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THE EFFECTS OF EU R&I FUNDING ON SME INNOVATION AND BUSINESS PERFORMANCE IN NEW EU MEMBER STATES: FIRM-LEVEL EVIDENCE

ABSTRACT: *SMEs are the most dynamic and vibrant part of the enterprise sector in terms of start-ups and new jobs, and a significant share of the EU's total innovation activities take place within them. This paper uses the Community Innovation Survey (CIS) 2014 and eCORDA data to analyse whether SME participation in EU research and innovation (R&I) funding programmes has increased their innovation activities and business performance. To achieve this, we empirically test whether SMEs that received EU funds recorded an improvement in their innovation and economic performance. This is measured by research and development (R&D) expenditure, product innovation, turnover, and employment. The paper focusses particularly on new EU member countries and among them to those from Central and Eastern Europe (CEE). It explores the theoretical and methodological backgrounds that guided us in these analyses and performs treatment effect analysis at firm level, using CIS CD-ROM data that we received on request from Eurostat. The obtained results indicate that EU R&I funding is beneficial to the innovation activities of SME recipients, and to their overall business performance. It also assists new EU member states in the process of 'catching up' to the growth levels of more established EU economies.*

KEY WORDS: *SMEs, innovation, R&D, EU R&I funding*

JEL CLASSIFICATION: O31, O32, O38, O52

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1. INTRODUCTION

Small and medium-sized enterprises (SMEs) play an important role in the research and innovation value chain in the European Union (EU), as they are important innovation creators and knowledge spillover conduits. This is especially true of those that are fast growing or have a high growth potential. SMEs have been included in collaborative projects at the EU level that provided them with valuable financial assistance to stimulate their research, innovation, and creativity. EU policy aims to achieve more involvement from SMEs as recipients of European Union Research and Innovation (EU R&I) funding within the Horizon 2020 programme. This is justified by the need to surmount the previous fragmentation of funding programmes, and by the quest to create an integrated EU finance programme directed specifically at SME innovation growth needs. The purpose of increasing the availability of EU funding through Horizon 2020 is to limit market failure in SMEs' access to finance, especially in the early and risky stages of the innovation process. This facilitates the implementation of the EU2020 Strategy (European Commission, 2010a) and its flagship initiative Innovation Union (European Commission, 2010b).

Analyses and studies to date have identified a controversy that centres on identifying the net effects of national public and EU R&D funding on firm-level innovation.[1] This relates especially to the 'additionality' that such funding brings to the productivity and employment growth of an enterprise, particularly an SME (see, e.g., Radicic & Pugh, 2017; Radas et al., 2020). Because of data limitations, it is challenging to quantify this additionality in a methodologically convincing way, and to determine the causality of its impact. The net effects of public funding on innovation performance depend on a multitude of factors at firm level (age, size, labour skills) and characterise the technological level of specific industries (low-tech vs. high-tech industries). The specificities of national innovation systems also play an important role in determining the impact and effectiveness of innovation support measures, including public funding schemes. The latter is especially true in new EU member states (Stojčić et al., 2020). Although they often

[1] We distinguish between R&I (research and innovation) and R&D (research and development). Prior to Horizon 2020, which extended finance to innovative activities, the term R&D was commonly used, whereas afterwards the term R&I became more standard. In this paper we refer mainly to EU R&I funding and to R&D expenditure and investment by businesses.

identify positive impacts, empirical studies to date have not reached a conclusive answer on this issue, particularly when it comes to determining the causality of impacts (see Zuniga-Vincente et al., 2014; Čučković & Vučković, 2018).

For these reasons, it is worth exploring different approaches to measuring the innovation impacts of EU R&I funding, at both firm and aggregate macroeconomic levels. The investigation of innovation impacts is pertinent to EU policy and decision-making, and essential to a proper evidence-based assessment of the EU2020 Strategy and its flagship initiative, Innovation Union.

This paper has two objectives. The first is to analyse whether SMEs' participation in EU R&I funded projects results in an increase in their innovation activities, performance, and R&D investments based on CIS 2014 data (received from Eurostat on CD-ROM). To do this, we perform a firm-level treatment-effect analysis in which innovation and economic performance specifications are considered as outcome variables. The countries analysed are those encompassed by CIS: Bulgaria, Cyprus, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, and Slovakia. In addition, we divide firms into the categories of high and medium-high technology manufacturing SMEs, and knowledge intensive services (KIS) SMEs

Since the CIS 2014 data mostly provide information on the use of EU funds prior to the current Horizon 2020 programme, the second objective is to analyse in more detail the effect that SME participation in Horizon 2020 has had on SMEs' economic performance (measured by turnover and employment). This analysis is based on data obtained on request from eCORDA and the European Commission Directorate General for Research and Innovation.

This text aims to contribute to current discussions within the field of innovation by further exploring how EU R&I funding policies under Horizon 2020 work in practice, and their impact on SMEs as important innovation actors and knowledge spillover conduits. We specifically want to test if improved access to and use of EU innovation funding has had a beneficial impact on the innovation performance of SMEs in new EU member states, in which those from Central and Eastern Europe (CEE) prevail in the CIS dataset. We are particularly interested in ascertaining how SMEs respond to EU R&I funding, and how it affects their

consequent R&D and innovation investment decisions and business performance.

The analysis therefore attempts to answer two research questions (RQs):

RQ1: Does an SME's increased participation in EU R&I funding result in an increase in its product and process innovation activities?

RQ2: What are the business performance effects of such innovation funding (measured by turnover and employment)?

The specific research contribution of this paper is its analyses of the innovation impacts of EU R&I funding based on CIS 2014 survey data (received from Eurostat on CD-ROM), which are not publicly available. To do this, we utilise Propensity Score Matching (PSM), a method that estimates the effects of EU funds against the counterfactual. The paper's secondary contribution is its econometric analysis of Horizon 2020's impacts on SME innovation from 2014 to 2017, which is based on more aggregate data obtained on request from eCORDA and the European Commission Directorate General for Research and Innovation.

The paper is structured as follows. Following the introduction, in Section 2 we explore the theoretical and methodological backgrounds that guided us in our analyses, and assess the effects of EU funds on selected indicators of SME performance. This is based on a sample of 43,246 firms, of which 4.3% of SMEs received EU funds. Section 3 provides an overview of Horizon 2020 support provided to SMEs for R&I from 2014 to 2017. Section 4 reviews major issues determining the innovation performance of new EU member states from Central and Eastern Europe. In Section 5 we use panel data analysis to explore the specific effects of Horizon 2020 funding on SME innovation and business performance in EU member states, and explain their policy implications. The final section draws conclusions from the research, explains its limitations, and identifies areas for further study.

2. ASSESSMENT OF THE IMPACT OF INCREASED EU R&I FUNDING ON SMES' INNOVATION AND ECONOMIC PERFORMANCE

2.1. Literature review and methodological background

The positive impact of R&D on economic growth and productivity has been confirmed by a number of theoretical and empirical studies (see Hall, 2011; Mohnen & Hall, 2013; Grossman & Helpman, 1994; Aghion & Howitt, 1997; Howitt, 2004; Cameron et al., 2005; Kafouros, 2005; Coe et al., 2009; O'Mahony & Vecchi, 2009; Bravo-Ortega & Marin, 2011). An overview of empirical studies (see Peters et al., 2014) shows that firms that invest in R&D usually experience an increase in productivity. The relation between innovation and productivity can be direct (a positive relation between innovation expenditure and product and process innovation output, and from innovation output to productivity [Peters et al., 2014; Hall 2011]) or indirect (due to knowledge spillovers [see, e.g., Hall et al. 2010]). Because of market failures, however, access to finance is the largest obstacle to innovation that SMEs face, and it has a bigger impact on them than on larger firms. To resolve this problem, support measures for innovation and R&D activities is available from different institutional sources. Evidence of the impact of such support measures is plentiful, but it is diverse for several reasons, including methodology, sample size, and the specific type of innovation support source (national or EU).

The first methodological issue relates to innovation measurement: How should we measure the variables that make up innovation performance (product and process innovation) and productivity in SMEs to create a key economic performance indicator? The literature proposes different indicators, each with advantages and disadvantages. Most empirical studies use one of two ways to measure innovation: input indicators, such as R&D employees or expenditures, or output indicators, such as patents, new products and services, successfully introduced processes, and increases in sales, exports, profits, or efficiency (Mohnen & Hall, 2013). In practice, it has been shown that input and output measures are highly correlated (Becker, 2015). In this paper, we use the Community Innovation Survey's (CIS) definitions for different types of innovation, since it is our main data source. First, a product innovation is defined as the introduction of a product or service that has new or significantly improved characteristics or uses. This includes important augmentations to technical specifications, components and materials, incorporated software, user

friendliness, or other functional characteristics. Second, process innovation is defined as the implementation of a new or significantly improved production or delivery method, and includes changes to techniques, equipment, and/or software. The empirical literature proves that these two types of innovation have distinct impacts on economic performance: generally positive for product innovation, and small or negative for process innovation (see Hall, 2011; Peters et al., 2014; Damijan et al., 2014). The former can be measured by sales of new products, but if this data is unavailable it can be captured by dummy variables (taking the value of 1 if the firm introduced an innovation, and 0 otherwise). In addition, a distinction can be made between 'new to the firm' and 'new to the market': Is the product novel for one firm but already on the market, or is it a product or process that did not exist before? Although measuring productivity is a challenge, in this research we will use productivity proxied by the firms' turnover. Another issue is the selection of a sample and of an appropriate model for the analysis. In the literature, authors use different models to estimate the effect of public support on aspects of economic and innovation performance at all levels (firm, sectoral, and aggregate), such as SEM, ALS, GMM, sequential IV, the panel VAR approach, and counterfactual analysis.

Because of the methodological challenges described, results in the literature are mixed, especially for different types of innovation (for a survey overview see, e.g., Aerts & Czarnitzki, 2004; Czarniki & Delanote, 2015; Catozzella & Vivarelli, 2011; Czarnitzki & Lopes Bento, 2013; Becker, 2015; Radas et al., 2020; Stojčić et al., 2020; Grabowski & Staszewska-Bystrova, 2020). For example, Grabowski and Staszewska-Bystrova (2020) investigate the impact of public support for innovation activities on propensities to introduce product, process, and organisational and marketing innovations in European SMEs, based on CIS 2014 data. Their results show that the EU New Member States (NMS) invest mainly in the acquisition of machinery, equipment, software, buildings, knowledge, and training, while the old EU countries invested in R&D and innovation. They point out that EU funds are more beneficial to manufacturing, while national and local support is more effective in the service sector. Radas, Mervar and Škrinjarić (2020) also perform SME-level analysis, using data from CIS 2008 and CIS 2012, and find that national and EU public funds lead to smaller additionality in less developed EU countries, while crowding-out was observed in the newest EU member states. Radicic and Pugh (2017) use a sample of SMEs from EU28 to

evaluate the input and output additionality of national and EU R&D funds. Their analysis shows diverse results. While for innovation inputs they find positive treatment effects from both national and EU R&D funds, the results for innovation outputs show no evidence of additionality from national programmes, and cannot reject crowding-out from EU ones. We can thus confirm the European paradox for SMEs: EU support promotes innovation inputs but not innovation outputs. Czarnitzki and Delanote (2015) evaluate the impact of direct R&D subsidies on several R&D input measures, and on patents as an R&D output measure. The authors estimate the difference between the observed R&D of subsidised firms and the counterfactual situation, in which these firms would not have been subsidised. Their results support the prevailing policy position: to give preferential treatment to small, young, and independent firms active in high-tech sectors. They also show that previous estimations of innovation policy impacts may have been misleading, as they do not distinguish between preferential firm profiles in policy schemes.

As shown in the literature review, counterfactual analysis is the most frequently used methodological approach in recent studies. This method compares two groups of firms: the treatment group, whose firms have benefited from a specific programme, and the control or comparison group, which is similar in all aspects to the treatment group, except the firms within it have not been exposed to the programme in question. The control group shows what would have happened to treatment group members if they had not been exposed to the programme (European Commission, Centre for Research on Impact Evaluation). Without information on the counterfactual, the next best alternative is to compare the outcomes of treated individuals with those in an untreated comparison group. To do this, the comparison group must be as similar as possible to the treated group, so that the latter would have had outcomes similar to those of the former if the treatment had not been applied (World Bank, 2010). In the next sub-section we will explain the methods used in this paper (Propensity Score Matching [PSM] and Average Treatment Effect [ATE]), the data used, and the results obtained.

2.2. Model specification, data, and results

Theoretically, an ideal model would compare outcomes for SMEs that received EU funds with outcomes for the same group if they had not received those funds. In practice, however, once SMEs have received funds it is impossible to observe

what would have happened if they had applied for the funding but did not receive it. Thus, based on previous research, we approximated the effects of EU funds by comparing the outcomes of SMEs that received the funds (treatment group) with the outcomes of similar SMEs that did not (comparison group). Researchers generally use one of two approaches to define the counterfactual of a treated group (see World Bank, 2010): either they create a comparator group through statistical design, or they modify the targeting strategy of the programme to remove differences that would have existed between the treated and non-treated groups before comparing outcomes across them. The latter approach is used in this paper, and we used Propensity Score Matching to estimate the effects of EU funds against the counterfactual. As previously stated, the goal is to estimate the effect of the EU funds on treated SMEs, taking into account what would have happened if they had not received them. We can thus estimate the difference between defined outcomes for firms that received funds and for those that did not: i.e., the average treatment on the treated (ATT) effect. The propensity score is a number that depicts the conditional probability of being assigned or not assigned to a particular treatment. Different approaches can be used to match participants and nonparticipants on this basis, including nearest neighbour (NN), caliper and radius, stratification and interval, kernel, and local linear matching (LLM) (see World Bank, 2010). In this paper we use the NN method, which is the most common form of matching in statistics literature. In this method each treated unit is matched to the untreated unit with the nearest propensity score. Once each treated unit is matched with an untreated unit, the difference between the outcomes of the treated and untreated matched units can be computed. The average treatment effect on the treated (ATET) is then obtained by averaging these differences. For the estimation we use Stata's built-in 'teffects' command, which is flexibile in terms of estimators and functional forms for outcome and treatment-assignment models (StataCorp, 2013).

The data used for the first part of the analysis were obtained from the Community Innovation Survey (CIS) 2014, received from Eurostat on CD-ROM. Their focus is on small and medium enterprises (SMEs) as defined by the European Commission: a) a medium-sized company has a staff headcount <250, turnover ≤ € 50 m or balance sheet total≤ € 43 m; b) a small company has a staff headcount <50, turnover ≤ € 10 m or balance sheet total ≤ € 10 m; and c) a micro company has a staff headcount <10, turnover ≤ € 2 m or balance sheet total ≤ € 2 m. The

geographical focus includes firms in 10 new EU member states: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, and Slovakia.

The sample consists of 43,246 SMEs, 4.3% of which received EU funds. The first cluster includes SMEs from all sectors, but we also performed analysis specifically for the high and medium-high manufacturing sectors, and the knowledge intensive services (KIS) sector (filtered according to Nace Rev.2 classification). In addition, we compared the efficiency of EU funds with those received from central government.

We performed treatment effects analysis from observational data using nearest neighbour (NN) matching. The variables chosen to estimate a propensity score should relate to outcomes as well as to participation decision, and should be based on economic theory and previous empirical findings (Caliendo & Kopeinig, 2005). Consequently, our analysis uses the variables of treatment, outcome, and control/explanatory, explained in Table 1.

The results show that SMEs in all sectors that obtained EU funds recorded better results in product and process innovation, innovation expenditures, and share of turnover from product innovations that were new to the market. Further, EU funds proved to be more efficient than national funds, although the latter had a positive impact on SME innovation performance, except in the category of process innovation where the estimated coefficient is not statistically significant. If we analyse two sectors – high and medium-high manufacturing and KIS – we can see the contrasting impact of public funding on innovation indicators. Although in the former sector public funding has a larger impact on innovation inputs than it does on output (the positive effect of EU funds on turnover from innovation is not statistically significant), the opposite is true for KIS (the impact of EU funds on process innovation is negative, and not statistically significant). Finally, in all cases, EU funds prove more efficient than national funds.

Table 1: Variables used in the analysis

	TREATMENT VARIABLES
fund_eu	1=firm received EU funds; 0=otherwise
fund_gmt	1=firm received central government funds; 0=otherwise
	OUTCOME VARIABLES
inn_process	1=firm introduced a new or significantly improved method of production; logistic, delivery, or distribution system; and/or supporting activities; 0=otherwise
inn_newmkt	1=firm introduced a product new to the market; 0=otherwise
inn_exp	total expenditure on innovation activities in 2014 (ratio/turnover), in log
turn_mkt	% of turnover from product innovations new to the market
	EXPLANATORY (CONTROL) VARIABLES
gp	1= firm is part of an enterprise group; 0=otherwise
co	1= firm has reported cooperation arrangements on innovation activities; 0=otherwise
mareur	1=firm is present in EU/EFTA/CC market; 0=otherwise
empud	1=more than 50% of employees have a tertiary education, 0=otherwise
marloc	1=firm present in local/regional market (within country); 0=otherwise
marnat	1=firm present in national market (other regions of country); 0=otherwise
maroth	1= firm present in all other countries; 0=otherwise
pub_proc	1= firm has procurement contracts for domestic and/or foreign public sector organisations; 0=otherwise

Source: Authors' compilation based on CIS 2014 CD-ROM data.

The results are presented in Table 2.

