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DOI: 10.15290/oes.2026.01.123.10

SAVINGS, INVESTMENT, CAPITAL TO LABOUR RATIO AND LABOUR PRODUCTIVITY IN THE EUROPEAN UNION OVER THE PERIOD 2000–2022[1]

Summary

Purpose | This article examines the relationship between savings and labour productivity at a level of generality appropriate to macroeconomic analysis. The aim is to validate the logical connection between these two categories.

Research method | The study begins with an analytical approach, using theoretical models to demonstrate how savings are transformed into investment, investment into physical capital, and then – by increasing the capital-labour ratio – into labour productivity growth. These relationships are then verified empirically through correlation and cointegration analysis.

Results | The findings confirm the validity of the analytical reasoning. They indicate a logical link between savings and labour productivity at the macroeconomic level, although this link tends to weaken as GDP per capita increases.

Originality/value/implications/recommendations | This analysis is diagnostic and cognitive in nature, offering high-level insights into the issue of labour productivity at the national level.

Keywords: labour productivity, savings, investment, capital to labour ratio

JEL classification: E20, E21, E22

[1] Article accepted on 2.10.2025.

1. Introduction

From the macroeconomic perspective, savings are the main source of financing for investment. This assumption is considered self-evident and requires no further justification, as it constitutes a fundamental principle of economic theory. Likewise, it can be assumed that investment leads to an increase in physical capital, after accounting for depreciation and replacement investment. Given a constant labour supply, this increase in capital leads to changes in production techniques, which become more capital-intensive and, consequently, more productive. As a result, at this level of generality, labour productivity – measured as output per unit of labour – rises.

The aim of this article is to present those relationships using the analytical approach and to provide empirical evidence of their validity at the macroeconomic level for the European Union as aggregate, as well as for the selected countries. From the cognitive perspective, the objective is to illustrate the logic of these macroeconomic relationships, while acknowledging that they may evolve as the level of economic development increases. Our analysis deliberately avoids extending conclusions beyond what is explicitly stated in the theoretical framework and empirical-graphical analysis. We streamline the reasoning by omitting extraneous details, maintaining a high level of generality to highlight the core issue: the relationship between savings and labour productivity.

The article is structured as follows: the introduction is followed by an analytical overview of the transmission mechanism through which savings influence labour productivity. The next section presents a review of the relevant literature. The final part offers an empirical verification of the relationships outlined earlier. The article concludes with a summary.

2. Theoretical framework

The research problem is focused on the mechanism through which savings are transmitted to labour productivity at the macroeconomic level. Given a certain degree of generality, this mechanism can be synthesised and analytically stated as follows:

$$S_{t-n} \Rightarrow I_t \Rightarrow K_{t+1} \Rightarrow \frac{K}{L} \Rightarrow \frac{Y}{L} \quad (1)$$

where:
S – gross savings,
I – gross investment,
K – physical capital,
L – labour supply,
K/L – capital to labour ratio,
Y/L – labour productivity,
all variables in real terms.

This transmission mechanism can be examined within both long-term models, namely economic growth models [Solow, 1956; Romer, 1986], and short-term frameworks, as reflected in the approaches of Keynes [1936] and Kalecki [1986]. In the neoclassical economic growth framework, the relationship between savings, investment, capital accumulation, and productivity is central to determining the long-term trajectory of output per worker. In a closed economy, savings directly translate into investment expenditures. Investment, in turn, drives the accumulation of physical capital, which – together with labour and technological progress – shapes the productive capacity of the economy.

The Solow model [1956] formalises this relationship [see Tokarski, 2011], indicating that while capital accumulation can temporarily accelerate growth, long-term economic growth rate depends solely on the rate of technological change. Consequently, the influence of savings on growth rate diminishes as an economy approaches its long-run equilibrium (steady state). The Solow framework also provides the basis for further modifications that extend the analysis of how savings affect productivity and, in turn, economic growth. A comprehensive review of these extensions is offered in Dykas, Tokarski and Wisła [2023], including, for example, bipolar growth models in which investment can be financed through both domestic and foreign savings or models introducing fluctuations on the investment side, with an investment rate changing along a sine wave in time.

While this outlines the general background, our study concentrates on the short-term perspective. Accordingly, and with reference to the theoretical models presented below, we examine the following variable pairs: savings and investment; investment and capital; capital and the capital-to-labour ratio; and the capital-to-labour ratio and labour productivity.

2.1. Savings and investment

According to Keynes [1936], savings represent the portion of national income not allocated to consumption. In his view, the level of savings is determined by the volume of investment. The investment process triggers multiplier effects and leads to income growth. Since $S = Y - C$ (where Y is gross product and C is consumption), an increase in income not accompanied by a proportional rise in consumption results in higher savings. The level of saving is, therefore, determined by investment, which in Keynes' model is autonomous.

