a_{68}=0$.

This specification implies the nullity of the short-term impact of money supply shocks on both the real output and the real effective exchange rate. Moreover, trade openness is very important for the equilibrium of the trade balance of the Maghreb countries. Notwithstanding, its effect is examined only on short-term domestic production but with no effect on the external variables. This explains that supply and external demand shocks are not affected by shocks to the short-term trade openness. Therefore, get the following restrictions: $a_{82}=a_{85}=a_{810}=0$.

The labor force shock can have an effect only on domestic production and the capital stock. In addition, lower wages in the Maghreb countries encourage foreigners to invest as long as the political and security environment is favorable. Given such conditions, authors propose the following constraints: $a_{92}=a_{94}=a_{96}=a_{97}=0$. Moreover, a consumer spending shock will have a significant effect on economic growth, employment, money supply, CPI and trade openness. Taking into account such conditions, authors allocate the following constraints: $a_{101}=a_{103}=a_{104}=a_{105}=a_{108}=0$.

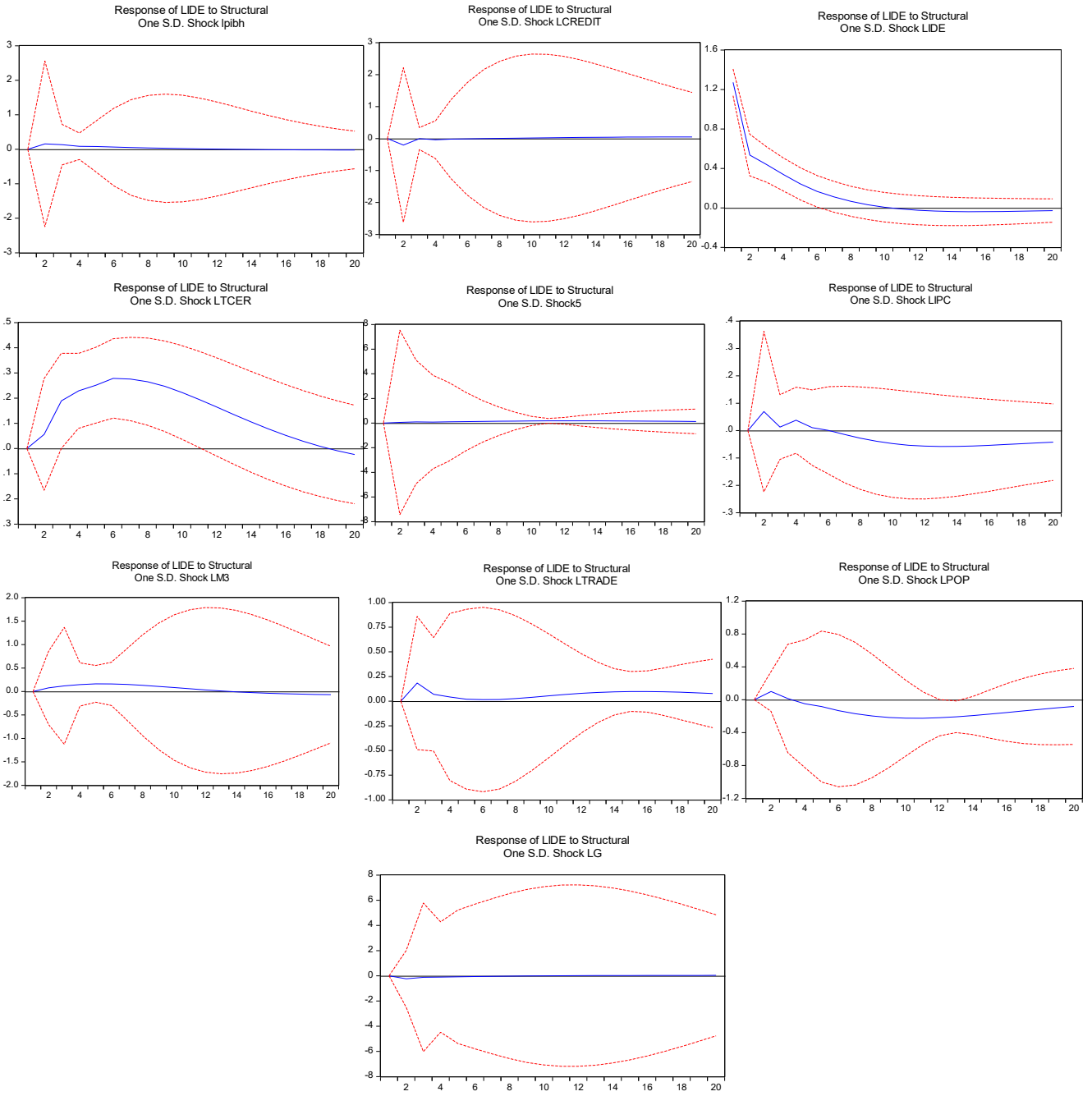
In total, the system consists of the following 10 equations:

$$
\begin{aligned}
&b_{11}\varepsilon_t^{GDPC} = e_t^{GDPC} + a_{12}e_t^{CREDIT} + a_{13}e_t^{FDI} + a_{14}e_t^{REER} + a_{15}e_t^{GFCF} + a_{16}e_t^{CPI} + a_{18}e_t^{TRADE} + a_{19}e_t^{POP} + a_{110}e_t^{G};\\
&b_{22}\varepsilon_t^{CREDIT} = e_t^{CREDIT} + a_{24}e_t^{REER} + a_{26}e_t^{CPI} + a_{27}e_t^{M_3} + a_{28}e_t^{TRADE} + a_{29}e_t^{POP} + a_{210}e_t^{G};\\
&b_{33}\varepsilon_t^{FDI} = e_t^{FDI};\\
&b_{44}\varepsilon_t^{REER} = e_t^{REER} + a_{47}e_t^{M_3};\\
&b_{55}\varepsilon_t^{GFCF} = a_{51}e_t^{GDPC} + a_{52}e_t^{CREDIT} + e_t^{GFCF} + a_{56}e_t^{CPI} + a_{57}e_t^{M_3} + a_{58}e_t^{TRADE} + a_{59}e_t^{POP};\\
&b_{66}\varepsilon_t^{CPI} = a_{61}e_t^{GDPC} + e_t^{CPI} + a_{67}e_t^{M_3} + a_{69}e_t^{POP} + a_{610}e_t^{G};\\
&b_{77}\varepsilon_t^{M_3} = a_{72}e_t^{CREDIT} + a_{73}e_t^{FDI} + a_{74}e_t^{REER} + a_{75}e_t^{GFCF} + e_t^{M_3} + a_{78}e_t^{TRADE};\\
&b_{88}\varepsilon_t^{TRADE} = a_{81}e_t^{GDPC} + a_{83}e_t^{FDI} + a_{84}e_t^{REER} + a_{86}e_t^{CPI} + e_t^{TRADE} + a_{89}e_t^{POP};\\
&b_{99}\varepsilon_t^{POP} = a_{91}e_t^{GDPC} + a_{93}e_t^{FDI} + a_{95}e_t^{GFCF} + a_{98}e_t^{TRADE} + e_t^{POP} + a_{910}e_t^{G};\\
&b_{1010}\varepsilon_t^{G} = a_{102}e_t^{CREDIT} + a_{106}e^{CPI} + a_{107}e_t^{M_3} + a_{109}e_t^{POP} + e_t^{G}.
\end{aligned}
\tag{5}
$$

3.2. Impulse function and variance decomposition

The decomposition of the variance of forecast errors and the shock response functions are two traditional and relevant exercises that highlight the internal dynamics of a variance system. Table 3 presents the results of the decomposition of the variance of the forecasting error of foreign direct investment (FDI).

Indeed, the foreign direct investment shock contributes about 65% of its change. This predominance of the foreign direct investment shock persists in both the short and long term. On the other hand, are witnessing weak incremental contributions with close proportions for shocks; real Supply, credit and commercial openness. The most insignificant factor in explaining the variance of FDI is the one attributed to shocks in domestic investment, public expenditure, and money supply to the extent that they never exceed 4% of GDP of the variability of this variable.



Source: Author's calculations.

Figure 3. Reaction of different shocks to foreign direct investment (FDI)

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Table 3. Decomposition of the Variance of Foreign Direct Investment (FDI)

Source: Author's calculations.

Period	Real Supply Shock	Credit Supply Shock	Foreign Exchange Supply Shock	Exchange Shock	Domestic Investment Supply Shock	Monetary Demand Shock	Monetary Supply Shock	Open Trade Supply Shock	Labor Demand Shock	Public Spending Shock
1	0.000	0.000	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	1.166	1.962	91.212	0.151	0.160	0.231	0.293	1.619	0.482	2.724
3	1.769	1.724	88.260	1.640	0.490	0.210	0.866	1.627	0.433	2.981
4	1.906	1.633	85.197	3.522	0.696	0.248	1.639	1.558	0.485	3.117
5	2.014	1.539	81.826	5.569	1.014	0.236	2.493	1.471	0.702	3.136
6	2.036	1.453	78.041	7.878	1.416	0.222	3.242	1.395	1.259	3.060
7	2.010	1.377	74.369	9.915	1.907	0.217	3.807	1.331	2.122	2.944
8	1.961	1.312	70.940	11.595	2.483	0.230	4.160	1.289	3.211	2.817
9	1.899	1.258	67.850	12.871	3.129	0.265	4.326	1.278	4.428	2.696
10	1.835	1.216	65.149	13.749	3.820	0.317	4.350	1.309	5.665	2.589

The response function of FDI to shocks is shown in Figure 3. The results show that FDI responds to structural shocks in real supply and credit in the same way. The supply shock effect is reflected in the slight but persistent but insignificant increase during the forecasting period. While, the credit shock causes a decrease during the first three years, then it vanishes until the end of the period.

However, authors are interested in the influences of the exchange rate impulses on FDI. Under the assumption of an active transmission power of the nominal exchange rate to FDI, the nominal exchange rate variation leads to a variation of the FDI. Indeed, in the long term, we observe a positive and significant effect of exchange shock until the twentieth forecasting period. Then, this shock vanishes at the end of the period. Finally, the FDI shock response function shows a fairly weak effect of the consumer price index shock on FDI. Indeed, in the long run, the shock effect of FDI is insignificant on the price level.

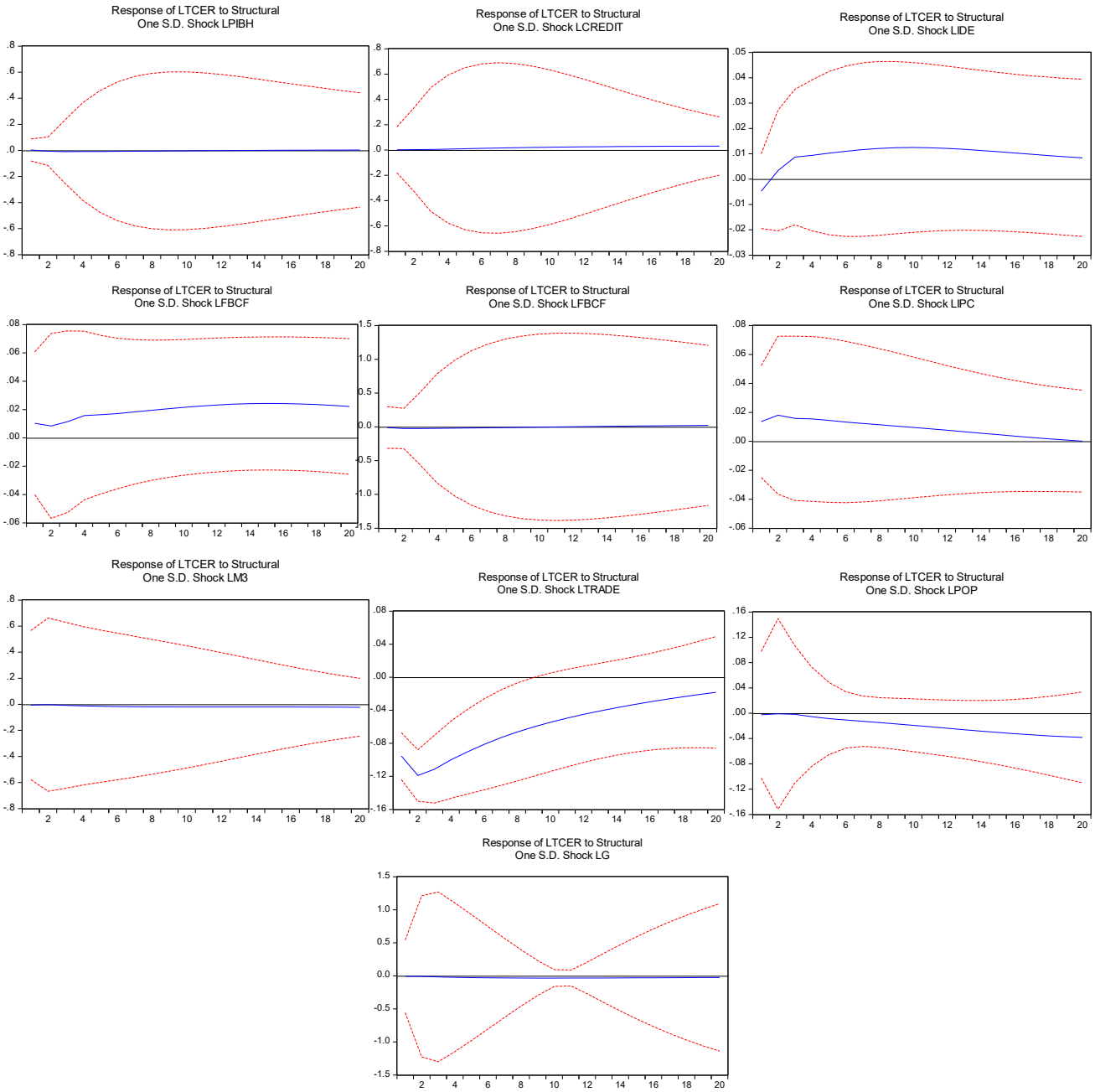
From the variance decomposition in Table 4, we observe a predominance of external shocks in the explanation of the real effective exchange rate fluctuations. This predominance is mainly attributable to shocks to trade opening, which contributes about 95% of the exchange rate fluctuations whatever the horizon chosen. For the domestic shocks, results show that their contribution to nominal exchange rate fluctuations remains very limited. Indeed, we find from the variance analysis that the share of the exchange rate variability due to different domestic shocks (real supply, credit, domestic investment, supply and demand, and demand shock of work) hardly exceeds 3%, except in the case of a public expenditure shock of 7%.

Table 4. Variance Decomposition of the Real Effective Exchange Rate (REER)

Source: Author's calculations.

Period	Real Supply Shock	Credit Supply Shock	Foreign Exchange Supply Shock	Exchange Shock	Domestic Investment Supply Shock	Monetary Demand Shock	Monetary Supply Shock	Open Trade Supply Shock	Labor Demand Shock	Public Spending Shock
1	0.103	0.028	0.237	1.094	1.134	1.926	0.363	94.448	0.060	0.606
2	0.212	0.058	0.138	0.709	2.966	2.045	0.168	93.171	0.027	0.506
3	0.369	0.071	0.283	0.794	3.592	1.957	0.264	91.677	0.026	0.967
4	0.442	0.148	0.389	1.100	3.780	1.973	0.468	89.891	0.079	1.731
5	0.482	0.294	0.495	1.356	3.784	1.982	0.746	88.064	0.182	2.616
6	0.498	0.502	0.603	1.603	3.690	1.980	1.067	86.190	0.320	3.547
7	0.497	0.769	0.715	1.869	3.542	1.972	1.403	84.266	0.495	4.472
8	0.487	1.088	0.827	2.154	3.365	1.959	1.733	82.319	0.711	5.357
9	0.471	1.454	0.936	2.458	3.179	1.939	2.046	80.364	0.972	6.182
10	0.451	1.858	1.037	2.780	2.997	1.913	2.336	78.408	1.286	6.933

However, depending on the nature of their shock effects, as presented in Figure 4, it is remarkable that the contribution of external shocks (FDI and TRADE) to the effective exchange rate fluctuations is significant throughout



Source: Author's calculations.

Figure 4. Reaction of different shocks on the exchange rate (REER)

the forecasting period. Indeed, the currency shock responds positively and significantly to the shock of FDI which is negatively affected by the shock of commercial opening.

Regarding the contribution of domestic shocks to the level of the effective exchange rate, the shock response functions revealed a significant effect of the monetary demand shock (CPI) and the domestic investment supply shock (GFCF) on the exchange rate. This result is perfectly consistent with the conclusions drawn from the decomposition of the variance. Indeed, the exchange rate shock response function shows a weak or even a negative effect of the shocks (real supply, credit, money supply and public expenditure) on the long-term exchange rate.

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CONCLUSION

In this article, authors estimated the dynamic behavior of regional economic activity following real effective exchange rate and FDI shocks using Structural Autoregressive Vector (SVAR) methodology with annual data over the same time interval. In this way, the results of the estimation of these models show a regional dynamic, that is to say that the order of the regions with respect to their respective sensitivity to changes in the real exchange rate is the same. These countries have negative and statistically significant responses, while the responses of economic activity are much weaker and not significant. As with the previous approach, the sensitivity analysis performed on the SVAR models suggests that the results are very robust.

Briefly, authors were able to demonstrate initially that FDI and REER stimulate economic growth in the Maghreb economies in exchange for regime transmutations. In addition, the participation of FDI in socio-economic development seems weakly significant, without the implementation of a policy of support and guidance aimed at reducing the catastrophic effects on the economy and converging its investments towards sectors with high added value. Indeed, the economic privileges of the IDE are indisputable, but are not certain, to bring the maximum benefits of the establishment of foreign firms in the host country. It is essential that firms have appropriate situations that encourage domestic as well as foreign investment that encourage innovation and improve skills, and contribute to a competitive climate.

