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# NAŠE GOSPODARSTVO
## Revija za aktualna ekonomska in poslovna vprašanja

# OUR ECONOMY
## Journal of Contemporary Issues in Economics and Business

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# What is the Nature of the Dynamics between Government Spending and Aggregate Output in the Nordic Countries?

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## Abstract

The main aim of this paper is to examine the relationship between government consumption and aggregate output in five Nordic countries in two different scenarios: first, in periods when government consumption increases and, second, in periods when government consumption decreases. Therefore, the nonlinear ARDL model is applied to test for the presence of a short-run and long-run asymmetry in output response to government consumption. The key findings are as follows. First, based on the linear model, a positive connection between government consumption and economic activity has been confirmed, both in the short and long term, which is also in line with the predictions of economic theory. Second, based on the nonlinear model, six out of ten short-term coefficients are statistically significant, as are six out of ten long-term coefficients, with statistically significant asymmetry detected in four out of ten cases. Thus, estimated test statistics and graphical analysis suggest the presence of a negatively inclined asymmetry in the relationship between government consumption and the dynamic of aggregate output with stronger output response in periods when government consumption decreases.

**Keywords:** fiscal policy, Nordic countries, nonlinear ARDL model

## Introduction

In the macroeconomic sense, the new millennium has shaken the foundations of economic science and called into question the predictive and explanatory power of economic theories developed on the shoulders of great economic minds and economic experiences of the 20th century. Although at the turn of the millennium macroeconomics may have functioned more and more as a sophisticated science based on rigorous mathematical models and bold assumptions and some even dared to compare them with certain physical models based on known laws of nature, economic developments over the past two decades thoroughly shook mainstream economics. By no means that economic theory and institutions of economic policy were wrong. On the contrary, most of the accumulated knowledge may even fully correspond to these times within given economic circumstances. Macroeconomics has run into difficulties because of prescribing the existing medicine to new

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economic problems, which is problematic due to the basic nature of social and, thus, economic development which has underlying characteristics of a constantly changing living organism that actively responds to stimuli and new information. Even though at first some new discoveries may seem like everlasting laws or assumptions, they can quickly trigger different behavior of those same actors in the economy, based on which some economic laws or assumptions were initially detected at all.

So, we have experienced several economic shocks, to name just the biggest, the global financial crisis with a prolonged debt crisis in the euro area, then, a period of deflationary pressures partly offset by large scale monetary measures, and, finally, the rise of the centennial epidemic and related economic shocks which still require extreme caution by the economic policy to maintain business cycle stability, even though threats of higher inflation persist. It is economic policy, both monetary and fiscal, that has come under severe scrutiny and criticism (Bernanke, 2019). If we focus only on the scientific debate and ignore the institutional malfunctions that are partly embedded in the system (Reichlin, 2020), especially in the euro area, we can recognize that in the last decade some alternative macroeconomic narratives have risen to the surface, for example, the theory of secular stagnation (Summers, 2016), the so-called permanent and persistent state of underutilization to which, until recently, the mainstream economics did not pay even the slightest attention. Although inflationary pressures emerged in 2021, this perception of inflationary pressures required more than a decade of extremely loose monetary policy, historically benevolent fiscal transfer policies, and supply-side shocks in terms of relatively large output constraints accompanied by unexpected structural turbulences (Andre et al., 2021).

Consequently, it is quite understandable to pose questions that address the issues of efficiency of economic policy where especially monetary policy is under severe pressures because of the interest rates near zero lower bound, which certainly reduces the potency of monetary policy in a function of the business cycle stabilizer. From this, it is logical that the focus of research has been shifted to the field of fiscal policy and its instruments where the transmission mechanism is yet to be fully explained (Ahuja & Pandit, 2021). Although in the last decade a macroeconomic framework has been reestablished within which fiscal policy has gained significance relative to the period before the Great Recession (Shambaugh, 2019), a detailed analysis of the effectiveness of fiscal stimuli within different scenarios and circumstances remains unclear. The main emphasis of the current research is, therefore, on the analysis of the short and long-run effects of fiscal policy on economic growth with a special focus on the impact of structural characteristics of countries and dynamics of the business cycle on the effectiveness of fiscal measures which may help to elucidate fiscal policy transmission mechanism. One of these peculiarities is the presence of nonlinear processes in the relationship between fiscal spending and economic activity.

The main goal of this paper is, therefore, to analyze thoroughly the connection between government spending and aggregate output via the application of linear and nonlinear autoregressive distributed lag (ARDL) models on the new sample of five Nordic economies. According to economic theory, there is a positive relationship expected between government spending and the dynamics of output, thus both variables should be moving in the same direction, which can be tested with the linear model. However, the main interest is to determine whether the output response to either positive or negative dynamics in government spending is equal in its magnitude or, in other words, whether we can expect asymmetric output response in those two different scenarios. A nonlinear ARDL model is used to assess the presence of the aforementioned economic phenomenon.

The remainder of this study is comprised of the following chapters. Chapter 2 provides some insights into the nature of the relationship between government spending and economic activity through an overview of the relevant empirical literature with a special focus on Nordic countries. In chapter 3, we present the methodological framework used in this paper and, in chapter 4, we briefly describe the dataset that enters our analysis. Results are listed, explained, and interpreted in chapter 5 while chapter 6 concludes.

## Empirical Literature Review

In this chapter, we present the key findings of the empirical literature in the field of examining the effectiveness of fiscal policy in ensuring sustainable and stable rates of economic growth. At the same time, we also review the main characteristics that, according to the latest findings, affect the effectiveness of fiscal incentives. Some estimates of fiscal multipliers along with specific characteristics, structural and dynamic, that determine the size of multipliers are also elaborated. Moreover, special attention is dedicated to studies that consider the sample of Nordic countries.

The foundations for the study of the transmission mechanism of fiscal policy and the effectiveness of fiscal stimulus were laid by seminal papers Blanchard and Perotti (1999) and Perotti (2002), which examined the impact of

government spending and taxes on GDP and other macroeconomic variables, such as interest rates and price levels. Key findings support conventional wisdom of economic theory and can be summarized as positive estimates of the government spending multiplier and negative estimates of the tax multiplier while the potential for fiscal stimulus to boost economic growth has been diminished in developed countries since the 1980s. On the eve of the Great Recession, Giordano et al. (2007) support the notion of discretionary fiscal policy. Nevertheless, as in Blanchard and Perotti (1999) and Perotti (2002), limited capacity to fight slumps in real GDP was attributed to fiscal policy. More recently, Burriel et al. (2019) stressed the important role of discretionary fiscal policy, House et al. (2020), however, stated that austerity measures have led to greater falls in GDP over the recent decade than would be realized in the counterfactual scenario.

The evolution of economic research showed that estimates of fiscal multipliers as one of the most important metrics for studying the effectiveness of fiscal policy vary both between countries and within phases of the business cycle. Therefore, the focus of the empirical literature was moved on to the study of individual structural and dynamic factors that could explain this variation of the size of fiscal multipliers. The first set of studies examine the role of a business cycle and a common conclusion has emerged that fiscal multipliers tend to increase during recession periods (Auerbach & Gorodnichenko, 2010, 2011, 2014; Batini et al., 2012; Qazizada & Stockhammer, 2015). Nevertheless, some studies, for example, Ramey and Zubairy (2014), despite being in minority, showed that the size of fiscal multipliers does not necessarily differ between phases of the business cycle. In addition to this, Auerbach and Gorodnichenko (2017) showed that in times of severe and prolonged recession accompanied with interest rates near zero lower bound when monetary policy has a reduced capacity to stimulate the economy further, the size of fiscal multipliers increases. The gradual shift of attention to fiscal policy to ensure economic growth was greatly accelerated during the COVID 19 pandemic when the officials of monetary policy institutions urged fiscal policy authorities for a more active role, which was translated into massive fiscal expansion on the country and international level (Gaspar et al., 2021; Schnabel, 2021).

The second set of studies examines the structural characteristics of countries and their role in determining the dynamics between government spending and economic activity. There are some factors, namely lower public indebtedness, higher level of development, lower trade openness, periods of the credit crunch, and financial stress where consensus is gradually emerging in the direction of higher estimated fiscal multipliers (Ilzetzki et al., 2013; Hory, 2016; Koh, 2017; Borsi, 2018). Nevertheless, certain studies also offer results that contradict the growing majority. Koh (2017), for example, reports that are not necessarily smaller in the case of higher trade and financial openness, fiscal multipliers and that the role of the exchange rate regime by determining the effectiveness of fiscal incentives is not clear.

As far as the analysis of the effectiveness of fiscal policy in the Nordic countries is concerned, there is less empirical evidence available. However, certain studies have addressed the aforementioned problem at least in a somewhat broader form. Ravn and Spange (2014) note that fiscal policy has only a short-run impact on economic activity with the estimated government spending multiplier being larger than the tax multiplier. The output effect of fiscal stimuli is statistically significant only in the short run. Nevertheless, the fiscal multiplier reaches the value of the impact slightly above unity. Then, its values drop to around 0.6 in one year. The quoted authors also demonstrate that exogenous shocks to government spending account for less than 10 % of the movements in output over the business cycle in Denmark. Based on the standard structural VAR methodological framework, Lehmus (2014) estimates fiscal multiplier using Finnish data. He finds spending multipliers larger than 1 in the short run and tax multipliers half of that value. Yet, tax multipliers are more persistent in time. Furthermore, if public investments data are added to the public spending variable, the expenditure multiplier becomes more persistent. Ahonen (2020) estimates with the application of the Bayesian time-varying parameters vector autoregression model on Finish economy covering for 1985-2018 that the government consumption multiplier has fluctuated over time reaching values between 1.2 and 1.85. In addition to this, she finds higher average values of the fiscal multiplier in the period 2000-2018. Nevertheless, the model does not provide any clear explanation for the increase in the cumulative spending multiplier.

Without explicit empirical research, Martorano (2015) just merely addresses the topic of the effectiveness of fiscal policy in Iceland. He compares the paths of economic recovery from the 2008 financial crisis in Iceland and Hungary and finds that the Icelandic government met the objectives of the IMF program by replacement of the previous flat tax system with a progressive tax structure while the Hungarian government, following a different strategy, had to ask for additional help. He also argues that Iceland, when pursuing the goal of inclusive economic recovery, helps to reduce income inequality with social transfers. For Norway, Aursland et al. (2020) find that the zero lower bound on nominal interest rates and downward nominal wage rigidity can account for higher

fiscal multipliers individually during recessions. In joint presence, however, the existence of downward nominal wage rigidity reduces the multiplier at the zero lower bound. They show that the state-dependency is robust to alternative assumptions about the origin of the recession, the nature of the fiscal stimulus, and its financing source.

Hjelm and Stockhammer (2016) use quarterly Swedish data set on fiscal variables, namely government consumption, investments, transfers to households, indirect taxes on consumption goods, and direct taxes on household income, and estimate the effects on GDP and employment for the period 1980-2015. According to their results, the fiscal policy generally has a Keynesian effect although often insignificant with on average larger fiscal multipliers throughout flexible exchange rate regime. In the linear model, government investment generates the strongest multiplicative effect. In the nonlinear model, however, all three fiscal spending variables, namely government consumption, investments, and transfers to households, have a substantial positive impact on employment in recession periods while the employment just barely reacts to shocks in taxes. In addition to this, the results from the nonlinear model are sensitive to fiscal instruments and the definition of recession periods. Hatemi (2014) does not find support for a discretionary fiscal policy in Sweden. This seems to be the case regardless of whether the asymmetric process is taken into account in the estimation of the impulses or not. Hence, he argues that the Ricardian equivalence might hold in the case of Sweden. Consequently, these results can also be interpreted as empirical evidence that the stance of fiscal policy, regardless of whether it is contractionary or expansionary, is not a major factor behind the performance of the Swedish economy.

The autoregressive distributed lag approach (ARDL) which is also used in this paper has been already applied to modeling fiscal policy actions. Among others, Alexiou and Nellis (2017) found that the size of the fiscal multiplier does not differ substantially over the phases of the business cycle and that government consumption has a positive effect on economic growth, regardless of inflation rates. On the other hand, there was a lack of evidence that low-interest rates significantly determine the relationship between government consumption and output. It is important to note that the study takes into account only the Greek economy. Furthermore, Sharma and Mittal (2019) provide some evidence about the presence of an asymmetric connection between fiscal deficit and GDP in the short and long run based on the nonlinear ARDL model for India where, according to their findings, fiscal deficit harms GDP. Asandului et al. (2020) estimate on a sample of twelve post-communist economies and asymmetric ARDL approach that cumulative impact of fiscal policy generates inflationary output effect for countries in their sample.

As was shown in this chapter, many new papers have recently emerged in the field of studying and analyzing the transmission mechanism of fiscal policy, addressing various aspects of the effectiveness of fiscal stimuli in promoting economic growth. Although consensus is gradually being made, there are still different interpretations of the impact of some individual structural and dynamic factors on the size of fiscal multipliers. As a result, the transmission mechanism of fiscal policy has been only partially explained so far. For that reason, our study focuses on identifying the possible presence of asymmetric processes in the relationship between government spending and economic activity in a special sample of five Nordic countries, all of which record a relatively high share of government spending in GDP.

## Methodology

For estimating the relationship between government consumption and economic activity, we initially use the linear autoregressive distributed lag model following Pesaran et al. (2001) and then, the upgraded nonlinear autoregressive distributed lag model introduced by Shin et al. (2014). The aforementioned methodological technique was applied in Senekovič (2021) by assessing the fiscal policy actions of the world's largest developed economies. However, it is also utilized in various research areas of macroeconomics, such as testing for purchasing power parity (see, for example, Arize and Bahmani oskooee (2021)) or analyzing the role of the tourism sector in aggregate output (see, for example, Husein and Kara (2020)).

The relationship between government consumption and economic activity is first estimated via the autoregressive distributed lag model following Pesaran et al. (2001) which is noted as a linear or symmetric ARDL model from here on. The model is presented in equation 1.

$$\Delta logY_t = \alpha_0 + \sum_{i=1}^{n_1} \alpha_{1i} y_t \Delta logY_{t-1} + \sum_{i=0}^{n_2} \alpha_{2i} \Delta \log G_{t-i} + \\ + \alpha_3 \log Y_{t-1} + \alpha_4 \log G_{t-1} + \varepsilon_t \quad (1)$$

Where the coefficients $\alpha_{2i}$ represent short-run effects of government consumption (measured in first differences) on economic activity and the coefficient $\alpha_4$ represents long-run effect estimated based on the lagged variable of government consumption. Notations are as follows. G stands for government consumption and Y stands for aggregate output.

Shin et al. (2014) upgrade the linear ARDL model by introducing some nonlinearities into it. To detect asymmetries in the relationship between independent and dependent variables Shin et al. (2014) decompose fluctuations in the independent variable, in our case in government consumption, into its positive and negative partial sums, which is represented in equation 2 and equation 3.

$$logG_t^+ = \sum_{j=0}^{t} \Delta logG_j^+ = \sum_{i=1}^{t} max(\Delta logG_{j,0}) \tag{2}$$

$$logG_t^- = \sum_{j=0}^{t} \Delta logG_j^- = \sum_{i=1}^{t} min(\Delta logG_{j,0}) \tag{3}$$

Then Shin et al. (2014) develop a nonlinear model by replacing independent variables, in our case government consumption, with partial sum components defined in equations 1 and 2. The nonlinear (asymmetric) ARDL approach is then defined in equation 4 as follows.

$$\Delta logY_t = \beta_0 + \sum_{i=1}^{n_1} \beta_{1i} y_t \Delta logY_{t-1} + \sum_{i=0}^{n_2} \beta_{2i} \Delta logG_{t-i}^+ + \sum_{i=0}^{n_3} \beta_{3i} \Delta logG_{t-i}^- + \beta_4 logY_{t-1} + \beta_5 logG_{t-1}^+ + \beta_6 logG_{t-1}^- + \mu_t \tag{4}$$

Where coefficients $\beta_{2i}$ represent the short-run effect of government spending on economic activity in case of positive dynamics of government consumption, and coefficients $\beta_{3i}$ represent the effect of government spending on economic activity in case of negative dynamics in government consumption. The long-run output effect of government spending for the case of positive and negative dynamics in government spending is represented by the coefficients $\beta_5$ and $\beta_6$, respectively.

## Data Properties

For the present study, we use a quarterly dataset for five Nordic countries, namely Denmark, Finland, Iceland, Norway, and Sweden. For all five countries, data were retrieved from the International Monetary Fund (2021). In pursuit of estimating the relationship between government consumption and economic activity with focusing on detecting potential asymmetries among those two variables, we use GDP and government final consumption expenditures as it is defined in the expenditure structure of the GDP as proxy variables. Time series for each country cover timespan from 1995Q1 to 2020Q4 which comprises 104 data points per country. For each of the five countries, government consumption and GDP data were obtained in constant national currency units in absolute terms, wherewith the exception of Iceland, variables were also seasonally adjusted by the database. Finally, we transform real government consumption and real GDP variables into a logarithmic form.

Compared to other developed countries, the role of the state has been traditionally emphasized in the economies of the Nordic countries. Thus, unlike Anglo-Saxon as well as continental capitalism, Nordic capitalism is even more socially oriented in terms of providing a relatively denser social network that helps members of society overcome obstacles when their existence is threatened. As a result, the Nordic countries recorded a higher share of government expenditure in GDP, which was around or slightly above 25% for all countries in 2020, with Iceland having the highest share of 27.8% and Finland the lowest share of government consumption in GDP with 24.4%. For comparison, we cite the share of government consumption in Germany, which is considered the benchmark of continental Europe, and the European Union average. In the case of the former, the share is 22.4%, and in the case of the latter 22.7%. On the other hand, the average share of government consumption in GDP for OECD countries amounts to 18.8% (World Bank, 2021).

## Interpretation of Results

In this chapter, we present the estimates for each country separately, for both the symmetric (linear) and asymmetric (nonlinear) models. In the case of the asymmetric model, the results are also shown in a graphical form where a short-dashed line represents the output response in the case of a positive change in real government spending while a long-dashed line indicates the response of real output in the case of negative change in real government consumption. The solid line represents the perceived asymmetry. The shaded area represents the 90% confidence interval in detecting output response asymmetry between the aforementioned two scenarios. Graphical representations of the results of the nonlinear model are plotted on a 20 quarters horizon. The results are presented in alphabetical order of the included countries.

In the case of Denmark (Table 1), the results of the linear model show a positive statistical link between the dynamics of government consumption and the dynamics of aggregate output with the coefficient being statistically significant in both the short and long term. The magnitude of the output effect of government consumption is stronger in the long

run. In the asymmetric model, in the short run, a positive output response is estimated in periods when government consumption increases and negative output response in periods when government consumption decreases. Conversely, in the long run, in both cases, a positive output response was observed, regardless of the dynamics of government consumption. In the nonlinear model, estimated coefficients are statistically significant only when government consumption decreases. The analysis of the output response through the prism of detecting asymmetry is of interest where statistically significant both short-term and long-term asymmetries are found (Figure 1). In the short term, we observe a negatively inclined asymmetry, which means that under negative dynamics in government consumption, the output response is stronger in its magnitude. On the other hand, in the long run, however, this output response goes into positive territory.

**Table 1.** Denmark results

| Linear (symmetric) ARDL model | | | | |
|---|---|---|---|---|
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\alpha_0$ | 0.216 | 1.26 | 0.210 |
| Short-run | $\alpha_2$ | 0.597 | 3.77 | 0.000 |
| Long-run | $\alpha_4$ | 0.807 | 4.23 | 0.000 |
| Nonlinear (asymmetric) ARDL model | | | | |
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\beta_0$ | 1.495 | 3.08 | 0.003 |
| Short-run positive | $\beta_2$ | 0.016 | 0.50 | 0.621 |
| Short-run negative | $\beta_3$ | -0.204 | -2.63 | 0.010 |
| Long-run positive | $\beta_5$ | 0.135 | 0.31 | 0.582 |
| Long-run negative | $\beta_6$ | 1.764 | 4.39 | 0.039 |
| Asymmetry testing | | | | |
| | | F-statistic | | Prob. level |
| Short-run asymmetry | | 6.838 | | 0.010 |
| Long-run asymmetry | | 9.680 | | 0.003 |

**Figure 1.** Asymmetry testing for Denmark

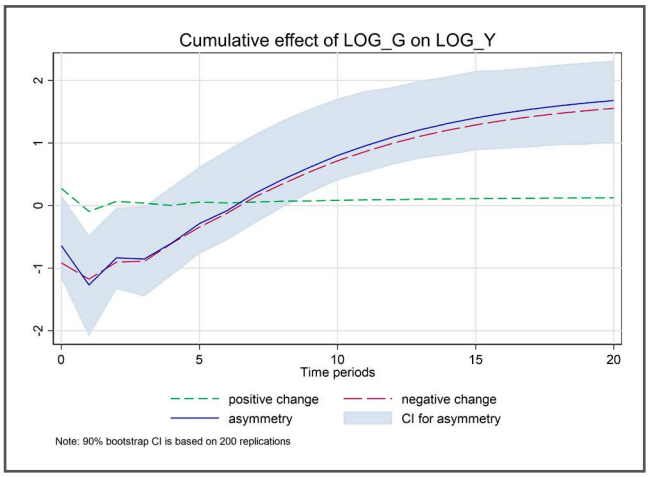



**Figure 2.** Asymmetry testing for Finland

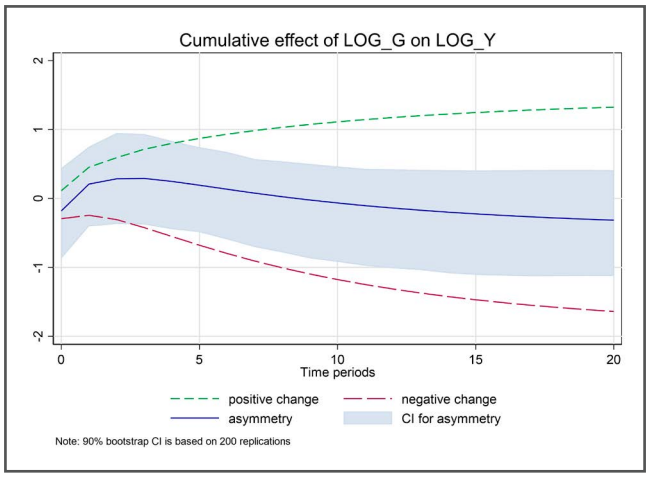


**Table 2.** Finland - results

| Linear (symmetric) ARDL model | | | | |
|---|---|---|---|---|
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\alpha_0$ | 0.026 | 0.13 | 0.896 |
| Short-run | $\alpha_2$ | 0.096 | 1.76 | 0.082 |
| Long-run | $\alpha_4$ | 1.123 | 4.30 | 0.000 |
| Nonlinear (asymmetric) ARDL model | | | | |
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\beta_0$ | 0.776 | 1.73 | 0.087 |
| Short-run positive | $\beta_2$ | 0.106 | 0.97 | 0.334 |
| Short-run negative | $\beta_3$ | -0.138 | 0.86 | 0.392 |
| Long-run positive | $\beta_5$ | 1.431 | 3.14 | 0.080 |
| Long-run negative | $\beta_6$ | -1.871 | 1.682 | 0.198 |
| Asymmetry testing | | | | |
| | | F-statistic | | Prob. level |
| Short-run asymmetry | | 0.561 | | 0.456 |
| Long-run asymmetry | | 0.418 | | 0.520 |

Table 2 presents the results for Finland where a positive relationship between government consumption and economic activity is estimated within a linear model, which is in line with assumptions of economic theory. Both coefficients, short-term and long-term, are statistically significant, with the long-term effect on the output being stronger. In the nonlinear model, the estimated coefficients – except for the output response in periods of positive dynamics in government consumption – do not meet the criteria for achieving statistical standards for significance. Nevertheless, in line with economic theory predictions, a positive output response is recorded when government consumption increases and a negative output response when government consumption decreases. In terms of magnitude, a stronger long-term effect of government consumption on output is again perceived, in both scenarios, in the case of negative and positive dynamics of government consumption. From Figure 2, one can observe a relatively symmetrical response of output. Thus, it is not surprising that even through test statistics, we reject the assumption of the presence of an asymmetric response of output to changes in government consumption. Nevertheless, only based on graphical analysis and beyond statistical standards, we can only speculate that for Finland the output response is slightly stronger under positive dynamics in government spending in the short term, while in the long run, the output response is slightly more intense in the case of negative dynamics in government spending.

In the symmetric model for Iceland, we estimate a positive relationship between government consumption and economic activity. On the other hand, however, the statistical significance of both coefficients, short-term and long-term, is on the verge of admissibility (Table 3). Nevertheless, the long-term effect, which is otherwise more intense in magnitude, can still be characterized as statistically significant. Conversely, in the asymmetric model, all estimated coefficients are statistically significant, and the signs of the coefficients are also in line with the expectations of economic theory. In contrast to the results for Denmark and Finland, in the case of Iceland, a stronger short- and long-term output response is observed under the scenario where government consumption increases. Test statistics confirm the presence of an asymmetric long-term effect of government consumption on output, namely, asymmetry is slightly inclined in favor of a positive scenario. In addition to this, Figure 3 shows a slightly stronger short-run response of output in the case of negative dynamics of government consumption. This short-run asymmetry, however, is not supported by statistical criteria.

The results for Norway are mixed and a bit contradictory compared to results for other Nordic countries. Even though the linear model provides positive short-run and long-run estimates which are also statistically significant, which confirms an established positive relationship between dynamic activity in government consumption and

**Table 3.** Iceland - results

| Linear (symmetric) ARDL model | | | | |
|---|---|---|---|---|
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\alpha_0$ | 0.760 | 2.75 | 0.007 |
| Short-run | $\alpha_2$ | 0.163 | 1.64 | 0.105 |
| Long-run | $\alpha_4$ | 2.461 | 1.72 | 0.089 |
| Nonlinear (asymmetric) ARDL model | | | | |
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\beta_0$ | 5.582 | 4.20 | 0.000 |
| Short-run positive | $\beta_2$ | 0.390 | 3.60 | 0.001 |
| Short-run negative | $\beta_3$ | -0.295 | 3.03 | 0.003 |
| Long-run positive | $\beta_5$ | 0.871 | 83.0 | 0.000 |
| Long-run negative | $\beta_6$ | -0.658 | 26.6 | 0.000 |
| Asymmetry testing | | | | |
| | F-statistic | | Prob. level | |
| Short-run asymmetry | 0.694 | | 0.407 | |
| Long-run asymmetry | 30.38 | | 0.000 | |

**Table 4.** Norway – results

| Linear (symmetric) ARDL model | | | | |
|---|---|---|---|---|
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\alpha_0$ | 0.688 | 2.92 | 0.004 |
| Short-run | $\alpha_2$ | 0.319 | 3.18 | 0.002 |
| Long-run | $\alpha_4$ | 0.633 | 5.68 | 0.000 |
| Nonlinear (asymmetric) ARDL model | | | | |
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\beta_0$ | 2.171 | 2.30 | 0.024 |
| Short-run positive | $\beta_2$ | -0.068 | -0.41 | 0.686 |
| Short-run negative | $\beta_3$ | 0.085 | 2.39 | 0.004 |
| Long-run positive | $\beta_5$ | 0.390 | 2.32 | 0.132 |
| Long-run negative | $\beta_6$ | 0.413 | 0.18 | 0.673 |
| Asymmetry testing | | | | |
| | F-statistic | | Prob. level | |
| Short-run asymmetry | 0.018 | | 0.891 | |
| Long-run asymmetry | 1.209 | | 0.275 | |

economic activity, the results from the nonlinear model do not corroborate these findings (Table 4). A mere look at Figure 4 reveals the unusual response of output to the initial dynamics in government consumption. Thus, in the case of an increase in government consumption, output initially reacts positively. After the first quarter, however, it slips into the negative zone and then continues in the positive zone after the fifth quarter. At the same time, neither the short-term nor the long-term coefficient is statistically significantly different from zero. In the scenario

**Figure 3.** Asymmetry testing for Iceland

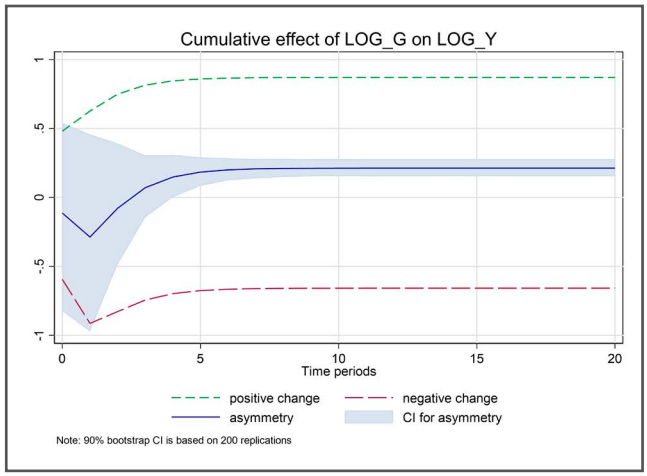
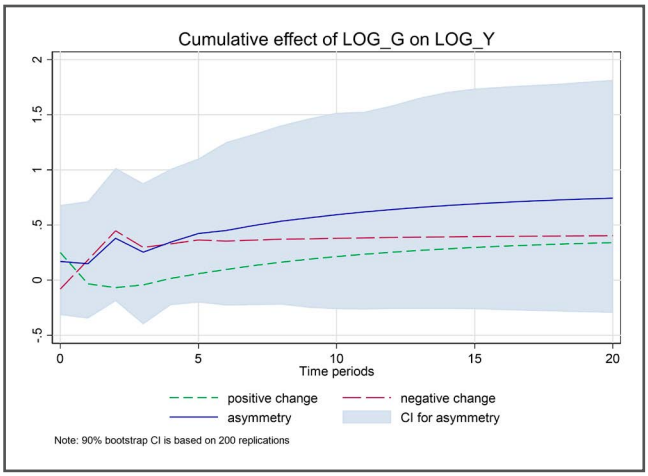



**Figure 4.** Asymmetry testing for Norway



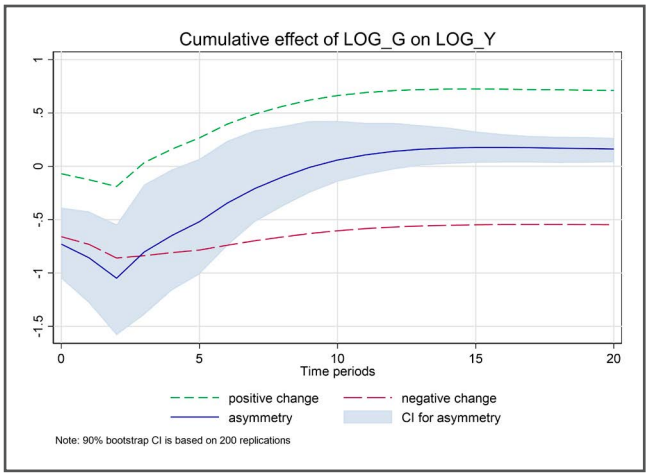

of negative dynamics of government consumption, the output response is even more unusual. Thus, at first, the reaction of the output is slightly negative. Already in the first quarter, however, it turns into a positive area and persists in it over the entire forecast horizon. In terms of magnitude, the response of output is even stronger in the case of negative dynamics of government consumption, as shown by both the estimated coefficients in Table 4 and the dynamic of output response in Figure 4.