In contrast, Kalecki [1986] argues that gross savings, representing internal capital accumulation within firms, influence investment decisions. Actual investment lags behind investment decisions – this is mainly due to the fact that the investment process takes time. Adopting Kalecki's reasoning at the macroeconomic level, we can, therefore, conclude that the following relationship exists between gross private savings and investment (lag of 1 period assumed):

$$I_t = f\left(S_{t-1}\right), \tag{2}$$

where:
I_t – gross investments at time,
t – gross private savings at time *t-1.*

2.2. Investment and physical capital

As per Jorgenson's model of investment [Jorgenson, 1963], gross investment is a function of the optimal level of capital stock. Gross investment includes investment for replacement, which serves to offset capital depreciation. If we accept the neoclassical assumption that a firm's objective is to maximise profit and that this profit is allocated to the capital, we can assume that the optimal

level of output is that of year t+1 and the optimal level of capital stock is equal to the capital stock of period t+1. Therefore, at the macroeconomic level:

$$K_{opt} = K_{t+1} = K_t + I_t - \delta K_t \tag{3}$$

where:
K_{opt} – optimal level of capital stock,
K_t+1, K_t – capital stock at time *t+1*,
t, I_t, – gross investment at time *t*,
δ – capital depreciation rate.

2.3. Capital accumulation; capital to labour ratio and labour productivity

Continuing with Jorgenson's approach [Jorgenson, 1963], it can be assumed that the optimal level of capital stock is a function of both expected output and the cost of using factors of production:

$$K_{opt} = (\frac{w}{q})^{1-\alpha} (\frac{\alpha}{1-\alpha})^{1-\alpha} Y^e \tag{4}$$

where:
w – labour unit price,
q – capital unit price,
α – parameter representing the share of capital in the total output,
Y^e – the expected output.

As, according to the previous assumption, $K_{opt} = K_t$+1 and $Y^e = Y_t$+1 , the following relationship is obtained:

$$K_{t+1} = (\frac{w}{q})^{1-\alpha} (\frac{\alpha}{1-\alpha})^{1-\alpha} Y_{t+1} \tag{5}$$

which means:

$$K_t = (\frac{w}{q})^{1-\alpha} (\frac{\alpha}{1-\alpha})^{1-\alpha} Y_t \tag{6}$$

If we assume that the relationship between the prices of factors of production remains constant, we can deduce the following:

$$Kt = aY_t \tag{7}$$

where:
a – parameter, $a > 0$.

Dividing bilaterally by labour supply, the relationship between the capital to labour ratio and labour productivity can be determined as follows:

$$\frac{K_t}{L_t} = a \cdot \frac{Y_t}{L_t} \tag{8}$$

This relationship can be further substantiated by reference to neoclassical theories of economic growth. On the basis of the Solow model [1956], the aggregate production function may be expressed as follows:

$$Y = F\left(K, L\right) = (K)^{\alpha}(AL)^{1-\alpha} \tag{9}$$

where:
A – technological progress,
L – labour supply,
K – physical capital,
α – parameter representing the share of capital in total output.

In per capita terms:

$$\frac{Y}{L} = (\frac{K}{L})^{\alpha} A^{1-\alpha} \tag{10}$$

If we make the simplifying assumption of full employment of the labour factor, the output per unit will, at the same time, serve as a measure of labour productivity. So, as per formula (10), labour productivity will be a function of technological progress (defined exogenously) and the capital to labour ratio.

In summary, the mechanism outlined in (1) provides a structured approach to understanding how savings influence labour productivity at the macroeconom-

ic level. By examining the relationships between savings, investment, capital accumulation, and productivity, this framework allows for both theoretical and empirical investigation of the channels through which macroeconomic savings can affect output per worker.

3. Literature review

While the previous section discussed theoretical perspectives on the mechanism through which savings affect labour productivity, this section reviews the empirical literature. A comparable analytical approach to the one developed in this paper has been applied by Pawłowska [2017] and Pawłowska and Rembisz [2018, 2020], although their focus is on the agricultural sector, whereas our aim is to draw conclusions at a more general level.

Beginning with the link between savings and labour productivity (and thus economic growth), Aghion, Comin, and Howitt [2006] provide empirical evidence for this relationship by examining the impact of domestic savings on productivity and growth. Their findings confirm the existence of this link, but mainly for countries distant from the global technological frontier. In advanced economies, investment is more often financed through foreign savings, resulting in a weaker correlation between domestic savings and productivity growth.

It is important to note that the relationship between savings and economic growth is not necessarily unidirectional and that there may be reverse causality between the variables [Carrol, Weil, 1994]. Mohan [2006] concludes that the relationship from growth to savings was observed more often than from savings to growth. Conversely, Misztal [2011] found the opposite – the results of his study indicate a one-way causal relationship from savings to product in both developed, developing and transition countries. However, he found no causality from product to savings in either group of countries. Didelija [2021], on the other hand, using Bosnia and Herzegovina as an example, does not find a one-way relationship between savings and growth, but – as she notes – the examined variables show cointegration, i.e. they have the same stochastic trend. Overall, the empirical evidence on this issue is mixed and the direction

of the link between saving and economic growth (and hence productivity) is not clear. However, for the purposes of our analysis, we will not focus on causality, but rather on demonstrating the coexistence of certain phenomena. Therefore, acknowledging the complexity and non-obviousness of the relationship, the question of its direction is beyond the scope of our analysis.

As the aim of our paper is to focus on the mechanism on how savings are translated into labour productivity, it is important to see the link between the particular elements specified in our analytical approach. Starting from the relationship between savings and investment, the contributions of Feldstein and Horioka [1980] have proved to be influential in this context. They assumed that, given perfect mobility of financial capital, the relationship between the domestic savings rate and the investment rate would be high for closed economies and low for open economies. Since the relationship between these variables turned out to be high (21 OECD countries were studied between 1960 and 1974), they concluded that the mobility of this capital was low. Although the conclusion itself was considered controversial (the empirics point to a progressive liberalisation of capital flows), the relationship between savings and investment has been confirmed. Further verification of that relationship can be found in the work of Dritsaki [2015] – using Greece as an example, Onafowara, Owoye and Huart [2011] for selected European Union countries, and David, Goncalves and Werner [2023], who consider this issue separately for developing and developed countries.