Table 2: Average Treatment Effects on the Treated (ATET)

	All sectors		High and Medium-High Manufacturing		Knowledge-Intensive Services (KIS)	
OUTPUT	EU funds (1 vs. 0)	Central government funds (1 vs. 0)	EU funds (1 vs. 0)	Central government funds (1 vs. 0)	EU funds (1 vs. 0)	Central government funds (1 vs. 0)
inn_process	0.045*	0.018	0.114*	0.052**	-0.087	-0.045
	(0.013)	(0.014)	(0.024)	(0.025)	(0.039)	(0.040)
inn_newmkt	0.085*	0.064*	0.086*	0.065**	0.161*	0.169*
	(0.017)	(0.018)	(0.029)	(0.031)	(0.046)	(0.045)
inn_exp	1.894*	1.768*	1.239*	0.951*	3.171*	3.221*
	(0.172)	(0.172)	(0.207)	(0.206)	(0.596)	(0.594)
turn_mkt	0.035*	0.031*	0.017	0.019	0.070*	0.059**
	(0.007)	(0.008)	(0.013)	(0.014)	(0.024)	(0.025)

Note: Standard errors in parentheses: * P < 0.01, **P < 0.05, *** P < 0.10

Source: Authors' calculation using CIS 2014 CD-ROM data.

The results for these two groups should, however, be read with caution, since the Rosenbaum test shows that they are sensitive to possible deviations from the identifying unconfoundedness assumption (for details see Becker & Caliendo, 2007). The Rosenbaum bounds approach uses the sensitivity parameter gamma (Γ) to test which magnitude of the hidden bias would render the test statistics of the study inference insignificant. A larger Γ magnitude implies a greater robustness of outcome. This is in line with findings in the literature (Caliendo & Kopeinig, 2005; Radas et al., 2020; Stojčić et al., 2020). Analysing each source of funding separately, sensitivity analysis suggests that in the case of EU funding, the models that are sensitive to selection bias are those with the outcome variables 'process' and 'product innovation' – however, at rather high values of gamma, and this holds only for two analysed sub-sectors. In the case of national funding, the models that are sensitive to selection bias are those with the outcome variables 'process' and 'product innovation', for all analysed sectors. Also, in the case of national funding, models are sensitive to unobserved heterogeneity at lower values of gamma. A summary of the Rosenbaum bounds approach is presented in Tables 3a and 3b.[2]

Table 3a: Sensitivity analysis by Rosenbaum bounds approach: hidden bias at 5% (overestimation) for EU funding (yes/no)

	All sectors	High and Medium-High Manufacturing Sectors	KIBS
inn_process	no	yes, when Γ ≥1.70	no
inn_newmkt	no	yes, when Γ ≥1.20	yes, when Γ ≥1.50
inn_exp	no	no	no
turn_mkt	no	no	no

Source: Own calculation.

[2] The detailed results of the Rosenbaum bounds tests are available from the authors upon of request.

Table 3b: Sensitivity analysis by Rosenbaum bounds approach: hidden bias at 5% (overestimation) for national funding (yes/no)

	All sectors	High and Medium-High Manufacturing Sectors	KIBS
inn_process	yes, when Γ ≥1.30	yes, when Γ ≥1.30	yes, when Γ ≥1; at Γ≥1.20 changes sign
inn_newmkt	yes, when Γ ≥1.10	yes, when Γ ≥1.10	yes, when Γ ≥1.60
inn_exp	no	no	no
turn_mkt	no	no	no

Source: Own calculation.

The sensitivity of our results was also tested with inverse probability weighted regression adjustment (IPWRA), which is seen as doubly robust (as in Stojčić et al., 2020). All tests can be found in the Appendix (Tables A1–A3). We also tested the overlap of the propensity score between treated and non-treated firms after matching (Figure A1. in the Appendix).

The performed analysis of the impact of EU funds confirms the positive effect of these funds on the innovation and economic performance of SMEs, based on CIS 2014 data. Because the CIS 2014 database covers the period prior to the Horizon 2020 programme, our paper is unique in its discussion of the effects of Horizon 2020 on SME turnover and employment.

3. HORIZON 2020 FUNDING FOR RESEARCH AND INNOVATION IN SMALL AND MEDIUM-SIZED ENTERPRISES

In this section, our analysis focuses on revealing how much of the available support SMEs used during Horizon 2020's implementation. The target was at least 20%. For comparison, the average participation of SMEs in the Seventh Framework Programme (FP7) budget was approximately 15%. The visible and measurable impact of funding in terms of 'additionality' (i.e., European added value [EAV]) and its effect on economic performance (see European Commission, PPMI study, 2017a) are discussed in Section 4 of this paper.

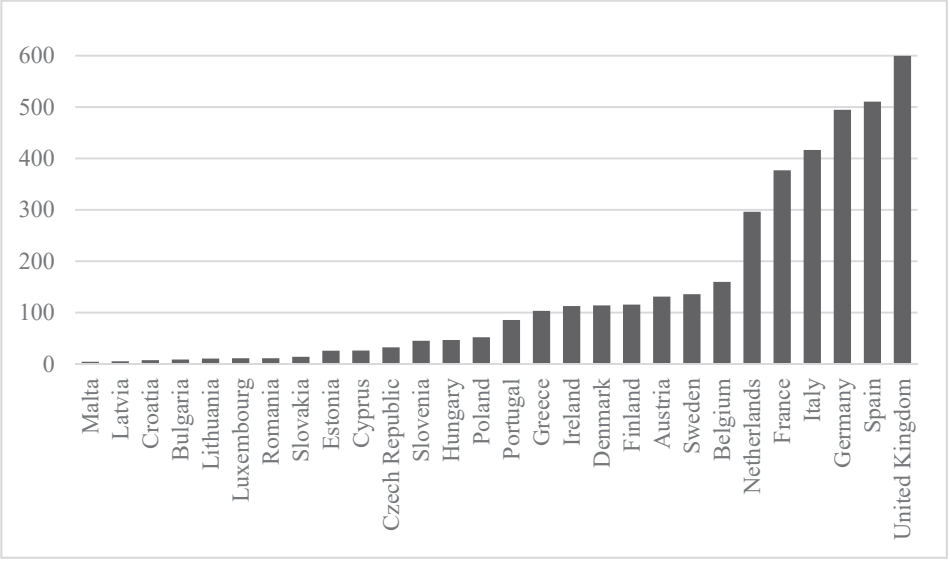
The Horizon 2020 programme is known to have brought an integrated and simplified approach to financing the R&I needs of SMEs. It was specifically designed to "develop, grow and internationalise highly innovative SMEs, regardless of whether they are high-tech or research-driven, or social or service companies whose innovations are not based on research" (European Commission, 2015). The rationale behind Horizon 2020 was to enable increased SME participation in EU R&I programmes in order to enhance innovation activities in the EU through improved access to finance.

According to Horizon 2020, data collected for the first three years (2014–2016) show increased levels of participation and overall satisfactory progress in specific SME participation across the programme.

The Interim Evaluation Report (European Commission, Annex 1, 2017b) shows that by January 2017, SMEs accounted for almost 24% of the value of approved grants from Horizon 2020's dedicated budget (approximately EUR 3.5 billion). These funds were allocated through the 'Societal Challenges' and 'Leadership in Enabling Industrial Technologies (LEIT)' programmes. This indicates that the policy plan for increased SME participation in funding through approved grants (with a target of 20%) was fulfilled in the first half of Horizon 2020's implementation. SME participation in the total number of supported projects was even higher, at almost 27%. It is envisaged that a total of EUR 6 billion from this combined budget will have been invested in Europe's most innovative SMEs by the end of 2020 by means of collaborative consortia grants, while an additional EUR 3 billion will be invested through the dedicated SME Instrument (SMEI).

According to eCORDA data from June 2017, total Horizon 2020 allocations to SME recipients in 2014–2017 amounted to approximately EUR 4 billion for collaborative and single beneficiary projects granted through the combined LEIT and Societal Challenges budgets (see Figure 1).

Figure 1: Total Horizon 2020 Budget Allocation for SMEs, 2014–2017, by EU member country (in EUR billion)

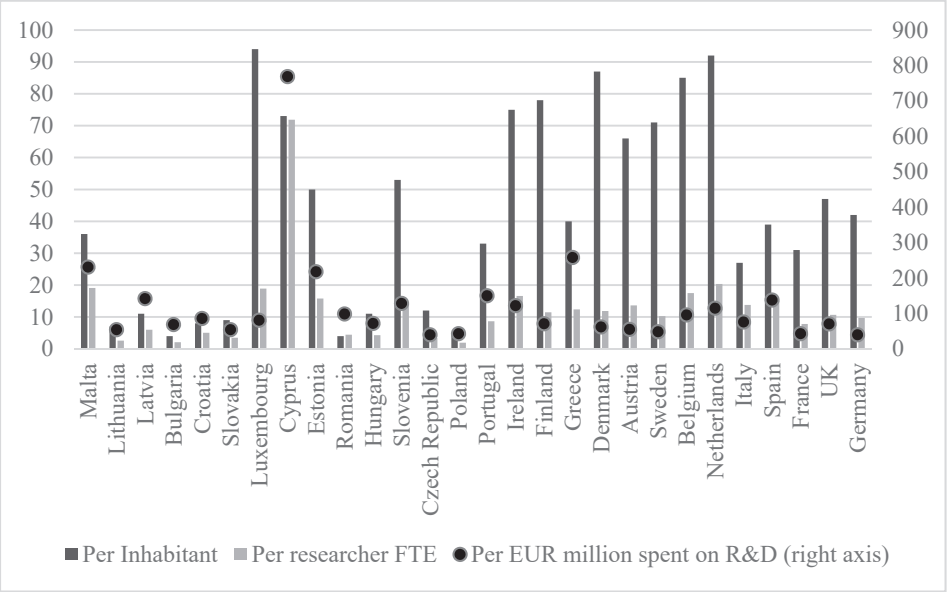


Source: eCORDA self-reported data by SME project beneficiaries, cut-off date June 2017. Obtained by request from the European Commission's Directorate General for Research and Innovation (DG R&I).

As Figure 1 shows, Croatia, Latvia, and Malta are among the lowest performing countries in terms of absorbing available Horizon 2020 SME funds in 2014–2017, while Slovenia, Slovakia, and Hungary were six times more successful. These figures should, however, be interpreted with caution, as they are not statistical, but rather self-reported SME project data collected by eCORDA surveys in the given period.

Figure 2 shows the value of Horizon 2020 contributions to total R&D investments, taking into account each country's population size, number of researchers, and national R&D investments.

Figure 2: Horizon 2020 contributions normalised by population size, number of researchers, and amount of R&D investment



Source: Authors' compilation based on the Horizon 2020 Interim Evaluation Report (European Commission, 2017b, Annex 1).

Figure 2 shows that when taking 'normalising' factors into account, Slovenia, Estonia, and Cyprus outperform the EU-15 countries, despite the modest increase in the trend of Horizon 2020 funding to EU-13 countries compared with that of the FP7 (from 4.2% to 4.4% in the observed period).

The analyses presented in the Horizon 2020 Interim Evaluation Report also show that the situation can be specific and heterogeneous at the country level, depending on the amount of national R&D investment, population size, and number of researchers. The results support the conclusion that countries that received a larger amount of EU R&I funding scored better in innovation performance when measured on the European Innovation Scoreboard. Although the data confirm the traditional dichotomy between the old (EU-15) and new (EU-13) member states in terms of participation and success rates, the divisions are not always consistent. In absolute terms, EU-15 countries received 85.7% of the total EC contribution for SME Instrument grants, compared to only 8.4% for

EU-13 countries, demonstrating the larger capabilities of innovative and growth-oriented SMEs. According to the Interim Report, despite having less funding, the SMEs in EU-13 countries demonstrated a significantly improved capability to catch up compared to that shown in the FP7 (European Commission, 2017b).

Table 4 shows the value of Horizon 2020's total R&D investments for different groups of EU countries from a comparative normalised perspective, to highlight the contrast between the absorption of funding in EU-15 and EU-13 member states.

Table 4: Horizon 2020 contributions normalised by population size, number of researchers, and national R&D investment

	Horizon 2020 contribution (EUR million)	Horizon 2020 contribution per researcher (EUR)	Horizon 2020 contribution per inhabitant (EUR)	Per EUR million spent on national R&D
EU-28	18,953	10,426	37	63,429
EU-13	907	3,812	9	67,524
EU- CEE (8)	721	4,821	13	73,766
EU-15	18,046	11.423	44	63,277

Source: Horizon 2020 Interim Evaluation Report (European Commission, 2017b, Annex 1). The amounts for the sub-group EU-CEE (8) are calculated by the authors.

These aggregate figures reveal interesting facts about the efficiency of investments in R&I, and underline the dichotomy between the established EU-15 states and the less advanced EU-13 members. Most interesting for this paper are the new member states from Central and Eastern Europe, which are the focus of the next section.

4. MAJOR ISSUES THAT DETERMINE INNOVATION PERFORMANCE OF NEW EU MEMBER STATES FROM CENTRAL AND EASTERN EUROPE

In this section we will outline some of the major issues accented in recent literature that largely determine the current position and innovation outcomes of CEE countries. This is necessary to gain a better understanding of the context in

which innovating firms from this region operate, innovate, and consequently grow. In addition, this section will reveal that although increased access to and use of public R&D funding is important to drive and scale up innovation in SMEs, improving the innovation process at the firm level is a more complex undertaking in CEE countries.

Technology upgrades and innovation that lead to the creation of new and competitive market products and services have been a pivotal issue in the economic growth of most new EU members from Central and Eastern Europe (CEE), especially since the global financial crisis. A number of empirical studies by authors familiar with the region (see Radošević, 2017; Radošević et al., 2020, Hashi & Stojčić, 2013a; Hashi & Stojčić, 2013b; Stojčić, 2020; Stojčić et al., 2020; Radas et al., 2020) have detected and investigated the issues behind its modest innovation performance and low productivity gains, despite the continuous increase in external R&I funding, including public funds from the EU and national sources.

Several important findings have emerged from empirical studies that focus on the specific problems of innovation performance in new EU member states from this region. When analysing the determining channels and mechanisms that have the biggest effect on the innovation performance of CEE countries, Radošević (2017) considers that unlike advanced countries, their growth comes less from R&D-driven innovation and more from the spillover and absorption effects of the intensified interactions of domestic R&D with imported advanced technology. He argues that although a singular focus on R&D policies is important for CEE countries, it does not produce effects equal to those in advanced EU economies. This is because the former's R&D sector has traditionally been more suited to the absorption and adaptation of new knowledge brought by imported technology, rather than being an innovation driver itself. This reflects the structure of the CEE economies and the competiveness of certain industries in the EU and world markets.

One of Radošević's (2017) findings is that CEE countries base their current innovation policies mainly on imitating those of advanced EU member states, by "narrowly focusing on R&D drivers of innovation" (Radošević 2017). It may be more productive for CEE countries to pursue their own innovation policies

instead, and adjust them to country-specific and regional economic characteristics and challenges so that they better reflect the innovation drivers in local economic structures. Radošević argues that technology upgrades and improvements to production capabilities that stem from the effective use of imported advanced technology would only generate the necessary R&D innovation-driven growth at its later stages. Improving productivity efficiency based on innovation would also stimulate the catching-up process, leading to a faster convergence with more developed EU economies.

Radošević (2017) emphasises the importance of additional factors that determine the mode of innovation and future growth of CEE countries. He argues that existing innovation policies in this region focus on "upstream" R&D activities and programmes (i.e., R&D-based growth), at the expense of equally important "downstream" innovation factors, such as skills, management quality, and engineering, as well as the quality of export products: "Instead of innovating based on R&D, these economies are much more likely to innovate based on incremental innovation, cost-oriented process innovations, and technology adoption. These are demand-driven innovations, rather than supply or R&D-driven ones" (Radošević, 2017). It is evident from Radošević's study that non-R&D innovating firms dominate in CEE countries, especially in those countries that are less developed. He finds that exports from CEE countries predominantly comprise the low value-added products in the global production chain. These factors determine the innovation and competitiveness rank of new CEE EU member states, and send important messages to their policymakers. Radošević argues that as well as upgrading their technology through imports, the technological progress of these countries should be augmented by upgrading their domestic technologies and advancing their position in global value chains. Finally, Radošević suggests the use of appropriate innovation metrics that reflect CEE-specific innovation factors and technological upgrades, as those currently in use (such as the EU Innovation Union Scoreboard) focus more on R&D and technology. In his later work (Radošević et al., 2020), Radošević develops a specific composite innovation policy index – the Technology Upgrading Intensity Index – to better reflect the significant contributions of non-R&D factors in CEE countries.

The findings of earlier studies by Hashi and Stojčić (2013a and 2013b) are consistent with those of Radošević (2017). The former define innovation as a complex multi-stage, non-linear process that is highly dependent on the diversity of incentives to innovate at the firm level. They argue that "in the presence of market imperfections, horizontal and vertical knowledge and technology spillovers generated through formal and informal enterprise networks, imitation of rivals' actions, and cooperation with universities, research laboratories, and other scientific institutions can help firms to overcome barriers to innovation and raise the quality-driven competitiveness of the entire industry" (Hashi & Stojčić, 2013a). In their study of CEE countries, Hashi and Stojčić examine the overlooked issues of innovation mechanisms at the industry level, focussing particularly on empirical investigations of the relationship between knowledge spillovers, innovation activities, quality upgrading, and industries' EU market share. They argue that it is important to look into the structure of exported products to better understand the differences in growth between CEE countries. Hashi and Stojčić's (2013a) empirical study of CEE countries examines their access to R&D subsidies, which is also the focus of our paper. They conclude that the coefficient of the variable on the use of EU subsidies is significantly positive, and is therefore more important than domestic subsidies as a channel for improving the quality of its export coefficient. Further, they confirm the causality of innovation performance on export and import quality in CEE countries, and find that these states gain important knowledge spillovers from international trade. Hashi and Stojčić state, "a 1% increase in the innovation output of an industry increases the relative quality of its exports by about 0.04%" (Hashi and Stojčić, 2013a). Their study also uncovers a positive and statistically significant coefficient in the examined firms' investment in machinery and equipment, finding that "a 1% increase in investment increases the relative quality of the industry's exports by about 0.13%" (Hashi & Stojčić, 2013a). Hashi and Stojčić's research demonstrates the range of important factors – including large discrepancies in leading industrial sectors – that determine the final innovation output of CEE countries.