In the case of Sweden (Table 5), based on a linear model, we estimate a positive relationship between the dynamics of government consumption and the movement of GDP, which is also statistically significant both in the short and long term. On the other hand, the nonlinear model produces statistically significant estimates of the coefficients that also follow economic theory in signs. Only long-term asymmetry is identified through statistical standards. However, the detection of statistically significant short-term asymmetry slightly misses the limit value. Figure 5 depicts negatively inclined short-term asymmetry and positively inclined long-term asymmetry. In addition to this, based on graphical analysis, we find that the long-term asymmetry in the output response is milder compared to the short-term period.

**Table 5.** Sweden – results

| Linear (symmetric) ARDL model | | | | |
|---|---|---|---|---|
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\alpha_0$ | 0.383 | 1.85 | 0.068 |
| Short-run | $\alpha_2$ | 1.968 | 13.2 | 0.000 |
| Long-run | $\alpha_4$ | 0.805 | 5.58 | 0.000 |
| Nonlinear (asymmetric) ARDL model | | | | |
| | Coefficient | Estimates | t-statistic | Prob. level |
| Constant | $\beta_0$ | 1.759 | 3.22 | 0.002 |
| Short-run positive | $\beta_2$ | 0.123 | 2.77 | 0.007 |
| Short-run negative | $\beta_3$ | -0.059 | 1.71 | 0.090 |
| Long-run positive | $\beta_5$ | 0.734 | 47.9 | 0.000 |
| Long-run negative | $\beta_6$ | -0.352 | 5.17 | 0.026 |
| Asymmetry testing | | | | |
| | F-statistic | | Prob. level | |
| Short-run asymmetry | 2.011 | | 0.160 | |
| Long-run asymmetry | 10.47 | | 0.002 | |

**Figure 5.** Asymmetry testing for Sweden




Bottom line, the results in the case of empirical analysis of the relationship between government consumption and economic activity in the Nordic sample and by applying a linear model show the existence of a positive relationship between government consumption and output dynamics in both short and long term. A statistically significant positive short-term relationship was found in four out of five cases while a statistically significant positive long-term relationship was estimated for all countries included in our sample.

On the other hand, the results of the nonlinear model are somewhat less unambiguous. First, six coefficients out of ten are assessed as statistically significant in the short-term analysis of the output effect of government consumption. Second, six coefficients out of ten are estimated as statistically significant in the analysis of the long-term impact of government consumption on economic activity. Third, signs of estimated coefficients are in line with economic theory, except for Norway where estimates suggest a different interpretation, and Denmark in the scenario of negative dynamics of government consumption and assessment of long-term impact. And finally, statistically significant asymmetry is detected in four out of ten cases considering both short- and long-run asymmetry for five sample countries. Nevertheless, the results regarding the perception of the asymmetry in the output response to the initial change in government consumption need further clarification.

The graphical analysis alone reveals a slightly more complete picture with an asymmetric short-term output response observed in three out of five cases. If we exclude results for Norway, for which estimates are relatively atypical, and Finland, for which we found rather symmetric output response, in the case of Denmark, Sweden, and conditionally Iceland, however, we can safely speak of detected negatively inclined short-run asymmetry. As regards the graphical analysis of the long-term effect of government consumption on economic activity, asymmetry can be detected when Norway is excluded due to atypical results and Finland due to a relatively symmetrical output response. This is especially evident in the case of Sweden and Iceland, which is also confirmed by test statistics while in the case of Denmark there is a statistically significant long-run asymmetry. However, the interpretation of the Danish output response is a bit contrary to conventional economic wisdom.

Our results are partially comparable with the results of studies that estimate the size of fiscal multipliers depending on the business cycle phase, with most of these studies finding higher multipliers during recession periods. Assuming that the negative dynamics in government consumption coincides with recessionary periods, in the cases of Sweden, Denmark, and partly Iceland where negatively inclined short-run asymmetry is detected, our results are in line with, for example, Auerbach and Gorodnichenko (2010, 2011, 2014), Batini et al. (2014), and Koh (2017) who all assessed larger fiscal multipliers in times of recession. It is also interesting that our results which are indeed estimated based on a more recent data sample show a negatively inclined short-term asymmetry in the Swedish case which is not consistent with Hatemi's (2014) estimates.

Although the results for the sample of the five Nordic countries do not offer a completely clear interpretation, we can, nevertheless, at least partially support the assumption that the dynamics in government consumption have a stronger effect on output during periods of declining government consumption. As a result, the application of austerity measures during recessionary periods works counterproductive, because spending cuts deepen fiscal deficit instead of improving the country's fiscal position.

## Conclusion

Explaining the transmission mechanism of fiscal policy in stabilizing the business cycle has gained importance over the last decade. Several issues have arisen addressing differences in the effectiveness of fiscal stimuli in boosting economic growth. According to the recent empirical literature, the heterogeneity in the impact of fiscal stimuli could be explained mainly due to structural differences among individual economies, e.g. trade or capital openness, the level of public or private indebtedness, but also due to cyclical and, thus, non-linear processes in business cycle dynamics. The change in the research focus and the shift to the fiscal field coincides with the development of the economic reality after the Great Recession, which is marked by the relatively exhausted

potential of the monetary authorities and lower average rates of economic growth.

In this paper, we focus on testing the presence of nonlinear or asymmetric processes in the relationship between government consumption and economic activity. Using a nonlinear ARDL model based on the quarterly sample of the five Nordic countries, we check for the presence of short-term and long-term asymmetry in the response of output to the initial positive or negative dynamics in government spending.

The main findings of our research are the following. Based on the linear model, a positive link between government consumption and economic activity has been confirmed, both in the short and long term, which is in line with the predictions of economic theory. Based on the nonlinear model, six out of ten short-term coefficients are statistically significant as are six out of ten long-term coefficients, with results for Norway not offering the possibility of a clear economic interpretation. Thus, based on estimated test statistics and graphical analysis, we can conclude on the presence of short-term or long-term asymmetry in three of the remaining four countries, as in the Finnish case the output response in both scenarios turned out to be relatively symmetric. Nevertheless, the results suggest the presence of a negatively inclined asymmetry in the relationship between government consumption and economic activity with stronger output response in periods when government consumption decreases. The results, therefore, support the notion that the reduction of fiscal spending in recessionary periods induces a stronger output response and, consequently, further decline of economic activity, which in turn leads to additional fall of aggregate tax revenue and further deterioration of fiscal balance.

Future research should be focused on expanding the sample countries, especially in terms of differentiation of the countries according to their structural and dynamic characteristics, which can, in fact, contribute to a better understanding of the capabilities of fiscal policy to effectively counteract business cycle deviations. Additional research effort should also be directed to expand the basic model with additional variables, which would allow even more detailed analysis and understanding of the specifics of the fiscal policy transmission mechanism.

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# Kakšna je narava dinamike med državno potrošnjo in agregatnim outputom v nordijskih državah?

## Izvleček

Glavni namen tega članka je analiza razmerja med državno potrošnjo in agregatnim outputom v petih nordijskih državah v primeru dveh različnih scenarijev: prvič, v obdobjih, ko se državna potrošnja povečuje, in drugič, v obdobjih, ko se državna potrošnja zmanjšuje. Za testiranje prisotnosti kratkoročne in dolgoročne asimetrije pri odzivu outputa na državno potrošnjo uporabimo nelinearni ARDL model. Ključne ugotovitve so naslednje. Prvič, na podlagi linearnega modela je bila potrjena pozitivna povezava med državno potrošnjo in ekonomsko aktivnostjo tako na kratek kot na dolgi rok, kar je tudi v skladu z napovedmi ekonomske teorije. Drugič, na podlagi nelinearnega modela je šest od desetih kratkoročnih koeficientov ocenjenih za statistično značilne, prav tako šest od desetih dolgoročnih koeficientov, pri čemer je statistično značilna asimetrija odkrita v štirih od desetih primerov. Ocenjena testna statistika skupaj z grafično analizo tako kaže na prisotnost negativno nagnjene asimetrije v razmerju med državno potrošnjo in dinamiko agregatnega outputa z močnejšim odzivom outputa v obdobjih, ko se državna potrošnja zmanjšuje.

**Ključne besede:** fiskalna politika, nordijske države, nelinearni ARDL model

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# A Comparative Analysis of Competitive Trade in a Cluster Market of the European Union: The Revealed Comparative Advantage (RCA) Index

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## Abstract

This research is concerned with the comparative analysis of competitive trade within the cluster market economies of the European Union. The aim of this paper is to carry out trade analysis within the competing countries in the European market from 2009 to 2018 which represents the period after the global crisis of 2008 and prior to the Covid-19 pandemic of 2019 for the purpose of determining the extent of competitive trade within the European economies. The chosen metric is Béla Balassa's Revealed Comparative Advantage (RCA) index used for determining various countries' comparative advantage or disadvantage in trade. The findings show that the countries with RCA > 1 thrive economically in comparison to other competing lower economies. And the fact that the European Union economy thrives on mechanized trade other than agricultural products irrespective of the competitive market. This study is a significant contribution towards improving the Ricardian model of comparative advantage on trade within a cluster market in the European economies.

**Keywords:** competitiveness, revealed comparative advantage, international trade

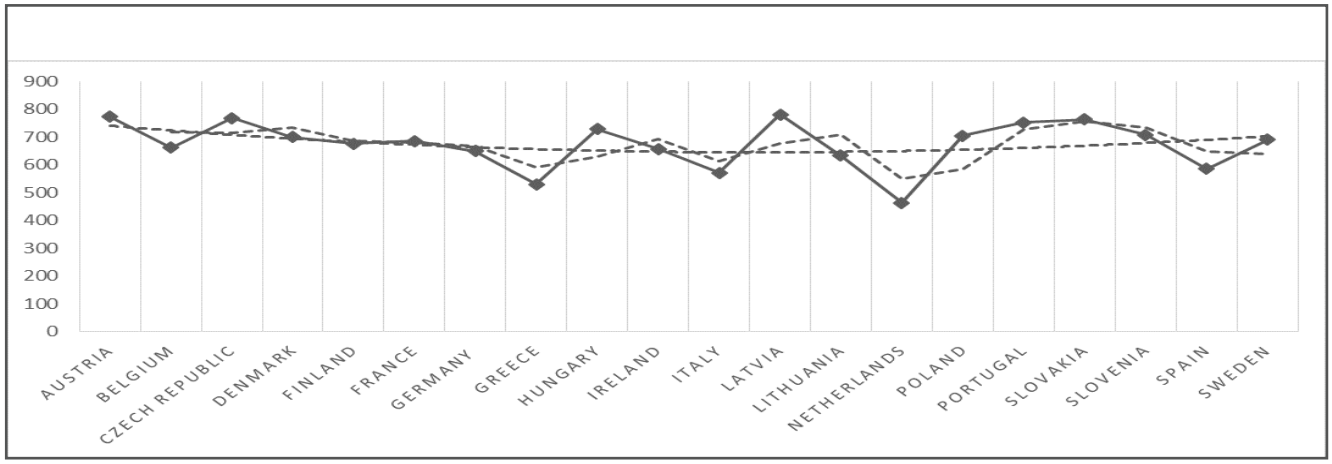
## Introduction

This paper aims to carry out a comparative analysis of trade within the competing economies in the European Union from 2009 to 2018 (after the recession and before the Covid-19 pandemic) in order to ascertain the level of trade competitiveness within the economies of the European Union.

The analysis is geared towards improving the Ricardian theory of comparative advantage using the Revealed Comparative Advantage model of Béla Balassa (1965) as the mathematical technique employed in order to give credence to the theory. The period from 2009 to 2018 was chosen because of the improvement in trade in the European economy after the 2008 global recession. The final year of data used for the study was 2018, as it allows clear analysis of the global trend after the recession prior to the Covid-19 pandemic. The desired metric for the analysis is the Revealed Comparative Advantage (RCA) Index which is derived for 20 products group and 27 countries that make up the European Union.

In 1993, the European Union single market was established according to In't Veld (2019, 804). It was estimated that it could raise overall GDP by 6.5% in the near future Cecchinic et al. (1988). The evidence of the existence of the internal market was fortified by the sharing of competencies by the Union and the member states. Irrespective of this likely estimation, the overall GDP has since increased overtime.

**Figure 1.** Asymmetry testing for Sweden




In order to achieve this, and project higher values that would consequently stimulate growth and development in futuristic terms, there is a need for the advancement in trade between the European economies. According to the Eurostat report, the 27 European Union countries generated a gross domestic product (GDP) of 13.94 trillion euros from 2009 to 2018. However, the share of trade exchange between the European countries showed Latvia, Austria, Belgium, Czech Republic, Germany, Poland, Portugal, Slovakia, Slovenia, Sweden, Hungary, Finland, France, and Denmark gradually improved in trade between 2009 and 2018 immediately after the global recession. Although, there was a cyclical trend in trade movement (Figure 1) due to the erratic trade flow year on year between the countries. Spain, Greece, Italy and Netherlands occupied the least position of share of trade within the European Union using the available data of 21 countries in the Eurostat database.

Irrespective of Germany's position as the largest economy in the European Union, the available data showed that Germany occupied the 15th position while France occupied the 11th position with a cumulative value of 649.9 and 685.6 respectively. Latvia and Austria top the list of highest shares of trading economies from 2009 to 2018 with a cumulative value of 781 and 773.4 respectively. The trade exchange on the goods produced also showed that from 2009 to 2018 the European Union market improved after the economic crisis and financial meltdown. The 2009-2018 analysis (Table 1) further showed the product per share for all traded goods in the European Union and its level of significance on the European Union economy in general.

The traded goods and services in the European Union are majorly within the industrialized market compared to the Agricultural products. The World Integrated Trade Solutions database further revealed that within the period 2009-2018, consumer goods were the largest of all the traded goods in the European Union with 419.01 per product share, while minerals and hides and skins occupy the lowest position of 5.87 and 6.03 per product share respectively (Table 1).

It was indicative that the consumer goods, capital goods, intermediate goods, machinery and electronics, fuels, chemicals, transportation, raw materials, polymer products, and metals are the highest valued products for trade in the European Union market within the period 2009–2018.

Textiles and clothing, wood, vegetable, animal, hides and skins, on the other hand, all of which are attributable to agricultural produce, were ranked lower in the product per share. However, the product per share of industrialized market comprising both Consumer goods, Capital goods, Manufacturing, and Transportation, are worth 1,822.38 on an average of 195.91 per share. The Industrialized products make up 84.6 per cent of the total product share compared to the agricultural products worth 262.05 on an average of 36.60 per share which was 12.17 per cent of the total product per share (Figure 2).

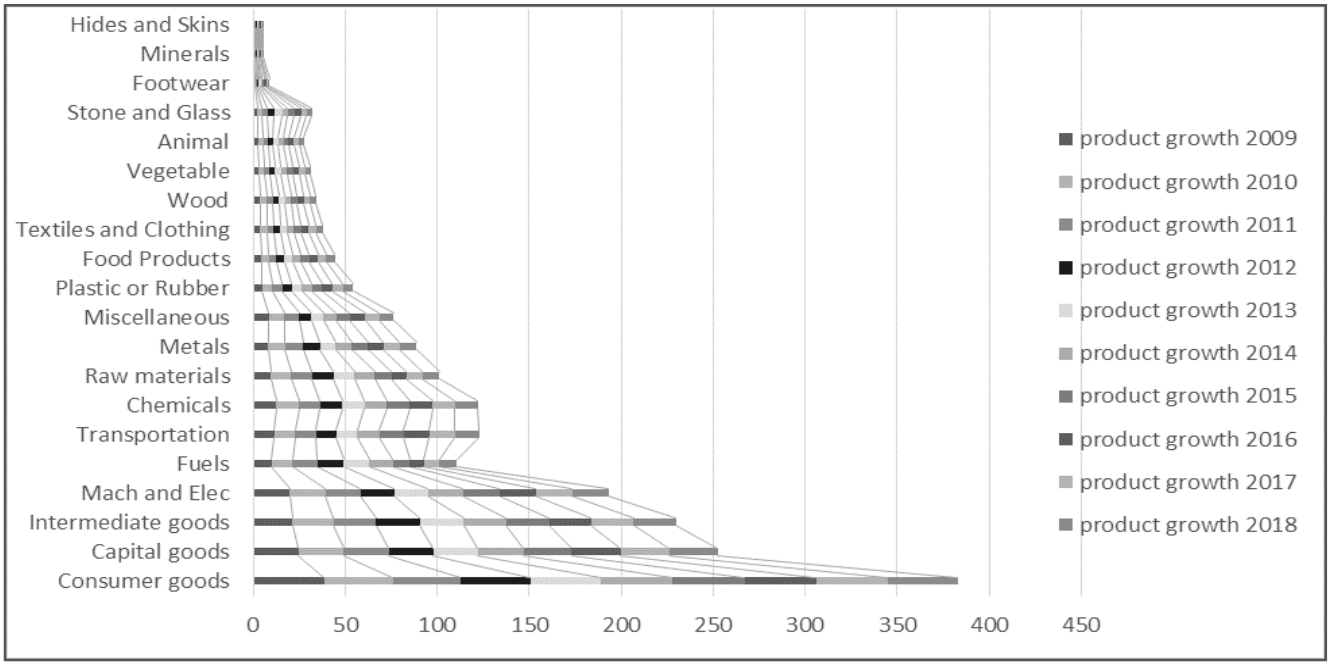
Moreover, there is an indication that from 2009 to 2018, there was a cyclical fluctuation between one product per share in comparison to the other. The cumulative product per share gave an insight into the analytical share performance of each product compared to the agricultural sector that had minimal

**Table 1.** Product per share for all traded goods produced in EU 2009 – 2018

| Product Group | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| Consumer goods | 38.49 | 37.32 | 37.2 | 37.58 | 38.39 | 39.1 | 39.2 | 38.8 | 38.49 | 38.4 |
| Capital goods | 24.55 | 24.69 | 24.6 | 23.98 | 24.2 | 24.9 | 26.2 | 26.7 | 26.42 | 26.3 |
| Intermediate goods | 21.17 | 22.43 | 23.2 | 23.68 | 23.8 | 23.1 | 23.4 | 22.8 | 23.07 | 23.2 |
| Mach and Elec | 19.72 | 19.59 | 19 | 18.35 | 18.31 | 19 | 19.8 | 19.9 | 19.71 | 19.8 |
| Fuels | 9.98 | 11.54 | 13.2 | 14.46 | 14.03 | 12.8 | 9.14 | 7.58 | 8.58 | 9.3 |
| Transportation | 11.39 | 11.38 | 11.5 | 11.07 | 11.23 | 11.9 | 13.3 | 14.1 | 13.7 | 13.2 |
| Chemicals | 12.65 | 12.2 | 11.7 | 11.89 | 12.04 | 12.2 | 12.5 | 12.3 | 12.14 | 12.3 |
| Raw materials | 9.71 | 10.77 | 11.5 | 11.83 | 11.4 | 10.8 | 9.02 | 8.36 | 8.8 | 9.15 |
| Metals | 8.19 | 9.27 | 9.72 | 9.1 | 8.68 | 8.75 | 8.7 | 8.28 | 8.95 | 9.17 |
| Miscellaneous | 8.49 | 8.49 | 7.92 | 6.69 | 6.75 | 6.87 | 7.33 | 8.22 | 7.87 | 7.76 |
| Plastic or Rubber | 5.05 | 5.28 | 5.43 | 5.27 | 5.4 | 5.48 | 5.61 | 5.58 | 5.67 | 5.58 |
| Food Products | 4.49 | 4.11 | 4.02 | 4.19 | 4.39 | 4.49 | 4.68 | 4.72 | 4.64 | 4.56 |
| Textiles and Clothing | 3.93 | 3.69 | 3.62 | 3.48 | 3.6 | 3.81 | 3.94 | 4.02 | 3.98 | 3.92 |
| Wood | 3.72 | 3.61 | 3.39 | 3.26 | 3.29 | 3.36 | 3.43 | 3.41 | 3.29 | 3.33 |
| Vegetable | 3.01 | 2.85 | 2.98 | 3.14 | 3.21 | 3.13 | 3.3 | 3.34 | 3.28 | 3.11 |
| Animal | 2.81 | 2.69 | 2.66 | 2.68 | 2.85 | 2.85 | 2.78 | 2.82 | 2.83 | 2.71 |
| Stone and Glass | 2.36 | 2.54 | 2.81 | 3.79 | 4.2 | 3.25 | 3.43 | 3.62 | 3.13 | 3.01 |
| Footwear | 0.81 | 0.78 | 0.8 | 0.77 | 0.84 | 0.91 | 0.97 | 1.02 | 1.03 | 1.04 |
| Minerals | 0.44 | 0.51 | 0.57 | 0.56 | 0.55 | 0.55 | 0.51 | 0.49 | 0.58 | 0.59 |
| Hides and Skins | 0.46 | 0.48 | 0.51 | 0.53 | 0.57 | 0.59 | 0.62 | 0.61 | 0.61 | 0.6 |

Source: Author's Calculation/ World Integrated Trade Solutions database

**Figure 2.** Top 20 Product growth in the European Union 2009 – 2018




*Source: World Integrated Trade Solutions database 2009-2018*

product share in the analysis. However, irrespective of the share of trade exchange by country (Figure. 1), the European Union export trade analysis from the World Integrated Trade Solutions database revealed that Germany has the largest export trade of 8,137.61 (US $ billion), amongst the 27 countries that make up the European Union, while France stood at 4,878.40 (US $ billion). The Netherlands had a total of 3,538.72 (US $ billion), and Italy and Belgium stood at 3,342.80 (US $ billion) and 2,595.84 (US $ billion), respectively. The export trade analysis placed these counties as the major players in the European Union market irrespective of the share of trade exchange by the European Union economies.

The objective of this paper is to comparatively analyze trade competitiveness in a defined cluster market of the European Union, and to determine the extent of competitive trade within the economies of the European Union from 2009 to 2018. In the next section, the theoretical framework of the research is discussed with an emphasis on the Revealed Comparative Advantage (RCA) index. The methodology and hypothesis tested are discussed in section three. The results section reveals the computed figures for countries and products with RCA greater than 1, and the top 20 product groups with economic growth in the European Union cluster market as a whole.

## Literature Review

The presumption that the world is a global economy is technically different in diverse perspectives where trade competition exists between global economies in a competitive market. The principle of comparative cost advantage propounded by David Ricardo (1817) may have logically been fairly viewed from the perspective of the weaker economies, and not necessarily with the objective of countries producing what they have a comparative advantage over. This perception, if objectively controlled, would have eradicated some socio-economic issues emanating from global trade and market competition between world economies. The major aim of institutionalizing global trade is to create opportunities for availability of different goods and services at cheaper prices competitive for the economies of the world. However, Nansen (2017) asserts that global trade is not a free market system.

In Nansen's perspective, a free market cannot exist in a stable equilibrium unless it is also a fair market. Diverse unprecedented assumptions had equally trailed the field of trade in international economics with different conceptual and empirical formulations that do not show the realistic development of trade performance due to the different views emanating from scientific research studies. The general perception that the world is presumed a global economy is the likely perception that established the European Union founding principle making free trade one of the European Union policies where trading in a competitive market is fundamental.

In Faccarello's study, the principle of comparative advantage acts as a simple result of the decisions of agents in a free market (Faccarello, 2017). It is expected that the more productive economy should exchange its higher comparative advantage products and services with another economy where it has a lower advantage. And since it is expected that trade with other nations tends to increase the number of goods consumers can choose from, multinational competition will lower cost of those goods (Katz, 2018); various arguments of economic scholars and economic theorists have emerged against the Ricardian comparative advantage model and the likely insinuation that the model is subjected to the absolute control of the more technologically advanced economies in international trade. This has motivated the likely indication that the Ricardian comparative advantage model is not totally in the hands of free trade where the global market system takes cognizance.

New trade theory explained in empirical terms that comparative-advantage-based models have some inherent difficulties (Shiozawa, 2017) which exist in international trade between countries. The assumption is that the technologically advanced economies should export their capital-intensive products and import labour-intensive products. However, that has since ceased to exist. The more technologically advanced economies are mostly economic-giants who eventually thrive on both capital-intensive and labour-intensive products. This correlation simply creates a crack in the walls of the purpose of David Ricardo's comparative advantage principle, which continues to promote the economic growth of participating world economies in global trade, thereby fostering global growth and development.

However, in Ricardo's earlier prediction, the Heckscher-Ohlin (H-O) model clearly stated that international trade is determined by differences in factor endowment. A clear indication that the opportunity cost of labour alone may not necessarily promote the required development where economic values are of importance. The same reason reflects the author's choice for using the European Union as a formidable region for the purpose of this research in comparison to other economies of the world. The European Union is one of the world's most cooperative and powerful economies and is mostly perceived as the largest single market area in international trade.

It is, however, significant to ascertain that the economies of the global market are not totally driven by David Ricardo's

principle of comparative advantage, but absolutely driven by the opportunity cost of factor endowment, such as labour and capital, enjoyed by the competitive economies of the world. The reason may not be unconnected with the viewpoints of some researchers who argue in the direction of its economic supremacy over the rest of the competing markets, especially where fundamental factors resulting from trade-competition in economic terms need to be critically examined. This is where the author is inclined towards a further research into the intrinsic value of interest where trade in a global market is of importance.

Another reason aggregated to these economic theorists is their economic speculations and theoretical assumptions towards the concept of globalization, and its inter-relationship with trade liberalization in the competing world economies. The first is the perception of trade liberalization from the basis of eliminating tariff barriers from international trade. The second is the non-consideration of agricultural products even where some economies may not be technologically advanced in the market competition evidently leading to unproductive economic growth. Consequently, it was argued that trade liberalization tends to benefit the stronger economies while the weaker economies are at a more disadvantaged position in the competitive market. According to Wyplosz (2013), "it is probably fair to assert that the prevailing view of the Euro area crisis is the consequence of serious competitiveness losses in the affected countries, which is entirely and uniquely based on one version or another of a displayed unit labor cost."

From the author's viewpoint, the cluster market existing in the European Union is assumed a global market within a conjugal and inter-related effort of a single economy, where each participating economy takes cognizance. According to Albrow et al. (1990), his definition of globalization is attributed to the various processes by which the people of the globe are integrated into a single world. Martins et al. (1997) also view it as an economic globalization from the insinuation of a progressive networking of national market economies politically connected as a global economy in which the distribution of resources is continually governed by neoliberal principles while minimizing government participation with an emphasis on the market in economic matters. In Jones's (1995) perception, "globalization may simply be an intensification of the process of international interdependence, a function of the growth of competition in an international free trade system intensified by the diffusion of technology." It is, however, clearly indicated that the emphasis of Martins et al. places a functional dependence on growth of competition in a free trade system within the context of globalization, a typical reference to the European Union single market system.

The European Union market might have considered the inter-relationship between free trade and market forces, disenchanted by prevailing policies of advanced economies. According to Katz (2018), global trade is not a free market system. A free market cannot exist in a stable equilibrium unless it is a fair market. In her book, Factors Influencing International Trade, reviewed by Hashaw Elkins, Frances Katz clearly confirmed one of such criteria as being due to the low cost of foreign labour and lack of overseas regulation regarding safety and quality (Katz, 2018). Since it is often assumed that international trade is supposed to stimulate mutual benefit and a positive relationship between countries, the expected objective in this regard has remained in the realm of the unknown. "The expected objective has partly been misinterpreted to deliver the opposite rather than its genuine purpose" Milanovic (2012).

A larger perspective is the implication that access to free trade between countries is greatly hindered by the choices of the various economies that take decisions in a free market system. Since free trade is an economic transaction between countries, the cost or benefit derived from such activity need to be emphasized as a direct consequence on foreign trade, which could directly affect the objectives of Ricardo's principle of comparative advantage or disadvantage. The sole reason international trade has remained a point of focus for globalization stems from the Ricardian principle of comparative advantage where the global economy exchanges goods and services they have a comparative cost advantage to produce considering the opportunity cost of production with consequent price reduction in the variety of goods in different countries. As a result, Marrewijk's (2017) perception of the Ricardian model not directly considering factor endowment, such as the relative amount of labour and capital in international trade is peculiar in its entirety.