Investments build physical capital and – as shown in the previous section – the level of physical capital can be linked to the level of labour productivity. The transmission mechanism here is as follows: investment in physical capital typically involves innovation and *ceteris paribus*, increase in capital per worker raises output per worker (improves productivity). Increases in productivity and output may in turn stimulate further capital investment. Empirical studies confirm the existence of such a relationship [Funk and Strauss, 2000; Studziene and Saboniere, 2019; Bellocchi et al, 2023]. Khanna and Sharma [2021] analysed how productivity is affected by investment in new technologies, thus combining the issue of capital accumulation and technological progress. AlKathir [2022], in turn, decomposes labour productivity growth in manufacturing into technical efficiency change, technological progress and

capital accumulation. He concludes that labour productivity growth is primarily driven by capital accumulation and, to a lesser extent, technological progress, while technical efficiency is deteriorating over the examined period. Also Gardiner and others [2020], based on analysis for UK, find that regional variations in capital stocks for per worker make a significant contribution to regional variations in labour productivity (at the same time underlying that the effect of capital stock depends on the level of human capital). Based on the above, we may expect the higher level of physical capital and K/L ratio at the level of national economy, the higher labour productivity. Combining it with the savings – investment relationship – there should be a link between savings and labour productivity.

In conclusion, the existing literature confirms the presence of a relationship between savings, investment, and productivity, but different strands of research emphasise distinct aspects. One line adopts a long-term perspective, examining the link between savings and economic growth. Another focuses on sectoral analyses rather than on the economy as a whole. A further strand investigates individual components of the transmission mechanism. Our study contributes by re-examining the mechanism at the macroeconomic level. This approach fills a niche by offering a generalised and transparent framework that highlights and confirms well known structural regularities that may be, however, somehow lost in more disaggregated or fragmented analyses.

4. Empirical verification

Data

The relationships presented in the analytical approach have been empirically verified using data from the Eurostat and the World Bank database (accessed 10.09.2024).

The following time series for the period 2000–2022 were used:

- *S*: gross savings in real terms (2015=100) in EUR million. Data from the World Bank (indicator: *Gross savings*) – data in local currency at current prices, converted to EUR at 2015 constant prices based on Eurostat data.

- *I:* gross investment in real terms (2015=100) in EUR million (indicator: *Gross fixed capital formation*)
- *K*: physical capital in real terms (2015=100) in EUR million (indicator: *Capital stocks by industry (NACE Rev.2) and detailed asset type*)
- *L*: labour supply (indicator: *Population by sex, age, country of birth and labour status – Persons in labour force*)
- *Y:* GDP in real terms (2015=100) in EUR million (indicator: *GDP and the main components*).

Since our analysis focuses on fundamental relationships and is conducted at a high level of generality, we do not account for potential structural breaks in the time series. While structural breaks may influence short-term dynamics, their consideration falls outside the scope of this study, which aims to identify long-run patterns.

The analysis was conducted at the EU aggregated level, and at the level of the selected economies representing different levels of development, as measured by GDP per capita. In accordance with Eurostat data (GDP per capita, PPS for 2023, current prices), three groups of countries were identified: 1) up to 30 000 PPS, 2) up to 40 000 PPS, 3) above 40 000 PPS. From each of these groups, one country was selected for analysis: 1) Poland, 2) the Czech Republic, 3) Germany. This approach is supported by neoclassical growth theory [Solow, 1956], which posits that as we approach the long-term steady state, the role of savings and productive capital accumulation in the dynamics of GDP per capita (and thus also in the dynamics of labour productivity) declines. Consequently, the pattern of relationships between pairs of variables in the analytical approach is expected to differ among countries. Analysis at EU aggregate level serves only as a point of reference.

Methods

The analysis was conducted for each pair of variables specified in the analytical model, namely: (4.1) savings and investment; (4.2) investment and physical capital; (4.3) physical capital and capital-to-labour ratio; (4.4) capital-to-labour and labour productivity ratio; and finally between (4.5) savings and labour productivity ratio. The following procedures were applied:

1. Pearson correlation coefficients were calculated for each pair of variables.
2. Graphical representations – including time series line plots and scatter plots – were employed for each variable pair. These visualisations provided initial insights into the relationships.
3. To examine whether the variables exhibit long-run relationships, we conducted cointegration analysis using the Johansen cointegration test. Prior to this, we applied the Augmented Dickey-Fuller (ADF) test to ensure that all time series were integrated of order one, which is a prerequisite for the Johansen test.