In addition, the economic growth in Tunisia and Morocco is real despite the fragility of the latter. On the other hand, in Algeria, Mauritania and Libya, the economic development is unreal (fictitious) since it refers to the growth of hydrocarbon exports but not that of products and services (rentier economy). Based on this reality, authors cannot overlook the economic performance achieved in recent years by hydrocarbonate-production countries, such as Algeria.

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“Assessment of the uneven use of information resources in the business process circuit”

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Oleksandr Milov (Ukraine), **Stanislav Milevskyi** (Ukraine),
Hryhorii Kots (Ukraine)

ASSESSMENT OF THE UNEVEN USE OF INFORMATION RESOURCES IN THE BUSINESS PROCESS CIRCUIT

Abstract

An approach is proposed for assessing the uneven use of information resources in the organization's business processes. Formal representations of the organization's business processes and security systems are presented, reflecting both business operations carried out in a certain sequence and information resources that ensure the implementation of the relevant business operations, the place of information resources in the general outline of business processes is indicated. The circuits of the security system business processes of and the business processes of the main object of modeling are considered, including both business processes for managing security and business processes for ensuring security management. The assessment of the non-uniform use of information resources in a business process scheme is based on the consistent construction of an information resource incidence matrix for individual business operations, a frequency relationship matrix reflecting the sharing of information resources, and a matrix of derivatives in a discrete formulation. The proposed approach is demonstrated on a conditional example containing both the notional costs of information resources and weighting factors of the importance of business operations that reflect their criticality in the general contour of business processes. Estimates obtained as a result of applying the approach make it possible to group information resources, focusing on the frequency of their joint use in the business processes, which ultimately makes it possible to justify the choice of information resources for protection against threats from cyber intruders.

Keywords information resources, business process, security system, frequency matrix, discrete mathematics, threats, cyber-attacks

JEL Classification C65, G2, M15

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ОЦІНКА НЕРІВНОМІРНОГО ВИКОРИСТАННЯ ІНФОРМАЦІЙНИХ РЕСУРСІВ У КОНТУРІ БІЗНЕС-ПРОЦЕСІВ

Анотація

У статті запропоновано підхід до оцінювання нерівномірного використання інформаційних ресурсів у бізнес-процесах організації. Наведено формальні пояснення як бізнес-процесів і систем безпеки організації, що відображають виконання бізнес-операцій у певній послідовності, так і інформаційних ресурсів, які забезпечують виконання цих операцій. Визначено місце інформаційних ресурсів у загальній системі бізнес-процесів. Розглянуто контури бізнес-процесів системи безпеки та основного об'єкта моделювання, які містять у собі як бізнес-процеси для управління безпекою, так і ті, що пов'язані з забезпеченням цього управління. Оцінка нерівномірного використання інформаційних ресурсів у схемі бізнес-процесів заснована на послідовній побудові матриці інцидентності інформаційних ресурсів для окремих бізнес-операцій, частотної матриці відносин, що відображає спільне використання інформаційних ресурсів, і матриці похідних у дискретному формулюванні. Запропонований підхід продемонстровано на умовному прикладі, що містить як умовну вартість інформаційних ресурсів, так і вагові коефіцієнти важливості бізнес-операцій, що відображають їх значення в загальному контурі бізнес-процесів. Оцінки, отримані в результаті застосування підходу, дозволяють згрупувати інформаційні ресурси, орієнтуючись на частоту їх спільного використання в контурі бізнес-процесів, що зрештою дає змогу обґрунтувати вибір інформаційних ресурсів для захисту від кіберзловмисників.

Ключові слова інформаційні ресурси, бізнес-процес, система безпеки, частотна матриця, дискретна математика, загрози, кібератаки

Класифікація JEL C65, G2, M15

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INTRODUCTION

Information infrastructure is a central concept that defines the entire cycle of designing and operating a business system. The protection of information assets within the assets of an enterprise is a critical moment, the absence of which casts doubt on the very idea of the existence of an information structure. Therefore, the support and protection of the enterprise management system implies, first of all, the support and protection of the business processes themselves and the development of the infrastructure component of the business system, and in particular the information system, by overcoming the infrastructure and information fragmentation of the enterprise units (Evseev & Dorohov, 2011; Magomaeva, 2017; Milov & Korol, 2019; Stelmashonok, 2006).

The concept of information assets includes all technical and software, patents, trademarks and everything that allows employees to realize their production potential, as well as the relationship between the company and its major customers, government agencies, and other business entities. Protection of information assets consists in maintaining the integrity, accessibility and confidentiality of information in business systems (Evseev, Kots & Korol, 2015; Hamdan, 2013; Kotenko & Karsaev, 2001).

The analysis of possible threats showed that the information infrastructure should have the property of protecting the information used in business processes. This property characterizes the ability to provide protection against unauthorized (intentional or accidental) receipt, alteration, destruction or use of commercial, official or technological information.

The process-oriented approach to the creation (improvement) of the infrastructure for protecting information of business processes will allow us to consider the process of formation (development) of an information protection system as one of the auxiliary business processes that provide the basic processes of the enterprise. This makes it possible to develop an information protection infrastructure in close interconnection with the design of other business processes, which will undoubtedly increase their integration, flexibility, balance, and manageability (Rigin, 2012).

1. AIMS

The existing systems of protection against business objects from cyberattacks are based on threat classifiers, which are largely focused on ensuring the security of information resources, as the goals of cyberattacks, and not on ensuring the security of business processes directly (Evseev, Rzayev, Mammadova, Samedov & Romashchenko, 2018; Yudin & Buchyk, 2015(a), 2015(b); Yudin, Buchyk, Chunarova & Varchenko, 2014). Because of this, a certain contradiction arises, consisting in the existence of a certain gap between the assessment of the security of the business process and the information resource used by it. This article attempts to jointly assess both information resources and the organization's business processes used, taking into account the fact that the same resource can be used in different business processes. The proposed approach is aimed at ensuring the security of business processes of the organization, allowing you to create a circuit of business processes of the security system (Evseev, 2016, 2019).

2. RESULTS

Consideration of the proposed approach should begin by presenting the outline of the organization's business processes, the security system and the place of information resources in them.

The circuit of the organization's business processes should be considered as the main object of cyber-attacks. An organization's business process circuit (BP) is a set of business processes and their implementation of information resources, the implementation of which in a given sequence leads to the achievement of the organization's goals, which can be described as follows:

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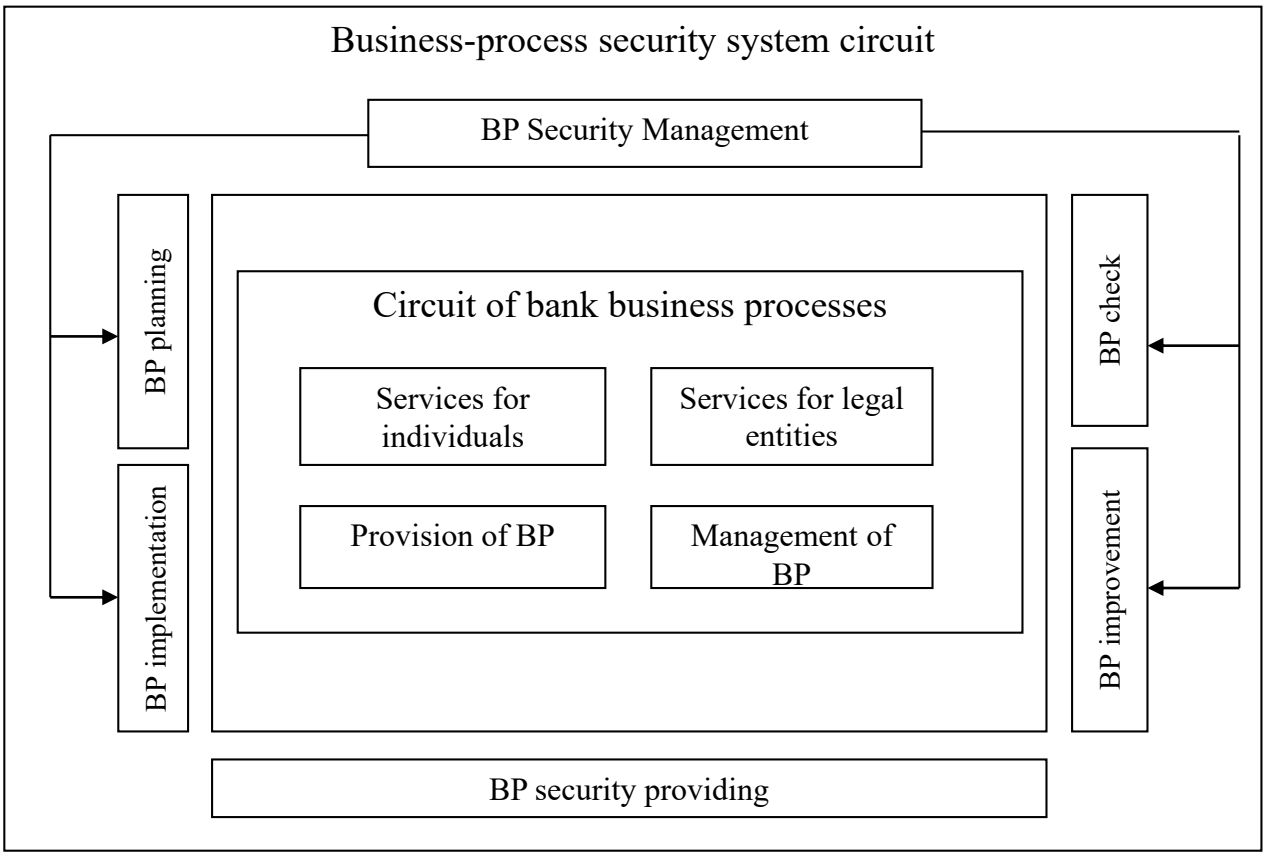

Source: Author's development.

Figure 1. The circuits of the business processes of the organization and the security system

$$S^{BP} = \left\{ \left\langle S^{BP_1}, IR^{BP_1}, T^{BP_1} \right\rangle, \ldots, \left\langle S^{BP_n}, IR^{BP_n}, T^{BP_n} \right\rangle \right\}, \quad (1)$$

where S^{BP} - is the loop of business processes as a set of BPs, each of which represents:

- S^{Bpi} - is the *i*-th business process, defined by the structure of relationships of individual business operations performed in a certain sequence;
- IR^{BPi} - a set of information resources of the *i-th* business process;
- T^{BPi} - a set of threats to the *i-th* business process.

Ensuring the protection of the organization's business processes can be represented similar to the BP contour, but not the security system. The security system business process circuit is a set of business processes and the resources necessary for them, the implementation of which ensures the normal functioning of the organization's business process circuit. This BP loop can be represented similarly, namely:

$$S^{BS} = \left\{ \left\langle S^{BS_1}, Rs^{BS_1}, T^{BS_1} \right\rangle, \ldots, \left\langle S^{BS_m}, Rs^{BS_m}, T^{BS_m} \right\rangle \right\}, \quad (2)$$

where S^{BP} is the circuit of business processes of the security system as a set of BPs, each of which represents, S^{BSi} - *i*-th business process defined by the structure of the links of individual business operations that are performed in a specific sequence in the security system, IR^{BSi} - a set of information resources protected by the *i*-th business process of the security system, T^{BSi} - a set of threats, the *i*-th business process of the security system provides protection against.

The relationship between information resources (IR) and the business processes in which they are used can be represented as an incidence matrix (A). Rows of this matrix correspond to information resources, and columns correspond to business processes. Matrix elements are defined as follows:

$$a_{ij} = \begin{cases} 1 \;\; if \;\; i-th \;\; resource \;\; is \;\; uaed \;\; by \;\; j-th \;\; process \\ \hline 0 \;\; in \;\; other \;\; cases \end{cases}. \qquad (3)$$

Let's consider a truncated version of the matrix of incentivities for the bank's business processes. As before, rows correspond to information resources, and columns correspond to business processes. Let there be 7 business processes and 5 information resources used in the framework of these business processes. The type of incident matrix for this case is presented in Table 1.

Table 1. Matrix of incidents of information resources for business processes

Source: Suggested by the authors.

Resources	Business processes						
	BP_1	BP_2	BP_3	BP_4	BP_5	BP_6	BP_7
R_1	1	1	–	–	1	1	–
R_2	1	–	1	1	–	1	1
R_3	–	1	1	–	1	–	1
R_4	1	1	–	1	1	–	1
R_5	1	–	1	1	–	1	–

The objective will be to ensure, with limited financial resources, the protection of as many business processes as possible through the protection of the information resources they use.

To solve this problem, the incident matrix must be supplemented with the cost indicators of each of the resources used (this is an estimate of the cost of protecting the corresponding resource). The incident matrix takes the following form (Table 2).

Table 2. Valuation of information resources incidental to business processes

Source: Suggested by the authors.

Resources	Business processes							The cost of the *i*-th resource (ci) (UAH)
	BP_1	BP_2	BP_3	BP_4	BP_5	BP_6	BP_7	
R_1	1	1	–	–	1	1	–	42.000
R_2	1	–	1	1	–	1	1	38.000
R_3	–	1	1	–	1	–	1	21.500
R_4	1	1	–	1	1	–	1	35.700
R_5	1	–	1	1	–	1	–	12.300

If we evaluate the cost of the corresponding business process based on the cost of the resources used by it, then in general terms the cost of the *j*-th business process can be calculated as:

$$C_j = \sum_{i=1}^{5} a_{ij} \cdot c_i. \qquad (4)$$

In the example, the costs of business processes are shown in the last line added (Table 3).

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Table 3. Business processes valuations

Source: Suggested by the authors.

Resources	Business processes							The cost of the *i*-th resource (ci) (UAH)
	BP_1	BP_2	BP_3	BP_4	BP_5	BP_6	BP_7	
R_1	1	1	–	–	1	1	–	42.000
R_2	1	–	1	1	–	1	1	38.000
R_3	–	1	1	–	1	–	1	21.500
R_4	1	1	–	1	1	–	1	35.700
R_5	1	–	1	1	–	1	–	12.300
Business process cost	127.300	99.200	71.800	86.000	99.200	92.300	95.200	–

Thus, using the incident matrix, an assessment was made of the value of business processes as the main activities (activities) of the company, bringing it surplus value.

It should be noted that business processes have different values for the organization, therefore, in addition to the cost indicators of the resources used, which can be entered into the used classification of threats, it is also necessary to set the importance (or value, or priority) of the corresponding business process. Supplementing the table used with weights of the importance of business processes (w_j), we can calculate the present values of business processes using the following expression (Table 4):

$$C_j = \sum_{i=1}^{5} a_{ij} \cdot c_i \cdot w_j . \qquad (5)$$

Table 4. Values of business processes

Source: Obtained by authors from previous tables.

Resources	Business processes							The cost of the *i*-th resource (ci) (UAH)
	BP_1	BP_2	BP_3	BP_4	BP_5	BP_6	BP_7	
R_1	1	1	–	–	1	1	–	42.000
R_2	1	–	1	1	–	1	1	38.000
R_3	–	1	1	–	1	–	1	21.500
R_4	1	1	–	1	1	–	1	35.700
R_5	1	–	1	1	–	1	–	12.300
Weight (value) of the business process (w_j)	1	1.2	1.1	1	1.25	1.3	1.1	–
Present value of a business process	127.300	119.040	78.980	86.000	124.000	119.990	104.720	

The obtained estimates of the present value of the organization's business processes make it possible to evaluate the value of business processes to determine the sequence of protection against cyber-attacks. However, it should be noted that the organization's business processes are not completely independent, since in the general case the same resource can be used in different business processes.

To correctly assess the relationship of the organization's business processes through shared resources and, based on this, determine the group of protected resources, we will use the methods of discrete mathematics and the theory of partially ordered systems (Gorbatov, 1976, 2000).

The intensity of the participation of information resources in the business processes of the organization will be characterized using the frequencies of their use. To do this, we introduce into consideration the frequency matrix of relations $F=[f_{ij}]_{n\cdot n}$ characterizing the model M, the incidence matrix of which is $A(M)=[a_{ij}]_{m\cdot n}$.

A frequency matrix of relations $F=[f_{ij}]_{n\cdot n}$ is a matrix, each row (column) of which is mutually associated with an information resource, and the element f_{ij} is equal to the number of business processes in which the i-th and j-th

information resources are used, if $i \neq j$, otherwise ($i=j$) - the number of business processes in which the i-th information resource is used. Moreover, if $i=j$, then f_{ij} is the natural frequency of the resource, if, then f_{ij} is the mutual frequency of the use of resources i and j. The greater the value of f_{ii}, the greater the importance of this resource for the organization's business processes. The frequency matrix F is symmetric with respect to the main diagonal. The greater the value of f_{ij}, the greater the importance of information resources of the i-th and j-th type for the contour of the company's business processes.

It can be shown that the frequency matrix of relations F, which characterizes the model, whose incidence matrix A satisfies the relation:

$$F=A^T \cdot A, \qquad (6)$$

where A^T – transposed matrix A.

For the above example, the frequency matrix of relations constructed with respect to information resources will have a dimension of 5x5 and will look as follows:

$$F = \begin{bmatrix} 4 & 2 & 2 & 3 & 2 \\ 2 & 5 & 2 & 3 & 4 \\ 2 & 2 & 4 & 3 & 1 \\ 3 & 3 & 3 & 5 & 2 \\ 2 & 4 & 1 & 2 & 4 \end{bmatrix}.$$

To build groups of business processes similar to each other in terms of information resources used, it is necessary to introduce the concept of a derivative over a pair of elements in a discrete formulation. Such a derivative is calculated according to the elements of the frequency matrix of relations as follows:

$$d_{ij} = \frac{f_{ii} - 2f_{ij} + f_{jj}}{f_{ij}}. \qquad (7)$$

This value shows the degree of uneven use of pairs of information resources in the circuit of the company's business processes. The matrix $D=|d_{ij}|$ has the following form:

$$D = \begin{bmatrix} 0 & 2.5 & 2.0 & 1.0 & 2.0 \\ 2.5 & 0 & 2.0 & 1.3 & 0.25 \\ 2.0 & 2.0 & 0 & 1.0 & 6.0 \\ 1.0 & 1.3 & 1.0 & 0 & 2.5 \\ 2.0 & 0.25 & 6.0 & 2.5 & 0 \end{bmatrix}.$$

The highest value in the resulting matrix is 6.0, corresponding to the pair (3, 5). As you can see from the original incident matrix, they are practically not shared in the business processes under consideration, therefore, joint protection of these resources will lead to the protection of different groups of business processes. While the resources included in the pair (2, 5) turn out to be similar in terms of using business processes. From this it follows that when building the protection of resource 2, it is necessary to protect resource 5, since they are used together in a group of business processes. An analysis of the obtained values of the matrix D will allow us to form groups of resources that require simultaneous protection for the normal functioning of the organization's business processes.