Radošević and Yoruk (2018) investigate why middle-income countries, which prevail among the new EU members from CEE countries, are locked in the "middle income trap", in which innovation output does not adequately reflect general income and development levels. They also explore why increased

technological upgrades and R&D investments in innovation activities are not appropriately reflected in the pace of CEE economic growth, as they are in more advanced EU member states. Although CEE countries are divergent, only a few (Slovenia, Estonia, and the Czech Republic) have managed to avoid this trap and move into the lower high-income group. These countries have displayed better productivity and management capabilities, as well as more efficient use of benefits from the innovation process that are designed to help them catch up with advanced EU economies.

In his recent study, Stojčić (2020) focuses on the importance of collaborative innovation activities to the innovation output of CEE countries. This is a distinctive feature of successful innovation activities, and Stojčić's study contributes to a better and deeper understanding of its impact. There is increasing evidence that innovation activities are a product of collaborative effort, which is particularly beneficial to the commercialisation of innovation. Based on empirical evidence, Stojčić argues that innovating firms from CEE countries build stronger innovation competences and capabilities for both the creation and commercialisation of innovations. His treatment analysis of a sample of over 10,000 firms from Eurostat's Community Innovation Survey finds that the innovation activities of firms are dependent on an extensive and diverse network of collaborators, which contribute to increased domestic innovation competencies and capabilities. Stojčić's research finds evidence of the positive impact of collaboration on the commercialisation of existing products, and to a lesser extent, on incremental and radical innovations.

Stojčić, Srhoj, and Coad's (2020) recent article focuses on the specificities of national innovation systems that largely determine the impact and effectiveness of innovation support measures. These measures include public procurement for innovation (PPI) and public funding schemes, particularly in the new CEE EU member states. When examining the additionality to the innovation output of 8 CEE countries based on CIS data, Stojčić, Srhoj, and Coad find that additionality is achieved when firms receive both public funding and innovation-oriented public procurement, and are able to benefit from its synergetic effects. However, they argue that the strongest effect on additionality relates to PPI, and thus more attention should be paid to this instrument if CCE policymakers wish to strengthen their indigenous innovation capabilities. Futher, the instrument

should be tailored to specifically incentivise innovation through novel products and services. Such capabilities are crucial to the innovation process, which has a larger impact on the growth of these countries and on their catching up with advanced EU members.

To address the divergence of development in CEE countries, Radas, Mervar and Škrinjarić (2020) divide them into two clusters. Their study, based on Community Innovation Survey data from 2008–2012, reveals that SMEs from the newest EU member states (Bulgaria, Romania, and Croatia) were unable to benefit effectively from EU funding, and subsequently failed to produce the desired "additionality" to internal R&D activities at the firm level. An interesting insight from this study is that economically successful countries (those that joined in 2004) were able to extract more benefits from public funding, leading to the conclusion that success breeds success in innovation activities.

5. ABSORPTION OF HORIZON 2020 PROGRAMME BUDGETS BY SMES IN THE EU: PANEL DATA ANALYSIS

To determine the effects of participation in EU funding programmes on the innovation and economic performance of SMEs (in the period before Horizon 2020), we analysed its impact on a sample of firms from 10 new EU member states (more than 40,000 observations). We then investigated the aggregate impact for 25 EU states by assessing the impact of the total amount (in EUR) that SMEs received from the Horizon 2020 budget on two variables that capture their economic performance: turnover and number of employees. To achieve this, we used the first difference (FD) approach, since our sample covers only two years (T=2) (see Allison, 2009).

The model is expressed as:

$$\Delta y_{it} = \delta_0 + \beta_1 \Delta x_i + \Delta u_i, \quad t=2 \tag{1}$$

where y_{it} is the value of the dependent variable for i^{th} country at time t, and X_i encompasses the values of the independent variables. The advantage of using this model when T=2 is that there is no need to include further variables to control for unit-specific characteristics: by using the same units at both times these are

automatically controlled for.[3] Due to missing data, the analysis includes all EU member states except Luxembourg, Malta, Croatia, Poland, the Czech Republic, Lithuania, and the UK, making a total of 21 Member States in the sample. The dependent variables in Models 1 and 2 are the SMEs' number of employees and total turnover (EUR millions) respectively, as reported at the beginning of the project and for the latest reporting period. The independent variable is the same in both models, and is defined as the total Horizon 2020 Budget Allocations to SMEs (in 2014 and 2016). Data on the employment and turnover of SMEs were obtained on request from DG R&I, A5 Unit, while data on the Horizon 2020 budget allocation came from eCORDA (self-reported data by the SMEs project beneficiaries). This approach enables us to specifically analyse those SMEs that received funds. The descriptive statistics of variables are shown in Table 5, and the results are presented inTable 6.

As expected, the results show that participation in the Horizon 2020 programme positively affected the economic performance of SMEs' employment and turnover. With a EUR 1 increase in Horizon 2020 funds, an SME's turnover increases by EUR 1.33, and a 1% increase in Horizon 2020's allocated budget increases employment by 0.12%. However, because many factors influence an SME's business performance, the impact of EU R&I funding cannot be assessed solely in relation to Horizon 2020 support. This is duly stressed in the Horizon 2020 Interim Report (Annex 1). Horizon 2020's impact on performance should therefore be interpreted with caution, particularly considering that its implementation and analysis covers a limited 2-year period, especially when interpreting the effect on turnover, the coefficient of which is statistically significant at the p=0.1 level.

[3] Together, fixed effects and first differences are unbiased and consistent; and when T is 2 as in our case, the estimators produce identical estimates. The robustness is also tested by including both country and time-fixed effects (Table A4 in Appendix).

Table 5: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
turn	42	1.67e+08	3.29e+08	224200	1.66e+09
empl	42	2094	6589.344	6	33155
H2020budget	42	3.37e+07	4.56e+07	440775	1.83e+08

Source: Data obtained on request from DG R&I, A5 Unit, and eCorda.

Table 6: Results of the First Difference (FD) regression model [4]

VARIABLES	(Model 1) Employment	(Model 2) Turnover
H2020fund	0.117***	1.332*
	(0.022)	(0.792)
Observations	42	42
R-squared	0.510	0.263

Note: Robust standard errors clustered at the country level are given in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' calculations, based on data obtained on request from the European Commission, DG R&I, A5 Unit.

When the figures are analysed at the aggregate level, it can be seen that countries in which SMEs received more Horizon 2020 funding recorded better business performance, measured by employment and turnover growth. Additionally, the data reveal divergent results between countries: unsurprisingly, new member states perform worse than old ones in terms of both their absorption of Horizon 2020 funds and firms' economic performance.

Our results, although only indicative at this phase, are in line with previous studies. They provide a solid foundation for further research using a more sophisticated econometric cause-effect analysis over a longer period of time, preferably one that covers the whole seven years of the Horizon 2020 programme.

[4] The authors used this approach in their research for Deliverable 2.2. of the Horizon 2020 'I3U' project, where the first results of their study were disseminated (see Vučković & Čučković, 2018. Available at www.i3u-innovationunion.eu).

5.1. Some policy implications

Policy implications that can be drawn from analyses of the Horizon 2020 data demonstrate that countries that received larger amounts of EU R&I funding (overwhelmingly the more developed member states) score better on the European Innovation Scoreboard in innovation performance and outcomes. The data confirms the traditional dichotomy of old (EU15) and new (EU13) member states in relation to funding participation and success rates, but the divisions are not always consistent, as the cases of Slovenia, Estonia, and Cyprus clearly show. In absolute terms, EU-15 countries received 85.7% of the total EC contribution for SME Instrument grants, compared to only 8.4% for EU-13 countries. This highlights the greater capabilities of innovative and growth-oriented SMEs. However, despite their lower funding, SMEs in more developed EU-13 countries demonstrated a significantly improved capability for catching up. In this respect, SMEs from less developed CEE countries, including Croatia, require concerted policy efforts at multiple levels to further develop their innovation and catching-up capabilities, and to increase their potential to absorb available R&I funds from EU and other sources, which will help them scale up this process.

Our review of other empirical studies on the key innovation capabilities of firms from this region shows that when the data are contextualised to fit CEE countries, policymakers must consider many other important factors when formulating their policies based on evidence. Effective policy design requires appropriate innovation metrics, which determine the specific factors and dominant drivers of regional firm-level innovation and technological upgrade.

6. CONCLUDING REMARKS

This paper presents significant empirical evidence of the positive impact of EU R&I funds on the innovation and economic performance of SMEs in new EU member states. In response to our first research question (RQ1), we find support for the conclusion that increased availability and use of EU and other public funding assists SMEs, which generally face greater financial restraints than larger businesses, particularly at the early stages of developing innovative products and processes. Our results are consistent with the Horizon 2020 Interim Evaluation, which shows that SMEs that participated in EU-funded projects delivered a substantial number of new innovations. This demonstrates that participation in

such projects is beneficial to the advancement of SMEs' innovation and commercialisation activities, as well as to their technological upgrading and economic performance and efficiency (see EC, 2017a and EC, 2017b).

Regarding the potential leverage effect of Horizon 2020 funding on total SME R&I expenditures, when we compared the parameters at the beginning and end of the project (using data we received from DG R&I, A5 Unit), the results showed that participation in Horizon 2020 funding programmes positively affected the employment and turnover of SMEs. Although the potential bias and quality of SMEs' self-reported data should be taken into account, our results show that an increase in Horizon 2020 funds by EUR 1 increases the recipient SME's turnover by EUR 1.33, and a 1% increase in funding improves its employment rate by 0.12%. These results answer our second research question (RQ2).

Based on CIS 2014 data, and taking into consideration the methodological limitations, our analyses of the selected innovation and economic performance indicators show that SMEs that received EU funds perform better than than they would have done if they had not eceived EU funds. They also have a higher probability of receiving additional funding from other sources, including private investment.

However, the results presented here should be interpreted with caution, as the econometric analyses behind this paper's impact assessments are limited in scope and duration. This means they are more illustrative and indicative in nature, because they were hampered by data availability and quality. Additionally, because the selected models were based mainly on cross-sectional CIS data and eCORDA data on SMEs as funding recipients (which at that time captured only about 10% of completed projects), the correlations identified do not necessarily provide appropriate causality conclusions.

Future research avenues include assessment of the broader indirect impacts of public funding on SME business performance, such as its impact on SME competitiveness, and the quality of investments and exports within certain industries and types of SMEs. This could be studied in relation to fast-growing young firms, and the issues of crowding in/out (i.e., whether EU R&I funds should augment those financed by SMEs, or whether they are a substitute for private R&I) could be examined based on historical micro-data. Such research

would shed more light on the complexity of SME performance, and direct our attention to the multiple factors and policy contexts of firm and sector levels in the CEE region that significantly affect SME innovation, such as underlying R&I behavioural and organisational aspects, firm age and size, and labour and management skills. The impact of other, non-financial, innovation incentives from the fragmented eco-innovation environment could also be explored, at EU, national, and regional levels. Identifying clusters of countries or sub-regions with similar innovation drivers within the divergent group of new EU members from Central and Eastern Europe might also provide policymakers with interesting new observations. Finally, performing country-level analyses, for example, on a sample of innovating SMEs in Croatia, could provide insight into the specifics of the important non-R&I factors that drive the innovation performance and growth of that country, which is lagging considerably behind its CEE peers.

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APPENDIX

Table A1: Sensitivity analysis – IPWRA and NNM estimations (all sectors)

	NNM		IPWRA	
OUTPUT	EU funds (1 vs. 0)	Central government funds (1 vs. 0)	EU funds (1 vs. 0)	Central government funds (1 vs. 0)
inn_process	0.045*	0.018	0.039*	0.017
	(0.013)	(0.014)	(0.013)	(0.014)
inn_newmkt	0.085*	0.064*	0.082*	0.064*
	(0.017)	(0.018)	(0.016)	(0.018)
inn_exp	1.894*	1.768*	1.939*	1.824*
	(0.172)	(0.172)	(0.168)	(0.169)
turn_mkt	0.035*	0.031*	0.034*	0.032*
	(0.007)	(0.008)	(0.008)	(0.008)

Note: Standard errors in parentheses; * P < 0.01, **P < 0.05, *** P < 0.10

Source: Authors calculation using CIS2014 CD-ROM data.

Table A2: Sensitivity analysis – IPWRA and NNM estimations (High and Medium-High Manufacturing Sectors)

	NNM		IPWRA	
OUTPUT	EU funds (1 vs. 0)	Central government funds (1 vs. 0)	EU funds (1 vs. 0)	Central government funds (1 vs. 0)
inn_process	0.114*	0.052**	0.104*	0.062**
	(0.024)	(0.025)	(0.022)	(0.024)
inn_newmkt	0.086*	0.065**	0.074*	0.071**
	(0.029)	(0.031)	(0.028)	(0.030)
inn_exp	1.239*	0.951*	1.223*	0.933*
	(0.207)	(0.206)	(0.202)	(0.193)
turn_mkt	0.017	0.019	0.021***	0.021
	(0.013)	(0.014)	(0.012)	(0.013)

Note: Standard errors in parentheses; * P < 0.01, **P < 0.05, *** P < 0.10

Source: Authors calculation using CIS2014 CD-ROM data.

Table A3: Sensitivity analysis – IPWRA and NNM estimations (KIBS)

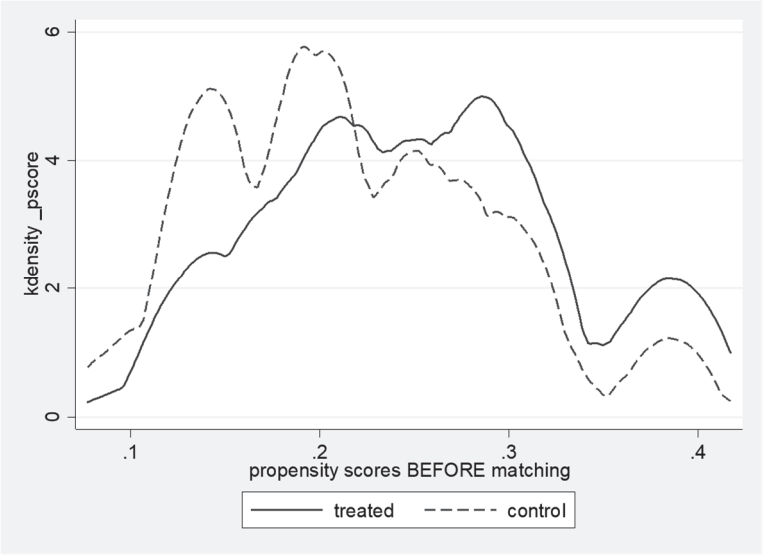
	NNM		IPWRA	
OUTPUT	EU funds (1 vs. 0)	Central government funds (1 vs. 0)	EU funds (1 vs. 0)	Central government funds (1 vs. 0)
inn_process	-0.087	-0.045	-0.827	-0.026
	(0.039)	(0.040)	(0.037)	(0.038)
inn_newmkt	0.161*	0.169*	0.130*	0.159*
	(0.046)	(0.045)	(0.042)	(0.043)
inn_exp	3.171*	3.221*	3.092*	3.155*
	(0.596)	(0.594)	(0.586)	(0.604)
turn_mkt	0.070*	0.059**	0.064*	0.061**
	(0.024)	(0.025)	(0.024)	(0.024)

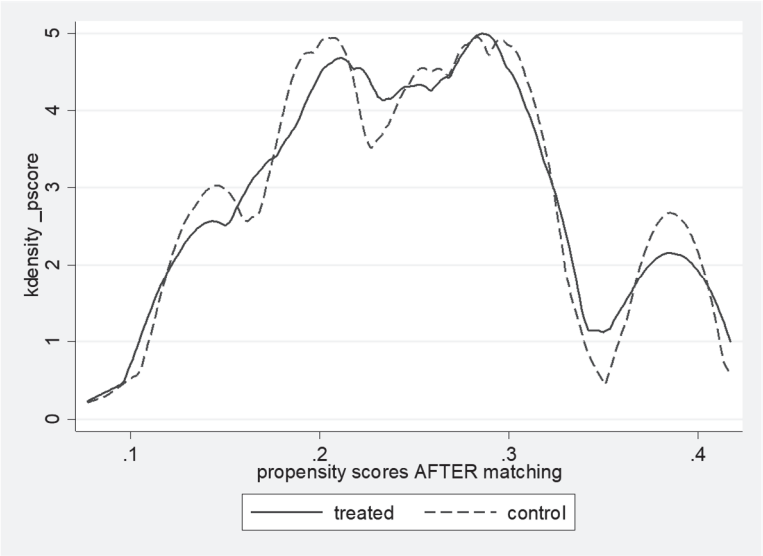
Note: Standard errors in parentheses; * P < 0.01, **P < 0.05, *** P < 0.10

Source: Authors calculation using CIS2014 CD-ROM data.