The European Union's economic recovery between 2013 and 2019 has been resiliently significant since the 2008 financial crisis. However, 2020 was another year of economic recession in the European Union and the Eurozone due to the pandemic, which affected world economies equally. As noted from Zafiu and Saracu (2012), an economic crisis can be defined as a period in the dynamics of a system, where a multitude of difficulties arise as a conflict or tension, which makes it difficult for normal functioning of economic activities. The economic crisis also represents a situation in which the economy of a country passes through a sudden reduction in its force, usually brought about by a financial crisis. The economic crisis may take the form of stagflation, a recession or an economic depression (Doinita et al., 2012). According to Silvia et al. (2011), the technical innovations may not bring real progress as long as 'stability-with-fractions' remains the dominant pattern.

According to Charles Wyplosz (2013, p. 63) on the European Sovereign debt crisis, labour costs are directly comparable and offer a clear picture of the evolution of national competitiveness viewed from two assumptions. First, the European Union has a single goods market and separate labour markets. Second, the European Union does not need to be concerned with exchange rates because all wages and GDPs are in euros in the economic market of the European countries.

However, Wyplosz was also of the view that it is probably fair to assert that the prevailing perception of the euro area crisis is the result of serious competitiveness losses in the affected countries, which may be entirely and uniquely based on one version or another of a displayed unit labour cost. This invariably means that policies aiming at restoring competitiveness look at the symptoms and not the cause (Wyplosz, 2013, p. 65). He further argues that the assumptions given by Lebrun and Perez (2011) and Mallariopoulos (2010) on the euro area countries only compete with each other, while intra-euro area trade often represents the largest part of the overall trade, and the fact that the individual countries have different specializations, which makes trading with different parts of the world unacceptable.

The research question is: how can the level of trade between competing economies in a cluster market be determined using the European Union as a case study? Since international trade mostly involved the relative concept of the principle of comparative advantage, which was introduced and instituted by David Ricardo (1817), the most recognized application for determining the comparability between economies is the Revealed Comparative Advantage (RCA) Index. Béla Balassa's (1965) Revealed Comparative Advantage (RCA) index was proposed for the computation of a country's trade performance and the relative comparison of products and services. This metric is useful for obtaining theoretical results for a specific country's economies in international economics. The Revealed Comparative Advantage (RCA) is often referred to as an index by Béla Balassa (1965). The index is also used to compute the relative advantage or disadvantage of different goods and services in various sectors of different countries.

However, there are diverse assumptions by different scholars and researchers in the field of international economics on the alleged inconsistency of the Revealed Comparative Advantage (RCA) index put forward by Béla Balassa in relation to the computation of trade performance. According to Leromain and Orefice (2013), "the Balassa index suffers some empirical distribution weakness, mainly time instability and poor empirical distribution characteristics" (Yeats, 1985, Hinloopen and Van Marrewijk, 2001, 65). They concluded that the Balassa index is computed on observed trade flows, which mixes up all the factors influencing trade flows. In a recent paper, Costinot et al. (2012) provide an instituted micro-founded version of David Ricardo's comparative advantage model, with a suggestion for a new measure of computing a comparative-advantage-based model in an attempt to overcome the shortcomings of Balassa. According to Sanidas and Shin (2007, 447),"those newly suggested indices can be classified in three classes: trade-cum-production indices containing both trade and production variables, e.g. Lafay index (Lafay, 1992); exports-only indices containing only exports variables, e.g. the symmetric RCA index, Dalum et al. (1998, 438), weighted RCA index, Proudman and Redding (2000), and additive RCA index, Hoen and Oosterhaven (2006); and an indices using hypothetical situation such as comparative - advantage - neutral point, e.g. normalized RCA, Yu et al. (2009, 278)." However, irrespective of a dataset that could provide new econometrics for Béla Balassa's (1965) Revealed Comparative Advantage (RCA) index, "the fact remains that Béla Balassa's index remains the most widely used and acceptable trade performance indices for measuring country - product - sector relative performance.

Adigwe (2021) further explains that "there is a possibility of developing a cross-sector assessment of countries' competitiveness in comparison to their products and services should the Revealed Comparative Advantage (RCA) Index be employed." It is, however, indicative that Balassa previously adopted Liesner's (1958, 310) concept of measuring relative export performance using export trade shares as an index for measuring comparative advantage. Some authors finally studied the Balassa index, and recommended that the empirical analysis discovered by the Balassa index is theoretically complete, validating it as a very useful tool for making critical analysis and economic decisions. With this explicit improvement on the RCA, there is a clear focus on a country's comparative advantage or disadvantage considering a specific product or service.

## Methodology

The desired metric for the empirical analysis is the RCA index derived for 20 products group and 27 countries that make up the European Union. The data for the period 2009–2018 was used because of the improvement in exports after the 2008 global recession. Trade exports within the period 2009–2018 showed improvement after the 2008 sovereign debt crisis in Europe and prior to the 2019 global pandemic.

The study used data collated by the World Integrated Trade Solutions database and the Eurostat database report. The focus of the analysis is on 20 products group and 27 countries that make up the European Union with an RCA index

greater than 1. The data of the market products and services was compared relative to one another to arrive at their RCA. The Revealed Comparative Advantage (RCA), known as the Balassa index (1965), was used to determine the extent of competitive trade through a mathematical computation formulated for obtaining theoretical results for each of the specific country's economies.

The index was also used to compute the relative advantage or disadvantage of different goods and services in the various product groups classified in the form of consumer goods, industrialized or mechanized goods, capital goods, service delivery and agricultural products of the various economies in the European Union.

The Balassa index formula is given as follows:

$$RCA_{ij} = (Z_{ij} / Z_j) / (Z_{iw} / Z_w)$$

where $RCA_{ij}$ is the revealed comparative advantage index for the commodity index i of the country index j; $Z_{ij}$ is country j's exported commodity i; $Z_j$ is country j's total exports; $Z_{iw}$ is the commodity i of the global exports while $Z_w$ is total global exports. A comparative advantage is "revealed" if RCA > 1. Where RCA is less than 1, the country is said to have a comparative disadvantage in the commodity.

For a secondary data analysis, data collected from the country's Economic Chamber of Commerce was used.

The following hypotheses were tested:

H1: Countries with RCA > 1 thrive economically in comparison to other competing lower economies.

H2: The European Union economy thrive on mechanized trade other than agricultural products irrespective of the competitive market.

## Results

The computation of the RCA index was carried out on 20 products exported by the range of product category, and by each country in the European Union. The data analysis of each country's trade exchange performance was compared relative to one another to arrive at their RCA (Table 2). This confirms the hypothesis H1: Countries with RCA > 1 thrive economically in comparison to other competing lower economies.

However, it is indicative that almost all the European Union countries have an RCA > 1; Germany, Spain, Lithuania, the Netherlands, Italy, Ireland, Greece, Belgium and Finland have an RCA > 2 except in 2014, where they had an RCA of 1.02 each.

However, irrespective of this unprecedented RCA in 2014, the author presumes that the economic improvement from 2009 to 2018 may not be unconnected with the European Union trade and cohesion policies that cushioned the effect of inequalities and ultimately strengthened the economic ties between these competing economies in the European Union market. The data for the remaining six competing economies in the European Union was not readily available in order to determine their comparative advantage or disadvantage in export trade. However, since the result showed about 78 per cent of the research analysis, the hypothesis H1 is validated.

The RCA index for product group showed fluctuations over the years under review. Consumer goods, however, maintained an RCA > 1 over the years. Capital goods and intermediate goods, as well as machineries and electronics, also maintained an RCA > 1.

Evaluating the RCA index of the products group revealed that consumer goods, capital goods and the manufacturing sector tend to have the largest market share in the European Union compared to other products in the agricultural sector with an RCA < 1. This further means that the industrialized sector of the European Union market is productively engaged in consumer goods, capital goods and manufacturing far above other products in the economies of scale. It is also proof of the product share in the European Union market when compared to other products.

This analysis demonstrates that given the product group in the EU market, the statistics of product share clearly show that mechanized products enjoy a greater part of the market share in the European Union economy than any other product group. The RCA index proves H2 (H2: The European Union economy thrives on mechanized trade other than agricultural products irrespective of the competitive market) to be true.

This invariably means that the European Union economy has a higher rate of trade exports and market consumption of these group of products in comparison to stone and glass, footwear, animals, hides and skins, minerals and vegetables. According to the Journal of Policy Modeling (2019), the European Union accounts for 21 per cent of global economic output, which is second only to the United States.

From 2009 to 2018, the export share in manufacturing and technology was 92.7 per cent, while other products, which includes wood, vegetable, animal, minerals, and footwear made up 7.3 per cent. This reflects the fact that the European Union is a productive region with a growing export share in manufacturing and technology compared to agricultural products.

**Table 2.** RCA Index for Countries in the European Union Trade Exchange 2009 – 2018

| Product Group | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| Consumer goods | 38,49 | 37,32 | 37,2 | 37,58 | 38,39 | 39,1 | 39,2 | 38,8 | 38,49 | 38,4 |
| Capital goods | 24,55 | 24,69 | 24,6 | 23,98 | 24,2 | 24,9 | 26,2 | 26,7 | 26,42 | 26,3 |
| Intermediate goods | 21,17 | 22,43 | 23,2 | 23,68 | 23,8 | 23,1 | 23,4 | 22,8 | 23,07 | 23,2 |
| Mach and Elec | 19,72 | 19,59 | 19 | 18,35 | 18,31 | 19 | 19,8 | 19,9 | 19,71 | 19,8 |
| Fuels | 9,98 | 11,54 | 13,2 | 14,46 | 14,03 | 12,8 | 9,14 | 7,58 | 8,58 | 9,3 |
| Transportation | 11,39 | 11,38 | 11,5 | 11,07 | 11,23 | 11,9 | 13,3 | 14,1 | 13,7 | 13,2 |
| Chemicals | 12,65 | 12,2 | 11,7 | 11,89 | 12,04 | 12,2 | 12,5 | 12,3 | 12,14 | 12,3 |
| Raw materials | 9,71 | 10,77 | 11,5 | 11,83 | 11,4 | 10,8 | 9,02 | 8,36 | 8,8 | 9,15 |
| Metals | 8,19 | 9,27 | 9,72 | 9,1 | 8,68 | 8,75 | 8,7 | 8,28 | 8,95 | 9,17 |
| Miscellaneous | 8,49 | 8,49 | 7,92 | 6,69 | 6,75 | 6,87 | 7,33 | 8,22 | 7,87 | 7,76 |
| Plastic or Rubber | 5,05 | 5,28 | 5,43 | 5,27 | 5,4 | 5,48 | 5,61 | 5,58 | 5,67 | 5,58 |
| Food Products | 4,49 | 4,11 | 4,02 | 4,19 | 4,39 | 4,49 | 4,68 | 4,72 | 4,64 | 4,56 |
| Textiles and Clothing | 3,93 | 3,69 | 3,62 | 3,48 | 3,6 | 3,81 | 3,94 | 4,02 | 3,98 | 3,92 |
| Wood | 3,72 | 3,61 | 3,39 | 3,26 | 3,29 | 3,36 | 3,43 | 3,41 | 3,29 | 3,33 |
| Vegetable | 3,01 | 2,85 | 2,98 | 3,14 | 3,21 | 3,13 | 3,3 | 3,34 | 3,28 | 3,11 |
| Animal | 2,81 | 2,69 | 2,66 | 2,68 | 2,85 | 2,85 | 2,78 | 2,82 | 2,83 | 2,71 |
| Stone and Glass | 2,36 | 2,54 | 2,81 | 3,79 | 4,2 | 3,25 | 3,43 | 3,62 | 3,13 | 3,01 |
| Footwear | 0,81 | 0,78 | 0,8 | 0,77 | 0,84 | 0,91 | 0,97 | 1,02 | 1,03 | 1,04 |
| Minerals | 0,44 | 0,51 | 0,57 | 0,56 | 0,55 | 0,55 | 0,51 | 0,49 | 0,58 | 0,59 |
| Hides and Skins | 0,46 | 0,48 | 0,51 | 0,53 | 0,57 | 0,59 | 0,62 | 0,61 | 0,61 | 0,6 |

Source: Author's Calculation/ Eurostat Database 2009-2018

**Table 3.** RCA Index for Top Product group in the European Union Trade 2009 – 2018

| Product Group | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| Consumer goods | 2.19 | 2.16 | 2.13 | 2.13 | 2.12 | 2.12 | 2.12 | 2.13 | 2.13 | 2.13 |
| Capital goods | 1.45 | 1.43 | 1.42 | 1.42 | 1.41 | 1.41 | 1.41 | 1.41 | 1.41 | 1.41 |
| Intermediate goods | 1.31 | 1.30 | 1.28 | 1.28 | 1.27 | 1.27 | 1.27 | 1.28 | 1.28 | 1.28 |
| Mach and Elec | 1.11 | 1.10 | 1.09 | 1.09 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 |
| Fuels | 0.64 | 0.63 | 0.63 | 0.63 | 0.62 | 0.62 | 0.62 | 0.63 | 0.63 | 0.62 |
| Transportation | 0.70 | 0.69 | 0.69 | 0.69 | 0.68 | 0.68 | 0.68 | 0.69 | 0.69 | 0.68 |
| Chemicals | 0.69 | 0.68 | 0.68 | 0.68 | 0.67 | 0.67 | 0.67 | 0.67 | 0.67 | 0.67 |
| Raw materials | 0.58 | 0.58 | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 |

Source: Author's Calculation/ World Integrated Trade Solutions Database 2009-2018

## Discussion

The RCA index is very useful in the evaluation of a country's comparative advantage as well as the country's products and services. The comparative analysis gave credence to the assessment of trade in each of the country's product groups and year on year basis of comparison between the economies in the cluster market. This further proved that the extent of a country's economic growth and development is determined to a large extent by the rate of the RCA in its

comparative advantage to the other economies. This invariably means that where there is a higher level of trade in an economy within a competitive market, there is the possibility of producing an RCA >1, while a lower level of trade could translate to an RCA <1. However, the analysis had proved that the share of trade exchange between competing economies does not necessarily affect the economic strength of a country. This reason for this conception is, however, beyond the scope of this paper. Meanwhile the possibility of harnessing the growth potential of economy is also fundamental where export trade is concerned.

In the analysis, there was a clear indication that manufacturing- and technological-based mechanized trading in the European Union cluster market had developed over the years from 2009 to 2018 with the potential of further development in the nearest future. Meanwhile, the RCA indices had shown relative trading fluctuations between the European economies implying the likely unstable trend if the market forces within the European economy were not critically monitored. For example, the export trade of Belgium and Spain have increased indices from 2009 to 2018, while Poland, Austria, Sweden, the Czech Republic, Denmark and Hungary have fluctuating indices in export trade growth potential over the period under review. However, the economic relations between the competing economies had strengthened over time due to the European Union's cohesion policy.

David Ricardo's principle of Comparative Advantage actually induced global economic growth and development in the competitive economies of the global market. However, the author is of the opinion that Ricardo's principle did not really consider the absolute advantage derived in a technologically driven market. This is because Ricardo's only factor of production is labour, and this factor had evidently been outweighed by the evidence of the inclusion of technology in labour-intensive products rather than capital-intensive products in an absolute advantage position relative to other lower economies in a competitive market.

The author's submission is that trade between countries in the global market is absolutely driven by the opportunity cost of the benefit derived from the factor endowment, and not necessarily for the purpose of promoting the comparative-advantage-based model. Hence, the dynamics of trade in the competitive economies tend to be absolutely driven by an intrinsic value of interest of the competing economies. The author's perception is that the more advanced countries of the world are prone to using prerogative controls of an opportunity cost in trade between economies in a free-market system where competition is not risk-averse. The technologically advanced economies gain the absolute control in international trade, which evidently does not end in the hands of a free market system.

## Conclusion

The aim of this research was to conduct a comparative analysis of competitive trade in the cluster market economies of the European Union using the Revealed Comparative Advantage (RCA) index in order to improve on the Ricardian model of comparative advantage in a contemporary trend of economic realities. The RCA index was used as the metric suitable for determining the extent of trade performance between the countries in the European Union considering mechanized trade in comparison to agricultural products. The underlying analysis and results proved that the aim of the research was achieved.

However, the advent of global investment transcends the internal or domestic market, which gives rise to trading activities amongst countries particularly with the aim of creating room for exchange of goods and services. This concept further enhances global market competition that could lower production costs, thereby making it competitive at a reduced cost, which could be adduced to the single market economy of the European Union. There could be the perception that the barriers to trading activities in the global market are numerous: cultural beliefs, language interpretations, embargos, tariffs on goods and services, exchange controls and vast a number of incidental factors, which are likely to discourage the primary objective of achieving a global market trade between countries in the European cluster market.

Also, the likely regulations of economic policies in any particular country, which may threaten the existence of the investment of another, had also been considered within the European Union single market system. For example, the Eurostat database reported that the European Stability and Growth Pact led to pegging of the new annual net debt of the European Union member states to a maximum of 3 per cent of their respective gross domestic product. This is in addition to the national debt of up to 60 per cent of the economic power of the member state.

Meanwhile, one of the reasons international trade has remained a point of focus for globalization stems from the Ricardian principle of comparative advantage where the global economy exchange goods and services they have comparative cost advantage to produce if considering the opportunity cost of production vis-a-vis the variety of goods produced in different countries.

Since this research specifically focused on the available data of European countries, further research could be carried out on the global economy in general. The results shown from this analysis only provided the comparative position of competitive trade and the product groups and services in the

economies of the European Union. It is, however, critical to further analyze other areas of research interest raised by the author as well as other economic factors that have created the need for other studies relating to per capita income, and the level of activities in the European market. This research is a significant contribution towards improving the Ricardian model with the contemporary study of economic realities within the European Union economy while considering a cluster market as a reference in the global community.

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# Primerjalna analiza konkurenčnega trgovanja na trgu Evropske unije: indeks razkritih primerjalnih prednosti (RCA)

## Izvleček

Ta raziskava obravnava primerjalno analizo konkurenčne trgovine znotraj grozdov tržnih gospodarstev Evropske unije. Cilj tega članka je izvedba trgovinske analize znotraj konkurenčnih držav na evropskem trgu od leta 2009 do 2018. To je obdobje po svetovni krizi leta 2008 in pred pandemijo covida-19 leta 2019, namen analize pa je določiti obseg konkurenčne trgovine znotraj evropskih gospodarstev. Izbrana metrika je indeks razkritih primerjalnih prednosti (RCA) Béle Balasse, ki se uporablja za določanje primerjalne prednosti ali slabosti trgovanja različnih držav. Ugotovitve kažejo, da države z RCA > 1 v primerjavi z drugimi konkurenčnimi gospodarstvi na nižji ravni gospodarsko uspevajo. In dejstvo je, da gospodarstvo Evropske unije uspeva z mehaniziranim trgovanjem, ki ne zajema kmetijskih proizvodov, ne glede na konkurenčni trg. Študija je pomemben prispevek k izboljšanju Ricardovega modela primerjalnih prednosti na skupnem trgu evropskih gospodarstev.

**Ključne besede:** konkurenčnost, razkrite primerjalne prednosti, mednarodna trgovina

# The Impact of Macroprudential Policy Instruments on Financial Stability in Southern Europe[1]

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## Abstract

This paper is a contribution to the body of research examining the impact of macroprudential policy instruments on financial stability. The following hypothesis was tested (H1): Macroprudential policy instruments (household borrowing costs; interbank loans as a percentage of total loans; loan to deposit ratio; leverage ratio; and solvency ratio) enhance financial stability, as measured by credit growth, in four southern European economies (Greece, Italy, Portugal and Spain) from Q4 2010 to Q4 2018. The empirical results of this study suggest that, of the investigated macroprudential policy instruments, household borrowing costs, interbank loans as a percentage of total loans and loan to deposit ratio exhibit the predicted impact on credit growth rate. Leverage ratio and solvency ratio do not exhibit the expected impact on the response variable. Moreover, only three out of the five explanatory variables are statistically significant in the model. Consequently, it is not possible to confirm or reject the hypothesis based on the available data and results.

**Keywords:** macroprudential policy, macroprudential instruments, systemic risk, financial stability

## Introduction

In this paper, the impact is investigated of five macroprudential policy instruments on financial stability in four southern European EU member states (Greece, Italy, Portugal and Spain) over the time span from Q4 2010 to Q4 2018. The substantial losses that banks incurred during the 2007-2008 subprime crisis called into question the risk-taking behaviour of banks. Lehman Brothers' default pointed out the fact that financial stability has a macroprudential or systemic dimension. If the financial

*1 Disclaimer: The views and opinions expressed in this paper are solely those of the authors and do not in any way reflect the official policy, position, or opinion of the Faculty of Economics and Business, University of Maribor or of Credit Suisse Group AG.*

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system is treated simply as the sum of its parts, its historical tendency to transition between booms and busts can be overlooked (Beck & Gambacorta, 2020). Prior to the emergence of the crisis, the banks were involved in exuberant risk-taking activities (Luu & Vo, 2020) and excessive lending to borrowers with dubious creditworthiness, which led to credit and asset price booms, a banking crisis, and a surge in non-performing loans (Festić & Romih, 2008).

In the fallout of the crisis, policymakers and academics recognised that more effective macroprudential policies and regulatory measures were required to reduce excessive optimism among economic agents, stem moral hazard behaviour, and prevent banks from unrestrained risk-taking (Luu & Vo, 2020). The 'Greenspan doctrine' (Greenspan, 2002, 2011), which advocated the view that it is preferable to inject liquidity into the financial system after a final crisis had occurred, has ended. The ex-ante policy interventions are no longer seen as too costly, blunt or unpredictable in their effects (Jeanne & Korinek, 2020). In the past few years, there has been a spike in empirical and theoretical studies on the subject of macroprudential policy and macroprudential regulation. This paper is a contribution to this field.

## Theoretical Background of Empirical Analysis

Macroprudential policy is concerned with systemic risk, which is defined as 'the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy' (Group of Ten, 2001). There are three sources of systemic risk: macroeconomic shocks, which cause distress in the financial system; excessive leverage, which leads to imbalances in the financial system; and increasing interconnectedness and herd behaviour, which exacerbates contagion risk (Constâncio, 2016).

The European Central Bank (ECB, 2013c) defines financial stability as 'a condition in which financial system intermediaries, markets, and market infrastructure can withstand shocks without major disruption in financial intermediation and, in general, supply of financial services.' The macroprudential approach to financial stability sees risk as endogenous, i.e. contingent on the behaviour of all institutions that make up the financial system. Macroprudential policy is concerned with endogenous processes in the financial system, in which financial institutions that may be individually stable can find themselves in a situation of systemic instability. Institutions influence the prices of financial assets, the quantities borrowed and lent, and consequently the resilience of the economy and the strength of the institutions themselves. From a macroprudential perspective, for soundness of the financial system as a whole it is neither necessary nor sufficient for each individual institution to be sound (Borio, 2011). What is important from a macroprudential perspective is the existence of correlated (common) exposures, diversification and pro-cyclicality (in other words, how system-wide risk can be magnified by interactions between the financial system and the real economy as well as by those within the financial system).

The aim of macroprudential policy, tools, instruments and measures is to build up (capital and liquidity) buffers in expansionary periods, so that they can be drawn down in periods of financial distress. This dampens the pro-cyclicality[2] of the financial system, mitigates systemic risk and fosters financial stability (Borio, 2011).

Literature examining the impact of macroprudential policy instruments is very broad and versatile. In general, three strands of literature can be identified (Morgan, Regis & Salike, 2019): The first strand is empirical research that employs cross-country macro data, the second are case studies of countries using micro-level data, while the third group of studies – which are the most recent – employs both macro- and micro-level data to estimate the impact of country-specific macroprudential policy instruments on financial stability.

Some studies assess the impact of macroprudential policy instruments on financial variables, such as asset prices, credit and financial imbalances in the economy (e.g. Akinci & Olmstead-Rumsey, 2018; Cerutti, Dagher & Dell'Ariccia, 2015; Lim et al., 2011), whereas others focus on the impact of macroprudential policy instruments on macroeconomic variables traditionally targeted by monetary policy – inflation and output (e.g. Richter et al., 2019; Kim & Mehrotra, 2017). Most studies construct dummy indices that are based on the dates of policy measures (Lim et al., 2011; Shim et al., 2013; Cerutti, Claessens & Laeven 2017; Cerutti, Correa, Fiorentino & Segalla, 2017; Akinci and Olmstead-Rumsey, 2018). The dummy indices signal a tightening or loosening of the macroprudential policy stance, but do not reflect the intensity of changes in macroprudential policy instruments (Kim & Oh, 2020). Some relatively recent studies incorporate the intensity of macroprudential policy measures. For example, Alam et al. (2019) and Richter et al. (2019) created a loan-to-value (LTV) index, which reflects the intensity of changes in the LTV cap, while Vandenbussche et al. (2015) designed dummy indices of policy measures, which incorporate the intensity of the changes.

*2 Procyclicality is defined as the inclination of the financial system to reinforce the business cycle (Festić, 2006).*

Most of the literature is predominantly concerned with examining the impact of macroprudential policy instruments on bank lending as an intermediate target instead of on bank risk, the containment of which is the ultimate macroprudential policy objective (Altunbas, Binici & Gambacorta, 2017). Recent empirical results indicate that debt-to-income caps and loan-to-value caps are more effective than capital requirements for limiting credit growth (Claessens, Ghosh & Mihet, 2013). For instance, in Switzerland, the application of a countercyclical capital buffer to domestic residential mortgages had a negligible effect on loan granting (Basten & Koch, 2015). The key objective of the Basel III macroprudential tools is to bolster the resilience of the banking system (Altunbas, Binici & Gambacorta, 2017). Smoothing the credit cycle and restraining the boom is a welcome side effect that may be more or less pronounced (Drehmann & Gambacorta, 2012). Another strand of literature (e.g. Jakubik & Hermanek, 2008) investigates the impact of macroprudential policy instruments on financial stability by constructing stress scenarios and presenting stress test results.

The evidence on how effective macroprudential policy is on dampening the procyclicality of banking activity is accumulating, although it is still fragmented (Galati & Moessner, 2014; Claessens, Ghosh & Mihet, 2013). Macroprudential policy instruments seem to be effective in mitigating the sensitivity of leverage and credit to the business cycle, i.e. the procyclicality of leverage and credit growth (Lim et al., 2011). Macroprudential tools also appear to be effective in restraining asset growth, leverage and credit growth (Vandenbussche et al., 2015; Alper et al., 2014; Cerutti, Claessens & Laeven, 2017; Claessens, Ghosh & Mihet, 2013). In spite of these positive indications that the research on macroprudential policies is proceeding in the right direction, the evidence on the effectiveness of macroprudential policy measures is preliminary and there is still much to be done (Olszak, Roszkowska & Kowalska, 2018; Claessens, 2014; Akinci & Olmstead-Rumsey, 2018).

## Empirical Analysis: Data Specification and Variables, Hypothesis and Methodology

### Data and variables

All the data used in this empirical analysis were retrieved from the Statistical Data Warehouse of the European Central Bank (SDW, 2020), hereinafter the ECB SDW.

The following explanatory variables, representing macroprudential policy instruments, are employed in the model for this research paper:

- BCH = *cost of borrowing from monetary financial institutions (MFIs) for households and non-financial corporations (NFCs)*.
- *INL = interbank loans as percentage of total loans, measured as interbank loans divided by total loans*.
- *LDR = loan-to-deposit ratio, measured as the total number of loans, divided by the total number of deposits.*
- *LR = leverage ratio, measured as total assets divided by total equity.*
- *SR = solvency ratio, measured as total own funds, divided by risk weighted assets*.

The following response variable, representing financial stability, is used in the model for this research paper:

- CGR = *credit growth rate, measured by the domestic credit-to-GDP gap*.

Financial stability is proxied with credit growth and/or house price growth in most papers that investigate the impact of macroprudential policy instruments on financial stability, e.g. Poghosyan, 2020; Richter, Schularick & Shim, 2019; Morgan, Regis & Salike, 2019; Kim & Oh, 2020; Nakatani, 2020; Davis, Liadze & Piggott, 2019; Olszak, Roszkowska & Kowalska, 2019; Ma, 2020; Meuleman & Vander Vennet, 2020; Cizel, Frost, Houben & Wierts, 2019; Bambulović & Valdec, 2020; Gambacorta & Murcia, 2020; and Ely, Tabak & Teixeira, 2021.

The model used in this paper was applied to four southern European EU member states (Greece, Italy, Portugal and Spain) and 34 quarters (Q3 2010 to Q4 2018). After taking the time series at first difference for stationarity purposes, the number of quarters is reduced to 33 (Q4 2010 to Q4 2018).

### Hypothesis and the expected relationship between the explanatory and response variables

The following hypothesis (H1) was tested: 'Macroprudential policy instruments (cost of borrowing from MFIs for households and NFCs; interbank loans as a percentage of total loans; loan-to-deposit ratio; leverage ratio; and solvency ratio) enhance financial stability, as measured by credit growth'.

The cost of borrowing from MFIs for households and NFCs can be seen as an indirect macroprudential policy instrument if, for instance, due to higher reserve requirements or changes in another macroprudential policy measure implemented by the macroprudential authorities, banks decide to pass on the higher costs to their customers (Arregui et al. 2013; Zhang & Zoli, 2014). Higher mortgage interest rates and/or

higher interest rates on other types of loans imply that fewer clients will be able to take out more expensive loans. This is likely to reduce the banks' extension of credit and suppress credit growth in the economy. As such, it is assumed that an increase in BCH (the cost of borrowing from MFIs for households and NFCs) will have a negative effect on credit growth, thereby promoting financial stability.

