ECONOMIC ANNALS

230

Ekonomski anali, founded in 1955
by the Faculty of Economics, University of Belgrade
Volume LXVI, No. 230 / July – September 2021

UDC: 3.33 ISSN: 0013-3264

ECONOMIC ANNALS
Publisher: Faculty of Economics, University of Belgrade

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Website: *http://www.ekof.bg.ac.rs/publikacije/casopisi/ekonomski-anali/*
E-mail: *ea@ekof.bg.ac.rs*

The journal is published quarterly
Annual subscription: 2400 RSD
Account No. 840-1109666-73
(Faculty of Economics, Belgrade)
Circulation: 200 copies

UDC: 3.33 • ISSN: 0013-3264

Print
JAVNO PREDUZEĆE „SLUŽBENI GLASNIK" – Beograd, www.slglasnik.com

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ECONOMIC ANNALS, Volume LXVI, No. 230 / July – September 2021
UDC: 3.33 ISSN: 0013-3264

https://doi.org/10.2298/EKA2130007B

*Miloš Božović**

MUTUAL FUND PERFORMANCE: SOME RECENT EVIDENCE FROM EUROPEAN EQUITY FUNDS

ABSTRACT: *This paper studies the performance of mutual funds that specialise in equity investment. We use a sample of the top sixteen actively managed European equity funds operating in the United States between July 1990 and November 2020. Using standard factor models, we show that none of our sample funds generated a positive and significant alpha. The observed funds could not outperform a simple passive strategy that involves tradeable European benchmark portfolios in the longer run. As a rule, the funds in our sample did not exploit the known asset pricing anomalies.*

KEY WORDS: *investment funds, active strategy, European stocks, Fama-French factors, momentum*

JEL CLASSIFICATION: G12, G15, G23

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1. INTRODUCTION

Active mutual funds aim to manage investment portfolios in a way that reflects their competitive edge. This edge may consist of more profound knowledge and understanding of the market, available technology, and economies of scope; investment talent, instinct, and mental effort; or at very least the time and costs associated with selecting appropriate financial instruments through careful analysis. In brief, we expect actively managed funds to provide value to their investors through delivering returns higher than any alternative with similar risk. If successful, their active investment strategies should provide excess returns above and beyond the market risk premium or other known risk factors.[1]

Nevertheless, studies so far have shown quite the opposite: actively managed mutual funds provide predominantly lower returns than the market portfolio (see, for example, Fama & French, 2010; Berk & van Binsbergen, 2012). Historically, only a fraction of funds has been able to generate abnormal returns when trading friction is taken into account (Wermers, 2000; Kosowski et al., 2006). There is a compelling body of empirical evidence that 'top' mutual funds (irrespective of the ranking criteria) are unable to generate persistent returns and that their performance is mainly ephemeral (Mateus et al., 2019). Only the 'losers' tend to exhibit persistent losses (Carhart, 1997).

The mutual fund industry in the U.S. is significantly larger than in any other region or country, accounting for almost half of global assets under management. It is also one of the vital investment vehicles for a typical U.S. family: in 2018, more than 43% of households held mutual fund investment units (Elton & Gruber, 2020). Therefore, it is not surprising that the vast majority of research focuses on U.S. mutual funds and their performance measures. On the other hand, although individually smaller in market capitalisation than their U.S. counterparts, European stock markets attract many global institutional investors. However, very few studies on the performance and persistence of mutual funds

1 With around 55 trillion U.S. dollars of assets under management in 2019 and projections of over 100 trillion U.S. dollars by the end of 2027 (Goswami et al., 2020), the global mutual fund industry is at the forefront of active investment efforts. In 2019 the management fees charged by the active funds were more than five times larger than the average compensation required by the passive funds: despite both having a declining tendency, the ratio of compensation for active and passive mutual funds continues to increase (PwC, 2020).

specialise in European stocks. Some notable exceptions, such as Otten & Bams (2002), Vidal-García (2013), and Graham et al. (2019), focus on European mutual funds. The literature on the performance of U.S. or international funds that concentrates on European asset markets is scarce at best.

Motivated by this research gap, we investigate the performance of actively managed European equity funds operating in the United States. The U.S. European equity funds hold at least three-quarters of their assets in European stocks. They primarily invest in developed European markets such as Germany, France, the United Kingdom, Switzerland, and the Netherlands. Some funds are also exposed to the emerging markets of Eastern Europe. We focus on the top sixteen mutual funds, based on their U.S. News Mutual Fund Score. We use monthly fund returns between July 1990 and November 2020 and regress them on European Fama & French portfolios and momentum. None of the funds in our sample generated a positive and significant alpha. Therefore, even the top funds could not outperform a simple passive strategy that uses tradable portfolios or exploits well-known market anomalies.

The paper contributes to the literature on mutual fund performance in several ways. First, it is one of the rare empirical studies related to the performance of U.S. European equity funds. Consistent with the general literature on fund performance, we verified that the observed funds provide no abnormal returns beyond what can be easily explained by the ordinary risk premia. Second, the paper hints at some of the investment strategies applied by the observed funds. Third, we find that two persistent anomalies in Europe are currently not exploited by the sample funds.

The remainder of this paper is organized as follows. In Section 2 we provide a brief review of the relevant literature on measures of mutual fund performance. This review sets the core methodology used in this research, presented in Section 3. Section 4 describes the data and presents preliminary results based on descriptive statistics. Section 5 presents and analyses the regression results. Concluding remarks are given in Section 6.

2. LITERATURE REVIEW

The research on mutual fund performance dates back to the 1960s and the seminal work by Jensen (1969). One of the main questions it tries to answer is whether excess returns of funds come from expertise or luck. Later, Carhart (1997) further refined this issue by introducing the notion of return persistence, which studies whether the funds can keep their good track record over significant periods. Good entry points to the literature on mutual fund performance are Cuthbertson et al. (2010) and Elton & Gruber (2020).

Traditionally, the main idea behind portfolio performance measurement is whether an investor can systematically achieve an abnormal return. The ‘abnormal’ in this context refers to any return beyond the investment portfolio’s risk premium. This logic immediately invokes the use of an asset pricing model that relates the expected return to an observable risk factor. Historically, Jensen (1969) applied the Capital Asset Pricing Model (CAPM) previously formalised by Sharpe (1963, 1964), Lintner (1965, 1969), and Mossin (1966). The abnormal return in CAPM was captured by a statistically and economically significant intercept (‘Jensen’s alpha’).

The main idea of CAPM, that the risk premium can be explained through a single-factor beta which captures the co-movement between the asset return and the market portfolio return, was revisited in the light of evidence of apparent ‘anomalies’. For example, Fama & French (1992) found that between 1960 and 1990, companies with relatively smaller market capitalisation paid a significantly larger premium than larger companies. Also, companies with a higher book-to-market ratio paid a substantially larger premium than stocks with a lower ratio. Neither the ‘size’ nor the ‘value–growth’ anomaly could be explained by the market beta alone. These findings prompted the extension of CAPM to multifactor models. The Fama & French (1993) three-factor model, which includes two additional factors that ‘explain’ the anomalies – the ‘small minus big’ (SMB) and the ‘high minus low’ (HML) factors – eventually became the standard benchmark model for measuring asset pricing and performance. Thus, the definition of ‘alpha’ was modified to account for the premium earned by exposure to all three factors.

Over time, it turned out that even the three-factor model could not explain the cross-section of stock returns. For example, it exhibits poor performance when stocks are grouped by industry (Fama & French, 1997). It also cannot explain the persistent abnormal returns of momentum portfolios formed by buying recent winner stocks and selling loser stocks (Carhart, 1997). The latter anomaly is successfully captured by adding the fourth factor—the 'winners minus losers' (WML) – to the existing three. The only issue with this factor is related to relatively low values of R^2 in cross-sectional regressions compared to the time-series regressions used to obtain the corresponding factor loadings (Cochrane, 1999).

The number of anomalies reported in the academic literature over the past three decades is substantial. Hou et al. (2017) were able to identify as many as 447 different average-return anomalies. Mateus et al. (2019) provide a thorough overview of the known anomalies in the context of fund performance and persistence measurement. Titman et al. (2004), Novy-Marx (2013), and many other authors have since pointed out that a possible reason why the three-factor model is incomplete is the lack of variation in average returns that originate from company profitability and investments. To account for these effects, Fama & French (2015) suggest a five-factor model that expands the three-factor model with a profitability factor ('robust minus weak', RMW) and an investment factor ('conservative minus aggressive', CMA). The two additional factors can also explain several other anomalies, such as the high average returns associated with a low market beta, share repurchases, and low stock return volatility (Fama & French, 2016).

Despite the lack of an obvious link with fundamental macroeconomic variables or other systemic risk factors, the five-factor model can explain average returns for North America, Europe, Asia, and the Pacific (Fama & French, 2017). More specifically, average returns for most global markets increase with book-to-market ratio and profitability and decrease with the level of investment.[2] One of the crucial known drawbacks of the five-factor model is its inability to explain the low returns of companies with small market capitalisation whose stock prices behave like the prices of companies with low profitability that invest aggressively.

2 Among the rare exceptions to this stylized fact is the Japanese market, where average stock returns are positively associated with the HML factor but exhibit very weak correlations with RMW and CMA factors (Fama & French, 2017).

3. METHODOLOGY

We measure fund performance using the standard asset pricing models. We run a time-series regression of excess returns for each sample fund i on the set of risk factors f_{kt}:

$$r_{it} - r_t^f = \alpha_i + \sum_{k=1}^{K} \beta_{ik} f_{kt} + \varepsilon_{it}, \tag{1}$$

where ε_{it} is the usual regression residual. The least-square estimates of the coefficients give factor betas as loadings and alpha as the regressional intercept α_i. We use the Huber-White robust estimates of standard errors. An estimate for the risk premium of factor k can be obtained as the time-series average of the returns f_{kt}. The factors represent tradable mimicking portfolios for the actual sources of non-diversifiable economy-wide risks.

The asset pricing models used for performance measurement are the CAPM, the Fama and French (1993) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2015) five-factor model. In the CAPM, the only factor is the excess return on the value-weighted portfolio of European stocks. In the Fama and French (1993) three-factor model, the additional factors are the size (SMB) and the value (HML) portfolios. The Carhart (1997) four-factor model also includes the momentum (WML) portfolio. Finally, the Fama and French (2015) five-factor model extends the three-factor version to include the profitability (RMW) and investment (CMA) portfolios for the European market.

Each model applies the same null hypothesis of the absence of abnormal returns, captured by alpha. Since we run a time-series regression for each sample fund separately, we therefore test

$$H_0 : \alpha_i = 0$$

versus the alternative hypothesis

$$H_A : \alpha_i \neq 0.$$

If the null hypothesis is rejected in favour of the alternative, then there are two possibilities. If $\alpha_i > 0$, this indicates abnormal return by the fund i given the risk factors f_{kt}. On the other hand, if $\alpha_i < 0$, fund i provides a suboptimal premium with respect to the standard risk factors.

Even though this approach is well established in the empirical asset pricing literature, it is prone to the usual econometric challenges. Collot & Hemauer (2021) show that the two most important ones in this context are omitted-variable bias and errors-in-variables bias. The omission of some relevant pricing factors from Equation (1) will introduce bias and inconsistency in the OLS estimators for betas and alphas, especially for individual assets. A common approach in the empirical asset pricing literature to obtaining more precise coefficient estimates is to run factor regressions of portfolio returns rather than individual asset returns.

The imprecision resulting from omitted factors can further lead to errors-in-variable bias in the two-stage procedure of Fama & MacBeth (1973). This procedure uses the estimated coefficients from the first stage as explanatory variables in the second stage to obtain market prices of risk factors. Since we only run time-series regressions, there will be no errors-in-variable bias in our results. The issues with omitted-variable bias are alleviated by the fact that the explained variables are excess returns on equity funds, which by construction represent well-diversified portfolios rather than individual stocks.

4. DATA

The set of our explained variables consists of monthly stock returns on the top sixteen U.S. European equity mutual funds, based on their U.S. News Mutual Fund Score. The Mutual Fund Score represents an equally weighted score of the most popular fund rating services: CFRA, Lipper, Morningstar, TheStreet.com, and Zacks. The stocks for all of the top sixteen funds were traded on NASDAQ in U.S. dollars between July 1990 and November 2020. For each fund, we used the most extensive series available from Thomson Reuters Eikon (Refinitiv).

The data are summarised in Table 1. The columns show the fund ranking, name, ticker symbol, net assets under management, holdings turnover, and Morningstar overall rating. Our sample funds vary significantly in their asset size, ranging between 4.1 million and 1.2 billion U.S. Dollars. They also differ in the degree of active portfolio management, captured by the holdings turnover rate. This rate represents the fraction of portfolio investment holdings that change annually due to active trading. In general, most actively managed funds have double-digit turnover rates. There are several funds with three- and even four-digit rates in our sample, indicating an overly aggressive approach.

As described in Section 3, we use the usual benchmark portfolios for European stocks as explanatory variables: the excess return on the market portfolio, the Fama-French factors (SMB, HML, RMW, and CMA), and the momentum factor (WML). The monthly returns on these portfolios, available from Kenneth French's Data Library,[3] cover the same period as the mutual fund returns. All returns are in U.S. dollars and are adjusted for dividends and capital gains. The benchmark portfolios are constructed using stocks from the following countries: Austria, Belgium, Switzerland, Germany, Denmark, Spain, Finland, France, the United Kingdom, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, and Sweden.

The market factor is the U.S. dollar return on the European value-weighted market portfolio, net of the yield on a U.S. one-month T-Bill. The SMB, HML, RMW, and CMA factors are constructed by the standard sorting algorithm, based on the companies' size, book-to-market ratio, operating profitability, and investment at the end of each June. The momentum factor (WML) is the difference in the average returns on the top and bottom 30% of European stocks based on their lagged momentum. The lagged momentum represents a stock's cumulative annual return ending a month before the month of observation.

3 https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_5developed.html

Table 1: Overview of funds

Rank	Name	Ticker	Net Assets (USD million)	Holdings Turnover (%)	Morningstar Overall Rating
1	Morgan Stanley Europe Opportunity Fund Inc. Class A	EUGAX	205.7	13.00	★★★★★
2	T. Rowe Price European Stock Fund	PRESX	1,170.0	75.40	★★★★
3	Columbia Acorn European Fund Class A	CAEAX	108.8	30.00	★★★★★
4	Janus Henderson European Focus Fund Class A	HFEAX	392.7	160.00	★★★
5	Brown Advisory WMC Strategic European Equity Fund Inst. Shares	BAFHX	363.2	53.00	★★★★
6	Fidelity Advisor Europe Fund Class A	FHJUX	990.2	39.00	★★★★
7	BlackRock EuroFund Investor A Shares	MDEFX	122.9	39.00	★★★
8	Virtus Vontobel GreaterEuropean Opportunities Fund Class A	VGEAX	7.3	51.00	★★★★★
9	DFA Continental Small Company Portfolio Institutional Class	DFCSX	683.3	1.68	★★★★
10	Vanguard European Stock Index Fund Investor Shares	VEURX	20.0	3.00	★★★
11	Invesco European Small Company Fund Class A	ESMAX	238.5	N/A	★★★★
12	JPMorgan Europe Dynamic Fund Class A	VEUAX	541.2	159.00	★★★
13	Invesco European Growth Fund Class A	AEDAX	1,100.0	27.00	★★★
14	Franklin Mutual European Fund Class A	TEMIX	792.8	12.16	★★
15	ProFunds Europe 30 Fund Investor Class	UEPIX	4.1	1,122.00	★
16	DoubleLine Shiller Enhanced International CAPE Class I	DSEUX	43.0	48.00	★★★★

Sources: Thomson Reuters Eikon (Refinitiv), Kenneth French's Data Library, U.S. News Mutual Fund Score

All Fama-French factors are originally denominated in U.S. dollars. To convert them into euros or another non-USD currency, one can follow the methodology described in Glück et al. (2021). When applying the conversion, an important caveat is related to the difference in formulas between long factors such as the market portfolio, and long–short factors such as SMB or HML. As Glück et al. (2021) further argue, the currency of the factor returns has to be adjusted when working with non-U.S. samples from a non-USD perspective. However, in this paper we use the U.S. dollar as a base currency, as all the funds are located in the U.S. and are USD-denominated. Hence, conversion to local currencies is unnecessary, and the exchange rates have no impact on the results.

Table 2: Descriptive statistics

Rank	Fund/portfolio	Number of observations	Average excess return (%)	St. dev. of excess return (%)	Sharpe ratio
1	EUGAX	280	0.47	5.28	0.09
2	PRESX	365	0.51	5.46	0.09
3	CAEAX	111	0.94	5.19	0.18
4	HFEAX	230	1.04	6.64	0.16
5	BAFHX	85	0.54	5.07	0.11
6	FHJUX	80	0.39	5.30	0.07
7	MDEFX	313	0.51	6.16	0.08
8	VGEAX	139	0.90	6.51	0.14
9	DFCSX	365	0.58	6.20	0.09
10	VEURX	365	0.47	5.06	0.09
11	ESMAX	243	0.96	7.49	0.13
12	VEUAX	300	0.61	5.66	0.11
13	AEDAX	277	0.72	5.63	0.13
14	TEMIX	289	0.63	4.89	0.13
15	UEPIX	260	–0.03	6.49	0.00
16	DSEUX	47	0.70	5.75	0.12
	Value-weighted portfolio	365	0.35	3.85	0.09
	Market portfolio	365	0.50	4.97	0.10
	SMB	365	0.07	2.13	0.03
	HML	365	0.21	2.53	0.08
	WML	365	0.90	3.99	0.23
	RMW	365	0.38	1.59	0.24
	CMA	365	0.11	1.80	0.06

Source: Author’s estimations.

Table 2 shows the descriptive statistics for the dataset. The statistics are compiled for 16 mutual fund returns, the return on the value-weighted portfolio of these funds, and the 6 benchmark portfolios. The columns show the number of monthly observations in each series, the average excess return (as a percentage), the standard deviation of excess return, and the monthly Sharpe ratio. The Sharpe ratio suggests that the value-weighted portfolio performed worse than the market in terms of the risk–return trade-off.

This result becomes even more apparent in Figure 1, which compares the cumulative excess returns for the market portfolio and the value-weighted portfolio. The graphs represent the value of a dollar invested in the two zero-cost portfolios. Given that the value-weighted portfolio has lower volatility than the market portfolio, we adjust for the risk by scaling the former's excess return by the ratio of volatilities.[4] Even with the risk adjustment, the market portfolio is consistently above the portfolio of funds over the entire three decades. It gives an over 17% higher risk-adjusted cumulative return and an over 41% higher raw cumulative return. As the figure verifies, most of this difference comes from the relatively weak performance of the funds during the 1990s, when their active stock selection process did not pay off. From 2000 onwards the cumulative value of the fund portfolio correlates with the movement of the market portfolio of European stocks.

The key to understanding why the 'top' mutual funds performed worse than the most straightforward passive strategy is the choice of these funds. They are only the top sixteen funds ex-post, i.e., at the end of the sample. Their performance at an arbitrary moment may have little in common with their overall historical performance. Also, their past behaviour may not be consistent over time. This simple line of thought points to another conclusion: the top current performance of a fund is not necessarily the outcome of a consistent investment strategy.

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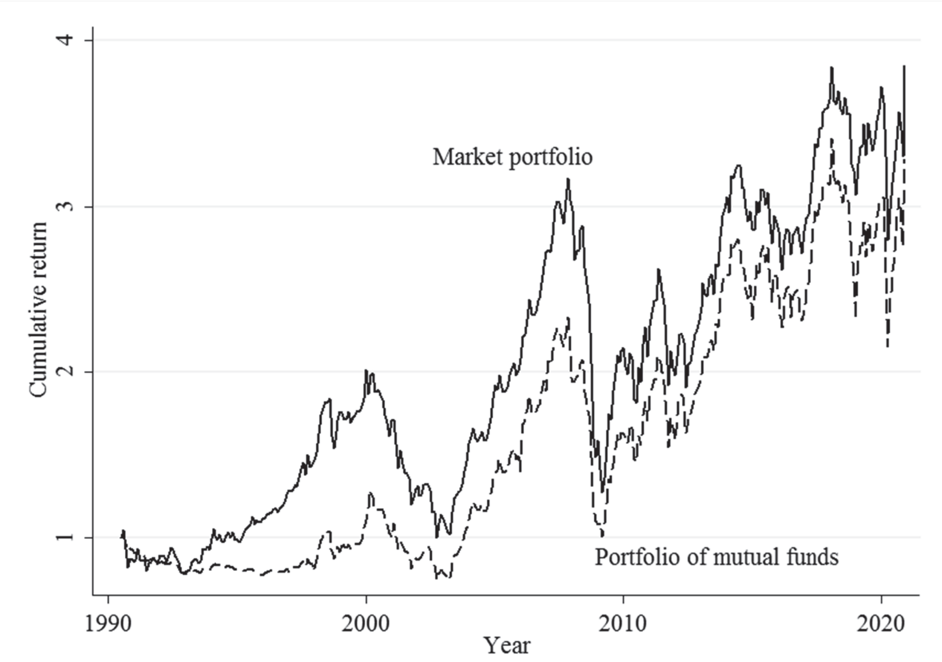
4 We multiply the excess return of the value-weighted portfolio by the volatility of the market portfolio and divide it by the volatility of the value-weighted portfolio.

Figure 1: Risk-adjusted cumulative returns of a value-weighted portfolio of the top sixteen U.S. European equity funds vs. the European market portfolio.



Source: Thomson Reuters Eikon (Refinitiv) and Kenneth French's Data Library
Note: Monthly data, July 1990 – November 2020. U.S. European equity funds = solid line and European market portfolio = dashed line.

At the individual level, nine funds appear to 'beat the market' in terms of the Sharpe ratio shown in Table 2. However, in Section 5 we will determine whether this implies actual abnormal returns, both statistically and economically. Every one of the top sixteen funds markedly underperformed two benchmarks, the momentum portfolio (WML) and the 'robust minus weak' portfolio (RMW), implying that any investor would be better off following either of these two simple strategies.

5. RESULTS

5.1. Overview

We begin our analysis by running a simple CAPM time-series regression of the following form:

$$r_{i,t} - r_t^f = \alpha_i + \beta_i \left(r_{M,t} - r_t^f \right) + \varepsilon_{i,t}, \quad (2)$$

where $r_{i,t}$ is the return of fund i in month t, as a percentage, r_t^f is the yield on the U.S. one-month T-Bill, $r_{M,t}$ is the return on the European market portfolio in month t, and $\varepsilon_{i,t}$ is the error term. The results are summarised in Table 3. The columns show the intercept (α), the market beta (β), and the fraction of variation in excess returns explained by the variation in the market excess return (R^2). The parameters are estimated using an ordinary least square estimator with robust standard errors.

Several results become immediately apparent from Table 3. First, the alphas are either insignificant or negative for individual funds. For the value-weighted portfolio the alpha is insignificant. Put differently, the average monthly return for the mutual funds that performed the best at the end of our sample was not significantly better than the return of a passive strategy: for one of the funds (UEPIX) it was 49 basis points worse than the return on the market portfolio. Second, all sixteen funds and their value-weighted portfolios have highly significant betas. The highly significant betas imply that their exposure to systemic risk can explain the funds' excess returns. Third, the regressions have relatively high R^2, which is usual for time-series factor regressions of returns (see, for example, Cochrane, 1999). The market risk factor alone is responsible for 73% of fund return variation on average. The variation in individual fund returns explained by this factor is above 90% in some cases (VEURX and DSEUX).

If we compare the results in Tables 2 and 3, it becomes apparent that the cross-sectional differences in average returns cannot be explained by only the differences in individual betas. This finding, illustrated in Figure 2, is prevalent in the literature and originates from high errors in beta estimates obtained from time-series regressions. Some of our sample funds were active for only a couple of years, implying that they have a relatively short time series and imprecise beta estimates in individual regressions.

Table 3. Time-series regressions of fund excess returns on market excess return

Rank	Fund/portfolio	α	β	R^2
1	EUGAX	0.06	0.84***	0.71
2	PRESX	0.05	0.93***	0.72
3	CAEAX	0.32	0.99***	0.83
4	HFEAX	0.38	1.01***	0.65
5	BAFHX	0.12	1.01***	0.80
6	FHJUX	0.03	1.03***	0.78
7	MDEFX	0.01	0.91***	0.55
8	VGEAX	0.28	0.79***	0.39
9	DFCSX	0.11	0.95***	0.58
10	VEURX	–0.02	0.99***	0.94
11	ESMAX	0.61	0.76***	0.30
12	VEUAX	0.09	0.94***	0.72
13	AEDAX	0.27	0.90***	0.71
14	TEMIX	0.28	0.65***	0.48
15	UEPIX	–0.49**	0.84***	0.68
16	DSEUX	–0.14	1.08***	0.91
	Value-weighted portfolio	0.02	0.66***	0.73

Source: Author's estimations.

Note: * – p-value < 0.10; ** – p-value < 0.05; *** – p-value < 0.01.

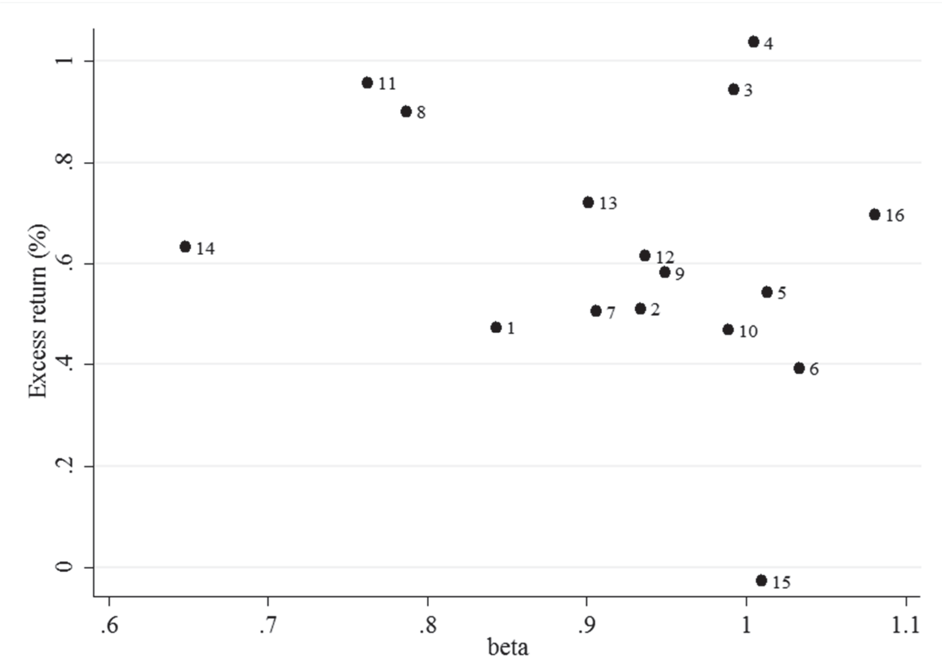
Notwithstanding the high correlations between fund returns and the market portfolio, Figure 2 also shows that the vertical dispersion is very high: individual average monthly excess returns differ by an entire percentage point. This difference implies that average fund returns vary in a range comparable to individual stocks. For funds that were actively trading during the entire sample (2 – PRESX, 9 – DFCX, and 10 – VEURX) the time series are relatively long, and the interpretation of the dispersion by the estimation errors in betas alone is implausible.

To capture the other possible sources of risk that drive the individual fund returns, we run a regression using the three-factor model of Fama & French (1993):

$$r_{i,t} - r_t^f = \alpha_i + \beta_i \left(r_{M,t} - r_t^f \right) + b_{SMB,i} SMB_t + b_{HML,i} HML_t + \varepsilon_{i,t}, \qquad (3)$$

where we include the European SMB and the HML factors. The regression results are summarised in Table 4. All alphas are now insignificant. Since the Fama-French factors represent tradable portfolios, the insignificance of alphas implies that none of the funds could beat a simple passive strategy of investing in a combination of the three factors.