TABLE 1

ADF test results (test statistics with p-values)

		S	I	K	K/L	Y/L
Aggragated EU	Absolute values	0.147 [0.969]	-0.759 [0.830]	-1.160 [0.693]	-0.846 [0.805]	-0.835 [0.808]
	First differences	-3.264 [0.016]	-3.677 [0.004]	-2.529 [0.108]	-4.428 [0.0002]	-5.498 [0.000002]
Poland	Absolute vales	3.467 [1]	-0.300 [0.922]	1.431 [0.9992]	0.405 [0.983]	1.007 [0.9968]
	First differences	-2.710 [0.072]	-3.670 [0.004]	-4.141 [0.0008]	-1.376 [0.595]	-4.269 [0.0005]
The Czech Republic	Absolute vales	1.359 [0.998]	-1.215 [0.670]	3.90204 [1]	2.050 [0.999]	-1.346 [0.609]
	First differences	-3.158 [0.0225]	-3.943 [0.002]	-2.628 [0.08716]	-2.499 [0.115]	-4.830 [0.00004]
Germany	Absolute vales	1.408 [0.999]	-0.336 [0.917]	0.007 [0.9582]	-0.975 [0.7641]	0.398 [0.983]
	First differences	-4.317 [0.0004]	-3.453 [0.009]	-3.811 [0.002]	-4.418 [0.0003]	-4.562 [0.0001]

Test with constant, lag length selected by AIC criterion (max 4).

Source: the authors' own elaboration.

As shown in Table 1, most variables are non-stationary in levels (fail to reject the null hypothesis of unit root for absolute values). All but three series were I(1). For the inconclusive cases – capital stock (K) for the EU, and capital-to-labour ratio (K/L) for Poland and the Czech Republic – the KPSS test was additionally employed. The KPSS results supported the classification of these series as I(1).

Results

The first step involved calculating correlation coefficients (Table 2), which show high values across all variable pairs. These results provide only an initial insight, as correlation does not necessarily imply a long-term relationship.

TABLE 2
The r-Pearson correlation coefficients matrixes

Aggregated EU					
S	I	K	K/L	Y/L	
1.00	1.00	1.00	0.99	0.92	S
	1.00	1.00	0.99	0.92	I
		1.00	0.99	0.92	K
			1.00	0.90	K/L
				1.00	Y/L

Poland					
S	I	K	K/L	Y/L	
1.00	0.94	0.98	0.99	0.98	S
	1.00	0.95	0.94	0.97	I
		1.00	0.99	0.98	K
			1.00	0.99	K/L
				1.00	Y/L

The Czech Republic					
S	I	K	K/L	Y/L	
1.00	0.92	0.95	0.94	0.92	S
	1.00	0.90	0.89	0.98	I
		1.00	1.00	0.95	K
			1.00	0.94	K/L
				1.00	Y/L

Germany					
S	I	K	K/L	Y/L	
1.00	0.93	0.97	0.71	0.89	S
	1.00	0.88	0.61	0.94	I
		1.00	0.79	0.92	K
			1.00	0.76	K/L
				1.00	Y/L

Source: the authors' own computation, Critical value (for a two-tailed 5% significance level) = 0.4329 for df = 19 (n = 21).

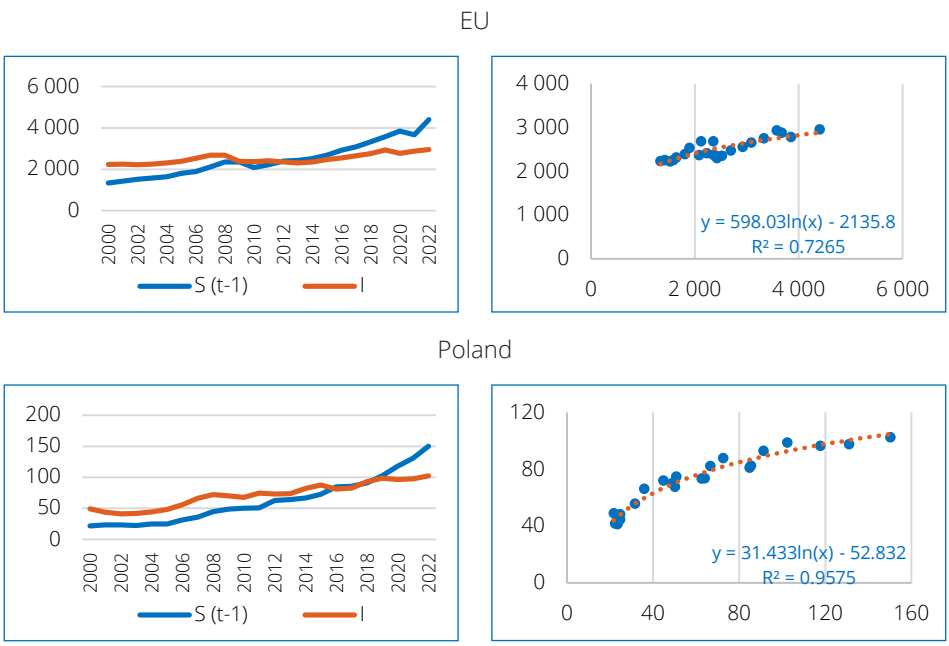
The second stage of our study involves verifying the relationships between pairs of the variables specified in the analytical model. This is achieved through visual analysis (time-series and scatter plots), supported by a regressio line.

4.1. Savings and investment

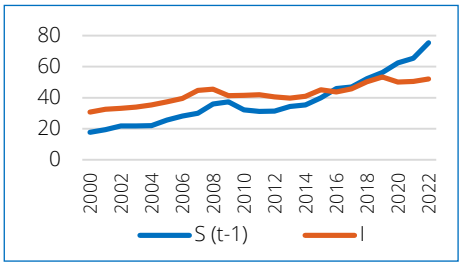
Chart 1 illustrates the relationship between savings and investment at the EU level and in three selected countries. Examining the variables over time reveals that investment initially rises in line with increasing savings. However, beyond a certain point, the level of savings exceeds that of investment. Regression analysis was conducted using both linear and logarithmic specifications. The logarithmic model provided a closer fit to the data. This suggests diminishing marginal returns to savings in terms of investment stimulation – i.e., initial increases in savings have a stronger impact on investment than subsequent increases. This pattern was observed across all the examined countries, with variations in the strength of the relationship.