Another macroprudential policy instrument which the authors of this paper decided to include in their analysis are interbank loans expressed as a percentage of total loans (INL). The higher the INL ratio, the more likely that a common shock to banks' external assets or liabilities will have systemic repercussions (i.e. will not stay with just one bank, but will also be transferred to other banks in the system). The lower the INL ratio, i.e. the less lending among banks and the more diversified banks' portfolios, the lower the likelihood and the strength of the propagation of contagion (Roncoroni et al., 2019). *The authors predict that an increase in the INL ratio will have a positive effect on credit growth, thereby undermining financial stability*.

The most widespread macroprudential policy tools, which existed already prior to the development of the Basel III, CRR and CRD IV standards and legal requirements, are the loan-to-value (LTV) caps and debt-to-income (DTI) or debt-service-to-income (DSTI) caps. The LTV ratio limits the amount of the loan relative to the value of the property. The DSTI ratio limits the debt servicing cost relative to the borrower's disposable income (Szpunar, 2017). The LTD ratio (hereinafter LDR) limits the amount of the loans that can be extended for each unit of currency of deposits. If the LDR is excessively high, a bank may not have sufficient liquidity in the event of loan defaults in a period of financial distress. These tools predominantly impact the supply and demand for mortgages. For the purposes of this study, the author decided to introduce the loan-to-deposit ratio (LDR) as the borrower-based explanatory variable. *The authors presume that an increase in the LDR will have a positive effect on credit growth, thereby compromising financial stability*.

Since mid-2021, the amended EU regulation has set forth a binding leverage ratio, which is a non-risk-based measure of banks' assets in relation to capital. The amount of an institution's Tier 1 capital base needs to amount to at least 3% of its non-risk-weighted assets ('exposure measure', which is a sum of on-balance sheet exposures, derivative exposures, securities financing transactions, and off-balance sheet items)[3]. In addition, global systemically important institutions (G-SIIs) will need to maintain an additional leverage ratio buffer. The purpose of the leverage ratio is to provide a back-stop to the risk-based measures and to prevent excessive leverage from building up. It does not distinguish one asset class from another (Linklaters LLP, 2019ab). For the purposes of this paper, the authors decided to employ leverage ratio as one of the macroprudential policy instruments, with the aim of investigating its impact on financial stability. This is because the banks have already been reporting it for some years now despite the fact that it is not yet binding. Moreover, it is one of the few measures that do not depend on the risk-weighted assets, but rather simply on assets without having risk weights applied to them. The authors' conjecture is that an increase in the leverage ratio (measured as total assets divided by total equity) will have a positive impact on credit growth, thereby compromising financial stability.

In 2013, the Basel III rules, which, by and large, have been transposed into the EU legislative requirements, introduced new macroprudential instruments, such as the countercyclical capital buffer (CCyB), which limits the build-up of systemic risk in expansionary periods (Szpunar, 2017). Other buffers, which need to be met with CET1 capital, are the systemic risk buffer (SRB), the global systemically important institutions buffer (G-SII buffer), the other systemically important institutions buffer (O-SII buffer), and the capital conservation buffer (CCoB). Moreover, higher CET1 ratios, and by extension higher solvency ratios (SR), can also be seen as a macroprudential policy instrument, since, as part of the Pillar 2 supervisory review process, supervisory authorities in the EU (the national supervisory authorities and the European Central Bank) set capital requirements for individual banks in the EU by considering their individual risk profiles and stress test results after having conducted a peer-comparison and considered micro- and macro-prudential indicators. Indeed, Klinger and Teply (2014) demonstrate that sufficient capital buffers are key for safeguarding the stability of the financial system as a whole. *The authors of this paper predict that an increase in the solvency ratio (SR) will have a negative effect on credit growth, thereby enhancing financial stability*.

The expected impact of an increase in individual explanatory variables on credit growth rate and on financial stability is shown in Table 1.

## Methodology

In order to test the hypothesis of this paper, the authors employed the quantitative research method of panel econometrics. Panel data allow for the identification of certain

*3 In this analysis the authors actually use a more traditional definition of the leverage ratio (i.e. total assets divided by total equity), however, the general idea is the same. The traditional definition of the leverage ratio is used because the time series for the leverage ratio which uses the new definition (Tier 1 capital divided by exposure measure) is not yet long enough.*

questions or parameters without the need to make restrictive assumptions and can be compared to cross-sectional assemblies or time series (Verbeek, 2004). Panel regression renders it possible to study variables that have both the space dimension (in this case, several countries) as well as the time dimension (in this case, several quarters). Furthermore, panel regression controls for omitted variables alleviates the problem of collinearity among explanatory variables, dismisses heterogeneous effects, and may reduce measurement errors and endogeneity bias by including the lags of the regressors. The problem of spurious regression can be circumvented by using the differences of the variables expressed as percentage changes (Festić, 2015; Festić, Kavkler & Repina, 2011; Hahn & Hausman, 2002; Murray, 2006). The stationarity of the time series is verified using the Augmented Dickey-Fuller (ADF) test. The authors tested both the fixed effect and the random effect models and verified the p-values of the redundant fixed effects test and the Hausman test (Hausman, 1978).

Some authors claim that the differences between various economies and/or quarters can be accommodated by introducing a different intercept, whereas the slope coefficients remain constant (Gujarati, 2003; Allison, 2009; Hsiao, 1985; Wooldridge, 2010). The combination of time series and cross-section observations results in less collinearity among variables, more variability, more degrees of freedom, more efficiency, and more informative data. Panel regression is used in several studies by, for instance, Gambacorta and Murcia (2020), Akinci and Olmstead-Rumsey (2018), Ercegovac, Klinac and Zdrilić (2020), Valdivia Coria and Valdivia Coria (2019), and Bambulović and Valdec (2020).

If the individual, or cross-section specific, error component (unobserved effect) $\varepsilon_i$, and one or more of the BCH, INL, LDR, LR and SR regressors are correlated, it is better to use the fixed effects rather than random effects model. Since the number of cross-sections in the model used in this paper (four cross-sections) is less than the number of coefficients (six coefficients, which include five explanatory variables and the constant), it will not be possible to estimate the cross-section random effects model and the cross-section and period random effects models together. Instead, the authors will estimate the fixed effects models as well as the period random effect model. Namely, when trying to empirically estimate a model where the number of cross-sections is less than the number of coefficients, an EViews error message is displayed, which reads 'Not possible to estimate, since random effects estimation requires number of cross sections > number of coefs for between estimator for estimate of RE innovation variance.'

**Table 1.** The expected impact (positive or negative) of a unit increase in individual explanatory variables on the credit growth rate and financial stability, and the expected signs of regression coefficients

| Explanatory variable experiencing a one-unit increase | Impact on CGR (expected sign of the regression coefficient) | Impact on financial stability |
|---|---|---|
| BCH | – | + |
| INL | + | – |
| LDR | + | – |
| LR | + | – |
| SR | – | + |

Notes: A plus (+) implies a positive impact, whereas a minus (-) stands for a negative effect.
Source: Authors.

Formal econometric tests help when deciding which model is more appropriate for use in a certain situation. The redundant fixed effects test is used to decide between the pooled and the fixed effects model. The Hausman test is used to distinguish between the fixed effects and the random effects model. If the null hypothesis is not rejected, the random effects estimator is consistent and efficient. On the other hand, if the alternative hypothesis is not rejected, the fixed effects estimator is at least as consistent as the random effects' estimator and hence preferred (Gujarati, 2003; Allison, 2009; Hsiao, 1985; Wooldridge, 2010).

## Empirical Results and Discussion

All the explanatory variables, as well as the response variable, in this research paper are stationary at first difference ($p < 0.05$, hence H0 is rejected; the unit root is not present; the time series is stationary), but most of them are not stationary at level (Table 2). All of the time series are integrated of order one, i.e. I (1). To denote that all variables are taken at first difference for stationarity, all the regressors and the regress and have a 'D' in front of their name (e.g. CGR becomes DCGR; BCH becomes DBCH and so forth for the rest of the variables) in Table 3. The authors tried to introduce lags and the logarithmic form to their models, however, those models proved to be less statistically significant and less robust than the models described in this paper.

The empirical results shown in Table 3 indicate that period fixed effects, together with the cross-section fixed effects and period fixed effects, are present in the model used in this paper, since the F probability of the redundant fixed effects test for each of the models is less than 0.01. Fixed effects are present in the model where the intercept varies over time (period fixed effects model), and where the intercept varies

both according to individual countries and time (cross-section fixed effects and period fixed effects model). However, fixed effects are not present in the model where the intercept varies according to individual countries (cross-section fixed effects model). The slope coefficients are constant in all the models. The random effects estimator is not consistent in the model, since the p-value of the Hausman correlated random effects test is less than 0.01. Hence, in the evaluation of the empirical results, only the period fixed effects model (hereinafter PFEM) is considered, together with the cross-section fixed effects and period fixed effects model (hereinafter CSFEPFEM).

**Table 2.** Unit root test (Fisher ADF-test)

| Response and explanatory variables | Level (x) ADF-Fisher Chi-square statistic (ADF-Fisher Chi-square probability) | First difference d(x) ADF-Fisher Chi-square statistic (ADF-Fisher Chi-square probability) |
|---|---|---|
| CGR | 1.815270 (0.3718) | 10.68471 (0.0000) |
| BCH | 2.92160 (0.9392) | 26.3717 (0.0009) |
| INL | 24.0973 (0.0022) | 70.4547 (0.0000) |
| LDR | 5.19312 (0.7368) | 54.9994 (0.0000) |
| LR | 7.05639 (0.5306) | 34.4759 (0.0000) |
| SR | 3.64628 (0.8875) | 64.1851 (0.0000) |

Notes: P-values for the Fisher-ADF panel unit root test are computed using the asymptotic Chi-square distribution and given in brackets. The maximum number of lags was automatically selected using the Schwarz Information Criterion.
Source: Authors.

In terms of the H1 hypothesis of this research, which states that (Table 1):

- an increase in BCH has a negative effect on CGR
- an increase in INL has a positive effect on CGR
- an increase in LDR has a positive effect on CGR
- an increase in LR has a positive effect on CGR
- an increase in SR has a negative effect on CGR

it can only be partially confirmed, given that the results of the empirical model (Table 3) indicate that:

- an increase in BCH has a negative effect on CGR (thus confirming the hypothesis of this research)
- an increase in INL has a positive effect on CGR (thus confirming the hypothesis of this research)
- an increase in LDR has a positive effect on CGR (thus confirming the hypothesis of this research)
- an increase in LR has a negative effect on CGR (thus rejecting the hypothesis of this research)
- an increase in SR has a positive effect on CGR (thus rejecting the hypothesis of this research)

Furthermore, the BCH, LDR and SR constants are statistically significant at a significance level of 1%, 5% or 10% in both the models under consideration (PFEM and CSFEPFEM).

The explanatory power of both *PFEM* and *CSFEPFEM* is relatively high, since the R-squared is 0.49 and 0.51 respectively. Prob(F-statistic) in both models is less than 0.01, implying that each model as a whole is statistically significant.

Only three regressors (out of five) have the signs predicted by hypothesis 1. Moreover, the INL and LR variables are not significant in the two models under observation. Consequently, it is not possible to either confirm or reject the hypothesis based on the available data.

The empirical results of this research indicate that macroprudential policy instruments have a certain impact on financial stability. The weaknesses of the regression models used in this study are that they do not capture well the interactions between macroprudential policy instruments, financial and real economic sectors, and the macroprudential policy transmission mechanism. Furthermore, the effects of macroprudential policy were not isolated from those of monetary policy (Carreras, Davis & Piggott, 2018). This study does not allow for a possible correlation between the time series processed in the long term because the variables are only included in the differences, which does not allow the long-term effects of macroprudential policy instruments to be studied.

Furthermore, certain macroprudential policy instruments appear to influence credit growth in a different matter to that expected. For instance, it would be expected that an increase in leverage ratio increases credit growth, thereby undermining financial stability. However, the empirical results of this research indicate that the opposite could be the case. A plausible explanation for this could be that in economic downturns, when credit growth is lower or negative, households, non-financial institutions and financial institutions are more indebted (i.e. more leveraged). In this case, the causal relationship goes from the

**Table 3.** Empirical results

| Response variable | Explanatory variable/statistics | Cross-section fixed effects | Period fixed effects | Cross-section fixed effects and period fixed effects | Period random effects |
|---|---|---|---|---|---|
| DCGR | C | -1.135984 | -1.202089 | -1.235976 | -1.134986 |
| | | (-6.826504) | (-7.394879) | (-7.574468) | (-6.714869) |
| | | (0.0000)*** | (0.0000)*** | (0.0000)*** | (0.0000)*** |
| | DBCH | -0.155138 | -2.273628 | -2.499281 | -0.327580 |
| | | (-0.181016) | (-1.799156) | (-1.891022) | (-0.396838) |
| | | (0.8567) | (0.0753)* | (0.0619)* | (0.6922) |
| | DINL | -0.047770 | 0.062179 | 0.080586 | -0.064091 |
| | | (-0.205247) | (0.256182) | (0.332676) | (-0.299922) |
| | | (0.8377) | (0.7984) | (0.7402) | (0.7647) |
| | DLDR | 0.077545 | 0.152839 | 0.130434 | 0.110332 |
| | | (1.778784) | (3.251095) | (2.614745) | (2.814914) |
| | | (0.0778)* | (0.0016)*** | (0.0105)** | (0.0057)*** |
| | DLR | -0.912542 | -0.523725 | -0.506713 | -0.778994 |
| | | (-2.943262) | (-1.592386) | (-1.436289) | (-2.832011) |
| | | (0.0039)*** | (0.1148) | (0.1545) | (0.0054)*** |
| | DSR | 0.526329 | 1.032807 | 1.018127 | 0.615472 |
| | | (2.121811) | (3.608084) | (3.563672) | (2.640203) |
| | | (0.0359)** | (0.0005)*** | (0.0006)*** | (0.0094)*** |
| | R-squared | 0.105464 | 0.487665 | 0.508308 | 0.113398 |
| | S.E. of regression | 1.612645 | 1.420939 | 1.415816 | 1.524492 |
| | F-statistic | 2.876725 | 2.315306 | 2.248502 | 3.120793 |
| | Prob. (F-statistic) | (0.017195) | (0.000667) | (0.000857) | (0.010970) |
| | Sum squared resid | 317.2760 | 181.7162 | 174.3944 | 283.5371 |
| | Durbin-Watson stat | 1.076571 | 1.240449 | 1.268606 | 1.093181 |
| | Redundant fixed effects test (F prob.) | (0.2811) | (0.0034) | (0.0040) | N/A |
| | Hausman correlated random effects test (Chi-square prob.) | N/A | N/A | N/A | 0.0003 |

Notes: In the table, all the regressors and the regressand have a 'D' in front of their name (e.g. CGR becomes DCGR; BCH becomes DBCH and so forth for the rest of the variables), since all the variables are taken at first difference for stationarity. The t-statistics are given in brackets below the coefficients and the p-values are given in brackets below the t-statistics. The significance levels are denoted as: ***Significant at 1%, **Significant at 5%, *Significant at 10%.
Source: Authors.

state of the economy (credit expansion or contraction) to the changes in the calibration of macroprudential instruments (in this case, the maximum allowed leverage ratio). Indeed, methodologically, any estimation deals with the inherent endogeneity problem, since policymakers usually implement measures in response to systemic risk, credit and financial cycles, indicated by, for example, excessive credit growth or excessive house price growth (Cizel et al., 2019; Gadatsch, Mann & Schnabel, 2018). As such, macroprudential policy instruments may be influenced by the target variables, which creates reverse causality. This could lead to an estimation bias, underestimating the effectiveness of macroprudential policy measures (Kuttner & Shim, 2016).

## Conclusion

The traditional policy measures were not sufficient to avert the 2007 global financial crisis and failed to ensure a smooth and fast recovery. Since 2007, macroprudential policy instruments have gained in recognition as a crucial tool in enhancing financial stability. Monetary policy, fiscal policy, and microprudential policies operate with a different toolkit and focus on achieving goals other than the stability of the financial system as a whole. In light of this, a fourth policy – namely macroprudential policy – is required to mitigate and prevent emergence shocks, which could destabilise the financial system as a whole and compromise financial stability.

The following hypothesis (H1) was tested: Macroprudential policy instruments (household borrowing costs; interbank loans as a percentage of total loans; loan to deposit ratio; leverage ratio; and solvency ratio) enhance financial stability, as measured by credit growth, in four southern European economies (Greece, Italy, Portugal and Spain) from Q4 2010 to Q4 2018.

The empirical results of the study suggest that, of the investigated macroprudential policy instruments, household borrowing costs, interbank loans as a percentage of total loans and the loan to deposit ratio exhibit the predicted impact on credit growth rate. Leverage ratio and solvency ratio do not exhibit the expected impact on the response variable. Moreover, the variables interbank loans expressed as a percentage of total loans and leverage ratio are not significant in the two models under observation. Consequently, it is not possible to either confirm or reject the hypothesis based on the available data and results.

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# Vpliv instrumentov makroprevidnostne politike na finančno stabilnost v Južni Evropi

## Izvleček

Pričujoči članek predstavlja prispevek k obstoječim znanstvenim raziskavam na področju učinkov instrumentov makroprevidnostne politike na finančno stabilnost. V članku smo preverili sledečo hipotezo (H1): instrumenti makroprevidnostne politike (stroški izposojanja gospodinjstev; medbančna posojila, izražena kot odstotek vseh posojil; razmerje med posojili in depoziti; stopnja finančnega vzvoda; in stopnja solventnosti) pozitivno prispevajo k finančni stabilnosti, izraženi s stopnjo rasti posojil, v štirih južnoevropskih gospodarstvih (Grčiji, Italiji, Portugalski in Španiji) od zadnjega četrtletja 2010 do zadnjega četrtletja 2018. Naši empirični rezultati kažejo, da imajo trije instrumenti (od preučenih petih instrumentov makroprevidnostne politike) predvideni vpliv na stopnjo rasti posojil. Ti instrumenti so stroški izposojanja gospodinjstev; medbančna posojila, izražena kot odstotek vseh posojil; ter razmerje med posojili in depoziti. Po drugi strani stopnja finančnega vzvoda in stopnja solventnosti nimata pričakovanega vpliva na odvisno spremenljivko. Razen tega so v našem empiričnem modelu le tri od petih pojasnjevalnih spremenljivk statistično značilne. Iz tega sledi, da na podlagi razpoložljivih podatkov in rezultatov ne moremo niti potrditi niti zavrniti postavljene hipoteze (H1).

**Ključne besede:** makroprevidnostna politika, makroprevidnostni instrumenti, sistemsko tveganje, finančna stabilnost

# Are African Stock Markets Efficient? A Comparative Analysis Between Six African Markets, the UK, Japan and the USA in the Period of the Pandemic

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## Abstract

The aim of this study is to test and compare the efficient market hypothesis, in its weak form, on the stock markets of Botswana, Egypt, Kenya, Morocco, Nigeria, South Africa, Japan, the UK and the USA from 2 September 2019 to 2 September 2020. This study is based on the following research question: has the global pandemic (COVID-19) reduced the efficiency – in its weak form – of African financial markets compared to the mature markets of the UK, Japan and the USA? The results sustain the evidence that the random walk hypothesis is not supported by the financial markets analysed in the period of the global pandemic. The variance ratio values are lower than the unit, which implies that the returns are self-correlated over time. A reversion to the average is also observed, with no differences identified between mature and emerging financial markets. In corroboration, the Detrended Fluctuation Analysis (DFA) exponents show that the financial markets present signs of (in)efficiency in its weak form, thus showing persistence in the yields. This therefore implies the existence of long memories validating the results of the variance using the Wright's Rank and Signs Test (2000), which prove the rejection of the random walk hypothesis.

**Keywords:** African stock markets, efficient market hypothesis, mean reversion, random walk

## Introduction

The COVID-19 pandemic has negatively affected global trade as well as social and cultural life, including tourism, trade in goods, production, and sectors such as transport. Therefore, rating agencies such as Moody's and Standard & Poors

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reduced China's growth forecast for 2020. In line with all these adverse effects, it seems inevitable that stock markets, economic growth and exchange rates have also been affected equally (Liu, Manzoor, Wang, Zhang and Manzoor, 2020). Interest in African Stock markets from international investors has been increasing and attracting significant private investment. There are currently over twenty-nine (29) stock exchanges in Africa with significant disparities in market size, number of companies listed, volume of transactions and access to information. These institutional limitations, together with the existence of information asymmetry, agency problems, regulatory constraints and the presence of weak financial institutions, have implications for the efficient market hypothesis (EMH) in these regional stock exchanges (Hawaldar, Rohith, & Pinto, 2020; Lawal, Nwanji, Adama, & Otekunrin, 2017; Lawal, Somoye, & Babajide, 2017; Tweneboah, Owusu, & Oseifuah, 2019).

Thus, the aim of this study is to test the hypothesis of an efficient market, in its weak form, in the stock markets of Botswana, Egypt, Japan, Kenya, Morocco, Nigeria, South Africa, the UK and the USA from 2 September 2019 to 2 September 2020, in order to cover the year most affected by the global pandemic. This test is conducted based on the following research question: Has the global COVID-19 pandemic reduced the efficiency, in its weak form, of African financial markets? The results suggest very pronounced structural breaks, the existence of reversion to the mean, and the rejection of the informational efficiency hypothesis in its weak form. In corroboration, the DFA exponents show that the financial markets present signs of (in)efficiency in its weak form, thus showing persistence in the yields. This, therefore, implies the existence of long memories validating the results of the variance using the Wright's Rank and Sign Test (2000), which prove the rejection of the random walk hypothesis. These results also suggest that prices do not fully reflect the available information and that price changes are not independent and identically distributed (i.i.d.) in all markets. The high sensitivity of prices to the arrival of new information is said to have been due to the climate of pessimism and uncertainty experienced by investors during the period of the global pandemic.

This study is justified because there are still some gaps in the literature relating to the efficient market hypothesis (HME) in African stock exchanges. For instance, hybrid evidence is inconclusive in empirical studies on Africa. The authors Smith, Jefferis and Ryoo (2002), Simons and Laryea (2006), Obayagbona and Igbinosa (2015), Whisky (2015), Ogbulu (2016), Lawal, Somoye and Babajide (2017), Fusthane and M (2017), and Ajekwe, Ibiamke and Haruna (2017) demonstrated that African markets display signs of marked levels of (in)efficiency in its weak form, substantiating that returns are predictable based on historical prices. In addition, the authors Kelikume (2016), Abakah, Alagidede, Mensah and Ohene-Asare (2018), and Hawaldar, Rohith and Pinto (2020) showed that African markets are efficient in their form and verified the fact that stock prices fully reflect all the information available in the market, and investors cannot obtain anomalous returns with the same level of risk. Therefore, this research is justified by the need to mitigate existing empirical divergences on the African stock market. Moreover, as these stock exchanges develop in the presence of imperfect information, investors, regulators and other participants demand transparency about the efficiency or inefficiency of these stock markets to avoid sharp structural breaks, which can cause significant losses to domestic and international investors.

In terms of structure, this test is organised into five sections. In addition to the current introduction, section 2 is a Literature Review on the random walk hypothesis in African financial markets, section 3 describes the methodology, and section 4 contains the data and results. Finally, section 5 contains the general conclusions of the work.

## Literature Review

The subject of the efficient market hypothesis (HME) denotes that the current price of assets reflects all the available information at a given moment, and the price adjusts quickly as new and unexpected information reaches the market. The hypothesis of reversion to the average, also called negative series correlation, has been interpreted as an efficient correction mechanism in developed markets and a speculative bubble sign in emerging financial markets (Summers, 1986; Fama & French, 1988).

The EMH assumes the absence of asymmetric information in trading activities in a traditional stock market. The EHM has been tested extensively in developed markets with mixed results. The same has happened in relation to African financial markets due to the presence of asymmetric information and institutional constraints. Validating the African economy's assumptions has continued to be of great interest to investors and academics, given the prominence of the African economy in global economic growth (Kelikume, 2016).

Smith, Jefferis and Ryoo (2002), and Simons and Laryea (2006) analysed market efficiency in its weak form in African markets. Smith, Jefferis and Ryoo (2002) tested the random walk hypothesis on the stock markets of South Africa, Egypt, Kenya, Morocco, Nigeria, Zimbabwe, Botswana and Mauritius. The authors show that the random walk hypothesis is rejected in seven of these markets due to the autocorrelation of the yields. For the South African market, the stock index follows the random walk hypothesis.

Simons and Laryea (2006) examined four African stock markets – Ghana, Mauritius, Egypt and South Africa. Based on the results of the parametric and non-parametric tests, the authors show that the South African stock market is efficient in its weak form. At the same time, Ghana, Mauritius and Egypt are inefficient.

Additionally, Tiwari and Kyophilavong (2014), Obayagbona and Igbinosa (2015), Whisky (2015), Ogbulu (2016), and Kelikume (2016) tested whether African markets are predictable. Tiwari and Kyophilavong (2014) examined the hypothesis of random walk in the BRICS stock indices. The authors demonstrated that these markets show inefficiency in its weak form, except for the Russian stock index. Obayagbona and Igbinosa (2015) show dependence on the series of returns and, therefore, non-randomness, demonstrating that the Nigerian market shows signs of (in)efficiency in its weak form. Whisky (2015) examined the behavior of four sectors in Nigeria, suggesting that the series of returns does not support randomness, except in the agricultural sector, which implies inefficiency in its weak form in this African market. Ogbulu (2016) shows that the Nigerian Stock Exchange (NSE) is (in)efficient in its weak form for the daily, weekly, monthly and quarterly time scales. Kelikume (2016) studied the Nigerian stock market from 1985 to 2015, showing that it follows a random walk behaviour, thus verifying signs of efficiency. In other words, stock prices fully reflect all the information available in the market, and investors cannot obtain abnormal returns with the same level of risk.

In terms of the risk, Lawal, Somoye and Babajide (2017), Fusthane and M (2017), Ajekwe, Ibiamke and Haruna (2017), Abakah, Alagidede, Mensah and Ohene-Asare (2018), and Hawaldar, Rohith and Pinto (2020) tested the hypothesis of arbitration, namely the possibility of investors obtaining abnormal returns without incurring additional risk. Lawal, Somoye and Babajide (2017) studied the validity of the random walk hypothesis in the seven largest African markets. The authors argue that the EHM is rejected in its weak form, implying that African markets are inefficient and that the implementation of adjusted trading strategies may provide trading by arbitration. Fusthane and M (2017) examined the Johannesburg Stock Exchange, pointing out that this market shows signs of inefficiency in its weak form. Along the same lines, Ajekwe, Ibiamke and Haruna (2017) established that the Nigerian stock market is efficient in its weak form. The implication of these results demonstrates that investors cannot have anomalous returns with the same level of risk. Abakah, Alagidede, Mensah and Ohene-Asare (2018) re-examined efficiency in its weak form, in the stock markets of South Africa, Nigeria, Egypt, Ghana and Mauritius. The authors point out that South African, Nigerian and Egyptian stock market indices follow the random walk hypothesis (RWH) and are efficient in their weak form. In contrast, the markets of Ghana and Mauritius are inefficient. Hawaldar, Rohith and Pinto (2020) examined the predictability of eight African stock markets. The authors determined that investors cannot obtain anomalous returns based on historical prices, proving that these markets are efficient in their weak form.

In summary, the aim of this paper is to provide information to investors and regulators in African financial markets, where individual and institutional investors seek to efficiently diversify their portfolios in a period of uncertainty and lack of confidence arising from the global COVID-19 pandemic.

## Methodology

The stock market index prices of Botswana, Egypt, Kenya, Morocco, Nigeria, South Africa, Japan, the UK and the USA were analysed from 2 September 2019 to 2 September 2020. The quotations are daily and were obtained from the DataStream platform in local currency to mitigate exchange rate distortions.

This sample period was chosen as a result of a study by Nsoesie, Rader, Barnoon, Goodwin and Brownstein (2020). According to these authors from Harvard Medical School, evidence has emerged that the first outbreak of the virus occurred in the city of Wuhan, China, in the period before December 2019. The study was based on the observation of an increase in vehicles in the car parks of main hospitals and the high number of searches of Chinese search engines (Baidu) related to symptoms of the virus in late summer 2019.

The preference for these African financial markets is explained by their unstable, rapidly developing economies linked by cultural heritage and other similar economic conditions. Additionally, following the 2008 financial crisis in international emerging markets and those of Africa, these markets became an important investment destination. The choice of financial markets in Japan, the UK and the USA is due to the relevance of these markets in a global context. They are also very relevant indices of the regions in which Asia, Europe and America are part.

This research was developed over several stages. In the first stage, descriptive statistics and the Jarque and Bera (1980) adherence test was used to verify that the data follow a normal distribution. Graphs were produced of the markets, in levels and yields, to estimate the evolution of the markets under analysis. Additionally, the stability of residues was examined. To verify the breaks in structure, the Clemente et al. test was used (1998). To test the market efficiency in its weak form, a non-parametric test developed by Wright (2000) was used because this test is more resilient to time

series that do not exhibit normality and are relatively consistent when they show series correlation. The aforementioned author's methodology consists of two tests: the position test (Ranks) for homoscedastic series, and the Signs test for heteroscedastic series.

The position test (Ranks) of the variance is supported in the ordering of the yield series.