Figure 2: Average monthly excess returns of the top sixteen U.S. European equity funds vs. their market beta.



Source: Author's estimations.

Note: The numerical labels correspond to the fund ranking in Table 1.

Again, all the funds have statistically significant market betas, while fourteen funds have at least one additional significant factor. Only five funds have statistically significant coefficients associated with all three factors. This result indicates the possibility that some of the funds in our sample may have insufficiently diversified portfolios that are not able to buffer any extreme variation in returns. If this interpretation is correct, the implication is that even the best funds follow strategies that rely too much on particular speculative choices, i.e., 'stock picking' or 'market timing', rather than some elaborate investment strategy.

It is worth noting that the majority of funds have negative coefficients corresponding to the HML factor. Table 2 shows that both the SMB and the HML portfolio considerably underperformed the market. In particular, the European HML portfolio exhibited a substantial downturn after the Global Financial Crisis (Figure 3). Most of the funds successfully exploited this fact: significant negative coefficients b_{HML} indicate that they predominantly took short positions in value stocks and long positions in growth stocks.

Table 4: Time-series regressions of fund excess returns on three Fama-French factors

Rank	Fund/portfolio	α	β	b_{SMB}	b_{HML}	R^2
1	EUGAX	0.08	0.87***	0.02	–0.19***	0.72
2	PRESX	0.05	0.95***	0.12	–0.09**	0.73
3	CAEAX	–0.06	1.10***	0.74***	–0.52***	0.93
4	HFEAX	0.15	1.07***	0.69***	–0.31***	0.70
5	BAFHX	–0.09	1.10***	0.02	–0.35***	0.83
6	FHJUX	–0.26	1.13***	0.08***	–0.42***	0.82
7	MDEFX	–0.05	0.89***	0.23	0.18*	0.56
8	VGEAX	–0.04	0.95***	–0.01	–0.59***	0.44
9	DFCSX	–0.02	0.97***	1.03***	0.29***	0.71
10	VEURX	–0.02	0.98***	–0.08**	0.03	0.95
11	ESMAX	0.33	0.80***	1.28***	–0.22	0.42
12	VEUAX	0.05	0.97***	0.36***	–0.10	0.74
13	AEDAX	0.26	0.97***	0.36***	–0.43***	0.77
14	TEMIX	0.22	0.65***	0.27**	0.08	0.50
15	UEPIX	–0.36	1.04***	–0.35***	–0.34***	0.72
16	DSEUX	–0.09	1.08***	–0.13	0.05	0.91
	Value-weighted portfolio	–0.00	0.68***	0.35***	–0.05	0.76

Source: Author's estimations.

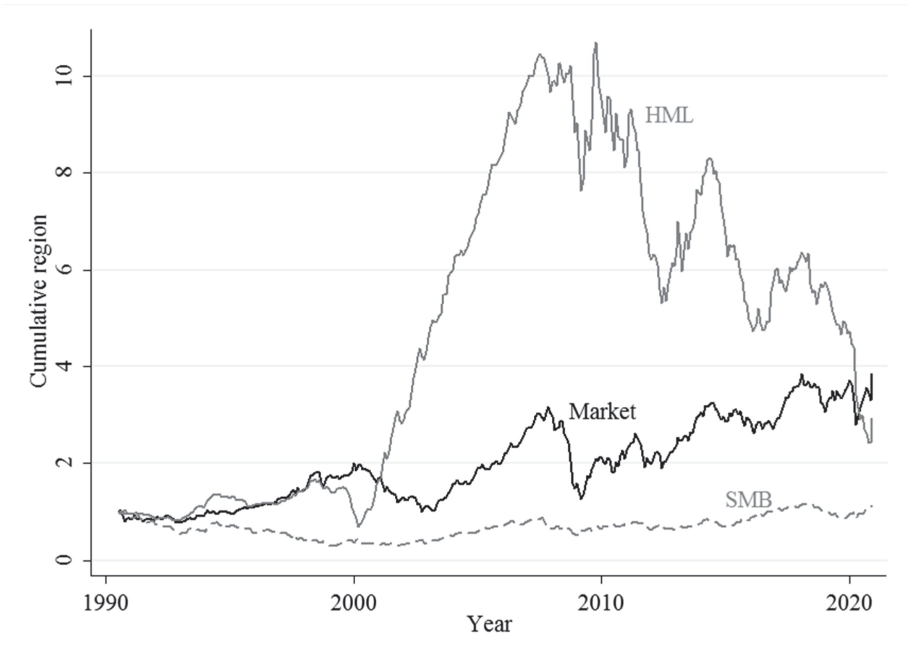
Note: * – p-value < 0.10; ** – p-value < 0.05; *** – p-value < 0.01.

Surprisingly, most of the top funds were not able to exploit the momentum anomaly. We can see this in Table 5, which summarizes the results of the four-factor regression:

$$r_{i,t} - r_t^f = \alpha_i + \beta_i \left(r_{M,t} - r_t^f \right) + b_{SMB,i} SMB_t + b_{HML,i} HML_t + b_{WML,i} WML_t + \varepsilon_{i,t}. \quad (4)$$

The regression given by Equation (4) includes the Carhart (1997) momentum factor WML for the European stocks. Again, all alphas are insignificant and all market betas remain highly significant, while the significance of the value-growth factor is somewhat reduced in favour of the momentum factor. All four factors are significant in only two funds. A puzzling result is that only two mutual funds (VEUAX and AEDAX) had positive momentum factor loadings, despite the WML portfolio's spectacular performance, with a monthly Sharpe ratio of 0.23 (Figure 4). It remains unclear why the remaining funds did not exploit this publicly available information. Three of the sample funds had a negative WML coefficient.

Figure 3: Risk-adjusted cumulative returns of the three Fama-French factors



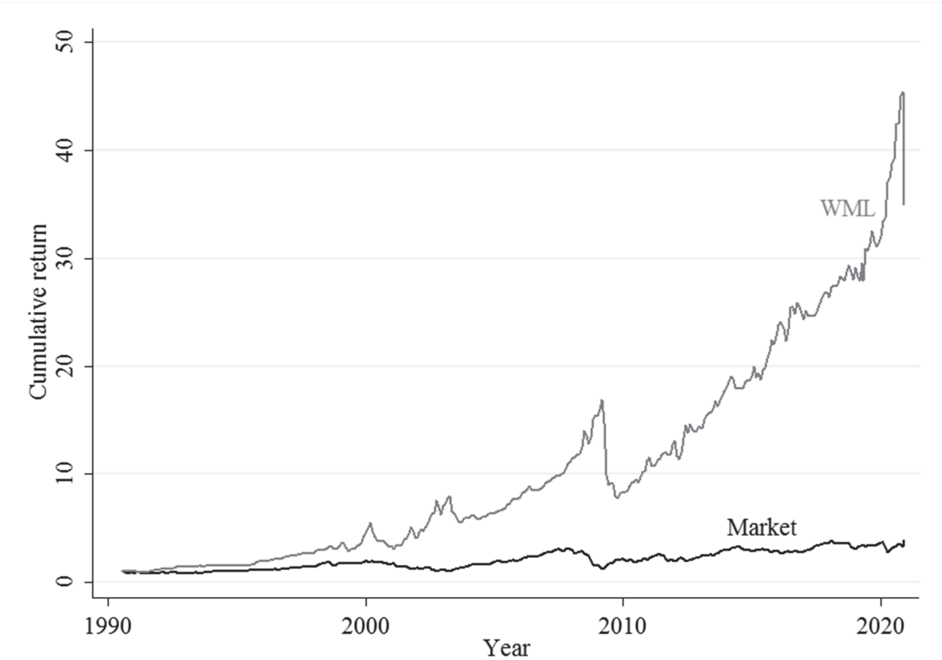
Source: Kenneth French's Data Library
Note: Monthly data, July 1990 – November 2020.

Equally perplexing are the results for the five-factor model of Fama & French (2015):

$$r_{i,t} - r_t^f = \alpha_i + \beta_i \left(r_{M,t} - r_t^f \right) + b_{SMB,i} SMB_t + b_{HML,i} HML_t + b_{RMW,i} RMW_t + b_{CMA,i} CMA_t + \varepsilon_{i,t}. \quad (5)$$

They are summarised in Table 6. The conclusions regarding alphas and market betas remain. The variance explained by the regressors represents an improvement over the CAPM, while the significance of HML coefficients is reduced. There are only two funds that had a negative HML factor loading at the 0.05 significance level. Similar to the momentum factor in Table 5, only one fund (AEDAX) had a significant positive coefficient corresponding to the RMW factor. The remaining funds had insignificant coupling with this factor, thereby entirely ignoring its monthly Sharpe ratio of 0.24 (Figure 5).

Figure 4: Risk-adjusted cumulative returns of the European momentum factor (WML) compared to the market portfolio



Source: Kenneth French's Data Library

Note: Monthly data, July 1990 – November 2020.

Table 5: Time-series regressions of fund excess returns on four Carhart factors

Rank	Fund/portfolio	α	β	b_{SMB}	b_{HML}	b_{WML}	R^2
1	EUGAX	0.11	0.86***	0.03	−0.20***	−0.02	0.72
2	PRESX	0.05	0.95***	0.12	−0.09*	−0.00	0.72
3	CAEAX	−0.06	1.10***	0.74***	−0.52***	−0.05	0.93
4	HFEAX	0.34	1.02***	0.73***	−0.39***	−0.19***	0.71
5	BAFHX	−0.01	1.05***	0.06	−0.48***	−0.18*	0.84
6	FHJUX	−0.22	1.10***	0.10	−0.50***	−0.12	0.82
7	MDEFX	0.09	0.86***	0.24	0.13	−0.12**	0.57
8	VGEAX	0.12	0.91***	−0.03	−0.74***	−0.24	0.45
9	DFCSX	0.02	0.96***	1.03***	0.23***	−0.03	0.71
10	VEURX	0.01	0.97***	−0.08**	0.02	−0.03**	0.94
11	ESMAX	0.46	0.76***	1.30***	−0.25*	−0.13	0.42
12	VEUAX	−0.09	1.00***	0.35***	−0.05	0.12**	0.75
13	AEDAX	0.03	1.03***	0.33***	−0.34***	0.22***	0.79
14	TEMIX	0.23	0.65***	0.27**	0.08	−0.01	0.50
15	UEPIX	−0.28	1.03***	−0.34***	−0.36***	−0.05	0.72
16	DSEUX	−0.09	1.09***	−0.14	0.06	0.01	0.91
	Value-weighted portfolio	−0.00	0.70***	0.35***	−0.07	−0.01	0.77

Source: Author’s estimations.

Note: * – p-value < 0.10; ** – p-value < 0.05; *** – p-value < 0.01.

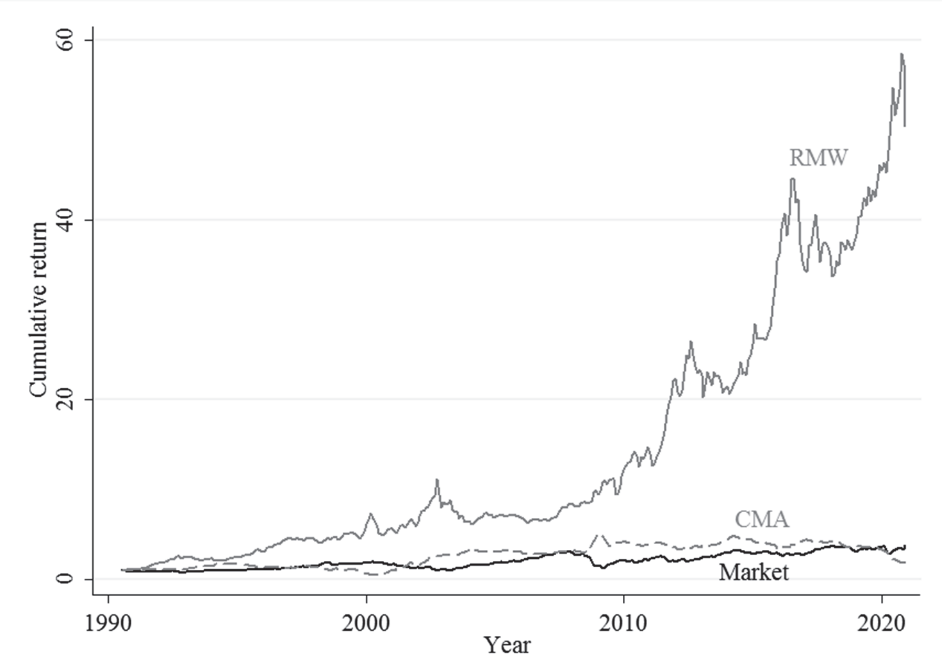
Table 6: Time-series regressions of fund excess returns on five Fama-French factors

Rank	Fund/portfolio	α	β	b_{SMB}	b_{HML}	b_{RMW}	b_{CMA}	R^2
1	EUGAX	0.16	0.84***	0.02	−0.20**	−0.16	−0.09***	0.73
2	PRESX	0.10	0.93***	0.11	−0.08	−0.09	−0.08	0.73
3	CAEAX	−0.10	1.10***	0.74***	−0.40**	0.21	−0.04	0.93
4	HFEAX	0.27	0.97***	0.60***	−0.03	−0.06	−0.72**	0.71
5	BAFHX	−0.11	1.08***	0.01	−0.25	0.18	−0.05	0.83
6	FHJUX	−0.24	1.14***	0.06	−0.52*	−0.27	−0.06	0.82
7	MDEFX	0.04	0.88***	0.23	0.13	−0.20	−0.01	0.56
8	VGEAX	−0.06	0.94***	−0.01	−0.53	0.08	−0.07	0.44
9	DFCSX	0.05	0.99***	1.03***	0.12	−0.17	0.14	0.72
10	VEURX	0.00	0.96***	−0.08***	0.07*	−0.03	−0.11*	0.95
11	ESMAX	0.47	0.70***	1.20***	0.06	−0.06	−0.62	0.43
12	VEUAX	0.05	0.93***	0.35***	0.02	0.03	−0.23	0.74
13	AEDAX	0.18	0.91***	0.33***	−0.12	0.29**	−0.46***	0.79
14	TEMIX	0.12	0.65***	0.26**	0.23*	0.27*	−0.13	0.50
15	UEPIX	−0.28	0.99***	−0.38***	−0.18	−0.04	−0.33*	0.72
16	DSEUX	−0.20	1.05***	−0.22	0.28	0.09	−0.47	0.92
	Value-weighted portfolio	0.02	0.66***	0.34***	0.02	−0.02	−0.17**	0.77

Source: Author's estimations.

Note: * – p-value < 0.10; ** – p-value < 0.05; *** – p-value < 0.01.

Figure 5: Risk-adjusted cumulative returns of the European RMW and CMA factors compared to the market portfolio



Source: Kenneth French's Data Library
Note: Monthly data, July 1990 – November 2020.

5.2. Discussion

The perplexing nature of our findings can be understood in the following simple manner. On the one hand, we know with absolute certainty that there are simple, commonly known investment strategies that investors could easily follow. These strategies could be fully implemented automatically to achieve a better risk–return trade-off than the market. Therefore, how is it possible that actively managed funds struggle to outperform even the market portfolio itself?

An alternative way of looking at these results is to not necessarily expect that all mutual funds will follow strategies that provide the best risk–return trade-off. However, what should be indisputable is that the performance of a typical equity fund should be reasonably close to the market portfolio. Table 2 shows that a value-weighted portfolio of even the top funds has a Sharpe ratio slightly below the market. When we consider the known trading anomalies, the inability of funds to generate positive and significant alphas becomes truly abstruse. The service that actively managed funds offer is careful investment selection: it remains unclear why they consistently fail in that effort, as the past three decades of research indicate (Cuthbertson et al., 2010; Fama & French, 2010).

Undoubtedly, some mutual funds will outperform the market, while others will underperform, even if we track their performance over extended periods. The idea is not to separate 'good' from 'bad' funds but to understand whether successful funds perform well merely as a coincidence or as a result of their skill and knowledge. A possible way to answer this question is to determine a measurable property or at least a criterion (even a qualitative one) that can be used to sort funds into portfolios. Such a metric or criterion would have to separate the funds ex-ante and track their performance over time. One metric commonly applied in the literature is the false discovery rate proposed by Barras et al. (2010). If investment skills positively influence performance, funds that are better according to the selection criterion will beat the market continuously and systematically.

Nevertheless, the vast majority of findings so far point to the same conclusion: there is no apparent relationship between the two, and mutual funds do not exhibit persistent returns. There is also no measurable causal link between good past and current performance. A typical mutual fund underperforms the market portfolio, while the fund returns show no predictability. Active investment strategies are not providing higher returns than passive investment strategies. They most likely provide lower returns when considering the typical transaction cost of 66 basis points per annum for global actively managed funds (PwC, 2020).

Another curious phenomenon is that the momentum and the profitability anomaly remain largely unexploited and continue yielding high Sharpe ratios. The momentum anomaly has been known since 1997 and the profitability anomaly since 2015. Nevertheless, they still significantly outperform the market, even when we consider the risk, as shown in Figures 4 and 5. This observation contrasts with the U.S. stock market, where benchmark portfolios became stagnant after a continuously increasing trend. The strong coupling with the benchmark portfolios is one of the usual explanations of why mutual funds fail to outperform the market in the longer run: only the equilibrium risk premia survive for decades. Otherwise, it would be difficult to understand why mutual funds do not perform better. However, such an explanation does not seem to be supported by the evidence we obtained for the European stocks.

Our findings for U.S.-based European equity funds are consistent with previous studies on the performance of mutual funds that invest in the United States (see, for instance, Mateus et al. 2019 for an overview). As we pointed out in Section 1, not many studies focus on the performance of European equity funds. Otten & Bams (2002) conduct an overview of 506 mutual funds from five European countries. They find that in four of these countries the funds outperform the market portfolio. They also report strong evidence of return persistence for U.K. funds. Vidal-García (2013) finds a similar persistence pattern for funds traded in six European markets between 1988 and 2010. These findings deviate from most studies for U.S.-based funds and are also in stark contrast to our evidence of underperformance for even the top-performing funds. Graham et al. (2019) report that both U.S. and European equity funds achieve high profits under very similar conditions, which could be a possible clue regarding their comparable lack of performance.

6. CONCLUSION

In this paper we have studied the performance of actively managed U.S. mutual funds specialising in investing in European stocks. Our sample consisted of monthly returns on the top sixteen mutual funds ranked by the U.S. News Mutual Fund Score between July 1990 and November 2020. We measured the performances of our sample funds through their abnormal returns, captured by the regressional intercept (i.e., alpha) in the standard factor models. We used four benchmark models: CAPM, the three-factor model of Fama & French (1993), the four-factor model of Carhart (1997), and the five-factor model of Fama & French (2015). We detected no abnormal positive returns for any of the funds: the CAPM model gave either insignificant or negative alphas. By contrast, all three multifactor models had systematically insignificant alphas for all the funds. Therefore, the top European equity funds' returns can be trivially explained by the known risk factors.

We found that the sample funds did not exploit some of the well-known market anomalies that could have significantly improved their performance. Only two funds had significant exposure to the European momentum factor (WML), and only one fund had significant exposure to the stocks of highly profitable companies (the RMW factor). Exposure to either of these two portfolios would have resulted in a considerable improvement in the Sharpe ratio of the observed funds. On the other hand, the funds successfully exploited the downturn of the value stocks, i.e., the negative average return on the HML factor during the previous six years.

An overly simplistic interpretation of the lack of exposure to WML and RMW factors is that the fund managers were unaware of the evidence regarding the market anomalies. Despite the naivety of such a conclusion, this is what the results seem to imply. Of course, we should take it with a grain of salt. The consistently high significance of market betas and the short positions in the HML factor together illustrate that the funds track the performance of at least two crucial benchmark portfolios.

Since at least two known anomalies persist in Europe, we show they represent significant potential to improve the risk–return trade-off of funds that focus on European stocks. This potential is currently used sub-optimally. Therefore, our findings present some relevant explorable avenues that investors and academic researchers alike can investigate. A possible limitation of our results relates to the relatively small cross-sectional dimension of the sample. Expanding the scope of the funds is a relevant avenue for further research.

ACKNOWLEDGEMENT

This research was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia. I am thankful to the anonymous reviewers of this manuscript for their valuable comments and suggestions. The usual disclaimer applies.

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Received: January 26, 2021
Accepted: August 23, 2021

ECONOMIC ANNALS, Volume LXVI, No. 230 / July – September 2021
UDC: 3.33 ISSN: 0013-3264

https://doi.org/10.2298/EKA2130035C

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BANK COMPETITION AND RISK-TAKING IN THE EUROPEAN UNION: EVIDENCE OF A NON-LINEAR RELATIONSHIP

ABSTRACT: *This paper assesses the impact of bank specialisation and business models on the relationship between competition and risk. We tested the non-linear relationship between bank competition and risk on an extensive sample of 5,119 European banks active during 2000–2018, using system GMM. The results confirmed the nonlinear relationship between competition and risk-taking. Cooperatives are better protected against liquidity risks and are more stable. Well-diversified banking entities take more risks than their counterparts, whereas larger institutions have a lower risk appetite and a higher exposure to liquidity shocks. Future regulations should consider different risk strategies to make them more efficient and to generate the expected outcomes. The most recent regulatory developments have reduced the risk appetite of large financial institutions. Lastly, it is critical that regulators monitor M&A activity and ensure the optimal competition level.*

KEY WORDS: *banking competition; bank stability; risk management; financial policy; business model*

JEL CLASSIFICATION: G21, G28

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1. INTRODUCTION

The most recent financial crisis led to stricter regulation of European banking. Banks had to comply with additional capital and liquidity requirements and these changes implied new costs for the financial institutions (FIs) that translated mainly into lower overall profitability. This left banks with the choice of either adjusting their operations or exiting the market. Top management are increasingly aware of their responsibility and legal liability and know that competent and prudent governance convinces regulators to refrain from imposing additional constraints on entrepreneurial activity. The increasing number of mergers and acquisitions (M&A) in response to the cost burdens caused by new regulations, the need to bail-out banks, low levels of profitability or excess of capacity meant that bank competition dropped after 2008. At the same time, the measures introduced by supervisory authorities should have diminished the risk appetite of FIs.

However, prior to 2008, European regulators encouraged financial institutions to compete more and deliver high quality products and services to their clients. At the same time, permanent efforts were made to integrate banking systems and create one single market for financial activities.

Bank risk-taking and its determinants has been widely discussed recently. Two main issues have been extensively investigated in the empirical literature. The first concerns the link between competition and bank risk-taking. However, as suggested by the meta-analysis of Zigraiova & Havranek (2016), results are relatively mixed and do not give a clear-cut answer as to how bank competition affects bank risk-taking and thus financial stability. While some papers find that bank competition is not beneficial to overall financial stability (see, e.g., Marcus, 1984; Chan et al., 1986; Keeley, 1990; Hellmann et al., 2000; Matutes & Vives, 2000; Allen & Gale, 2004 and Wagner, 2010), other researchers reach opposite results (see, e.g., Boyd & De Nicoló, 2005). In line with the theoretical predictions of Martinez-Miera & Repullo (2010), some recent empirical studies suggest that this relationship can be non-linear.

The second important issue investigated in the banking literature concerns the link between business model, ownership structures, and bank risk-taking. Indeed, standard property rights (Alchian & Demsetz, 1972) and agency (Jensen &

Meckling, 1976) theories suggest that the form of ownership is a key determinant of firms' risk-taking. In addition, papers like Hesse & Cihák (2007), Ayadi et al. (2010), Martinez-Miera & Repullo (2010), Presbitero & Zazzaro (2011), Liu et al. (2013), and Fiordelisi & Mare (2014) have shown that banking markets with a higher share of cooperative unions are less exposed to financial distress when the level of competition rises. Moreover, the benefits of income diversification depend on the size of the financial institution. For instance, Köhler (2015) finds that cooperative banks enjoy diversification benefits the most, as through their investment in non-interest activities they have lower risk exposure.

Against this background, our paper contributes to the existing literature by testing competition–risk nexus conditioned by the business model (i.e., structure of assets, funds, and revenues) and bank specialisation (i.e., commercial, cooperative, savings) to check whether financial institutions respond differently to competition according to how they operate and organise their activities.

To the best of our knowledge, no study exists in the literature that deals with this topic. A lot of research (e.g., Hesse & Cihák 2007; Altunbas et al. 2012; Fiordelisi & Mare 2014; Chiaramonte et al. 2015; Köhler 2015; Clark et al. 2018) only investigates the impact of business models on risk appetite or the influence of certain forms of bank specialisation on financial stability. The bulk of the literature primarily deals with the competition–stability controversy in commercial banking (Berger et al., 2009; Beck et al., 2013; Lapteacru, 2017), and only a few papers consider cooperatives (Clark et al., 2018). Moreover, we investigate the possible nonlinear relationship using the U-test. Lastly, the extended sample and timeframe allow for investigation of various macroeconomic and financial conditions, such as boom, financial crisis, and recession.

The remainder of the study is structured as follows. Section 2 briefly reviews the existing literature. In Section 3 we present the data used and methodology applied. The results are reported and discussed in Section 4, along with several robustness checks. Section 5 concludes.

2. LITERATURE REVIEW

The impact of bank competition on financial stability remains a topic of interest for researchers, policymakers, and regulatory authorities. Several theoretical and empirical studies find that competition is beneficial for overall financial stability (Boyd & De Nicoló, 2005; Schaeck et al., 2009), whereas earlier literature claims the opposite (Allen & Gale, 2004; Keeley, 1990). Martinez-Miera & Repullo (2010) reconcile these conflicting views and identify a risk-shifting effect that enhances stability due to lower default rates on loans as a result of decreasing interest rates, and a margin effect that reduces buffers against loan losses and promotes instability. The two competing forces result in a U-shaped relationship between competition and stability.

2.1. Competition–fragility

Fiercer bank competition generates higher financial instability and more fragile entities as FIs take up riskier projects with substantial and quick profits. These strategies expose financial institutions to higher risks and may lead to bankruptcy.

In deposit markets, increasing competition results in riskier bank decisions as franchise value declines (Marcus, 1984). Similarly, loan quality decreases with growth in the number of banks (Broecker, 1990) because more competition means lower informational advantage and higher risk exposure (Bofondi and Gobbi, 2004), while market power lessens bank default profitability (Jiménez et al., 2006). US financial liberalisation stimulates risk-taking and reduces charter value and total profits (Keeley, 1990; Edwards & Mishkin, 1995; Hellmann et al., 2000). The strongest US institutions should be solvent and hold risky assets (Demsetz et al., 1997). Boyd & De Nicolo (2005) argue that market concentration positively impacts banking fragility.

The concentration in the EU25 banking market has a significant negative effect on financial soundness, primarily due to the higher returns volatility of large FIs in concentrated markets. Moreover, East European banks are exposed to lower competition, have fewer diversification options, and a greater proportion belong to the government, and therefore they are considered more fragile (Uhde & Heimeshoff, 2009).

2.2. Competition–stability

The probability of default increases in a more concentrated banking sector, since the bankruptcy of a big FI creates systemic risk and higher loan interest rates generate credit risk due to moral hazard, adverse selection, and a higher non-performing-loans ratio (Stiglitz and Weiss, 1981; De Nicoló et al., 2006). In addition, market concentration decreases loan rationalisation, higher credits, and the probability of default (Caminal & Matutes, 2002), while fiercer competition does not boost risk in South-Eastern Asia (Liu et al., 2013).

Regarding European banks, more concentrated banking sectors reduce financial stability (Uhde & Heimeshoff, 2009). Competition significantly improves stability via the efficiency channel and lowers the systemic risk, measured by the aggregated value of non-performing loans. Fiercer competition improves overall bank capital and profitability, except in the case of fragile financial institutions (Schaeck & Cihák, 2014). No clear positive relationship between regulatory framework and competition level has been revealed in CEE countries. Once credit risk is taken into account, enhanced banking regulations and entry requirements have a negative effect on market power (Agoraki et al., 2011).