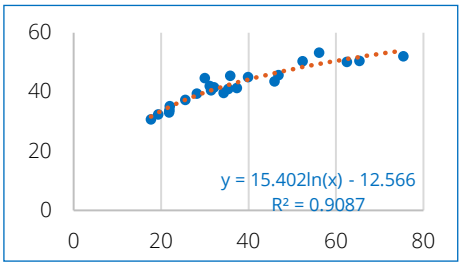
CHART 1

Relationship between savings and investment (EUR billion)

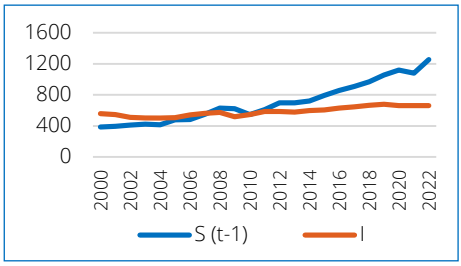


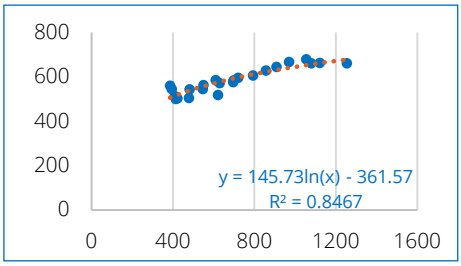
The Czech Republic





Germany





Source: the authors' own computation based on Eurostat and World Bank.

4.2. Investment and physical capital

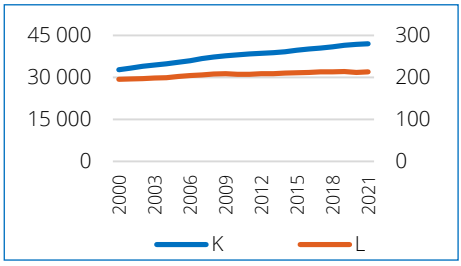
According to formula (3), the level of investment is related to the capital stock. Chart 2 provides visual support for this relationship, which is linear, as shown in the charts on the right. The estimated functional forms demonstrate a moderately fit ($R^2 = 0.53$ for EU) to a good fit ($R^2 = 0.90$ for Poland).

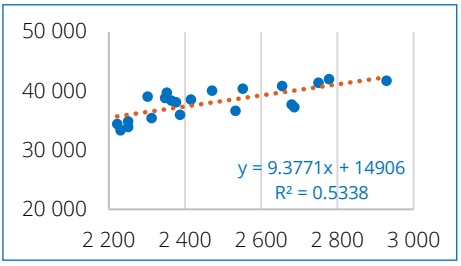
In this case, the linear specification provides a better fit than the logarithmic form. These findings are consistent with the theoretical expectation that investment contributes to capital accumulation over time.

CHART 2

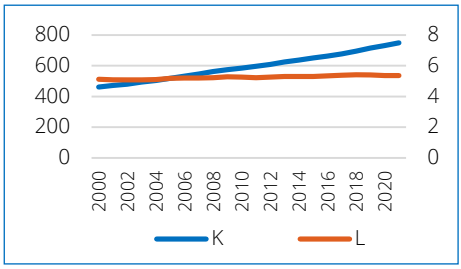
The relationship between investment and physical capital (EUR billion)