Thus, the proposed approach allows quantifying the uneven use of various information resources. Accounting for the resulting assessments can be used in constructing the circuit of business processes of the security system with the goal of efficiently distributing limited financial resources to protect the organization's business processes (Isaev, 2015; Weishaupl, Yasasin & Schiyen, 2015).

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CONCLUSION

The paper proposes an approach to assessing the uneven use of information resources in the organization's business processes. Formal representations of the business processes of the organization and the security system are given, the place of information resources is indicated. The assessment of the uneven use of information resources in the business process circuit is based on the construction of a frequency matrix of relations and the use of the concept of derivative in terms of discrete mathematics. The basis for their construction is the incidence matrix of information resources for business processes. The proposed approach is demonstrated using a conditional example. Estimates obtained as a result of applying the approach allow substantiating the choice of information resources for protection against threats of cyber-attacks.

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Formal analysis: Oleksandr Milov.
Funding acquisition: Hryhorii Kots.
Methodology: Oleksandr Milov.
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Investigation: Stanislav Milevskyi, Hryhorii Kots.
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Software: Stanislav Milevskyi.
Supervision: Oleksandr Milov.
Validation: Hryhorii Kots.
Visualization: Stanislav Milevskyi.
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“Efficiency and corporate governance of a state-owned enterprise: the case of the Tunisian national railway company”

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Afef Bouattour (Tunisia)

EFFICIENCY AND CORPORATE GOVERNANCE OF A STATE-OWNED ENTERPRISE: THE CASE OF THE TUNISIAN NATIONAL RAILWAY COMPANY

Abstract

The inefficiency of the State-Owned Enterprise is a matter of concern to economists. Among the studies carried out, those based on the theory of corporate governance were found. However, most of these studies focus on comparing the public enterprise governance with that of the private one. Thus, this article departs from this comparison towards an analysis of the governance of public enterprises to understand its inefficiency by examining the case of the Tunisian Railway Company. Starting with the approach used by Lehmann et al. (2002), it uses the Data Envelopment Analysis to evaluate the effectiveness of a governance system. The governance scores obtained were used to explain the efficiency variables for each year in the sample using regression in temporal data. The analysis revealed significant problems in governance mechanisms related to the lack of information transparency, weaknesses in functions of the government shareholder, and, in particular, control system failures.

Keywords public enterprise, efficiency, corporate governance, data envelopment analysis, governance system

JEL Classification L30, L32, L92, O18, R40

Афеф Буатур (Туніс)

ЕФЕКТИВНІСТЬ ТА КОРПОРАТИВНЕ УПРАВЛІННЯ ДЕРЖАВНИМ ПІДПРИЄМСТВОМ НА ПРИКЛАДІ ТУНІСЬКОЇ НАЦІОНАЛЬНОЇ ЗАЛІЗНИЧНОЇ КОМПАНІЇ

Анотація

Неефективність державного підприємства викликає занепокоєння економістів. Серед проведених досліджень знайдено такі, що грунтуються на теорії корпоративного управління. Однак більшість цих досліджень присвячено порівнянню управління державним підприємством і приватним. Взявши за приклад залізничну компанію Тунісу, автори статті відходять від цього порівняння та аналізують питання управління державним підприємством, щоб з'ясувати причини його неефективності. Почавши з підходу Леманна та ін. (2002), вони застосовують метод аналізу охоплення даних з метою оцінки ефективності системи управління. Отримані результати використано для пояснення змінних ефективності за кожен рік у вибірці з використанням регресії тимчасових даних. Виявлено значні проблеми в механізмах управління, пов'язані з непрозорістю інформації, слабкістю функцій держави-акціонера та, зокрема, збоями в системах управління.

Ключові слова державне підприємство, ефективність, корпоративне управління, аналіз охоплення даних, система управління

Класифікація JEL L30, L32, L92, O18, R40

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INTRODUCTION

Since the 1970s, the inefficiency of State-Owned Enterprise has been the subject of several theoretical and empirical studies (Lin et al., 1998; Shleifer & Vishny, 1994; Boycko et al., 1996). It was only in the late 1980s that studies on the efficiency of public enterprises, based on the theory of corporate governance, appeared (Charreaux, 1996). However, most of these studies fit into a logic of comparison of the public enterprise governance to the private one (Nellis, 1994; Charreaux, 1996). In addition, studies focusing only on the governance of public companies remain limited (Daiser, Ysa & Schmitt, 2017; Grossi et al., 2015). It is in this sense that this article moves away from the public / private comparison and tends towards an analysis of the governance of the public company in order to understand its inefficiency.

The aim of this research is to find out whether a failure in the governance mechanisms can explain the inefficiency of the State-Owned Enterprise. This study adopted the hypothetico-deductive type aproach, as it makes it possible to exploit theoretical results on the link between inefficiency and corporate governance. The line of research focuses on the use of governance theories to explain the inefficiency of the State-Owned Enterprise. However, the article considers that inefficiency follows an iterative and cumulative process whose explanation can only be composite.

Due to the exploratory character of this work in the Tunisian context, author chose the Tunisian National Railways Company (SNCFT) as a means of access to reality. The reason for this choice lies in the fact that railway undertakings are becoming inefficient in many countries, both underdeveloped and developed. In addition, the railway undertakings by their specificities are an example of State-Owned Enterprises in difficulty or even in a state of "virtual bankruptcy".

The rest of the paper consists of five sections. Section 2 recalled the origin of the theory of governance and its theoretical basis. Section 3 presents the methodology adopted for data analysis by specifying the econometric model. Section 4 presents the results obtained and their analysis. Section 5 presents discussion on SNCFT corporate governance problems. Finally, section 6 provides an overview of the implications of the analysis and the prospects for further research.

1. LITERATURE REVIEW

The issue of corporate governance sparked the interest of researchers in several areas (economic, political, management...). Governance, as pointed out by Charreaux (2006), has become inseparable from the economic development.

The theory of governance tends to determine the way in which people are governed. The theme of governance has its origins in the debate initiated by Berle and Means (1932), who attribute the problem of governance to the separation of the control function, which is the prerogative of the owners of the decision-making function that returns to the leaders. This property-decision separation occurred at the beginning of the century in large American companies. Given the failure of the control systems, this ownership-decision split has led to a deterioration of the efficiency and a stripping of the shareholders.

According to Charreaux (2006), the main corporate governance theories linked to the paradigm of efficiency relate to a certain model of creation and distribution of value by the organization. Referring to this author, we can distinguish three governance models that explain the efficiency of organizations differently: the financial model, the contractual partnership model and the cognitive model of governance.

1.1. The financial model of governance: the profitability of financial investment Protection

The first model is rooted in the theory of the Agency. The financial model of governance is based on the analysis conducted by Jensen and Meckling (1976). They see the firm as a knot of contracts established between the different partners whose interests diverge, causing conflict, and therefore the agency costs. Jensen and Meckling reduce

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agency relationships to relationships between managers and shareholders on the one hand, and between the firm and financial creditors on the other. This approach is the foundation of the shareholder financial design that still feeds the current debates. However, this design limits the governance system to mechanisms that align the interests of executives with those of shareholders (Rezaee, 2019).

In this perspective, as pointed out by Shleifer and Vishny (1997), the governance system's role is to protect the profitability of financial investment. The Governance system includes firm's internal control mechanisms resulting from shareholders, the Board of directors or executives as well as external mechanisms related to the market fonctionning.

These different mechanisms work together while being complementary or substitutable. It is in this sense that the role of these mechanisms differs according to the type of organization. Indeed, when it comes to firm managerial, market leaders becomes a mechanism of weight. Leaders seeking always to improve their value in this market by maximizing the firm's shareholder value. However, other internal mechanisms are required to ensure the maximization of the value. For example, the board of directors, or the control of managers, makes it possible to improve the efficiency of managers through the incentive systems they create.

Other mechanisms such as the takeover market can be used as a last resort, especially when losses are important. The origin of these impairment losses may differ depending on the nature of the conflicts of interest. The rooting of the leader behavior might be causing a loss of value in contributing to the increase in agency costs. It is as well as the governance system must reduce this loss of value through its control mechanisms. However, the costs of these mechanisms must be less than the gains that they allow. In some cases, the reduction of the decision-making latitude of the leader could be rather rather source of a lower efficiency, and therefore loss of value source.This financial model of governance, which highlights financial investors, and considers the shareholders as the only remaining creditors, not so interested in the alignment of the interests of managers with those of shareholders.

1.2. The contractual model of governance: Inefficient conflict resolution

The contractual model calls into question the status of residual creditor only granted to the shareholders. This challenge encourages the review of the problem of Division of the corporate pension. Indeed, it is the perception of a portion of the remuneration that could encourage other partners to create value. The second contractual partnership model calls into question the residual creditor status only granted to shareholders. This challenge encourages the reconsideration of the problem of sharing the organizational rent. Indeed, it is the perception of part of the rent that could encourage other partners to create value. It is in a sense that the distribution of this rent between the different factors of production, thus reaching the status of residual creditors, explains the effect of governance on the creation of value.

The governance system thus appears as the set of constraints that govern the negotiation for the sharing of the rent, taking place ex post between the different partners. The origin of this conception found in the theory of incomplete contracts, defines the property, not only by the residual decision rights, but also by the appropriation of the residual gains. It is thus possible to consider all the participants in the node of productive contracts as residual creditors. Managers and employees, who are attributed residual decision-making power, receive a portion of the organizational rent and are thus better incentivized to make efforts. Expanding ownership to all participants emphasizes the importance of human capital, which is central to the study of changing the nature of the firm in the new economy (Hayden and Bodie 2019). Indeed, the firm today differs considerably from the firm in Berle and Means and the biggest difference is the growing importance of human capital.

Given the change in the nature of the firm, the focus of governance must extend to the study of the mechanisms that give the firm the power to provide incentives for human capital. Thus, the study of governance must go beyond the analysis of Berle and Means (1932). In fact, the latter is limited to determining who the owners are, and whether the real owners can exercise their rights adequately. As a result, property rights appear stronger than management.

However, the consideration of the role of managers in the production of the organizational rent, accounts for the managerial rent due to their specific skills. In addition, the capital associated with the specific skills of employees contributes to the production of the organizational rent. The system of governance is thus a way of protecting the value of the human capital of employees (Clarke and Branson, 2012). The partnership approach leads to studying the governance system throw its capacity to create partnership value, which requires the definition of organizational rent. However, this partnership model of governance is mainly limited to the resolution of conflicts of interest and the appropriation of rent, neglecting the cognitive aspects raised by the third model of governance.

1.3. The cognitive model of governance: Role of human capital as an efficient vector

The third model focuses on productive dynamics. According to Langlois and Foss (1999), contractual theories neglect the productive dimension of the construction of rents. It is not enough to converge interests, but we must also focus on qualitative coordination, mainly related to the competence and cognitive patterns of different partners. This cognitive approach considers the firm as a collection of knowledge that is not limited to the collection of information, but extends to the interpretation made of this information by individuals according to the cognitive models they have followed. By taking into account cognitive aspects in value creation, the firm has a sustainable profitability (Foss and Jensen, 2018). In addition, the role of the governance system goes beyond conflict resolution, and provides the greatest potential for value creation through organizational learning and innovation. Thus, these different governance models show that the micro theories of governance are moving more and more towards the consideration of the role of human capital as a vector of creation of organizational value in modern enterprises, characterized by separation of ownership and control functions.

2. METHODOLOGY

Starting from the approach used by Lehmann et al. (2002), our method uses two stages:

- apply the Data Envelopment Analysis (DEA) technique to our sample in order to evaluate the effectiveness of the governance system, to obtain an efficiency score of the governance practices for each year of our sample;
- use the governance scores thus obtained as variables that explain the performance of each year of our sample by means of a temporal data regression.

Based on linear programming, the DEA method makes it possible to identify empirical production functions. Based on microeconomic theory, this méthod allows comparing all units that are similar, while simultaneously taking several dimensions. Thus, it is from the point of view of best practice that it determines the efficiency frontier. Each unit is considered a Decision Making Unit (DMU, in our case it is a year), which transforms "inputs" into "outputs".

The score for efficiency in the presence of several factors of inputs and outputs defined as follows:

$$Efficiency = \frac{\text{weighted sum of the outputs}}{\text{weighted sum of the inputs}}. \qquad (1)$$

Assuming that there are n DMU, each with m inputs and s outputs, the relative efficiency of a DMU test score p is obtained by solving the model, proposed by Charnes et al. (1978) following:

$$\begin{aligned} &\max \ \sum_{k=1}^{s} v_k y_{kp} \Big/ \sum_{j=1}^{m} u_j x_{jp}, \\ &\text{s.c.} \quad \sum_{k=1}^{s} v_k y_{ki} \Big/ \sum_{j=1}^{m} u_j x_{ji} \le 1; \quad v_k, u_j \ge 0; \ \forall \ k, j, \end{aligned} \qquad (2)$$

where $k=1,\ldots,s$, $j=1,\ldots,m$, $i=1,\ldots,n$, Y_{Ki} is the amount of output produced by MISP i, x_{jp} quantity of input product by DMU i, V_K weight given to output k and u_j weighting given to the input j.

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$$\begin{aligned} &\max \ \sum_{k=1}^{s} v_k y_{kp}, \\ &\text{s.c.} \ \sum_{j=1}^{m} u_j x_{jp} = 1; \ \sum_{k=1}^{s} v_k y_{ki} - \sum_{j=1}^{m} u_j x_{ji} \le 0; \ v_k, u_j \ge 0; \ \forall \ k, j. \end{aligned} \tag{3}$$

In order to identify the relative efficiency scores of all DMUs the above problem is executed n times. Each DMU thus chooses the weights of inputs and outputs that maximize its efficiency score. In general, a DMU will be considered effective if it gets a score of 1. Therefore, it will be considered ineffective if the score is less than 1. The DEA method identifies a set of effective units that corresponds to each DMU. For each inefficient DMU, the DEA identifies a set of effective units, which suit him and can constitute reference points for comparison. The dual problem presented in (4) gives the referencing.

$$\begin{aligned} &\min \ \theta, \\ &\text{s.c.} \ \sum_{i=1}^{n} \lambda_i x_{ji} - \theta x_{jp} \le 0; \ \sum_{i=1}^{n} \lambda_i y_{ki} - y_{kp} \ge 0; \ \ \lambda_i \ge 0; \ \forall \ i. \end{aligned} \tag{4}$$

With effective governance structures, the management of company is more efficient. As a result, it is more likely to make the best investments and strategic decisions, resulting in higher profitability.

In order to measure the efficiency of the governance systems of the SNCFT by DEA method, we will choose the inputs and the outputs. Like Lehmann et al. (2002), this study has chosen as inputs the ownership structure (measured by the productivity of the labor factor (assessed by: work/Production) and the financial structure (measured by the net debt ratio = Net Debt / Equity). Regarding the outputs, this analysis have selected intensity capital (investment in proportion to the production) and the growth of the turnover.

Inputs:

Concentration of ownership (CP): In analysis, mesure the concentration of the property by the productivity of the labor force in relation to the overall production measured by the operating revenues.

Financial structure (SF): For the financial structure, this paper will consider the debt ratio defined as (Total debt / Total assets). The company is all the more indebted as this ratio is high.

Outputs:

The investment and growth of the firm's turnover reflect the quality of the governance practices and their efficiency, insofar as they inform us, in case of abuse of the managerial discretion of the overinvestment in unprofitable projects (Bednar et al., 2015).

Investment (INV) or capital intensity (K / Y) defined as the annual expenditure of assets divided by total assets (Total non-financial assets / Total assets) (Lehmann et al., 2004).

Turnover growth (TCA) is defined as the logarithm of the annual turnover change, Log (CAn - CAn-1) (Lehmann et al., 2004).

3. RESULTS

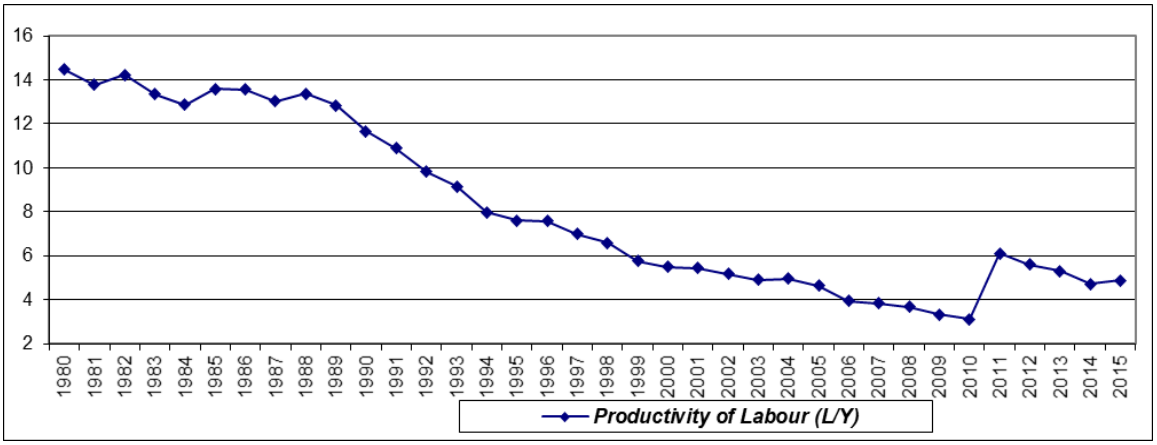
In this section, study consider the estimation by the DEA method of a governance index composed of two inputs and two outputs. Thus, will begin by presenting these variables. Indeed, and according to Chart 1, author record a considerable drop in the average productivity of work along the study period. This means a considerable increase in the ratio (L / Y), which shows that one hour of work always uses more equipment to produce more service at the

level of our society. This translates into a secular decline in labor productivity, which does not allow for a steady improvement in real wages and living standards. On average, this productivity is around 8.2 with a standard deviation almost half of 3.9 (see Table 1).