2.3. Competition–fragility and competition–stability

In their research on a 1999–2005 sample of 23 European and Middle Eastern states, Berger et al. (2009) claim that competition–stability and competition–fragility coexist: higher competition generates increasing non-performing loan (NPL) rates, whereas higher market power decreases insolvency risks.

2.4. Business model and bank specialisation

Several papers analyse the impact of bank type or ownership on risk-taking behaviour and competition–risk nexus.

Cooperative banks are, on average, more stable due to the ease of access to information on clients' creditworthiness, their lower returns' volatility (implicit lower profitability), and the mutual support mechanism that characterises their business model. However, cooperative banks are less likely to be bailed out in case of default since they are small and their default does not lead to panic in financial markets. When cooperative banks have a larger market share, commercial banks become less stable since they have less access to the retail market and so finance their activities using less stable revenues (Hesse & Cihak, 2007; Groeneveld & de Vries, 2009; Liu et al., 2013). Another study confirms that the more diversified banks are the more stable they are, especially in the case of savings and cooperative banks in EU15 countries (Köhler, 2015).

Iannota et al. (2007) identify different financial intermediation models in 15 European countries based on asset and funding structure. According to them, mutual banks have better loan quality and are less exposed to asset risk than public and private banks. In line with this, García-Marco & Robles-Fernández (2008) show that Spanish commercial banks adopt riskier strategies than savings banks. Cooperative and savings banks are more stable than their private counterparts in Germany due to consumer surplus maximisation, diverse shareholdings, a focus on capital endowment protection, and lower profit volatility (Beck et al., 2009).

Fiordelisi & Mare (2014) go a step further and find a positive relationship between competition and stability, meaning that cooperative banks are riskier in less competitive environments in Western Europe. Therefore, the competition–stability hypothesis holds in both the short and long run. Likewise, Clark et al. (2018) conclude that competition between cooperative banks in Western Europe reduces individual stability, though the relationship is hump-shaped because of market power in the loans market.

Several researchers have carried out in-depth analyses of financial reports to investigate further the link between specialisation, diversification, and risk-taking appetite. Non-interest-generating activities belong to two categories: trading activities and commission and fee activities. As fee-based activities in European countries are riskier than trading activities, non-traditional activities contribute to a more fragile banking system (Lepetit et al., 2008). On the other hand, high interest margins and loan-to-asset ratios stimulate the stability of the EU15 banking sector (Jonghe et al., 2010).

More recently, papers have emerged on the evolution of risk prior to and after the financial crisis according to business model and bank specialisation. Lower diversification of income sources prior to the financial crisis partly explains the ex-post distress of European and American listed banks (Altunbas et al., 2011). The business model is a major source of risk during and after global crises, except for in Europe (Prabha & Wihlborg, 2014). Similarly, cooperative banks in 26 OECD countries had a more stable business model during the global financial crisis due to their steadier returns. Prior to the crisis these institutions did not significantly impact stability since most banking entities were stable. During times of financial turmoil, having a higher share of cooperatives contributes to the stability of the financial sector (Chiaramonte et al., 2015). Retail-oriented business models are the most resilient and are less exposed to financial distress (Chaffai & Dietsch, 2015; Mergaerts & Vennet, 2016). The resilience to risk also depends on internal governance (Martín-Olivera et al., 2017).

Overall, no available research explicitly assesses the potential reaction of financial institutions to competitive pressures while considering their business model. Thus, our study advances the literature by considering the impact of the type of bank, diversification, and asset and fund structure on financial stability. All these elements are of interest in designing effective competitive and prudential regulation at the European level.

3. METHODOLOGY AND DATA

3.1. Sample

Using financial data provided by FitchConnect, we estimate the competition and risk measures for commercial, cooperative, savings, mortgage, investment, and private banks in the 28 member states of the European Union in 2000–2018.

Several steps were taken to ensure the high quality and relevance of the data. First, we included in our sample only banks with financial statements available for the last three years and positive values for inputs and outputs. We chose a minimum period of three years, since this is the time window used to estimate the Z-score. In addition, we selected FIs with unconsolidated reports, as these statements do not include any reference to business carried out abroad through subsidiaries. On top of this, all the banks were checked to see if they had been involved in an M&A process, and only the merged entity or the acquiring bank remained in the sample.

3.2. Empirical Strategy

We assess the competition–risk nexus using the following model:

$$Risk_{ij,t} = \beta_0 + \beta_1 \cdot Risk_{ij,t-1} + \beta_2 \cdot Competition_{ij} + \beta_3 \cdot Competition_{ij}^2 + \Theta \cdot Bank\,controls_{ij} + \Phi \cdot Macro\,controls_j + Crisis_t + \varepsilon_{ij,t} \quad (1)$$

where *i, j,* and *t* are the bank, country, and time dimensions respectively.

The dependent variable, bank risk, is estimated using a Z-score with a three-year window for ROAA mean and standard deviation (Yeyati & Micco, 2007; Beck et al., 2013; Liu et al., 2013):

$$Z_{it} = \frac{\frac{E_{it}}{A_{it}} + \mu_{ROAA_{it}}}{\sigma_{ROAA_{it}}} \quad (2)$$

where $\frac{E_{it}}{A_{it}}$ = equity to total assets ratio;

$\mu_{ROAA_{it}}$ = mean and standard deviation of $ROAA_{it}$.

We take the natural logarithm of (1+ Z-score), as suggested by Demirgüç-Kunt et al. (2008), Laeven & Levine (2009), and Houston et al. (2010), to lessen the impact of higher values for the Z-score and to enable the estimation of risk measure even when this is negative.

The regressor is competition, measured at the bank level, primarily by the adjusted Lerner index (Fernández de Guevara et al., 2007; Carbó et al., 2009; Weill, 2013; Lapteacru, 2017; Leroy & Lucotte, 2017): since the Lerner index suffers from several flaws and must be altered for efficiency, banks may not be efficient in terms of costs and profits (Koetter et al., 2012):

$$adjusted\ Lerner_i = \frac{\pi_i + tc_i - mc_i \cdot q_i}{\pi_i + tc_i} \quad (3)$$

with the bank profit being π_i, total cost tc_i, marginal cost mc_i and total output q_i.

The adjusted Lerner index ranges between zero and one, higher values showing stronger market power and lower competition. Financial institutions use labour, fixed assets, and customer deposits to finance total assets. We regress the following translog cost function by means of a panel data model with year fixed effects, using the Distribution Free Approach (DFA), along with cost and profit frontier. To obtain the marginal costs, we assume that each bank competes locally and specify the cost function for each country.

$$lnTC = \alpha_0 + \sum_{i=1}^{2}\alpha_1 lnQ_i + \frac{1}{2}\sum_{i=1}^{2}\alpha_1 ln(Q_i)^2 + \frac{1}{2}\sum_{i\neq j}^{2}\alpha_{i,j} lnQ_i lnQ_j + \sum_{i=1}^{2}\sum_{i=1}^{2}\delta_{i,k}(lnQ_i lnP_k)$$
$$+\sum_{i=1}^{3}\beta_k lnP_k + \frac{1}{2}\sum_{k=1}^{3}\sum_{m=1}^{3}\beta_{k,m}(lnP_k lnP_m) + \theta_1 \ln T + \frac{1}{2}\ln(T)^2 + \vartheta z, \quad (4)$$

where TC = LKOST + KCOST + FCOST;

$Q_{i,j}$ = the value of the output variable (total assets);

$P_{k,m}$ = three input prices (price of labour, measured as personnel expenditures/total assets; price of other inputs, measured as other operating expenses/total assets; price of funding, measured as total interest expenses/interest-bearing liabilities);

T = time trend;

z = total equity.

We include two alternative measures as robustness checks, the Boone indicator, computed for each bank, and liquidity risk (i.e., the share of liquid assets in deposits and short-term funding). Clerides et al. (2015) estimate the Boone (2008) index for each FI using the equation below:

$$profit\ elasticity_i = \frac{q_i \cdot mc_i}{q_i \cdot mc_i - tc_i\left(1 - adjusted\ Lerner_i\right)} \quad (5)$$

where q_i refers to bank output (i.e., total assets), mc_i represents the marginal cost, tc_i the total costs, and $adjusted\ Lerner_i$ is the index previously estimated.

The latter risk index is relevant and adds value to our research, since the most recent financial crisis has proven the importance of bank liquidity.

Following Berger et al. (2009), Martinez-Miera & Repullo (2010), Liu et al. (2013), and Clark et al. (2018), we introduce the squared term of competition to account for the U-shaped relationship and test it using the U-test. We employ several bank-level control variables commonly used in the literature (*Bank controls*$_{ij,t-1}$) to account for disparities in bank characteristics (Liu et al., 2013; Clark et al., 2018): (1) size as the logarithm of total assets, (2) diversification expressed by total non-interest operating income to gross revenues, and (3) efficiency measured by the cost-to-income ratio. *Macro controls*$_{j,t-1}$ include factors like GDP growth (%) and inflation (CPI) to control for heterogeneity across banking systems and macroeconomic conditions. The model also includes a dummy that accounts for the 2008–2010 crisis ($Crisis_t$). $\varepsilon_{ij,t}$ represents the error term. Table 1 in the Appendix shows the definition of all the variables previously mentioned, while Table 3 in the Appendix reflects important differences in the economic development and behaviour displayed by the analysed banks in time.

In the second specification we interacted the competition measure with the variables for bank specialisation and the business model, which shows the structure and diversification of assets and funding.

Given the potential endogeneity problems between bank competition and risk, we follow Beck et al. (2013) and Chiaramonte et al. (2015) and estimate the model with system GMM. Dependent variables are instrumented using lags 2–4, while the other variables are instrumented by themselves.

4. RESULTS

The results of the inverse U-test confirm the presence of a strong and significant inverse U-shaped relationship between competition and risk-taking (Table 4 in the Appendix). The turning point of 0.51 shows that beyond this value, market power enhances financial fragility. These outcomes support the paradigm proposed by Martinez-Miera & Repullo (2010). The risk-shifting effect dominates in concentrated markets, with high values for the adjusted Lerner index. By contrast, when banks compete more fiercely the margin effect prevails, lowering loan repayments and reducing the buffer that covers potential loan losses. The business cycle and the size of the FIs encourage bank stability, as expected. When economic conditions are good, banks loosen their lending requirements, whereas worse outlooks lead them to take more cautious risk strategies. At the same time, larger financial entities profit from economies of scale and market power (Saunders et al., 1990; Boyd & Runkle, 1993; Laeven & Levine, 2009; Demirgüç-Kunt & Huizinga, 2010; Brown & Dinç, 2011; Fu et al., 2014). Inflation, efficiency, and diversification contribute to making the financial system less stable. Banks are riskier and have a higher probability of default when they increase the share of non-interest income (Demsetz & Strahan, 1997; Stiroh, 2004; Laeven & Levine, 2009; Demirgüç-Kunt & Huizinga, 2010; Liu & Wilson, 2013; Liu et al., 2013). A high inflation rate translates into information asymmetry, price volatility, and a reduced ability to make the right decisions (Demirguc-Kunt & Detragiache, 1998; Lown & Morgan, 2006; Buch et al., 2014). Inefficient banks are riskier than their counterparts since they try to compensate for their low efficiency level by having more relaxed lending requirements and less restrictive credit monitoring (De Nicoló & Jalal, 2006; Agoraki et al., 2011).

Table 5 in the Appendix reports the results of the regression, taking into account the impact of bank specialisation on the competition–risk nexus. The outcomes of the Lind & Mehlum (2010) test reflect the strong and significant inverse U-shaped nexus. Cooperatives are risk-adverse, whereas for their counterparts that display the same behaviour it is not statistically significant (Hesse & Cihák et al., 2007; Groeneveld & de Vries, 2009; Beck et al., 2013; Liu et al., 2013; Liu & Wilson, 2013).

Given the influence of the business model on the relationship between competition and risk, well-diversified banks tend to face financial distress, while a solid funding structure guarantees that a financial institution is more stable (Table 6). These outcomes are similar to those of DeYoung & Roland (2001), Stiroh (2004), Acharya et al., (2006), Stiroh & Rumble (2006), and Demirgüç-Kunt & Huizinga (2010). Bank lending behaviour stimulates overall stability, since the financial institutions included in the sample constantly invest in soft information and monitor relationships with their clients to reduce the default risk (Liu et al., 2013). Whenever banks are exposed to increasing competition, assets and funding structures and diversification have a negative effect. This impact remains significant only for diversification.

All the results noted previously are complemented by robustness checks performed using alternative measures of the Boone indicator for competition and liquidity risk for risk. Competition stimulates bank stability and the non-linear relationship is confirmed in all the additional scenarios, including the Boone indicator (Table 7 in the Appendix). Commercial and cooperative banks appear to harm the stability of the banking sector, whereas savings banks are more solid. When the level of competition is on the rise, commercial banks and cooperatives apply riskier strategies to preserve their profitability and market position (Table 8 in the Appendix). Lending patterns and funding structure decrease the banks' risk exposure, while portfolio diversification contributes to a more fragile banking sector. The same results occur when there is greater competition (Table 9 in the Appendix). Based on the results of the U-test, Table 10 in the Appendix shows the quadratic relationship between bank competition and liquidity risk. Cooperative banks encounter the least exposure to liquidity risk, with fiercer competition having a negative impact (Table 11 in the Appendix). Diversification strategies and the funding structure expose financial institutions to additional challenges for their liquidity levels. However, if banks are exposed to greater competition, having a larger share of loans ensures safety (Table 12 in the Appendix).

5. CONCLUSIONS

In this study we investigate the impact of bank specialisation and business models on the competition–risk relationship using a sample of 5,119 commercial, cooperative, savings, mortgage, investment, and private banks from EU28 countries in 2000–2018. The current research finds evidence of a robust non-linear relationship between bank competition and risk, taking into account different variables like the adjusted Lerner index, the Boone indicator, the Z-score, and liquidity risk, and controlling for bank-specific and country-specific factors.

We analyse business models by considering loan share, diversification, and funding structure. Several outcomes are of interest to policymakers. First, depending on their type, financial institutions follow different risk strategies: well-diversified entities take more risks than their counterparts. Size does not harm overall financial stability, suggesting that the most recent regulatory developments have reduced the risk appetite of large financial institutions. Lastly, above a certain threshold a low level of competition enhances individual risk-taking behaviour and is detrimental to the stability of the banking sector. Therefore, it is critical that regulators monitor M&A activity and ensure the optimal level of competition. In the same vein, the designers of future regulations should consider these evidence in order to support the financial stability.

Further studies on this topic may consider alternative measures of liquidity risk along with indicators for interest rate and credit risk.

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Received: August 16, 2020
Accepted: February 27, 2021

APPENDICES

Table 1: Description of variables

Variable	Definition	Source
Dependent variables (bank level)		
Z-score	Measure of bank soundness that shows the capacity of the financial institutions to absorb losses.	Own calculation [a]
Liquidity risk	Liquid assets to deposits and short-term funding.	Own calculation [a]
Main regressors (bank level)		
Adjusted Lerner index	Scores for market power at bank-level adjusted for cost and profit inefficiency. The variable ranges between 0 and 1. The higher the value is, the lower the competition.	Own calculation [a]
Boone indicator	Scores for the profit efficiency of market power. The more negative the value is, the fiercer the competition.	Own calculation [a]
Bank controls (bank level)		
Size	Log of bank total assets.	Own calculation [a]
Diversification	Total non-interest operating income to gross revenues.	Own calculation [a]
Efficiency	Cost to income ratio.	FitchConnect
Specialisation	Variable successively equal to dummies for commercial, cooperative, and savings banks.	FitchConnect
Business Model	Variable that alternatively refers to asset structure (the share of total loans in total assets), diversification, and funding structure.	Own calculation [a]
Macro controls (country level)		
GDP growth	Annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	World Development Indicators
Inflation	Inflation measured by the consumer price index, reflecting the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals.	World Development Indicators
Crisis dummy	Dummy variable that takes the value 1 during the GFC (2008–2010) and 0 otherwise	Own calculation [a]

Note: [a] Based on FitchConnect data. Variables have annual frequency.

Table 2: Distribution of banks

Country	Total number of banks
Austria	551
Belgium	67
Bulgaria	25
Croatia	41
Cyprus	25
Czech Republic	36
Denmark	123
Estonia	13
Finland	59
France	344
Germany	1,796
Greece	14
Hungary	166
Ireland	29
Italy	735
Latvia	18
Lithuania	12
Luxembourg	116
Malta	19
Netherlands	42
Poland	175
Portugal	121
Romania	33
Slovakia	21
Slovenia	20
Spain	187
Sweden	117
United Kingdom	214
Total	**5,119**

Table 3: Descriptive statistics

Variable name	Observations	Mean	Standard deviation	p25	p50	p75	Min	Max
Dependent variables								
Z-score	42,146	5.73	3.52	4.58	5.48	6.54	0.00	42.73
Liquidity risk	55,053	0.26	0.31	0.09	0.16	0.30	0.01	2.19
Independent variables								
Competition								
Adjusted Lerner	54,306	0.35	0.15	0.27	0.35	0.43	–0.22	0.80
Boone	54,306	–0.07	0.05	0.07	0.08	0.15	–0.57	–0.02
Business models								
Loan share (asset structure)	54,953	0.58	0.21	0.49	0.61	0.72	0.00	8.95
Funding structure	55,079	0.81	0.17	0.80	0.87	0.90	0.00	5.92
Diversification	55,414	0.22	0.17	0.13	0.18	0.26	0.00	1.00
Specialisation								
Commercial bank	55,414	0.05	0.21	0.00	0.00	0.00	0.00	1.00
Cooperative bank	55,414	0.13	0.34	0.00	0.00	0.00	0.00	1.00
Savings bank	55,414	0.02	0.14	0.00	0.00	0.00	0.00	1.00
Bank controls								
Efficiency	55,411	0.80	4.90	0.60	0.69	0.76	0.00	658.00
Size	55,414	20.51	1.86	19.27	20.34	21.54	11.95	29.00
Macro controls								
GDP growth	55,414	1.45	2.31	0.58	1.70	2.82	–14.81	25.12
Inflation rate	55,414	1.66	1.48	0.99	1.55	2.08	–4.48	45.67
Crisis	55,414	0.16	0.37	0.00	0.00	1.00	0.00	1.00

Table 4: Bank competition and risk

Dependent variable	Z-score
Explanatory variable	(1)
Z-score (lag)	0.327**
	(0.071)
Adjusted Lerner	6.059**
	(0.598)
Adjusted Lerner squared	–5.986**
	(0.699)
Crisis	–0.345**
	(0.046)
GDP growth	–0.005
	(0.007)
Inflation	–0.053**
	(0.014)
Size	0.146**
	(0.016)
Diversification	–0.974**
	(0.133)
Efficiency	–0.019**
	(0.006)
Nr. of observations	36,199
Nr. of banks	4,301
	6.020
Inverse U-shape test	[0.000]
Turning point	0.506
95% CI, Fieller method	[0.472; 0.551]
AR(1)–(p-value)	0.000
AR(2)–(p-value)	0.199
Hansen j statistic (p-value)	0.197

Note: The table reports the estimation results of the following regression $Risk_{ij,t} = \beta_0 + \beta_1 \times Risk_{ij,t-1} + \beta_2 \times Competition_{ij} + \beta_3 \times Competition^2_{ij} + \Theta \times \text{ Bank controls}_{ij} + \Phi \times \text{ Macro controls}_j + Crisis_t + \varepsilon_{ij,t}$. Estimations are run using system GMM. The U-shape test is based on Lind & Mehlum (2010), with the p-value of the test statistic reported between square brackets. The Hansen test assesses the joint validity of the instruments used. Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 5: Bank competition, risk, and specialisation

Dependent variable	Z-score	Z-score	Z-score
Explanatory variable	(2)	(3)	(4)
Z-score (lag)	0.328**	0.329**	0.327**
	(0.071)	(0.071)	(0.071)
Adjusted Lerner	6.070**	6.507**	6.083**
	(0.597)	(0.661)	(0.599)
Adjusted Lerner squared	–5.880**	–6.304**	–5.999**
	(0.690)	(0.745)	(0.697)
Crisis	–0.347**	–0.327**	–0.345**
	(0.046)	(0.046)	(0.046)
GDP growth	–0.005	0.000	–0.005
	(0.007)	(0.007)	(0.007)
Inflation	–0.047**	–0.052**	–0.052**
	(0.013)	(0.014)	(0.014)
Size	0.145**	0.139**	0.146**
	(0.016)	(0.015)	(0.016)
Diversification	–0.911**	–1.031**	–0.983**
	–0.13	–0.136	–0.134
Efficiency	–0.018**	–0.019**	–0.019**
	(0.006)	(0.006)	(0.006)
Commercial bank	0.127		
	(0.111)		
Adjusted Lerner *Commercial bank	–2.207**		
	(0.345)		
Cooperative bank		0.603**	
		(0.113)	
Adjusted Lerner * Cooperative bank		–1.455**	
		(0.449)	
Savings bank			0.246
			(0.160)
Adjusted Lerner *Savings bank			–0.261
			(0.487)
Nr. of observations	36,199	36,199	36,199
Nr. of banks	4,301	4,301	4,301
	5.780	5.960	6.030
Inverse U-shape test	[0.000]	[0.000]	[0.000]
Turning point	0.517	0.516	0.507
95% CI, Fieller method	[0.480; 0.565]	[0.482; 0.561]	[0.473; 0.552]
AR(1)–(p-value)	0.000	0.000	0.000
AR(2)–(p-value)	0.200	0.201	0.199
Hansen j statistic (p-value)	0.209	0.200	0.197

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Bank competition, risk and business model

Dependent variable	Z-score	Z-score	Z-score
Explanatory variable	(5)	(6)	(7)
Z-score (lag)	0.324**	0.327**	0.335**
	(0.071)	(0.071)	(0.070)
Adjusted Lerner	7.549**	7.132**	4.556**
	(0.852)	(0.682)	(0.685)
Adjusted Lerner squared	−6.059**	−5.428**	−3.757**
	(0.701)	(0.670)	(0.530)
Crisis	−0.357**	−0.323**	−0.331**
	(0.047)	(0.046)	(0.045)
GDP growth	−0.002	−0.008	−0.015*
	(0.007)	(0.007)	(0.007)
Inflation	−0.059**	−0.045**	−0.061**
	−0.014	−0.014	−0.014
Size	0.115**	0.122**	0.084**
	(0.014)	(0.014)	(0.012)
Diversification	−1.016**	1.195**	−0.859**
	(0.146)	(0.224)	(0.128)
Efficiency	−0.027**	−0.022**	−0.025**
	(0.007)	(0.006)	(0.008)
Loan share	1.161**		
	(0.292)		
Adjusted Lerner *Loan share	−2.512**		
	(0.748)		
Adjusted Lerner *Diversification		−5.681**	
		(0.656)	
Funding structure			1.939**
			(0.280)
Adjusted Lerner * Funding structure			−0.459
			(0.566)
Nr. of observations	36,056	36,199	36,084
Nr. of banks	4,267	4,301	4,281
Inverse U-shape test	3.390	2.670	2.820
	[0.000]	[0.004]	[0.002]
Turning point	0.623	0.657	0.606
95% CI, Fieller method	[0.546; 0.712]	[0.589; 0.750]	[0.499; 0.720]
AR(1)–(p-value)	0.000	0.000	0.000
AR(2)–(p-value)	0.192	0.198	0.220
Hansen j statistic p-value	0.184	0.210	0.208

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Bank competition and risk, Robustness checks with Boone indicator

Dependent variable	Z-score
Explanatory variable	(8)
Z-score (lag)	0.307**
	(0.071)
Boone	4.818**
	(1.192)
Boone squared	4.448*
	(2.291)
Crisis	–0.279**
	(0.045)
GDP growth	0.011
	(0.007)
Inflation	–0.028*
	(0.013)
Size	0.217**
	(0.022)
Diversification	–0.578**
	(0.129)
Efficiency	0.000
	(0.012)
Nr. of observations	36,271
Nr. of banks	4,285
U-shape test	0.150
	[0.439]
Turning point	–0.542
95% CI, Fieller method	[–Inf; +Inf]
AR(1)–(p-value)	0.000
AR(2)–(p-value)	0.121
Hansen j statistic (p-value)	0.228

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Bank competition, risk and specialisation, Robustness checks with Boone indicator

Dependent variable	Z-score	Z-score	Z-score
Explanatory variable	(9)	(10)	(11)
Z-score (lag)	0.307**	0.306**	0.307**
	(0.071)	(0.071)	(0.071)
Boone	4.363**	4.917**	4.796**
	(1.180)	(1.199)	(1.205)
Boone squared	2.938	4.636*	4.395*
	(2.256)	(2.297)	(2.321)
Crisis	−0.287**	−0.280**	−0.279**
	(0.046)	(0.046)	(0.045)
GDP growth	0.012*	0.011	0.011
	(0.007)	(0.007)	(0.007)
Inflation	−0.028*	−0.028*	−0.028*
	(0.013)	(0.013)	(0.013)
Size	0.216**	0.217**	0.217**
	(0.022)	(0.022)	(0.022)
Diversification	−0.531**	−0.575**	−0.576**
	(0.127)	(0.129)	(0.130)
Efficiency	0.000	0.000	0.000
	(0.012)	(0.012)	(0.012)
Commercial bank	−0.990**		
	(0.131)		
Boone*Commercial bank	−3.739**		
	(0.841)		
Cooperative bank		−0.091	
		(0.163)	
Boone* Cooperative bank		−1.915	
		(3.758)	
Savings bank			0.002
			(0.377)
Boone*Savings bank			0.656
			(4.363)
Nr. of observations	36,271	36,271	36,271
Nr. of banks	4,285	4,285	4,285
U-shape test	–	0.230	0.130
		[0.410]	[0.449]
Turning point	−0.743	−0.530	−0.546
95% CI, Fieller method	[−Inf; +Inf]	[−10.271; −3.770]	[−Inf; +Inf]
AR(1)–(p-value)	0.000	0.000	0.000
AR(2)–(p-value)	0.121	0.121	0.121
Hansen j statistic (p-value)	0.221	0.225	0.228

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 9: Bank competition, risk, and business model; Robustness checks with Boone indicator

Dependent variable	Z-score	Z-score	Z-score
Explanatory variable	(12)	(13)	(14)
Z-score (lag)	0.310**	0.306**	0.325**
	(0.070)	(0.071)	(0.069)
Boone	3.502*	4.859**	–8.115**
	(1.410)	(1.206)	(1.618)
Boone squared	5.450*	3.994*	2.911
	(2.434)	(2.319)	(2.506)
Crisis	–0.265**	–0.280**	–0.269**
	(0.045)	(0.046)	(0.045)
GDP growth	0.013*	0.011	–0.005
	(0.007)	(0.007)	(0.006)
Inflation	–0.02	–0.028*	–0.036**
	(0.012)	(0.013)	(0.012)
Size	0.192**	0.217**	0.090**
	(0.019)	(0.022)	(0.011)
Diversification	–0.426**	–0.615**	–0.625**
	(0.135)	(0.177)	(0.124)
Efficiency	–0.001	0.001	–0.027**
	(0.012)	(0.012)	(0.007)
Loan share	0.835**		
	(0.198)		
Boone*Loan share	3.879**		
	(1.478)		
Boone*Diversification		–0.420	
		(0.941)	
Funding structure			3.292**
			(0.339)
Boone* Funding structure			18.215**
			(2.315)
Nr. of observations	36,142	36,271	36,173
Nr. of banks	4,255	4,285	4,273
U-shape test	1.60 [–0.055]	–	–
Turning point	–0.321	–0.608	1.394
95% CI, Fieller method	[–0.912; –0.812]	[–Inf; +Inf]	[–Inf; +Inf]
AR(1)–(p-value)	0.000	0.000	0.000
AR(2)–(p-value)	0.126	0.121	0.152
Hansen j statistic (p-value)	0.278	0.226	0.335