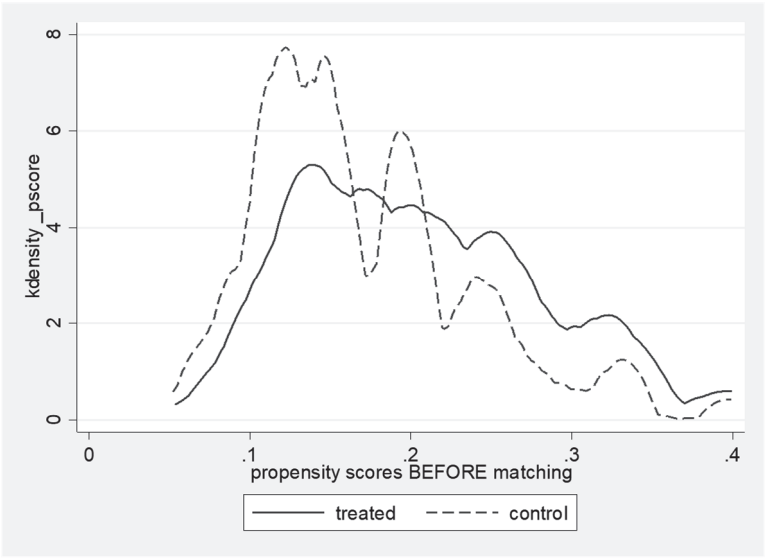
Figure A1. Kernel density of the estimated propensity scores before and after matching for each source of funding (total sample)

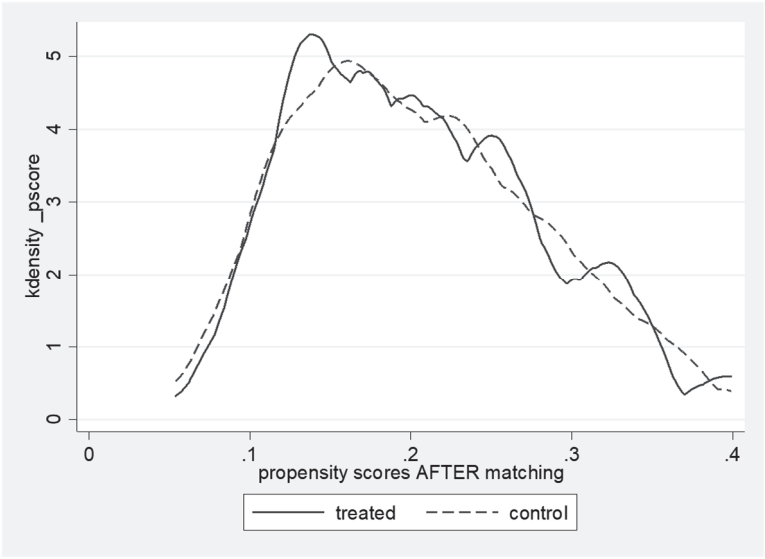
a) EU funds





b) National funds





Source: Authors calculations.

Note: *We also examined whether the treatment model balanced the covariates, and the weighted standardized differences are all close to zero and the variance ratios are all close to one implying that model balances the covariates.*

Table A4: Model including country and year fixed effects

VARIABLES	(Model 1) Employment	(Model 2) Turnover
H2020 fund	0.241***	1.395*
	(0.066)	(0.700)
Time fixed effects	YES	YES
Country fixed effects	YES	YES
Observations	42	42
R-squared	0.998	0.964

Note: *** *p<0.01,* ** *p<0.05,* * *p<0.1.*

Source: Authors' calculations, based on data obtained on request from the European Commission, DG R&I, A5 Unit.

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EMPLOYEE REACTIONS TO CROSS-BORDER ACQUISITIONS: EVIDENCE FROM AN ACQUIRED SERBIAN COMPANY

ABSTRACT: *The purpose of this paper is to examine factors influencing employee reactions to changes brought about by cross-border acquisitions. The research was conducted in a company operating in Serbia's retail sector that was acquired by a Belgian multinational company. The data were collected from 344 respondents. Measures of central tendency, the Mann-Whitney U test, and regression analysis were used to test the research hypotheses. The research results show that employee reactions to changes brought by cross-border acquisition were generally positive. The study show that corporate cultural differences between the acquiring company and the acquired company and the support of transformational leaders resulted in employees reacting positively to the changes. The study attempts to improve understanding of employee reactions during the process of change occurring as a result of cross-border acquisition. Additionally, this study has practical implications, as it points to how the appropriate management of human resources contributes to positive employee reactions.*

KEY WORDS: *employee reactions, cross-border acquisitions, acquired company, corporate cultural differences, transformational leadership.*

JEL CLASSIFICATION: G34, M54, M14

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1. INTRODUCTION

Although companies engage in acquisition processes with optimism, empirical evidence shows that a large number of acquisitions are unsuccessful and that many companies do not realize the expected results. In an effort to identify the causes of failure and the factors that are critical for successful acquisitions, research emphasizes the importance of 'soft' factors. Many companies focus on tangible financial, business, and managerial strategies that can be planned in advance, as well as on potential synergetic benefits. However, Buono and Bowditch (1989) point out that top management often neglects the behavioural aspect of acquisitions. Cartwright and Cooper (1990) agree that the behavioural aspect of acquisitions is an often "neglected" or "hidden" factor in the success of acquisitions. Neglecting human resource issues is somewhat surprising, since human resource management plays an important role in the process of post-acquisition integration.

Acquisitions include organisational change and the integration of certain parts or all parts of the functions and activities of an organisation. Managing such organisational changes is a big challenge since employees may react negatively and resist changes. Acquisitions can be traumatic events for employees because they involve possible lay-offs, adjusting to a new corporate culture, and the introduction of new forms of management and new business rules. The psychological reactions of employees during acquisitions are thus an interesting area of research. However, studies of employee reactions toward change during and after acquisitions have primarily focused on developed economies (Kavanagh and Ashkansasy; 2006; Schweizer and Patzelt, 2012, Teerikangas, 2012), while research on transitional economies is limited. Transitional economies are characterized by a damaged socialist administrative heritage, inefficient human resources, and obsolete management practices, and changes are necessary at both the macro level (changes in the institutional and economic setting) and at the micro level (reorganisation of companies after acquisition). Therefore, the challenges that employees face in transitional economies are greater than in developed economies. This study attempts to fill the research gap by exploring employee reactions to cross-border acquisitions and the factors influencing them in a transitional economy. The research was conducted in a company operating in Serbia's retail sector, which was acquired by a Belgian multinational company.

The study makes a significant empirical contribution in the areas of acquisitions and organisational behaviour. First, it adds to the understanding of employee reactions to cross-border acquisition in the context of a transitional economy. Second, it investigates how employees can be made to positively perceive corporate cultural differences. Third, it emphasizes the significance of transformational leaders, who are essential in creating positive employee reactions toward change. Fourth, the study provides practical recommendations for managers involved in cross-border acquisitions as to the appropriate human resource practices needed to elicit positive employee reactions.

The paper is structured as follows. The first section presents the theoretical background and hypotheses. The second describes the research methodology, particularly the sample research, the way of measuring the research variable, and the method of analysing the data. The third section presents the research results and discussion. Finally, the last section presents the study's theoretical and practical contribution and future directions of research.

2. THEORETICAL BACKGROUND AND HYPOTHESIS

2.1. Employee reactions to cross-border acquisitions

Organisational and personal changes resulting from cross-border acquisitions create unavoidable uncertainty for employees, as many of the changes are of an evolutionary character and final outcomes are often unknown in the initial phase of the acquisition process. Organisational changes often result in unfavourable consequences for employees, resulting in their resistance. Some research has focused on studying the reactions and behaviours of employees and how they experience these processes (Marks and Mirvis, 1992; Galpin and Harndon, 2007; Teerikangas, 2012; Schweizer and Patzelt, 2012; Gunkel et al., 2015).

Employees often experience a high level of concern and uncertainty after the announcement of an acquisition, fearing that they could lose their job or their existing status and position and experience problems related to career development. During the acquisition process rumours may emerge that lead to concern and counterproductive behaviour (Buono and Bowditch, 1989). These rumours are often based on fear rather than on reality and may significantly strengthen employees' concern and stress.

The announcement of an acquisition will most probably initiate questions from employees on the characteristics of the organisation, the integration process, and the outcomes of acquisition. When faced with unexpected events the employees need to understand the meaning of these events and to decide how to respond to them. During cross-border acquisition the employees in an acquired company fear a possible loss of identity. This can lead to serious intergroup/outgroup polarisation, which may create serious inter-organisational conflict (Marks and Mirvis, 1986).

According to job characteristics theory (Oldham and Hackman, 1976), employee reactions are influenced by the characteristics of the organisational tasks that they have to perform after the acquisition. The main characteristics of organisational tasks (diversity of skills, task identity, task importance, task autonomy) have a great influence on employees' perception of acquisitions, their motivation, and their dedication. In cross-border acquisitions employees face uncertainty and concern regarding their competence fulfilling new roles and meeting new demands (Chung et al., 2014). Other dimensions of the business environment such as career development, geographic transfer, and safety at work also influence employee reactions. Employees often react negatively to changes since a large number of acquisitions are followed by changes in the organisational structure, labour relations, and company culture, a lack of communication, career disruption, and loss of status. During the early phase of integration the loss of existing structures and insufficiently developed new structures may lead to negative employee reactions, which makes their adjustment to the new situation more difficult and leads to them having less commitment to the new company (Schweizer and Patzelt, 2012). Galpin and Herndon (2007) emphasize that the productivity and morale of employees in the acquired company may decline significantly due to negative employee reactions toward changes resulting from cross-border acquisition, resulting in negative effects such as declining productivity, absenteeism, declining morale, workers leaving the organisation, and resistance to changes during the first months of the post-acquisition period (Schweiger and DeNisi, 1991; Cartwright and Cooper, 1997; Marks and Mirvis, 2001). This contributes to the outflow of value and the inability to realise projected cash flows and synergies (Schweiger and Very, 2003).

While most of the literature highlights the negative reactions of employees to acquisitions, Teerikangas (2012) demonstrates the possibility of positive employee reactions toward change. In a study of acquisitions by Finnish multinational companies, Teerikangas (2012) examined employee reactions in the pre-acquisition phase and found that in 6 out of 8 researched companies the employees had a positive attitude to the upcoming acquisition, perceiving it as an opportunity rather than a threat. The target companies were aware of the necessity for change and recognized the attractiveness of the acquiring companies. As a result of that, the management of the target companies became proactively involved in successfully implementing the acquisitions. Sarala et al. (2019) point out that employees in economically less developed economies can perceive cross-border acquisitions positively. If the acquiring company is from a highly developed, economically strong economy, the employees of the acquired company understand that there will be increased opportunities for improving personal skills and knowledge and for career development. Personal skills and knowledge are improved by knowledge transfer via various mechanisms, including employee rotation and joint training and education (Aleksić Mirić, 2017). Chung et al. (2014) emphasize that employees react positively to changes when they expect benefits from them. Employees with a positive attitude to organisational changes are prepared to be patient, follow new workplace rules and norms, endure temporary discomfort, overcome obstacles, and work consistently towards realising set goals.

Although empirical research on how acquisitions influence employee reactions is mixed, most research finds that employees have negative reactions toward change. Hence, the first research hypothesis is:

Hypothesis 1: *During the process of cross-border acquisition the employees of the acquired company react negatively to the changes.*

2.2. Corporate cultural differences and employee reactions

When companies from different countries are involved in acquisitions there is a high probability that cultural conflict will occur. The employees may experience psychological stress and concern due not only to differences in corporate culture but also to differences in national cultures. Weber and Camerer (2003) define corporate culture as a shared social understanding that results in company

members having common assumptions and viewpoints. Another definition of corporate culture is "a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation or internal integration, that has worked well enough to be considered valid and, therefore, to be taught new members of organisation as the correct way to perceive, think, and feel in relation to those problems" (Schein, 1992, p.12). The decisions that managers and employees make, the actions they take, and the interactions they participate in are largely determined by the values and norms of corporate culture (Janićijević et al., 2018). Companies are cultural configurations built into a national context; hence, corporate culture also reflects certain national cultural values (Dauber, 2012).

According to Hofstede (2001), the four fundamental dimensions of national culture are power distance, uncertainty avoidance, individualism–collectivism, and masculinity–femininity. Power distance indicates "the level to which the less powerful members of society accept that power is distributed unequally" (Hofstede 2001). Uncertainty avoidance expresses the level to which the members of society feel uncomfortable with issues of uncertainty and ambiguity. Individualism implies a loose social structure in which each individual is fully responsible for their own destiny, and collectivism implies a strong social structure in which individuals have the right to expect the community to take care of them and their family (Janićijević, 2003). Cultures where 'feminine' values prevail appreciate interpersonal relationships, quality of life, cooperation, balance, and harmony, while cultures where 'masculine' values prevail appreciate accomplishment, material rewards for success, assertiveness, and aggressiveness (Janićijević and Marinković, 2015). The culture influences individual perceptions and behaviour, as well as management styles, decision-making, and conflict resolution (Popli et al., 2016).

Corporate culture influences both employees' type of skill and behaviour, and human resource practices. When two companies involved in cross-border acquisition have very different corporate cultures their employees will have fundamentally different skills and behaviours (Sarala et al., 2016). Cultural differences cause differences in organisational behaviour, including work motivation, defining goals, communicating, decision-making and management style, performance evaluation, and rewards (Bogićević-Milikić and Janićijević,

2009). Cultural differences between the acquiring company and the acquired company may become an obstacle to realising the benefits of integration, exacerbate problems of social integration, and reduce employees' organisational commitment to the company (Shi, 2017).

Acquisitions affect the process of employee identification because they involve organisational changes that often imply loss of identification with previous organisational attributes, formation of a new identity, and re-identification with the new entity (Guerrero, 2008). Van Dick et al. (2006, p.72) emphasize that a strong "sense of continuity" will facilitate post-acquisition identification. If employees perceive fewer changes in their jobs, then their identification is more likely to be transferred and retained after the acquisition. If, on the other hand, there is discontinuity (moving to another location, change in the corporate culture) it is less likely that a group will transfer its previous identification to the new organisation (Ullrich et al., 2005).

A cultural conflict occurs when employees are faced with different modes of operating concerning communication style, hierarchy, team work, and monitoring, and believe their way to be superior (Marks and Mirvis, 1992). Usually the acquiring company will impose its own work rules, behavioural norms, and corporate culture. Cultural differences tend to create perceptions of 'us vs. them' and 'inferior vs, superior', which may cause negative employee reactions and lead to distrust, conflict, stress, resistance, and limited cooperation (Wang et al., 2020). Sarala (2009) examines the impact of cultural differences on employees and post-acquisition conflict in a sample of domestic and cross-border acquisitions implemented by a Finnish company in the period 2001–2004. The study finds that differences in corporate culture increase uncertainty, stress, and anxiety for employees in the acquired companies, resulting in negative reactions toward change and less commitment to realising acquisition objectives.

The review of the literature has emphasized the problems and negative employee reactions that result when there are differences in corporate culture. Therefore, the following hypothesis is proposed:

Hypothesis 2: *Corporate cultural differences cause negative employee reactions to changes demanded by cross-border acquisition.*

2.3. Transformational leadership and employee reactions

Organisational changes in a company can be realised by transformational factors that include a new mission, strategy, or corporate culture, and transactional factors that include new procedures, tasks, and individual skills (Chung et al., 2014). Acquisitions, and especially cross-border acquisitions, involve radical changes, primarily in the acquired companies. These are highly emotional events for the employees, and the uncertainty regarding the acquisition situation arouses strong psychological reactions that can result in positive or negative behaviour. Avolio and Bass (2002) emphasize that efficient employee reactions toward changes are highly dependent on transformational leadership, defined as a leadership style that increases awareness of the collective interest among organisational members and helps them to realise collective objectives (Garcia-Morales et al., 2012). Theories of transformational leadership emphasize emotions, values, and the importance of leader orientation in stimulating employees to accept changes and realise common objectives. The employees are valuable organisational resources, and transformational leaders take responsibility for them and promote their professional development.

Transformational leadership is a process in which one person influences another to voluntarily and enthusiastically direct their efforts and abilities to realising defined objectives (Nel et al., 2004). A transformational leader helps employees become aware of organisational problems and provides the necessary resources and feedback to develop a sense of acceptance, safety, and efficiency. Their role is to provide appropriate support to employees, to build the "connective tissue" that helps each side understand the other, to find the appropriate balance between individual interests and company interests, and to convince employees to take personal responsibility regarding ethics and adherence to a common goal (Sitkin and Pablo, 2005). The four dimensions of transformational leadership are: charisma or idealised influence (the leaders act as a role model), inspirational motivation (inspiring employees to accept changes with enthusiasm), intellectual stimulation (encouraging employees to be creative and innovative in new circumstances), and individual considerations (providing help to each individual employee by reacting to his/her problems) (Bass, 1999). In order to develop employee commitment to changes, leaders should demonstrate commitment to change through personal example, provide a clear image or vision of the future, share information, enable employees to participate in changes, tell employees

what exactly is expected from them, and provide necessary support to employees in the form of advice, understanding, and training. Thus, leaders reduce uncertainty among organisation members regarding their role and the future direction of the organisation's development (Chipunza et al., 2011).

Some empirical studies have investigated the influence of transformational leadership on employee reactions (Nemanich and Keller, 2007; Chung et al., 2014; Gunkel et al., 2015; Bader et al., 2015). Nemanich and Keller (2007) show that transformational leadership in the context of acquisitions has a positive influence on employee satisfaction. Analysing a Chinese retail company which is acquired by a large American company, Chung et al. (2014) research employee reactions during and after acquisition in a sample of 174 respondents. The research results show that the support of trained leaders had a significant influence on employees' support for the process of change. A study by Gunkel et al. (2015) analyses cross-border acquisitions in a sample of three companies from Germany, Luxemburg, and Netherlands, acquired by the same company. The research shows that the leaders' support helped create a positive attitude among the employees. Bader et al. (2015) research reactions and responses to acquisitions in a sample of 186 employees in Korean companies that were subject to cross-border acquisition. They analyse how the support of management at various levels in the hierarchy is reflected in employee attitudes to acquisition and find that support from leaders positively impacts employee satisfaction.

Based on the results of these studies, it is expected that the support of transformational leaders during a cross-border acquisition will lead to a positive employee reaction. Hence, the following hypothesis is proposed:

Hypothesis 3: *The support of transformational leaders during the acquisition process results in a positive employee reaction towards the changes demanded by cross-border acquisition.*

3. METHOD

3.1. Sample and procedure

The research focuses on a leading retail business in Serbia that was subject to cross-border acquisition in 2011 by a Belgian company. The acquired company

is one of the leading companies in the retail sector in the Republic of Serbia, while the acquiring company is Belgian multinational company. The multinational company had a retail network on three continents and wanted to expand into the South Eastern Europe market. The research was conducted two years after the acquisition as part of wider research. A traditional paper-and-pencil questionnaire was used to collect the data. A draft version of the questionnaire was tested on a small sample of the respondents, who were asked to provide feedback on the questionnaire item. As a result of this pilot test the author redefined certain items, thus ensuring that there was no confusion about the translated questionnaire.