This lack of labor productivity has led to considerable losses leading to the increase in the ratio of debt to equity presented in Chart 2. This ratio assesses the debt capacity of the company and makes it possible to verify that the amount of the company's debt is not too large compared to the amount of equity (53.2% with a standard deviation of 18%). For our case, the higher the rate, the more the SNCFT is in debt. The ratio is less than 1; otherwise the company no longer has room to maneuver in terms of recourse to external financing.

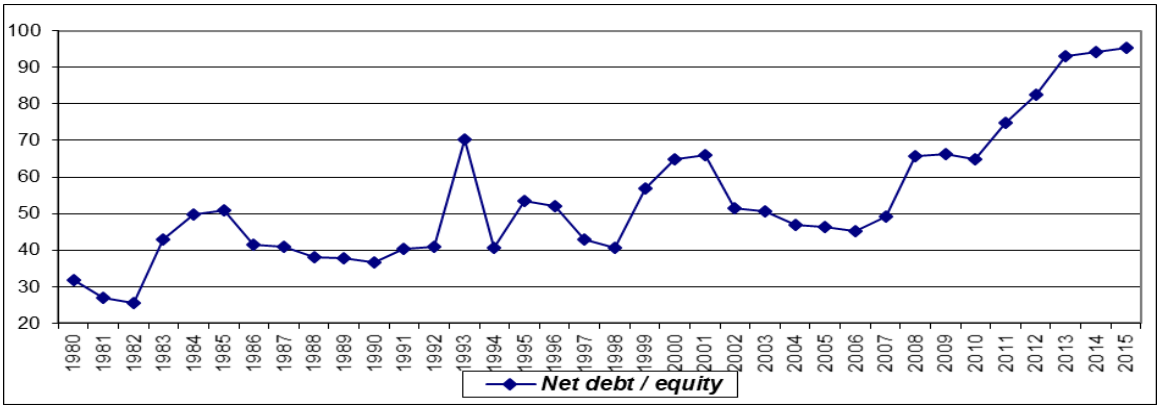
Capital intensity is equal to the ratio of economic assets on the turnover. It measures the amount of capital committed for a given turnover. It also corresponds to the inverse of the rate of rotation of the economic assets. Indeed, the absence of a clear trend in the evolution of the capital-production report (K/Y) along the study period (see chart 3), means that the same amount of equipment makes roughly the same volume of production.

It is therefore necessary to expect the same absence of trend in the evolution of the rate of return of capital. Income related to the determination of capital increases only if the capital stock (Investment) grows.



Source: Estimates of the author of the database.

Figure 1. Evolution of the average productivity of labour



Source: Estimates of the author of the database.

Figure 2. Evolution of the ratio of debt to equity

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Table 1. Descriptive analysis of the inputs and outputs of the DEA model

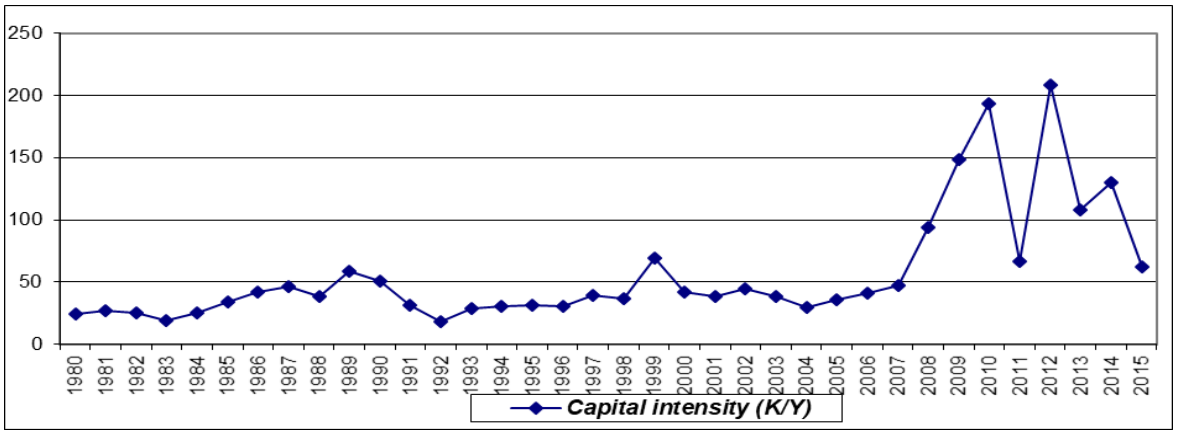
Source: Estimates of the author of the database.

Designation	Labor productivity (L/Y)	Net debt/ equity	Capital intensity (K/Y)	Growth of the turnover
Average	8.17	53.27	56.48	1.48
Standard deviation	3.88	18.04	46.15	11.32
Minimum	3.12	25.68	17.77	–57.83
Maximum	14.48	95.38	208.11	20.22

The increase from 2008 has given an overall average of 56.5% but with a deviation high of 46%, in fact, with a minimum capital intensity of 17.77% 1992 and maximum intensity of 208.1% in 2012. However, this intensity was low since the 1980s until the middle of the 2000s, from which there has been a continuous positive development up to the year 2010. About evolution that began in the mid-2000s, she finds its justification in the effects of the reforms carried out by the State. However the recorded fall in 2011 is explained in political and social disruption experienced by the country in 2011 (successive strikes, sit-ins), which led to a rail activity characterized by a significant drop in traffic, especially for phosphate and freight. With regard to the maximum value recorded in 2012, it is not significant in the sense that it simply reflects a political strategy, it is obvious that this increase could not last and will be followed by a decrease of the following years reaching 62.48% in 2015.

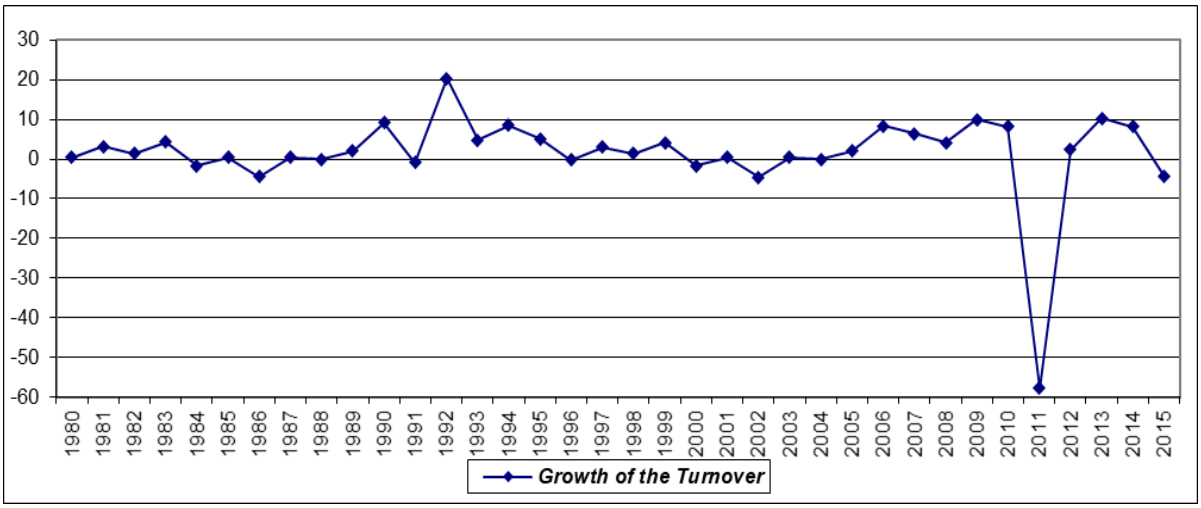
The growth in turnover therefore does not allow the accumulation of technological capital, in other words increasing the stock of scientific and technical knowledge that used in production. As a result, the growth of SNCFT is not at the root of technical progress and increasing returns to scale, which in turn will not favor higher production (see Chart 4). Indeed, the average growth rate is low of 1.48% with a standard deviation too high of 11.3%. This is mainly due to the sharp drop in 2011, which reached a negative rate of –58%.

To move to the index of governance cleared, must add an important clarification. Indeed, the most used governance indicators are composite indicators based on perceptions. Even the most carefully constructed composite indicators suffer from limitations that their users seem to ignore. The company needs greater transparency both in production and in the use of these indicators.



Source: Estimates of the author of the database.

Figure 3. Evolution of capital intensity



Source: Estimates of the author of the database.

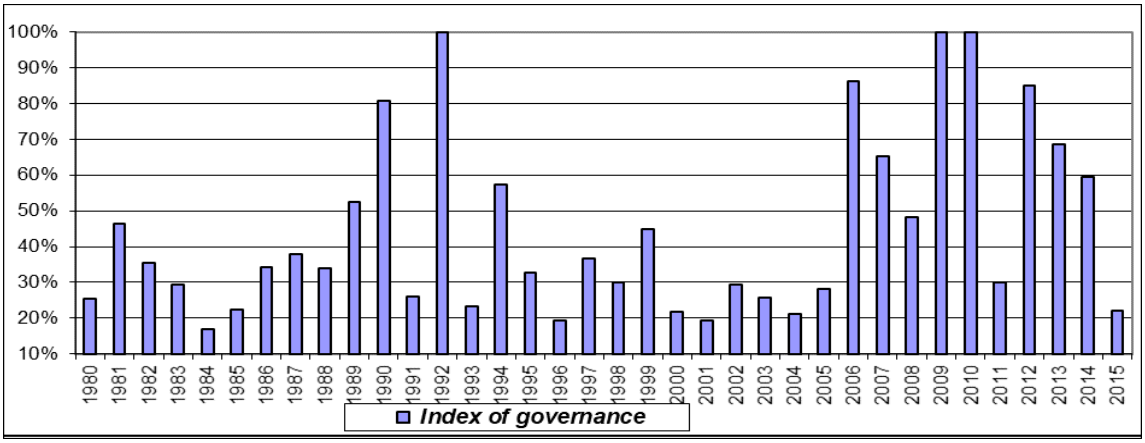
Figure 4. Evolution of the rate of growth of the turnover

Table 2. Descriptive analysis of estimated governance index

Source: Estimates of the author of the database.

Designation	Governance index
Average	44.31%
Standard deviation	25.46%
Minimum	16.79%
Maximum	100%

Based on the model 3 above, author were able to identify a governance index and represent its evolution in graph 5. This index shows an average of 44.3% with an important deviation of 25.5%. In general, the SNCFT society suffers from a problem of governance, with the exception of a few years where this index shows high scores. From these results, author still confirm that the best time is between the middle of the years 2000 and 2010. The recovery from 2012, we always attribute it to a political factor rather than greater awareness for the improvement of corporate governance. The proof is always in the decline following years from 84.9% in 2012 to only 22% in 2015.



Source: Estimates of the author of the database.

Figure 5. Estimated SNCFT Governance index

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The results say that corporate governance remains weak as a whole compared to the needs of national public policy. This confirms the diagnosis previously made. Indeed, our analysis of the system of governance within the SNCFT, has left to find significant problems in the governance mechanisms related to the opacity of the information, to the weakness of the State-shareholder service and in particular to the failures of control systems.

4. DISCUSSION

Looking for indicators of governance at the level of a public company in Tunisia is a very difficult task. Indeed, the assessment of governance implies transparency and access to information that are almost utopian. This is the first indicator of poor governance. Other indicators linked to the control system, to the Board of Directors and to the State-SNCFT program-contracts, can be indicative of the governance within this company.

4.1. Opaque transparency and faulty information

A lack of transparency characterizes the management system of SNCFT like any public company in Tunisia. According to the recent World Bank report (2014) "The public enterprise sector continues to suffer from a lack of transparency for stakeholders, (...) which is not conducive to good governance" (pp. 11). By consulting the official website of SNCFT, it is impossible to find information (apart from train schedules and other low added value information) that can inform stakeholders about the situation or the functioning of the company. Thus, not only is the amount of information available far from sufficient, but its quality is poor. However, the publication of information, of sufficient quality and quantity, is the very foundation of a favorable environment for SNCFT. The presence of a shareholder State function institutionally crumbled accentuates this failure in terms of transparency.

4.2. Institutional fragmentation of the State shareholder

The weakness of the shareholder function and the multitude of units in charge of monitoring public companies is a characteristic common to all public companies in Tunisia. By following a decentralized model, SNCFT operates in an institutional framework divided between several ministries, with a hegemonic power of the ministry of supervision. The supervising ministry, whose main responsibility is to supervise the SNCFT, intervenes in an important way in the decision-making of the company and in the legal framework. There is a confusion in its supervisory role that brings together the function of shareholder and controller of the public interest, and even of economic and social development. This confusion emanates from the entanglement of the roles of the state. Indeed, there is no clear, well-defined conception of the prerogatives of guardianship. The shareholder function is not only ambiguous, but also not applied as it should be. The shortcomings that characterize the shareholder function affect all the institutions of the chain.

The fragmentation of the shareholder function between several ministries, accompanied above all by the domination of guardianship, is an obstacle to the autonomy of management of SNCFT. In addition, fragmentation among several ministries results in a dilution of responsibilities, and systematic inconsistency. The dilution of responsibilities is even more prejudicial when accompanied by a scattering of rare skills. This weakness of the State shareholder function is all the more evident with the evaluation of the program contracts established between the State and SNCFT. These program contracts linking SNCFT to the State deemed by law to reflect the strategic orientations of the State. In reality, these contracts (if they exist) have deficiencies that can be located at several levels.

Firstly, the State and SNCFT do not systematically establish these program contracts. Secondly, the improvement of the company's situation after a program contract does not mean that the latter has achieved its objectives. This gap which constitutes a breach of the terms of the contract is never sanctioned, which removes the commitment aspect that characterizes the contracts. The lack of respect for the terms of the contract concerns the SNCFT and the State. In other words, contracts have rather the aspect of project. Finally, a Board meeting never discusses these contracts. It was always a point treated among others. In addition, their follow-up present deficiencies related on the one hand, to the problem of lack of information dealt with above, on the other hand to the failures of the control system.

4.3. A control system failing

Three major failures of SNCFT's control system can explain its inability to improve efficiency.

Firstly, on the control side, there is a focus on the shape more than on the bottom. The compagny privileges the control of the procedures compared to that of the results. This explains the inefficiency of these procedures in determining SNCFT's difficulties. The lack of transparency mentioned above, handicaps the control, reduced to a simple follow-up of the procedure. According to the report of the World Bank, the skills of controllers in Tunisia are limited, which prevents them from carrying out their mission in the face of asymmetric information (as cited in World Bank, 2014, p. 20).

Secondly, the controlers have the status of inspectors recruited by the National School of Administration, and have the "rank-function" to carry out their mission. Except that in practice, they face several obstacles. In fact, supervisors are often handicapped in their mission by the hierarchical power in their ministry, or at the level of the first ministry, and depend on the orders of mission that they issue to them. The only control body that escapes this dependence is the court of accounts by its status of magistrate.

Thirdly, a lack of coordination between the different bodies of control is detectable and caused by mission orders which are not in the program, and which disrupt the scheduled tasks. In addition, given the number of State-Owned Enterprises to control, membership of the various control external appears insufficient to achieve this mission. For this reason, the SNCFT could not benefit from a thorough and regular control of its accounts and financial management. The inadequacy or inefficiency of internal audit services aggravate this failure.

4.4. A weak Board

An imbalance characterizes the constitution of the board of SNCFT. In fact, out of thirteen members, six are representatives of the ministries and two representatives of the government. This domination, if it hides a political appointment, is all the more prejudicial to the effectiveness of the activity of the council based on a political choice and not on criteria of competence. In addition, departments are inclined to become involved in SNCFT's operational decisions, thus limiting the role of the Board of Directors to a mere instrument in the service of a department.

Regarding the members of the Board of Directors of the SNCFT, as for other public companies, it is clear that they do not grant the importance required for their participation. Indeed, for most it is additional salary rather than an effective participation in the defence of the interests of the State. In addition, the power of the Board of Directors is limited, since in reality the appointments of the SNCFT leadership escape him. The guardianship authority must approve all decisions of the Board. These practices are inconsistent with the rules of good governance.

Another practice contrary to the rules of good governance is the cumulation of functions. Indeed, the Chief Executive Officer of the SNCFT ensures both the function of Chairman of the Board and General Manager of the company. This practice leads automatically a conflict of interest and often leads to derivatives (Aquilera et al., 2016). The possibility of derivatives is all the greater since there are no conditions of appointment to the title of Director as seniority, age, or a specific skill. Criteria specified in the Act, are membership in the Board of Directors, the Tunisian nationality, experience during at least five years and exercise as public official with the category.

All these shortcomings both in terms of the state shareholder function and in the control systems, the lack of transparency or the weakness of the board of directors, are indicators of poor governance within SNCFT. With such failures in governance, the inefficiency of SNCFT and its inability to recover its financial position, become obvious. This confirms the link between inefficiency and governance.

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CONCLUSION

Governance system includes firm's internal control mechanisms resulting from shareholders, the Board of directors or executives as well as external mechanisms related to the market fonctionning. The Board of Directors as internal control mechanism plays a very important role in the reduction of asymmetric information in a way that garanties the integrity of the financial statements.

These control mechanisms reduce the costs resulting from the conflicts between executives and shareholders as well as the opportunistic behavior. In addition, the mechanisms related to regulation, law or financial information can overcome the conflicts of interest between the firm and financial creditors. The combination of the insufficiencies of the information and the failure of the control shows that the public company, suffers from the problems of control collective actionsl.