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 10: Bank competition and risk, Robustness checks with liquidity risk

Dependent variable	Liquidity risk
Explanatory variable	(15)
Liquidity risk (lag)	0.842**
	(0.042)
Lerner	–0.116**
	(0.030)
Adjusted Lerner squared	0.167**
	(0.045)
Crisis	0.000
	(0.002)
GDP growth	0.002**
	(0.000)
Inflation	0.004**
	(0.002)
Size	0.001**
	(0.000)
Diversification	0.104**
	(0.026)
Efficiency	–0.001
	(0.002)
Nr. of observations	47,932
Nr. of banks	4,891
U-shape test	3.510
	[0.000]
Turning point	0.348
95% CI, Fieller method	[0.312;0.397]
AR(1)–(p-value)	0.000
AR(2)–(p-value)	0.576
Hansen j statistic (p-value)	0.704

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 11: Bank competition, risk, and specialisation; Robustness checks with liquidity risk

Dependent variable	Liquidity risk	Liquidity risk	Liquidity risk
Explanatory variable	(16)	(17)	(18)
Liquidity risk (lag)	0.842**	0.839**	0.842**
	(0.042)	(0.043)	(0.042)
Adjusted Lerner	–0.114**	–0.133**	–0.117**
	(0.030)	(0.036)	(0.030)
Adjusted Lerner squared	0.166**	0.177**	0.168**
	(0.045)	(0.049)	(0.045)
Crisis	0.000	0.000	0.000
	(0.002)	(0.002)	(0.002)
GDP growth	0.002**	0.002**	0.002**
	(0.000)	(0.000)	(0.000)
Inflation	0.004**	0.004**	0.004**
	(0.001)	(0.002)	(0.001)
Size	0.001**	0.001**	0.001**
	(0.000)	(0.000)	(0.000)
Diversification	0.103**	0.108**	0.104**
	(0.026)	(0.027)	(0.026)
Efficiency	–0.001	0.000	–0.001
	(0.002)	(0.002)	(0.002)
Commercial bank	0.010		
	(0.010)		
Adjusted Lerner*Commercial bank	–0.009		
	(0.027)		
Cooperative bank		–0.029**	
		(0.008)	
Adjusted Lerner *Cooperative bank		0.067**	
		(0.023)	
Savings bank			0.000
			(0.010)
Adjusted Lerner*Savings bank			0.014
			(0.025)
Nr. of observations	47,932	47,932	47,932
Nr. of banks	4,891	4,891	4,891
U-shape test	3.550	3.370	3.520
	[0.000]	[0.000]	[0.000]
Turning point	0.345	0.374	0.347
95% CI, Fieller method	[0.307;0.394]	[0.337;0.431]	[0.312;0.399]
AR(1)–(p-value)	0.000	0.000	0.000
AR(2)–(p-value)	0.576	0.588	0.576
Hansen j statistic (p-value)	0.704	0.703	0.704

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 12. Bank competition, risk, and business model; Robustness checks with liquidity risk

Dependent variable	Liquidity risk	Liquidity risk	Liquidity risk
Explanatory variable	(19)	(20)	(21)
Liquidity risk (lag)	0.790**	0.843**	0.826**
	(0.050)	(0.042)	(0.045)
Adjusted Lerner	–0.004	–0.132**	0.292**
	(0.025)	(0.035)	(0.063)
Adjusted Lerner squared	0.139**	0.158**	0.073*
	(0.039)	(0.043)	(0.030)
Crisis	0.000	0.000	–0.002
	(0.002)	(0.002)	(0.002)
GDP growth	0.002**	0.002**	0.003**
	(0.000)	(0.000)	(0.000)
Inflation	0.005**	0.004**	0.003*
	(0.002)	(0.001)	(0.001)
Size	0.005**	0.001**	0.001
	(0.001)	(0.000)	(0.001)
Diversification	0.068**	0.069**	0.092**
	(0.018)	(0.025)	(0.024)
Efficiency	0.000	0.000	–0.001
	(0.002)	(0.002)	(0.002)
Loan share	–0.094**		
	(0.023)		
Adjusted Lerner *Loan share	–0.165**		
	(0.045)		
Adjusted Lerner *Diversification		0.091*	
		(0.054)	
Funding structure			0.007
			(0.017)
Adjusted Lerner* Funding structure			–0.426**
			(0.082)
Nr. of observations	47,755	47,932	47,891
Nr. of banks	4,853	4,891	4,886
U-shape test	1.850 [0.032]	3.12 [0.001]	–
Turning point	0.015	0.419	–1.988
95% CI, Fieller method	[–0.250;0.179]	[0.338;0.531]	[–9.632;–0.928]
AR(1)–(p-value)	0.000	0.000	0.000
AR(2)–(p-value)	0.502	0.582	0.621
Hansen j statistic (p-value)	0.782	0.702	0.771

Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

ECONOMIC ANNALS, Volume LXVI, No. 230 / July – September 2021
UDC: 3.33 ISSN: 0013-3264

https://doi.org/10.2298/EKA2130067C

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‘SOFT’ SUPPORT INFRASTRUCTURE AND THE PERFORMANCE OF SMALL AND MEDIUM-SIZED ENTERPRISES IN EUROPEAN COUNTRIES

ABSTRACT: *The purpose of this paper is to examine the relationship between ‘soft’ support infrastructure (SSI) and the performance of small and medium enterprises (SMEs). The study encompasses European countries’ economic activity and SMEs’ output in 2015 and 2018. The focus of the research is SMEs in the European Union member states and the Western Balkan countries. The analysis was conducted using partial least squares structural equation modelling (PLS-SEM). This method enabled the examination of links between variables that are not directly observable. The results show that countries investing in SSI have better SME performance. Based on the statistical analysis, among other things, the authors identify the Human Development Index and the use of information and communication technology at the company level as the two most significant factors that impact on SMEs’ performance.*

KEY WORDS: *small and medium enterprises, performance, human capital, ICT use, PLS-SEM*

JEL CLASSIFICATION: O1, O2, O3

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1. INTRODUCTION

According to the OECD, small and medium enterprises (SMEs), as the predominant form of business and employment, are the key actors in building more inclusive and sustainable growth, increasing economic resilience, and improving social cohesion (OECD, 2019a). In fact, across the OECD member states, SMEs account for about 60% of employment and between 50% and 60% of added value and are the main drivers of productivity growth in many regions and cities (OECD, 2019a). In European Union member states, SMEs represent more than 99% of all businesses (EC 2019). The same can be said of the Western Balkan countries (OECD, 2019b).

Business development agencies (BDAs) have a crucial role in the development of SMEs in Europe. As stated by Audet and St-Jean (2007), public authorities throughout the world, recognizing both the importance and vulnerability of SMEs, have, over the years, created BDAs and set up numerous venture development support and assistance measures. Despite all these efforts, SME owner-managers do not seem to make maximum use of the services available. In many European regions, companies do not make use of all the advantages of public support services. Some companies find them to be useless, and others do not have information about the public support services available. According to OECD et al. (2019a), in Western Balkan countries only a small percentage of companies are satisfied with the services provided by the public BDAs.

Roig-Tierno et al. (2015) examine the relationship between the growth of BDAs and their use to innovative entrepreneurs. The study considers three types of support infrastructure: incubators, technology centres, and universities. Employing crisp-set qualitative comparative analysis, the study tests the existence of such a relationship using empirical data from a sample (n=107) of young innovative companies. The results show that combining the use of incubators, technology centres, and universities can positively affect the growth of young innovative companies. Based on similar research, at the beginning of the new millennium, Western Balkan governments supported the establishment of various BDAs. Following this experience of Western Balkan economies shows that investment in the business infrastructure that encourages SME development is not a cost but a path to economic prosperity (Ćudić & Milovanović, 2011).

Based on the needs of SMEs today, authors focus more on ‘soft’ support infrastructure, which includes human capital development, intellectual property, knowledge, ICT facilities, university–industry collaboration, professional and organisational networks, and supporting research and development (R&D), among other things (Diebolt & Hippe, 2016; Dragoiu, 2016; Pantea, 2019). Thus, in the research part of this paper, the authors generate a composite variable called ‘soft support infrastructure’ (SSI), which includes the most frequent indicators mentioned within this term in the literature.

In addition, unlike large companies, SMEs simply do not have the human, financial, or technical resources to carry out extensive in-house R&D, but they can access these resources from outside sources. Various organisations provide support to SMEs, with the aim of supporting their growth and development, and these organisations’ work differs across Europe (Miörner et al. 2019). The differences in approach to supporting SMEs also lead to SMEs achieving different results. This motivated the authors of this paper to explore what are the main factors that impact SMEs’ performance in European countries. Thus, this research aims to answer the following question: Which type of soft support is the most important for SMEs to achieve the best performance?

2. LITERATURE REVIEW

In the context of company development, the term ‘soft’ support is used for various purposes. This section of the research aims to identify the most recent and relevant articles that examine this topic, which focuses predominantly on human development. Many other indicators also supplement the term ‘soft’ support infrastructure.

In a recently published study, Gudz et al. (2021) determine that many European SMEs enjoy state support through their taxation systems, which necessitates the determination of a fair tax burden and appropriate fair tax bases. They highlight the role of SMEs in ensuring technological progress, eliminating regional imbalances in economic development, achieving socio-political stability in society, and strengthening national security. They suggest classifying SMEs as independent or dependent to guide SME sector activities to ensure both social stability and compliance with obligations to manage public finance at all levels.

Researchers share the opinion that highly developed human resources and innovation-driven companies are major pillars of the high-performing economies (Laužikas & Dailydaitė, 2015; Sá & Pinho, 2019). The recent debate on European development policies is articulated around two major fields of research that are highly integrated with each other. One of these is the level of investment in research, innovation, and the innovative capacity of the European regions. Another is the degree of competitiveness of European production and regional systems (Sabatino & Talamo, 2017).

Innovation is often seen as being carried out by highly educated labour in R&D-intensive companies with strong ties to leading centres of excellence in the scientific and scholarly world. In a broader perspective, innovation is the attempt to try out new or improved product processes, or ways to do things – an aspect of most, if not all, economic activities (Fagerberg et al. 2009). The European SMEs have recognized the importance of innovation for their development and the creation of added value, which can result in higher company profits and higher salaries (OECD,2019b).

Čučković & Vučković (2021) use the Community Innovation Survey (CIS) 2014 and eCORDA data to analyse whether SME participation in EU research and innovation (R&I) funding programmes has increased their innovation activities and business performance. The paper focuses particularly on new EU member countries, including those from Central and Eastern Europe (CEE). The obtained results indicate that EU R&I funding is beneficial to the innovation activities of SME recipients, and to their overall business performance. It also assists new EU member states that are in the process of 'catching up' to the growth levels of more established EU economies.

Empirical analyses uncover the importance of the traditional linear model of local R&D innovation and the local socioeconomic conditions necessary for the genesis and assimilation of innovation and its transformation into economic growth across European regions (Rodríguez-Pose & Crescenzi, 2006). Cinnirella & Streb (2017) merge individual data on valuable patents granted in Prussia in the late 19th century with county-level data on literacy, craftsmanship, secondary schooling, and income tax revenues to explore the complex relationship between various types of human capital, innovation, and income. Their findings support the notion that the accumulation of primary human capital is crucial for the transition to modern economic growth. Latterly, as stated two decades ago, “Determining the actual, as opposed to the possible, impact of the new technology on literacy could be one of the most interesting research challenges in this field” (Hannon, 2000).

Human resources have a vital role in economic development. Superior staff training, coupled with providing a general state of good health that in turn ensures a long and productive life, find expression in the development of society and translate into licenses, patents, know-how, and prestigious brands – in other words, progress (Vlad et al. 2012). In their research, Nuvolari & Vasta (2015) perform an econometric exercise in which they assess the connection between different forms of human capital and patent intensity. They establish a robust correlation between literacy and “basic” patent intensity. The effect of human capital on growth involves multiple channels. On the one hand, an increase in human capital directly affects economic growth by enhancing labour productivity. On the other hand, human capital is an essential input into R&D and therefore increases labour productivity indirectly by accelerating technological change. Different types of human capital, such as primary and higher education and in-work training, can play different roles in both production and innovation activities.

Intellectual property rights have an exceptional role in the use of knowledge obtained through R&D for business purposes. Mok et al. (2010) design guidelines for intellectual property education from the perspective of university researchers and employees and private and public institution researchers. This study shows the relative importance of the attributes related to intellectual property education and the vital conditions of that education. Furthermore, the cooperation between universities and companies is vital for the successful use of intellectual property rights (see Kneller et al. 2014). Previous studies have found that universities are more likely to collaborate with industry if they are mature and large (Cunningham and Link 2014). Thus, there is a need for governmental intervention that will enhance university/SME collaboration. Nugent et al. (2019) prove that awarding university–industry-targeted grants rather than non-targeted grants coincides with increased patent activity. Skorupinska (2017) evaluates the relationships between ICT, organisational practices, internationalisation, innovation, and human capital in a sample of Polish companies and finds ICT innovation to be the main determinant of labour productivity.

Hence, various factors generate company development. Based on a review of the literature that examines SSI, the authors of this study identified, among other things, human capital development and ICT use at the company level as the most relevant elements for increasing SMEs' performance.

3. DATA SET AND RESEARCH METHOD

3.1. Data Set

As stated in the introduction to this research, innovative SMEs are a major pillar of Europe's economic competitiveness. For the purposes of this paper, a company's innovative activities are represented by the number of their patent applications filed under the World Intellectual Property Organisation's (WIPO) Patent Cooperation Treaty (PCT). To complement national data, the metric provides the number of international PCT applications by residents of a given country. It serves to capture innovative worldwide activity, with an emphasis on inventions in medium- or lower-income economies and inventions that may have a strong international appeal (WIPO et al. 2019).

As explained, human capital plays a crucial role in every company (Ilczuk, 2017). Numerous studies deal with the relationship between the Human Development Index (HDI) and companies' innovation activities (Yelkikalan & Aydın, 2015). The United Nations Development Program's HDI is a standard international development measure (Cahill, 2002). HDI is a statistical composite index of life expectancy, education, and per capita income indicators, which are used to rank countries into four tiers of human development.

In previous studies, the authors of this paper found a strong correlation between functional literacy and company performance (see Ćudić, 2021). As a reference for functional literacy among the observed countries, we used the OECD's Program for International Student Assessment (PISA) test results as one of the most accepted approaches to measure and compare functional literacy and education systems globally. PISA measures 15-year-olds' ability to use their reading, mathematics, and science knowledge and skills to meet real-life challenges.

Research collaboration between universities and industry is measured by the Global Innovation Index for the period 2010–2018, provided by Cornell University, the Institut Européen d'Administration des Affaires (INSEAD), and WIPO. The document states that linkages and public/private academic partnerships are essential to innovation, and draws on both qualitative and quantitative data to measure them, including business–university collaboration on R&D. Based on WIPO reports (2010–2018), the authors add average gross domestic spending on R&D as the indicator that significantly influences SME development.

The use of ICT in SMEs is associated with the adoption of digital technologies, the degree of digitalisation of business practices, and the adoption of new (digital) business models. The available evidence suggests that small and micro enterprises that are not active in ICT-intensive sectors especially lag in the adoption of digital technologies, business practices, and business models (Saam et al. 2016).

Thus, based on the literature review, we identified six main factors that impact SMEs' business performance: innovation activities, human capital, functional literacy, university–industry collaboration, gross domestic spending on R&D, and ICT use. A higher level of these factors' development results in a significantly higher level of performance by the SMEs. When discussing SMEs achievement, the main criterion for measuring their performance is value added (Horobets, 2019). In the literature there are two main additional indicators: the number of SMEs per 1,000 inhabitants and the number of employees in the SMEs (Kassem & Trenz, 2020; Rusu & Roman, 2017). This research adds one more indicator that presents the countries' overall economic situation: GDP per capita. Based on statistical analysis, we assess the impact of soft support infrastructure on the performance of European SMEs.

3.2. Research Method

This research uses structural equation modelling (SEM). SEM includes many statistical methodologies to estimate a network of causal relationships, defined according to a theoretical model and linking two or more latent complex concepts, each measured through a number of observable indicators. The basic idea is that complexity inside a system can be studied by taking into account a causality network among latent concepts, called latent variables, each measured by several observed indicators, usually defined as manifest variables. Thus, structural equation models represent a "joint-point" between path analysis and confirmatory factor analysis (Esposito Vinzi et al. 2010). Among the methods of estimating SEM models, the covariance-based (CB) method[1] of Jöreskog enjoyed the greatest popularity for a long time. So universal was its recognition that in social sciences the phrases 'structural equation modelling' (SEM) and 'covariance-based structural equation modelling' (CB-SEM) were synonymous for many years (Chin et al. 1996). Meanwhile, Wold developed an alternative approach, the partial least squares method (PLS), whose application for estimating models with latent variables he described and presented in various works (Wold 1979, 1980b, and 1980a). Because the PLS method was an alternative to Jöreskog's 'hard' modelling based on strong assumptions regarding distributions' normality and requiring large samples, Wold referred to his PLS approach as 'soft' modelling (1980b, 1982).[2] After a time, the term 'PLS-path modelling'[3] came into use, and then, to emphasize that PLS was an alternative to CB, it began to be referred to as 'PLS structural equation modelling' (PLS-SEM).

PLS-SEM and CB-SEM were developed as entirely distinct, although complementary, methods with specific purposes and requirements. This was clearly stressed by the authors of both approaches at the beginning of the 1980s (Jöreskog and Wold 1982). Today PLS-SEM and CB-SEM's varying properties are well known, with emphasis on the complementarity of the two methods rather than the competition between them. The advantages of the non-parametric,

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1 In the CB-SEM method, a theoretical covariance matrix is estimated on the basis of a structural equations model. The estimation of model parameters is performed in such a way as to minimize the difference between the theoretical covariance matrix and the estimated covariance matrix.

2 Herman Ole Andreas Wold (1908–1992) was a Norwegian-born econometrician and statistician who had a long career in Sweden. Wold was known for his work in mathematical economics, in time series analysis, and in econometric statistics. Wold contributed to the methods of partial least squares (PLS) and graphical models.

3 Among other things, to distinguish models containing latent variables estimated utilising the PLS method from PLS-based regression. Even now, in many publications, authors confuse the work of H. Wold and that of S. Wold.

variance-based PLS-SEM modelling are at the same time the disadvantages of the parametric, covariance-based CB-SEM, and vice versa. Therefore, the choice of method should depend on the empirical context and research purpose (Hair et al. 2019)[4].

The SEM model consists of two sub-models, a structural one and a measurement one. In PLS-SEM terminology, the terms ‘inner model’ and ‘outer model’, respectively, are also used. A structural model describes the relationships between latent variables, whereas a measurement model describes the relationships between the latent variables and the indicators by which they are identified, also known as manifested variables (Wold, 1980a).

When constructing a structural model, particular attention must be paid to two aspects: the nature of the analysed latent variables and the associations that occur between them. It is important to distinguish between exogenous and endogenous variables. Furthermore, all the formulated elements of the conceptual framework should be derived from theory and logic. If a theoretical basis is lacking or the theory is inconsistent, one should rely on one’s own judgment, experience, and intuition (Hair et al. 2017).

Specification of the measurement model is an equally important stage of the modelling process. Verification of the hypotheses reflected in the structural model’s equations can be reliable when, and only when, the latent variables are correctly defined by means of indicators. The choice of indicators is as crucial as

4 In recent literature, some question if the choice of PLS-SEM methodology leads to the identification of biased correlations, especially related to manifest variables (Dijkstra & Henseler, 2015). PLS-SEM and CB-SEM assume different ways of how the data represent measurement models that the researcher specifies in a reflective or formative way. CB-SEM assumes the data follow a common factor model in which the indicator covariances define the nature of the data, whereas PLS adheres to a composite model approach in which data are defined by means of linear combinations of indicators. Thus, while the measurement models may follow a reflective (or formative) specification, the underlying data model may be composite-based (or common factor-based). Numerous studies have explored PLS's performance in terms of parameter accuracy when data are assumed to follow a common factor model approach. Overall, these studies suggest that the bias that PLS produces when estimating common factor models is comparably small, provided that the measurement models meet minimum recommended standards in terms of the number of indicators and indicator loadings (see Sarstedt et al. 2016).

the choice of the way in which they are defined (Hair et al. 2017). Definition of latent variables by means of indicators can be done either deductively or inductively (Rogowski 1990). Under the former approach, indicators reflect the defined latent variable and are then referred to as 'reflective indicators', while the measurement model is called a 'reflective measurement model'. In the case of inductive definition, it is assumed that indicators make up the latent variables; hence the expressions 'formative indicators' and 'formative measurement model'. The type of definition (inductive or deductive) should follow from the assumed theoretical description (Rogowski 1990). Moreover, the choice of observable indicators should be preceded by an in-depth and thorough literature review, including the theory and empirical studies in measuring the latent variables present in the model.

Apart from examining the relationship between latent variables, PLS-SEM modelling also helps estimate these variables' values (weighted sums of indicators). Therefore, for each of the latent variables in the model a synthetic measure is calculated, which can be used to obtain a linear ordering of the analysed objects.

Estimation of a PLS-SEM model is performed using the PLS method. The algorithm simultaneously estimates inner model parameters – path coefficients – and outer model parameters, outer weights, and outer loadings. The procedure also yields estimations of the values of all the latent variables included in the model. The estimation aims to maximise the explained variance of the latent dependent variables. The first stage involves the iterative estimation of measurement model weights and the values of latent variables. In the second stage the loadings and path coefficients of the structural model are estimated. A detailed description of the PLS algorithm can be found in, e.g., Henseler et al. (2012) and Wold (1982), and its generalisation in Rogowski (1990). Verification of a PLS-SEM model is a two-stage process. First, the structural model is assessed. Second, if the validity of the structural model is confirmed, the structural model is tested. Table 1 lists the properties of the model that should be evaluated.

Table 1: Evaluation of PLS-SEM models

<table>
<tr><td colspan="6">Evaluation of the measurement models</td></tr>
<tr><td colspan="3">Reflective measurement models</td><td colspan="3">Formative measurement models</td></tr>
<tr><td rowspan="2">Internal consistency</td><td>Cronbach's alpha</td><td>0.60–0.95</td><td rowspan="2">Convergent validity</td><td rowspan="2">Redundancy analysis</td><td rowspan="2">≥ 0.7 correlation</td></tr>
<tr><td>Composite reliability</td><td>0.60–0.95</td></tr>
<tr><td rowspan="2">Convergent validity</td><td>Loadings</td><td>≥ 0.7</td><td rowspan="2">Collinearity between indicators</td><td rowspan="2">Variance inflation factor (VIF)</td><td rowspan="2">≥ 0.5</td></tr>
<tr><td>The average variance extracted (AVE)</td><td>≥ 0.5</td></tr>
<tr><td rowspan="3">Discriminant validity</td><td colspan="2">Cross-loadings</td><td rowspan="3">Significance of outer weights</td><td rowspan="3">p-value</td><td rowspan="3">< 0.05</td></tr>
<tr><td colspan="2">Fornell–Larcker criterion</td></tr>
<tr><td>Heterotrait–monotrait (HTMT) ratio</td><td>< 0.9</td></tr>
<tr><td colspan="6">Evaluation of the structural models</td></tr>
<tr><td colspan="2">Collinearity</td><td colspan="2">Variance inflation factor (VIF)</td><td colspan="2">≥ 0.5</td></tr>
<tr><td colspan="2">Predictive power</td><td colspan="2">Coefficients of determinations (R^2)</td><td colspan="2">Values of 0.75, 0.50, and 0.25 are considered substantial, moderate and weak</td></tr>
<tr><td colspan="2">Predictive relevance</td><td colspan="2">Stone–Geisser's Q^2 value</td><td colspan="2">≥ 0</td></tr>
<tr><td colspan="2">Significance of path coefficients</td><td colspan="2">p-value</td><td colspan="2">< 0.05</td></tr>
</table>

Source: Authors' work based on Hair et al. (2017).

SEM using the PLS procedure used to be difficult due to the unavailability of software. Now the situation has greatly improved thanks to the wide range of user-friendly programmes that enable estimation and statistical verification of PLS-SEM models; e.g., WarpPLS (Kock 2020), ADANCO (Henseler & Dijkstra, 2015), SmartPLS (Ringle et al. 2015). This study uses the SmartPLS software.

4. SPECIFICATION OF THE MODEL

The model used for the realisation of the research objective, i.e., proving the influence of soft support infrastructure on SME performance, contains the following equation:

$$SPI_t = \alpha_1 SSI_t + \alpha_0 + v_t \qquad (1)$$

where:

SPI_t – SME performance in year *t*,

SSI_t – soft support infrastructure in year *t*,

α_0, α_1 – structural parameters of the model,

v_t – random component,

t – the year 2015 or 2018.[5]

The model uses the deductive approach to defining latent variables, i.e., each latent variable as a theoretical notion is a starting point in the search for empirical data. The choice of indicators was made on the basis of substantive and statistical criteria. From the statistical perspective, the following things were taken into account: diversity of indicator values, measured by the coefficient of variation[6] (critical value of the coefficient was established at 10%); and the quality of the estimated model (model evaluation measures – ex post analysis). The indicators that passed substantive and statistical verification are presented in Table 2.

5 The Program for International Student Assessment (PISA) results are one of the significant indicators in the model. The PISA test was conducted across OECD countries in 2015 and 2018, which is why the authors chose these two years to examine changes in variables.

6 This is calculated as the ratio of the standard deviation to the arithmetic mean, expressed in percentage.

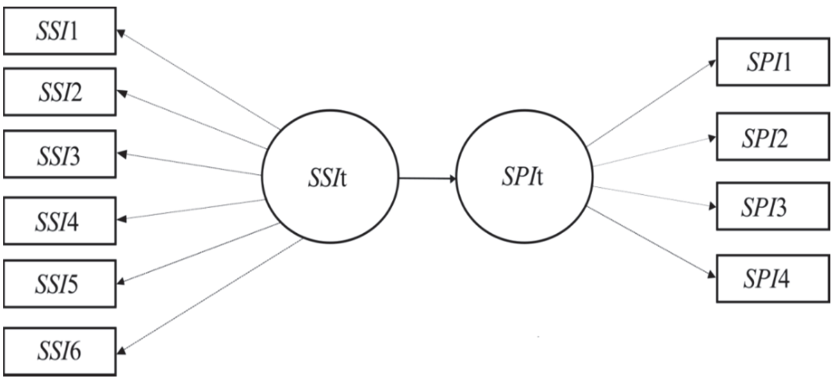
Table 2: Indicators of latent variables SSI_t and SPI_t qualified for the model

Symbol of indicator	Description of indicator	Data source
SSI1	Number of PCT patents by origin	WIPO, 2015 and 2018
SSI2	Human Development Index	UNDP, 2015 and 2018
SSI3	Program for International Student Assessment	OECD, 2015 and 2018
SSI4	University–industry collaboration	WIPO, 2015 and 2018
SSI5	Gross domestic spending on R&D	World Bank
SSI6	ICT use	ITU, 2015 and 2018
SPI1	The added value created by SMEs	Eurostat, national statistics
SPI2	Number of SMEs per 1000 inhabitants	Eurostat, national statistics
SPI3	Number of employees in SMEs	Eurostat, national statistics
SPI4	GDP per capita	World Bank, 2015 and 2018

Notes: SSI_t – soft support infrastructure in year *t*; SPI_t – SME performance in year *t*.
Source: Authors.

Indicators of the SSI latent variable point to the most frequent and significant soft support infrastructure for SMEs. Meanwhile, the SPI measures reflect the performance of SMEs. A diagram of the model, considering both the internal and external relationships, is presented in Figure 1.