The human resources management of the acquired company was contacted to approve the research, emphasizing that this type of research could be useful to the company. The management approved its implementation, motivated the employees to participate in the research, and facilitated the distribution and collection of the questionnaire in all parts of the Republic of Serbia where the company operates in order to make the sample representative. Thus, the support of the human resources department ensured the representativeness of all employee categories regarding qualifications, position in the company, sector in the company, and geographical prevalence. The acquired company has 6,356 employees, and the research was conducted on a representative sample of 344 respondents, or 5.41%. Table 1 presents the structure of the respondents according to gender, age, years of work experience, position, and company sector. In the respondent structure, 86.6% are in sales and 13.4% are in administration, which includes risk and control, category management, logistics, marketing and strategy, legal affairs, SAP (System Analysis Program) project, finance and accounting, indirect procurement, human resources and organisational development, IT development, business development, and joint services. An analysis of the company's annual business reports shows that the structure of sales and administrative employees corresponds to their participation in the sample.

Table 1: Sample characteristics

Variable	Frequency	% of Total
Gender		
Male	97	28.2
Female	194	56.4
No response	53	15.4
Age distribution		
18–25	20	5.8
26–35	114	33.1
36–45	106	30.8
46–55	54	15.7
>55	9	2.6
No response	1	11.9
Years of work experience		
<5	70	20.4
5–10	72	20.9
11–15	68	19.8
16–25	43	12.5
>25	52	15.1
No response	39	11.3
Position		
Managerial positions (top, middle, and operative management)	43	12.5
Operating positions	221	64.2
No response	80	23.3
Sector in the company		
Sales	298	86.6
Administration	46	13.4

Source: Author

Because we wanted to include employees who had sufficient years of service to be able to form an attitude towards the acquisition, and as the research was conducted two years after the acquisition, it was important to calculate the stability index of the employees who participated in the survey. The stability index was calculated as the ratio of the number of respondents with five or more years

of service to the total number of respondents. The stability index was 75% for sales employees and 85% for administration employees.

3.2. Measures

Employee reactions to the acquisition were measured using a 6-item scale. According to the theory of job characteristics, employee reactions to acquisitions are influenced by the characteristics of the organisational tasks that employees need to perform after the acquisition. Employee reactions also depend on dimensions of the business environment such as career development and the possibility of losing a position or job. A sample item from the questionnaire is: "I could easily respond to the requirements of the new job". All items were rated on a five-point Likert scale where 1 means strongly disagree, indicating a negative reaction to the acquisition, and 5 means strongly agree, indicating a positive reaction.

Corporate cultural differences were measured by items adapted from surveys developed by Chatterjee et al. (1992), Lubatkin et al. (1999), and Weber (1996). The respondents were asked to indicate the degree of change in the acquired company's corporate culture after the acquisition. The analysed dimensions were innovation, top management contact, autonomy and decision-making, reward orientation, and performance orientation. Sample items are: "After the acquisition there were changes in the ways of rewarding and encouraging employees" and "After the acquisition there were changes in the degree to which the company leant on employees to improve their performance". The 5-point response scale for each item ranged between 1 (strongly disagree) and 5 (strongly agree). Additionally, **national cultural differences** were measured according to the four dimensions of power distance, uncertainty avoidance, individualism–collectivism, and masculinity–femininity (Hofstede, 2001).

Transformational leadership was measured using a modified Multifactor Leadership Questionnaire (Bass and Avolio, 2000). The respondents were asked to rate whether the management exhibited leadership behaviour, inspired employees, acted as models of respect, encouraged innovative behaviour, and helped employees to overcome problems. Transformational leadership was measured using 13 items. Sample items are: "The best managers spoke optimistically about the future of the company" (for inspirational motivation)

and "The best managers stimulated the employees through their personal example" (for idealised influence). The 5-point response scale for each item ranged between 1 (strongly disagree) and 5 (strongly agree).

3.3. Data analysis

The data was analysed using the Statistical Package for Social Sciences (SPSS Version 20.0). The reliability and internal consistency of the variables was measured using Cronbach's Alpha. The analysis showed that all variables had a high level of internal consistency. The transformational leadership variable had the highest (α = 0.975), followed by corporate cultural differences (α = 0.915). The employee reactions variable had the least internal consistency (α = 0.865), but it was significantly above the acceptable coefficient level of 0.7.

Table 2: Values of Cronbach's Alpha and the Kolmogoro-Smirnov test

Variable	Cronbach's Alpha	Kolmogoro-Smirnov test		
		Statistic	df	Sig.
1. Employee reactions	0.865	0.101	327	0.000
2. Corporate cultural differences	0.915	0.66	333	0.001
3.Transformational leadership	0.973	0.089	315	0.000

Source: Author's calculation

The Kolmogoro-Smirnov test was used to test the normality of the variables' distribution. Normality of distribution of the variables exists if Sig. >0.05. The test results found that the assumption of normality of distribution was not confirmed. Therefore, the significance of differences between sub-samples was tested using the non-parameter Mann-Whitney U test. Table 2 presents the values of Cronbach's Alpha and the Kolmogoro-Smirnov test. Measures of central tendency (mean, median, mode), the Mann-Whitney U test, and regression analysis were used to test the research hypotheses.

4. RESULTS AND DISCUSSION

Table 3 shows the mean, median, and mode of the employee reactions variable. Table 4 shows mean values of the items used to measure the employee reactions variable. The value of the mean is above 3 (mean=3.66), and the value of the

median is 3.80. The respondents' reaction to changes brought by the acquisition was generally positive. The highest degree of agreement was in relation to the respondents' ability to respond to the demands of their new job (mean=4.08). This shows that organisational tasks assigned to employees after the acquisition did not change significantly and the employees consider that they have a sufficient level of knowledge and capabilities to perform them.

Table 3: Employee reactions variable – mean, median, mode, and standard deviation

Variable	*N*	*Missing N*	*Mean*	*Median*	*Mode*	*SD*
Employee reactions	327	17	3.66	3.80	3.00	0.949

Source: Author's calculation

Table 4: Items for measuring the employee reactions variable – mean, median, mode, and standard deviation

Items	N	Mean	Median	Mode	SD
I could easily respond to the requirements of the new job	341	4.08	4.00	5.00	1.093
During the acquisition process I could concentrate at work	338	3.93	4.00	5.00	1.149
During the acquisition process I was not afraid of losing my position	338	3.77	4.00	5.00	1.206
During the acquisition process I was not afraid that I would be fired	336	3.69	4.00	5.00	1.262
My expectations of future changes were positive	344	3.56	4.00	4.00	1.156
I understood the changes as an opportunity to develop my career	340	3.30	3.00	4.00	1.275

Source: Author's calculation

The research results show that the respondents expressed the least degree of agreement with the item "I understood the changes as an opportunity to develop my career" (mean=3.30). For most of the items the value of the arithmetic mean is above 3.5, which means that with the exception of seeing change as a career

opportunity the employees had a generally positive attitude toward the changes. Such results are opposite to most research, which shows that employees generally perceive changes brought by acquisition negatively. However, they are in accordance with the research of Teerikangas (2012), which finds that the respondents in the researched companies perceived changes after acquisition as an opportunity since they realised their necessity and significance. Also, since the Serbian company in this study was acquired by a company from an economically developed country, the employees viewed the acquisition as an opportunity to improve their personal skills and acquire additional competence by working in a multinational company. Therefore, Hypothesis 1 is not supported by the results.

Additionally, since it is a retail company, it is useful to determine whether employee perceptions differ depending on whether they are employed in sales or administration. As the test of the normality distribution of the variables showed that there are statistically significant deviations from normal distribution, the Mann-Whitney U test was used to test the significance of the difference between the two sub-samples.

Table 5: Significance testing for differences in employee reactions in sales and administration

	Sector	**N**	***Mean Rank***	***Sum of Ranks***
Employee	Administration	45	99.31	4469.00
reactions	Sales	282	174.32	49159.00
	Total	327		
Sig.				0.000

Source: Author's calculation

Table 5 shows the results of the Mann-Whitney U test used to test differences in employee reactions in the administration and sales sectors. The analysis shows that employee reactions differ (p=0.000) depending on whether the respondents are employed in administration or sales: sales employees reacted more positively to changes (Mean Rank=174.32) than administration employees (Mean Rank=99.31). Table 6 shows the differences in employee attitudes by individual item. The biggest difference is in the items "During the acquisition process I was not afraid that I would be fired", so it can be concluded that administration employees were more afraid of losing their job than sales employees.

Table 6: Significance testing for the different employee reactions in sales and administration

	Company sector	N	Mean Rank	Sum of Ranks
My expectations of future changes were positive	Administration	46	132.83	6110.00
	Sales	298	178.62	53239.00
	Total	344		
I observed the changes as an opportunity to develop my career	Administration	46	115.78	5326.00
	Sales	294	179.06	52644.00
	Total	340		
During the acquisition process I was not afraid of losing my position	Administration	46	102.47	4713.50
	Sales	292	180.06	52577.50
	Total	338		
During the acquisition process I was not afraid that I would be fired	Administration	45	97.77	4399.50
	Sales	291	179.44	52216.50
	Total	336		
During the acquisition process I could concentrate at work	Administration	46	130.22	5990.00
	Sales	292	175.69	51301.00
	Total	338		
I could easily respond to the requirements of the new job	Administration	46	150.73	6933.50
	Sales	295	174.16	51377.50
	Total	341		

Source: Author's calculation

Table 7 shows the mean, median, and mode of the organisational culture differences variable. The value of the arithmetic mean is above 2.5 (2.99), which means that respondents perceive that the organisational culture has changed to a certain extent. The value of the arithmetic mean of the dimensions of organisational culture are 3.13 for innovation, 2.93 for top management contact, 2.84 for autonomy and decision-making, 2.66 for reward orientation, and 3.01 for performance orientation. The research results show that the innovation dimension has changed the most, while the reward-orientation dimension has changed the least.

Table 7: Organisational culture differences variable: mean, median, mode, and standard deviation

Variable	N	Missing N	Mean	Median	Mode	SD
Organisational cultural differences	333	11	2.99	3.00	3.00	1.05

Source: Author's calculation

Table 8 shows the Hofstede indexes of the four dimensions of the national cultures of Serbia and Belgium. The greatest degree of similarity is in the dimension of uncertainty avoidance, which is high in both Serbia and Belgium. Companies in cultures with a high degree of uncertainty avoidance have a large number of formal rules to regulate employee behaviour, standardisation, and formalisation, in order to ensure greater stability and predictability. The power distance index is higher in Serbia than in Belgium, meaning that Serbs accept a hierarchical order and centralisation and unconditional obedience to people in positions of power are popular. The value of the masculinity/femininity index for Serbia is 43, meaning that Serbia has medium to medium-high levels of 'feminine' values that focus on 'working in order to live': people value equality, solidarity, and quality in their working lives. Belgium's score is similar but slightly higher (54). The greatest degree of difference is in the dimension of individualism/collectivism. While Serbia is a country that has a collectivistic culture, shown by its low individualism index, Belgium is a country with an individualistic culture.

Table 8: Hofstede indexes of the four dimensions of national culture: Serbia and Belgium

	Serbia	Belgium
Power distance index	86	65
Uncertainty avoidance index	92	94
Individualism/collectivism index	25	75
Masculinity/femininity index	43	54

Source: https://www.hofstede-insights.com/country-comparison/

Table 9 shows the mean, median, and mode of the transformational leadership variable. The value of the arithmetic mean of transformational leadership is 3.26.

The values of the arithmetic mean of the transformational leadership dimensions are 3.38 for inspirational motivation, 3.30 for idealised influence, 3.06 for individual consideration, and 3.16 for intellectual stimulation. The research results show that employees have a positive perception of the support from leaders, especially in terms of leaders' effort to inspire and encourage employees.

Table 9. Transformational leadership variable: mean, median, mode, and standard deviation

Variable	N	Missing N	Mean	Median	Mode	SD
Transformational leadership	315	29	3.26	2.98	3.00	1.11

Source: Author's calculation

Table 10 presents the results of the regression models. Model 1 tests the impact of corporate cultural differences on employee reactions. This model is statistically significant ($F = 139.456$; $p = 0.00$) and explains 30.7% of the variance in the employee reactions variable (adjusted $R^2 = 0.307$). Model 2 tests the impact of the variable 'transformational leadership' on the dependent variable 'employee reactions'. This model is statistically significant ($F = 113.503$; $p = 0.00$) and explains 27.2% of the variance in the employee reactions variable (adjusted $R^2 = 0.272$). The results of the first regression analysis represented by Model 1 show that differences between the corporate cultures of the acquiring company and the acquired company cause a positive employee reaction to the acquisition ($\beta = 0.554$; $p = 0.00$). This is opposite to the formulated hypothesis that differences in corporate culture negatively influence employees and cause a negative reaction to changes. A possible explanation could be that leaders explained and communicated the necessity of the changes (including changes in corporate culture) to the employees. These research results show that Hypothesis 2 is supported.

Table 10: Results of regression analyses

Variable	Model 1			Model 2		
	β	SE	VIF	*β*	SE	VIF
Corporate culture differences	0.554**	0.042	1.000			
Transformational leadership				0.524**	0.042	1.000
Model statistics						
R^2	0.554			0.274		
Adjusted R^2	0.307			0.272		
F	139.456**			113.503**		

Source: Author's calculation Note: Standardised (β) regression coefficients are shown; **p < 0.01.

The results of the second regression analysis represented by Model 2 show that the support of transformational leaders has a positive influence on employee reactions (β = 0.524; p = 0.00). Such results are expected, given that transformational leaders cause positive employee reactions by explaining the meaning and purpose of cross- border acquisition, communicating a vision of future development, providing necessary help to employees, inspiring and encouraging employees, and transferring realistic information about the necessity of implementing changes. Therefore, the results support Hypothesis 3.

5. CONCLUSION AND IMPLICATIONS

Acquisitions are one of the most difficult organisational changes that employees can face during their working lives. The speed of globalisation during the last few decades has led to a large number of companies adopting cross-border acquisition as a strategy to expand markets. Cross-border acquisitions often have negative consequences for companies and their employees due to cultural differences and possible cultural conflict. The announcement of an acquisition will likely initiate questions from employees regarding the characteristics of the acquiring organisation, the integration process, and the outcomes of the acquisition. Faced with unexpected events, the members of the organisation have to understand their meaning and how they will respond.

The results of this study of a Serbian company that was acquired by a Belgium multinational company show that the employees reacted positively to the changes. Positive employee reactions mean that the employees are better motivated and their commitment to achieving acquisition objectives increase, whereas negative reactions such as anxiety, concern, and frustration reduce the commitment of employees to realising organisational goals. The research finding that the Serbian employees reacted positively to the changes from the acquisition is unexpected in a country whose national culture has an extremely high level of risk aversion. This result is also contrary to the initial assumption based on research in developed economies. The positive employee reactions to the analysed acquisition can be explained by employees' perception that they stand to gain certain benefits from a successful multinational company that operates in a large number of countries and has a presence on three continents. This is in accordance with the opinion of Sarala et al. (2019), who emphasize that often the employees in companies acquired from less developed economies see cross-border acquisitions, especially those by companies from economically developed countries, as an opportunity to improve skills, knowledge, and competences. Further, an internationally recognised multinational company can improve the acquired company's performance by introducing innovative ways of operating, thus benefitting employees in terms of increased salaries and career advancement.

The results of the Mann-Whitney U test show that the sales employees reacted more positively to the changes than the administration employees. This is unexpected, as the comparative stability index results for the two sectors suggest that the administrative staff would have a more positive attitude to change. One explanation for the results of the Mann-Whitney U test is that the administration employees are exposed to greater changes. According to the job characteristics theory, employee reactions are influenced by the organisational task characteristics (diversity of skills, task identity, task importance, task autonomy) that they have to perform after the acquisition, which change more for administration employees than for sales employees. Administration employees face uncertainty and concern because of their competence fulfilling new roles and demands after the acquisition. However, it is also possible that the results of the Mann-Whitney U test are affected by the high turnover rate among sales staff, because employees who left the company are not included in the sample.

The research results show that differences in corporate culture influence the creation of positive employee reactions toward changes that must be implemented in the acquired company. Additionally, support from transformational leaders contributes to a positive employee reaction toward the changes demanded by implementing a cross-border acquisition. Employees react positively to changes when they are personally convinced of the purpose of the changes. Hence, explaining the reasons for change and communicating an attractive and convincing vision can be critical in determining a positive employee reaction. In order to mitigate negative reactions it is important to implement management practices that focus on communication, convey realistic information about the necessity of implementing changes, inspire employees, and include training, and transformational leaders are responsible for all these activities.

This study constitutes a significant theoretical and practical contribution to the literature. First, it contributes to a better understanding of employee reactions to cross-border acquisitions in the context of a transitional economy, and thus to the literature on acquisitions and organisational behaviour in general. The study shows that despite challenges posed by cross-border acquisition, employees will respond positively to changes if they perceive acquisition as an opportunity rather than a threat. Second, the study emphasizes that differences in corporate culture can contribute to positive employee reactions if the necessary changes are appropriately communicated. Third, the study emphasizes the role of transformational leaders, who contribute significantly to creating positive employee reactions by supporting employees and managing changes appropriately during the cross-border acquisition. Fourth, the study results provide significant implications to practitioners indicating that adopting appropriate human resource practices during acquisitions reduces negative employee reactions. Hence, if a company has transformational leaders at various positions, it will increase the number of employees who react positively to changes and therefore will reduce the likelihood that employees would leave the acquired company due to inability to cope with uncertainty and problems.