The analysis carried out at the level of the SNCFT found problems of governance that can explain the society inefficiency. For the governance of the SNCFT, it is possible to undertake a set of measures, which summarized in three key elements:

Firstly, the SNCFT must have management with increased autonomy and accountability of the Board of Directors. That is what requires an overhaul of the legislative framework and a need of transparency and a quality of the information.

Secondly, the SNCFT must have a clear strategy for the achievement of well-designed objectives under a program contract. The latter must materialize a mutual commitment to the achievement of the objectives. The monitoring of achievement, which depends on both external and internal control, needs an improvement by revising the system and improving the functioning of the Board of Directors.

Thirdly, the State shareholder fonction needs clarification to avoid entanglement of the roles of the State and the resulting ambiguity. This function should focus on highlighting the requirement of technical skills to allow proper monitoring.

On a pragmatic level, the interest of this article is twofold. For SNCFT, this research work made it possible to diagnose its difficulties by focusing on the interaction between its inefficiency and the failures of corporate governance mechanisms. Thus, reforms of the system of governance are recommendations allowing the improvement of its deteriorating situation for several decades. In addition to the interest for SNCFT, this research can also concern all other Tunisian public companies, which are as inefficient and face difficulties that may be even more important.

As an extension to this research, author consider the study of the impact of executive remuneration systems on the performance of the public company. The present work could therefore be extended by examining the problems relating to the executive remunération systems which are important in the financing decision and consequently in performance.

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“The economic mechanism for the formation of land rent at agricultural enterprises”

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Dmytro Shyian (Ukraine), **Anatolii Moskalenko** (Ukraine),
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THE ECONOMIC MECHANISM FOR THE FORMATION OF LAND RENT AT AGRICULTURAL ENTERPRISES

Abstract

The current stage of land relations in the agrarian sector is characterized by significant development of lease relations. Today, these relationships are heavily influenced by competition for land tenure, leading to increased land payments. Considering this, as well as the prospects for the agricultural land market formation, the task was to assess the dependence of agricultural land rent on the intensity and economic efficiency of wheat, corn for grain, sunflower production. The research was carried out on the example of agricultural enterprises of Kharkiv region. Grouping, a graphical method was chosen as research methods. The subject of the study was also the rent dynamics for agricultural land in Kharkiv region and Iowa, the USA.

The obtained results made it possible to establish the fact that the rent value depends on the total amount of expenses, and the expenses on the articles «wages», «depreciation». It is concluded that the reasons for this may be related to the investment of these enterprises in human capital and the fixed assets that make them lease on more favorable terms for share owners. No dependence was found between the rent value on the value of the yield and the financial result on the selected crops. At the same time, there is a clear tendency that with the increase in the value of the rent, there is an increase in the ratio of its value to the value of costs and income from the crop sector. It is concluded that this can lead to a decrease in investment opportunities for the enterprises with the highest level of lease payments for agricultural land.

Keywords land lease, land market, yield, profit, production intensity

JEL Classification O13, Q15, Q24

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ЕКОНОМІЧНИЙ МЕХАНІЗМ ФОРМУВАННЯ ОРЕНДНОЇ ПЛАТИ ЗА ЗЕМЛЮ В СІЛЬСЬКОГОСПОДАРСЬКИХ ПІДПРИЄМСТВАХ

Анотація

Сьогоднішній етап розвитку земельних відносин в аграрному секторі характеризується значним розвитком орендних відносин. Ці відносини сьогодні перебувають в значній мірі під суттєвим впливом конкуренції за право оренди землі, що призводить до зростання плати за землю. Виходячи з цього, а також з перспектив формування ринку сільськогосподарської землі було поставлено завдання здійснити оцінку залежності орендної плати за землю сільськогосподарського призначення від рівня інтенсивності та економічної ефективності виробництва пшениці, кукурудзи на зерно, соняшнику. Дослідження здійснювалось на прикладі сільськогосподарських підприємств Харківської області. В якості методів дослідження було обрана групування, графічний метод. Об'єктом дослідження виступала також динаміка орендної плати за землі сільськогосподарського призначення в Харківській області та штаті Айова США.

Отримані результати дали можливість встановити, що величина орендної плати знаходиться в залежності від загальної величини витрат, та витрат по статтям «оплата праці», «амортизація». Робиться висновок, що причини цього можуть бути пов'язані з інвестуванням даних підприємств в людський капітал та основні засоби, що змушують їх укладати договори оренди на більш сприятливих умовах для власників паїв. Не було встановлено залежності рівня орендної плати з величиною урожайності та фінансовим результатом по обраним культурам.

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В той же саме час має місце чітка тенденція, що з зростанням величини орендної плати відбувається зростання співвідношення її величини з величиною витрат та доходів від галузі рослинництва. Робиться висновок, що у підприємств з найбільшим рівнем плати за оренду землі сільгосппризначення це може призводити до зменшення їх інвестиційних можливостей.

Ключові слова оренда землі, ринок землі, урожайність, прибуток, інтенсивність виробництва

Класифікація JEL O13, Q15, Q24

INTRODUCTION

The present stage of rural economic development is largely characterized by leasing-related processes. First and foremost, it concerns the land. Land reform, which has been ongoing in Ukraine since the early 1990s, has actually created a new class of land share owners. In early 2018 there were an estimated 6.9 mln of them. Today, the country folk receive a large share of their income precisely in the form of rent for land shares. In addition, increasing competition for leaseholder forces producers to improve efficiency in order to be able to fulfill their obligations to employers. In addition, increasing competition for leaseholder forces manufacturers to increase production efficiency in order to be able to fulfill their obligations to employers.

However, now land leasing issues also have important scientific and practical aspects. In particular, the question of the rent value impact on the investment development of enterprises, the production structure, and the employment level in rural areas needs further investigation.

1. LITERATURE REVIEW

Today, the problem of leasing relations in agriculture is the focus of agrarian economic science in Ukraine. The works of Dobryak (2004), Zos-Kior (2015), Malik (1993), Martin (2011), Koshkalda (2011), Stupen (2018), Tretiak (2004, 2008), Fedorov (2011), Khodakivska (2016), Shary (2013), Shebanina (2011), Shpychak (2001, 2018) and others are devoted to this problem.

A wide range of issues concerning land tenure are discussed. In particular, this relates to the interdependence between the amount of rent and the factors that affect its value. Thus, Moskalenko (2013), having carried out research on the example of agricultural enterprises in Polissia region, has concluded that larger agricultural land owners, as a rule, pay higher rent due to higher yields of cereals and sunflower. Moreover, it has been established that these enterprises also have a smaller share of the livestock sector in the structure of marketable products. Savarina (2010) made it clear that a rent increase of up to 5% would lead to a profitability level of around 9.8%.

It is noted that in the developed countries, agricultural land rental markets are quite stable. According to Melnyk, Makarenko (2012), in the process of land turnover, the share of sales and purchase operations averages 1-3% of their area. In many countries, this may fluctuate. In the US and Ireland, it is 1.2%, the UK, France and Italy - 2.0%, Germany, Holland, Belgium - 1.5-2.5%, in Denmark - about 4% of the total value of the land fund. In addition, the vast majority of countries have significant restrictions on the size of land that can be owned by one person. According to the data provided by Loiko (2017), in Hungary and Lithuania, the maximum land area per person is 300 hectares, in Romania - 200 hectares, in Japan - 3 hectares, Denmark - 150 hectares. There are also restrictions on the area of agricultural land that can be rented by one person. In particular, in Hungary the maximum area of land that can be rented by one person is 2500 hectares, in Denmark - 150 hectares, in France - 200 hectares. Such market regulation for the sale and lease of agricultural land practically makes it impossible to generate speculative capital and minimizes the distance between owners and rural communities. Unfortunately, nowadays in Ukraine, the absence of such restrictions, in many cases is one of the factors that creates political problems and social tension around the problem of land market introduction. In addition, as noted by Yukhymenko, Zagursky (2010), a major drawback of modern lease relations from their point of view, is the prevailing short-term lease agreements, which do not create motivation to care for the land in their leaseholders, prevent its depletion on the basis of short-term monocultural agriculture.

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Kalyuzhny (2002) addressed this problem in 2002. He believed that the lease term should be at least five to seven years in order to ensure that the lease relations were combined with the processes of investment and greening of production. This problem actually occurred 8-10 years ago. However, according to Zhytomyr region, cited by Loiko (2019), already in 2018, 80.5% of leases were concluded for a period of 7 years or more, whereas in 2014 their share was equal to only 16.9%.

From the point of view of Berezivska (2013), land lease also has another advantage over its purchase - it makes it impossible to further subdivide the land and therefore maintain a sufficient level of production concentration. Andriichuk (2017) raises the issue of a relationship between the enterprise size and rent. From his point of view, the monopolization of land rent in agriculture is a real threat that requires state intervention. The author also believes that the methodological approach to determining the size of leased land should be based on the principle of granting the right to lease only as much land as the agricultural production association needs to provide raw materials for its own production capacity. However, in this case, the question is who should make such calculations and whether they will entail an increase in corruption in public authorities?

Foreign authors also pay considerable attention to issues related to agricultural land leases. Thus, Soule, Tegene, Wiebe (2000), analyzing data from 941 corn producers in the USA, conclude that leaseholders with longer leases are more responsible for environmental measures. An analysis of farm performance on the example of Poland was made by Latruffe, Balcombe, Davidova, and Zawalinska (2005). In this case, all enterprises were divided on the basis of their specialization in plant and animal production. The authors conclude that the scale effect has an impact on the enterprises' level of efficiency. In addition, livestock enterprises use the agricultural land more efficiently. In their opinion, this factor should be taken into account in the development of legislative acts regarding land lease and state support for agricultural enterprises.

It should be noted that in the long run, the effectiveness of agrarian policy, including the land reform in the state, will be determined by the level of social protection of the rural population and the development of rural territories. That is why the current stage of land reform, including land leasing issues, should be aimed at achieving the strategic goals of the state - sustainable development of rural areas, termination of their depopulation and improving the use of agricultural land.

2. AIMS

The purpose of the study is to analyze the dynamics and dependence of the rent level on the intensity and economic efficiency of major crops production in agricultural enterprises of Kharkiv region.

3. METHODS

The study was conducted based on 2018 statistics of agricultural enterprises in Kharkiv region, acting as leaseholders of agricultural land. There were 521 enterprises. When the boundaries of groups of enterprises were determined, they were checked for compliance with the law of normal distribution. To evaluate in detail the obtained results, use the graphical method of displaying the established dependencies with the determination of regression parameters, coefficients of determination. There was a grouping of enterprises according to the level of rent with the division into six groups. A large number of businesses have produced reliable results. To analyze the dynamics of rent change, Iowa State data for 1999–2018 and Kharkiv region for 2010–2018 were used.

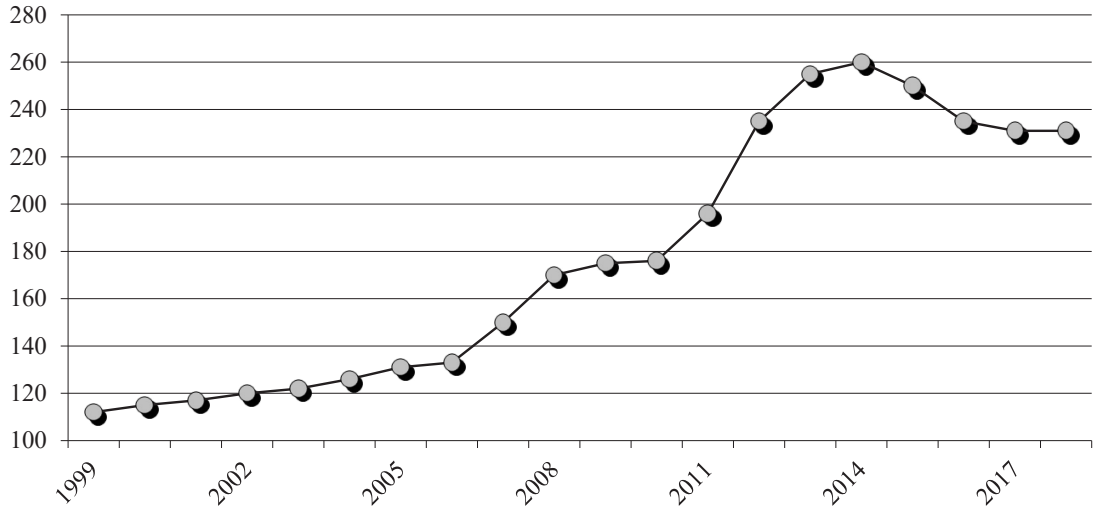
4. RESULTS

To start with, we look at the dynamics of changing the rent value in both Ukraine, and one of the US states, namely Iowa. The choice of this state is due to the fact that it is the leading agricultural state in the US in the production of pork, eggs and a number of farms per inhabitant. In addition, natural climatic conditions of this state are similar to the natural conditions of Kharkiv region. In particular, their latitude does not significantly differ.

Figure 1 shows the dynamics of rent changes per acre of agricultural land in Iowa for the period 1999–2018. During the period under review, the rent increased from $ 112 to $ 230 / acre, or 2.1 times. At the same time, since 2012 the price of land lease has stabilized. Moreover, compared to 2015, in 2018 it even decreased by $ 30 / acre. Thus, today there is a relative stabilization of agricultural land price in the United States.

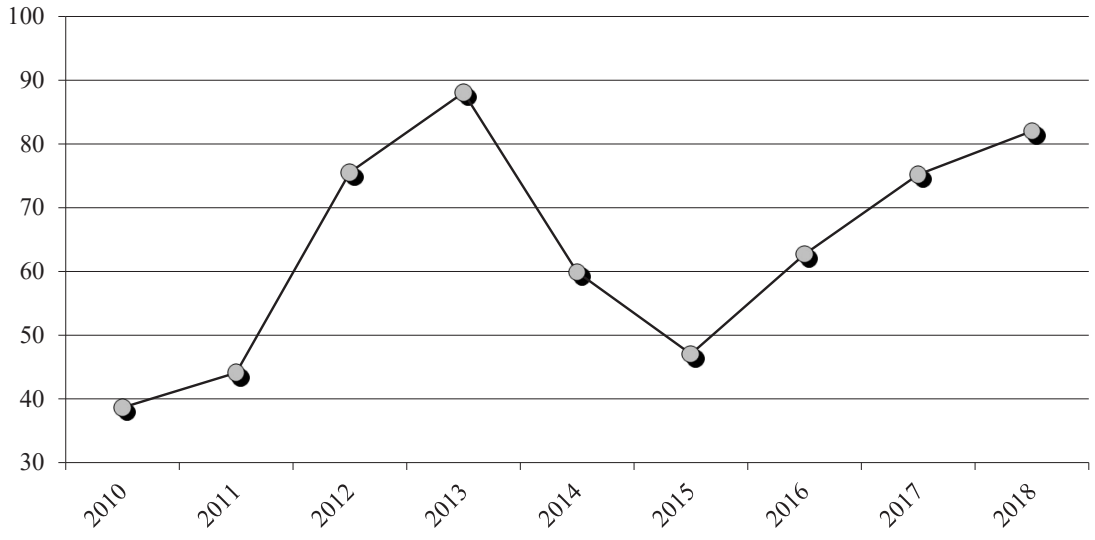
The dynamics of rent in agricultural enterprises in Kharkiv region has been analyzed. At the same time, in order to be able to compare the data with the State of Iowa, the amount of rent was translated into US dollars based on the average rate of UAH / USD for each year. The period covered 2010–2018. Unfortunately, it was not possible to obtain information for a longer period. Statistical reporting of agricultural enterprises was used to determine the rent.The data in Figure 2 make it possible to assess the nature of the rent change.

First of all, it should be noted that the rent is given per hectar of arable land, not per acre as in Iowa. Based on the fact that one hectare is approximately 2.47 acres, it can be concluded that the absolute value of rent in Iowa in different years was approximately 8-10 times greater than in Kharkiv region.



Source: Compiled by the authors based on the data (USDA, 2020; Statistics by Subject, 2020, pp. 26).

Figure 1. The dynamics of rent in Iowa in 1999–2018, USD / acre



Source: Compiled by the authors based on the data of the State statistics committee.

Figure 2. Dynamics of rent per a hectare of arable land in Kharkiv region in 2010–2018, USD / ha

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Absolute value of rent in Iowa in different years was approximately 8-10 times greater than in Kharkiv region. This indicates that the level of rents in Ukraine can potentially increase even more. Regarding the tendency of change in the land lease value, in this case there are two periods. The first one covers the years 2010–2015 and is characterized by a gradual increase in the rent until 2013 inclusive. In 2013, rents peaked at $ 88 / ha. However, the sharp fall in the hryvnia in 2014 also led to a fall in the US dollar rent. In 2015, it reached a minimum of $ 47 / ha. Since 2016, a new period has begun, characterized by an increase in the level of rent. It peaked in 2018 at $ 82 / ha.

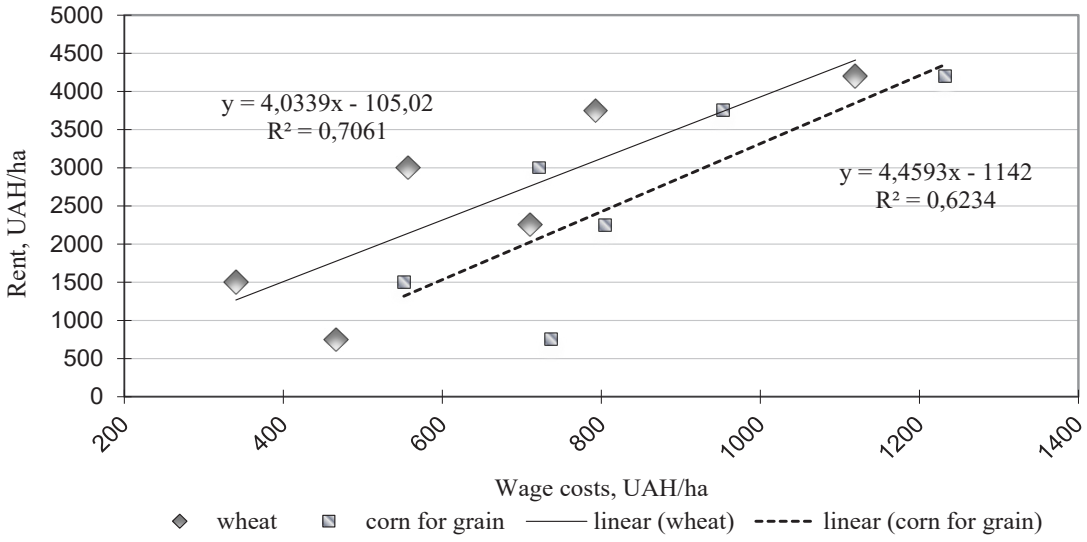
Thus, during 2016–2018 the main trend was the increase in the rent value. This is largely due to the expectations of business entities about the introduction of the agricultural land market. In addition, the competition level for land use rights between agricultural enterprises is increasing, which is also causing land prices to rise. On the whole, it can be stated that, based on the above data, the tendencies in the change of the lease price of agricultural land in Ukraine are multifaceted and largely related to the macroeconomic situation.