Figure 1: Internal and external relationships of the model

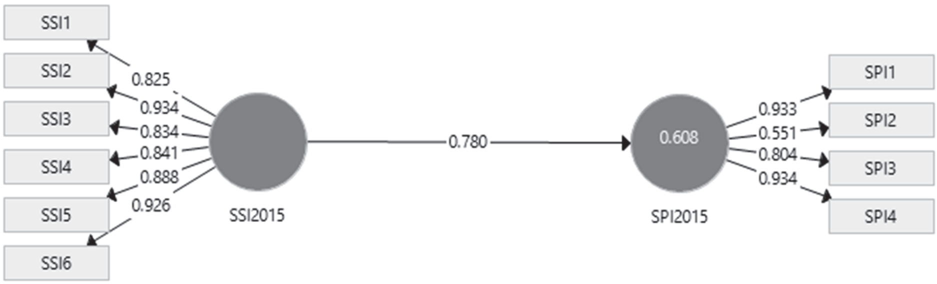


Source: Authors’ work.

5. ESTIMATION RESULTS AND STATISTICAL VERIFICATION OF THE MODEL

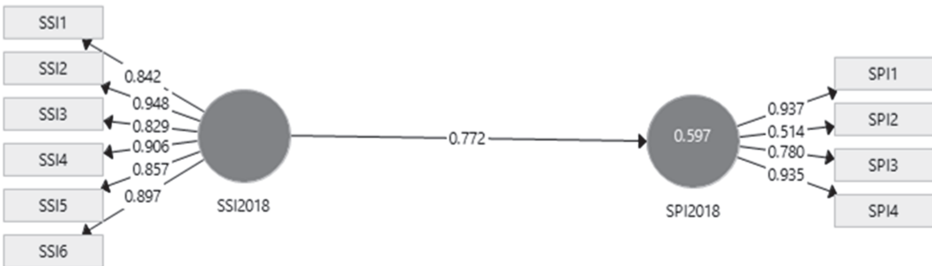
Figures 2 and 3 show the PLS-SEM estimation results obtained in the SmartPLS software (Ringle et al. 2015). The numbers on the arrows pointing from latent variables to indicators are outer loadings, while the number on the arrow between latent variables is the path coefficient. The results of the modelling are interpreted in section 5.

Figure 2: Results of estimation of PLS-SEM$_{2015}$ model



Source: SmartPLS.

Figure 3: Results of estimation of PLS-SEM$_{2018}$ model



Source: SmartPLS.

Table 3 summarizes the results of the reflective measurement model assessment.

Table 3: Assessing the results of reflective measurement models

Latent Variable	Indicators	Convergent Validity						Internal Consistency Reliability			
		Loadings		Indicator Reliability		The average variance extracted (AVE)		Composite Reliability		Cronbach’s Alpha	
		>0.7		>0.5		>0.5		0.6–0.95		0.6–0.95	
		2015	2018	2015	2018	2015	2018	2015	2018	2015	2018
SSI	SSI1	0.825	0.842	0.681	0.709	0.767	0.776	0.952	0.954	0.939	0.942
	SSI2	0.934	0.948	0.872	0.899						
	SSI3	0.834	0.829	0.696	0.687						
	SSI4	0.841	0.906	0.707	0.821						
	SSI5	0.888	0.857	0.789	0.734						
	SSI6	0.926	0.897	0.857	0.805						
SPI	SPI1	0.933	0.937	0.870	0.878	0.673	0.656	0.888	0.879	0.837	0.824
	SPI2	0.551	0.514	0.304	0.264						
	SPI3	0.804	0.780	0.646	0.608						
	SPI4	0.934	0.935	0.872	0.874						

Source: Authors’ work.

The size of the outer loadings is also commonly called ‘indicator reliability’. The common rule of thumb is that outer loadings should be 0.7 or higher. Indicators with very low outer loadings (below 0.4) should be eliminated from the model. Indicators with outer loadings between 0.4 and 0.7 should be considered for removal only when deleting the indicator increases the composite reliability (Hair et al. 2017). It can be seen that one of the indicators (SPI2) has an outer loading below 0.7. However, removing this indicator from the model was not considered due to its substantive importance. The average variance extracted (AVE) values are more significant than the acceptable threshold of 0.5, confirming convergent validity. Cronbach’s alpha and composite reliability are shown to be larger than 0.6, demonstrating high levels of internal consistency reliability among the indicators of each latent variable.

Finally, the discriminant validity was assessed on the basis of the Fornell–Larcker (1981) criterion. According to this criterion, the AVE’s square root of each latent variable should be higher than the variable’s highest correlation with any latent variable in the model. Table 4 shows the Fornell–Larcker criterion assessment results, with the square root of the reflective latent variables’ AVE on the diagonal and the correlations between the latent variables in the off-diagonal. The result indicates that discriminant validity is well established.

Table 4: Fornell–Larcker criterion

Latent Variable	2015		2018	
	SSI	SPI	SSI	SPI
SSI	0.876	0.780	0.881	0.772
SPI		0.820		0.810

Source: Authors' work.

Tables 5 and 6 contain the results of the structural model assessment. Assuming a 5% significance level, the relationships of both structural models are significant (p-values equal to 0.000). The value of the coefficient of determination R2 justifies the conclusion that, to a moderate extent, the exogenous variable SSI determines the variability of the endogenous variable SPI. The Q^2 values of the Stone–Geisser test, which verifies the soft model in terms of its predictive relevance (see Table 5), are considerably above zero, which proves the model's high prognostic quality.

Table 5: Assessing the results of structural models

	Path Coefficients		Standard Deviation		T Statistics		P-Values		R^2	
	2015	2018	2015	2018	2015	2018	2015	2018	2015	2018
SSI → SPI	0.780	0.772	0.067	0.069	11.693	11.170	0.000	0.000	0.601	0.597

Source: Authors' work.

Table 6: Stone-Geisser test Q^2 values

Indicator	2015	2018
SPI1	0.636	0.630
SPI4	0.573	0.042
SPI3	0.249	0.210
SPI2	0.063	0.565
General	0.380	0.362

Source: Authors' work.

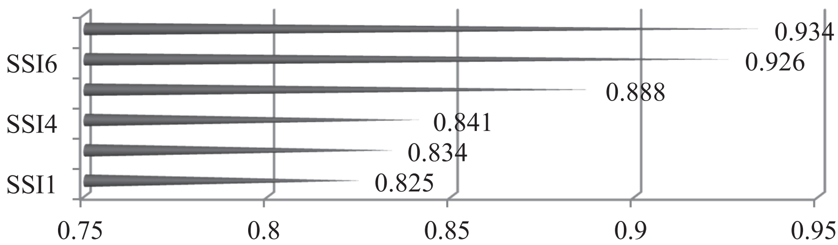
Both the measurement models and the structural models were positively assessed. Therefore, in the next modelling stage the results can be interpreted.

6. INTERPRETATION OF MODELLING RESULTS: 2015

Figures 4 and 5 present the ordering of the indicators of each of the latent variables in terms of outer loadings, i.e., in terms of the strength of the relationship between the values of the latent variable and the values of the indicators. The following interpretation of the π_{ij} outer loading is assumed:

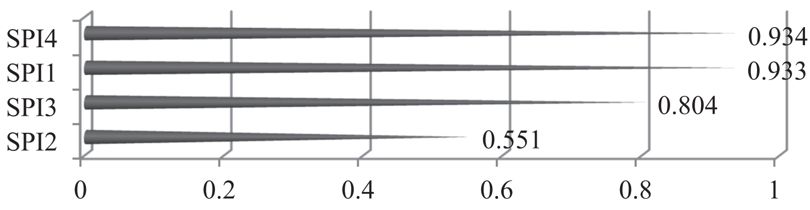
- $|\pi_{ij}| < 0.2$ no correlation;
- $0.2 \leq |\pi_{ij}| < 0.4$ weak correlation;
- $0.4 \leq |\pi_{ij}| < 0.7$ moderate correlation;
- $0.7 \leq |\pi_{ij}| < 0.9$ strong correlation;
- $|\pi_{ij}| \geq 0.9$ very strong correlation.

Figure 4: Outer loadings of SSI_{2015} latent variable



Source: Authors' work.

Figure 5: Outer loadings of SPI_{2015} latent variable



Source: Authors' work.

All indicators reveal at least a strong correlation with the SSI latent variable. On the other hand, the SPI_{2015} latent variable is very strongly reflected by two indicators: GDP per capita (SPI4) and Added value created by SMEs (SPI1), strongly reflected by one indicator, Number of employees in SMEs (SPI3), and moderately correlated with one indicator, Number of SMEs per 1000 inhabitants (SPI2).

The estimation of the structural model parameters indicates a positive, significant correlation between soft support infrastructure and the level of SME performance in the studied group of 33 European countries in 2015 (see Eq. 2). This means that those countries that reported more intensive soft support infrastructure also had better SME performance in that year.

$$SPI_{2015} = 0.780 * SSI_{2015} - 3.7965 \quad (2)$$[7]

In the EU-28 countries, many businesses treat SSI as a vital source for increasing SME performance. However, Balkan countries still use SSI inadequately. There is a strong or very strong correlation between indicators and latent variables. By analysing the results, it is clear that human capital and ICT use play an essential role in SME development. We have identified many variables that influence ICT use on a company level through the literature review. However, we selected ICT use, functional literacy, and gross domestic spending on R&D as vital. Moreover, in our previous research we found a direct relationship between ICT use and ICT access, functional literacy, and gross domestic spending on R&D. Thus, to increase their performance, companies from all sectors have to implement the opportunities that ICTs provide. Digitalisation drives the emergence of new business models that may allow SMEs to scale up very quickly, often with just a few employees, few tangible assets, and little geographical market presence. We compiled two rankings of the studied countries based on estimated values of the variables SSI_{2015} and SPI_{2015}: rankings of SME soft support infrastructure and SME performance. The results are shown in Table 7.

[7] Parameter α_0 was estimated in the PLS programme (Rogowski 1993).

Table 7: Rankings of selected European countries in terms of SME soft support infrastructure and SME performance in 2015

Country	SSI_{2015}	SMP_{2015}
Albania	33	31
Austria	9	5
Belgium	8	9
Bosnia and Herzegovina	31	33
Bulgaria	27	24
Croatia	24	26
Cyprus	25	22
Czech Republic	14	10
Denmark	3	6
Estonia	12	16
Finland	1	11
France	11	21
Germany	5	8
Greece	26	32
Hungary	21	23
Ireland	10	2
Italy	17	12
Latvia	22	20
Lithuania	18	17
Luxemburg	6	1
Malta	16	7
Montenegro	30	27
Netherlands	4	4
North Macedonia	32	30
Poland	20	25
Portugal	19	13
Romania	28	28
Serbia	29	29
Slovakia	23	18
Slovenia	13	15
Spain	15	19
Sweden	2	3
United Kingdom	7	14

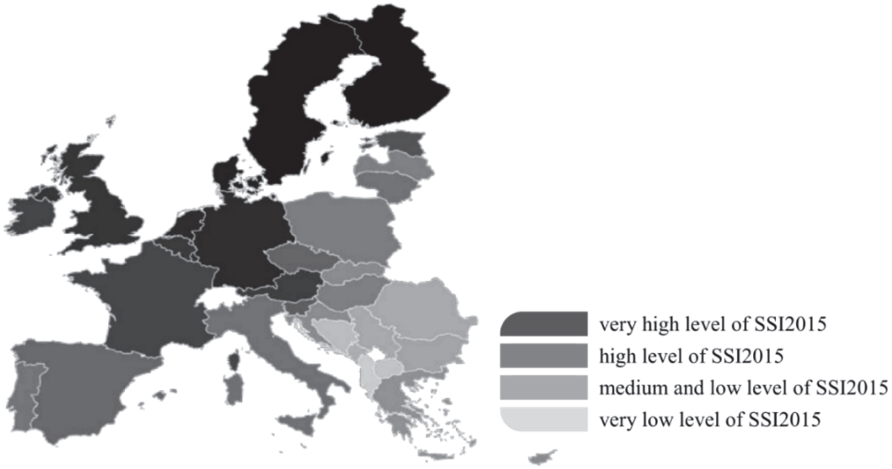
Source: Authors’ work.

The countries are also divided into typological groups according to similar volumes of SME soft support infrastructure and SME performance. The results of the grouping are presented in Figure 6 and Figure 7. The boundaries between the groups are based on the arithmetic means and standard deviations of the synthetic measure z_i (equal to 0 and 1, respectively, for each of the latent variables).

The groups are as follows:

- Group I (very high level of latent variable): $z_i \geq 1$;
- Group II (high level of latent variable): $0 < z_i \leq 1$;
- Group III (medium and low level of latent variable): $-1 < z_i \leq 0$;
- Group IV (very low level of latent variable): $z_i \leq -1$.

Figure 6: Division of selected European countries into typological groups according to SME soft support infrastructure in 2015

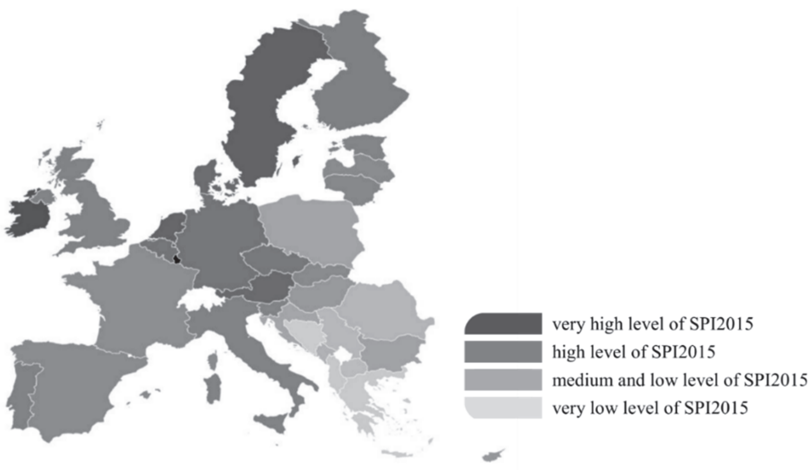


Note: SSI2015 – soft support infrastructure in 2015.
Source: Authors' work.

As presented in Figure 6, a very high level of development soft support infrastructure was observed in 2015 in the following seven countries: Finland, Sweden, Denmark, the Netherlands, Germany, Luxemburg, and the United Kingdom. The group of countries with a high level of soft support infrastructure comprised nine countries: Belgium, Austria, Ireland, France, Estonia, Slovenia, the Czech Republic, Spain, and Malta. Ten countries qualified for the group of economies with medium and low levels of soft support infrastructure: Italy, Lithuania, Portugal, Poland, Hungary, Latvia, Slovakia, Croatia, Cyprus, and Greece. Seven countries were characterised by very low levels of soft support infrastructure: Bulgaria, Romania, Serbia, Montenegro, Bosnia and Herzegovina, North Macedonia, and Albania.

According to soft support infrastructure, the ranking of countries demonstrates the predominance of North and Western European economies and ‘catch-up’ economies from Central Europe. The lower ranks comprise South-Eastern European and Balkan economies. However, when the benefits of SSI are considered in the form of higher SME performance, the classification looks a little different. As presented in Figure 7, the top ranks are occupied by relatively small economies based on highly developed human capital, focusing on functional literacy, innovation, ICT use, and the R&D sector (Luxemburg, Ireland, and Sweden). The group of the countries with a high level of SME performance comprises 15 countries: the Netherlands, Austria, Denmark, Malta, Germany, Belgium, the Czech Republic, Finland, Italy, Portugal, the United Kingdom, Slovenia, Estonia, Lithuania, and Slovakia.

Figure 7: Division of selected European countries into typological groups according to SME performance in 2015



Note: SPI2015 – SME performance indicator in 2015.
Source: Authors’ work.

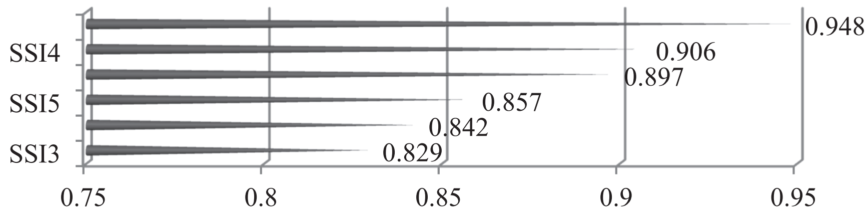
Nine countries comprised the group of economies with medium and low levels of SME performance: Latvia, Spain, France, Cyprus, Hungary, Bulgaria, Poland, Croatia, and Montenegro. Countries with weak indicators of human capital, functional literacy, and ICT use, and a small percentage of spending on R&D sectors rank at the bottom (Romania, Serbia, North Macedonia, Albania, Greece, Bosnia and Herzegovina).

It is clear that knowledge and innovation are closely concentrated in a few European regions (EPO 2010–2019). Therefore, it is important to pursue analyses that promote a better understanding of the internal structure of the innovation processes taking place in European regions. Such knowledge can help, for example, regional authorities develop better strategies, focusing on areas requiring technical and financial support (Szopik-Depczyńska et al. 2018).

7. INTERPRETATION OF MODELLING RESULTS: 2018

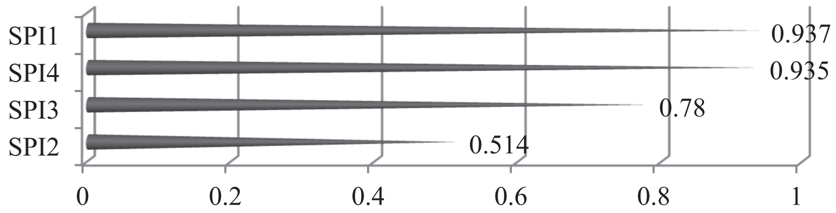
Figures 8 and 9 present the strength of reflecting the latent variable by their indicators. All the indicators of SSI_{2018} reveal at least a strong correlation with the latent variable. Conversely, the latent variable SPI_{2018} is strongly reflected by three indicators: Added value created by SMEs (SPI1); Number of employees in SMEs (SPI3); and GDP per capita (SPI4), while the indicator Number of SMEs per 1000 inhabitants (SPI2) is moderately correlated with the variable.

Figure 8: Outer loadings of SSI_{2018} latent variable



Source: Authors' work.

Figure 9: Outer loadings of SPI_{2018} latent variable



Source: Authors’ work.

There are no significant changes in the strength of reflecting the latent variable by their indicators in 2018 compared to 2015. The estimation results reveal a weakening of the impact of SSI3, SSI5, and SSI6 on the latent variable SSI_t. In the model constructed for data from 2015 this impact was more substantial, whereas here it is a little weaker. The differences between the two sets of modelling results are also visible in the strength of the influence of the SSI1, SSI2, and SSI4 indicators.

On the other hand, the latent variable SPI_{2018} is strongly reflected by three indicators: Added value created by SMEs (SPI1); Number of employees in SMEs (SPI3); and GDP per capita (SPI4). The indicator ‘Number of SMEs per 1000 inhabitants’ (SPI2) is moderately correlated with the variable. There are no significant changes in 2018 in comparison to 2015.

The estimation of the path coefficient (see Eq. 3) indicates a positive and significant correlation between soft support infrastructure and the SME performance level in European countries in 2018. This means that countries that recorded a more developed soft support infrastructure in 2018 also had better SME performance in that year. The strength of the correlation is a little lower than in 2015. SSI turns out to be a key factor of SSI growth throughout the studied group.

$$SPI_{2015} = 0.772^{*}SSI_{2015} - 4.2092^{8} \quad (3)$$

Table 8 presents the analysed countries ranked according to their volume of soft support infrastructure as well as the performance of their SMEs in 2018. Figures 10 and 11 show the results of the European countries’ grouping.

[8] Parameter α_0 was estimated in the PLS programme (Rogowski 1993).

Table 8: Rankings of selected European countries in terms of SME soft support infrastructure and SME performance in 2018

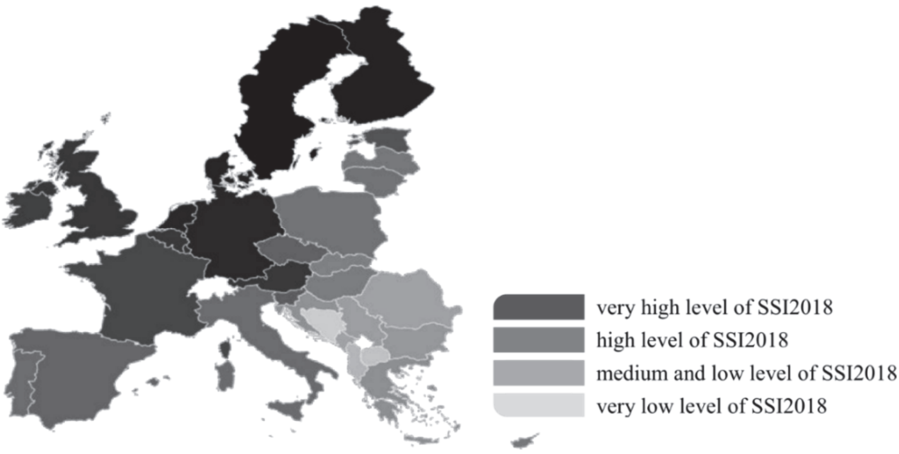
Country	SSI2018	Change[9]	SMP2018	Change
Albania	31	↑	31	-
Austria	8	↑	5	-
Belgium	9	↓	9	-
Bosnia and Herzegovina	33	↓	33	-
Bulgaria	27	-	24	-
Croatia	26	↓	26	-
Cyprus	21	↑	22	-
Czech Republic	14	-	10	-
Denmark	3	-	6	-
Estonia	12	-	13	↑
Finland	2	↓	12	↓
France	11	-	20	↑
Germany	5	-	8	-
Greece	25	↑	32	-
Hungary	23	↓	23	-
Ireland	10	-	2	-
Italy	17	-	16	↓
Latvia	22	-	18	↑
Lithuania	20	↓	14	↑
Luxemburg	6	-	1	-
Malta	16	-	7	-
Montenegro	30	-	27	-
Netherlands	4	-	4	-
North Macedonia	32	-	30	-
Poland	19	↑	25	-
Portugal	18	↑	11	↑
Romania	29	↓	28	-
Serbia	28	↑	29	-
Slovakia	24	↓	21	↓
Slovenia	13	-	15	-
Spain	15	-	19	-
Sweden	1	↑	3	-
United Kingdom	7	-	17	↓

Source: Authors' work.

9 Position change in 2018 compared to 2015.

When comparing the above rankings with those obtained based on 2015 data, one notices small changes in the countries’ ordering in terms of soft support infrastructure and relatively small changes in SME performance (see columns 3 and 5 in Table 8). Figure 10 presents details of the division of selected European countries into typological groups according to SME soft support infrastructure in 2018.

Figure 10: Division of selected European countries into typological groups according to SME soft support infrastructure in 2018



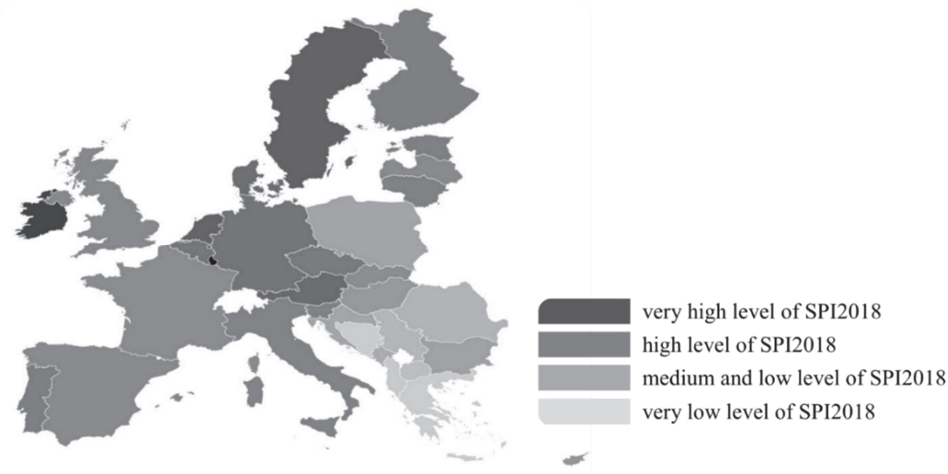
Note: SSI2018 – soft support infrastructure in 2018.
Source: Authors’ work.

As in 2015, a very high level of development of soft support infrastructure was observed in 2018 in the following six countries: Sweden, Finland, Denmark, the Netherlands, Germany, and Luxemburg. The group of countries with a high level of soft support infrastructure comprised nine countries: the United Kingdom, Austria, Belgium, Ireland, France, Estonia, Slovenia, the Czech Republic, and Spain. Twelve countries qualified for the group of economies with medium and low levels of soft support infrastructure: Malta, Italy, Portugal, Lithuania, Poland, Cyprus, Latvia, Hungary, Slovakia, Greece, Croatia, and Bulgaria. Six Balkan countries were characterised by very low levels of soft support infrastructure: Serbia, Romania, Montenegro, Albania, North Macedonia, and Bosnia and Herzegovina.

The authors analysed the progress of SSI among the European countries in three observed years. The only country that changed its rank by four positions was Cyprus (25th in 2015, 21st in 2018), while Albania progressed by two places (33rd in 2015, 31st in 2018). Six countries moved up by one position: Austria, Greece, Poland, Portugal, Serbia, and Sweden. The majority of countries (17) did not change their position: Bulgaria, the Czech Republic, Denmark, Germany, Estonia, France, Ireland, Italy, Latvia, Luxemburg, Malta, Montenegro, the Netherlands, North Macedonia, Slovenia, Spain, and the United Kingdom. Relatively small changes in position prove that it takes a significant effort to change any element of the soft support infrastructure in the short run. Meanwhile, four countries fell by one rank (Belgium, Finland, Romania and Slovakia), and Bosnia and Herzegovina, Croatia, Hungary, and Lithuania fell by two ranks.

However, when one considers the benefits of SSI in the form of higher SME performance, the classification looks a little different. The division of the selected European countries into typological groups according to SME performance in 2018 is presented in Figure 11.

Figure 11: Division of selected European countries into typological groups according to SME performance in 2018



Note: SPI2018 – SME performance indicator in 2018.
Source: Authors' work.

As presented in the SPI indicator analysis in 2015, the top ranks are occupied by two small economies based on highly developed human capital, with a focus on functional literacy, innovation, ICT use, and the R&D sector (Luxemburg and Ireland). The group of countries with a high level of soft support infrastructure comprised 16 countries: Sweden, the Netherlands, Austria, Denmark, Malta, Germany, Belgium, the Czech Republic, Portugal, Finland, Estonia, Lithuania, Slovenia, Italy, the United Kingdom, and Latvia. Nine countries qualified for the group of economies with medium and low levels of soft support infrastructure: Spain, France, Slovakia, Cyprus, Hungary, Bulgaria, Poland, Croatia, and Montenegro. Countries with weak indicators of human capital, functional literacy, and ICT use and a small percentage of spending on R&D sectors (Romania, Serbia, North Macedonia, Albania, Greece, and Bosnia and Herzegovina) rank at the bottom.

In addition, the rankings of nine of the countries changed in terms of SME performance. Two EU member-state countries progressed by three positions: Estonia (16th in 2015, 13th in 2018) and Lithuania (17th in 2015, 14th in 2018). Two countries progressed by two positions: Portugal and Latvia. France progressed by one place. Finland fell by one rank, and the United Kingdom and Slovakia by two. Italy fell by three ranks, from 12th in 2015 to 16th position in 2018.

8. CONCLUSIONS

This paper presents the results of an empirical study on the relationship between soft support infrastructure and SME performance in selected European countries. The research involved developing a PLS-SEM model, measurement of the latent variables based on sets of observable variables, and estimation and verification of the PLS-SME model. The outcomes of the modelling reveal a positive significant influence of soft support infrastructure on SME performance in the analysed European countries.