This study has some limitations. Focusing on one acquired company limits the generalisation of the research results. However, observing one case of cross-border acquisition enables an in-depth analysis and detailed examination of

employee reactions. Also, such approach provides the possibility for future research, i.e. implementation of longitudinal study. After a certain time period this company can be studied again to determine whether the initial positive reactions and perceptions of employees have been retained and whether the multinational company has benefitted employees in terms of improved knowledge, experience, working conditions, salaries, and position in the company. An additional limitation is the high turnover rate of sales staff, which possibly affected the results of the Mann-Whitney U test, as employees who left the company are not included in the sample.

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THE CORRELATION BETWEEN STOCK RETURNS BEFORE AND AFTER ANALYST RECOMMENDATION REVISIONS

ABSTRACT: *In this study I analyse the correlation between stock returns before and after analyst recommendation revisions. I hypothesise that if a recommendation revision for a given stock takes place after a short period when the stock's price moves in the opposite direction, it may indicate that the fundamentals that caused the analyst to revise their recommendation are less completely (if at all) incorporated in the stock price, significantly increasing the probability of subsequent post-event price drift. Analysing a large sample of recommendation revisions, I document that both recommendation upgrades and downgrades are followed by significant one-to-six-month price drifts (reversals) if they are preceded by the opposite-sign (same-sign) short-term cumulative abnormal returns. The effect remains significant after accounting for additional relevant company-specific (size, Market Model beta, historical volatility) and event-specific (stock's return and trading volume on the event day, brokerage firm size, analyst experience, recommendation category before the revision, number of categories changed in the revision) factors.*

KEY WORDS: *analyst recommendation revisions; behavioural finance; under-reaction; stock price drifts.*

JEL CLASSIFICATION: G11, G14, G19.

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1. INTRODUCTION

Stock prices are widely considered to reflect all the information that may be relevant to the respective stocks, at both the market-wide and the respective company's level. The question that preoccupies a large number of financial researchers and stock market practitioners is whether the stock prices immediately incorporate all the relevant information and if it is possible to gain systematic and consistent profits based on pre-determined and continuously repeating price patterns.

One of the issues attracting a lot of interest in this respect refers to stock returns following company-specific events, including analyst recommendation revisions.

Extensive previous literature comprehensively analyses the effects of analyst recommendations on stock prices, and concludes that the investment information they contain is valuable for investors (e.g., Michaely and Womack, 2006; Loh and Mian, 2006; Kecskes et al., 2010; Li et al., 2015). Importantly, recommendation revisions are reported to be more informative than the recommendation levels (e.g., Francis and Soffer, 1997; Jegadeesh et al., 2004; Jegadeesh and Kim, 2010) and to result in significant abnormal stock returns in the direction of the revision.

An additional important aspect of stock price reactions to analyst recommendation revisions refers to systematic price drifts following the initial revisions (e.g., Diether et al., 2002; Gleason and Lee, 2003; Nagel, 2005). These drifts are documented to last up to one month following recommendation upgrades and up to six months following recommendation downgrades. The magnitude of both the immediate stock price reactions to recommendation revisions and the post-recommendation drifts are shown to be different for different groups of stocks (e.g., Womack, 1996; Barber et al., 2001) and different categories of stock analysts (e.g., Loh and Mian, 2006; Sorescu and Subrahmanyam, 2006; Loh and Stulz, 2011).

The main goal of the present study is to analyse stock price dynamics surrounding analyst recommendation revisions. Specifically, I analyse the correlation between stock returns before and after these events. I suggest that if a recommendation revision for a given stock takes place after a short period when the stock's price

moves in the opposite direction, it may indicate that the fundamentals that caused the analyst to revise their recommendation are less completely (if at all) incorporated in the stock price, significantly increasing the probability of subsequent post-event price drift.

Employing an extensive database of stock recommendation revisions, I find corroborative evidence for the study's hypothesis. I document that one-, three-, and six-month positive price drifts after recommendation upgrades are significantly more pronounced if the latter are preceded by relatively low (lowest sample quintile or decile) short-term (5- or 10-day) cumulative abnormal returns. Symmetrically, I detect that one-, three-, and six-month negative price drifts after recommendation downgrades are significantly more pronounced if the latter are preceded by relatively high (highest sample quintile or decile) short-term (5- or 10-day) cumulative abnormal returns. These findings may imply that if a recommendation revision is preceded by the opposite-sign short-term stock returns there may be an underreaction to the underlying fundamental information, so that during the subsequent period the respective stock's price may be more likely to experience a drift. The documented effect of short-term stock returns preceding recommendation revisions on post-revision stock price dynamics remains significant after accounting for additional company-specific (size, Market-Model beta, historical volatility) and event-specific (stock's return and trading volume on the event day, the experience of the analyst who issued the revision and the size of the brokerage firm they work for, the recommendation category before the revision, the number of categories changed in the revision) factors, and is robust to dividing the sampling period into shorter sub-periods.

The rest of the paper is structured as follows. Section 2 reviews the literature dealing with recommendation revisions and subsequent stock price drifts. Section 3 presents and explains the study's research hypothesis. Section 4 introduces the database and the research design. Section 5 reports the empirical tests and their results. Section 6 concludes and provides a brief discussion.

2. LITERATURE REVIEW

As information intermediaries, financial analysts play an important role in modern financial markets (e.g., Lang and Lundholm, 1996; Healy and Palepu, 2001; Beyer et al., 2010). The analysts' opinions about specific stocks may be

expected to provide previously unknown information, and therefore their activity may improve market efficiency (e.g., Grossman, 1995; Frankel et al., 2006). A large body of financial literature focuses on recommendation revisions, defined as the difference between analysts' current recommendations and their previous recommendations regarding the same stocks (Boni and Womack, 2006). These revisions are documented to be more informative than the recommendation levels and to have stronger effects on stock prices (e.g., Francis and Soffer, 1997; Jegadeesh et al., 2004; Jegadeesh and Kim, 2010).

The general conclusion arising from the previous literature dealing with analyst recommendation revisions is that they contain useful investment information for investors. Stickel (1995) documents that short-term stock price reactions to recommendation revisions issued by brokerage houses are a function of the strength of the recommendation, the size of the recommended firm, the contemporaneous earnings forecast revisions, the magnitude of the change in recommendation, the reputation of the analyst, and the size of the brokerage house. Womack (1996) studies revisited buy and sell recommendations of stocks by security analysts and finds systematic differences between pre- and post-recommendation prices. He establishes that, though few recommendations coincide with new public news or provide previously unavailable facts, recommendation revisions, especially recommendation downgrades, are accompanied by economically and statistically significant returns. Green (2006) shows that brokerage firm clients who have early access to stock recommendations receive an important investment advantage.

A well-established group of studies concentrates on the reasons for differential stock price reactions to analyst recommendations and recommendation revisions. Mikhail et al. (2004) report that analysts whose recommendation revisions earned the highest (lowest) excess returns in the past continue to outperform (underperform) in the future, therefore concluding that security analysts are consistent in their stock-picking abilities. Loh and Mian (2006) detect that possessing more accurate forecasts of companies' earnings helps analysts to issue more profitable stock recommendations. Loh and Stulz (2011) demonstrate that a recommendation issued by a leading analyst is more likely to generate a sizable stock reaction. Michaely and Womack (2006) and Kecskes et al. (2010) suggest that stock recommendations result in higher stock price reactions and are

more profitable if they are accompanied by the same-direction earnings forecast revisions. Jegadeesh and Kim (2010) document that recommendations moving away from consensus produce stronger effects on stock prices. Li et al. (2015) conclude that analyst recommendations play an important role in generating the momentum effect.

Numerous studies conclude that stock price reactions to analyst recommendations may be incomplete, resulting in predictable post-recommendation price drifts (e.g., Elton et al., 1986; Brav and Lehavy, 2003; Gleason and Lee, 2003). The latter usually last up to one month for recommendation upgrades and up to six months for recommendation downgrades (e.g., Womack, 1996; Barber et al., 2001). An important observation in this respect is that unlike immediate price reactions to stock recommendations which are in line with the notion of efficient capital markets, systematic post-recommendation price drifts contradict Malkiel and Fama's (1970) semi-strong form of market efficiency, which states that investors should not be able to gain profits based on publicly available information.

The magnitude of post-recommendation price drifts may be different for different types of recommendations and different groups of stocks. Womack (1996) reports that the drifts following 'sell' recommendations are larger and last longer than those following 'buy' recommendations. Barber et al. (2001) argue that post-recommendation price drifts are more significant for smaller companies' stocks. Stickel (1995) suggests that the price drifts are more pronounced after recommendation revisions issued by larger brokerage houses.

The fact that analyst recommendation revisions are followed by systematic and significant price drifts raises the question as to why the relevant underlying information is not immediately incorporated in the stock price. Several studies (e.g., Diether et al., 2002; Nagel, 2005) propose short-sale constraints as a potential reason for negative drifts after downgrades, yet these constraints cannot explain under-reaction to upgrades. Barber et al. (2001) simply suggest that markets in general are not efficient in the semi-strong form, implying that it may be possible to predict stock returns based on public information, like analyst recommendations.

However, the most popular explanation for the existence of post-recommendation price drifts arises from investors' inattention. Theoretical models point out that the latter may lead to underreaction to all kinds of public information. Hirshleifer et al. (2011) build a model where part of the investors do not consider the information contained in an earnings surprise with respect to the firm's future profitability, and conclude that this kind of behaviour may result in the company's stock price underreacting to earnings surprises. Peng and Xiong (2006) construct a model where investor attention constraints lead to "category learning", when investors focus on market-wide and industry-wide rather than firm-specific information, such as analysts' stock recommendations, implying that investors could underreact to this kind of information.

Another strand of empirical study finds corroborative evidence for the above-mentioned models' predictions, employing different proxies for investor inattention and analysing different types of company-specific news. Chen et al. (2004) analyse recommendation revisions around stock additions to and deletions from the S&P500 index and detect their asymmetric price effects, attributing the differences to increased attention to a stock that becomes part of the index. Hong et al. (2007) report that a number of industry returns can forecast the market's return by up to two months and suggest that investors are inattentive to the predictive information contained in industry returns. In the same spirit, Cohen and Frazzini (2008) document that a strategy of buying (selling) stocks of firms whose customers experience positive (negative) news may yield excess returns, and based on this finding argue that investors are inattentive to customer linkages between firms. Hou et al. (2009) show that an earnings momentum strategy is more profitable when investors are inattentive, employing share turnover as a proxy for investor attention. Hirshleifer et al. (2009) find weaker reactions to earnings announcements on high-news days (days when numerous earnings announcements are issued), when investors may be more inattentive. Drake et al. (2012) detect weaker price reactions to earnings announcements immediately preceded by abnormal Google search activity. Yuan (2015) demonstrates that attention-grabbing events, such as front-page articles about the stock market or record levels for the Dow Jones Index, can help to predict future stock market returns, especially when the market index level is already high.

A number of studies concentrate on the effect of investor inattention on stock price reactions to analyst recommendation revisions and on subsequent price drifts. Loh (2010) employs the prior stock turnover and the number of simultaneously published earnings announcements to indicate how distracted investors may be, and the percentage of institutional ownership and the number of analysts covering the stock to reflect the number of sophisticated investors who pay attention to the firm as alternative proxies for investor inattention, and concludes that investors tend to underreact to news about firms that attract less attention. This means that if investors temporarily neglect the information contained in stock recommendations, predictable price drifts should follow as a result of the gradual incorporation of this information. Gavriilidis et al. (2016) continue Loh's (2010) line of reasoning but focus on attention-grabbing recommendations, proxied by abnormally high event-day trading volumes, rather than on attention-grabbing firms. They argue that attention-grabbing recommendations are followed by consistently more pronounced post-announcement drifts than otherwise similar recommendations. This effect appears to be more pronounced for upgrades than for downgrades.

3. RESEARCH HYPOTHESIS

As shown in the previous section, previous financial literature concludes that analyst recommendation revisions are followed by systematic and significant post-recommendation price drifts. The main goal of this study is to predict the dynamics of these drifts.

I hypothesise that if a recommendation upgrade (downgrade) for a given stock takes place a short time after the stock's price decreased (increased), then the stock's price may have a higher potential for moving upwards (downwards) following the revisions, so that a stronger post-recommendation price drift may be expected. On the other hand, if a recommendation upgrade (downgrade) for a given stock takes place shortly after the stock's price increased (decreased) it may indicate that the fundamentals that caused the analyst to revise their recommendation are more completely incorporated in the stock price, significantly increasing the probability of subsequent post-recommendation price reversal.

Thus, the study's main research hypothesis deals with the effect of pre-recommendation stock returns on post-recommendation stock price dynamics, and may be formulated as follows:

Hypothesis: *If a recommendation upgrade (downgrade) is preceded by relatively low (high) abnormal short-term stock returns the stock's cumulative abnormal returns following the recommendation upgrade (downgrade) should be higher (lower).*

4. DATA DESCRIPTION AND RESEARCH DESIGN

The study's sample of stock recommendations is retrieved from the Thomson Financials I/B/E/S database for the period 2003 to 2017, where stock recommendations are coded in integers from 1 (Strong Buy) to 5 (Strong Sell). I concentrate on recommendation revisions; that is, on the differences between the current and the previous most recent recommendation levels, since previous literature reports that recommendation revisions are more informative than mere levels (e.g., Boni and Womack, 2006; Jegadeesh and Kim, 2010). I define the day when a recommendation revision was issued as the event day (Day 0), except when a revision falls on a non-trading day. In the latter case, I define the event day as the trading day following the day when the recommendation was revised.

Similarly to Li et al. (2016), I remove from the sample recommendation re-initiations (new recommendations issued by an analyst with respect to a stock after more than a year after their previous recommendation with respect to the same stock). Furthermore, in line with Loh (2010) and in order to be sure that a stock price's reaction to a recommendation revision was not partially driven by the same company's contemporaneous earnings announcement, I exclude from the sample recommendation revisions that were issued in the three-day window centred around the I/B/E/S quarterly earnings announcement dates. Additionally, I do not consider stocks with share prices below $1.00.

I merge the recommendation data form I/B/E/S with daily stock price data for all NYSE, AMEX, and NASDAQ common stocks from the Center for Research in

Security Prices (CRSP).[1] In addition, for each recommendation revision I match the respective company's market capitalisation, as recorded on a quarterly basis at http://ycharts.com/, for the closest preceding announcement date.

Table 1 in the Appendix reports basic descriptive statistics for the sample companies undergoing stock recommendation revisions and for the analysts involved. The statistics include companies' market capitalisation for the closest preceding announcement date; Market Model beta estimated over days –251 to –1 (roughly one year) preceding the event day, with the S&P 500 Index employed as a proxy for the market portfolio; standard deviation of daily stock returns over the same period; and analyst experience proxied by the number of years that the analyst existed in I/B/E/S prior to the specific recommendation revision. The sample consists of 77,894 (87,342) recommendation upgrades (downgrades). The mean market capitalisation equals 4,654 (4,497) million dollars, the mean beta is 1.03 (1.12), the mean historical volatility of stock returns equals 1.75% (1.80%), and the mean analyst experience is 5.70 (5.59) years. Thus, overall, there appears to be no substantial differences in the basic descriptive statistics between the recommendation upgrades and downgrades.

Table 2 in the Appendix classifies the analyst recommendation revisions in the sample by recommendation category before the revision (Panel A), by the number of categories changed in the revision (Panel B), and by calendar years when the recommendation revisions were issued (Panel C). For the vast majority of analyst recommendation revisions in the sample only one rating category is changed, and the distribution of the revisions by years is quite homogeneous. Once again, the distribution characteristics of the recommendation upgrades and downgrades look quite similar.

5. RESULTS

5.1. Stock price dynamics following recommendation revisions: Total sample

In order to estimate and quantify stock price dynamics immediately before and after analyst recommendation revisions (events), I calculate daily abnormal stock

[1] The two data sets are merged based on either CUSIP or exchange tickers combined with the requirement that the period these identifiers are used in the data sets overlap.

returns (ARs) employing Market Model Adjusted Returns (MMAR).[2] I define the estimation window as days –261 to –11 preceding the event, and within this window, for each event *i*, run the following regression of the respective stock's returns on the contemporaneous market (S&P 500 Index) returns:

$$SR_{it} = \alpha_i + \beta_i MR_{it} + \varepsilon_{it} \quad (1)$$

where *SRit* represents the stock's return on day *t* (*t* runs from –261 to –11) preceding event *i*; and *MRit* refers to the market return on day *t* preceding event *i*. Subsequently, I use the regression estimates $\widehat{\propto_i}$ and $\widehat{\beta_i}$ to calculate ARs for each of 10 days preceding event *i*, for Day 0, and for each of 126 days following the event, as follows:

$$AR_{it} = SR_{it} - \left[\widehat{\propto_i} + \widehat{\beta_i} MR_{it}\right] \quad (2)$$

where *ARit* represents the abnormal stock return on day *t* following event *i* (*t* runs from –10 to 126), and *SRit* and *MRit* refer to the stock and the market returns for the respective days following event *i*.

In order to test the study's research hypothesis I need to estimate the post-event stock price dynamics. To do so, I employ cumulative ARs (CARs) for Days 1 to 21, Days 1 to 63, and Days 1 to 126, roughly corresponding to one month, three months, and six months after the revision, respectively.[3]

Table 3 in the Appendix depicts CARs for the three above-mentioned post-event periods following recommendation upgrades and downgrades, and their statistical significance. The results demonstrate that both upgrades and downgrades are followed by significant price drifts. The findings are also consistent with previous literature (e.g., Womack, 1996; Barber et al., 2001) regarding the fact that the magnitude of the drifts following recommendation

[2] Alternatively, I calculate ARs using Market Adjusted Returns (MAR) – return differences from the market index, and the Fama-French three-factor model. The results (available upon request) remain qualitatively similar to those reported in Section 5.