The next stage of the study was to analyze the dependence of the rent on the level of intensity and economic effi-ciency of individual crops production. The three most important crops were selected for Kharkiv region: wheat, corn for grain and sunflower. As of 2018, these three crops occupied 79.0% of arable agricultural enterprises area of the region. In total there were 521 enterprises. Table 1 shows the results of agricultural enterprises grouping by the level of rent per 1 ha of arable land.

Table 1. Impact of individual crops production costs on the value of rent per 1 ha of arable land in agricultural enterprises of Kharkiv region in 2018

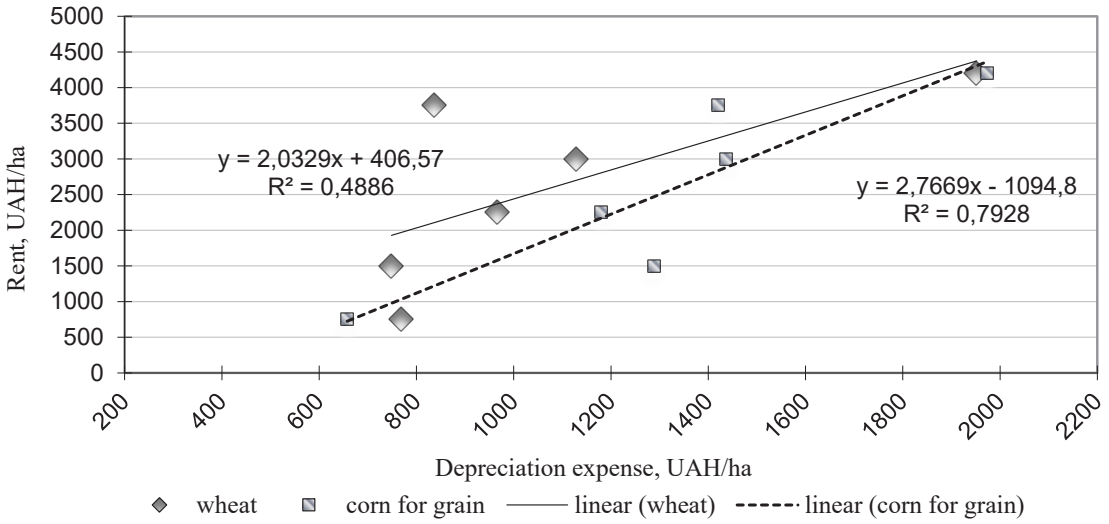
Source: Compiled by the authors according to the statistics of agricultural enterprises.

Costs per 1 ha of cultivated area, UAH	Groups of enterprises for rent, UAH / ha						
	Up to 750	750.1-1.500	1500.1-2.250	2250.1-3.000	3000.1-3.750	Over 3.750	In the regione
Wheat: total	9.862	11.049	12.333	12.841	13.540	15.371	12.491
Wages	467	340	710	557	793	1.120	626
for depreciation	769	749	966	1.128	837	1.952	995
Corn for grain: total	14.188	14.592	14.799	16.341	19.078	17.593	16.140
Wages	738	552	805	722	953	1.233	796
For depreciation	658	1.288	1.180	1.438	1.421	1.974	1.349
Sunflower: total	11.883	20.276	15.311	16.740	16.865	16.128	16.598
Wages	754	1.312	1.321	1.412	1.024	2.061	1.320
For depreciation	540	495	839	706	966	1.007	756



Source: Compiled by the authors according to the statistics of agricultural enterprises.

Figure 3. Relationship between the wage costs per 1 ha of wheat and corn for grain and rent for 1 ha of arable land in agricultural enterprises of Kharkiv region in 2018 (data grouped)



Source: Compiled by the authors according to the statistics of agricultural enterprises.

Figure 4. Dependence between the amount of depreciation per 1 ha of sown wheat and corn for grain and the amount of rent per 1 ha of arable land in agricultural enterprises of Kharkiv region in 2018 (data grouped)

First and foremost, the fact that across all three crops there is a relationship between the cost of 1 acreage and the rent per 1 ha of arable land, draws our attention. For enterprises with a large rent up to 750 UAH / ha, the average cost per 1 ha of acreage was equal to 9.862 UAH for wheat, 14.188 UAH for corn and 11.883 UAH for sunflower. In the group of enterprises with the value of rent 2,250.1-3.000 UAH / ha, the costs of these crops were already equal respectively: 12.841 UAH / ha, 16.341 UAH / ha and 16.740 UAH / ha. In the latter group with the highest level of rent the cost of wheat and corn for grain was slightly higher than in the above group, and it was lower for sunflower. At the same time, the relationship between rent and individual cost items has been much clearer. In this case, two items were selected: remuneration and depreciation. It is through these cost items that the highest level of wheat and corn relationship has been established (Figure 3 and 4). It should be noted separately that the level of correlation between rent and depreciation costs was average ($R^2 = 0.4886$). A similar situation was with sunflower.

According to the given culture in the group with the amount of rent up to 750 UAH / ha wages payment per 1 ha was equal to 754 UAH / ha, depreciation costs - 540 UAH / ha, in the group with the amount of rent 2,250.1 - 3.000 UAH / ha respectively 1.412 UAH / ha and 706 UAH / ha, in the group with the rent over UAH 3.750 / ha - UAH 2.061 / ha and UAH 1.007 / ha, respectively. What can such dependencies indicate?

First, the increase in the costs of the article «wages» indicates that the level of remuneration at the enterprises with higher rents is higher. Today, unfortunately, statistics does not allow us to estimate the level of labor costs per hectare or 1 quintal. At the same time, with a high degree of probability, it can be argued that the increase of expenses is not due to an increase in the amount of labor costs, but because of an increase in the level of wages. The proof of this is expenses on the article «depreciation». Its increase makes it possible to argue that enterprises with higher levels of arable land costs also have more modern machinery that requires skilled labor. The combination of these indicators explains the established pattern. However, the question remains: how it relates to the rent value. From our point of view, the increase in costs under these articles shows the desire of business owners to invest in both human capital, and fixed assets. This policy, in turn, also requires a stable lease relationship, forcing leaseholders to pay higher rents.

The next stage of the analysis was to investigate the relationship between the rent value and the production performance indicators of the three selected crops (Table 2). Analyzing the above data, we should, first of all, note the fact that for all three crops the yield remained relatively stable from group to group. Moreover, in the corn for grain in the first group, with the lowest rent, the yield was the highest. This result was unexpected for us, given that the level of costs per 1 ha tended to increase according to Table 1. Its interpretation may be due to the fact that

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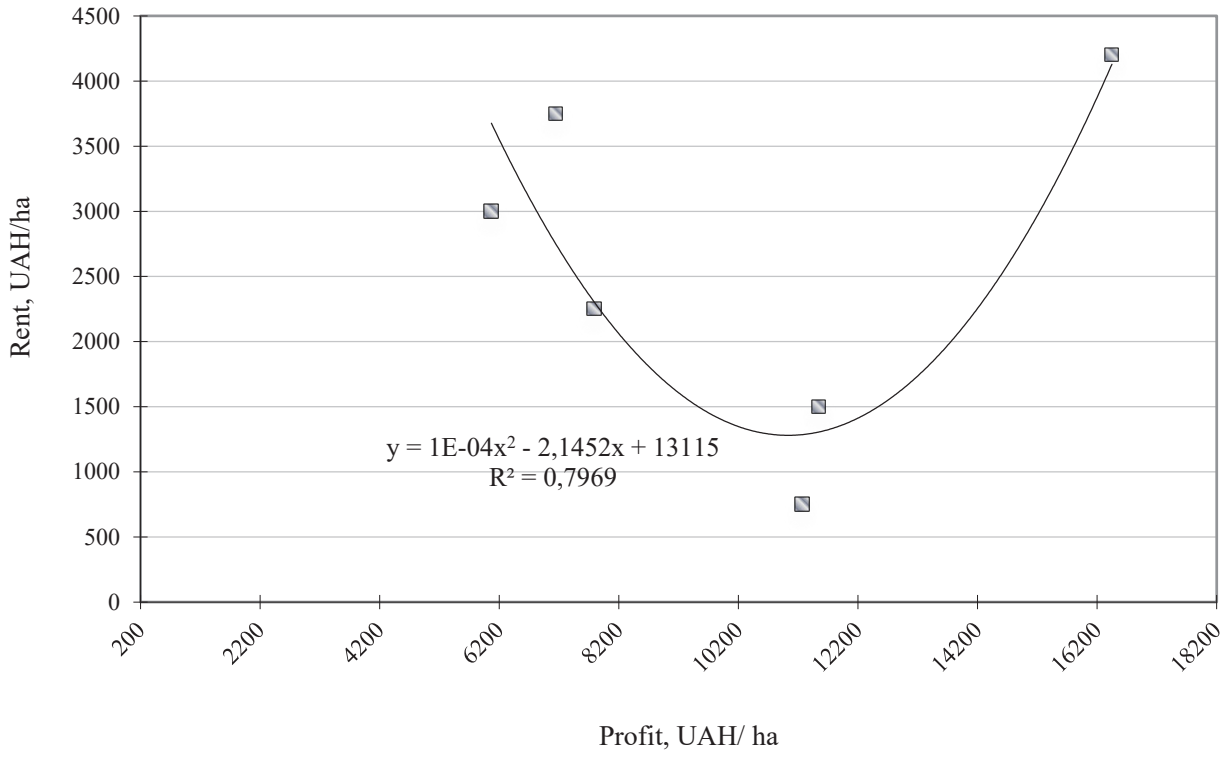
these costs were not sufficiently effective in the respective enterprises and did not allow to increase the yield level. At the same time, in terms of profit, the situation was different. The profit value for wheat did not change signifi-cantly in all groups except the latter, where it was higher than the regional average. For corn, the highest value of profits was at the enterprises of the first group with the smallest amount of rent. At the enterprises with the level of rent of 1.500,1-2.250 UAH / ha, it was the lowest. One of the possible reasons for this may be the increase in costs. The corresponding decrease in profits is due to the increase in rent. For sunflower and wheat, the largest value of profits was found at the enterprises of the last group (Figure 5).

Table 2. Influence of the production efficiency level of individual crops on the amount of rent per 1 ha of arable land at the agricultural enterprises of Kharkiv region in 2018

Source: Compiled by the authors according to the statistics of agricultural enterprises.

Index	Groups of enterprises for rent, UAH / ha						
	Up to 750	750.1-1.500	1.500,1-2.250	2.250,1-3.000	3.000,1-3.750	Over 3.750	In the region
Wheat:							
Yield, quintal / ha	34.7	33.2	33.8	34.5	35.8	35.6	34.3
Profit, UAH / ha	3.839	3.839	3.916	3.585	3.824	4.669	3.813
Corn for grain:							
Yield, quintal / ha	71.2	58.1	61.5	60.3	67.2	66.8	62.6
Profit, UAH / ha	10.575	6.571	4.152	4.462	6.409	7.358	5.707
Sunflower:							
Yield, quintal / ha	31.3	37.4	28.0	27.2	28.1	28.8	29.6
Profit, UAH / ha	11.269	11.545	7.792	6.069	7.143	16.447	8.369

For enterprises with lease rates from UAH 1.500 / ha to UAH 3.750 / ha, the profit margin was much smaller than in other groups. These groups comprise approximately 2/3 of all enterprises, that is, the bulk of them. The decline in sunflower yields may also be related to the increase in rents. These data indicate that the change in income has no clear relationship with the change in rent. Businesses are actually investing in land leases by reducing the financial result.



Source: Compiled by the authors according to the statistics of agricultural enterprises.

Figure 5. Relationship between profit value per 1 sowing area and rent for 1ha of arable land at the agricultural enterprises of Kharkiv region in 2018 (data grouped)

In order to verify this assumption, we have analyzed the dependence of the rent on the level of expenditures and income in the crop sector. In addition, the effect of the arable land as a factor in the size of the enterprise on the value of rent was also studied.

Table 3. Dependence of rent on expenses, income and size of enterprises in Kharkiv region in 2018

Source: Compiled by the authors according to the statistics of agricultural enterprises.

Index	Groups of enterprises for rent, UAH / ha						
	Up to 750	750.1-1.500	1.500,1-2.250	2.250,1-3.000	3.000,1-3.750	Over 3.750	In the region
Arable land, ha	1.716	1.490	1.892	2.205	2.396	1.161	1.887
Commodity crop production per 1 ha of arable land, UAH	17.654	19.122	14.334	15.353	16.970	15.336	15.938
The share of rental costs in the total value of the costs in the crop industry, %	4.3	11.0	24.0	30.8	40.5	50.6	26.7
The share of rental costs in commodity products of the crop sector, %	1.8	6.0	13.4	16.8	19.3	27.3	14.2
Share of crop production costs in the structure of expenditures on agricultural products, %	77.3	90.4	78.6	73.3	85.8	73.7	79.1

The first conclusion that can be drawn from the above data is the fact that the size of the business, which in this case is characterized by arable land, does not have a clear relationship with the rent. Moreover, in the latter group of enterprises with the highest level of rent the average arable land was much smaller. Thus, the view that larger companies are able to pay a larger amount of rent does not find confirmation according to the statistics of Kharkiv region. The value of crop products, in this case, in different groups of the studied enterprises remained relatively stable. Accordingly, the value of crop products sales cannot be a source for rent formation.

Two other relative indicators allow us to estimate the relationship between the rent and the level of income and crop production expenses per 1 ha of arable land. In this case, we have the following dependence: the increase in the lease value leads to an increase in its share in relation to both the costs of the crop, and commodity industries. Its share in relation to commodity products at the enterprises of the first group with the level of rent up to 750 UAH / ha was equal to 1.8%, and to the expenses - 4.3%, while at the enterprises with the value of rent 2.250,1-3.000 UAH / ha these indicators were already equal to 16.8% and 30.8%, respectively, and for enterprises with rents over UAH 3.750 / ha - 27.3% and 50.6%. In the latter group, virtually half of all costs are related to land rent. The obtained data, in turn, can explain the lack of correlation between the cost level and yield. The absence of rising costs for high-rent businesses is due to the fact that a significant amount of these costs are related to land rents and, therefore, cannot be a source of increased crop yields.

In order to check whether the livestock production acts as a source of additional rent formation, we evaluated the share of the crop industry expenses in the structure of expenses in the agricultural production. It has been found that there is no significant difference in this indicator, for example, between the group with the level of costs up to 750 UAH / ha and more than 3.750 UAH / ha. Thus, at the enterprises of the first group the magnitude of this indicator was 77.3%, at the enterprises of the second group –73.7%. Therefore, rent is a significant factor in influencing profit margins and spending levels at agricultural enterprises.

CONCLUSION

The research conducted on the example of agricultural enterprises in Kharkiv region has made it possible to establish correlation between the level of production intensity of wheat, corn for grain, sunflower and the level of rent. This dependence was particularly clearly stated in terms of labor costs and depreciation per 1 ha of the acreage of these crops. At the same time, there were no clear patterns between the level of production efficiency and rent. It has been suggested that the decrease in the profit level in individual groups in the production of sunflower and corn for grain may be due precisely to the increase in the level of rent. However, this hypothesis needs further

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validation. In addition, due to the lack of information, it was not possible to investigate the impact of the quality and location of agricultural land on the rent value.

A correlation has been found between the amount of rent and the total amount of expenses, revenues from the crop sector. In the group of enterprises with the highest level of rent there is a significant influence of its value on the formation of the general level of expenses. A considerable part of the income (27.3%) from the sale of crop production in this group of enterprises goes to the payment of land rent.

It can be summarized that the increase in the value of rent is largely determined by the market and the leaseholders' desire to obtain guarantees of land tenure in order to minimize the risk to future production activities. As a result, businesses paying significant rents, substantially limit investment opportunities. This can create strategic threats for them in terms of economic security.

AUTHOR CONTRIBUTIONS

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Formal analysis: Dmytro Shyian, Anatolii Moskalenko.
Funding acquisition: Dmytro Shyian, Anatolii Moskalenko.
Methodology: Dmytro Shyian, Anatolii Moskalenko.
Resources: Anatolii Moskalenko.
Software: Kseniia Kirichenko.
Visualization: Kseniia Kirichenko.
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Writing – review & editing: Anatolii Moskalenko, Kseniia Kirichenko.

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“The impact of real exchange rates on price competitiveness in Eastern European countries”

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Nadiia Proskurnina (Ukraine), **Jürgen Kähler** (Germany),
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THE IMPACT OF REAL EXCHANGE RATES ON PRICE COMPETITIVENESS IN EASTERN EUROPEAN COUNTRIES

Abstract

The subject of this paper is empirical research on studies of exchange rates in Eastern European countries, such as Albania, Bulgaria, Bosnia and Herzegovina, Belarus, Czech Republic, Estonia, Croatia, Hungary, Latvia, Lithuania, Moldova, (North) Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, and Slovenia, in order verify the validity of theories that explain these changes. This research aims to explain the mixed evidence of the Balassa-Samuelson effect in Ukraine, taking into account the intentions of Ukraine to become a member of the European Union. Unlike previous works, the attention is shifted to a review of empirical evidence and the identification of main factors that limit the ability to verify the theory. The main conclusion is that all the currencies studied underwent substantial real appreciations during the study period. Thus, it can be concluded that an adequate monetary policy in countries under study is very important, given that local exchange markets are not sustainable enough and the volatility of exchange operations is higher than in countries with developed economies. However, the Balassa-Samuelson Hypothesis (BSH) can explain the impact of the real exchange rate due to changes in productivity in countries in transition.