Based on the literature review, we identified six main factors that impact SME performance: innovation activities, human capital, functional literacy, university–industry collaboration, gross domestic spending on R&D, and ICT use. A higher level of development of these factors results in improved SME performance. The most critical indicators in the SME results were the added value created by SMEs, the number of SMEs per 1000 inhabitants, the relative number of employees in SMEs, and GDP per capita. All the indicators of soft support infrastructure (SSI) reveal a strong correlation with the following latent variables: Number of PCT patents by origin (SSI1), Human Development Index (SSI2), Program for International Student Assessment (SSI3), University–industry collaboration (SSI4), Gross domestic spending on R&D (SSI5), and ICT use (SSI6). On the other hand, the latent variable SMEs' performance (SPI) is strongly reflected by three indicators: Added value created by SMEs (SPI1), Number of employees in SMEs (SPI3), and GDP per capita (SPI4). The indicator Number of SMEs per 1000 inhabitants (SPI2) is moderately correlated with the variable.

Soft support infrastructure is weakest in the Balkan countries (Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, and Serbia), as well as the three EU member states that are geographically part of the Balkans (Bulgaria, Romania, and Greece). Moreover, SMEs from the Balkan countries had the weakest performance in both observed years. To improve the region's economic situation, the Balkan countries should revise their education systems and invest more money in the functional literacy and business skills of employees in all business sectors. Based on both public and private initiatives, this investment will have a long-term positive impact on company productivity and profit. In the short run they should follow successful examples from the EU member states and launch specialised programmes to improve workforce skills and increase ICT literacy. We suggest Austria and Slovenia as the best models for Balkan countries, as they have been the best models for the Balkan economies in many fields throughout history. In the future, BDAs have to be more focused on the SMEs' real needs if they want to justify their role in society. Moreover, in line with global movements, they have to predict the needs of SMEs.

This research provides new knowledge on how soft support infrastructure accelerates SME performance in Europe. To the best of the authors' knowledge, it is the first study to investigate links between ICT use at the company level, human development, R&D, and functional literacy, and SMEs' performance indicators, using the PLS-SEM method. Based on the described indicators, we improved a model of SME development driven by investment in soft support infrastructure.

Acknowledgement: This paper was created in the programme group P6-0372 and supported by the Slovenian Research Agency (ARRS) – No. 5442-1/2018/89.

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Received: January 21, 2021
Accepted: August 25, 2021

ECONOMIC ANNALS, Volume LXVI, No. 230 / July – September 2021
UDC: 3.33 ISSN: 0013-3264

https://doi.org/10.2298/EKA2130101L

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THE NEUTRALITY OF TAXATION OF INVESTMENT PROJECTS IN SERBIA

ABSTRACT: *The paper analyses the neutrality of taxation of investment projects on the example of Serbia. The aim of the research is to confirm/reject the existence of uniformity of the tax burden on investment projects that differ regarding the asset type, industry and the source of finance. The uniformity of tax burden, that is, the absence of discrimination and distortive effects of taxation, may be considered a confirmation of the tax neutrality. To investigate neutrality of taxation the analysis employed King-Fullerton framework of calculating effective marginal tax rates. The research results show that the tax treatment of investment projects in Serbia is nondiscriminatory. Marginal effective tax rates for different types of investment projects do not vary widely; that is, there are no investment projects that have a markedly favourable (unfavourable) tax treatment compared to the other types of investment projects.*

KEY WORDS: *Investment decision making, tax burden, tax neutrality, marginal effective tax rate*

JEL CLASSIFICATION: D22, G11, H21, H32, H71

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1. INTRODUCTION

Taxation is one of many factors that influence the investment decision-making process in corporations. More specifically, taxation may affect the decision to invest in a particular investment project in a certain national tax jurisdiction, as well as the volume of investment. Assuming the influence of other factors is held constant in the observed period, it can be argued that companies will invest more in countries with a relatively low tax burden, while countries with a relatively high tax burden will attract less capital or possibly suffer an investment outflow. Thus, in order to obtain an impartial assessment of the profitability of investment projects, companies have to consider the tax regime.

The traditional approach to the analysis of the tax burden on investment projects is based on the research of Jorgenson (1963), Hall and Jorgenson (1967), and King (1974). Jorgenson (1963) estimates the impact of taxes on the cost of capital; that is, the rate of return that an investment project must generate to be profitable for the investor after paying taxes. Hence, the cost of capital can be defined as the minimum rate of return that a project must generate to position itself at a break-even point, or the point where the depreciation cost is settled and taxes and dividends are paid to government and shareholders respectively (Gale & Orszag, 2005, 410). The model of investment project analysis with the cost of capital as a central variable is further expanded in Hall and Jorgenson (1967), using the basic assumption that a firm seeking to maximize profits invests until the present value of the marginal return of the investment project becomes equal to the marginal cost of purchasing the particular asset.

King and Fullerton (1983) expand the concept of the cost of capital developed by Hall and Jorgenson (1967) by including personal income taxation (dividends and capital gains received by shareholders) and various investment project sources of finance. In addition to different sources of finance, King and Fullerton (1983) assume that investment projects differ with respect to the asset type being financed, the sector of the economy in which the investment is made, and the characteristics of the after-tax return on the investment project. The measuring of marginal effective tax rates is carried out for new (marginal) investment projects that represent different combinations of these characteristics. Thus, the size of the effective tax rate depends on the distinct combination of these characteristics (Gordon, Kalambokidis & Slemrod, 2003, 8).

King and Fullerton (1983) define the marginal effective tax rate using a marginal tax wedge. The marginal tax wedge represents the difference between the before-tax rate of return on the marginal investment and the after-tax rate of return. The before-tax rate of return is the rate of return on one extra unit of capital engaged in an investment project in the absence of taxation, while the after-tax rate of return is the rate of return received by the shareholder after paying corporate and personal income taxes. Thus, the marginal tax wedge measures the difference between the rate of return that the company realises on one extra (marginal) unit of capital and the rate of return realised by the investor (shareholder or creditor of the company) after paying corporate income tax and personal income tax. The marginal effective tax rate is obtained by dividing the difference between the before-tax and the after-tax rates of return by the before-tax rate of return.

The subject of this research is the measurement of the marginal effective tax rate (METR) as an indicator of the tax burden on marginal investment projects. The primary aim of the research is to determine the extent of tax distortion on the investment decision-making process in the Serbian corporate sector based solely on the measurement of marginal effective tax rates, viewed exclusively from the perspective of a uniform tax treatment of investment projects with different characteristics. In this regard the paper evaluates whether the taxation of new investment projects in Serbia is neutral; that is, taxation does not discriminate against any particular type of new investment project.

The analysis aims to show whether there are investment projects in Serbia that have favourable tax treatment, resulting in greater investor interest, or investment projects that have unfavourable tax treatment, which investors avoid. The different tax treatment of investment projects will be quantified following the conceptual framework to measure the marginal effective tax rate, confirming or rejecting the existence of the neutrality of taxation.

The paper is structured as follows. The second section provides an overview of previous research that deals with measuring effective tax rates as an indicator of the tax burden on investment projects. The third section presents the King-Fullerton framework used to calculate marginal effective tax rates. The fourth section analyses the research data and methodology implemented to measure marginal effective tax rates for the example of Serbia. The fifth part discusses the empirical results, with the emphasis on determining those investment projects that have favourable tax treatment and those whose financing is significantly discouraged by the tax system. The final part of the paper draws appropriate conclusions that can serve as a recommendation to national tax policy creators.

2. LITERATURE REVIEW

The literature analysing the tax burden on investment projects is extensive. Most of the research takes the analysis of diminishing marginal expected returns as its starting point. With regard to the effective tax burden, differences in the taxation of investment projects are an important research issue. The impact of taxation on the investment process is usually assessed through the cost-of-capital function, which represents the minimum required before-tax rate of return the project should generate to be considered profitable.

The concept of the cost of capital was developed by Jorgenson (1963) as a variable that not only includes the cost of financing a new investment project but also depends on the nominal tax rate, economic asset depreciation, inflation, and other variables. Hall and Jorgenson (1967) established the relationship between cost of capital and investment volumes as the basis for measuring the impact of taxation. King and Fullerton (1983) developed the concept of marginal effective tax rates, which Fullerton (1983) pointed to as probably the most adequate methodological tool for measuring tax incentives for the realisation of new investment projects. Initially, King and Fullerton (1983) developed a model to measure METR using the cost of capital and calculating METRs for domestic investment by including taxation on both the corporate and personal level, based on a sample of four countries (the United Kingdom, Sweden, Germany, the United States). The approach is based on the construction of a hypothetical marginal investment project. For each hypothetical investment project the impact of taxation on the cost of capital is measured.

Given that King and Fullerton (1983) focused on domestic investment in buildings, machinery, and inventory financed by domestic savings, this model was later expanded several times. Boadway, Bruce, and Mintz (1984) used a similar approach, but developed a model for a small open economy. However, when international capital flows entered an expansionary phase during the 1980s the tax burden on cross-border investments became a significant research issue.

Keen (1991) and Alworth (1998) showed that this methodology can be extended and implemented in research on multinational corporation taxation by introducing the problem of international double taxation and different sources of finance.

In one of the most influential studies that uses the King-Fullerton framework to measure the marginal effective tax rate, the OECD (1991) compared estimates of marginal effective tax rates for domestic and foreign direct investment in all OECD member countries. This study extended the calculation of tax rates from the original four countries in King and Fullerton (1983) to 24 OECD member countries, 12 of which were members of the European Community. The approach used in OECD (1991) was extended in a European Commission (1992) study that measured tax rates for transnational investments by looking at the case of a branch in one country financed by a parent company in another country. The calculations in this study were based on the assumption of uniform interest and inflation rates in all European Community member states, taking into account the fact that barriers to capital movements within the Community were significantly reduced and that the countries were gearing up to monetary union.

A few years later, Devereux and Griffith (1998) significantly modified the King-Fullerton framework by developing a conceptual framework for analysing the impact of taxation on a company choosing between several distinct investment alternatives. They also introduced a new measure of the impact of taxation on investment projects, the average effective tax rate, based on the standard marginal effective tax rate approach. The average effective tax rate can be measured for any rate-of-return level, not only at the level of the cost of capital. More precisely, the marginal effective tax rate represents the value of the average effective tax rate, but for marginal investment projects (Sorensen, 2004, 6). The rate of return on a marginal investment is reduced to the value of the cost of capital, which is a condition for equal marginal and average effective tax rates. The European Commission (2001) implemented the Devereux-Griffith approach in one of the most comprehensive studies, assessing the effective corporate tax rates on domestic and transnational investments in 15 EU member states.

As King and Fullerton (1983) analysed the corporate sector exclusively, further expansions were made to include other sectors. Bowenberg and ter Rele (1998) applied the original framework to self-employed individuals and entrepreneurs, and Jorgenson and Yun (2001) calculated effective tax rates for both the corporate and non-corporate sectors. Valenduc (2004) used the King-Fullerton approach to determine effective tax rates for small enterprises in Belgium operating in the unincorporated sector. Gordon and Tchilinguirian (1998) developed the methodology by expanding the emphasis in the King-Fullerton framework on investment in buildings, machinery, and inventory to calculating effective tax rates for R&D investment. Investment in research and development was classified as investment with either short-run or long-run returns.

In the last decade several researchers have used the King-Fullerton framework. De Almeida (2010) calculates tax wedges and marginal effective tax rates for the Brazilian corporate sector by analysing the existing state of affairs and conducting alternative policy simulations. De Almeida and Paes (2013) analyse capital income taxation in Brazil using two features not introduced in the original King-Fullerton framework: the interest on net equity (INE), which, similarly to dividends, is paid to shareholders, and the differentials in interest rates available to Brazilian companies. The authors show that marginal effective tax rates are very sensitive to which interest rate is available to companies, since debt financing could be the best or the worst option depending on that rate. Barrios et al. (2014) provide estimates of marginal effective tax rates for a sample of 17 OECD countries and 11 economic sectors, considering labour and energy taxation as well as capital taxation. The effective tax rates for capital taxation are derived directly from King and Fullerton (1983) and the ZEW database on corporate taxation is the main data source. The authors conclude that the effective tax rates on capital vary extensively across sector and country. Holečkova and Menzl (2018) examine tax neutrality in the Czech Republic by calculating tax wedges in 2010 and 2018 based on statutory tax parameters and the assumed depreciation rates. The weights for the assets and the sources of finance are the same as in OECD (1991). The authors use the statutory tax rates and the assumed depreciation rates to calculate the total tax wedge, which is much lower than the OECD average, while partial tax wedges are similar in value to those in OECD (1991), and even lower in some cases. Johansson et al. (2020) examine marginal effective tax rates for industrial foundations, legal entities founded by entrepreneurs for achieving favoured tax status conditioned on engagement in philanthropic activities, in the period 1862–2018. The authors analyse the retained earnings and new equity as sources of finance, while debt is disregarded, since the control in industrial foundations is exercised through ownership. The analysis reveals the importance of including the cash flow effect of the requirement to donate part of the net income for charitable purposes, since in this case the recalculated METR on new share issues increases substantially and this source of finance becomes disadvantaged compared to retained earnings.

3. THE KING-FULLERTON CONCEPTUAL FRAMEWORK

As already pointed out, the marginal effective tax rate is an indicator of the tax burden on an investment project. Due to its marginal character, the central point of the calculation is the marginal investment project. Profit maximisation means that the company invests up to the point where the cost of the asset purchase equals the present value of the after-tax return and depreciation through the life cycle of the project. The marginal rate of return on the extra unit of capital that a company achieves at this point represents the cost of capital, which is the central concept for measuring the marginal effective tax rate.

A company that aims to realise an investment project must provide sources of finance. The real interest rate, denoted by r, acts as an intermediary between the investment decisions of the company and the saving decisions of individuals, because it represents the opportunity cost of financing the investment project. Hence, the expression for the real interest rate is as follows:

$$r = \frac{(1+i)}{(1+\pi)} - 1 \tag{1}$$

The relationship between the cost of capital and the real interest rate, expressed as the cost-of-capital function, depends on tax legislation provisions. If s denotes the after-tax rate of return, it can be calculated using the following equation (King & Fullerton, 1983):

$$s = (1 - m_i)(r + \pi) - \pi - w_p \, , \tag{2}$$

where m_i denotes the marginal personal tax rate on interest income, π is the inflation rate, and w_p is the marginal personal tax rate on wealth that exists, for example, in the United States.

If p denotes the before-tax return on a marginal investment project, net of depreciation, in the absence of taxation, p = s = r. However, taxes insert a wedge between the before-tax rate of return on investment and the after-tax rate of return on savings. The tax wedge, w, represents the difference between the rate of return generated by the investment project and the rate of return on the savings which finance the project:

$$w = p - s, \tag{3}$$

and the marginal effective tax rate, t, is the tax wedge divided by the before-tax rate of return:

$$t = \frac{p - s}{p} \tag{4}$$

The marginal effective tax rate for investment projects with different characteristics can differ significantly. King and Fullerton (1983) examine three investment project characteristics and consider three alternatives for each characteristic. The first characteristic is the asset type in which the company invests, which is divided into three groups: buildings, machinery, and inventory. Machinery includes plants, production machines, equipment, and means of transport. Investment in financial assets, research and development, or intangible assets is not included. The second characteristic is the sector of the economy in which the investment project is positioned, which can be manufacturing, other industry, or commerce. The definition of manufacturing follows the standard industry classification and includes the entire manufacturing sector. The 'other industry' sector includes construction, transport, communications, and water, electricity, and gas production. The commerce sector includes wholesale and retail activities and non-financial services but excludes agriculture, state-owned production, and financial services. The third characteristic is the finance source, which can be retained earnings, new shares issuance, or debt (bond issuance and bank borrowing).

The three alternatives for each of the three characteristics result in 27 distinct hypothetical investment projects. The marginal effective tax rate is calculated for each of 27 investment projects. The underlying assumptions are a fixed nominal tax rate, the absence of uncertainty, and a constant inflation rate.

The analysis focuses on a marginal investment project with an initial cost of one unit of capital. Following the methodology of King and Fullerton (1983), if MRR denotes the gross marginal rate of return generated by the project, assuming that the investment asset is depreciated at a constant exponential rate δ,

$$p = MRR - \delta \tag{5}$$

where p equals the net income.

It should be noted that economic depreciation and tax depreciation usually differ. Economic depreciation is assumed to be exponential, while tax depreciation is, in general, not exponential. If τ denotes the corporate income tax rate and ρ denotes the cash flow discounting rate, the present value of the profits generated by the project, net of taxes, is

$$V = \frac{(1-\tau)MRR}{\rho+\delta-\pi} \tag{6}$$

From Equation (6) it can be seen that nominal profit increases at the rate of inflation π, decreases at the rate of depreciation δ, and is discounted at the rate ρ. The discount rate depends on the real interest rate and the rate of inflation. The initial project cost is unity (one extra unit of capital) minus the present value of tax allowances given for asset A. Hence, the initial cost of the project is

$$C = 1 - A\,. \tag{7}$$

By making V from Equation (6) equal to C from the Equation (7) the cost of capital is calculated as

$$p = \frac{(1-A)}{1-\tau)}(\rho+\delta-\pi) - \delta\,. \tag{8}$$

Equation (8) derives the cost of capital for investments in buildings and machinery. To derive the cost of capital for inventory if the FIFO accounting method is used, the effect of inflation must be adjusted for. It is also important to point out that inventory is accounted for by its acquisition value and therefore does not depreciate over time (de Almeida 2010, 20).

In order to derive the expression for the present value of tax relief, King and Fullerton (1983) assume that it takes three forms: standard depreciation allowances, immediate expenses, and tax credits. The value of standard depreciation allowances depends on the method of calculating the depreciation that is allowed for tax purposes (declining balance method or linear method).

Regarding the taxing of inventory, if v denotes the part of inventory recognized at historical cost, i.e., FIFO accounting, then, if relative prices do not change, the marginal investment in one unit of inventory will lead to $tv\pi$ additional tax on an annual basis (Holečkova and Menzl, 2018, 15). If FIFO accounting is used the value of v will be one, and if LIFO accounting is used the value of v will be zero. King and Fullerton (1983) suggest that when a company uses weighted average cost accounting to calculate the value of inventory the value of *v* should be set to 0.5.

The next step in the analysis is to link the discount rate to the market interest rate. When taxation is present the discount rate will differ from the market interest rate and will depend on the source of finance.

In case of debt financing, interest income is taxed but interest payments are tax deductible. The rate at which a firm discounts after-tax cash flows is the after-tax interest rate (de Almeida & Paes, 2013, 189):

$$\rho = i(1-\tau)\,. \tag{9}$$

If new shares issuance is the source of finance, the opportunity rate of return is equal to the return that could be earned by providing a company loan and is expressed as $(1\text{-}m_i)i$, where i denotes nominal market interest rate and m_i stands for the personal income tax rate on interest income. The discount rate equates the return of dividends after paying tax at m_d rate with the opportunity return rate. Hence, the discount rate in case of new shares issuance is:

$$\rho = \frac{(1-m_i)i}{(1-m_d)} \tag{10}$$

From Equation (10), it can be concluded that if $m_i = m_d$, ρ equals i.

The retained earnings allow investors to realise capital gains that are taxed by capital gains tax rather than personal income tax. If the project return is denoted by ρ, then the investor requires a rate of return that equates ρ(1-z) and i(1-m), where z denotes the effective capital gains tax rate. According to King and Fullerton (1983), the discount rate in the case of retained earnings finance is

$$\rho = \frac{(1-m_i)i}{(1-z)} \tag{11}$$

The inclusion of tax deferral in this case implies that the statutory tax rate z_s has to be converted to the effective tax rate z that represents the present value of future capital gains taxes levied on one unit of capital gain:

$$z = \frac{\lambda z_s}{\lambda + \rho_i} = \frac{\lambda z_s}{\lambda + i(1-m_i)} \tag{12}$$

where ρ_i denotes the nominal discount rate for the investor, and λ denotes the part of capital gains realised in a particular fiscal year.

4. DATA AND METHODOLOGY

To calculate the METR for Serbia it is necessary to set the value of both a number of tax parameters in compliance with tax legislation provisions and a number of non-tax (economic) parameters. King and Fullerton (1983) define tax parameter values based on the provisions of the relevant tax laws, and non-tax parameters – such as the economic life of fixed assets, the recognition of inventory costs, capital stock structure, and company financial resources – based on various national surveys.

Since, to the authors' best knowledge, no research has been conducted in Serbia that systematically analyses the structure of national capital stock in the manner required for calculating marginal effective tax rates, this paper uses an approach that estimates the necessary parameters based on a sample of companies. The economic depreciation rates for buildings, plants, and equipment and inventory recognition are estimated for a sample of 223 companies that in the 2018 fiscal year achieved the highest operating incomes in Serbia, based on financial reports publicly available at the Business Registers Agency and at the Belgrade Stock Exchange for those companies whose shares are listed on the stock exchange listing or on the open market. Initially, the group consisted of 250 companies, but 27 companies were excluded from the analysis because they did not meet the necessary requirements (assets did not include buildings and business facilities, depreciation rate on buildings was not reported, none of three financing sources was used because companies were in bankruptcy or restructuring, companies incurred losses in previous fiscal years, etc.). In addition, the METR does not consider state companies, so a number of companies are not included for this reason, which is somewhat a disadvantage, given that state companies in Serbia have significant financial strength.

The companies were selected keeping in mind the requirements of the framework to be implemented, which only analyses the domestic non-financial corporate sector. Business income was taken as the initial criterion for sample selection because corporations generate significantly higher business income than unincorporated businesses. The sample in this paper consists of companies that operate entirely in the corporate sector, either as joint stock companies or as limited liability companies.

The sample consists of 223 companies, of which 82 companies (37% of the sample) are joint stock companies and 141 (63%) are limited liability companies. Regarding sectoral classification, 113 (51%) are manufacturing companies, 39 companies (17%) are in other industries, and 71 companies (32%) are in commerce.

The asset classifications considered are 1) buildings, 2) plants and equipment, and 3) inventory. From the fixed assets in the financial statements of companies operating in Serbia we singled out real estate, plants, and equipment (account 02), construction facilities (account 022), and plants and equipment (account 023), and from the current assets we selected class 1 – inventory (materials, products in progress, and finished products).

Economic activity is classified as three sectors given in King and Fullerton (1983): manufacturing, other industry, and commerce. Other industry includes construction, transport, communications, and electricity, gas, and water, and commerce comprises wholesale, retail, and service activities of a non-financial nature. Our analysis uses the classification of economic activities in the Ordinance Concerning the Classification of Activities (The Official Gazette of Serbia, No. 54/2010). Manufacturing includes sector C –processing industry (economic areas 10–33). Other industry includes sectors D –supply of electricity, gas, steam, and air conditioning (35), E – water supply (36–39), F – construction (41–43), H – traffic (49–53), and J – information and communications (58–63). Commerce includes sector G – wholesale and retail trade (45–47), and sector I – accommodation and food services (55–56).

The sources of finance used are debt, new issue of shares, and retained earnings. Debt includes both the issuance of company bonds and bank loans. For the purposes of this analysis, the new issue of shares is expanded to include new issuance of membership units in limited liability companies, as this organisational and legal form plays an important part in the Serbian economy. From the perspective of tax treatment, the position of owners in joint stock companies and limited liability companies is similar because both dividends and shares in profits are taxed by capital income tax within personal income tax.

The three characteristics, each with three alternatives, result in 27 individual combinations, and it is necessary to calculate the marginal effective tax rate for each one. From the data in our sample the structure of capital stock in Serbia can be deduced; in other words, it is possible to determine the matrix of capital weights for each of the 27 alternative investment projects. Given that both the share of all three economic sectors in the total capital stock and the structure of capital in each of the sectors are known, weights can be derived at the level of each sector for nine investment projects that differ regarding asset type and source of finance, as shown in Table 1.

Table 1: Matrix of weights in capital stock for investment projects

	Buildings	Plants and equipment	Inventory	Total
Manufacturing				**0.545**
Retained earnings	0.036	0.077	0.0276	0.1406
New shares issuance	0.0316	0.068	0.0243	0.1239
Debt	0.072	0.1547	0.0553	0.282
Other industry				**0.344**
Retained earnings	0.0514	0.034	0.0098	0.0952
New shares issuance	0.0706	0.0467	0.0129	0.1302
Debt	0.0649	0.043	0.0118	0.1197
Commerce				**0.113**
Retained earnings	0.015	0.0057	0.0168	0.0375
New shares issuance	0.0099	0.0038	0.011	0.0247
Debt	0.0211	0.0081	0.022	0.0512
	0.372	**0.441**	**0.191**	Σ= 1.00

Source: Authors

The combined share of buildings, plants, and equipment in capital stock is 81.3%. According to Karapavlović et al. (2020) the average share of property, plants, and equipment in the total assets of Serbian companies was 44.7% in the period 2014–2016, which means that the observed sample is capital intensive. In addition to calculating capital weights, the sample will be used to calculate the values of economic (non-tax) parameters and tax parameters, which are necessary to calculate effective tax rates. The economic parameters included in the calculation are economic depreciation rate, nominal interest rate, real inflation rate, and real interest rate. Of the economic parameters only the rate of economic depreciation is calculated on a sample basis, both for buildings and for plants and equipment, as shown in Table 2.

Table 2: Non-taxation (economic) parameters for Serbia

<table>
<tr><th>Economic parameters</th><th colspan="2"></th><th>Entire sample</th><th>Sector 1</th><th>Sector 2</th><th>Sector 3</th></tr>
<tr><td>Economic depreciation rate</td><td colspan="2">δ</td><td></td><td></td><td></td><td></td></tr>
<tr><td>- buildings</td><td colspan="2">δ_b</td><td>2.1%</td><td>2.08%</td><td>1.8%</td><td>2.23%</td></tr>
<tr><td rowspan="2">- plants and equipment</td><td rowspan="2">δ_{pe}</td><td>lower</td><td>7.44%</td><td>6.85%</td><td>6.00%</td><td>9.26%</td></tr>
<tr><td>higher</td><td>15.82%</td><td>15.94%</td><td>18.5%</td><td>18.07%</td></tr>
<tr><td>Nominal interest rate (2009–2017)</td><td colspan="2">i</td><td colspan="4">9.83%</td></tr>
<tr><td>Inflation rate (2007–2017)</td><td colspan="2">π</td><td colspan="4">6.78%</td></tr>
<tr><td>Real interest rate</td><td colspan="2">r</td><td colspan="4">2.85%</td></tr>
</table>

Source: Authors

Given that the rates of economic depreciation that companies apply to different categories of plants and equipment differ significantly, the rate of economic depreciation is calculated as two levels, lower and higher. The average rate of economic depreciation is used to calculate tax rates for plants and equipment. The nominal interest rate is based on the average weighted interest rates on one-year maturity government bonds in the period 2009–2017, and the actual inflation rate is based on National Bank of Serbia data on the consumer price index for the period 2007–2017.

Regarding tax parameters, tax rates are defined by the provisions of the relevant tax laws (Law on Personal Income Tax, Law on Corporate Income Tax, Law on Property Tax). For the purposes of this analysis, only tax treatment of inventory, that is, the value of the parameter v, is derived from the sample. The value of v = 0.5 is assigned to those companies that use the weighted average price method to calculate inventory costs and the value of 1 to those companies that use the FIFO method. As can be seen in Table 3, the prevalent method in Serbian companies is the weighted average price, which is used by 85% of the observed companies and is why the value of v is relatively small.