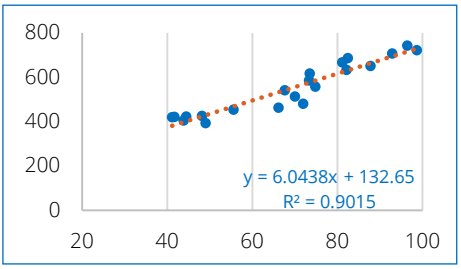
EU



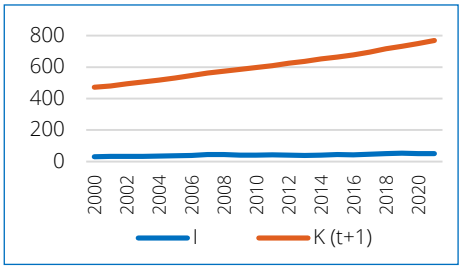


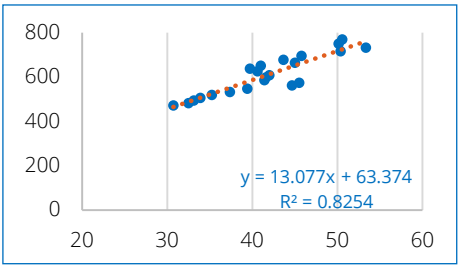
Poland



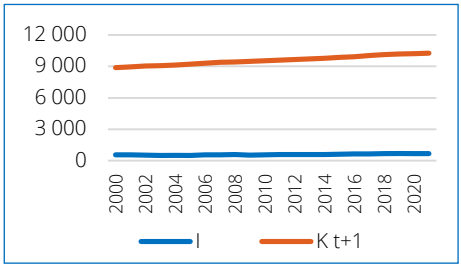


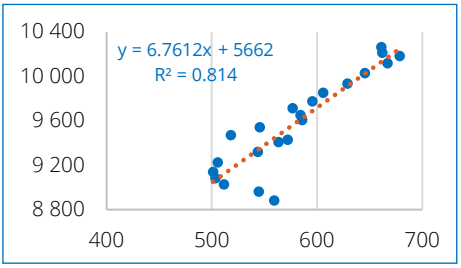
The Czech Republic





Germany





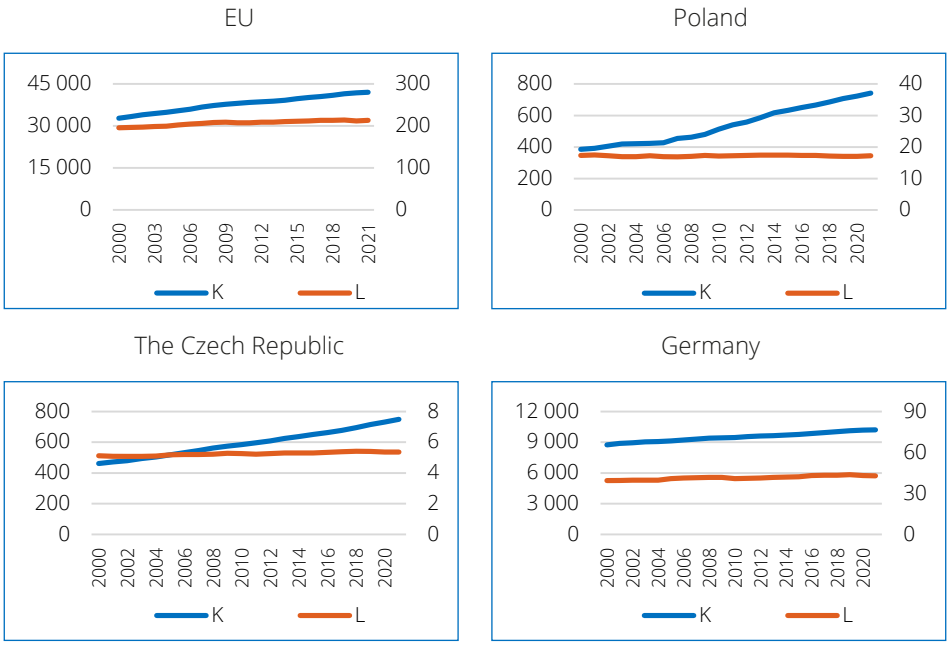
Source: the authors' own computation based on Eurostat and World Bank.

4.3. Physical capital and the capital to labour ratio

Chart 3 shows that while physical capital has increased over time, labour supply has remained relatively stable. This trend is evident both at the EU level and in Poland and in the Czech Republic. Germany, however, displays a different pattern, with only modest capital growth. This is evidenced by Eurostat data, which indicate a 17% increase of physical capital in Germany, in contrast to 93% in Poland and 70% in the Czech Republic over the examined period.

CHART 3

Relationship between capital and labour (capital in billion EUR; labour in million – on secondary axis)

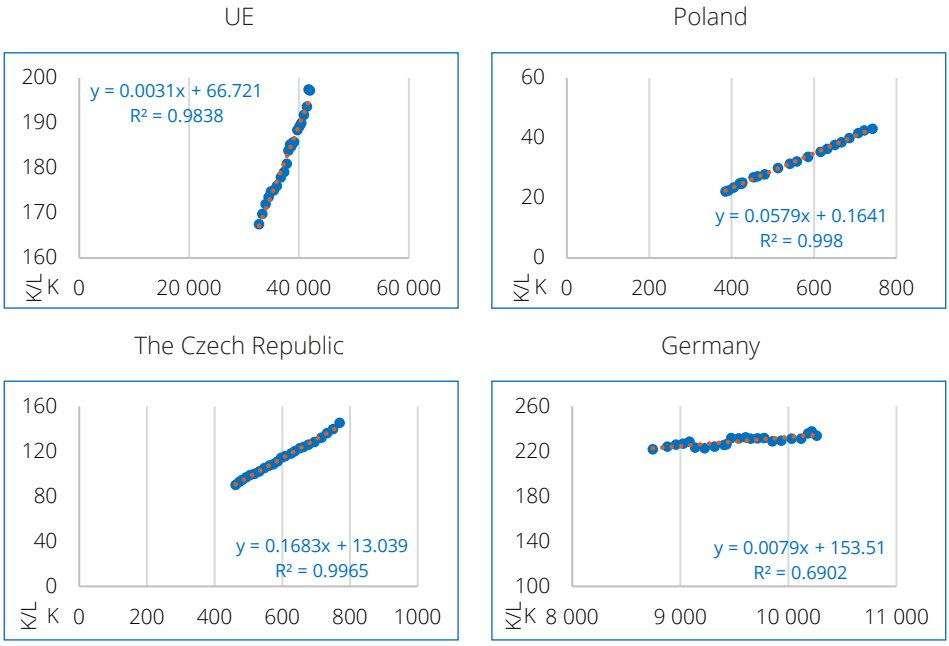


Source: the authors' own computation based on World Bank.

Based on the above, we expect a linear positive relationship between the capital stock and capital to labour ratio. The existence of such a relationship is confirmed by graphs in Chart 4.

CHART 4

Capital and capital to labour ratio (capital in billion EUR; capital to labour ratio billion EUR per unit of labour)



Source: the authors' own computation based on Eurostat.