Keywords purchasing power parity, real exchange rate, the Balassa-Samuelson effect, real effective exchange rate, changes in productivity

JEL Classification B27, C33, C58, E5, F36, F4

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ВПЛИВ РЕАЛЬНИХ ОБМІННИХ КУРСІВ НА ЦІНОВУ КОНКУРЕНТОСПРОМОЖНІСТЬ КРАЇН СХІДНОЇ ЄВРОПИ

Анотація

Предметом даної статті є емпіричне дослідження щодо вивчення валютних курсів валют у країнах Східної Європи, таких як Албанія, Болгарія, Боснія та Герцеговина, Білорусь, Чехія, Естонія, Хорватія, Угорщина, Латвія, Литва, Молдова, (Північ) Македонія, Чорногорія, Польща, Румунія, Сербія, Словаччина, Словенія з метою перевірити обґрунтованість теорій, що пояснюють ці зміни. Це дослідження має на меті пояснити неоднозначні докази Баласса-Самуельсона також і в Україні, враховуючи стійке прагнення нашої країни стати членом Європейського Союзу. На відміну від існуючих досліджень, в статті увагу зосереджено на наявності емпіричних доказів та визначенні основних факторів, які підтверджують або обмежують можливість перевірки теорії. Основний висновок полягає в тому, що всі валюти країн, що досліджувались, були значною мірою переоцінені протягом періоду дослідження. Також, можна зробити висновок, що адекватна грошово-кредитна політика в країнах, що вивчаються, є дуже важливою, враховуючи, що місцеві валютні ринки недостатньо стійкі, а волатильність валютних операцій вище, ніж у країнах з розвиненою економікою. Однак, гіпотеза Баласа-Самуельсона підтвердила свою здатність пояснити вплив реального обмінного курсу за рахунок зміни продуктивності реальних секторах економіки під час перехідного періоду.

Ключові слова паритет купівельної спроможності (PPP), реальний обмінний курс, ефект Баласса-Самуельсона, реальний ефективний змінний курс, зміна продуктивності

Класифікація JEL B27, C33, C58, E5, F36, F4

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INTRODUCTION

One of the tasks for a new country is to have higher productivity growth than an average rate growth in EU, and the rate of inflation should achieve the level where the prices are stable. Also, it is important to support an optimal inflation rate. However, due to the fact that the majority of countries joining the European Union has undergone or are still in the process of transition, this task is difficult. The vital role plays an exchange rate, which links the real and nominal sides of the convergence according to Maastricht criteria.

To apply the exchange rate regime that is most suitable for the current economic situation, a theoretical background is needed. If the theory has been tested and proven, it can help a country to strengthen the economy, but also improve the trading relations.

The idea of changes in real exchange rate via the improvement in relative productivity between traded and non/traded sector of the economy has been offered by Balassa (1964) and Samuelson (1964). The hypothesis of researchers has found a lot of empirical evidences decades ago. However, the estimates were not supported by high-quality data and poor econometric tools. After half of the century the theory has developed and nowadays it can be applied not only for domestic but also for international comparison. The Balassa-Samuelson hypothesis has been used recently tested by the majority of European countries in transition due to the desire to fulfil Maastricht criteria of the European Monetary Union. EU membership imposes certain rules controlling the real exchange rate and inflation in the economy of a potential member. During the literature review on the empirical evidences of the Balassa-Samuelson Hypothesis in European countries, there are always specific factors that affect the evaluation.

Literature review. One of the most used empirical tools for analyzing the degree of misalignment of a real exchange rate (RER) is the Purchasing Power Parity (PPP). It has got brief attention after the 90s due to the availability of a wider range of datasets and new econometrical tools. Even if the theory still counted as poorly tested and it is not always confirmed by practical evidences, the PPP theory plays an important role for various international organizations, including the World Bank and European Union (European Union).

The theory was articulated by Cassel (1918). Originally it is based on the law of a single price which claims, that after conversion of currencies between two trading countries, their national prices on a common basket good will be equalized. The first studies applied a theory via testing such currencies as the pound sterling, the French franc, and the US dollar over a period of more than one hundred years. The enlargement of researches on the PPP, economists suggested that it is a useful tool which can be implemented in the long run for understanding the behaviour of currency exchange rates (Chinn, 2006). Based on this statement, it can be assumed that if various types of costs and benefits (such as transport and information) are symmetrical for two trading countries, then in the short-term concept of PPP will not hold. According to Cassel's (1918) theory, the deviations between exchange rates and PPP are counted as a minor issue. The applicability of the theory was presented in findings during the Gold Standard period, time intervals between wars, and through timelines of the validity of systems with fixed exchange rates. The theory did not have significant empirical results during the time of changing fixed currency rates to a floating regime.

After the cancellation of the Bretton Woods agreement, economists have got controversial results regarding PPP, which is called Power Purchasing Parity Puzzle (Rogoff, 1996). The PPP puzzle has two main arguments. The first one is the availability to hold PPP in a long period. The solution of this issue has been introduced in works of Taylor (2002) and Sarno (2002). They explained the presence of such an effect using non-linearities in exchange rates. However, the second part of the puzzle stated on stationary behaviour of half-lives of deviations from PPP (Froot and Rogoff, 1994; Giovannini, 1998; Halpern and Wyplosz, 2001; Isard, 1977). In empirical studies, the aggregation of time in data has been stated as a major cause of the bias. Indeed, one of the researches showed that half-life deviations can be minimized to two and a half years (Flood and Taylor, 1996).

The imperfection of the model was also mentioned due to the absence of many goods in a common good basket, which cannot be internationally traded due to limitations of trade barriers. Under these settings, the theory misses the link between the prices of a large group of goods and exchange rates (Rogoff, 1996).

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Furthermore, the majority of studies of the model's imperfection identified more reasons for the disproportion in PPP. An exchange rate movement (Isard, 1977), trade barriers (Parsley and Wie, 1996), pricing to the market (Dornbusch, 1987), transport costs and tariffs (Sarno and Chowdhury, 2001; Sarno and Taylor, 2002), monetary and currency shocks (Clarida and Gali, 1994) were taken as major factors that affect the disproportion between real exchange rates.

The question of currency shock effect has got a lot of attention, especially during the time of evaluation PPP theory separately for countries with high-, middle- and low- income. For more developed countries half-time was stated from 4 to 5 years. That means that such type of effects on RER will decrease by approximately 15% each year. This fact just strengthens the power of other factors on changes in exchange rates (O'Connell and Wie, 1997). On the other hand, it was argued that they can cause short-term effects, for example as a monetary policy (Dornbusch, 1987). The theories providing the background reasoning of deviations in the model were needed. One of the alternative theories which explain the nature of deviations in PPP is called the Balassa-Samuelson Hypothesis (BSH).

The theory was built in seminal papers of Balassa (1964) and Samuelson (1964). However, the hypothesis can be also called Harrod-Balassa-Samuelson, Ricardo- Harrod-Balassa-Samuelson-Penn, due to their scientific contribution to the theory independently from each other (Taylor, 2002). In this paper, terms such as the Balassa-Samuelson (BS) effect, hypothesis and model will be used.

In the first work of Balassa and Samuelson was found the positive correlation between price levels and GDP per capita. Such dependence explained the reason for an unjustifiable appreciation of currencies in high-income countries. Later it was argued that if unequal international levels of labor productivity will be higher in exported production of goods than in the production of non-exported goods, the national currency of the country with rapid growth will have relatively higher prices. As a result, the connection between the ratio of PPP and exchange rates is a growing income function (Balassa, 1964; Samuelson, 1964).

The model was not formulated in the early works of Balassa and Samuelson. The starting point was an assumption regarding the dependence of prices and productivity, which was proved by empirical results. The main idea of the original BS theory is that the relative change of productivity in sectors dependent on the tradability of goods will cause changes in the comparative prices.

Further, the theory has got a mathematical formulation. The BS model assumes that a country has two sectors of traded and non-traded goods. The function of capital and labor with different sectoral productivity accumulate an output. Labor in the model is counted mobile and fully used (Blaszkiewicz, Kowalski, Rawdanowicz and Wozniak, 2004).

The basic model assumes the free factors of production:

$$Y_T = A_T K_T L_T^{1-\alpha}, \qquad (1)$$

$$Y_N = A_N K_N L_N^{1-\beta}, \qquad (2)$$

where the total output (a sum of Y_T and Y_N) is a constant value to scale Cobb-Douglass function of three inputs A (productivity), K (capital) and L (labour) for two sectors of traded (T) and non-traded goods (N) (Blaszkiewicz, Kowalski, Rawdanowicz and Wozniak, 2004).

Under the assumption of perfect competition and capital mobility, the rental rate of capital (R) and the wage gives (W):

$$R = (1-\alpha_T)\cdot A_T \cdot \left(\frac{K_T}{L_T}\right)^{-\alpha_T} = P\cdot(1-\alpha_N)\cdot A_N \cdot \left(\frac{K_N}{L_N}\right)^{-\alpha_N}. \qquad (3)$$

$$W = (\alpha_T)\cdot A_T \cdot \left(\frac{K_T}{L_T}\right)^{1-\alpha_T} = P\cdot(\alpha_N)\cdot A_N \cdot \left(\frac{K_N}{L_N}\right)^{1-\alpha_N}. \qquad (4)$$

Log-differentiating of R and W will give a result:

$$\Delta P = (\frac{\alpha_T}{\alpha_N}) \cdot \Delta A_T - \Delta A_{N.} \qquad (5)$$

The model includes two missing points of PPP theory:

1. Changes in labor productivity and real incomes due to technological progress effects fluctuation between exchange rates.
2. The sector of non-tradable goods (including services) is a part of a deviation result in PPP theory.

Nevertheless, even due to the new view on the behaviour of real exchange rates, the model had its' imperfections. First of all, there was no explanation regarding the demand side of tradable and non-tradable goods. Asea and Mandoza (1994) and Gregorio, Giovannini and Wolf (1994) have incorporated the model including governmental expenditure as the factor of shifting demand between goods. From their findings, the demand can cause changes in relative prices.

The first time the relationship between relative exchange rates and productivity differentials was tested in a work of Hsieh (1982) on examples of Japan, Germany and their major trading partners. However, the BS model, which is used until nowadays was presented later in the 90s by Marston (1987). The author included the evaluation of the relationship between relative productivity, exchange rates and relative prices. He used a dataset from the Economic Cooperation and Development Organization and built a model of real yen to the USA dollar exchange rate for a 10-year period. In empirical evidences the long-term appreciation of the yen against the dollar was explained via the existence of productive differentials between tradable and non-tradable goods.

Contradicting the previous works regarding the estimation of the BSH in Central and Eastern Europe by Mihaljek and Klau (2004), Egert (2002a, 2002b, 2003, 2004, 2005) and Candelon and Kool (2007). It is necessary to emphasize that works of Mihaljek and Klau and also Egert have got different results.

Table 1. Review of Egert's studies on the Balassa-Samuelson Hypothesis in selected European countries

Author	Period	Countries	Existence of the BS effect
Egert (2002)	1991-2001	Czech Republic, Hungary, Poland, Slovenia, Slovakia	Appreciation was explained for half of the countries (especially in Poland with 3%)
Egert et.al. (2003)	1995-2000	Czech Republic, Hungary, Poland, Slovenia, Slovakia + Croatia, Estonia, Latvia, Lithuania	No effect
Egert (2005)	1991-2004	Bulgaria, Croatia, Romania, Russia, Turkey, Ukraine	The BS effect exists, but its' contribution does not play major role in RER changes

From Table 1 the existence of the BS effect can be doubtful for Central and Eastern European countries. However, the author in his latest work stated on the importance to take into consideration country-specific factors, which can affect the overall result of the estimation. For example, in the 2005's work the RER behaviour was tested on the existence of Dutch disease (Egert, 2005). Even if at the end the result was not the same as predicted.

The finding on study cases based on one country had also controversial results. For example, the study case of Romania (Table 2).

The findings during the domestic evaluation of the BS effect showed that the estimation result can vary dependently on the used type of model, the classic or extended one (Dumitru and Ionela, 2009).

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Table 2. Review of studies on the Balassa-Samuelson Hypothesis in Romania

Author	Period	Type of study	Existence of the BS effect
Halpern and Wyplosz (2001)	1991-1998	International	3% is an average annual appreciation explained by BSH
Arratibel et.al (2002)	1990-2001	International	No significant effect
Egert (2005)	1991-2004	International	The effect is poorly determined
Dumitru (2008)	1998-2006	Domestic	The effect can be estimated from 0.24% to 5.06%
Dumitru and Ionela (2009)	1998-2006	Domestic	The effect can be estimated from 0.6% to 2.46%
Dedu and Dumitrescu (2010)	2002-2006	Domestic	Low estimation results

The BSH can be applied for one economy, as well as for a comparison of RER between two or several countries.

Methods of research. An important econometric issue in testing for PPP is the fact that price levels and nominal exchange rates are typically non-stationary variables. To avoid spurious correlation, PPP is tested with cointegration analysis or in the form of relative PPP.

When a summary measure of price competitiveness vis-à-vis the main trading partners is required, a weighted average of real exchange rates, i.e. a real effective exchange rate ($REER_t$), is computed. This leads to several issues of index construction like the choice of weights, of prices or price indices and of countries, for an overview see Chinn (2006). As regards weights, the most popular method is to use double weights that take into account direct trade flows and also third-market effects. Because of data availability, the most popular choice of a price index is the consumer price index (CPI) but also indices of labor unit costs, whole-sale prices or GDP deflators are used. For consistency, the nominal exchange is converted to an index with the same base period and base-period value, typically 100, as the price indices. Alternatively, absolute prices can be applied instead of price indices.

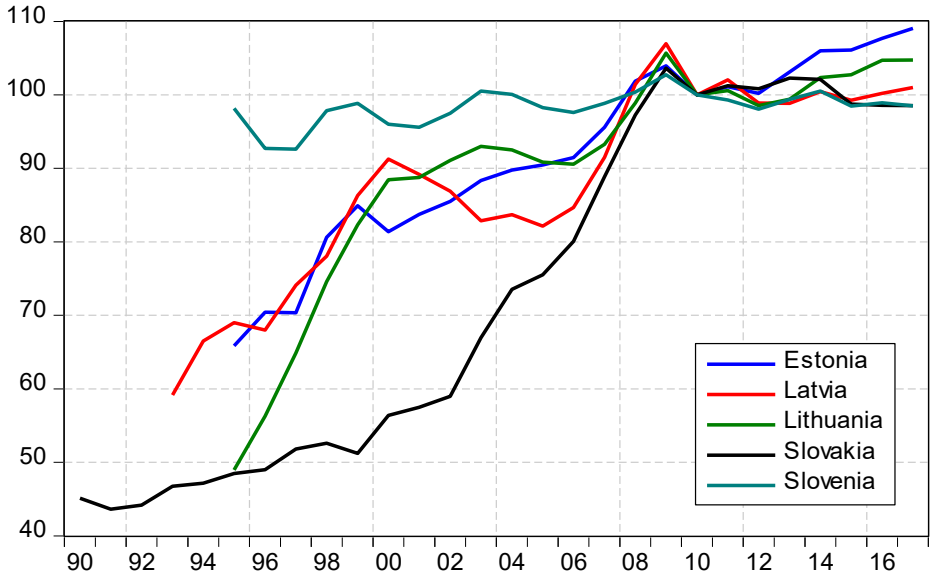
There are two important implications of using price indices instead of absolute prices. First, in testing for PPP with price indices, there is the implicit assumption that PPP holds in the base period. Secondly, the value of a real exchange rate at a time can only be interpreted as the cumulative relative change with respect to the base period. A value larger (smaller) than the base value cannot be interpreted as overvaluation (undervaluation). When the analysis is conducted with price indices, it would be more appropriate to refer to cumulative relative PPP instead of absolute PPP and the terminology absolute PPP should be reserved for studies where absolute prices are used. In the first case, the price index answers the question: How much more or less does the basket of goods and services cost at a time than in the base period? In the second case, the question is: How much does this basket cost in the currency of the country? Authors refer to the first real exchange rate as based on cumulative relative effects (Q_t^{CR} and $REER_t^{CR}$ for real effective exchange rates) and the second real exchange rates are based on price levels (Q_t^{PL} and $REER_t^{PL}$). The extent of cumulative appreciation or depreciation with respect to the base period is measured by Q_t^{CR} or $REER_t^{CR}$ whereas Q_t^{PL} and $REER_t^{PL}$ measures the extent of over- or undervaluation (Chinn, 2006).

The aim of this paper is to reveal the impact of the real exchange rates politics on price competitiveness in east European countries analyzing trends in relative productivity changes of traded vis-à-vis non-traded sector.

1. RESULTS

Since the geographical notion of East Europe is not uniquely defined, it is acceptable to define the sample countries as those European countries on the territory of the former COMECON, including the associate member Yugoslavia, but without Russia. This includes the following 19 countries: Albania, Bulgaria, Bosnia & Herzegovina, Belarus, Czech Republic, Estonia, Croatia, Hungary, Latvia, Lithuania, Moldova, (North) Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine. The $REER_t^{CR}$ shown in Figures 1-3 are based on CPI. Data sources are IMF and Eurostat.