Table 3: Tax parameters for Serbia

Corporate income tax rate		**τ**		15%
Tax depreciation rate		**φ**		
- buildings				2.5% LM
- plants and equipment				10% and 15% (12.5%) DM
Inventory		**Weighted average price**	**FIFO**	**v**
	Overall	191	32	0.572
	Sector 1	93	20	0.54
	Sector 2	36	3	0.538
	Sector 3	62	9	0.56
Personal income tax rates				
- interest income		$\mathbf{m_i}$		15%
- dividend income		$\mathbf{m_d}$		15%
- realised capital gain		$\mathbf{z^*}$		8.1%
Effective property income tax rate		**e**		0.4%

*LM – linear method * DM – declining balance method

Source: Authors

Regarding tax depreciation of fixed assets, the Law on Corporate Income Tax prescribes a linear depreciation for real estate in the broader sense and a declining balance depreciation for plants and equipment. For tax depreciation purposes, the Rulebook on the Classification of Fixed Assets puts plants and equipment in the second and third fixed-asset groups, with respective depreciation rates of 10% and 15%. In this paper it will be assumed that all plants and equipment are depreciated using the declining balance method at an average depreciation rate of 12.5%.

The effective tax rate on realised capital gains is obtained using Equation (12). The capital gains tax rate z_s is 15% in Serbia, and ρ_i denotes investors' nominal discount rate, expressed for Serbia as

$$\rho_i = \frac{i}{1+m_i} \tag{13}$$

where m_i stands for the personal income tax rate on interest income. This is distinct from the original King-Fullerton framework because interest on income tax is paid at source in Serbia, unlike in the United States, where it is paid after filing a tax return. For m_i =15% and $\lambda = 0.1$ (the average holding period for stocks is presumed to be 10 years), the effective capital gains tax rate z is 8.1% (the calculation is given in Appendix A).

Marginal effective tax rates for individual investment projects are calculated according to the following five steps.

First step. Since a constant real interest rate approach is used, it is necessary to calculate its value. Based on the data for the value of the nominal interest rate and the inflation rate, the real interest rate r is obtained using Equation (1). Personal income tax rates in Serbia are proportional, so in the case of Serbia the approach with a constant r can be reduced to a fixed after-tax rate of return approach denoted by s:

$$s = \frac{\frac{i}{1+m_i} - \pi}{1+\pi} \tag{14}$$

Second step: Calculating the discount rate for each of the three sources of finance:

- For retained earnings financing based on the following equation:

$$\rho = \frac{\left(\frac{i}{1+m_i} - z\pi\right)}{1-z} \tag{15}$$

where m_i denotes interest income tax rate, z denotes the effective capital gains tax rate, and π denotes the inflation rate.

- For new shares issuance based on the equation

$$\rho = \frac{\left(\frac{i}{1+m_i} - z\pi \right)}{\left(1-m_d\right)} \tag{16}$$

where m_d denotes the dividend income tax rate.

- For debt financing

$$\rho = i\left(1-\tau\right), \tag{17}$$

where i denotes the nominal interest rate, and τ stands for the corporate income tax rate.

Third step. Calculating the present value of tax depreciation deductions for buildings, plants, and equipment.

- The present value of tax depreciation for buildings, given that the linear method is used, is calculated using the formula

$$A = \frac{\tau\phi\left(1+\rho\right)}{\rho} * \frac{\left(\left(1+\rho\right)^n - 1\right)}{\left(1+\rho\right)^n} \tag{18}$$

where τ is the corporate income tax rate, ϕ is the depreciation rate, ρ is the discount rate, and n is the length of time period over which the asset is depreciated.

- For plants and equipment, since the declining balance method is used, the present value of tax depreciation allowance is calculated using the formula

$$A = \frac{\tau\phi\left(1+\rho\right)}{\left(\phi+\rho\right)} \tag{19}$$

Fourth step. Calculating the real before-tax rate of return p:

- for buildings, plants, and equipment, the before-tax rate of return is calculated using the formula:

$$p=\frac{(1-A)\big(\rho-\pi+\delta(1+\pi)\big)+(1+\rho)e}{(1-\tau)(1+\pi)}-\delta \tag{20}$$

- for inventory the following formula is used:

$$p=\frac{(1-A)\big(\rho-\pi+\delta(1+\pi)\big)+\tau v\pi}{(1-\tau)(1+\pi)}-\delta \tag{21}$$

Fifth step. Based on the before-tax rate of return p and the fixed after-tax rate of return s, calculation of the marginal effective tax rate is straightforward:

$$METR=\frac{p-s}{p}. \tag{22}$$

5. RESEARCH RESULTS

The tax wedges and marginal effective tax rates are calculated by following the explained procedure and implementing the necessary steps. Since a constant real interest rate approach is used, as the starting point the real interest rate is calculated using Equation (1) and is set at 2.85%. The after-tax rate of return is calculated using Equation (14) and is set at 1.65% (the calculations are given in Appendix A).

The after-tax rate of return can be considered constant, bearing in mind that income tax rates in Serbia are proportional; that is, all investors have similar personal income tax rates. After the investment project generates a return equal to the real interest rate the taxation of that return is the same for all investors, so it follows that if r is constant, the after-tax rate of return s for all individual investors has to be constant.

The next step involves calculating discount rates for different sources of finance. For retained earnings, new shares issuance, and debt financing the discount rates are obtained by Equations (15), (16), and (17), respectively. The discount rates for retained earnings, new shares, and debt financing are 8.7%, 9.41%, and 8.36%, respectively (Appendix B).

The next step calculates the present value of the tax depreciation allowance, which is related to the source of finance used (retained earnings, new shares issuance, or debt) and the respective discount rates. For buildings, Equation (18) is used for each of the three sources of finance, while for plants and equipment Equation (19) is used for each of three sources of finance (Appendix C).

The before-tax rates of return for buildings, plants, and equipment are calculated using Equation (20) and the procedure is given in Appendix D. The before-tax rates of return are sorted according to economic sector. For manufacturing, the parameters necessary to calculate the before-tax rate of return for buildings, plants, and equipment are given in Table 4. The difference in the present values of tax allowances for buildings is relatively small due to all sources of finance having the same depreciation rate and the same depreciation period (2.5% and 40 years, respectively). A similar situation exists with plants and equipment, as the same depreciation rate and the same depreciation method are applied to all assets in this category. The rate of economic depreciation of plants and equipment varies in terms of lower and higher rates, so that the pre-tax rate of return on plants and equipment will vary not only due to differences in discount rates but also due to differences in economic depreciation rates.

Table 4: Parameters for the calculation of before-tax rate of return for buildings, plants, and equipment

Buildings							
		Retained earnings		**New shares**		**Debt**	
Present value of tax depreciation allowances	A	0.0452		0.042		0.0466	
Economic depreciation rate	δ	2.08%		2.08%		2.08%	
Discount rate	ρ	8.71%		9.41%		8.36%	
Inflation rate	π	6.78%		6.78%		6.78%	
Property income tax rate	*e*	0.4%		0.4%		0.4%	
Plants and equipment							
		Retained earnings		**New shares**		**Debt**	
Present value of tax allowances	A	0.0961		0.0936		0.0974	
Economic depreciation rate	δ	6.85%	15.94%	6.85%	15.94%	6.85%	15.94%
Discount rate	ρ	8.71%		9.41%		8.36%	
Inflation rate	π	6.78%		6.78%		6.78%	
Property income tax rate	*e*	0.4%		0.4%		0.4%	

Source: Authors

The before-tax rate of return for inventory is calculated using Equation (21) and the parameters needed to calculate the before-tax rate of return in manufacturing are given in Table 5 (calculations are provided in Appendix E). It can be seen that when calculating the pre-tax rate of return for inventory within one sector the only variable that varies in value is the discount rate, so the differences in rates of return before tax are due to different discount rates.

Table 5: Parameters for the calculation of before-tax rates of return for inventory

	Retained earnings	New shares	Debt
v	0.54	0.54	0.54
ρ	8.71%	9.41%	8.36%
π	6.78%	6.78%	6.78%
δ	0	0	0

Source: Authors

The before-tax rates of return for investment in manufacturing are based on the calculated values of parameters in the relevant equations, as shown in Table 6. It can be seen that the highest rates of return before taxation are generated by projects that are financed by the issue of new shares, which automatically suggests that the tax burden on these projects is higher because the after-tax rate of return is constant. It should be noted that the fact that a project must generate a high rate of return before taxation does not represent a benefit to the investor, as it is the return necessary to make a project financially viable. Projects that are financed from retained earnings and debt have a more favourable tax treatment.

Table 6: Before-tax rates of return in manufacturing (%)

p	Buildings	Plants and equipment		Inventory
		lower δ	higher δ	
Retained earnings	2.76	2.75	3.32	2.72
New shares issuance	3.44	3.48	4.08	3.50
Debt	2.31	2.39	2.95	2.34

Source: Authors

Similarly, the values of before-tax rates for investment projects in other industry and commerce are calculated using the values of the variables identified in the previous section (tax and non-tax parameters, discount rates for different sources of finance, present value of tax allowance). Based on the formula for calculating the marginal effective tax rate, Table 7 shows the values of marginal effective tax rates for all 27 hypothetical investment projects. It can be seen that investments in buildings in the manufacturing sector that are debt-financed have the most favourable tax treatment, as the marginal effective tax rate on these investments is 28.38%. In addition, debt-financed investments in buildings in the other industry sector, in inventory in manufacturing, and in inventory in other industry have favourable tax treatment, with effective tax rates of 29.58%, 29.28%, and 29.28%, respectively.

Table 7: METR for investment projects (%)

	Buildings	**Plants and equipment**	**Inventory**
Manufacturing			
Retained earnings	39.90	45.54	39.23
New shares issuance	51.84	56.22	52.74
Debt	28.38	38.12	29.28
Other industry			
Retained earnings	39.24	47.79	39.18
New shares issuance	52.49	57.77	52.70
Debt	29.58	40.92	29.20
Commerce			
Retained earnings	40.39	49.23	39.73
New shares issuance	53.22	58.76	53.03
Debt	31.12	42.70	29.95

Source: Authors

On the other hand, investment in plants and equipment in the commerce sector financed by the issuance of new shares has the least favourable tax treatment because the marginal effective tax rate on this type of investment is 58.76%. Investment in plants and equipment in the manufacturing and other industry sectors financed by the issue of new shares also has unfavourable tax treatment, with effective tax rates of 56.22% and 57.77% respectively.

As shown in Table 8, if individual effective tax rates are presented with respect to the type of asset in which the funds are invested, economic sector, and source of finance, relative uniformity can be observed when comparing marginal effective tax rates by selected positions.

Table 8: METR for type of asset, sector of the economy, and source of finance

	METR (%)
Asset	
Buildings	39.07
Plants and equipment	45.71
Inventory	38.13
Sector of the economy	
Manufacturing	40.86
Other industries	43.85
Commerce	40.11
Source of finance	
Retained earnings	42.48
New shares issuance	54.38
Debt	33.66

Source: Authors

These positions were obtained by weighting the shares in the capital stock (capital weights from Table 1), and not by calculating the simple arithmetic mean of the corresponding effective tax rates for individual investment projects. When looking at the assets being invested in, marginal effective tax rates range between 38.13% and 45.71%. Inventory has the most favourable tax treatment, with an effective tax rate of 38.13%, while buildings are in a slightly less favourable position with a marginal effective tax rate of 39.07%. Investment in plants and equipment has a slightly more unfavourable position with a rate of 45.71%.

When it comes to the sectoral structure the situation is even more uniform, because investments in manufacturing and commerce have similar tax treatment (40.86% and 40.11% respectively), and investments in other industry are in a somewhat less favourable position (43.85%). Regarding the source of finance there are somewhat more pronounced differences, in the sense that debt-financed investments have the most favourable tax treatment, with a marginal effective tax rate of 33.66%; investments financed by retained earnings have slightly less favourable tax treatment (42.48%), and investments financed by the issue of new shares have the most unfavourable tax treatment, with an effective tax rate of 54.38%. These results support the research hypothesis that investment activities in Serbia are neutrally taxed; that is, the tax treatment of investment projects is non-discriminatory.

Comparing these results with previous research confirms the neutrality of taxation of investment projects in Serbia. According to a study conducted by the European Commission (2001), there is pronounced variability in the marginal effective tax rates in EU member states. In all member states except Ireland the marginal effective tax rates for debt-financed projects were negative (ranging between –56.2% and –8.7%), indicating extremely favourable tax treatment for these projects. On the other hand, for projects financed from retained earnings the effective tax rate ranged between 10% in Italy and 48.4% in Germany, while for projects financed by a new share issuance, marginal effective tax rates ranged between 10% in Italy and 44.4% in France. The results of the European Commission (2001) show a substantial difference between the tax treatment of debt-financed investment projects on the one hand, and projects financed from retained earnings and new share issues on the other. Such variation in tax treatment significantly impairs the neutrality of taxation due to the distortive effects that the tax system generates in favour of one group of investment projects at the expense of other types. De Almeida (2010) calculated marginal effective tax rates using the King-Fullerton approach in the case of Brazil. The effective tax rates for debt-financed projects were negative for investments in buildings and equipment, while the effective tax rate for inventory was zero. For projects financed by both retained earnings and the new issue of shares, effective tax rates ranged between 20.4% and 31.7%. This case showed a clear bias in favour of debt-financed investment projects as opposed to projects financed by retained earnings or new issue of shares. De Almeida and Paes (2013) confirmed that the Brazilian income tax system distorts incentives for allocation of capital between assets and sources of finance, since the effective tax rate is negative for debt (–27.07% on average) and positive for retained earnings and new equity (44.15% and 33.62% on average, respectively). Holečkova and Menzl (2018) calculated tax wedges for the Czech Republic for 2010 and 2018 based on statutory tax parameters and weights for finance sources in the OECD (1991). Their results suggest that in 2018 tax wedges were lowest for debt finance (0.5% on average) and higher for retained earnings and new equity (1.33% and 1.80% respectively). Also, the tax wedge for machinery was lower than the tax wedge for buildings and inventory (0.76% on average as opposed to 1.19% and 1.71% respectively). The authors concluded that the Czech tax system favours investment in machinery over buildings and inventory as regards assets, and debt over retained earnings and new equity as regards sources of finance.

The uniformity of marginal effective tax rates in Serbia can be explained by the equality of nominal tax rates, bearing in mind that the nominal tax rates on dividend income, profit shares, interest, capital gains, and corporate income are identical. As in previous studies, debt is the best choice as a source of finance regarding tax treatment because the interest is deductible when calculating corporate income tax. The discount rate for debt finance is accordingly the lowest, so that in this case the present value of depreciation deductions is the highest (both for buildings and plants and equipment), which combined lead to the lowest before-tax rate of return in the case of debt financing. The difference in the case of financing between the discount rate from retained earnings and from the issue of new shares exists solely due to the lower effective realised capital gains tax rate compared to the dividend income tax rate.

Regarding debt-finance tax treatment, investment projects financed by debt do not get preferential tax treatment; that is, the marginal effective tax rates, although lower than other financing sources, are not negative. In most countries, marginal effective tax rates for debt financing are negative, which means that investment projects are financed not only by the private sector but also by the government sector. This phenomenon occurs if companies can deduct the interest cost from the income tax base at a higher rate than the rate at which interest recipients pay tax on the same interest income. Therefore, in a situation where the corporate income tax rate is higher than the interest income tax rate the marginal effective tax rate may be negative, and investment projects financed in this way have a very favourable tax treatment, which is not the case in Serbia.

6. CONCLUSION

The paper provides marginal effective tax rates for hypothetical investment projects using the example of Serbia and the King-Fullerton framework. Marginal effective tax rates, as indicators of the tax burden on investment projects, are used to analyse neutrality in the taxation of investment projects. Although most previous research using the King-Fullerton framework highlights the way taxation distorts the investment decision-making process, the analysis of taxation of investment projects in Serbia shows a relative neutrality of taxation. The Serbian tax system is characterised by a relative uniformity of marginal effective tax rates. Effective tax rates for different types of asset differ by only a small percentage, and the situation is similar in terms of the sectoral structure of effective tax rates. The tax treatment of the source of finance is only slightly more unequal, considering that the tax treatment of debt financing is more favourable than financing from retained earnings and the issue of new shares. This regime can be explained by the fact that debt has a relatively favourable tax treatment compared to the other two sources of finance because the interest cost can be deducted from the tax base when calculating corporate income tax. However, this comparative advantage is much less pronounced than the superiority that debt has in many other countries where effective tax rates are very low, and in many cases are negative. Thus, the empirical results support the neutrality of taxation of investment projects in Serbia.

Regarding the recommendations that could be addressed to the creators of tax policy in Serbia, it seems that, from the perspective of neutrality in taxation, the current model of taxation of investment projects is satisfactory. Without going into the issues of the vertical and horizontal equity of personal income tax in Serbia, corporate income tax revenue, and other topics of economic debate, and focusing on a strict interpretation of the results obtained implementing the King-Fullerton framework, it can be concluded that the Serbian tax system achieves tax neutrality because it neither favours nor discriminates against various types of investment project to a significant extent. From this point of view, it can be concluded that the existing taxation system should not be changed, and if changes are needed to achieve greater tax revenues, they should be done in a way that maintains neutrality in the taxation of investment projects.

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Received: October 29, 2020
Accepted: September 16, 2021

APPENDIX

Appendix A

Parameter	Equation	Value
Real interest rate	$r = \frac{(1+i)}{(1+\pi)} - 1 = \frac{1+0.0983}{1+0.0678} - 1$	2.85%
Effective capital gains tax rate	$z = \frac{\lambda z_s}{\lambda + \rho_i} = \frac{\lambda z_s}{\lambda + \frac{i}{1+m_i}} = \frac{0.1 * 0.15}{0.1 + \frac{0.0983}{1+0.15}}$	8.1%
After-tax rate of return	$s = \frac{\frac{i}{1+m_i} - \pi}{1+\pi} = \frac{\frac{0.0983}{1+0.15} - 0.0678}{1+0.0678}$	1.65%

Appendix B

Discount rates		
Source of finance	**Equation**	**Value**
Retained earnings	$\rho^{RE} = \frac{\left(\frac{i}{1+m_i} - z\pi\right)}{1-z} = \frac{\frac{0.0983}{1+0.15} - 0.081 * 0.0678)}{(1-0.081)}$	8.7%
New shares issue	$\rho^{NS} = \frac{\left(\frac{i}{1+m_i} - z\pi\right)}{(1-m_d)} = \frac{\left(\frac{0.0983}{1+0.15} - 0.081 * 0.0678\right)}{(1-0.15)}$	9.41%
Debt	$\rho^{D} = i(1-\tau) = 0.0983 * (1-0.15)$	8.36%

Appendix C

Tax allowances for buildings, plants, and equipment		
Buildings	**Equation**	**Value**
Retained earnings	$A_B^{RE} = \frac{t\phi_B\left(1+\rho^{RE}\right)}{\rho^{RE}}\left(1-\frac{1}{\left(1+\rho^{RE}\right)^T}=\right)$ $= \frac{0.15*0.025*1.087}{0.087}\left(1-\frac{1}{\left(1+0.087\right)^{40}}\right)$	0.0452
New shares	$A_B^{NS} = \frac{t\phi_B\left(1+\rho^{NS}\right)}{\rho^{NS}}\left(1-\frac{1}{\left(1+\rho^{NS}\right)^T}\right) =$ $= \frac{0.15*0.025*1.0941}{0.0941}\left(1-\frac{1}{\left(1+0.0941\right)^{40}}\right)$	0.042
Debt	$A_B^{D} = \frac{t\phi_D\left(1+\rho^{D}\right)}{\rho^{D}}\left(1-\frac{1}{\left(1+\rho^{D}\right)^T}\right) =$ $= \frac{0.15*0.025*1.0836}{0.0836}\left(1-\frac{1}{\left(1+0.0836\right)^{40}}\right)$	0.0466
Plants and equipment		
Retained earnings	$A_{PE}^{RE} = \frac{t\phi_{PE}\left(1+\rho^{RE}\right)}{\left(\phi_{PE}+\rho^{RE}\right)} = \frac{0.15*0.125*\left(1+0.087\right)}{\left(0.125+0.087\right)}$	0.0961
New shares	$A_{PE}^{NS} = \frac{t\phi_{PE}\left(1+\rho^{NS}\right)}{\left(\phi_{PE}+\rho^{NS}\right)} = \frac{0.15*0.125*\left(1+0.0941\right)}{\left(0.125+0.0941\right)}$	0.0936
Debt	$A_{PE}^{D} = \frac{t\phi_{PE}\left(1+\rho^{D}\right)}{\left(\phi_{PE}+\rho^{D}\right)} = \frac{0.15*0.125*\left(1+0.0836\right)}{\left(0.125+0.0836\right)}$	0.0974

Appendix D

Before-tax rates of return	**Buildings, plants, and equipment**	Value
	Buildings	
Retained earnings	$p_B^{RE} = \frac{(1-0.0452)\left(0.087-0.0678+0.0208(1+0.0678)\right)+(1+0.087))0.004}{(1-0.15)(1+0.0678)}-0.0208$	2.76%
New shares	$p_B^{NS} = \frac{(1-0.042)\left(0.0941-0.0678+0.0208(1+0.0678)\right)+(1+0.941))0.004}{(1-0.15)(1+0.0678)}-0.0208$	3.44%
Debt	$p_B^{D} = \frac{(1-0.0466)\left(0.0836-0.0678+0.0208(1+0.0678)\right)+(1+0.0836))0.004}{(1-0.15)(1+0.0678)}-0.0208$	2.31%
	Plants and equipment	
Retained earnings	$p_{PE}^{RE} = \frac{(1-0.0961)\left(0.087-0.0678+0.0685(1+0.0678)\right)+(1+0.087))0.004}{(1-0.15)(1+0.0678)}-0.0685$	2.76%
New shares	$p_{PE}^{NS} = \frac{(1-0.0936)\left(0.0941-0.0678+0.0685(1+0.0678)\right)+(1+0.0941))0.004}{(1-0.15)(1+0.0678)}-0.0685$	3.48%
Debt	$p_{PE}^{D} = \frac{(1-0.0974)\left(0.0836-0.0678+0.0685(1+0.0678)\right)+(1+0.0836))0.004}{(1-0.15)(1+0.0678)}-0.0685$	2.39%

Appendix E

Before-tax rates of return	Inventory	Value
Retained earnings	$p_I^{RE} = \frac{(1-0)(0.087-0.0678+0*(1+0.0678))+0.15*0.54*0.0678}{(1-0.15)(1+0.0678)}-0$	2.72%
New shares	$p_I^{NS} = \frac{(1-0)(0.0941-0.0678+0*(1+0.0678))+0.15*0.54*0.0678}{(1-0.15)(1+0.0678)}-0$	3.50%
Debt	$p_I^{NS} = \frac{(1-0)(0.0836-0.0678+0*(1+0.0678))+0.15*0.54*0.0678}{(1-0.15)(1+0.0678)}-0$	2.34%

ECONOMIC ANNALS, Volume LXVI, No. 230 / July – September 2021
UDC: 3.33 ISSN: 0013-3264

https://doi.org/10.2298/EKA21301350

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THE ASYMMETRIC EFFECTS OF CURRENCY DEVALUATION IN SELECTED SUB-SAHARAN AFRICA

ABSTRACT: *Economic activities in many sub-Saharan African (SSA) countries have weakened markedly in the last few years, with deterioration in trade balances, increasing foreign reserve depletion, and exchange rate depreciation. This situation has led to a call by the International Monetary Fund for more flexible exchange rate adjustment and even currency devaluation to reverse the economic downturn. This call for devaluation has generated controversy among economists and policymakers in these countries and has revived the need to study the effects of devaluation on economic output in SSA countries. This study therefore examines the asymmetric effects of currency devaluation as a policy shift on economic output between 1980 and 2019 in six selected SSA countries, namely Ghana, Kenya, Tanzania, Mozambique, Nigeria, and Malawi. The study employs the smooth transition regression (STR) model to determine the relative asymmetric responses of economic output to devaluation and non-devaluation regimes. The results of STR are mixed, as devaluation asymmetrically impacts positively and significantly on economic output in Ghana, Kenya, Tanzania, and Mozambique, but is insignificant in the case of Nigeria and Malawi. This mixed result suggests that the impact of currency devaluation on economic output differs across countries depending on the structure and size of the economy, the nature of goods produced, and the supportive policies in place, among other things. The policy implication of the findings is that policymakers in various countries should understand the peculiarity of core macroeconomic variables in order to design and implement robust policies.*

KEY WORDS: *asymmetric effects, currency devaluation, economic output, Africa.*

JEL CLASSIFICATION: C58, F33, N17, O47.

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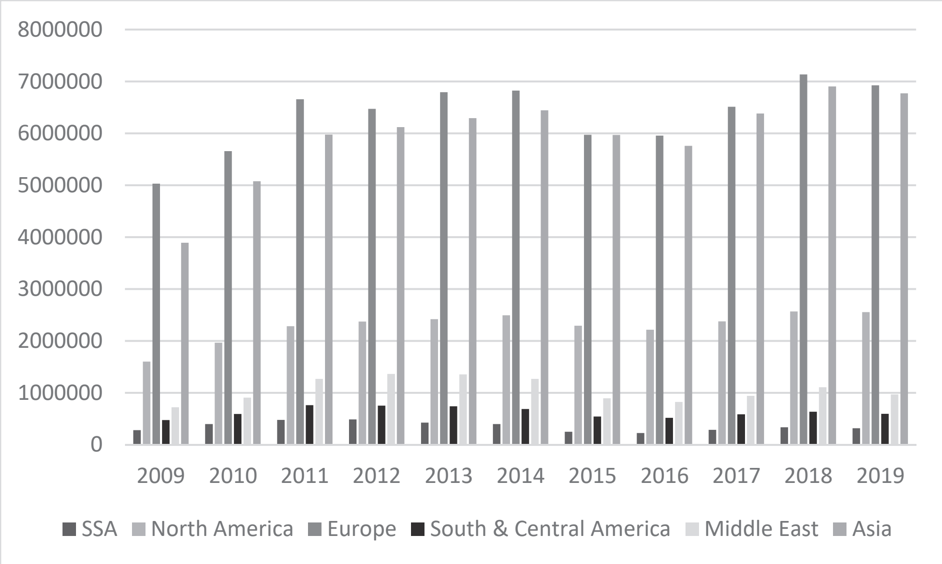
1. INTRODUCTION

Currency devaluation is often regarded as an essential policy instrument in the stabilisation of an economy's external sector. Theoretically, currency devaluation or exchange rate depreciation improves the terms of trade by raising the price of imported goods and services and lowering the price of exports, thus leading to an improvement in a country's balance of payment position. This improvement in foreign sector operations may lead to an expansion of aggregate output and employment in the macroeconomy. This has led many developing countries, including in sub-Saharan Africa (SSA), to devalue their currencies or operate a more flexible exchange rate system at one time or the other since the 1980s (Rawlin, 2011; World Economic Outlook, 2014).

However, the deterioration in sub-Saharan Africa's trade balances during times of devaluation and a flexible exchange rate raises questions regarding the region's competitiveness. The region's share of world trade has been infinitesimal. As recorded by the World Trade Organization (2020), in 2000 the SSA share of world trade was 1.5%, while the developed countries accounted for 65%. By 2013, SSA accounted for about 2.3% of world trade and developed countries for 50.1%. In 2015 SSA's percentage share of world trade had declined to 1.9%, rising slightly to 2.1% in 2019, while that of developed countries was 53.7% in 2015 and increased to 56.6% in 2019. When compared with the total exports of other regions between 2009 and 2019, depicted in Figure 1, SSA's share of exports remains the lowest. This further raises the question of whether a policy of currency devaluation has ever enhanced growth through an improvement in trade.

However, many economists argue that it is wrong to generalise the effects of devaluation on output, as the state of the economy, the nature of goods produced, and other supporting economic policies can influence the effectiveness of devaluation on the economy (Mills and Pentecost, 2001; World Economic Outlook, 2015). This suggests that attributing the poor trade performance of SSA in the international markets to the effects of devaluation without a proper investigation is unscientific; hence in this study we investigate the asymmetric effects of currency devaluation on economic output in selected SSA countries using a regime switching model.

Figure 1: Total exports by region, 2009-2019



Source: World Trade Statistics 2020.