For clarity, $r(r_t)$ is considered the profitability position, $r_t$, between $r_1$, $r_2$, …, $r_T$:

$$r_{1t}^{'} = \frac{\left(r(r_t) - \frac{T+1}{2}\right)}{\sqrt{\frac{(T-1)(T+2)}{12}}} \quad (1)$$

$$r_{2t}^{'} = \Phi^{-1}\left(\frac{r(r_t)}{T+1}\right) \quad (2)$$

Where $\Phi^{-1}$ refers to the cumulative reverse standardised normal distribution, $r'_{2t}$ is a standardised linear transformation of the yield position, and $r'_{2t}$a standardised reverse normal transformation.

$$R_1(q) = \left(\frac{\frac{1}{Tq}\sum_{t=q+1}^{T}(r_{1t}^{'} + r_{1t-1}^{'} + \cdots + r_{1t-q}^{'})^2}{\frac{1}{T}\sum_{t=q+1}^{T}(r_{1t}^{'})^2}\right) \times \left(\frac{2(2q-1)(q-1)}{3qT}\right)^{-1/2} \quad (3)$$

$$R_2(q) = \left(\frac{\frac{1}{Tq}\sum_{t=q+1}^{T}(r_{2t}^{'} + r_{2t-1}^{'} + \cdots + r_{2t-q}^{'})^2}{\frac{1}{T}\sum_{t=q+1}^{T}(r_{2t}^{'})^2}\right) \times \left(\frac{2(2q-1)(q-1)}{3qT}\right)^{-1/2} \quad (4)$$

The rejection of the RWH of yields is generated by a simulation process, in which the values of the $r_{1t}^{'}$ and $r_{2t}^{'}$ statistics are replaced by the $r_{1t}^{'*}$ and $r_{2t}^{'*}$ simulated value Using bootstrap estimates, which result in successive random generation of data, in order to simulate the statistical properties of the true sample distribution, the exact distribution of $R_1(q)$ and $R_2(q)$ can be approximated to a given confidence level.

Wright's methodology (2000) proposes a second test, called the signal variance ratio, which considers the signal yield, $r_t$, to calculate the signal ratio, being the same heteroscedastic. Thus, the following test statistic can be used:

$$S_1(q) = \left(\frac{\frac{1}{Tq}\sum_{t=q+1}^{T}(S_t + S_{t-1} + \cdots + S_{t-q})^2}{\frac{1}{T}\sum_{t=q+1}^{T}(S_t)^2}\right) \times \left(\frac{2(2q-1)(q-1)}{3qT}\right)^{-1/2} \quad (5)$$

where

$$S_t = 2\upsilon(r_t, 0)$$

$$\upsilon(x_t, p) = \begin{cases} 0,5 & se\ x_t > p \\ -0,5 & se\ x_t \le p \end{cases} \quad (6)$$

The distribution of $S_1(q)$ can be approximated by $S_1^*(q)$ through bootstrap techniques, as in the case of the ratio of variance by rankings. $S_1^*(q)$ is obtained from the $\{S_t^*\}_{t=1}^{T}$ sequence, as each of its elements registers a value of 1 or -1, with the same probability.

Detrended Fluctuation Analysis (DFA) was used in order to validate the results. DFA is an analysis method that examines time dependency in non-stationary data series. By assuming that time series are non-stationary, this technique avoids spurious results when the analysis focuses on long-term data series relationships (Bashir, Yu, Hussain and Zebende, 2016; Guedes, Ferreira, Dionísio and Zebende, 2019).

A DFA is based on the following interpretation:

**Table 1.** Detrended Fluctuation Analysis (DFA)

| Exponent | Type of signal |
|---|---|
| $\alpha_{DFA} < 0.5$ | long-range anti-persistent |
| $\alpha_{DFA} \simeq 0.5$ | uncorrelated, white noise |
| $\alpha_{DFA} > 0.5$ | long-range persistent |

Source: Authors

## Results

In terms of the main results, it is important to highlight the results illustrated in Figure 1, which depict the evolution, in return, of the nine financial markets. The graphical analysis of the indices indicates that they show very similar behaviour patterns during the sample period. These patterns were strongly marked by the occurrence of the global COVID-19 pandemic. In contrast, the graphical analysis also verifies the existence of a bear market period between February, March and April 2020, which is characterised by a sharp drop in the index resulting from the evolution of the global COVID-19 pandemic.

Table 2 shows the main descriptive statistics of the financial markets under analysis, and allows us to ascertain that Botswana, Egypt, Japan, Kenya, Morocco, Nigeria, South

Africa and the UK stock market returns present negative daily averages, with the exception of the Japanese and US markets, which show positive daily averages. The US market exhibits the most pronounced standard deviation (0.020652). Additionally, the authors of this paper verified that all the markets present negative asymmetries, while the short ones have values above 3, which contradicts the hypothesis that the data follow a normal distribution (asymmetry = 0, kurtosis = 3). In corroboration, the adherence test of Jarque-Bera provides evidence that the data series do not follow normal distributions.

Since the time series are estimated, it is necessary to examine the stationary nature of the data series of the nine markets. The Levin, Lin and Chu (2002) test postulate that the null hypothesis has unitary roots, showing the stationary nature of the time series. However, the Hadri test (2000) postulates the stationarity in the null hypothesis. As can be see, there is rejection, which demonstrates that the data series is not stationary and that the time series may not be stable. As a result of this evidence, the Clemente et al. (1998) test is to be conducted to analyse the stationarity with breaks in structure.

Figure 2 shows the stability tests performed on stock market residuals, assessing the existence of disturbances in variance. Additionally, when examining the graphs and the 95% probability limits, a violation of the limits of the probability can be verified, thus the time series shows unstable behaviour.

Figure 3 illustrates the unit root test results, with structure breaks, by Clemente et al. (1998), showing the existence of structural breaks in March 2020, except for the Botswana Stock Exchange, which was expected given the evolution of the global COVID-19 pandemic. These findings are corroborated by the authors Sansa (2020), He, Liu, Wang and Yu (2020), who showed structural breaks in the financial markets resulting from the global pandemic.

Table 5 shows the results of the non-parametric version of Wright's variance test (2000), which includes the Rank and Signs variance tests. In both cases, the statistics were calculated for lags of 2, 4, 8 and 16 days. Considering the results of the Wright's Rank and Signs variance test (2000), the RWH is rejected in all stock market indices. Therefore, the results sustain the conclusion that the analysed financial markets do not support the RWH during this period of the global pandemic. The values of the variance ratios are lower than the unit, which implies that returns are autocorrelated over time, and there is a reversion to the mean. No differences were identified between mature and emerging financial markets. Under these conditions, markets tend to overreact to information – whether good or bad news – eventually adjusting in the following days. The high sensitivity of prices to the arrival of new information was due to the climate of pessimism and uncertainty experienced by investors during the sample period studied. Additionally, the hypothesis of informational efficiency of the financial markets may be questioned. These results are corroborated by the studies of the authors Aggarwal (2018), and Sadat and Hasan (2019), as well as partially by those of Ngene, Tah and Darrat (2017), Abakah, Alagidede, Mensah and Ohene-Asare (2018), and Malafeyev et al. (2019).

Table 6 shows that the results of the DFA exponents are demonstrated, showing that the financial markets display signs of (in)efficiency in its weak form. The persistence in the yields is then substantiated, i.e. the existence of long memories, thus validating the results of the Wright's Rank and Signs variance test (2000), which shows the rejection of the RWH. These findings demonstrate that prices do not fully reflect the available information and that changes in prices are not i.i.d. in all markets. This situation has implications for investors, since some returns can be expected, thus creating opportunities for arbitrage and abnormal returns instead of the assumptions of random walk and information efficiency.

**Table 6.** DFA exponent for return. The values of the linear adjustments for αDFA always had $R^2 > 0.99$

| Index | DFA exponent (Covid-19) |
|---|---|
| Botswana | 0.61 ≈ 0.0214 |
| Egypt | 0.63 ≈ 0.0079 |
| Japan | 0.65 ≈ 0.0019 |
| Kenya | 0.60 ≈ 0.0073 |
| Morocco | 0.62 ≈ 0.0081 |
| Nigeria | 0.77 ≈ 0.0190 |
| South Africa | 0.64 ≈ 0.0015 |
| UK | 0.64 ≈ 0.0029 |
| US | 0.59 ≈ 0.0175 |

Note: The hypotheses are $H_0$: $\alpha = 0.5$ and $H_1$: $\alpha \neq 0.5$
Source: Authors

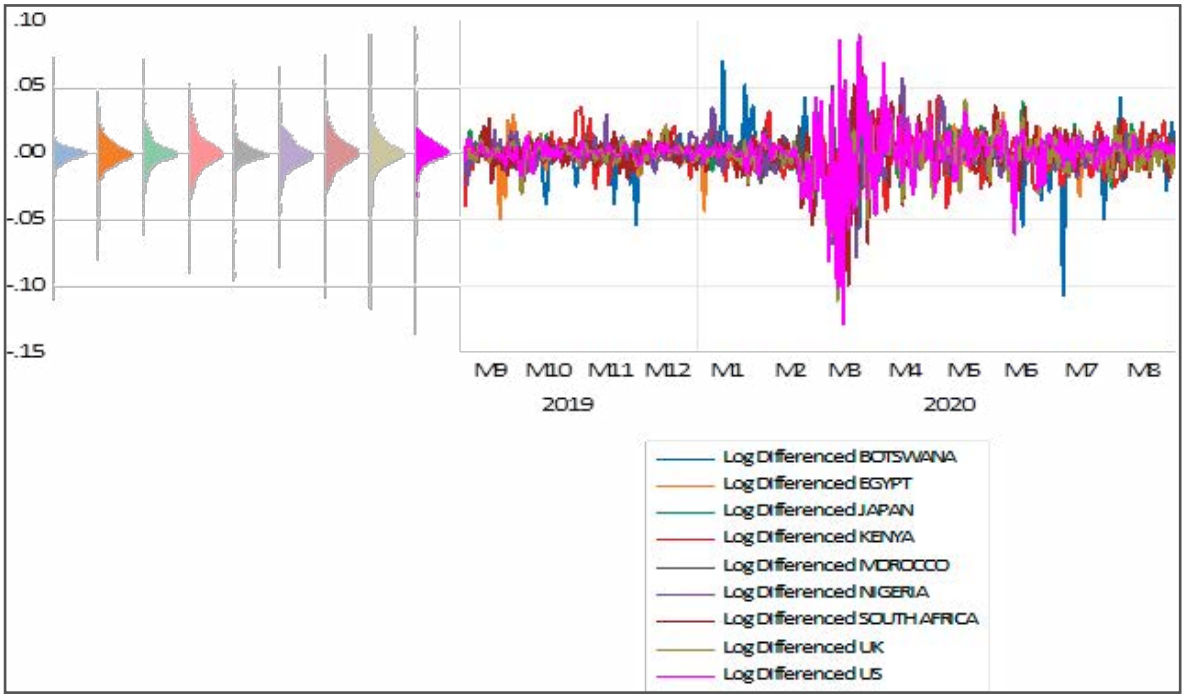
## Discussion and Conclusions

This study tested the hypothesis of efficiency, in its weak form, in the stock markets of Botswana, Egypt, Japan, Kenya, Morocco, Nigeria, South Africa, the UK and the USA during the period from 2 September 2019 to 2 September 2020. The aim was to determine whether these markets have long memories in their returns, i.e. whether past prices help to predict future prices. For this purpose, two tests were conducted, namely an econometric and an economophysical.

The first tested market efficiency, in its weak form, through a non-parametric test, the position test (Ranks) for the homoscedasticity series, and the Signs test for the heteroskedasticity series. The second test examined the time dependency in non-stationary data series through the DFA methodology.

In the first test, the Wright's Rank and Signs variance ratios test was estimated. In both cases, the statistics were calculated for lags of 2, 4, 8 and 16 days. Considering the results of the Rank and Signs variance test, the RWH is rejected in all the stock indexes. The results thus support the conclusion that

**Figure 1.** Evolution, in return, of the nine financial markets in the period between 02/09/2019 and 02/09/2020




Source: Authors

**Table 2.** Descriptive statistics, return, of the nine financial markets analysed, in the period from 02/09/2019 to 02/09/2020

| | Botswana | Egypt | Japan | Kenya | Morocco | Nigeria | South Africa | UK | US |
|---|---|---|---|---|---|---|---|---|---|
| Mean | -0.001470 | -0.001006 | 0.000298 | -0.000407 | -0.000504 | -0.000946 | -6.77E-05 | -0.000714 | 0.000719 |
| Std. Dev. | 0.014387 | 0.013725 | 0.012811 | 0.016262 | 0.011857 | 0.014550 | 0.019396 | 0.017086 | 0.020652 |
| Skewness | -1.572172 | -1.493110 | -0.133368 | -0.760551 | -2.349464 | -0.867744 | -1.184155 | -1.185227 | -1.100900 |
| Kurtosis | 18.81400 | 9.589017 | 8.185755 | 6.067979 | 22.43120 | 8.963956 | 9.911942 | 12.71763 | 14.05248 |
| Jarque-Bera | 2848.831*** | 73.4786*** | 95.4717*** | 128.5001*** | 379.512*** | 422.7801*** | 584.9979*** | 096.397*** | 1391.766*** |
| Observations | 263 | 263 | 263 | 263 | 263 | 263 | 263 | 263 | 263 |

Note: *** represent significance at 1%.
Source: Authors

the RWH is not backed up by the financial markets analysed during this period of the global pandemic. The values of the variance ratios are lower than the unit, implying that returns are autocorrelated over time. There is a reversion to the mean and no differences between mature and emerging financial markets. Under these conditions, markets tend to overreact to information – irrespective of whether the news is good or bad – eventually correcting in the following days.

The second DFA test shows signs of (in)efficiency in its weak form. Indicating persistence in profitability, or the existence of long memories, thus validates the results of the Wright's Rank and Signs variance test, which also shows the rejection of the RWH. These findings reveal that prices do not fully reflect the available information and that price changes are not i.i.d., in all markets.

**Table 3.** Levin, Lin and Chu (2002) stationary test, applied to the nine financial markets for the period from 09/02/2019 to 09/02/2020

| Method | Statistic | Prob.*** |
|---|---|---|
| Levin, Lin & Chut* | -46.9363 | 0.0000 |
| Intermediate results on UNTITLED | | |

| Series | 2nd Stage Coefficient | Variance of Reg | HAC of Dep. | Lag | Max Lag | Bandwidth | Obs |
|---|---|---|---|---|---|---|---|
| Botswana | -0.96947 | 0.0002 | 1.E-05 | 0 | 15 | 40.0 | 262 |
| Egypt | -0.71834 | 0.0002 | 3.E-06 | 0 | 15 | 122.0 | 262 |
| Japan | -0.87115 | 0.0002 | 3.E-06 | 0 | 15 | 96.0 | 262 |
| Kenya | -0.81164 | 0.0002 | 4.E-06 | 1 | 15 | 131.0 | 261 |
| Morocco | -0.80662 | 0.0001 | 6.E-06 | 0 | 15 | 45.0 | 262 |
| Nigeria | -0.70982 | 0.0002 | 1.E-05 | 0 | 15 | 34.0 | 262 |
| South Africa | -1.05047 | 0.0004 | 1.E-05 | 0 | 15 | 66.0 | 262 |
| UK | -1.00337 | 0.0003 | 1.E-05 | 0 | 15 | 58.0 | 262 |
| US | -0.85068 | 0.0003 | 3.E-05 | 6 | 15 | 30.0 | 256 |
| | Coefficient | t-Stat | SE Reg | mu* | sig* | | Obs |
| Pooled | -0.86535 | -39.695 | 1.007 | -0.508 | 0.740 | | 2351 |

Note: *** represent significance at 1%.
Source: Authors

**Table 4.** Hadri (2000) stationary test, applied to the nine financial markets for the period from 09/02/2019 to 09/02/2020

| Method | Statistic | Prob.*** |
|---|---|---|
| Hadri Z-stat | 2.45648 | 0.0070 |
| Heteroscedastic Consistent Z-stat | 2.79639 | 0.0026 |
| Intermediate results on UNTITLED | | |

| Series | LM | Variance HAC | Bandwidth | Obs |
|---|---|---|---|---|
| Botswana | 0.1333 | 0.000211 | 1.0 | 263 |
| Egypt | 0.0927 | 0.000239 | 1.0 | 263 |
| Japan | 0.1225 | 0.000215 | 3.0 | 263 |
| Kenya | 0.0855 | 0.000363 | 3.0 | 263 |
| Morocco | 0.1393 | 0.000167 | 1.0 | 263 |
| Nigeria | 0.1265 | 0.000351 | 4.0 | 263 |
| South Africa | 0.0754 | 0.000416 | 6.0 | 263 |
| UK | 0.0843 | 0.000339 | 5.0 | 263 |
| US | 0.0911 | 0.000322 | 5.0 | 263 |

Note: *** represent significance at 1%.
Source: Authors

**Figure 2.** Stability tests performed on the residuals of the nine financial markets in the period from 02/09/2019 to 02/09/2020

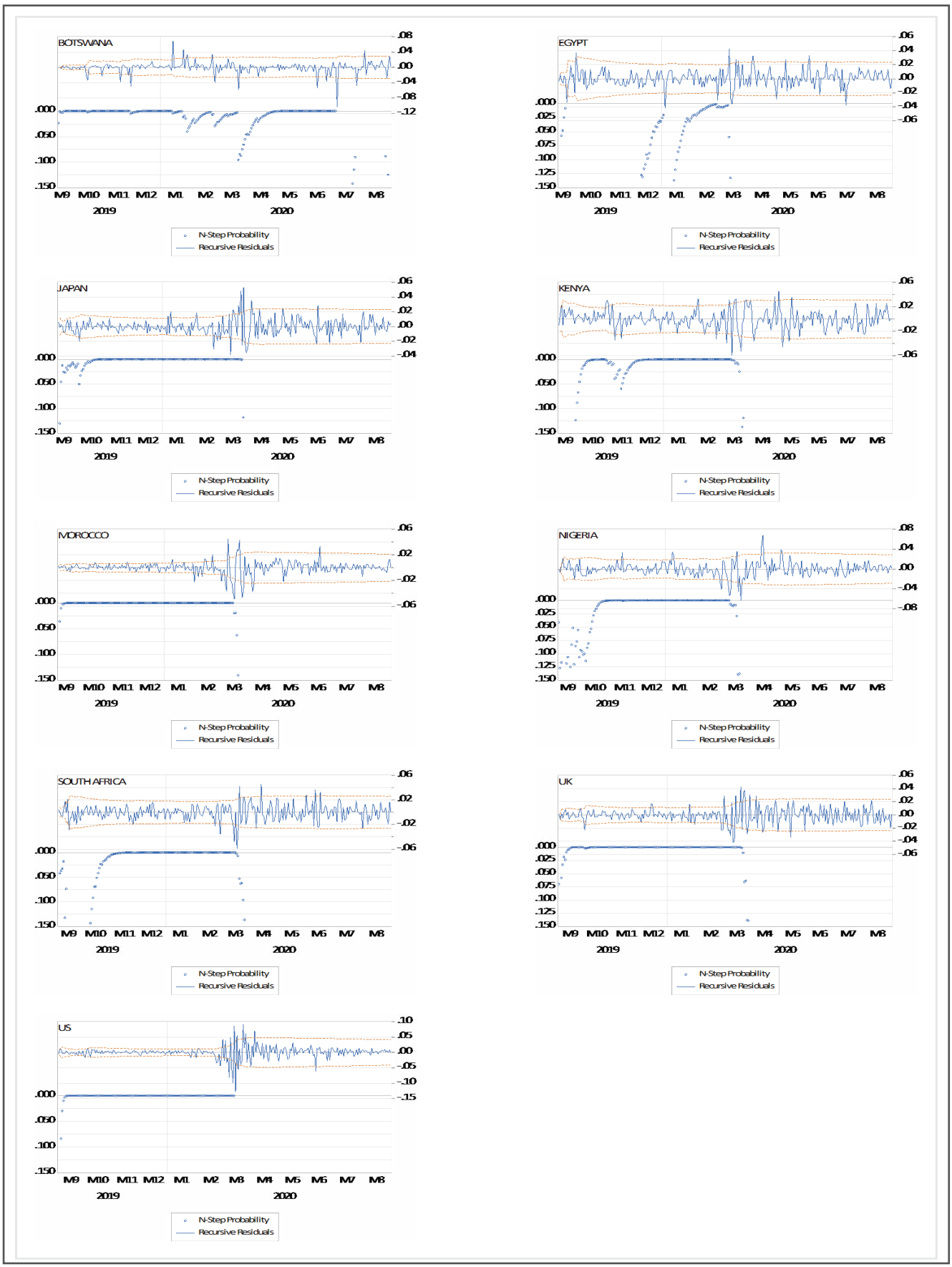


**Figure 3.** Stationary tests with breaks in the structure of Clemente et al. (1998), in return, related to the nine financial markets in the period from 09/02/2019 to 09/02/2020

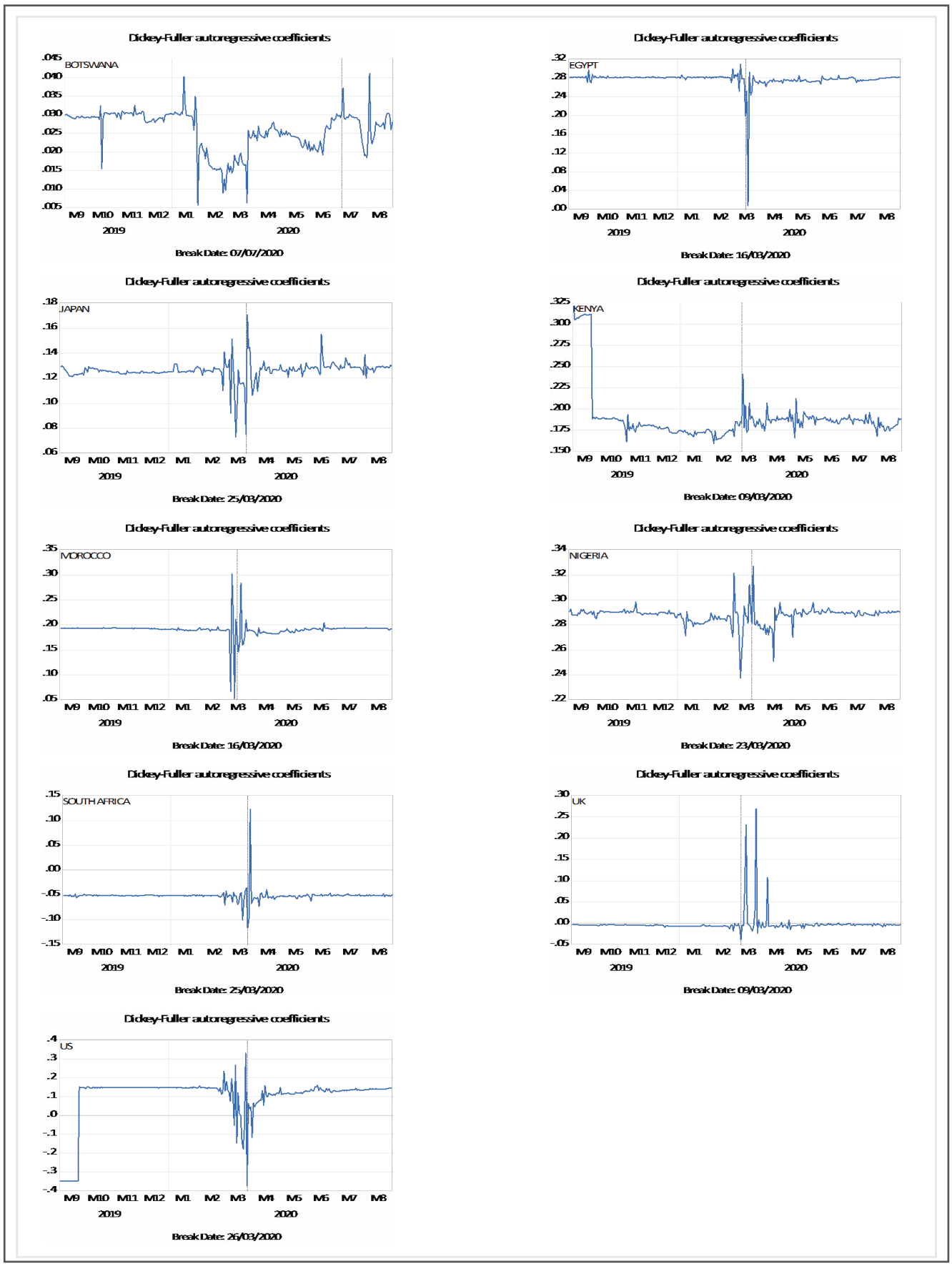


**Table 5.** Tests of the Wright's Rank and Signs Ratios (2000), in return, referring to the nine financial markets in the period from 09/02/2019 to 09/02/2020

| Null Hypothesis: Botswana is a random walk (rank score variance ratio) | | | | |
|---|---|---|---|---|
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 7.769864 | 262 | 0.0000 |
| | Wald (Chi-Square) | 60.68542 | 4 | 0.0000 |
| | | | | |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.519976 | 0.061780 | -7.769864 | 0.0000 |
| 4 | 0.285238 | 0.115580 | -6.184123 | 0.0000 |
| 8 | 0.133499 | 0.182748 | -4.741497 | 0.0000 |
| 16 | 0.094114 | 0.271938 | -3.331219 | 0.0010 |
| | | | | |
| Null Hypothesis: Botswana is a martingale (sign variance ratio test) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 6.054460 | 262 | 0.0000 |
| | Wald (Chi-Square) | 38.17342 | 4 | 0.0000 |
| | | | | |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.625954 | 0.061780 | -6.054460 | 0.0000 |
| 4 | 0.488550 | 0.115580 | -4.425070 | 0.0000 |
| 8 | 0.351145 | 0.182748 | -3.550539 | 0.0000 |
| 16 | 0.315840 | 0.271938 | -2.515867 | 0.0040 |
| | | | | |
| Null Hypothesis: Egypt is a random walk (rank score variance ratio) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 6.083644 | 262 | 0.0000 |
| | Wald (Chi-Square) | 40.47185 | 4 | 0.0000 |
| | | | | |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.624151 | 0.061780 | -6.083644 | 0.0000 |
| 4 | 0.313415 | 0.115580 | -5.940335 | 0.0000 |
| 8 | 0.179850 | 0.182748 | -4.487867 | 0.0000 |
| 16 | 0.106560 | 0.271938 | -3.285454 | 0.0020 |

**Table 5.** Tests of the Wright's Rank and Signs Ratios (2000), in return, referring to the nine financial markets in the period from 09/02/2019 to 09/02/2020 (continued)

| Egypt is a martingale (sign variance ratio test) | | | | |
|---|---|---|---|---|
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 3.368337 | 262 | 0.0060 |
| | Wald (Chi-Square) | 11.75573 | 4 | 0.0230 |
| | | | | |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.839695 | 0.061780 | -2.594769 | 0.0060 |
| 4 | 0.610687 | 0.115580 | -3.368337 | 0.0010 |
| 8 | 0.515267 | 0.182748 | -2.652461 | 0.0070 |
| 16 | 0.448473 | 0.271938 | -2.028133 | 0.0290 |
| | | | | |
| Null Hypothesis: Japan is a random walk (rank score variance ratio) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 8.090627 | 262 | 0.0000 |
| | Wald (Chi-Square) | 66.69285 | 4 | 0.0000 |
| | | | | |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.500159 | 0.061780 | -8.090627 | 0.0000 |
| 4 | 0.307603 | 0.115580 | -5.990621 | 0.0000 |
| 8 | 0.162038 | 0.182748 | -4.585334 | 0.0000 |
| 16 | 0.105081 | 0.271938 | -3.290890 | 0.0010 |
| | | | | |
| Null Hypothesis: Japan is a martingale (sign variance ratio test) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 7.413625 | 262 | 0.0000 |
| | Wald (Chi-Square) | 55.36321 | 4 | 0.0000 |
| | | | | |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.541985 | 0.061780 | -7.413625 | 0.0000 |
| 4 | 0.354962 | 0.115580 | -5.580872 | 0.0000 |
| 8 | 0.255725 | 0.182748 | -4.072677 | 0.0000 |
| 16 | 0.211832 | 0.271938 | -2.898335 | 0.0050 |

**Table 5.** Tests of the Wright's Rank and Signs Ratios (2000), in return, referring to the nine financial markets in the period from 09/02/2019 to 09/02/2020 (continued)

| Null Hypothesis: Kenya is a random walk (rank score variance ratio) | | | | |
|---|---|---|---|---|
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 5.354766 | 262 | 0.0000 |
| | Wald (Chi-Square) | 29.69610 | 4 | 0.0000 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.757748 | 0.061780 | -3.921185 | 0.0000 |
| 4 | 0.381095 | 0.115580 | -5.354766 | 0.0000 |
| 8 | 0.209973 | 0.182748 | -4.323031 | 0.0000 |
| 16 | 0.119039 | 0.271938 | -3.239563 | 0.0010 |
| Null Hypothesis: Kenya is a martingale (sign variance ratio test) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 3.953933 | 262 | 0.0000 |
| | Wald (Chi-Square) | 15.92664 | 4 | 0.0020 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.755725 | 0.061780 | -3.953933 | 0.0000 |
| 4 | 0.618321 | 0.115580 | -3.302291 | 0.0000 |
| 8 | 0.507634 | 0.182748 | -2.694232 | 0.0040 |
| 16 | 0.468511 | 0.271938 | -1.954446 | 0.0350 |
| Null Hypothesis: Morocco is a random walk (rank score variance ratio) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 6.847880 | 262 | 0.0000 |
| | Wald (Chi-Square) | 47.24316 | 4 | 0.0000 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.576937 | 0.061780 | -6.847880 | 0.0000 |
| 4 | 0.378446 | 0.115580 | -5.377687 | 0.0000 |
| 8 | 0.232358 | 0.182748 | -4.200545 | 0.0000 |
| 16 | 0.153260 | 0.271938 | -3.113724 | 0.0010 |