[3] I analyse post-recommendation periods of one, three, and six months following, for example, Loh (2010) and Gavriilidis et al. (2016).

upgrades gradually decreases after the first post-event month, while the magnitude of the drifts following recommendation downgrades increases during the whole analysed six-month post-event period.

5.2. Effect of short-term stock returns preceding recommendation revisions on post-recommendation stock price dynamics

To test the main research hypothesis of the study I divide the above-described sample of recommendation revisions according to the magnitude of the short-term abnormal stock returns registered before the event. Table 4 in the Appendix presents CARs for Days 1 to 21, Days 1 to 63, and Days 1 to 126 following recommendation upgrades and downgrades, separately for the subsample representing the highest and the lowest 5-day pre-event CAR quintiles and deciles, and the respective CAR differences. Table 5 in the Appendix performs the same analysis based on the 10-day pre-event CAR classification.[4] The results support the existence of the effect of short-term pre-event returns on post-event stock price dynamics, indicating that:

- After recommendation upgrades preceded by the lowest-quintile or decile 5- or 10-day CARs, that is, in the cases where the fundamentals that caused the analyst to revise their recommendation are not incorporated in the stock price before the recommendation, there are significantly positive average CARs, or price drifts, over all the post-event periods, whose magnitude slightly increases as the post-event window is expanded. For example, average CAR for days 1 to 126 after recommendation upgrades preceded by the lowest-decile 5-day CARs is 1.53%. On the other hand, stocks whose 5- or 10-day CARs before recommendation upgrades are in the highest quintile or decile experience significantly negative average post-event CARs, or price reversals.
- Symmetrically, after recommendation downgrades preceded by the highest-quintile or decile 5- or 10-day CARs there are significantly negative average CARs, or price drifts, over all the post-event periods, whose magnitude also increases as the post-event window is expanded. For example, the average CAR for days 1 to 126 after recommendation downgrades preceded by the highest-decile 5-day CARs is –1.67%. On the other hand, stocks whose 5- or

[4] In addition, I have classified recommendation revisions by their 30-day pre-event CARs. The results with respect to the post-event CAR dynamics (available upon request) are qualitatively similar to those presented in Section 5.

10-day CARs before recommendation downgrades are in the lowest quintile or decile exhibit significantly positive average post-event CARs, or price reversals.

- For both recommendation upgrades and downgrades, average CAR differences between the events preceded by the highest- and the lowest-quintile or decile 5- or 10-day CARs are highly significant, and their magnitude gradually increases as longer post-event periods are considered. For example, for post-event days 1 to 126, average CAR differences between large stock price increases (decreases) preceded by the highest- and the lowest-decile 5-day CARs is –1.87% (–2.05%). This result provides the major support for the study's hypothesis, implying that post-event positive (negative) price drifts are significantly stronger for recommendation upgrades (downgrades) preceded by relatively low (high) CARs.[5]

5.3. Multifactor analysis

After documenting the effect of short-term stock returns preceding recommendation revisions on post-event stock price dynamics, I test its persistence, controlling for additional, potentially relevant company- and event-specific factors. For this purpose, separately for recommendation upgrades and downgrades, I run the following cross-sectional regressions for post-event days 1 to 21, 1 to 63, and 1 to 126:

$$\begin{aligned} CAR_{it} &= \beta_1 Preceding\_High_i + \beta_2 Preceding\_Low_i + \beta_3 MCap_i + \beta_4 Beta_i + \\ &+ \beta_5 SRVolat_i + \beta_6 SR0_i + \beta_7 AbVol0_i + \beta_8 Experience_i + \beta_9 BrokerSize_i + \\ &+ \beta_{10} Magnitude_i + \sum_{s=j}^{j+3} \gamma_s from_{si} + \varepsilon_{it} \end{aligned} \quad (3)$$

where *CARit* represents the cumulative abnormal stock return following event *i* for the post-event window *t* (Days 1 to 21, 1 to 63, or 1 to 126); *Preceding_Highi* is a dummy variable, taking the value 1 if the 5- or 10-day CAR preceding event *i*

[5] As a robustness check, I have excluded from the sample the recommendation revisions that were accompanied by the same companies' earnings announcements (within the time window from Day –2 to Day 2), and have repeated for this filtered sample the same analysis as described in Subsection 5.2. The results with respect to the post-event CAR dynamics (available upon request) are qualitatively similar to those presented in Subsection 5.2.

is in the highest sample quintile, and 0 otherwise; *Preceding_Lowi* is a dummy variable, taking the value 1 if the 5- or 10-day CAR preceding event *i* is in the lowest sample quintile, and 0 otherwise;[6] *MCapi* denotes the natural logarithm of the firm's market capitalisation corresponding to event *i*, normalised in the cross-section; *Betai* refers to the estimated Market Model beta for event *i*, calculated over the Days –261 to –11 and normalised in the cross-section; *SRVolati* is the standard deviation of the stock's returns over the Days –261 to –11 corresponding to event *i*, normalised in the cross-section; *SR*0 *i* represents the Day-0 stock return corresponding to event *i*; *AbVol0i* is the abnormal Day-0 stock trading volume corresponding to event *i*, calculated as the difference between the stock's actual Day-0 trading volume and its average trading volume over Days -261 to –11, normalised by the standard deviation of its trading volume over the same estimation window; *Experiencei* is the natural logarithm of the number of years that the analyst providing recommendation revision *i* existed in I/B/E/S prior to the revision, normalised in the cross-section; *BrokerSizei* is the size of the brokerage firm (assets under management) that has released revision *i*, normalised in the cross-section; *Magnitudei* is the number of recommendation categories changed in the revision (event *i*); and *fromsi* are dummy variables, taking the value 1 if the initial recommendation category (according to the numerical scale) before revision is *s* (with *j* equal to 1 for downgrades and 2 for upgrades, to span all possible recommendation revisions within each regression).

Tables 6 and 7 report regression coefficient estimates for all the post-event windows, with 5- and 10-day pre-event periods respectively, employed to measure abnormal stock returns preceding the event. The results corroborate the study's hypothesis, demonstrating that:

- For recommendation upgrades, regarding all the post-event windows, regression coefficients on *Preceding_High* are significantly negative and regression coefficients on *Preceding_Low* are significantly positive, indicating once again that positive post-event price drifts following recommendation upgrades are significantly more (less) pronounced if the latter are preceded by relatively low (high) short-term CARs.

[6] I have repeated the regression analysis defining the *Preceding_Highi* and *Preceding_Lowi* variables for the highest and the lowest pre-event CAR deciles, rather than quintiles. The results (available upon request) remain qualitatively similar to those reported in Subsection 5.3.

- Similarly, for recommendation downgrades, considering all the post-event windows, regression coefficients on *Preceding_High* are significantly negative and regression coefficients on *Preceding_Low* are significantly positive, implying that negative post-event price drifts following recommendation downgrades are significantly more (less) pronounced if the latter are preceded by relatively high (low) short-term CARs.
- For all the post-event windows following recommendation upgrades (downgrades), the regression coefficients on *MCap* are significantly negative (positive), the regression coefficients on *SRVolat* are significantly positive (negative), and the regression coefficients on *Beta*, *Experience,* and *Magnitude* are positive (negative) and marginally significant. These findings suggest that recommendation upgrades (downgrades) for low capitalisation, high-beta, and highly volatile stocks, as well as those issued by more experienced analysts and involving more changed categories in the revision, tend to be followed by more pronounced price drifts. These results may be attributed to the fact that investors probably possess less fundamental information on these groups of stocks, which makes their reaction to these companies' events weaker, and in some cases probably insufficient, creating room for subsequent price drifts. Once again, we note that the effect of the short-term pre-event stock returns on the post-event stock price dynamics remains significant after accounting for the above-mentioned factors.
- The coefficients on *SR0, ABVOL0,* and *BrokerSize* are non-significant, indicating that the magnitude of the initial reactions to recommendation revisions, as expressed by both stock price change and the trading volume on the day of the revision, as well as the size of the brokerage firm that issued the recommendation revision, do not significantly affect post-event stock returns.

5.4. Sub-period analysis

As an additional robustness check, I split the sampling period into three equal sub-periods: years 2003 to 2007 (sub-period 1), years 2008 to 2012 (sub-period 2), and years 2013 to 2017 (sub-period 3), and repeat the analysis performed in Subsection 5.2 separately for each of the sub-periods.

Tables 8 and 9 in the Appendix comprise post-event CARs and CAR differences following the highest and the lowest 5-day and 10-day pre-event CAR quintiles

and deciles, for sub-period 1. Tables 10 and 11 provide the same statistics for sub-period 2, while Tables 12 and 13 similarly refer to sub-period 3. The results look very similar for all the three sub-periods, indicating that the effect of short-term stock returns preceding recommendation revisions on post-event stock price dynamics is not driven by any period-specific characteristics.

6. CONCLUDING REMARKS

In this study I analyse the correlation between stock returns before and after analyst recommendation revisions. I hypothesise that if a recommendation revision for a given stock takes place after a short period when the stock's price moves in the opposite direction, it may indicate that the underlying information is not sufficiently incorporated in the stock price, significantly increasing the probability of subsequent post-event price drift.

Analysing a vast sample of recommendation revisions, I find corroborative evidence for the study's hypothesis. I document that both recommendation upgrades and downgrades are followed by significant one-to-six-month price drifts (reversals) if they are preceded by the opposite-sign (same-sign) short-term cumulative abnormal returns. The effect remained significant after accounting for additional relevant company-specific (size, Market Model beta, historical volatility) and event-specific (stock's return and trading volume on the event day) factors, and proved to be robust to different proxies for defining large price changes and to different methods of adjusting returns, such as market-adjusted returns, market-model excess returns, and Fama-French three-factor model excess returns.

Based on the study's findings, we may conclude that the strategy based on buying (selling short) stocks that have experienced recommendation upgrades (downgrades) preceded by relatively low (high) short-term abnormal returns may be promising, at least in a perfect stock market with no commissions. This conclusion may be an additional challenge for the Efficient Market Hypothesis, and probably calls for some further research that concentrates on analysing data from additional stock markets and differentiating between groups of stocks based on public company characteristics and between periods of bull and bear markets.

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APPENDIX (TABLES)

Table 1: Descriptive statistics for the firms making up the sample and the stock analysts

Category of recommendation revisions	Number of recommendations revisions	Market capitalisation, $ millions		Market Model Beta		St. Dev. of historical stock returns, per cent		Analyst experience, years	
		Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Upgrades	77,894	4,654	12,235	1.03	0.35	1.75	0.82	5.70	2.53
Downgrades	87,342	4,497	12,140	1.12	0.37	1.80	0.85	5.59	2.54
Total	*165,236*	*4,578*	*11,672*	*1.08*	*0.34*	*1.78*	*0.84*	*5.64*	*2.51*

Table 2: Descriptive statistics of the recommendation revisions in the sample

Panel A: Recommendation revisions by category before revision			
Category before revision	Number of recommendation revisions		
	Upgrades	Downgrades	Total
1	0	14,826	14,826
2	4,659	46,312	50,971
3	42,829	22,394	65,223
4	29,226	3,810	33,036
5	1,180	0	1,180
Total	*77,894*	*87,342*	*165,236*
Panel B: Recommendation revisions by number of categories changed in the revision			
Number of categories changed in the revision	Number of recommendation revisions		
	Upgrades	Downgrades	Total
1	72,023	80,469	152,492
2	5,552	6,485	12,037
3	256	298	554
4	63	90	153
Total	*77,894*	*87,342*	*165,236*

Panel C: Recommendation revisions by calendar year			
Year	Number of recommendation revisions		
	Upgrades	Downgrades	Total
2003	4,995	5,849	10,844
2004	5,225	5,710	10,935
2005	5,197	5,644	10,841
2006	5,278	6,025	11,303
2007	5,091	5,807	10,898
2008	5,181	5,770	10,951
2009	5,282	5,785	11,067
2010	5,086	5,821	10,907
2011	5,244	5,896	11,140
2012	5,198	5,743	10,941
2013	5,041	5,793	10,834
2014	5,308	5,944	11,252
2015	5,240	5,739	10,979
2016	5,202	5,867	11,069
2017	5,326	5,949	11,185
Total	*77,894*	*87,342*	*165,236*

Table 3: Stock price dynamics following recommendation revisions: Total sample

Days relative to event	Average CARs following recommendation revisions, % (2-tailed p-values)	
	Upgrades	Downgrades
1 to 21	***0.42 (0.21%)	***–0.49 (0.11%)
1 to 63	***0.41 (0.19%)	***–0.61 (0.00%)
1 to 126	***0.35 (0.15%)	***–0.94 (0.00%)

Asterisks denote 2-tailed p-values: ***p<0.01

Table 4: Stock price dynamics following recommendation revisions as a function of 5-day CARs preceding the event

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.15 (2.02%)	***1.08 (0.02%)	***–1.23 (0.02%)	**–0.16 (1.85%)	***1.15 (0.01%)	***–1.31 (0.00%)
1 to 63	***–0.26 (0.36%)	***1.27 (0.00%)	***–1.53 (0.00%)	***–0.29 (0.31%)	***1.36 (0.00%)	***–1.65 (0.00%)
1 to 126	***–0.34 (0.16%)	***1.53 (0.00%)	***–1.87 (0.00%)	***–0.38 (0.12%)	***1.65 (0.00%)	***–2.03 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.15 (0.00%)	***0.20 (0.95%)	***–1.35 (0.00%)	***–1.18 (0.00%)	***0.21 (0.85%)	***–1.39 (0.00%)
1 to 63	***–1.47 (0.00%)	***0.31 (0.25%)	***–1.78 (0.00%)	***–1.57 (0.00%)	***0.33 (0.18%)	***–1.90 (0.00%)
1 to 126	***–1.67 (0.00%)	***0.38 (0.15%)	***–2.05 (0.00%)	***–1.81 (0.00%)	***0.43 (0.09%)	***–2.24 (0.00%)

Asterisks denote 2-tailed p-values: **p<0.05; ***p<0.01

Table 5: Stock price dynamics following recommendation revisions as a function of 10-day CARs preceding the event

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.16 (1.98%)	***1.10 (0.02%)	***–1.26 (0.00%)	**–0.17 (1.80%)	***1.16 (0.01%)	***–1.33 (0.00%)
1 to 63	***–0.28 (0.32%)	***1.28 (0.00%)	***–1.56 (0.00%)	***–0.31 (0.28%)	***1.37 (0.00%)	***–1.68 (0.00%)
1 to 126	***–0.35 (0.14%)	***1.55 (0.00%)	***–1.90 (0.00%)	***–0.39 (0.11%)	***1.67 (0.00%)	***–2.06 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.18 (0.00%)	***0.20 (0.97%)	***–1.38 (0.00%)	***–1.20 (0.00%)	***0.22 (0.80%)	***–1.42 (0.00%)
1 to 63	***–1.49 (0.00%)	***0.33 (0.21%)	***–1.82 (0.00%)	***–1.59 (0.00%)	***0.33 (0.19%)	***–1.92 (0.00%)
1 to 126	***–1.69 (0.00%)	***0.39 (0.13%)	***–2.08 (0.00%)	***–1.84 (0.00%)	***0.44 (0.08%)	***–2.28 (0.00%)

Asterisks denote 2-tailed p-values: **$p<0.05$; ***$p<0.01$

Table 6: Multifactor regression analysis of stock price dynamics following recommendation revisions as a function of 5-day CARs preceding the event: Dependent variables – Stock CARs for different post-event windows

Panel A: Recommendation upgrades			
Explanatory variable	Coefficient estimates, % (2-tailed p-values)		
	CAR (1, 21)	CAR (1, 63)	CAR (1, 126)
Preceding_High	***–0.56	***–0.67	***–0.79
	(0.00%)	(0.00%)	(0.00%)
Preceding_Low	***0.70	***0.85	***0.92
	(0.00%)	(0.00%)	(0.00%)
MCap	**–0.27	***–0.29	***–0.31
	(1.06%)	(0.94%)	(0.65%)
Beta	0.07	0.09	*0.10
	(20.17%)	(13.75%)	(9.88%)
SRVolat	**0.26	**0.27	**0.25
	(1.48%)	(1.43%)	(1.92%)
SR0	–0.04	–0.05	–0.04
	(30.71%)	(29.84%)	(35.20%)
AbVol0	0.02	0.01	0.01
	(41.57%)	(58.20%)	(53.02%)
Experience	*0.13	*0.14	*0.12
	(7.58%)	(6.87%)	(8.51%)
BrokerSize	0.04	0.03	0.05
	(27.84%)	(32.08%)	(26.30%)
Magnitude	*0.09	*0.11	*0.12
	(9.12%)	(8.28%)	(7.91%)
from2	***0.34	***0.37	***0.41
	(0.25%)	(0.14%)	(0.08%)
from3	**0.29	**0.28	***0.37
	(1.34%)	(1.59%)	(0.87%)
from4	***0.38	***0.42	***0.51
	(0.04%)	(0.01%)	(0.00%)
from5	***0.36	***0.41	***0.49
	(0.18%)	(0.07%)	(0.01%)

Asterisks denote 2-tailed p-values: *p<0.10; **p<0.05; ***p<0.01

Table 6 (continued):