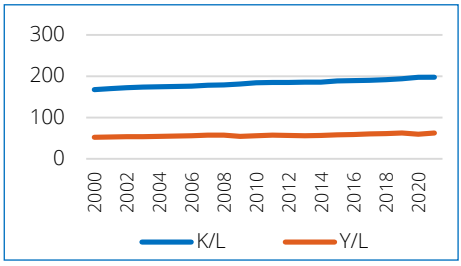
4.4. Capital to labour ratio and labour productivity

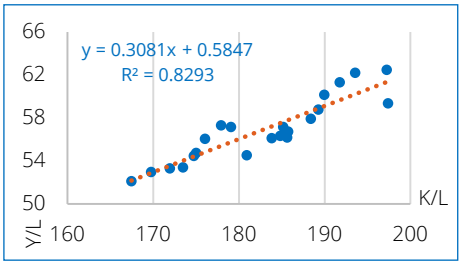
The next stage of the analysis examined the relationship between the capital-to-labour ratio and labour productivity. The analysis at the aggregated European Union level reveals the existence of a relationship in this respect. At the individual country level, a strong relationship is observed in Poland and in the Czech Republic (R^2 coefficients of 0.97 and 0.93, respectively), and to a lesser extent in Germany (R^2 coefficient of 0.66). This suggests that other factors, particularly technical, technological and organisational progress, may have a greater influence on labour productivity in Germany than in Poland and in the Czech Republic. Consequently, the estimated functional form demonstrates a lesser degree of fit to the data.

CHART 5

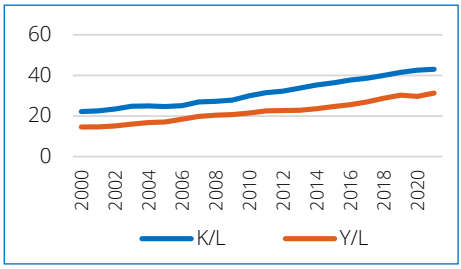
Capital to labour ratio and labour productivity (billion EUR per unit of labour)