Many researchers have empirically investigated the effects of currency devaluation on output in both developed and developing economies, but their empirical findings remain mixed and controversial. Whereas some studies find devaluation effects to be expansionary (Maehle et al. (2013) for Ghana, Kenya, Malawi, Mozambique, Tanzania, Uganda, and Zambia; Brixiona and Ncube (2014) for Zimbabwe; Klau (1998) for the Communauté Financière Africaine (CFA) and non-CFA countries), others find devaluation effects to be contractionary Fouopi (2012) for CFA countries; Kamal (2015) for 33 developed and developing countries; Pal (2014) for India; Alawin et al. (2013) for Jordan; Onwuka and Obi (2015) for Nigeria, Ghana, Kenya, Malawi, Zambia, and Mali; Miteza, (2006) for Poland, Hungary, Czech Republic, Slovakia, and Romania). Studies by Ayen (2014) for Ethiopia, Alemu (2014) for 14 Asian countries, and Datta (2012) for Pakistan, to mention but a few, find mixed results. Almost all the studies reviewed except Pal (2014) for India and Cheikh (2013) for 12 European countries use real exchange rate as a proxy for devaluation without considering currency devaluation as a policy shift. Anecdotal evidence suggests that almost all SSA countries have devalued their currencies at one point or the other. These studies did not account for structural breaks in the unit root test. Perron (1989;

1997) shows that failure to allow for an existing structural break in the series leads to a bias that reduces the ability to reject a false unit root null hypothesis. This study departs from previous studies by accounting for the effects of structural breaks as well as employing a regime switching model. Against this backdrop, it investigates the asymmetric effects of currency devaluation on economic output in selected sub-Saharan African countries using the Smooth Transition Regression (STR) model.

2. LITERATURE REVIEW

Theoretically, currency devaluation or exchange rate depreciation (in a flexible exchange rate system) is expected to improve the balance of payments (BOP) and thereby enhance economic output. However, there has been serious theoretical debate as to whether devaluation is expansionary or contractionary, especially in developing countries. Viewpoints in the literature diverge and are broadly classified into two main theoretical paradigms, traditionalist and structuralist. The traditionalists are of the view that devaluation is expansionary, while the structuralists are of the view that devaluation can produce contractionary effects depending on the existing economic structure (Cooper 1971; Caves, Frankel, and Jones 1996; Krugma and Taylor (1978); van Wijnbergen 1986; Edwards 1986). The traditionalist views focus on the elasticity theory, Keynesian theory, and monetarist theory. The structuralists explain two channels through which devaluation might adversely affect macroeconomic performance, namely demand-side and supply-side channels (Acar, 2000). Studies by Cooper (1971), Caves, Frankel and Jones (1996), Krugma and Taylor (1978), van Wijnbergen (1986), and Edwards (1986), among others, explain the following channels through which devaluation may create adverse effects on aggregate demand and lead to a decrease in output and employment.

2.1 Empirical Studies

The many empirical studies have used different methods to test the conflicting theories regarding the effect of currency devaluation or depreciation on economic performance. While some studies have performed a cross-country analysis of Asian countries, others study country-specific effects, while only a very few perform a cross-country study of SSA countries.

Studies on the impact of currency devaluation on economic output abound for Asian countries and emerging economies, notably Miteza (2006), Upadhayaya et al. (2013), Christopoulos (2004), and Bussiere (2010). Miteza (2006) investigates the impact of currency devaluation on aggregate output for 5 transition economies – Poland, Hungary, Czech Republic, Slovakia, and Romania – between 1993 and 2000, using panel unit root and panel cointegration tests to establish whether there is integration and a long-run relationship between aggregate output and currency devaluation. The study uses real exchange rate as a proxy for devaluation, while industrial production is used to proxy real GDP because of non-availability of data for some of the countries. The empirical results suggest evidence of a long-run relationship between aggregate output and devaluation. The study finds that devaluation has adverse effects in the long run.

Similarly, Upadhayaya, Rainish, Kaushik, and Bhandari (2013) examine the effects of currency devaluation on total output for 4 South-East Asian countries from 1980 to 2010. The study employs panel unit root and panel cointegration tests. An empirical model that includes monetary, fiscal, and exchange rate variables is formulated and two versions of this model are used. The first model includes real exchange rate while the second includes nominal exchange rate and price ratio. The empirical results suggest that currency devaluation is contractionary in both the short and medium term; hence, the negative effect comes from changes in the nominal exchange rate.

Basirat, Nasirpour, and Alireza (2014) investigate the effect of exchange rate fluctuations on economic growth in 18 selected developing countries over the period 1986 to 2010, taking into consideration the rate of financial market development. To justify the rationale for considering the rate of financial market development the study argues that the effect of exchange rate fluctuations varies between countries, and that one of the factors that determines this variation is country-specific financial market efficiency. Employing panel data analysis for 18 countries, the results suggest that the effects of exchange rate fluctuations and financial development on economic growth are negative and significant.

Christopoulos (2004) investigates the effect of currency devaluation on output expansion in a sample of 11 Asian countries between 1968 and 1999. The study employs a panel unit root test and panel cointegration test to confirm the existence of a long-run relationship in 5 of the 11 countries. The study finds that devaluation exerts a negative impact on output growth, while devaluation improves output growth for 3 of the countries. In related studies but for different economic regions, Kalyoncu, Artan, Tezekici, and Ozturk (2008) examine the effect of currency devaluation on output level for 23 OECD countries. The study employs the OLS estimation technique as well as unit root and cointegration tests. Their result, similar to that of Christopolus (2004), shows that in the long run, output growth is affected by currency devaluation in 9 out of the 23 countries. In 6 countries out of the 9, devaluation exerts a negative impact on output growth, while it improves output in 3 countries. Thus, their empirical results are mixed.

The few studies that investigate the impact of currency devaluation on economic output in sub-Saharan African countries include Klau (1998), who examines the role of exchange rate policies on inflation and output in the Communauté Financière Africaine (CFA) countries with a fixed exchange rate regime, and non-CFA countries in Sub-Saharan Africa with a more floating exchange rate policy. The study adopts a panel estimation technique for 22 SSA countries. It finds that devaluation impacts positively on output, and that exchange rate appreciation leads to a lower rate of inflation in the two groups. In a related study, Fouopi (2012) investigates the effects of currency devaluation on output in Communauté Financière Africaine (CFA) countries, employing panel regression estimation and using real effective exchange rate as a proxy for currency devaluation. The empirical results, which contradict Klau (1998), show that devaluation has no impact on output growth in CFA countries.

Maehle, Tefeira, and Khachatryan (2013) review different exchange rate policy reforms in selected SSA countries and their associated economic performance during and after the reforms. They perform a critical review of exchange rate regimes in 7 SSA countries – Ghana, Kenya, Malawi, Mozambique, Tanzania, Uganda, and Zambia – using descriptive statistics, and posit that before the reforms these countries shared common features of extensive foreign exchange rationing, large black-market premia, and low per capita real income. However, after liberalisation, those countries that successfully reformed were markedly different. Rationing and parallel market premia became a thing of the past and their per capita income increased tremendously.

Onwuka and Obi (2015) examine the relationship between the real exchange rate volatility of Nigeria and the G-3 countries, and economic growth in 6 selected sub-Saharan African countries (Nigeria, Kenya, Ghana, Mali, Malawi, and Zambia) using quarterly data from 1980Q1 to 2013Q4. They employ the Kao and Johansen-Fisher combined cointegration test and the fully modified OLS (FMOLS) of Philips and Hansen to determine the long-run relationship between variables. Their result suggests evidence of a stable long-run relationship between model variables from 1980 to 2001 but is inconclusive for the period 2002 to 2013. It further shows that exchange rate volatility seems to have depressed economic growth in both periods.

Alege and Osabuohien (2015) investigate the nexus between exchange rate variations and imports and exports in sub-Saharan African countries using the panel data analytical technique. The empirical results suggest a low degree of responsiveness in both exports and imports to exchange rate movements. The study concludes that exchange rate depreciation would worsen the trade balance in the region. The study by Memiago and Eita (2017) on the impact of exchange rate movements on trade balance supports the findings of Alege and Osabuohien (2015).

Memiago and Eita (2017) examine the impact of changes in exchange rate on imports, exports, and trade balance in SSA using panel data analysis for 39 SSA countries between 1995 and 2012. The empirical results show a direct relationship between exchange rate variation and imports. The study concludes that a policy of exchange rate depreciation may inhibit the economy and may not have the desired effect on exports.

All the studies reviewed employ panel data analysis in their analytical frameworks and use exchange rate as a proxy for currency devaluation, without taking cognisance of currency devaluation as a policy shift. This study departs from previous studies in the region and adds to the existing literature by investigating comparatively how economic output responds asymmetrically to a devaluation regime and a non-devaluation regime using the smooth transition regression model by Terasvirta (1998, 2004), in line with Cheikh (2012) and Pal (2014).

3. METHODOLOGY AND DATA

This study employs a regime switching model by Terasvirta (1998, 2004), known as Smooth Transition Regression (STR), to model the asymmetric effects of currency devaluation on economic output in 6 selected sub-Saharan African countries, namely Nigeria, Ghana, Kenya, Tanzania, Mozambique, and Malawi. Given that in the sample period the selected countries practised both flexible and fixed exchange rate regimes at different times, the study uses devaluation and depreciation interchangeably (see IMF, 2019; CBN, 2016; Maehle et al., 2013; Pauw, Dorosh and Mazunda, 2013; Kapur et al., 1991). Data for the study are from the World Development Indicator (WDI 2016, 2019) and the Penn World Table (PWT) covering the period 1980 to 2019. GDP, GEX, and MS data are from WDI (2016, 2019) and nominal exchange rate is from PWT. The selected countries cut across oil exporters, middle-income, low-income, and fragile countries, as recently classified in World Economic Outlook (2016). To determine the order of integration of the model variables the study employs the Zivot-Andrews (1992) unit root test with structural breaks and the ADF test for variables without evidence of a break point.

3.1 Smooth Transition Regression (STR) Model

The smooth transition regression (STR) models transition as a continuous process depending on the transition variable. The STR model assumes a smooth change of economic variable from one regime to another and allows the incorporation of regime-switching behaviour both when the time is unknown with certainty and when there is a short and smooth transition to a new regime, as well as capturing nonlinearity in model variables (Terasvirta, 1998, 2004; Cheikh, 2012; Pal, 2014).

The general form for the STR model is given by:

$$y_t = \beta' x_t + \phi' x_t \, \mathrm{G}(S_t; \gamma, c) + \mu_t \tag{1}$$

where $\mu_t \sim iid\left[0, \sigma^2\right], x_t = \left(w_t', x_t'\right)'$ and $\left((m+1)\times 1\right)$ is the vector of independent variables, with β representing the linear parameter and ϕ denoting the nonlinear parameter(s). *G* is the continuous transition function bounded between 0 and 1, where 0 represents one exchange rate regime (baseline point), in this case the non-devaluation period, and 1 represents the devaluation regime and this depends on S, the transition variable; γ measures the speed of transition between the two regimes; and c measures the threshold effect. According to Terasvirta (2004), the candidate for the transition variable is one of the explanatory variables, lag of the dependent variable and trend value (t). The first step in the modelling process is to choose the transition variable, which is done by testing the null hypothesis of each of the possible transition variables. The next step is to choose the transition function, which is based on a sequence of nested hypotheses that test the order of polynomials in the auxiliary given below:

$$y_t = b_0 x_t' + b_1 \left(x_t' S_t \right) + b_2 \left(x_t' S_t^2 \right) + b_3 \left(x_t' S_t^3 \right) + \mu_t \quad (2)$$

under the null hypotheses:

$$H_{o4} : b_3 = 0 \quad (3)$$

$$H_{o3} : b_2 = 0 | \; b_3 = 0 \quad (4)$$

$$H_{o2} : b_1 = 0 | \; b_2 = b_3 = 0 \quad (5)$$

The three hypotheses above are tested with a sequence of F-tests named F_4, $F_{3,}$ and F_2 respectively. If the rejection of F_3 is the strongest (has the smallest p-value), LSTR2 or the ESTR model is chosen, while LSTR1 is chosen as the appropriate model if F_4 or F_2 has the smallest p-value (Terasvirta, 2004).

3.2. Model Set-up

Following Pal (2014) and Cheikh (2012), the STR model is given by:

$$GDP_{it} = \alpha + \sum_{j=0}^{p} \theta_{ij} RER_{it-j} + \sum_{j=0}^{p} \delta_{ij} MS_{t-j} + \sum_{j=0}^{p} \eta_{ij} GEX_{it-j} + G(\mathrm{S}_{it}; \gamma, \mathrm{c}) \left(\sum_{j=0}^{p} \phi_{ij} RER_{it-j} \right) + \mu_{it} \quad (6)$$

where GDP at constant price is expressed in billions of the local currency, GEX is measured as gross national expenditure at constant local currency, and MS is measured as broad money supply at current local currency. Real exchange rate is measured as the product of the nominal exchange rate and countries' price ratio

(P*/P). P* is proxied by the US wholesale price index (2000=100) and p is the domestic CPI. Nominal exchange rate is the ratio of national currency to the US Dollar. In line with the theory, an increase in the real exchange rate (RER) means domestic currency depreciation in real terms and this leads to an increase in economic output through improvement in BOP (World Economic Output, 2016). Theoretically, an increase in money supply (MS) drives real money balances above the level regarded as optimal by economic agents. This leads to an increase in expenditure from a given income and thus stimulates imports, increases money demand, and leads to a BOP deficit (Anoke, Odo, and Ogbonna, 2016; Adeyemi, Oseni, and Tella, 2020). Government expenditure (GEX) is expected to influence BOP positively through increase in income or through reduction in absorption capacity (Frankel, 1999; Alexander, 1952, 1959).

4. EMPIRICAL RESULTS AND FINDINGS

The study first tested for a break point in each of the model variables using the Bai-Perron (2003) multiple break point test, given the anticipation of a structural break in the model. The result shows evidence of a break point in all model variables. Therefore, the Zivot-Andrews (1992) unit root test with structural break was employed and the result is summarised in Table 1. As expected, the unit root test results indicate that most of the variables were stationary after first difference. Also, the result shows that the variables were integrated of different orders for all selected SSA countries except Malawi and Tanzania. Thus, further tests were based on their respective order of integration to avoid spurious results.

Table 1: Summary of Zivot-Andrews unit root test

Country	**Nigeria**		**Ghana**		**Kenya**		**Malawi**		**Tanzania**		**Mozambique**	
Variables	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**
RER	−5.43* (−4.93)	1	−5.77** (−5.57)	0	−6.20** (−5.57)	0	−6.91** (−5.57)	1	−6.51** (−5.34)	1	−8.09** (−5.34)	0
GDP	−6.47** (−5.57)	1	−7.89** (−5.57)	0	−7.82** (−5.57)	1	−8.31** (−5.34)	1	−5.09* (−4.93)	1	−5.91** (−5.57)	0
MS	−6.09** (−5.34)	0	−5.96** (−5.57)	1	−6.02** (−5.57)	0	−7.22** (−5.57)	1	−5.84** (−5.34)	1	−5.59** (−5.34)	2
GEX	−8.29** (−5.57)	1	−7.73** (−4.8)	1	−6.05** (−5.57)	0	−6.05** (−5.34)	1	−5.08* (−4.93)	1	−7.16** (−5.57)	1

Note: Figures in parenthesis are critical values. ** (*) denotes statistically significant at 1% and 5% levels of significance respectively. I(d) denote the order of integration of a variable. Source: Author's computation using E-views 9.0

4.1 Determination of Optimum Transition Variable and Function

The first step in the STR estimation is to determine the number of possible transition variables and the system automatically selected the optimum transition variable (Terasvirta 1998; 2004). The study chose exchange rate (RER) as the transition variable, while the optimum maximum lag value was selected to be 2 based on the information criteria. The result of the lag information criteria is presented in Table 2.

Table 2: AR lag order selection criteria results (Transition variable = RER_t)

Information Criteria	AIC			SBC		
Lag length	**1**	**2**	**3**	**1**	**2**	**3**
Nigeria	52.457	50.982*	55.356	59.876	53.212*	57.293
Kenya	55.398	53.245*	54.209	51.095	50.217*	54.764
Malawi	36.985	36.003*	39.108	37.029	35.026*	35.982
Mozambique	28.576	23.891*	25.096	31.098	29.049*	30.034
Tanzania	36.221*	42.567	38.198	42.896	41.562*	43.987
Ghana	38.456	38.086*	38.896	37.987	36.012*	37.860

Note: * denotes lag order selection by the criterion. AIC: Akaike information criterion. SBC: Schwarz information criterion. Source: Author's computation using JMulTi 4.0

We then tested for linearity against STR in each transition variable to determine the appropriate transition function. The result of the linearity tests is presented in Table 3 below.

Table 3: Linearity tests against STR GDP model with $S_t = RER_t$

	Nigeria	**Kenya**	**Malawi**	**Mozambique**	**Tanzania**	**Ghana**
Null hypothesis	RER_t	RER_t	RER_t	RER_t	RER_t	RER_t
F	1.05E-02	1.32E-01	3.81E-01	3.97E-03	3.97E-03	2.28E-02
F4	NA	1.06E-01	7.18E-01	1.27E-01	1.27E-01	6.48E-01
F3	1.06-02	6.10E-02	7.45E-02	5.21E-01	5.22E-01	3.77E-01
F2	2.38E-07	4.74E-03	1.33E-02	6.27E-04	6.28E-04	1.66E-02
Selected model	**LSTR1**	**LSTR1**	**LSTR1**	**LSTR1**	**LSTR1**	**LSTR1**

Note: The numbers are p-values of F version of LM linearity test. Source: Author's computation using JMulTi 4.0

The decision rule for selecting the transition function is based on a sequence of nested F-tests named F4, F3, and F2. The decision rule is to select the transition function with the smallest p-value of the F-test. In the results in Table 3 above, F2 has the smallest p-value for all the countries, suggesting that logistic smooth transition regression (LSTR1) is the appropriate transition function for all the selected SSA countries.

4.2 The Comparative Impact of Currency Devaluation on Output

The smooth transition regression model was employed to estimate the asymmetric effect of currency devaluation on economic output in the selected SSA countries. The result of the model selection favoured the logistic transition function which is centred very close to zero with a steep slope. This means that the regimes dictated by the non-linear model relate to devaluation (depreciation) with G = 1, versus non-devaluation, G = 0. This implies that we have asymmetric responses of output growth to devaluation and non-devaluation regimes. The results are summarised in Table 4.

The results from the estimated logistic smooth transition regression (LSTR) function, as in Table 4, are divided into three segments: the first segment shows the coefficients of the threshold parameters (c) and the speed of transition (γ) which measures the effect of devaluation as a policy shift. The threshold levels are quite similar (positive) for all the countries except Malawi, with a negative threshold level of –0.003, and are also significant at the 5% level for all the countries except Nigeria. The positive coefficient of threshold parameters suggests that as a country's exchange rate depreciates within the range of that country's threshold level, the country's output will increase, and when it is high and above that level it will lead to a decrease in the country's output level. Kenya has the highest threshold level, followed by Nigeria and Mozambique, with Tanzania having the least. The Kenyan threshold of 3.25 implies that currency depreciation above 325% will adversely affect the economy, but depreciation within the threshold will lead to an increase in output. This high threshold level for Kenya can be attributed to the fact that the Kenyan government was one of the first SSA countries to abolish all barriers to both current account balance and capital account restrictions and accepted the IMF Articles of Agreement (Article VIII) in the early 1990s (O'Connell et al., 2010).

Table 4: STR results of asymmetric impact of currency devaluation on output

	Country					
Variable	**Nigeria**	**Ghana**	**Kenya**	**Malawi**	**Tanzania**	**Mozambique**
Threshold (c)	0.431 (0.932)	0.3728* (0.051)	3.254** (0.000)	–0.003* (0.042)	0.341** (0.001)	0.407** (0.008)
Speed of Transition γ	82.261 (0.693)	12.382* (0.031)	236.19** (0.025)	6.391 (0.845)	0.731** (0.0000)	4.781** (0.0001)
G = 0 Non-devaluation Regime						
Constant	–0.016 (0.104)	14.02** (0.0000)	–0.07** (0.001)	–0.042 (0.386)	50.25* (0.043)	65.11** (0.001)
$lnGEX_t$	0.036 (0.188)	–9.661* (0.034)	0.023 (0.17)	0.081 (0.78)	1.03* (0.051)	2.37** (0.000)
$lnMS_t$	0.067* (0.045)	–16.41** (0.002)	–0.712 (0.662)	0.861 (0.189)	1.301** (0.0000)	0.087 (0.134)
$lnRER_t$	0.009 (0.73)	0.051** (0.008)	–0.009* (0.051)	–0.201 (0.561)	2.732** (0.001)	–10.542** (0.000)
G = 1 Devaluation regime						
Constant	26.31 (0.831)	0.104 (0.01)	23.11 (0.67)	0.76 (0.72)	–66.21 (0.09)	–8.99** (0.000)
$lnGEX_t$	0.69* (0.05)	5.19 (0.485)	–0.002 (0.079)	–0.341 (0.931)	9.34** (0.000)	1.713** (0.001)
$lnMS_t$	–63.15 (0.87)	19.32 (0.176)	0.076 (0.44)	–0.871 (0.74)	4.54* (0.05)	0.008** (0.000)
$lnRER_t$	10.34 (0.17)	0.761** (0.0001)	0.008** (0.009)	–0.639 (0.17)	2.020* (0.03)	19.532** (0.001)
R^2	0.876	0.788	0.598	0.602	0.986	0.808
Adj. R^2	0.845	0.767	0.581	0.597	0.953	0.802
ARCH Test	(0.33)	(0.08)	(0.12)	(0.67)	(0.19)	(0.29)
J.B Test	(0.54)	(0.19)	(0.81)	(0.003)	(0.051)	(0.764)
A/C	(0.67)	(0.13)	(0.02)	(0.07)	(0.51)	(0.23)
PC	(0.09)	(0.08)	(0.87)	(0.06)	(0.08)	(0.19)

Note: Figures in parenthesis are p-values of t-statistics. ** (*) denotes statistically significant at 1% and 5% levels of significance respectively. A/C represents LM test for no autocorrelation. PC denotes LM test for parameter constancy. Variables are based on their order of integration. Source: Author's computation using JMulTi 4.0

The threshold coefficient of 0.431 for Nigeria suggests that an exchange rate depreciation above 43.1% will affect the economy negatively. Evidence of this was seen in October 2015 when the exchange rate depreciated above 100% following the 8% devaluation of the naira from N155 to N168. Nigerian GDP grew by –0.36% (year-on-year) in real terms in the first quarter of 2016, the lowest in more than a decade. The year-on-year inflation rate in Nigeria jumped from 9.3% in October 2015 to 17.6% in August 2016. This was the highest since 2005, as the cost of housing, food and non-alcoholic beverages, and transport surged, mostly due to rising import costs occasioned by a weak naira after devaluation (NBS, 2016; CBN, 2016).

The results further suggest that the transition between two extreme regimes (G = 0 and G = 1) is smooth for Malawi, Tanzania, and Mozambique, while the high gamma coefficient for Nigeria, Ghana, and Kenya indicates a rather abrupt transition (policy change). This result supports the finding of Cheikh (2012), who found Belgium to have a high gamma coefficient compared to 5 other European countries. The gamma coefficient measures the effects of devaluation on output. The gamma coefficients are significant for Ghana, Kenya, Tanzania, and Mozambique since their p-values are less than 0.05, and insignificant for only Nigeria and Malawi. This implies that devaluation as a policy shift has a significant impact on output for Ghana, Kenya, Tanzania, and Mozambique, whereas for Nigeria and Malawi devaluation as a policy shift is insignificant. This mixed result supports the findings of Maehle et al. (2013), who found that some SSA countries that successfully reformed their economies experienced improvements, but some (for example, Malawi) did not.

The results from the second and third segments (devaluation and non-devaluation regimes) show that the coefficients of real exchange rate are positive in both regimes for Nigeria, Ghana, and Tanzania, but are negative for Malawi. In the case of Kenya and Mozambique the coefficients of real exchange rate are negative in the non-devaluation period but positive and significant in the devaluation period. The implication of the result for Kenya and Mozambique, as expected, is that the real exchange rate has a negative but significant impact on the economy before devaluation but a positive and significant impact during the devaluation period. This result supports the conventional wisdom that devaluation is expansionary. In the case of Nigeria, the coefficient of real exchange rate is 0.009% in the non-devaluation period, implying that a 1% depreciation in the exchange rate will increase output by 0.009%, but with the introduction of a new exchange rate policy the coefficient of real exchange rate increased from 0.009% to 10.34%, suggesting that 1% depreciation will increase output by 10.3%. The Ghanaian exchange rate coefficient increased from 0.051%

in the non-devaluation regime to 0.761%, while the Tanzanian exchange rate coefficient declined slightly from 2.73% in the non-devaluation era to 2.02% in the devaluation era with all being significant. The Malawian evidence supports the structuralists' viewpoint which posits that devaluation is contractionary, as the coefficient of real exchange rate remained negative and insignificant in both regimes.

The coefficients of government expenditure (GEX) are insignificant for Nigeria, Kenya, and Malawi, but significant for Ghana, Tanzania, and Mozambique in the non-devaluation segment. While the coefficients of Tanzania and Mozambique are positive and significant, the Ghana coefficient is negative but significant. In the devaluation segment the coefficients of GEX are positive and significant for Nigeria, Tanzania, and Mozambique. This supports the theoretical viewpoint that increase in government expenditure leads to increase in economic output through the multiplier.

The estimated coefficients of money supply (MS) are positive and significant for Nigeria and Tanzania and negative but significant for Ghana is in the non-devaluation era, whereas in the devaluation period only those of Tanzania and Mozambique are significant, which contradicts the theory's postulates. It is worth noting that the results are mixed.

The coefficient of multiple determination (R^2) and its adjusted version (adjusted R^2) show that variation in the regressors significantly account for the variation in the dependent variable, given the high R squared (above 70%) in all countries except Kenya and Malawi, with an R squared of 59.8% and 60.2% respectively.

The quality of the estimated LSTR model was examined by conducting several misspecification tests: the ARCH-LM test, Jarque-Bera (J-B) test, autocorrelation test, and parameter constancy test. The model passed the main diagnostic tests for most countries. In Table 4 the p-value of the ARCH-LM test is greater than 0.05 for all the countries, suggesting no ARCH effect in the model. In the case of the Jarque-Bera test, the p-value shows evidence of normal distribution of the model residual for all the countries except Malawi and Tanzania, whose p-value of the J-B test is less than 0.05. The results further indicate no evidence of serial autocorrelation in the model for all the countries except Kenya, as their p-values are greater than 0.05. Finally, the result for all countries shows evidence of parameter constancy since the p-value is greater than 0.05.

5. CONCLUSION AND POLICY IMPLICATIONS

This paper has demonstrated an asymmetric effect of devaluation on output growth in Sub-Saharan Africa. The empirical results indicate an asymmetric response of output growth to devaluation and non-devaluation regimes. The threshold levels are positive for all the countries except Malawi, with a negative threshold level of –0.003. This implies that as a country's exchange rate depreciates within the range of the individual country's threshold level the country's output will increase, but above that level it will lead to a decrease in the country's output.

The results further show that currency devaluation has a significant impact on output for Ghana, Kenya, Tanzania, and Mozambique; but has insignificant impact in the case of Nigeria and Malawi. These mixed results suggest that the impact of currency devaluation on output is country-specific, depending on the state and size of the economy, the nature of goods produced, and the supportive policies in place.

Thus, economic policymakers should understand the peculiarities of core macroeconomic indicators in order to design and implement a robust and effective exchange rate policy. For example, devaluation has no significant impact on output in Nigeria and Malawi. The finding of an insignificant impact of currency devaluation on output in Nigeria and Malawi support the structuralists' viewpoint that devaluation can produce contractionary effects in some circumstances.

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Received: September 28, 2020
Accepted: April 15, 2021

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