**Table 5.** Tests of the Wright's Rank and Signs Ratios (2000), in return, referring to the nine financial markets in the period from 09/02/2019 to 09/02/2020 (continued)

| Null Hypothesis: Morocco is a martingale (sign variance ratio test) | | | | |
|---|---|---|---|---|
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 4.695296 | 262 | 0.0000 |
| | Wald (Chi-Square) | 22.93522 | 4 | 0.0000 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.709924 | 0.061780 | -4.695296 | 0.0000 |
| 4 | 0.603053 | 0.115580 | -3.434383 | 0.0010 |
| 8 | 0.530534 | 0.182748 | -2.568919 | 0.0130 |
| 16 | 0.400763 | 0.271938 | -2.203577 | 0.0150 |
| Null Hypothesis: Nigeria is a random walk (rank score variance ratio) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 6.476426 | 262 | 0.0000 |
| | Wald (Chi-Square) | 42.91433 | 4 | 0.0000 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.599885 | 0.061780 | -6.476426 | 0.0000 |
| 4 | 0.391809 | 0.115580 | -5.262071 | 0.0000 |
| 8 | 0.204557 | 0.182748 | -4.352669 | 0.0000 |
| 16 | 0.127734 | 0.271938 | -3.207590 | 0.0010 |
| Null Hypothesis: Nigeria is a martingale (sign variance ratio test) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 4.571735 | 262 | 0.0000 |
| | Wald (Chi-Square) | 22.14425 | 4 | 0.0010 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.717557 | 0.061780 | -4.571735 | 0.0000 |
| 4 | 0.515267 | 0.115580 | -4.193909 | 0.0000 |
| 8 | 0.381679 | 0.182748 | -3.383455 | 0.0010 |
| 16 | 0.230916 | 0.271938 | -2.828157 | 0.0030 |

**Table 5.** Tests of the Wright's Rank and Signs Ratios (2000), in return, referring to the nine financial markets in the period from 09/02/2019 to 09/02/2020 (continued)

| Null Hypothesis: South Africa is a random walk (rank score variance ratio) | | | |
|---|---|---|---|
| Joint Tests | | | |
| | Value | df | Probability |
| Max \|z\| (at period 2) | 7.221207 | 262 | 0.0000 |
| Wald (Chi-Square) | 52.90245 | 4 | 0.0000 |

| Individual Tests | | | | |
|---|---|---|---|---|
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.553872 | 0.061780 | -7.221207 | 0.0000 |
| 4 | 0.283339 | 0.115580 | -6.200557 | 0.0000 |
| 8 | 0.181556 | 0.182748 | -4.478529 | 0.0000 |
| 16 | 0.116130 | 0.271938 | -3.250261 | 0.0010 |

| Null Hypothesis: South Africa is a martingale (sign variance ratio test) | | | |
|---|---|---|---|
| Joint Tests | | | |
| | Value | df | Probability |
| Max \|z\| (at period 2) | 4.818856 | 262 | 0.0000 |
| Wald (Chi-Square) | 25.50291 | 4 | 0.0000 |

| Individual Tests | | | | |
|---|---|---|---|---|
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.702290 | 0.061780 | -4.818856 | 0.0000 |
| 4 | 0.473282 | 0.115580 | -4.557161 | 0.0000 |
| 8 | 0.410305 | 0.182748 | -3.226813 | 0.0000 |
| 16 | 0.326336 | 0.271938 | -2.477269 | 0.0080 |

| Null Hypothesis: The UK is a random walk (rank score variance ratio) | | | |
|---|---|---|---|
| Joint Tests | | | |
| | Value | df | Probability |
| Max \|z\| (at period 2) | 8.044168 | 262 | 0.0000 |
| Wald (Chi-Square) | 64.89393 | 4 | 0.0000 |

| Individual Tests | | | | |
|---|---|---|---|---|
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.503030 | 0.061780 | -8.044168 | 0.0000 |
| 4 | 0.282822 | 0.115580 | -6.205027 | 0.0000 |
| 8 | 0.177048 | 0.182748 | -4.503196 | 0.0000 |
| 16 | 0.107695 | 0.271938 | -3.281279 | 0.0000 |

**Table 5.** Tests of the Wright's Rank and Signs Ratios (2000), in return, referring to the nine financial markets in the period from 09/02/2019 to 09/02/2020 (continued)

| Null Hypothesis: The UK is a martingale (sign variance ratio test) | | | | |
|---|---|---|---|---|
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2)* | 3.970425 | 262 | 0.0003 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.466014 | 0.134491 | -3.970425 | 0.0001 |
| 4 | 0.239752 | 0.239710 | -3.171532 | 0.0015 |
| 8 | 0.148832 | 0.367746 | -2.314553 | 0.0206 |
| 16 | 0.071438 | 0.524701 | -1.769699 | 0.0768 |
| Null Hypothesis: The US is a random walk (rank score variance ratio) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 10.25450 | 262 | 0.0000 |
| | Wald (Chi-Square) | 113.7720 | 4 | 0.0000 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.366475 | 0.061780 | -10.25450 | 0.0000 |
| 4 | 0.244683 | 0.115580 | -6.535007 | 0.0000 |
| 8 | 0.151129 | 0.182748 | -4.645026 | 0.0000 |
| 16 | 0.078112 | 0.271938 | -3.390064 | 0.0010 |
| Null Hypothesis: The US is a martingale (sign variance ratio test) | | | | |
| Joint Tests | | | | |
| | | Value | df | Probability |
| | Max \|z\| (at period 2) | 7.413625 | 262 | 0.0000 |
| | Wald (Chi-Square) | 55.36321 | 4 | 0.0000 |
| Individual Tests | | | | |
| Period | Var. Ratio | Std. Error | z-Statistic | Probability |
| 2 | 0.541985 | 0.061780 | -7.413625 | 0.0000 |
| 4 | 0.354962 | 0.115580 | -5.580872 | 0.0000 |
| 8 | 0.255725 | 0.182748 | -4.072677 | 0.0000 |
| 16 | 0.211832 | 0.271938 | -2.898335 | 0.0050 |

SM

Source: Authors

In reply to the research question, evidence was found in the results of both tests which confirm that mature and emerging financial markets show signs of (in)efficiency in their weak form. These findings have implications for investors, as some returns can be expected, thus creating opportunities for arbitrage and abnormal returns.

The overall conclusion that is to be highlighted, as supported by the results obtained through the tests performed using econometric and mathematical models, is that the global pandemic has had a significant impact on the memory properties of the markets analysed. The results show that the markets have persistence and long memories in their returns, implying in return that investors will be able to obtain abnormal returns without incurring additional risk. This study suggests that, in order to mitigate risk and improve portfolio efficiency, investors should diversify their portfolios and invest in less risky markets.

As for future research suggestions, this study used general indexes of a daily frequency to analyse efficiency in its weak form. In the continuation of this study, it would also be interesting to use higher frequency data, intraday-based, quotes per minute, to perform a more refined analysis of the data and highlight more robust results.

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# Ali so afriški borzni trgi učinkoviti? Primerjalna analiza med šestimi afriškimi trgi, Združenim kraljestvom, Japonsko in ZDA v obdobju pandemije

## Izvleček

Namen te študije je preizkusiti in primerjati hipotezo učinkovitega trga v njeni šibki obliki na borznih trgih Bocvane, Egipta, Kenije, Maroka, Nigerije, Južne Afrike, Japonske, Združenega kraljestva in ZDA od 2. septembra 2019 do 2. septembra 2020. Študija temelji na naslednjem raziskovalnem vprašanju: Ali je globalna pandemija (covida-19) v svoji šibki obliki zmanjšala učinkovitost afriških finančnih trgov v primerjavi z razvitimi trgi Združenega kraljestva, Japonske in ZDA? Rezultati potrjujejo dokaze, da finančni trgi, analizirani v obdobju te globalne pandemije, ne podpirajo hipoteze naključnega sprehoda. Vrednosti variančnih razmerij so nižje od ena, kar pomeni, da se donosi sčasoma samokorelirajo. Ugotovljen je bil tudi povratek k povprečju, pri čemer razlike med razvitimi finančnimi trgi in tistimi, ki so v vzponu, niso bile prepoznane. To potrjujejo eksponenti detrendne analize fluktuacije (DFA), ki prikazujejo, da finančni trgi kažejo znake (ne)učinkovitosti v svoji šibki obliki, kar kaže na obstojnost donosa. S tem implicirajo obstoj dolgih spominov in potrjujejo rezultate Wrightovega (2000) testa variance, kar dokazuje zavrnitev hipoteze slučajnega hoda.

**Ključne besede:** afriški borzni trgi, hipoteza učinkovitega trga, povprečna reverzija, naključni sprehod

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# The Use of Statistical Methods in Croatian Enterprises During the Early Stages of COVID-19

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## Abstract

The appropriate application of statistical methods in enterprises should have an important role in business decision-making processes. However, Croatian enterprises still tend to have certain resistance to statistical methods. The new challenges introduced by the COVID-19 pandemic emphasised the importance of conducting statistical analyses as support for making business decisions. In order to investigate the situation and attitudes towards the use of statistical methods, primary research was conducted in the form of a web survey on a sample of 768 Croatian enterprises, of which 40% use statistical methods in their business. The research revealed the level of statistical methods use in Croatian enterprises, demonstrated which statistical methods Croatian enterprises prefer, and defined who is most responsible for their use. Furthermore, the reasons for the use of statistical methods and the major obstacles to the use of more intensive statistical methods were also investigated. The results are described and discussed on an overall level and by considering the size of the enterprises.

**Keywords:** Croatian enterprises, use of statistical methods, stratification, web survey

## Introduction

The COVID-19 pandemic, which started at the very beginning of 2020, drastically changed the way of life to which the world had been accustomed. The measures introduced in many countries to prevent the spread of COVID-19 had a huge impact on people and their well-being. As a result, people were not only at risk of catching COVID-19 but were/are at risk of various physical and psychological disorders as a consequence of the restrictive measures and constant awareness of the dangers of COVID-19 (Simon et al., 2021). Enterprises have also faced new challenges. The first set of challenges relates to employees, the second relates to doing business with other enterprises, while the third set of challenges are associated with relationships with clients and/or buyers. Of course, the difficulty level of the challenges that an enterprise has to cope with not only differs between enterprises themself but also between countries.

Similar to enterprises in other countries, Croatian enterprises have had to deal with the negative effects of the COVID-19 crisis. However, during the crisis, Croatia was struck by two earthquakes, which resulted in severe material damage and human casualties. Therefore, Croatian enterprises had to deal with two catastrophes at the

same time (OECD, 2021), thus these enterprises needed all the help they could get to overcome these crises.

Statistic methods could be the perfect tool to use to enable easier recovery from the COVID-19 crisis. If they are used in an appropriate way, such methods can offer very important assistance in making business decisions. Consequently, the aim of this paper is to investigate the role of statistical methods in Croatian enterprises. Previous research (Žmuk, 2015, 2018) has shown that roughly only one third of Croatian enterprises use statistical methods in their business as additional help in making appropriate and timely business decisions. To this end, the research demonstrates whether the COVID-19 crisis caused Croatian enterprises to change their opinion and attitude towards statistical methods and their usefulness in business processes. Therefore, the main research hypothesis is that more than one third of Croatian enterprises use statistical methods. This will be investigated at an overall level as well as at the level of enterprises. In addition, various aspects of the statistical methods use in Croatian enterprises will be investigated.

The paper is organised as follows. It begins with an introductory chapter and a brief literature review, followed by a chapter in which the data collection and methodology approaches are described. The third chapter data analyses the data collected and the results obtained from the web survey conducted. The fourth and final chapter contains a conclusion and offers recommendations for future research.

## Literature Review

The impact of the COVID-19 crisis on the largest multinational enterprises was investigated by Coeurderoy and Yang (2020). The authors concluded that in the short term, European enterprises could be the main victim due to the deglobalisation processes that started as a response to the COVID-19 crisis. As a follow up to that, De Vet et al. (2021) observed the impact of the COVID-19 crisis on industrial sectors in the countries of the European Union. In order to help industries in their recovery, De Vet et al. (2021) emphasised the importance of the role of governments in introducing appropriate recovery measures.

Siuta-Tokarska (2021) observed the problems and responses of micro-, small- and medium-sized enterprises in Poland during the COVID-19 crisis. The research showed that almost 90% of the observed enterprises reported disruption in their business due to social isolation and changes in customer behaviour. The following were highlighted as the main sources of difficulties: a drop in demand, disruptions in the supply chain, employee leave, quarantine or illnesses of staff, closing of state borders and delays in payments (Siuta-Tokarska, 2021). Problems in the supply chain were declared as the main challenges. The enterprises in Poland responded to those challenges by improving their businesses by introducing the possibility of remote working for their employees. However, the responses of enterprises in Poland to the COVID-19 crisis were negative and resulted in reductions in orders, production and employment (Siuta-Tokarska, 2021).

Cepel et al. (2020) investigated the impact of the COVID-19 crisis on the perception of business risks in the Czech Republic and Slovakia. A comparison of the survey results conducted prior to and during the COVID-19 crisis cited a large increase in the perception of financial risk as the most significant business risk in both countries. In contrast, personnel risk recorded a significant decrease in the share of the most significant business risks.

Roška, Buneta and Papić (2021) indicated that the vast majority of Croatian enterprises think that the COVID-19 crisis will have far more significant consequences than the financial crisis that started in 2008. In addition, 48.6% of enterprises estimated that it will take at least three years to fully recover from the negative impacts of COVID-19, whereas 21.2% of enterprises estimates that they will require five years to recover.

Of course, the COVID-19 pandemic not only affected the members states of the European Union, but also other countries worldwide. To this end, despite the fact that the COVID-19 crisis did not have an impact on some enterprises, the International Labour Organization (2021) found that at least 5% of Indian enterprises had to close their business permanently due to COVID-19.

Sonobe et al. (2021) investigated the impact of the COVID-19 crisis in micro-, small- and medium-sized enterprises in eight Asian countries: Bangladesh, India, Indonesia, Lao PDR, Malaysia, Mongolia, Pakistan and Vietnam. As is the case for enterprises in Poland, the observed Asian countries have also reduced the number of employees and generated lower sales revenues. A particularly interesting finding is that an increase in online sales tends to have negative impact on the employment level (Sonobe et al., 2021).

According to Dai et al. (2020), enterprises in China had to deal with lack of demand due to COVID-19. In addition, there were major problems in supply chains. It turned out that export-oriented enterprises were more hit by the COVID-19 crisis than those whose businesses are not based on export.

The Economic Commission for Latin America and the Caribbean (2020) emphasised the negative impact of the

COVID-19 crisis on the countries of Latin America and the Caribbean. According to the report, COVID-19 had the biggest impact on enterprises whose weaknesses and problems in business were already present over the long term. Over a third of employees were employed in enterprises which were heavily hit by the COVID-19 crisis. Additionally, due to reduced income, consumers lowered their consumption and changed their consumption habits. Although many enterprises will close their business permanently as a result of the COVID-19 crisis impact, the Economic Commission for Latin America and the Caribbean (2020) concluded that the impact of the COVID-19 crisis can differ greatly depending on the type and the sector of enterprise.

Oyewale, Adebayo and Kehinde (2020) compared the effects of the COVID-19 crisis on enterprises from the Nigerian agricultural and non-agricultural sectors. In addition, the authors investigated the impact of lockdowns and other measures on the enterprises from both sectors. They demonstrated that lockdown measures have a negative impact on sales, which was more pronounced among enterprises from the non-agricultural sector (Oyewale, Adebayo & Kehinde, 2020).

## Methodology

### Data and sample

Due to the General Data Protection Regulation (GDPR) (Intersoft consulting services, 2021) it can be difficult to obtain a sampling frame that can be used in web surveys. Administrative sources that contain a lot of important information about enterprises, which are confirmed as accurate, are tending to reduce the amount of information that they make public. Information relating to the e-mail address of enterprises, which is crucial in conducting web surveys, is often omitted. In order to overcome this problem, a compromise was made and an older version of the sampling frame from the end of 2016 was used in this business web survey. This means that new enterprises that were established in or after 2017 were not included in the survey. This could be considered as a limitation of the research. However, enterprises with four or more years of active business and experience took part in the web survey, meaning that these enterprises were able to provide better insights into, and share well justified thoughts about, the statistical methods used in their business processes due to the fact that they already have established procedures and processes.

Considering the main limitation of the sampling frame, which is not completely up to date as it is four years old, the Register of business entities in Croatia, led by the Croatian Chamber of Commerce (2021), was used to collect the necessary information about enterprises. For the purpose of this, research, only joint stock enterprises, limited liability enterprises and simple limited liability enterprises that are registered in Croatia were observed. According to the sampling frame, there were 721 joint stock enterprises, 35,643 limited liability enterprises and 1,495 simple limited liability enterprises. From a total of 37,859 enterprises in the sampling frame, there were 335 large enterprises, 1,134 medium-sized enterprises and 36,390 small and micro enterprises.

Due to the fact that the sampling frame used is not up to date, the authors of this research decided to contact all the enterprises listed. They believed that doing so would compensate for the inability to select new enterprises that were established four years ago or less. This is also a corrective measure for differences that could appear from the time when the sampling frame was created and when the web survey began. For example, in the meantime, enterprises could have changed their e-mail addresses and consequently would not be able to participate in the web survey. Additional reasons for contacting all the enterprises from the sampling frame can be found in previous research, which has shown quite low response rates in business web surveys in Croatia (Žmuk, 2015, 2018).

The authors began the web survey by sending an invitation to take part in the survey to the e-mail address of enterprises in the sampling frame on Friday 25 September 2020. From the 37,859 enterprises contacted, an error message was returned in 4,817 cases. Therefore, it was impossible to deliver an invitation email to take part in the web survey to 12.72% of enterprises from the sampling frame because, in most cases, the e-mail address was no longer active or the e-mail inbox size limit had been reached. It must be emphasised that it was impossible to deliver e-mails to 3,885 (10.26%) of enterprises from the sampling frame, even when the sampling frame was up to date at the end of 2016. Hence, the increase in the number of enterprises that did not receive the web survey invitation was lower than expected, which leads to the conclusion that the sampling frame used can still, even after four years, be considered usable.

The web survey closed on Thursday 31 December 2020. In the meantime, two reminders were sent. The first was sent on Tuesday 27 October 2020, while the second was sent on Wednesday 25 November, 2020.

A total of 2,125 enterprises took part in the web survey. Unfortunately, this figure does not reflect the number of fully completed questionnaires. Of this figure, 1,357 (64%) of the questionnaires were not fully completed, therefore such questionnaires will be omitted from further analysis. A total of 768 fully completed questionnaires were received, which

will be observed in the further analysis. A response rate 1 (American Association for Public Opinion Research, 2016) of 2.32% was achieved.

## Research instrument

The topic of the questionnaire was the use of statistical methods in Croatian enterprises. Therefore, the first question in the questionnaire was a filter question to distinguish between enterprises that apply statistical methods in their business and those that prefer not to use such methods. Depending on the answer to the filter question, the enterprises were sent different sets of questions. Consequently, the questionnaire for enterprises that use statistical methods was longer than that for enterprises that do not use them. According to the collected paradata, enterprises that use statistical methods took an average of 10.76 minutes to complete the questionnaire, whereas those that do not use statistical methods took an average of 5.69 minutes to complete their version of the questionnaire.

**Table 1.** Detrended Fluctuation Analysis (DFA)

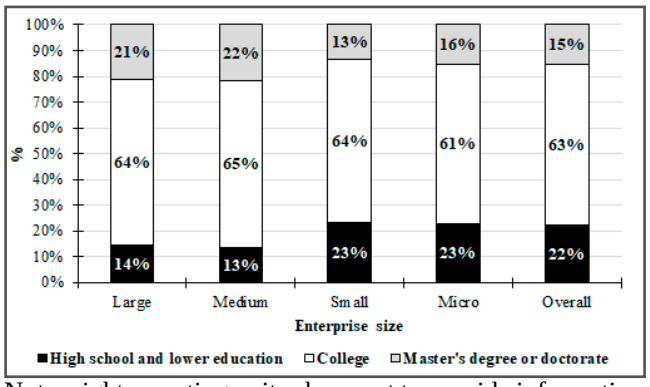
| Size of enterprise | Reporting units | | |
|---|---|---|---|
| | Gender | Number | Average work experience in years |
| Large | Male | 8 | 24.50 |
| | Female | 6 | 20.33 |
| | Total | 14 | 22.71 |
| Medium | Male | 32 | 26.09 |
| | Female | 29 | 19.97 |
| | Total | 61 | 23.18 |
| Small | Male | 134 | 24.84 |
| | Female | 119 | 23.12 |
| | Total | 253 | 24.03 |
| Micro | Male | 255 | 27.38 |
| | Female | 185 | 23.15 |
| | Total | 440 | 25.60 |
| Overall | Male | 429 | 26.43 |
| | Female | 339 | 22.81 |
| | Total | 768 | 24.84 |

Source: Author

Table 1 shows both the number of participating enterprises in the web survey according to their size as well as the number of reporting units according to their gender and average work experience. As expected, the highest share in the sample are small and micro enterprises (combined 90%), whereas large enterprises only account for a 2% share in the sample. Regardless of the size of the enterprise, more males than female reporting units filled out the survey questionnaire. A total of 56% male and 44% female participants took part in the web survey as reporting units for the enterprises where they work. Considering the average work experience of the reporting units, it can be concluded that the reporting units have a significant amount of experience, with average work experience of almost 25 years. This result is quite remarkable and should ensure that the answers provided are of high quality based on previous extensive business experience.

Figure 1 reveals the structure of reporting units according to the highest achieved education level. According to Figure 1, of the survey participants, 78% are highly educated, whereas 22% of the share of reporting units have a college or lower level of education. The share of reporting units with college education is fairly level across all the enterprises sizes, whereas the share of reporting units with a master's or doctoral degree is higher in medium- and large-sized enterprises than in micro- and small-sized enterprises.

**Figure 1.** The number of reporting units according to gender and average work experience




Note: eight reporting units chose not to provide information about the highest achieved education level.
Source: Author

## Statistical Analysis

In the analysis, the main focus is on the answers provided by enterprises that use statistical methods. The answers were observed and compared at an overall level and between different sizes of enterprises. The analysis alone is based on descriptive statistics methods which point out the situation relating to the use of statistical methods in the enterprises in the sample. The results of the descriptive methods, meanwhile, will make a good base for future in-depth analyses and conclusions about the entire population of Croatian enterprises.

## Results

A total of 768 enterprises took part in the survey by completing the questionnaire and their answers were then analysed. The first survey question asked enterprises to state whether they use any statistical methods in their business. The responses, shown according to the size of the enterprise, are shown in Table 2 and Figure 2.

As can be seen in Table 2 and Figure 2, only 40% of the enterprises in the sample use statistical methods in their business. The lowest figure is among micro enterprises, where among the 440 enterprises in the sample, only 135 (31%) use statistical methods. Approximately the same number of small enterprises in the sample use and do not use statistical methods. In contrast, statistical methods are convincingly used the most in the large enterprises. Only one (7%) large enterprise did not seem to use statistical methods.

The results shown in Table 2 and Figure 2 suggest that the bigger the enterprise, the more likely it is that statistical methods are used. One of the reasons for such a situation lies in the fact that the increase in enterprises also means an increase in the complexity of their business processes. Motivation for whether or not to use statistical methods will be analysed in detail later in this paper.

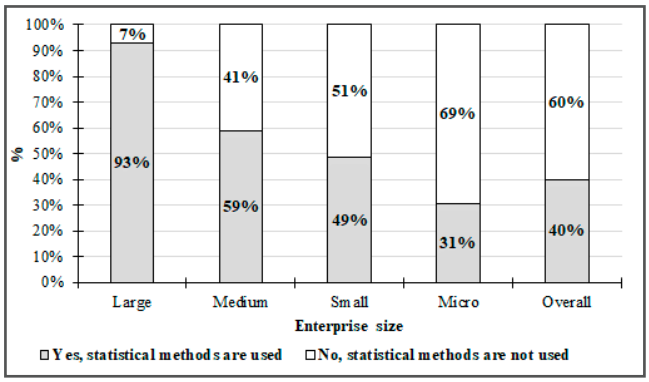
The focus in the following tables and figures is on those enterprises that use statistical methods. Thus, Table 3 illustrates the frequency of the use of certain statistical methods

**Table 2.** The number of enterprises in the sample according to whether statistical methods are used

| Size of enterprise | Use of statistical methods | | Total |
|---|---|---|---|
| | Yes | No | |
| Large | 13 | 1 | 14 |
| Medium | 36 | 25 | 61 |
| Small | 123 | 130 | 253 |
| Micro | 135 | 305 | 440 |
| Overall | 307 | 461 | 768 |

Source: Author

**Figure 2.** The share of enterprises in the sample according to whether statistical methods are used




Source: Author

**Table 3.** Frequency of the use of chosen statistical methods in Croatian enterprises in the sample, n=307

| | Frequency of use | | | | | |
|---|---|---|---|---|---|---|
| Statistical method | Every day | Weekly | Monthly | Yearly | Less than once a year | Never |
| Descriptive statistics | 7% | 8% | 21% | 17% | 3% | 44% |
| Outlier detection | 4% | 7% | 20% | 12% | 4% | 53% |
| Inferential statistics | 2% | 2% | 10% | 13% | 6% | 67% |
| Survey methods | 8% | 8% | 24% | 18% | 7% | 35% |
| Multivariate methods | 3% | 3% | 10% | 14% | 7% | 63% |
| Design of experiment | 1% | 2% | 8% | 10% | 7% | 71% |
| Statistical process control | 7% | 7% | 25% | 13% | 5% | 42% |
| Acceptance sampling | 4% | 4% | 16% | 13% | 7% | 57% |
| Naive forecast models | 4% | 4% | 11% | 13% | 7% | 61% |
| Smoothing methods | 0% | 3% | 8% | 11% | 5% | 72% |
| Regression models | 1% | 3% | 9% | 12% | 6% | 69% |

Source: Author

**Table 4.** Frequency of the use of chosen statistical methods in Croatian enterprises in the sample according to their size, n=307

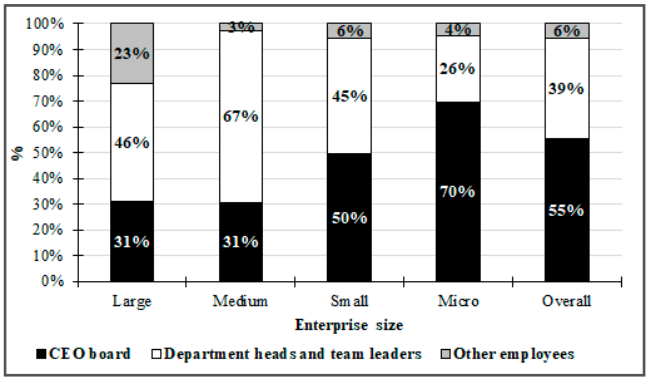
| Statistical method | Frequency of use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Enterprise size | Every day | Weekly | Monthly | Yearly | Less than once a year | Never |
| Descriptive statistics | Large | 23% | 8% | 46% | 8% | 0% | 15% |
| | Medium | 11% | 6% | 19% | 14% | 6% | 44% |
| | Small | 7% | 7% | 26% | 14% | 2% | 44% |
| | Micro | 5% | 9% | 16% | 21% | 3% | 46% |
| Outlier detection | Large | 15% | 46% | 31% | 8% | 0% | 0% |
| | Medium | 6% | 3% | 28% | 19% | 0% | 44% |
| | Small | 3% | 6% | 20% | 11% | 5% | 54% |
| | Micro | 4% | 5% | 17% | 10% | 4% | 59% |
| Inferential statistics | Large | 15% | 0% | 38% | 15% | 8% | 23% |
| | Medium | 0% | 3% | 3% | 25% | 8% | 61% |
| | Small | 1% | 3% | 9% | 14% | 7% | 66% |
| | Micro | 2% | 0% | 11% | 10% | 3% | 74% |
| Survey methods | Large | 23% | 23% | 31% | 8% | 0% | 15% |
| | Medium | 8% | 11% | 28% | 17% | 3% | 33% |
| | Small | 7% | 7% | 29% | 20% | 8% | 28% |
| | Micro | 7% | 6% | 18% | 17% | 9% | 43% |
| Multivariate methods | Large | 15% | 0% | 23% | 15% | 0% | 46% |
| | Medium | 3% | 0% | 19% | 14% | 3% | 61% |
| | Small | 2% | 3% | 11% | 15% | 8% | 61% |
| | Micro | 3% | 3% | 7% | 13% | 7% | 67% |
| Design of experiment | Large | 8% | 8% | 31% | 8% | 0% | 46% |
| | Medium | 0% | 3% | 8% | 14% | 8% | 67% |
| | Small | 0% | 2% | 8% | 9% | 10% | 72% |
| | Micro | 2% | 1% | 6% | 10% | 6% | 75% |
| Statistical process control | Large | 31% | 15% | 38% | 8% | 0% | 8% |
| | Medium | 11% | 14% | 31% | 17% | 3% | 25% |
| | Small | 6% | 7% | 28% | 9% | 6% | 45% |
| | Micro | 6% | 6% | 20% | 17% | 4% | 47% |
| Acceptance sampling | Large | 0% | 8% | 38% | 23% | 0% | 31% |
| | Medium | 3% | 0% | 33% | 17% | 6% | 42% |
| | Small | 3% | 3% | 14% | 12% | 10% | 58% |
| | Micro | 5% | 5% | 10% | 11% | 4% | 64% |
| Naive forecast models | Large | 0% | 0% | 23% | 31% | 0% | 46% |
| | Medium | 6% | 3% | 8% | 11% | 11% | 61% |
| | Small | 2% | 6% | 11% | 14% | 10% | 57% |
| | Micro | 5% | 3% | 11% | 12% | 3% | 66% |

**Table 4.** Frequency of the use of chosen statistical methods in Croatian enterprises in the sample according to their size, n=307 (continued)

| Statistical method | Frequency of use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Enterprise size | Every day | Weekly | Monthly | Yearly | Less than once a year | Never |
| Smoothing methods | Large | 8% | 0% | 31% | 15% | 0% | 46% |
| | Medium | 0% | 6% | 6% | 17% | 6% | 67% |
| | Small | 0% | 2% | 10% | 8% | 7% | 73% |
| | Micro | 0% | 4% | 6% | 13% | 3% | 75% |
| Regression models | Large | 8% | 0% | 15% | 15% | 0% | 62% |
| | Medium | 0% | 0% | 22% | 11% | 6% | 61% |
| | Small | 2% | 3% | 9% | 12% | 7% | 67% |
| | Micro | 0% | 3% | 5% | 13% | 5% | 74% |

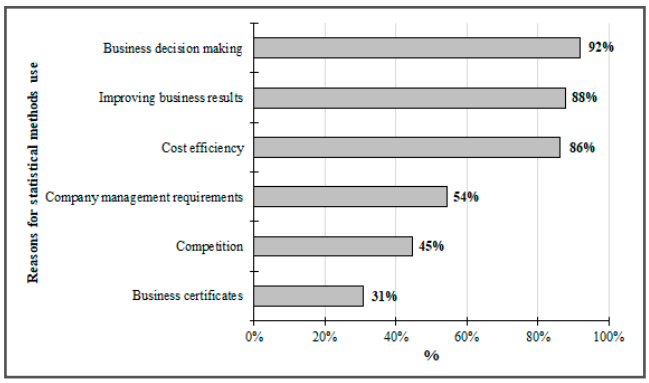
Note: the highest percentages of each observed statistical method and each frequency of shown in bold.
Source: Author

**Figure 3.** The share of employees that use statistical methods the most in Croatian enterprises in the sample according to their hierarchical level, n=307




Source: Author

**Figure 4.** The reasons for the use of statistical methods in the Croatian enterprises in the sample, n=307




Source: Author

in enterprises. Logically, the results in Table 3 only include enterprises in the sample – 307 of them – that confirmed that they use statistical methods. A total of 11 different statistical methods groups are recognised and listed. It is surprising that descriptive statistics methods, which tend to be observed as the simplest and most basic groups of statistical methods, are not the most frequently used in Croatian enterprises. As can be seen in Table 3, the most frequently used group of statistical methods are survey methods which are applied on a daily basis in 8% of enterprises. Survey methods are never used in 35% of enterprises that use statistical methods in their businesses. The next statistical method in the ranking, based on the share of enterprises that have never used a certain statistical method group, is statistical process control, which is not used in 42% of Croatian enterprises that use statistical methods. Survey methods and statistical process control are closely followed by descriptive statistics methods, which are not used in 44% of Croatian enterprises that use statistical methods.