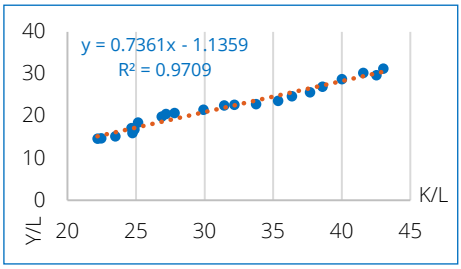
EU



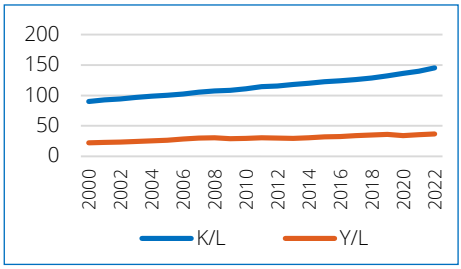


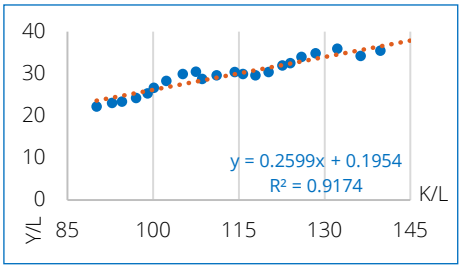
Poland



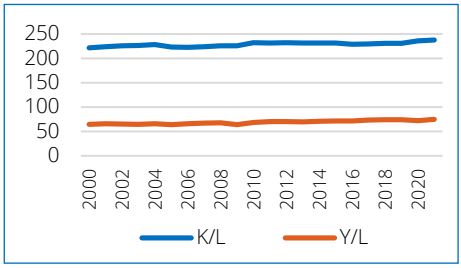


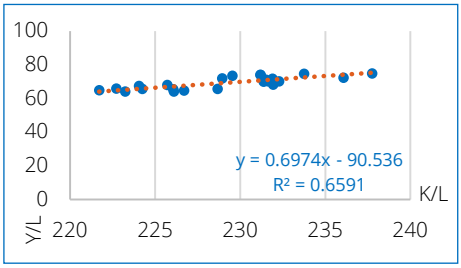
The Czech Republic





Germany



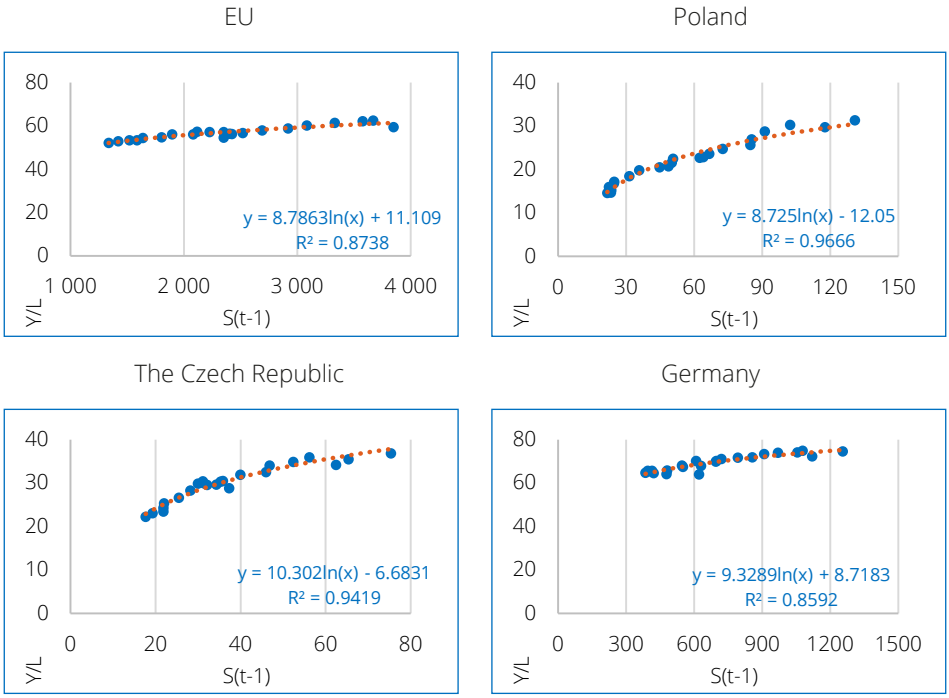


Source: the authors' own computation based on Eurostat.

4.5. Savings and labour productivity

In Sections 4.1–4.4, we conducted an empirical verification of the logical sequence of relationships between the pairs of variables under study. The central assumption underpinning this reasoning is the existence of a link between savings and labour productivity. An examination of the graphical representations in Chart 6, both for the European Union as a whole and for the selected countries, supports this assumption. Moreover, the estimated logarithmic functions suggest that, as expected, the strength of this relationship diminishes as the level of savings increases.

CHART 6
Savings and labour productivity



Source: the authors' own computation based on Eurostat and the World Bank.

The final step was to apply the Johansen test to assess the presence of cointegration (Table 3).

TABLE 3
Johansen cointegration test results

	Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value	Conclusion
EU	0	0.90552	91.700	[0.0002]	49.546	[0.0001]	At most one cointergating vector
		0.78259	42.154	[0.1550]	32.046	[0.0098]	
	2	0.26557	10.108	[0.9746]	6.4817	[0.9623]	
	3	0.14519	3.6263	[0.9240]	3.2944	[0.9153]	
	4	0.015681	0.33190	[0.5645]	0.33190	[0.5646]	
Poland	0	0.94904	114.8	[0.0000]	62.509	[0.0000]	At most two cointegrating vectors
	1	0.76283	52.288	[0.0166]	30.219	[0.0191]	
	2	0.5148	22.069	[0.3040]	15.187	[0.2876]	
	3	0.26594	6.8823	[0.5973]	6.4924	[0.5585]	
	4	0.018392	0.38984	[0.5324]	0.38984	[0.5324]	
The Czech Republic	0	0.88964	98.255	[0.0000]	46.284	[0.0005]	
	1	0.70875	51.971	[0.0180]	25.905	[0.0791]	
	2	0.5529	26.066	[0.1302]	16.904	[0.1831]	
	3	0.2761	9.1615	[0.3572]	6.785	[0.5231]	
	4	0.107	2.3765	[0.1232]	2.3765	[0.1232]	
Germany	0	0.83971	96.75	[0.0001]	38.446	[0.0101]	
	1	0.71918	58.304	[0.0032]	26.671	[0.0626]	
	2	0.56851	31.633	[0.0298]	17.651	[0.1479]	
	3	0.4707	13.983	[0.0826]	13.36	[0.0677]	
	4	0.029219	0.62275	[0.4300]	0.62275	[0.4300]	

Source: the authors' own computation.

The number of cointegrating vectors for each case was determined at 0.1 significance level. The outcomes of both the Trace and Maximum Eigenvalue (Lmax) tests were taken into consideration; the cointegrating rank was selected

as the first rank at which the p-value exceeds 0.1 in either of the tests. This indicates that the null hypothesis of at most *r* cointegrating vectors is rejected up to that point. In all cases there is at least one cointegrating vector among the analysed variables. This indicates that saving-driven investment, capital accumulation, and labour productivity are not drifting apart, but rather adjusting towards long-run equilibria.

The limitation of the analysis is the relatively short time series. That reduces test power and may understate the true cointegration rank, particularly for the EU aggregate. Nevertheless, the presence of at least one stable equilibrium in each case reinforces the article's central assertion that the saving-investment-productivity nexus is a fundamental characteristic of the European macroeconomies.

5. Conclusions

The analysis conducted in this study confirms the logical sequence linking savings, investment, capital accumulation, and labour productivity at the macroeconomic level. The empirical results for the European Union and selected countries demonstrate that higher savings are associated with increased investment, which, in turn, contributes to the growth of physical capital. This accumulation of capital, relative to labour, is reflected in a higher capital-to-labour ratio and, consequently, in greater labour productivity. The findings support the theoretical framework and provide evidence that, while the strength of these relationships may diminish as economies develop, the fundamental transmission mechanism remains observable.

However, several limitations should be acknowledged. The analysis relies on aggregate time series data, which may mask structural differences between countries and over time. The relatively short time span of the data (2000–2022) may reduce the statistical power of cointegration tests and limit the ability to capture long-term dynamics. Additionally, the study does not account for potential structural breaks, policy changes, or external shocks that could influence the relationships under investigation. The focus on a high level of generality means that other important determinants of productivity, such

as technological progress, human capital, and institutional factors, are not explicitly modelled.

Future research could address these limitations by employing longer time series, incorporating additional countries, or conducting disaggregated analyses at the sectoral or regional level. Further studies might also explore the role of technological change, human capital development, and institutional quality in shaping the relationship between savings, investment, and productivity.

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