Figure 1 shows the time series of $REER_t^{CR}$ for Eastern European EU-members that introduced the euro. The first country to do so was Slovenia in 2007, followed by Slovakia in 2009, Estonia in 2011, Latvia in 2014 and Lithuania in 2015. It is apparent that, except Slovenia (turquoise line), all countries underwent substantial real appreciations of their currencies in the period of transition, as predicted by the Balassa-Samuelson effect. The appreciation was

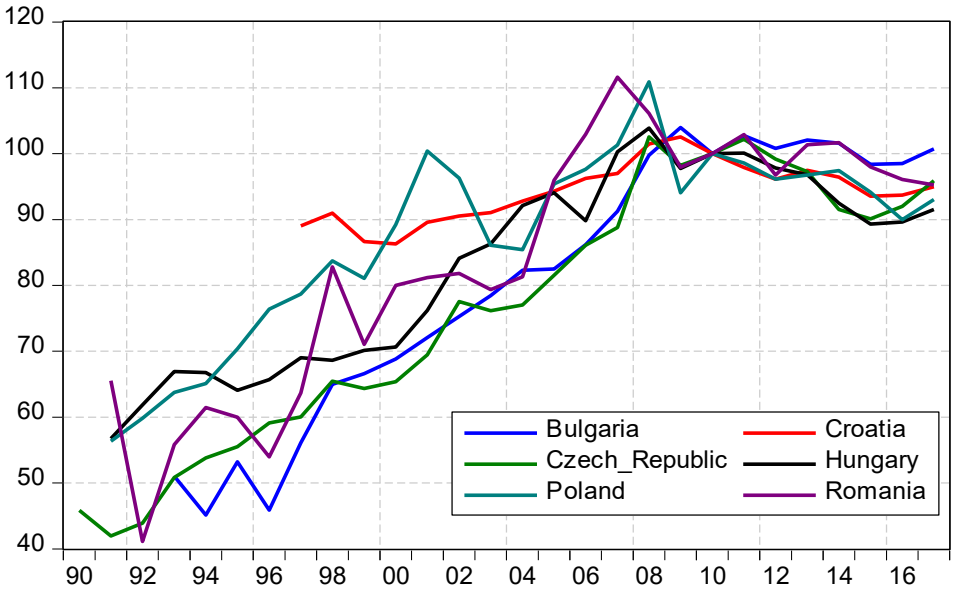


Source: CEPII. Research and expertise on the world economy (n.d.).

Figure 1. $REER_t^{CR}$ for countries that introduced the euro

especially strong for Slovakia (black line) and Lithuania (green line). The most remarkable fact is that for these five countries, the real appreciation came more or less to an end by 2009 or 2010, just after the International Financial Crisis and the Great Recession although Estonia (blue line) has seen a continuation of appreciation in recent years.

The time series of $REER_t^{CR}$ for the six Eastern European EU-members that have not introduced the euro yet in Figure 2 are not much different from the paths that the euro-countries show in Figure 1. Again by 2009 or 2010, the convergence in terms of $REER_t^{CR}$ was to a large extent complete. Bulgaria (blue line), the Czech Republic (green line) and Romania (purple line) are the countries that witnessed the largest appreciations of their currencies. The country with the smallest volatility in its $REER_t^{CR}$ is Croatia (red line). Some countries experienced real depreciation after 2010, especially Hungary (black line).



Source: CEPII. Research and expertise on the world economy (n.d.).

Figure 2. $REER_t^{CR}$ for EU countries with non-euro currencies

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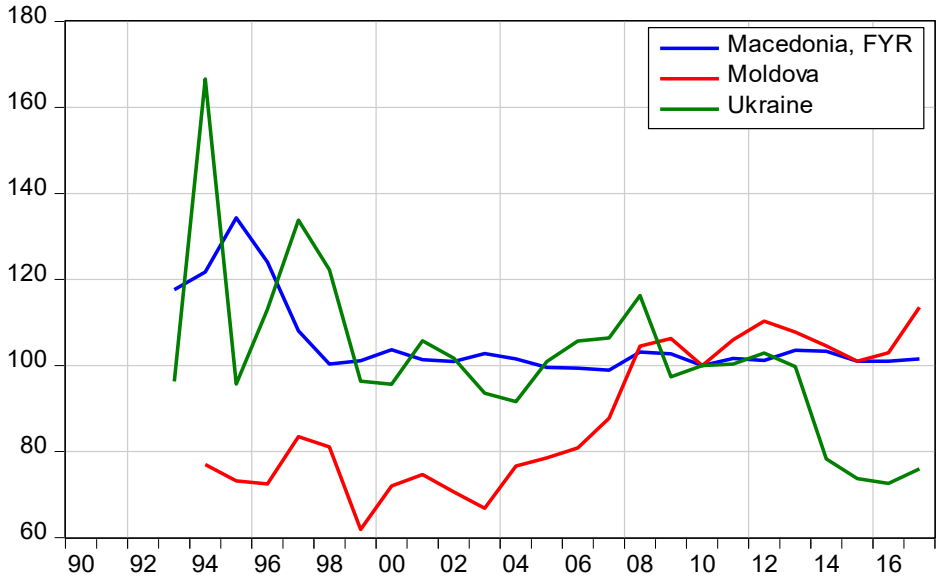
Figure 3 shows for three non-EU countries the development of their. The contrast to the other two groups of countries is quite remarkable, especially for Macedonia (blue line) and Ukraine (green line). Both countries experienced in the transition period a real depreciation of their currencies instead of a real appreciation. There was very high volatility of Ukraine's $REER_t^{CR}$ in the mid-1990s that might be related to the hyperinflation period of the karbovanets. The further real depreciation of the hryvnia after 2013 is certainly linked to political and military events in Ukraine.

Like the tongue-in-cheek Big-Mac Standard, the Q_t^{PL} can answer the question of whether a currency is undervalued or valued. As explained above, absolute PPP holds when $Q_t^{PL} = 1.0$. Alan Heston, Irving Kravis and Robert Summers from the University of Pennsylvania conducted an international project to collect and compare individual price around the globe and published the results in the Penn World Tables (PWT). When aggregated to a country's price level of a basket of goods and services, this can be used to create a real exchange rate Q_t^{PL}.

Meanwhile compiled at the University of California, Davis and the University of Groningen, the PWT report different price levels for different baskets of goods and services. Here the current prices of output-side GDP had been used. The USA is the reference country, for an overview of the PWT see Feenstra et al. (2015). Other than in a Q_t^{CR}, in a Q_t^{PL} prices are not summarized in a price index that is referenced to a base period but is expressed as the local currency cost of a basket of goods and services.

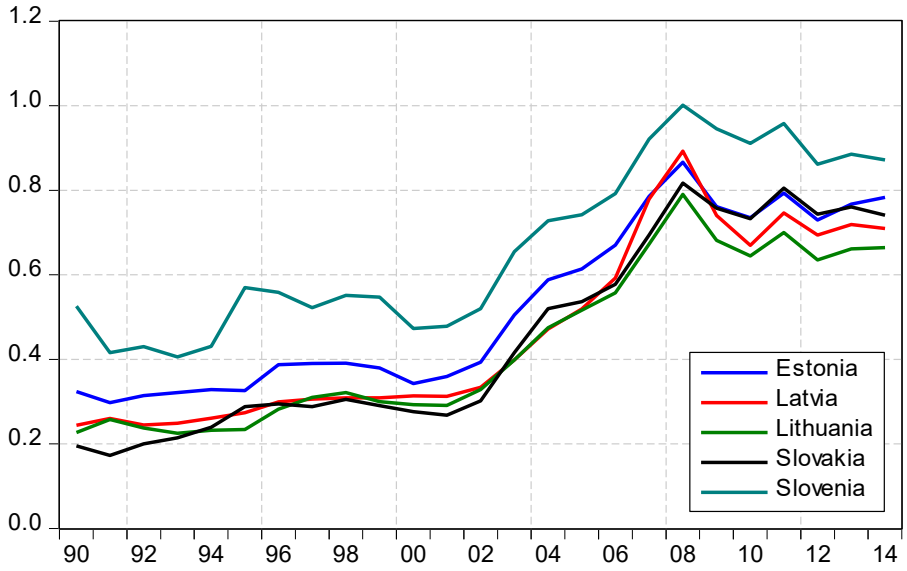
Figure 4 shows for the set of five East European countries that have introduced the euro, the real exchange rates Q_t^{PL} against the US dollar. Although there are substantial methodical differences between the $REER_t^{CR}$ in Figure 1 and the Q_t^{PL}, the paths of the real exchange rates are quite similar. All countries experienced strong real appreciations against the dollar until 2008 which was followed by more or less continuous real depreciations. Slovenia is the only country that reached parity with the price level of the USA in 2008, one year after the introduction of the euro. Figure 4 shows that the Baltic countries and Slovakia still enjoy quite substantial price advantages vis-à-vis the USA as a benchmark.

Figure 5 displays Q_t^{PL} for the same set of countries like in Figure 2 and both graphs show remarkably similar patterns. There were strong real appreciations of local currencies against the US dollar until 2008 and followed by a tendency of real depreciations thereafter. The most important additional information that can be derived from Figure 5 is that all countries have not exhausted their price advantage against the USA yet. This is especially true



Source: CEPII. Research and expertise on the world economy (n.d.).

Figure 3. $REER_t^{CR}$ for non-EU countries



Source: CEPII. Research and expertise on the world economy (n.d.).

Figure 4. Q_t^{PL} for countries that introduced the euro

for Bulgaria (blue line). In 1990 Bulgaria's price level was a fifth of the US price level. After a period of strong real appreciation of the lev that continued until 2008, Bulgaria's price level has maintained a rather stationary ratio of between 0.4 and 0.5 to the US price level, i.e. the price advantage of Bulgaria vis-à-vis the USA is still large.

The puzzling result of Figure 3 was that Macedonia and Ukraine did not show any prolonged periods of real appreciation according to their $REER_t^{CR}$. The story is completely different in Figure 6 which displays the Q_t^{PL} series instead. The Ukrainian price level increased from 15.4% of the US price level in 2000 to 41.4 percent in 2008 and the Macedonian price level rose from 22.7% of the benchmark in 2001 to 45.0% in 2008. Most importantly, all the countries maintained a very substantial price advantage against the benchmark throughout the sample period. In 2014 their price levels were still less half the price level of the USA. The strong real depreciation of the hryvna against the dollar in 2014 reduced the Ukrainian price level to less than a third of the US price level.

It is also acceptable testing for the Penn effect using the Q_t^{PL} series, i.e. that the value of the real exchange rate is an increasing function of the level of development as measured by GDP per capita. In terms of the Big Mac standard, the Penn effect implies that, when expressed in the same currency, Big Macs are cheaper in developing countries than in highly developed countries. The models had been drawn on the most recent PWT 9.0 that includes data for 182 countries starting in 1950. For most East European countries, the data start in 1990 and for some (Albania, Bulgaria, Hungary Poland and Romania) a few decades earlier. Based on this panel dataset the hypothesis that in the simple linear regression model had been tested:

$$Q_{it}^{PL} = \beta_1 + \beta_2 \frac{GDP_{it}}{Population_{it}} + \varepsilon_{it}, \qquad (6)$$

the slope coefficient β_2 is zero. In some variants of the model, fixed effects (FE) or random effects RE) are added to the right-hand side of (6).

Table 3 reports in the upper panel the results for the whole sample of 182 countries with a maximum number of 9.439 observations (year-countries) from the database CEPII. For all three model variants, the slope coefficient is positive. Although the adjusted R^2 is rather small, the slope coefficient is highly significant. All *t*-values are extremely large. The Schwarz Information Criterion (SIC) seems to suggest that the pooled model should be preferred to the FE model but direct testing of the FE model against both the pooled model (with an F test) and the RE model (with the Hausman test), shows that indeed the FE model is the best model.

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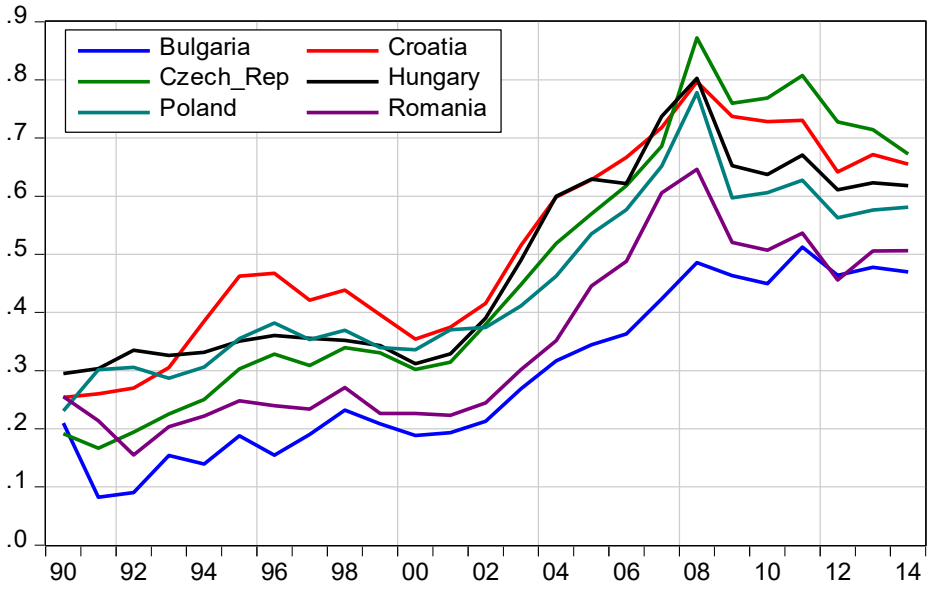
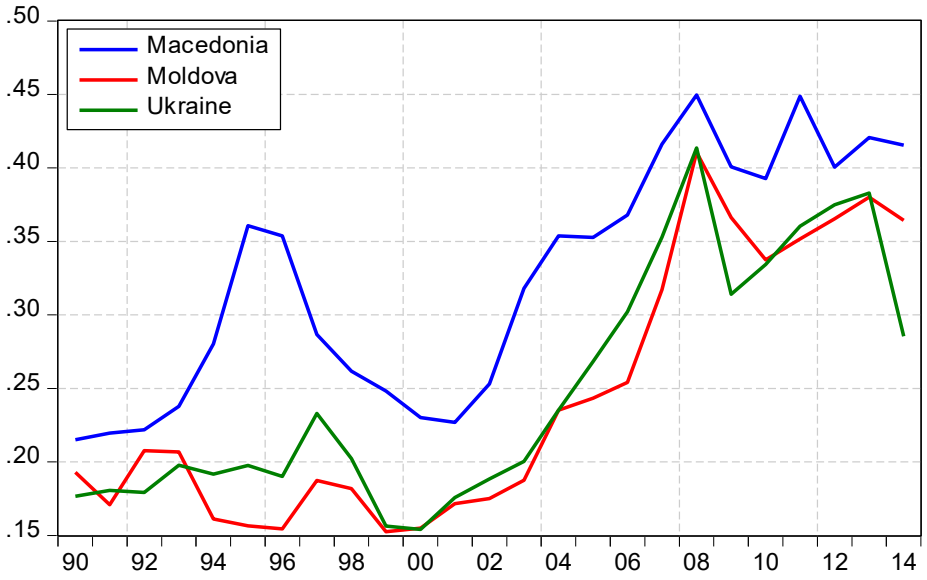


Source: CEPII. Research and expertise on the world economy (n.d.).

Figure 5. Q_t^{PL} for EU countries with non-euro currencies



Source: CEPII. Research and expertise on the world economy (n.d.).

Figure 6. Q_t^{PL} for non-EU countries

Table 3. Testing for the Balassa-Samuelson Effect

Modell	$\hat{\beta}_2$	$t(\hat{\beta}_2)$	$\overline{R}^2$	SIC	N
All countries					
Pooled	$6.79 \cdot 10^{-6}$	13.34	0.018	2.427	9.439
FE	$1.05 \cdot 10^{-5}$	11.43	0.096	2.500	9.439
RE	$8.66 \cdot 10^{-6}$	11.52	0.013	–	9.439
East European Countries					
Pooled	$1.89 \cdot 10^{-5}$	12.99	0.261	-0.364	475
FE	$2.82 \cdot 10^{-5}$	13.55	0.457	-0.473	475
RE	$2.58 \cdot 10^{-5}$	13.57	0.276	–	475

If the sample is restricted to the 19 East European countries listened above and the period starting in 1990, the sample size reduces to 475. The slope coefficient is highly significant positive and more than doubles compared to the full sample. In other words, the Penn effect is still intact: the poorer a country, the lower is its price level. The Penn effect can explain more than a quarter of the variability of the real exchange rate in this sub-sample.

CONCLUSION

To briefly summarize our main results it is very important to admit that the results of current research had underlined that such assumptions as low productivity growth in the non-tradable sector, the law of one price in traded goods, labor mobility, convergence between bordering countries may provide conflicting evidence while estimating the Balassa-Samuelson effect. Identifying a Balassa-Samuelson effect relying on proxies of productivity in the tradable and the non-tradable sectors may thus crucially depend on the choice of a particular monetary policy for the particular country while its currency's exchange rate may fluctuate. This can be the reason why in most East European countries the systematic real appreciation of their currencies came to an end when the International Financial Crisis erupted or shorter after. Secondly, REERs should be supplemented by real exchange rates based on absolute price levels to gauge the level of price competitiveness in addition to its trajectory over time. Thirdly, the Penn effect which states that overvaluation is a positive function of the level of development is still intact and also valid for the sub-sample of East European countries. Unlike previous studies for other European countries, Ukraine is in a lack of the theoretical and empirical testing of the Balassa-Samuelson effect and current research can become a starting point for further studying.

AUTHORS CONTRIBUTIONS

Conceptualization: Jürgen Kähler.
Data curation: Rosario Cervantes.
Formal Analysis: Jürgen Kähler.
Investigation: Nadiia Proskurnina.
Methodology: Jürgen Kähler.
Project administration: Jürgen Kähler.
Resources: Nadiia Proskurnina, Rosario Cervantes.
Software: Rosario Cervantes.
Supervision: Nadiia Proskurnina.
Validation: Rosario Cervantes.
Visualization: Jürgen Kähler.
Writing – original draft: Jürgen Kähler.
Writing – review & editing: Nadiia Proskurnina.

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