Table 3 reveals that the rates of Croatian enterprises that have never applied certain statistical methods are quite high ranging from 35% to 72%. This leads to the conclusion that Croatian enterprises use a narrow number of statistical method groups according to their specific business needs.

Table 4 illustrates the frequency of the use of certain statistical methods in enterprises according to their size. The results in Table 4 are consistent with those relating to the use of statistical methods, wherein a higher share of larger enterprises tend to use statistical methods than smaller enterprises. Almost all the observed statistical methods are the most frequently used by large enterprises, whereas micro enterprises account for the highest share of enterprises that

have never used certain statistical method groups in all the observed statistical method groups.

In general, among all enterprise sizes, the least often used groups of statistical methods turned out to be those that seem to be more complex in their application than other statistical method groups or those that relate more to certain kinds of enterprises. Such groups of statistical methods are multivariate methods, design of experiments, smoothing methods or regression modelling.

Figure 3 illustrates the structure of employees in the enterprises that most use statistical methods. It was expected that in the smaller enterprises, CEO boards would be the main users of statistical methods, whereas employees at a lower hierarchical level in the larger enterprises would be most engaged in the use of statistical methods. The survey results, however, revealed quite the opposite situation. According to the results, only in 4% of micro and 6% of small enterprises are CEOs most responsible for the use of statistical methods. In contrast, CEOs play a main role in the use of statistical methods in 23% of large enterprises.

**Table 5.** The reasons for the use of statistical methods in Croatian enterprises in the sample, according to enterprise size, n=307

| Reasons for the use of statistical methods | Enterprise size | | | |
|---|---|---|---|---|
| | Large | Medium | Small | Micro |
| Business decision making | 92% | 92% | 92% | 92% |
| Improving business results | 92% | 92% | 87% | 87% |
| Cost efficiency | 92% | 86% | 87% | 85% |
| Company management requirements | 85% | 53% | 57% | 50% |
| Competition | 46% | 61% | 43% | 41% |
| Business certificates | 54% | 36% | 34% | 24% |

Source: Author

If Croatian enterprises were asked what the main reasons are for using statistical methods, according to the survey results illustrated in Figure 4, they would convincingly agree that the most important reasons are improving the business decision-making process, improving business results and increasing cost the efficiency of the enterprise. The choice of these reasons confirmed that the vast majority of Croatian enterprises recognised the true reasons why statistical methods should be used in the first place. Convincingly, the least important reason for the use of statistical methods in enterprises is the situation where the use of statistical methods was a prerequisite in the process of getting certain business certificates.

Table 5 lists the reasons for the use of statistical method in Croatian enterprises according to their size. The more detailed results confirmed that the three reasons (business decision-making process, improving business results and increased cost efficiency of the enterprise) are the main reasons for the use of statistical methods for enterprises of all sizes. However, in terms of large enterprises, another important reason for the use of statistical methods is a requirement by management. This result is in line with previous results which have shown that in large enterprises, there is unexpectedly high share of CEOs who are responsible for the use of statistical methods. Competition, as a reason for the use of statistical methods, is the most emphasised in medium-sized enterprises. In more than a half of the large enterprises, the need to obtain a certain business certificate was also cited among the reasons for use of statistical methods.

Table 6 further defines the causes of obstacles that prevent the greater use of statistical methods to the level of enterprises according to their size. In general, among enterprises of all sizes, the main obstacles are confirmed to be insufficient knowledge of statistical methods and employees already being overloaded with other jobs and work-related tasks. However, in large enterprises, it is clear that the problem is a lack of staff who could apply statistical methods. Therefore, in large enterprises the problem is not only related to not knowing enough about statistical methods but also due to a lack of employees who could apply statistical methods. It seems that the bigger the size of the enterprise, the less financial resources present a limit to the greater use of statistical methods. However, almost half of micro enterprises stated that a lack of financial resources is a major obstacle preventing the greater use of statistical methods.

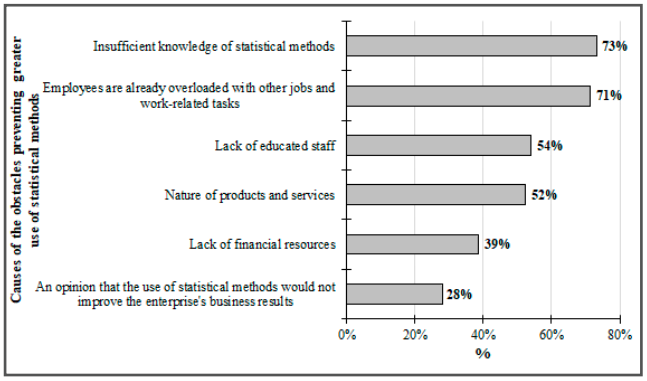
Whereas the enterprises that use statistical methods were asked about the causes of obstacles that prevent the greater use of statistical methods, the enterprises that do not use statistical methods at all were asked why they do not use them. Figure 6 shows the share of enterprises that cited the reasons for not applying statistical methods. The first notable statistic is the fact that the differences in levels between the various reasons for not applying statistical methods are not as great as the differences in the causes of obstacles that prevent the greater use of statistical methods. This means that those enterprises that do not use statistical methods tend to have a larger number of reasons for not applying such methods. The main reason for not applying statistical methods is employees already being overloaded with other jobs and work-related tasks. The result showing that half of the enterprises that do not use statistical methods

**Table 6.** The causes of obstacles that prevent the greater use of statistical methods in Croatian enterprises in the sample, according to enterprise size, n=307

| Causes of obstacles that prevent greater use of statistical methods | Enterprise size | | | |
|---|---|---|---|---|
| | Large | Medium | Small | Micro |
| Insufficient knowledge of statistical methods | 100% | 75% | 68% | 75% |
| Employees are already overloaded with other jobs and work-related tasks | 69% | 67% | 70% | 74% |
| Lack of educated staff | 77% | 53% | 54% | 52% |
| Nature of products and services | 46% | 47% | 47% | 59% |
| Lack of financial resources | 23% | 31% | 33% | 47% |
| An opinion that the use of statistical methods would not improve the enterprise's business results | 31% | 28% | 31% | 25% |

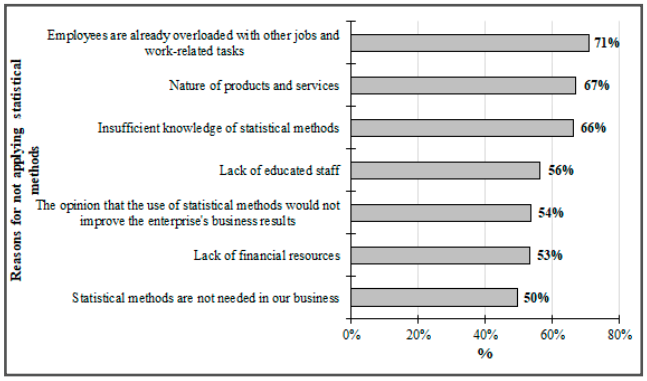
Source: Author

**Figure 5.** The causes of obstacles preventing the greater use of statistical methods in Croatian enterprises in the sample, n=307




Source: Author

**Figure 6.** The reasons for not applying statistical methods in Croatian enterprises in the sample, n=461




Source: Author

**Table 7.** The reasons for not applying statistical methods in Croatian enterprises in the sample, according to enterprise size, n=461

| Reasons for not applying statistical methods | Enterprise size | | | |
|---|---|---|---|---|
| | Large | Medium | Small | Micro |
| Employees already overloaded with other jobs and work-related tasks | 100% | 52% | 75% | 71% |
| Nature of products and services | 0% | 64% | 64% | 69% |
| Insufficient knowledge of statistical methods | 100% | 56% | 72% | 65% |
| Lack of educated staff | 100% | 36% | 62% | 56% |
| The opinion that the use of statistical methods would not improve the enterprise's business results | 100% | 72% | 49% | 54% |
| Lack of financial resources | 0% | 32% | 57% | 53% |
| Statistical methods are not needed in our business | 0% | 56% | 43% | 52% |

Source: Author

think that they do not need such methods in their business is very concerning.

In Table 7 the reasons are shown, according to size, for why those enterprises that do not use statistical methods at all do not apply them. It must be emphasised that there was only one large enterprise in the sample that did not use statistical methods, therefore the results shown for large enterprises are not representative. An interesting finding is that the opinion that the use of statistical methods would not affect the enterprise's business results is the main reason for not applying statistical methods in medium-sized enterprises, whereas a lack of financial resources is the least significant reason among these enterprises. In contrast, in micro and small enterprises the main reason for not applying statistical methods is that employees are already overloaded with other jobs and work-related tasks. The lowest share of micro and small enterprises stated that the reason statistical methods are not needed in their business is one of the reasons why they do not use such methods.

## Discussion

The results of the survey conducted produced some very interesting findings. First, it showed that 40% of the enterprises that took part use statistical methods in their business processes and in decision-making. Thus, the research hypotheses that more than one third of Croatian enterprises use statistical methods can be accepted (p-value<0.0001). In addition, this conclusion is valid for large (p-value<0.0001), medium (p-value<0.0001) and small (p-value<0.0001) enterprises. However, the results illustrated that less than one third of Croatian micro enterprises use statistical methods (p-value=0.8810). Based on these results, it can be concluded that enterprises have additionally recognised the importance of the use of statistical methods as a supportive tool for improving their business processes and for combatting the negative effects of the COVID-19 pandemic.

Interesting results were obtained when the frequency of the use of certain statistical methods is observed. Survey methods and statistical process control methods are the most frequently used. It was expected that descriptive statistic methods, being the most straightforward and easiest way to apply statistical methods, would be the most frequently used, however, the results showed that, surprisingly, they ranked in third place according to the frequency of their use. These results could suggest that enterprises are going beyond basics and starting to use more advanced statistical methods that are most appropriate for their business. This is especially the case in larger enterprises whereas small enterprises are still struggling with the basic statistical methods.

The results illustrate that in more than 50% of the surveyed enterprises that use statistical methods, it is the members of the CEO board who most use these methods in Croatian enterprises. It was expected that this share would decrease in line with the increase in the size of the enterprise, however, the results show that the share of members of the CEO board who use statistical methods the most in Croatian enterprises is 31% for both large and medium enterprises.

The main reasons for the use of statistical methods in Croatian enterprises are business decision-making, improving business results and cost efficiency. The importance of those reasons is at the same level for enterprises of all sizes. Similarly, the most important cause of obstacles that prevent the greater use of statistical methods is insufficient knowledge of statistical methods. This would explain why enterprises stick to the use of simpler statistical methods.

## Conclusions

The COVID-19 crisis is the most recent crisis to have threatened both the general population and enterprises to the same extent. Undoubtedly the crisis has presented all enterprises with a serious challenge. Statistical methods could be a very helpful tool to make dealing with the COVID-19 crisis itself easier, as well as other related challenges.

However, the web survey conducted on a representative sample of Croatian enterprises showed that only 40% of enterprises use statistical methods in their business (Žmuk, 2018). Nevertheless, it is an increase, albeit slight, in comparison to the previous research conducted prior to the start of the COVID-19 crisis. In addition, the fact that enterprises have started to recognise the role and importance of the use of statistical methods in decision-making is encouraging. Therefore, a further increase of the importance of the use of statistical methods in Croatian enterprises is expected.

However, more work needs to be done on educating managers about the importance and possibilities of the use of statistical methods in business decision-making. There are some positive changes in the attitude towards the acceptance of statistical methods in Croatian enterprises, which, for example, is reflected in the increased share of enterprises that use statistical methods, however, these changes are too slow and too few.

The limitation of the research can be found in the fact that there are too few enterprises with certain characteristics (such as large enterprises). Furthermore, in such web surveys, a question that is always raised is whether the questionnaire was completed by the most competent person

in an enterprise or whether it was delegated to a member of the technical staff who may not have a sufficient level of information and may not see the full picture about the observed topic in the questionnaire. Therefore, in addition to web surveys, the authors of this paper recommend that other additional and supportive survey modes, such as CATI, are applied. However, that would require more financial resources to be made available for such research.

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# Uporaba statističnih metod v hrvaških podjetjih v zgodnji dobi covida-19


## Izvleček

Ustrezna uporaba statističnih metod v podjetjih bi morala igrati pomembno vlogo v procesih poslovnega odločanja. Vendar pa se hrvaška podjetja statističnim metodam do določene mere še vedno upirajo. Novi izzivi, ki jih je prinesla pandemija covida-19, so poudarili pomen izvajanja statističnih analiz kot podpore pri sprejemanju poslovnih odločitev. Za preučitev stanja in odnosa podjetij do uporabe statističnih metod je bila izvedena primarna raziskava v obliki spletne raziskave na vzorcu 768 hrvaških podjetij. Ugotovili smo, da jih 40 % pri svojem poslovanju uporablja statistične metode. Raziskava je pokazala raven uporabe statističnih metod v hrvaških podjetjih in hkrati predstavila statistične metode, ki so v hrvaških podjetjih zaželene in kdo je najbolj odgovoren za njihovo uporabo. Analizirali smo vzroke za uporabo statističnih metod in glavne ovire, ki preprečujejo njihovo intenzivnejšo uporabo. Rezultati so predstavljeni in obravnavani na splošni ravni in ob upoštevanju velikosti podjetij.


**Ključne besede:** hrvaška podjetja, uporaba statističnih metod, stratifikacija, spletna raziskava

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# The Simplification of Public Administration: A Managerial Perspective

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## Abstract

The paper addresses the issue of complexity in the administrative processes of public institutions: in particular, accounting routines and processes are examined. Back-office activities, although having a mere supporting role in the delivery of public services, absorb a relevant part of the resources of public institutions. The aim of the paper is to analyse the factors that contribute to the enhancement of complexity of these activities. The paper is based on an in-depth analysis of two Italian public organisations: a university and an ASP (agency for services to persons). Italy is an interesting context since simplification policies have been adopted in the country at central government level and in specific sectors of public administration, however, at the institutional level, simplification initiatives depend on the initiative of the single organisation. The cases described in this paper show that complexity stems from the need for inspectory controls (which is typical of the law) as well as from the volume of information requested (which is typical of management studies) for different stakeholders and at different, yet correlated, levels. The paper suggests that public management scholars have the opportunity and the burden of a contribution in this field.

**Keywords:** simplification, support activities, processes, public administration, stakeholders

## Introduction and Purpose of the Paper

As a consequence of neoliberal policies, in many countries the direct intervention of public administration in the delivery of services to taxpayers has narrowed: public institutions have taken off the role of service providers, reserving themselves regulatory and coordination functions. A vision of an 'enabling state' has emerged, where, at the central and local levels, the state plans and (at least partly) finances

public services, but where provision is located within the independent sector – comprising both the voluntary and community sectors and the for-profit sector (Osborne & Mc Laughlin, 2005). With the rise in this model, the problem of efficiency in public organisations has shifted from the phase of service provision to administrative processes – the definition of rules and contracts – and so-called support activities (i.e. planning, budgeting, accounting and reporting, human resource management, procurement, and facility management). Even in organisations that deliver services to citizens, such as hospitals and universities, support activities take up a considerable volume of resources. Thus, the legitimacy of public institutions in the eyes of stakeholders increasingly depends on efficiency and effectiveness in these activities.

The issue of effectiveness has stimulated an important area of academic research in public management literature in the last 30 years, giving rise to the research stream on performance measurement and management (Bouckaert & Peters, 2002; Bouckaert & Halligan, 2007; Van Dooren et al., 2015). The debate on efficiency of public institutions has focused on cost measurement and on the need for a shift from cash to accrual accounting. This paper, however, considers that the choice of the accounting system does not exhaust the issue of efficiency: measuring the costs of public services does not necessarily make public institutions more efficient. As observed by Moore (1995, p.212): 'to keep an organisation performing well, managers must use and adjust their administrative systems: their structures, policy-making processes, personnel systems and control mechanisms. Operational managers may have to make changes in these systems to increase productivity, improve the quality of reporting to overseers… Thus, managers must often make administrative innovations…'. Simplification of administrative processes is considered one of the most urgent directions of innovation: the focus in this paper is on the factors that hinder simplification to the detriment of efficiency and effectiveness. Consistent with vast amounts of literature in management and managerial accounting, it is considered that complexity implies the use of resources. When increased complexity does not translate into additional value creation for the customer or user, it is a source of inefficiencies (Kaplan & Anderson, 2007), and ineffectiveness.

This paper explores the issue of simplification of support activities, in particular, accounting routines at the institutional level. To date, public financial management literature has focused on the search for the best accounting system, mainly comparing the benefits and the downsides of two competing accounting systems – cash accounting and accrual accounting (Carlin TM, 2005; Paulsson G., 2006; Christensen M., 2007; Lapsley et al. 2009; Agasisti et al. 2015; Cohen et al. 2021). Moreover, the debate on efficiency in public management studies has often been described as an attempt to determine the most appropriate accounting system for cost control. The organisational dimension of the accounting system has thus not always received adequate consideration. In particular, there are still not have enough studies on the causes and effects of complexity in support activities. This aim of this paper is to fill this gap; therefore its focus is not on which accounting system better fits the purposes of public administration, but rather on what activities are necessary to produce and use accounting information, and what their impact is on the organisation as a whole. To this end, two cases of complexity-driven inefficiencies are considered in two Italian public organisations.

To date, researchers of administrative law have been the leading players in the debate surrounding the simplification of administration. From a different perspective, econometrics considers the overlapping issue of efficiency and effectiveness of institutions (Agasisti, 2017; De Witte & Lopez Torres, 2017). Both aspects have mainly been studied at the field level. This paper instead adopts a managerial perspective, examining the issue of simplification at the institutional level. The cases discussed in the paper allow light to be shed on the determinants and consequences of complexity. Moreover, it demonstrates that the simplification of administrative processes also affects the value received by different stakeholders. In other words, simplification of support activities may also enhance effectiveness. The argument herein is exploratory and tentative: the paper represents a call for future research, more than a research report of an orthodox kind.

This paper is organised as follows: Section 2 considers the existing literature on simplification of administrative processes and the method of the research. The methodology is described in Section 3, while the subsequent sections examine the case studies (4), discuss the findings, and draw conclusions (5).

## Literature Review

The simplification of administrative processes is a multifaceted topic: it overlaps the broader theme of the 'modernisation' of public administration, while also intersecting the issues of efficiency and effectiveness. The simplification of administration is by no means a new theme: for over a decade, it has been a keyword in terms of both to the evolution of the legislative system and the relation between citizens and public administration. According to Ferrari (2018), simplification is 'a kind of slogan that summarises a series of trends all related to the democratic principle exalted by a new context of participation and translated into cooperative-contractual formulas and local autonomy, which varies in degree from country to country depending

on the level of vertical separation of power, horizontal subsidiarity (…), competition and the market, efficiency which is not just enterprise-oriented but is tempered by the need for forms of solidarity…'.

Given the multifaceted nature of the topic, it has been considered from various perspectives in several research fields. First, simplification has been analysed in extensive political science and law literature (i.e. administrative law and fiscal law). This depends on the fact that what is presented as 'bureaucratic degeneration' is, in reality, a multiplication of rules. From this perspective, simplification is meant as a 'reduction of the rules', aimed at producing both greater freedom of economic initiative and savings in public spending (Merloni & Pioggia, 2018). According to Travi (2018), the search for new tools that can reduce the impact of plentiful and not proportionate regulations on citizens has been dragging on for almost 20 years now. During this period, simplification measures both of general (i.e. referring to an indistinct number of administrative proceedings) and of punctual character (referring to individual proceedings) have been tried out.

The OECD Regulatory Policy Division has been conducting work on the simplification of administration since 2002. According to the OECD analysis, excessive regulatory burdens limit initiative, create possibilities for corruption and encourage the growth of an informal economy. However, regulatory burdens have tended to grow in number and complexity: the quantitative targets of administrative burden defined by all 27 EU member states and many other OECD countries have not been met. The increased complexity is attributed to the governments' need to obtain more information to implement their policies and target their regulations and instruments on more specific issues and populations. Citizens and companies, meanwhile, demand regulations that are efficient and cost-effective in achieving their goals, easily accessible and easy to understand. Those that must comply with regulations must be able to obtain information and guidance on what they need to do to meet the compliance requirements imposed on them. (OECD, 2011). The most common examples of simplification policies are: procedural simplification (Travi et al. 2018), in order to reduce fulfilments for citizens and businesses (e.g. the creation of one-stop shops (OSS)); managing the stock of legislation in order to make it more easily accessible; simplification of fiscal rules and tax obligations; a reduction in paper documents. Rixer (2015) made a catalogue of the simplification measures taken by the government in Hungary: according to his analysis, measures relating to the integration and accessibility of administrative bodies have been successful, while linguistic simplification has not. Khan (1989) considers administrative simplification in Pakistan. He finds that six types of strategy of administrative simplification can be adopted: escapism (i.e. minimising governments' involvement in social and economic matters) and reduction of the bureaucratic behaviour of public servants through simplification of rules, accountability, organisational design, technology, and a change in the attitudes of members of administrative organisations. Regonini (2016) considers the factors that hinder the simplification of administration in Italy: she finds that the legal language, the priority given by officers to self-defence over the objectives of the organisation and the existence of conflicting interests between public institutions and the beneficiaries of simplification are the main obstacles to effective simplification.

Despite the popularity of administrative simplification and administrative burden reduction programmes among civil servants and politicians, the perception by those who should mainly benefit from such programmes, businesses and/or citizens is below expectations.

This literature stream mainly considers the simplification of administration in regard to the relation of public administration with other subjects, i.e. citizens and businesses (Gobba, 2020). However, the daily experience of public servants shows that simplification also presents a significant issue within public institutions as well as in relations among public organisations. Among the reforms aimed at reducing complexity within the public sector are a reduction in the number of public bodies (e.g. a reduction in the number of municipalities in Greece, Denmark, Ireland, Albania) or of governmental levels (e.g. the case of 'provinces' in Italy). From this perspective, simplification stems from reforms of structural aspects of the public realm, thus implying different distribution of power and functions.

An interesting example of simplification policy at field level is the 'Reduction of bureaucracy for public sector staff' initiative by the National Audit Office (NAO) in the UK (2009). The aim of the report was to provide an overview of the government's approach to reducing bureaucracy generated by regulation through a range of measures 'such as reporting against targets, complying with service standards, responding to data requests and receiving inspection visits' (NAO, 2009). The document highlights that excessive requests for data from central government and management at a local level give rise to inefficiency in front-line activities. Support activities such as accounting and HR management were not analysed.

At an organisational level, simplification is still relatively unexplored. Literature on public management does not consider simplification in itself, rather the focus is on methods to enhance and measure efficiency and effectiveness such as business process reengineering (BPR), performance measurement, performance management and the accounting system. BPR is viewed as a comprehensive

and effective way for organisations to enhance efficiency (Rinaldi et al., 2014). Studies on BPR often adopt a normative approach and a technical point of view, with particular emphasis on the intensive use of ICT. However, re-engineering is much more than this: it implies the reinventing of government by reforming bureaucracy through restructuring and revitalisation of government processes. Solutions that characterise the New Public Management rhetoric are also mentioned as constitutive elements of BPR initiatives in the public sector: the enhancement of government entrepreneurship, the introduction of competitive spirit and the improvement of performance measurement (Halachmi, 1995). Thus, re-engineering is a call for a change of perspective as opposed to process modification or improvement: this intrinsically groundbreaking nature of BPR may present an obstacle to its implementation in the public sector, considering the incremental nature of government policy-making. Another obstacle to the introduction of BPR in the public sector may derive from resistance to change among public servants: radical changes stimulated by BPR imply that employees learn new skills and are moved to new positions that require more flexibility and cross-functional competencies (Halachmi, 1995). This study is not specifically focused on taking stock of the findings of BPR studies in public administration, however, they at least have the merit of having focused attention on the pitfalls of acting according to well-rooted habits.

This aim of this paper is to contribute to the debate on simplification in public administration by considering this issue from a different perspective. Such literature focuses on frontline activities, considering that the main aim of simplification is to improve service provision and accessibility. In this paper, however, the authors have considered the routines that feed the accounting system, the latter being a support activity according to the value chain model (M.Porter, 1985). Moreover, to date, simplification has mainly been considered at field and public sector levels, whereas this analysis covers the institutional level.

To date, the topic of the simplification of accounting procedures has not been considered at all in literature on the topic of public management. Instead, researchers' attention has been catalysed by the shift from cash-based to accrual-based accounting propitiated by New Public Management (NPM)-inspired policies. Using a mostly technical approach, researchers have concentrated on the adequacy of accrual accounting for public institutions and in the move toward International Public Sector Accounting Standards (IPSAS) (Guthrie, 1998; Carlin,2005; Paulsson, 2006; Christensen M., 2007; Christiaens & Rommel, 2008; Lapsley et al. 2009; Jagalla et al. 2011; Agasisti et al. 2015; Cohen et al., 2021). In summary, there are three main advantages of moving from cash accounting to accrual accounting: increased transparency of information, better potential for resource allocation, and more efficiency, thanks to the possibility of being able to measure the cost of services (Carlin, 2005). However, the shift to accrual accounting per se does not improve efficiency, rather the complexity of accrual-based systems may give rise to complexity and inefficiencies.

In contrast, in terms of routines and processes, accounting research has thus far focused on managerial accounting practices. An important body of literature considers the process of emergence and change of management accounting routines: in particular, the institutional theory (van der Steen, 2011) and the contingency theory have been adopted to explain how management accounting practices change. There is a lack of knowledge on how public organisations develop the routines and processes of the financial accounting system and how the resulting efficiency contributes to the creation of public value. This can be ascribed to the less discretional nature of financial accounting, which is strongly influenced by rules and principles.

This paper considers the routines and processes adopted by two public institutions in their budgeting, accounting and reporting system. According to the value chain model (M. Porter, 1985), accounting is a support activity. Routines are interpreted as a set of recurrent, situated practices. Burns and Scapens (2000) define routines as 'the way things are actually done' and as 'procedures habitually in use'. Thus, while a procedure may reflect the way a one-off activity is performed, routines are characterised by repetition. For the purposes of this paper, however, the concept of 'procedure' is used as a synonym for routine. The idea of procedure also somewhat overlaps with the concept of process; however, two aspects allow these concepts to be distinguished. According to ISO 9001 (2015), a process is 'a set of related or interacting activities, which transform inputs into outputs', while a procedure is 'a specific way to carry out an activity or a process'. Thus, two main differences between procedures and processes can be identified. First, procedures are based on rules that are either developed internally (i.e. by the organisation itself) or are imposed by third parties: these rules define how the process must be carried out. However, one process may be accomplished according to different procedures. Second, a procedure can be narrower than a process: in fact, a procedure can refer to a single activity, while a process is a set of related activities.

The functioning of the accounting system, regardless of whether it is cash- or accrual-based, implies the carrying out of activities ('how things are actually done'). Activities give rise to costs. There is a lack of knowledge on what the sources of inefficiencies are in the support activities performed in public institutions as well as on the possible strategies to improve efficiency in this area. It can be assumed that there

is a direct relation between the complexity of procedures and their cost: this assumption underlies a significant part of the research in the area of management accounting (Cooper and Kaplan, 1988). Thus, the simplification of processes and routines would reasonably enhance efficiency.

Notwithstanding the relevance attributed to simplification, the processes and the routines adopted in support activities have often become more and more complex: budgeting, accounting, reporting and auditing activities reflect this trend. A recent study by the Policy Department for Structural and Cohesion Policies of the European Parliament on the simplification of procedures within the European Structural and Investment Funds confirms that 'the problem is essentially one of the costs incurred in the process of financial control and audit versus the benefits this produces' and that 'at the present moment, significant simplification has yet to be realised' (Ferry & Polverari, 2018). The authors of this paper argue that researchers in public management may play an important role in the definition of simplification strategies for processes and routines at the institutional and infra-institutional level.

## Methodology

The paper is based on an in-depth analysis of two Italian public organisations: a university and an ASP (agency for services to persons).

Italy provides a favourable context for the analysis of the complexity of internal processes of public institutions: the country introduced several reforms inspired by New Public Management and laws aimed at simplifying public administration. The results, however, are controversial.

NPM-inspired reforms led to a marked increase in the adoption of contracting-out, the introduction of performance management systems (with legislative decrees No. 269/1999 and No. 150/2009), and the adoption of accrual accounting in several sectors of public administration. Performance-linked rewards have also appeared in the management of human resources (legislative decrees No. 150/2009 and No. 74/2017). These reforms were also applied to Higher Education, a sector relevant to this research, due to one of the case studies that the authors have chosen to describe. In particular, there have been two relevant reforms in Higher Education, both inspired by NPM policies. The first consisted of the introduction of new governance models for universities, the adoption of accrual accounting, and new rules for hiring professors (law No. 240/2010). The second reform related to the adoption of a performance-based funding system that has remarkably increased the sector's competitive dynamics.

Simplification policies mainly relate to the organisation and functioning of the State: a reduction in the number of government cabinets, competencies being transferred from central to local governments, and rationalisation of administration levels with the elimination of intermediate forms of local governments (known as 'provinces'). One of the consequences of the deep political crisis of the early 1990s was a marked swing towards decentralisation ('decentramento'), both of a political and an administrative kind (Pollitt & Bouckaert, 2011). Invoking the principle of 'subsidiarity', many functions were transferred to the regional and local levels. This was reinforced by a new constitutional law in 2001. Moreover, simplification implied the creation of executive agencies that were supposed to operate through performance contracts and the widespread introduction of 'one-stop shops' for businesses (Ongaro, 2004).

Italy, however, has a long tradition of a formalistic and bureaucratic approach to public administration: the above-mentioned reforms were introduced in an unfavourable context. The working environment of today's government officials, even in the face of NPM, remains bureaucratic rather than 'post-bureaucratic' (Parker and Bradley 2004). In this sense, Italy represents an interesting case. The central government level and specific sectors of public administration have shown interest in simplification policies, however, the implementation of such policies within single public institutions has not been solicited. The simplification process should not stop at the rationalisation of the political and administrative system of the country. Simplification should also involve the operating processes within organisations, however, in reality, to date there have been few investigations into this aspect. The aim of this paper is to study the complexity of the processes at the institutional level, therefore, the authors chose to consider routines related to support activities because they represent the prevailing activities performed by public institutions.

The aim of this analysis is to investigate the causes of complexity in support activities and their consequences on efficiency and effectiveness. To this end, the authors decided to focus on accounting procedures, since the planning, accounting and reporting system of public institutions was (and still is) among those most involved in regulatory interventions aimed at increasing efficiency and orientation to results. The aim of the reforms in this was to improve cost control, the transparency of financial reports, and the accountability of public managers through a comparison between the resources used and results. The reforms have mostly focused on technical aspects: contents and layout of the budget, base of the accounting system, layout of the financial reports, methodology of defining and measuring objectives. The design of the procedures that feed the accounting system is left to the initiative of the individual entity.

The accounting system represents a typical example of how the application of rules, inspired by the rhetoric of efficiency and effectiveness, is imposed in contexts characterised by attention to compliance with the rules. For the purposes of this paper, the authors decided to consider two institutions in two different sectors that are characterised by different accounting systems: the university adopts an accrual-based system, while the ASP (that provides welfare services) still uses commitment accounting. This aim of this choice is to avoid the risk of recognising elements of complexity that are particular to one specific sector or that depend on the adoption of a specific accounting base.

The university involved was immediately available to provide evidence for the analysis, having started its own path of simplification, therefore, the topic had already been raised within the institution. In November 2019 the university launched an initiative to simplify its internal procedures: a working group was set up with the participation of 11 members of the administrative staff and the authors. The working group met eight times between November 2019 and April 2020 and formulated a proposal for the simplification of two procedures. The meetings lasted an average of two hours and minutes were drawn up for each meeting. The process was interrupted due to the COVID-19 pandemic and because the introduction of new accounting routines would have only been possible with a broader modification of the organisation's administrative accounting regulation. This analysis is based on the participation at the meetings and the minutes produced by the administrative staff after each meeting.

In the ASP, the authors conducted three interviews with the employees of the accounting department of the institution between July and September 2020, with the aim of gathering evidence of complexity and inefficiencies in the accounting routines. Each interview lasted about one hour. The interviews revealed that accounting routines quite often worsened relations with suppliers, sometimes also resulting in lawsuits. A final interview with the general director was conducted and registered in March 2021.

## Case Studies

Even though technology today enables the collection and management of an increasing volume of data and information, the complexity of support activities in public administration has increased in recent decades. Complexity depends on the number of subjects involved in the processes and procedures, as well as on the volume of relations among them (Collison & Jay, 2012). Thus, a procedure that requires two signatures of different subjects working in different departments in order to authorise a transaction is more complex than a procedure where one subject can authorise the same transaction through a specific business application. The effects of complexity on the costs of support processes are plausibly negative: each adjunctive activity requires resources, i.e. expenses. Moreover, when activities do not add value for the addressees, complexity gives rise to inefficiency, i.e. the consumption of resources with no added value. This section describes some examples of processes and procedures that the authors had the opportunity to observe in the accounting departments of two public institutions.

As previously mentioned, the authors of this paper analysed some cases of complexity, as well as inefficiencies, in accounting routines, and they looked into the organizational dimension of the accounting system. The first case considers an ASP, which is a unique form of a public institution in Italy: the aim of the ASP considered herein is to provide hospitality and care to visually impaired persons. The care services range from professional training to recreational activities, physiotherapy, visual re-education, improvement of personal autonomy and schooling support. Each of the visually impaired people involved receives customised services for their specific needs. The institution is relatively small: it has 120 clients and 60 employees. This ASP still uses commitment accounting, although two years ago a decision was made to shift to accrual accounting. The total income in the budget for the year 2020 amounted to EUR 5.3 million.

Due to unpaid invoices, the institution has several ongoing legal disputes with suppliers. The decision not to pay the invoices was based on formal mistakes in documentation. The institution receives electronic invoices. In Italy, since 2007 (law No. 244) all suppliers of public administration must use electronic invoicing, in compliance with the EU 'i2010' strategic framework, which has been designed to facilitate digital convergence toward the Single European Information Space. The invoices are prepared as XML files according to a specific layout known as a 'PA invoice'. Electronic invoices usually have four times the number of pages of a paper document and include several codes that identify, among others, the type of document, the public investment project (CUP), and the specific tender (CIG). Reading an electronic invoice is more complex than a paper document and the ASP had to download specific software in order to make the invoices 'intelligible'. Suppliers transmit electronic invoices to the 'Interchange System' (IS) through accredited channels (i.e. file transfer protocol, web-services) or by certified electronic mail. The IS gets the e-invoices, check the files and feeds them into the institution's bookkeeping system; in the meanwhile, the IS delivers the document to the Department of Treasury. After the feed has been accomplished, the invoices must go through the institution's business process to be paid, however, the institution

can reject the invoices received. According to the general manager, there are four main reasons why an institution may not pay invoices:

1. The absence of a CIG code, i.e. an alpha-numerical code that identifies the tender. The code is created by the public institution at the time of the request of supply. It has a two-fold purpose: to control public administration's financial flows and to support the Agency for the Control of Public Contracts in its anti-corruption activity. Suppliers that are not used to working for public institutions are often not aware of the importance of a CIG code and do not include it on the invoice. According to decree No. 66/2014, however, this code is compulsory and public organisations cannot pay invoices if this element is missing.
2. Wrong code of document identification: another code is requested to indicate whether the document is an invoice, a credit note, a debit note or any other sort of document.
3. Incorrect rounding up or down of the invoice total, hence the sum is larger than that agreed in the contract.
4. The supplier is not up to date in terms of payments to the national or sectorial agencies that manage retirement contributions, hence the public entities cannot pay the supplier. As a consequence, this rule further enhances the supplier's financial distress and its inability to pay the contributions.

The administrative procedure adopted by the ASP provides that both the accountant and the head of the administrative department check that 30 conditions have been met in the invoice prior to proceeding with payment. This 'double-check' routine has been adopted due to the fact that quite a high number of invoices lacked some elements or contained other kinds of mistakes. The great number of data that has to be included in the invoice has increased the complexity of this document, and suppliers do not always have the competencies to manage it. One should also consider that the ASP may benefit from delayed payments to the suppliers, since the time involved in collecting cash from some of the people being cared for, as well as from other public institutions (i.e. the region) is quite long, therefore, the ASP may not pay invoices even if any of the mistakes they contain are merely formal. There are two main consequences of non-payment: first, an increase in legal expenditure due to lawsuits with the suppliers. The second consequence relates to the providers of the service, e.g. due to non-payment, the supplier of the canteen service may lower the quality of meals, thus diminishing the value for the recipients. The authors of this paper were able to glean information about this effect as a result of the interview carried out with the administrative staff and the general director.

The second case relates to the accounting procedures of an Italian university. This organisation differs from the previous one under different profiles: the main difference is the dimension of the institution. The university has more than 17,000 students, about 1,300 employees and its total income amounts to EUR 160 million. Compared to the ASP, this is a much more articulated organisation. Within the university, several organisational units use the accounting system: the central administration, which has several offices that deal with accounting, the management control system, asset management, taxation, and legal affairs, and the departments, i.e. the structures that provide teaching services and develop research projects. Italian universities adopted accrual accounting. In 2010, law No. 240 made it compulsory for the previously dominant commitment accounting to be substituted by accrual-based accounting. Implementing the reform took five years and required a great volume of financial and human resources. The main stimulus for introducing accrual accounting was cost control and the measurement of universities' economic sustainability. Academics, however, consider the profit-inspired logic of accrual accounting as separate from the context of universities, instead they want to know the residual value of financial resources available for research projects. For most projects the economic performance is simply not relevant, since research activities are not expected to generate profits.

The introduction of accrual accounting should have allowed universities to focus more on the consumption of resources, i.e. cost control. However, very few universities have actually adopted managerial accounting and the cost of teaching or research programmes barely correlates to the outcomes of institutional activities (Busetti & Dente, 2014). In the university considered in this paper, the administrative staff of the research and teaching departments (i.e. the faculties) are required to prepare an accrual-based budget for each research project submitted by academics to the financing institutions. This budget must be prepared following a format defined by the administration of the university, which is different to the format required by the subjects that finance the research project. This routine was introduced as an ex-ante internal control to avoid an eventuality that had occurred, i.e. the incurrence of losses from research projects. Thus, the administrative staff of the departments must prepare two different budgets for each research project proposal: one requested by the external funder and another according to rules defined by an organisation's central administration. The second budget replicates the information requested by the funders using a different layout and cost classification; moreover, some additional data are requested. Of course, the budget prepared for the university's central administration never complies with the budgeting rules set by the funders, thus, although on average only 10% of the submitted project proposals obtain a research grant, the staff

of the departments must prepare two different budgets for each application. This routine has meant a considerable burden on the workload of the administrative staff of the departments. The budgets of research projects prepared for internal use undergo a double check from two organisational units of the university's central administration. On one hand, the research office verifies the suitability of all budgets, i.e. that at least 20% or the total income from the project is allocated to cover general expenses of the university, while on the other, the financial accounting office checks compliance with the accounting internal regulation. Projects that do not meet all the conditions simply cannot be submitted.

The departments are also calling for a simplification of the rules in the phase of realisation of research projects. In particular, the central administration offices do not allow departments to spend 100% of the funds of a research grant. This rule also aims to prevent the risk of losses being incurred. In particular, a loss may arise when the funder considers that some of the expenses already reported in the research project are not eligible. In this situation, actual income from the research project is lower than expected, thus, if 100% of the resources have been used, the project generates a loss. Consequently, the accounting procedure states that departments cannot use funds until the end of the project for a value corresponding to the portion of the research grant that is expected to cover the general expenses. This share is far from negligible: it often reaches 20% of the whole grant. The administrative staff of the departments claim that this rule hinders the development of research activities: ineligible expenses are seldom reported and are usually, for very small amounts. Thus, the impossibility of using a portion of the research grant destined for general expenses for alternative purposes (e.g. co-financing of new research projects) presents a serious hindrance. Departments have proposed an alternative rule: charging a fixed percentage risk provision of the research grant, which, in their view, would allow the avoidance of any possible incurrence of losses while maintaining almost the whole research grant.

A third important measure of simplification relates to the financial reporting phase of research projects. The research office of the university's central administration requests that academic staff prepare a timesheet for each research project, even when not requested by external funders. The timesheet includes a daily record of the number of hours spent on a research project and the kind of activities performed. Compilation of the timesheet is a condition that each member of a research team must accomplish and that accountants must verify in order to conclude the financial reporting phase of a project. The completion of a timesheet is also necessary to remunerate the researchers and the administrative staff who took part in the research project. The research team usually agrees upon the remuneration – at least approximately – of each member of the group in the budgeting phase, depending on the value of the project and on each member's role in the project. The number of hours each employee is expected to spend on a project is another factor considered, although not the most important. Both the administrative staff of the departments and the academic staff consider completion of timesheets – when not requested by an external funder - as a useless and time-consuming burden. Moreover, the timesheet for internal use is not subject to any form of control. Therefore, it may be prepared inaccurately (when not arbitrarily) by the researchers and does not necessarily report what they actually did, rather, it complies with the initial decisions about the remuneration within the research team. Since researchers consider this as a bureaucratic burden, they are reluctant to comply with the task, therefore, collecting all the timesheets from researchers is often takes quite a lengthy process, which results in a delay in the payment of remuneration to the personnel involved in the project. The departments' administrative staff proposed that this phase is simplified by substituting the timesheet with a self-declaration signed by researchers stating the total number of hours spent on the project.

## Discussion and Conclusions

The debate on the simplification of public administration dates back to the 1950s when Kidneigh (1954) linked it to efficiency and effectiveness. At that time, the solution proposed was 'the use of scientific method and logical thought-ways in the process of translating objectives (policy) into services' and 'standardising operations through agreed upon uniformities in policy and procedure that can be articulated and communicated through a manual.' From a bureaucratic perspective, 'the standardisation of operations provided opportunities for simplifying the administrative process through job and duty analysis that can serve to reduce the number of steps to be taken in carrying out the work. This inevitably implies the division of labour in such a way as to provide for specialisation of workers with a reduction in the scope of responsibility for given workers assigned to given phases of the process.'

However, the fragmentation of tasks and responsibility did not produce the expected effects in terms of efficiency, effectiveness and accountability, rather, it demotivated civil servants, stimulated compliance with rules and procedures and scarce attention to results, and enhanced the complexity of processes. The need to overcome the complexity generated by the bureaucratic approach suggested the introduction of policies labelled with the general term 'New Public Management': hands-on professional management, explicit standards and measures of performance, emphasis on

output control, disaggregation of units in the public sector, orientation toward market mechanism, private sector management practices and parsimony in resource use (Hood, 1991). Simplification has become a central issue in research programmes on the relationship between public institutions and other subjects (namely: citizens and businesses) as well as on the simplification of the administrative and the fiscal legal systems. The main focus has been on system and field levels. At the institutional level, simplification has been studied with reference to front-office activities (NAO,2009; Rinaldi, 2015).

This paper considers the simplification of public administration from a different perspective: it deals with back-office procedures at the institutional level. In particular, the authors analysed support activities that represent the organisational dimension of the accounting system. The analysis was developed as a result of the daily experience of public servants in some organisational units dealing with the financial management of two Italian public institutions. Adopting this perspective, the author suggest that simplification must also take place within public organisations and in the relations with other categories of stakeholders.

The case of the ASP clearly shows that the complexity of the documents that feed the accounting system negatively affects relationships with suppliers. The ASP considered here is a small organisation: only three employees work in the accounting department. During the interviews it became apparent that elements of complexity occur in procedures that involve different stakeholders. Three factors give rise to complexity issues.

The first cause of complexity stems from the interaction between procedures at different levels. Electronic invoicing presented a radical change in the accounting procedures: it was introduced by law No. 244/2007 to enhance controls on public accounts, fight tax evasion, improve transparency and to ease the filing of the accounting documents. All these aspects were of concern for the Italian Ministry of Finance. Since 6 June 2014, it has been mandatory to electronically invoice Italian public administrations and to include a CIG code in the document as well as a code for the identification of the document. E-invoicing clearly simplifies the process of consolidation of public accounts at the level of the public sector as a whole; after seven years, however, this innovation is still having negative effects on the procedures at the institutional level due to the complexity of preparing e-invoices. The Italian Tax Agency has published a 150-page-long guide containing 'suggestions for completing an e-invoice'. Simplification of the procedure of consolidating accounts at the public sector level led to an increase in the complexity of procedures at the institutional level. This complexity particularly related to the relationships with the suppliers and resulted in public entities purchasing a lower quality of services, increased costs of legal disputes and a reduction in the services offered to those requiring care.

The second cause of complexity partially overlaps the first, albeit it relates to the involvement of different subjects in the same procedure instead of the interaction of procedures at different levels. The dematerialisation of documents clearly simplifies administrative processes, however, the obligation to state particular alphanumerical codes on invoices, as requested by the Ministry of Finance, makes the invoicing process more complex for suppliers. Enabling the central government's achievements has resulted in an increase of complexity for suppliers. Electronic invoicing generates advantages for the superordinate institution, however, what represents a simplification for this stakeholder is not necessarily such for other subjects. This case clearly shows that simplification policies adopted to the advantage of one subject may cause an increase in complexity for other subjects: simplification has different facets and has to be considered from different perspectives. Therefore, it is not just a question of 'how procedures should be simplified' but also 'in whose favour should procedures be simplified?' This suggests that simplification only generates efficiency and effectiveness when it produces benefits for all the stakeholders involved in a process. As highlighted by the OECD (2011), those that must comply with regulations must be able to obtain information and guidance on what they need to do to meet the compliance requirements imposed on them. In this specific case, simplification may be achieved by making it mandatory for public institutions to send an invoice proposal that the supplier would then accept.

As specified above, the administrative procedure of the ASP requires the general director and person responsible for the accounting function to double-check the invoice. This check of more than 30 different items in the invoice cannot be performed on the electronic version, because the format of e-invoices is too long and difficult to read. For this reason, the invoice is converted into another format and then printed out. All these activities are performed with the aim of avoiding the risk of paying a supplier in cases where it is prohibited by law. From the perspective of the organisation that adopted this procedure, the additional time necessary in which to perform this activity is preferable to the risk of unlawfully paying a supplier. In this sense, risk-reduction activities can produce negative effects on the complexity of the procedures. In fact, the general director is held accountable more for complying with the law than for keeping fair relations with the suppliers, thus minimising the costs of legal action and offering users a better service. Bureaucratic control based on adherence to the letter of the law still prevails in managerial controls. Several analysts see an inherent tension between basic private management

techniques involving competition, speed, efficiency, individual accountability and responsiveness to consumers, and the slow, detailed, egalitarian and equitable approach inherent in administrative law (Guyomarch, 1999). This tension implies that even if each organisation tends to design internal procedures considering both aspects, in the event of conflict between them the management needs to decide which one should be given priority. In this specific case, the general director of the institution is not assessed on the basis of clear goals in terms of a reduction in legal costs or an improvement in the quality of acquired services (e.g. catering services). The bureaucratic perspective instead prevails, and strict adherence to the norm is considered preferable, because this is considered more in line with the expectations of the main stakeholder, i.e. the Ministry of Finance. The negative effects related to the complexity introduced by electronic invoicing could only be reduced by formally setting performance goals related to the quality of the relationship with suppliers. In other words, it would be necessary to create incentives to abide to both logics (i.e. management efficiency and administrative law).

The indirect consequences of complexity should be also considered: a reduction in the quality of the service provided to those in need of care is an example of this. This effect depends on the progressive worsening of relations with the suppliers: this is the most remarkable outcome of complexity in this specific case.

The second institution considered in the paper, i.e. the university, is much bigger and more articulated. Internal procedures are more complex because of the greater number of subjects involved in the accounting system. In this public organisation, accounting procedures are still influenced by well-rooted habits that were established prior to the reform of the Higher Education sector and of universities' accounting systems. Prior to 2010, university departments (i.e. the organisational units where teaching and research activities are developed) enjoyed financial and accounting autonomy, and approved their own budget and financial statements. In the reform, the budget refers to the university as a whole, as does the financial statements. Nevertheless, the departments have tended to preserve their autonomy; they see the central administration of the university as an external subject with different objectives. In the university observed here, there is a deep contrast between the departments and the central administration: the latter performs control functions of the former. In the accounting procedure for the opening and the financial management of research projects, the departments accuse the research office of assuming the role of an inspector of their activities, rather than a role of a promoter of research activities and of providing support to the faculty for the preparation of research grants applications.

The complexity of the accounting procedure designed for the research projects can be first ascribed to the frequent controls by the central administration of the departments for the purpose of verifying the economic sustainability of the projects and on the researchers' activity (timesheets). According to the managers working in the central administration, controls are necessary, since in the past some research projects generated losses due to mistakes made by the research teams or the administrative staff in the departments. Losses incurred in one department had to be covered by the university as a whole, thus, research projects with a bad financial performance in one department led to other departments being deprived of resources.

Even after the reform of the Italian university system, which was introduced in 2010 and was markedly inspired by NPM, control activities performed by the central administration on the departments were not removed. The reform imposed a shift from commitment accounting to accrual accounting, consistent with the main tenets of NPM. The adoption of the new accounting system led to a radically different way of reporting transactions, however, the organisational dimension of the accounting system, i.e. its procedures, remained largely unchanged. In the case examined in this paper, the numerous accounting errors at the department level convinced the central administration to intensify its controls, thus reducing the autonomy and accountability of the departments. While NPM calls for more accountability of results, and less attention to the way processes are executed, the case described in this paper highlights how it can instead lead to opposite effects being produced. During the meetings of the working-group it became apparent the requests for simplification came from the administrative staff of the departments, who had seen their workload increase due to carrying out activities, such as the duplication of the budget of research projects, which they considered as 'non-value-added activities'. The particularly prudent accounting routine stemmed from a managerial imperative: to avoid negative margins on projects. This consideration is consistent with the managerial logic insinuated in Higher Education institutions by the reform in 2010. However, a bureaucratic approach was adopted to avoid the losses: instead of making the staff of the departments accountable for measurable financial goals of the research activities, the central administration of the institution preferred to set up a control procedure with the aim of protecting the organisation from incurring losses.

The second factor of complexity in the case of the university relates to the volume of data requested for internal purposes. The requests for data often go beyond real needs: the timesheets are just an example of this. Due to this continuous activity of data gathering, the departments' staff delegitimise all requests for new data. Although this aspect was not analysed in the previous section, during the meetings of

the working group it became apparent that the obligation to collect information for the managerial control system, social and sustainability reports, inclusivity reporting and for the consolidated financial statements of the university imposes heavy burdens on the activities of the administrative offices. On the one hand, the departments' staff undergo controls by the central administration, albeit they question their usefulness, while on the other, the staff working in the central administration must gather data for several (new) kinds of reports, often without having confirmation of their usefulness. Further research is needed to explore the effects of this form of complexity on employees' stress and motivation. The growing mass of information required from the accounting and managerial control systems has contributed to an increase in complexity. The same factor of complexity has been observed in other sectors of the Italian public administration, with almost no appreciable effects on political and managerial decisions (Caccia & Steccolini, 2006). This suggests the need for further empirical research into the usefulness for politicians, managers and citizens of imposing the production of a huge volume of data through highly complex accounting systems.

The cases described in the paper show that the complexity of procedures stems from the need for inspective controls (which is typical of law) and from the volume of information requested to manage organisations (which is typical of management studies). The authors examined two case studies based on the Italian context, however, the issue of the tension between legal control and efficiency also extends to other legal systems; presumably, different approaches are adopted in different contexts to manage this conflict, thus suggesting the need for comparative research. According to the authors' analysis, administrative controls are required by internally defined routines, or by hierarchically superordinate entities. These kinds of inspective controls are supposed to generate public value by preventing errors, opportunistic behaviour and incorrect decisions. However, little consideration has been given to the costs generated by administrative controls; the same can be said with reference to the proliferation of data that accounting systems have to produce. In managerial accounting literature, inspective controls are classified as boundary systems (Simons, 1995); their effects on the efficiency of public administration deserve more analysis. At least three main effects should be considered: a) the consequences of inspective controls and requests for new information on the efficiency of an organisation: each control as well each piece of information required takes time and human resources, lengthens processes and delays the achievement of the expected results; b) staff motivation: the case of the university's routine clearly shows that controls on research project budgets demotivate the administrative staff of the departments and fuel a long-lasting conflict between the departments and central administrative offices; c) the effects that inspective controls and adjunctive information have on the stakeholders: what is supposed to generate value for hierarchically superordinate institutions may produce negative consequences for other subjects (as is demonstrated by the case of the ASP) or may increase costs with no noticeable benefits.

The juridical-administrative analysis is not sufficient to approach the problem of public administration efficiency and neither is the managerial approach. The cases discussed in this paper suggest that the setting of administrative procedures must consider the fairness and correctness of activities, as well as their efficiency and effectiveness. This analysis suggests the need to start an interdisciplinary dialogue to develop solutions that balance opposing needs. The stakeholder theory (Mitchell et al., 1997) may represent a common ground for researchers in management as well as those in administrative law to analyse the effects of processes and procedures on different groups of stakeholders and to observe how public organisations react to opposing pressures exerted by them.

This paper suggests that public management scholars have the opportunity and the burden of a contribution in this field. Different questions that are strictly connected with the work of many civil servants deserve an answer: what factors boost complexity in administrative routines? What factors enable (or hinder) the simplification of process and routines? Is it possible to assess the cost of complexity in administrative processes and routines? Is there a relationship between the complexity of routines and organisational well-being? What role do interactive control systems (Simons, 1995) and process re-engineering (Ongaro, 2004) play in the simplification of processes and procedures? What are the effects of different institutional pressures on the design of administrative routines? Do public managers consider simplification of procedures a priority for public institutions?

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# Poenostavitev javne uprave: menedžmentska perspektiva

## Izvleček

Prispevek obravnava vprašanje kompleksnosti upravnih procesov javnih ustanov: preučujejo se zlasti računovodske rutine in procesi. Dejavnost zalednih pisarn, čeprav imajo pri zagotavljanju javnih storitev samo podporno vlogo, absorbira pomemben del sredstev javnih ustanov. Cilj prispevka je analizirati dejavnike, ki prispevajo k izboljšanju kompleksnosti teh dejavnosti. Delo temelji na poglobljeni analizi dveh italijanskih javnih organizacij: univerze in ASP (agencije za storitve osebam). Italija predstavlja zanimiv kontekst, saj so bile v državi politike poenostavitve sprejete na ravni centralne vlade in tudi v določenih sektorjih javne uprave, vendar pa so na institucionalni ravni pobude za poenostavitev odvisne od pobude ene same organizacije. Iz primerov, opisanih v prispevku, je razvidno, da kompleksnost izhaja iz potrebe po inšpekcijskem nadzoru (kar je značilno za pravo) in iz obsega zahtevanih informacij (kar je značilno za študije menedžmenta) za različne deležnike in na različnih, vendar povezanih ravneh. Prispevek nakazuje, da imajo znanstveniki s področja javnega menedžmenta priložnost in dolžnost prispevati na tem področju.

**Ključne besede:** poenostavitev, podporne dejavnosti, procesi, javna uprava, deležniki

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Primer 1a: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995).

Primer 1b: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995, p. 36).

Primer 2a: Engle and Granger (1987) present critical values also for other cointegration tests.

Primer 2b: Engle and Granger (1987, p. 89) present critical values also for other cointegration tests.

*Navedbe virov v seznamu virov*

Primer 1 – Knjiga: Gujarati, D. N. (1995). *Basic Econometrics*. New York: McGraw-Hill.

Primer 2 – Članek v reviji: Engle, R. F., & Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica,* 55(2), 251-276.

Primer 3 – Poglavje v knjigi, prispevek v zborniku: MacKinnon, J. (1991). Critical Values for Cointegration Tests. In R. F. Engle & C.W. J. Granger, (Eds.), *Long-Run Economic Relationships: Readings in Cointegration* (pp. 191-215). Oxford: University Press.

Primer 4 – Elektronski vir: Esteves, J., Pastor, J. A., & Casanovas, J. (2002). *Using the Partial Least Square (PLS): Method to Establish Critical Success Factors Interdependence in ERP Implementation Projects*. Retrieved from http://erp.ittoolbox.com/doc.asp?i=2321

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Example 1a: Another graphic way of determining the stationarity of time series is correlogram of autocorrelation function (Gujarati, 1995).

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*References in the list of references*

Example 1 – Book: Gujarati, D. N. (1995). *Basic Econometrics*. New York: McGraw-Hill.

Example 2 – Journal article: Engle, R. F., & Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica,* 55(2), 251-276.

Example 3 – Book chapter or article from conference proceedings: MacKinnon, J. (1991). Critical Values for Cointegration Tests. In R. F. Engle & C.W. J. Granger, (Eds.), *Long-Run Economic Relationships: Readings in Cointegration* (pp. 191-215). Oxford: University Press.

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