Panel B: Recommendation downgrades			
Explanatory variable	Coefficient estimates, % (2-tailed p-values)		
	CAR (1, 21)	CAR (1, 63)	CAR (1, 126)
Preceding_High	***–0.76	***–1.00	***–1.13
	(0.00%)	(0.00%)	(0.00%)
Preceding_Low	***0.59	***0.77	***0.92
	(0.00%)	(0.00%)	(0.00%)
MCap	***0.36	***0.38	***0.39
	(0.19%)	(0.17%)	(0.15%)
Beta	–0.09	*–0.11	–0.08
	(14.72%)	(9.97%)	(18.90%)
SRVolat	**–0.26	**–0.27	**–0.25
	(1.92%)	(1.71%)	(1.99%)
SR0	0.04	0.05	0.04
	(31.07%)	(28.46%)	(37.50%)
AbVol0	–0.02	–0.03	–0.01
	(42.15%)	(37.55%)	(60.18%)
Experience	*–0.15	*–0.16	*–0.18
	(7.02%)	(6.77%)	(6.38%)
BrokerSize	–0.03	–0.04	–0.02
	(29.65%)	(27.19%)	(40.01%)
Magnitude	*–0.11	*–0.13	*–0.12
	(8.74%)	(8.12%)	(9.38%)
from1	***–0.39	***–0.42	***–0.45
	(0.02%)	(0.00%)	(0.00%)
from2	***–0.36	***–0.39	***–0.56
	(0.11%)	(0.04%)	(0.00%)
from3	***–0.42	***–0.47	***–0.51
	(0.00%)	(0.00%)	(0.00%)
from4	***–0.38	***–0.41	***–0.53
	(0.07%)	(0.01%)	(0.00%)

Asterisks denote 2-tailed p-values: *p<0.10; **p<0.05; ***p<0.01

Table 7: Multifactor regression analysis of stock price dynamics following recommendation revisions as a function of 10-day CARs preceding the event: Dependent variables – Stock CARs for different post-event windows

Panel A: Recommendation upgrades			
Explanatory variable	Coefficient estimates, % (2-tailed p-values)		
	CAR (1, 21)	CAR (1, 63)	CAR (1, 126)
Preceding_High	***–0.58	***–0.69	***–0.78
	(0.00%)	(0.00%)	(0.00%)
Preceding_Low	***0.69	***0.85	***0.91
	(0.00%)	(0.00%)	(0.00%)
MCap	***–0.29	***–0.31	***–0.33
	(0.92%)	(0.80%)	(0.67%)
Beta	0.06	0.09	*0.10
	(19.23%)	(12.33%)	(9.81%)
SRVolat	**0.26	***0.28	**0.26
	(1.44%)	(0.97%)	(1.69%)
SR0	–0.04	–0.03	–0.05
	(29.96%)	(37.45%)	(26.83%)
AbVol0	0.01	0.01	0.02
	(47.50%)	(45.21%)	(36.46%)
Experience	*0.11	*0.12	*0.12
	(8.74%)	(8.51%)	(8.81%)
BrokerSize	0.03	0.02	0.04
	(31.05%)	(37.28%)	(27.56%)
Magnitude	*0.10	*0.12	*0.11
	(8.73%)	(7.08%)	(8.11%)
from2	***0.33	***0.34	***0.39
	(0.28%)	(0.19%)	(0.05%)
from3	**0.31	**0.30	***0.36
	(1.02%)	(1.24%)	(0.54%)
from4	***0.37	***0.39	***0.47
	(0.08%)	(0.06%)	(0.00%)
from5	***0.35	***0.37	***0.42
	(0.22%)	(0.17%)	(0.02%)

Asterisks denote 2-tailed p-values: *p<0.10; **p<0.05; ***p<0.01

Table 7 (continued):

Panel B: Recommendation downgrades			
Explanatory variable	Coefficient estimates, % (2-tailed p-values)		
	CAR (1, 21)	CAR (1, 63)	CAR (1, 126)
Preceding_High	***–0.78	***–1.03	***–1.15
	(0.00%)	(0.00%)	(0.00%)
Preceding_Low	***0.59	***0.79	***0.94
	(0.00%)	(0.00%)	(0.00%)
MCap	***0.34	***0.38	***0.39
	(0.37%)	(0.17%)	(0.12%)
Beta	–0.08	*–0.11	–0.09
	(17.49%)	(9.77%)	(10.93%)
SRVolat	**–0.24	**–0.26	**–0.27
	(1.97%)	(1.68%)	(1.27%)
SR0	0.04	0.03	0.04
	(28.72%)	(29.62%)	(31.04%)
AbVol0	–0.03	–0.02	–0.01
	(35.61%)	(41.18%)	(50.73%)
Experience	*–0.14	*–0.15	*–0.17
	(7.45%)	(7.20%)	(6.81%)
BrokerSize	–0.03	–0.04	–0.02
	(30.28%)	(27.52%)	(38.94%)
Magnitude	*–0.10	*–0.11	*–0.10
	(8.98%)	(8.67%)	(9.03%)
from1	***–0.37	***–0.39	***–0.47
	(0.05%)	(0.03%)	(0.00%)
from2	***–0.39	***–0.43	***–0.53
	(0.01%)	(0.00%)	(0.00%)
from3	***–0.43	***–0.46	***–0.51
	(0.00%)	(0.00%)	(0.00%)
from4	***–0.40	***–0.44	***–0.52
	(0.01%)	(0.00%)	(0.00%)

Asterisks denote 2-tailed p-values: *p<0.10; **p<0.05; ***p<0.01

Table 8: Stock price dynamics following recommendation revisions as a function of 5-day CARs preceding the event – Sub-period 1 (2003–2007)

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.13 (3.12%)	***1.05 (0.03%)	***–1.18 (0.04%)	**–0.14 (2.41%)	***1.12 (0.03%)	***–1.26 (0.00%)
1 to 63	***–0.24 (0.47%)	***1.21 (0.00%)	***–1.45 (0.00%)	***–0.26 (0.52%)	***1.32 (0.00%)	***–1.58 (0.00%)
1 to 126	***–0.31 (0.29%)	***1.44 (0.00%)	***–1.75 (0.00%)	***–0.35 (0.20%)	***1.59 (0.00%)	***–1.94 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.12 (0.00%)	**0.18 (1.24%)	***–1.30 (0.00%)	***–1.15 (0.00%)	***0.20 (0.97%)	***–1.35 (0.00%)
1 to 63	***–1.42 (0.00%)	***0.29 (0.41%)	***–1.71 (0.00%)	***–1.53 (0.00%)	***0.30 (0.31%)	***–1.83 (0.00%)
1 to 126	***–1.60 (0.00%)	***0.34 (0.21%)	***–1.94 (0.00%)	***–1.74 (0.00%)	***0.39 (0.18%)	***–2.13 (0.00%)

Asterisks denote 2-tailed p-values: **$p<0.05$; ***$p<0.01$

Table 9: Stock price dynamics following recommendation revisions as a function of 10-day CARs preceding the event – Sub-period 1 (2003–2007)

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.15 (2.18%)	***1.07 (0.04%)	***–1.22 (0.00%)	**–0.16 (1.98%)	***1.12 (0.02%)	***–1.28 (0.00%)
1 to 63	***–0.25 (0.58%)	***1.23 (0.00%)	***–1.48 (0.00%)	***–0.29 (0.42%)	***1.32 (0.00%)	***–1.61 (0.00%)
1 to 126	***–0.31 (0.22%)	***1.49 (0.00%)	***–1.80 (0.00%)	***–0.36 (0.18%)	***1.61 (0.00%)	***–1.97 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.14 (0.00%)	**0.19 (1.08%)	***–1.33 (0.00%)	***–1.16 (0.00%)	**0.20 (1.03%)	***–1.36 (0.00%)
1 to 63	***–1.43 (0.00%)	***0.30 (0.37%)	***–1.73 (0.00%)	***–1.53 (0.00%)	***0.31 (0.29%)	***–1.84 (0.00%)
1 to 126	***–1.62 (0.00%)	***0.35 (0.26%)	***–1.97 (0.00%)	***–1.75 (0.00%)	***0.39 (0.14%)	***–2.14 (0.00%)

Asterisks denote 2-tailed p-values: **p<0.05; ***p<0.01

Table 10: Stock price dynamics following recommendation revisions as a function of 5-day CARs preceding the event – Sub-period 2 (2008–2012)

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.17 (1.87%)	***1.10 (0.02%)	***–1.27 (0.01%)	**–0.18 (1.71%)	***1.17 (0.01%)	***–1.35 (0.00%)
1 to 63	***–0.28 (0.33%)	***1.30 (0.00%)	***–1.58 (0.00%)	***–0.32 (0.26%)	***1.39 (0.00%)	***–1.71 (0.00%)
1 to 126	***–0.37 (0.13%)	***1.56 (0.00%)	***–1.93 (0.00%)	***–0.41 (0.10%)	***1.69 (0.00%)	***-2.10 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.17 (0.00%)	***0.21 (0.93%)	***–1.38 (0.00%)	***–1.20 (0.00%)	***0.22 (0.79%)	***–1.42 (0.00%)
1 to 63	***–1.50 (0.00%)	***0.33 (0.21%)	***–1.83 (0.00%)	***–1.59 (0.00%)	***0.35 (0.16%)	***–1.94 (0.00%)
1 to 126	***–1.71 (0.00%)	***0.41 (0.12%)	***–2.12 (0.00%)	***–1.85 (0.00%)	***0.45 (0.07%)	***–2.30 (0.00%)

Asterisks denote 2-tailed p-values: **p<0.05; ***p<0.01

Table 11: Stock price dynamics following recommendation revisions as a function of 10-day CARs preceding the event – Sub-period 2 (2008–2012)

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.17 (1.88%)	***1.13 (0.01%)	***–1.30 (0.00%)	**–0.18 (1.74%)	***1.18 (0.00%)	***–1.36 (0.00%)
1 to 63	***–0.29 (0.30%)	***1.31 (0.00%)	***–1.60 (0.00%)	***–0.33 (0.24%)	***1.39 (0.00%)	***–1.72 (0.00%)
1 to 126	***–0.37 (0.12%)	***1.58 (0.00%)	***–1.95 (0.00%)	***–0.41 (0.12%)	***1.71 (0.00%)	***–2.12 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.20 (0.00%)	***0.21 (0.93%)	***–1.41 (0.00%)	***–1.23 (0.00%)	***0.23 (0.77%)	***–1.46 (0.00%)
1 to 63	***–1.53 (0.00%)	***0.35 (0.18%)	***–1.88 (0.00%)	***–1.63 (0.00%)	***0.35 (0.17%)	***–1.98 (0.00%)
1 to 126	***–1.74 (0.00%)	***0.42 (0.11%)	***–2.16 (0.00%)	***–1.88 (0.00%)	***0.47 (0.05%)	***–2.35 (0.00%)

Asterisks denote 2-tailed p-values: **p<0.05; ***p<0.01

Table 12: Stock price dynamics following recommendation revisions as a function of 5-day CARs preceding the event – Sub-period 3 (2013–2017)

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.16 (1.94%)	***1.09 (0.04%)	***–1.25 (0.02%)	**–0.17 (1.79%)	***1.16 (0.02%)	***–1.33 (0.00%)
1 to 63	***–0.27 (0.35%)	***1.29 (0.00%)	***–1.56 (0.00%)	***–0.31 (0.29%)	***1.37 (0.00%)	***–1.68 (0.00%)
1 to 126	***–0.35 (0.16%)	***1.54 (0.00%)	***–1.89 (0.00%)	***–0.40 (0.12%)	***1.66 (0.00%)	***–2.06 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	5-day pre-event CAR quintile			5-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.16 (0.00%)	***0.20 (0.95%)	***–1.36 (0.00%)	***–1.19 (0.00%)	***0.20 (0.92%)	***–1.39 (0.00%)
1 to 63	***–1.48 (0.00%)	***0.32 (0.24%)	***–1.80 (0.00%)	***–1.57 (0.00%)	***0.33 (0.23%)	***–1.90 (0.00%)
1 to 126	***–1.69 (0.00%)	***0.39 (0.17%)	***–2.08 (0.00%)	***–1.82 (0.00%)	***0.42 (0.11%)	***–2.24 (0.00%)

Asterisks denote 2-tailed p-values: **p<0.05; ***p<0.01

Table 13: Stock price dynamics following recommendation revisions as a function of 10-day CARs preceding the event – Sub-period 3 (2013–2017)

Panel A: Recommendation upgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	**–0.16 (1.94%)	***1.11 (0.03%)	***–1.27 (0.00%)	**–0.17 (1.78%)	***1.17 (0.00%)	***–1.34 (0.00%)
1 to 63	***–0.27 (0.35%)	***1.29 (0.00%)	***–1.56 (0.00%)	***–0.32 (0.26%)	***1.36 (0.00%)	***–1.68 (0.00%)
1 to 126	***–0.36 (0.13%)	***1.55 (0.00%)	***–1.91 (0.00%)	***–0.40 (0.14%)	***1.67 (0.00%)	***–2.07 (0.00%)
Panel B: Recommendation downgrades						
Days relative to event	Average post-event CARs, % (2-tailed p-values)					
	10-day pre-event CAR quintile			10-day pre-event CAR decile		
	Highest	Lowest	Difference	Highest	Lowest	Difference
1 to 21	***–1.19 (0.00%)	***0.20 (0.99%)	***–1.39 (0.00%)	***–1.22 (0.00%)	***0.22 (0.81%)	***–1.44 (0.00%)
1 to 63	***–1.50 (0.00%)	***0.35 (0.19%)	***–1.85 (0.00%)	***–1.62 (0.00%)	***0.33 (0.24%)	***–1.95 (0.00%)
1 to 126	***–1.72 (0.00%)	***0.40 (0.15%)	***–2.12 (0.00%)	***–1.84 (0.00%)	***0.45 (0.08%)	***–2.29 (0.00%)

Asterisks denote 2-tailed p-values: **p<0.05; ***p<0.01

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THE ROLE OF FOREIGN BANKS IN THE TRANSMISSION OF MONETARY POLICY: EMPIRICAL EVIDENCE FROM TUNISIA

ABSTRACT: *This paper presents an empirical analysis of the effect of monetary policy shocks on credit supply in Tunisia, using a vector autoregressive model and a nonlinear interactive model. The focus is on the magnitude of these shocks in the presence of foreign banks. The variables of interest are the concentration index of deposit banks, and monetary policy shocks based on the monthly data of 27 universal and business banks covering the period 1993 to 2016. The results support a positive and significant impact of concentration index on credit supply. However, monetary policy shocks appear to have no significant effect when the market is concentrated with the entry of foreign banks. The findings of this study also reveal that the entry of foreign banks neutralises monetary policy shock transmission in the credit supply, which may be offset by market discipline.*

KEY WORDS: *policy shocks, competitiveness, credit supply, banks, Tunisia.*

JEL CLASSIFICATION: E-E5-E52

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1. INTRODUCTION

Monetary policy shocks have gained the attention of policymakers and academics because they can be one of the primary causes of bank failure and trigger a financial crisis. However, there is still a lot of uncertainty around the effects of monetary policy shocks, despite twenty years of empirical research and many methodological advances. Studying the effects of monetary policy shocks is a difficult endeavour. Most researchers concentrate on examining the effects of monetary policy shocks on credit supply, while few works consider financial liberalisation as a relevant factor affecting the causal link between monetary policy shocks and credit supply. In light of this gap, several studies have examined the effects of financial liberalisation on credit risk. The current study bridges the existing gap in the literature by investigating the importance of liberalisation in the financial markets, measured by banking competitiveness.

This study refers to the theories of Bensaid and Palma (1995), Panzar and Rosse (1987), Gunji et al. (2009), and Gopalan and Rajan (2017). The objective is to demonstrate how a Nonlinear Interactive (NLI) model can connect these theories to evaluate the joint effect of policy monetary shocks and bank competitiveness on credit supply by regressing both monetary policy shocks and the combination of these shocks and the competitiveness index on the credit supply. The primary objective is to empirically investigate whether the concentration of foreign banks affects the causal relationship between the monetary shocks resulting from unexpected fluctuations in interest rates and credit supply in the Tunisian economy.

Regarding monetary policy shocks, our modelling is based on the works of Gunji et al. (2009), who use the residue of the interest rate equation in the VAR model. This model allows calculating the effect of monetary policy's exogenous shocks on economic factors. In other words, the authors consider the impulse response function, as the effect on the economic variables of exogenous shock changes in the interest rate, as a monetary policy.

The presence and design of foreign banks in the Tunisian market are formalised according to Panzar and Rosse's (1987) competitiveness index, showing the concentration of foreign bank ownership in the Tunisian interbank market. The underlying index measures the degree of competitiveness linked to the entry of

foreign banks. The underlying index differs from the classical Herfindahl-Hirschman Index (HHI) and the Concentration Ratios range (CRn) in two important respects. The latter indexes measure domestic banks' degree of concentration, whereas the Panzar-Rosse H-statistic defines a measure of competitive intensity that encompasses more than just domestic banks and includes foreign banks.

Primarily, there are two trends of opinion on this issue, with opposing approaches. The primary trend supports the adverse role of competitiveness in the connection between financial shocks and credit flexibility. Among other things, increased competitiveness and foreign concentration cause monetary shocks to increase the supply of credit and therefore attract more borrowers of lower quality, corrupting asset quality and increasing credit risk. Accordingly, financial deregulation together with the progression of the interest rate build the loan fee, resulting in an intermediation edge inconsistent with a market structure characterised by high competitiveness and an increased concentration of foreign banks. Therefore, this makes the decision criteria flow, increases the supply of credit, and degrades its quality (Grop and Vesela 2004; Bikker and Haaf 2002; Chan et al., 1986; Manove et al., 2001; Gehrig 1998; Marquez 2002; Bolt et Tieman, 2004; Reppulo 2004; Hellman et al., 2000; Ellizalde and Reppulo 2004).

On the other hand, in the presence of greater liberalisation following a rapid growth of credit supply, monetary policy shocks can negatively affect macroeconomic magnitudes. However, Ida et al. (2018) use a varying coefficient Bayesian panel VAR model, where the coefficients are allowed to vary as a function of the degree of financial, product, and labour market regulation, on data from 1976Q1–2006Q4 for 19 OECD countries. The object is to test whether the current account improves or deteriorates following a monetary policy expansion. Their empirical results support the theory. They therefore conclude that following a monetary policy expansion, the current account is more likely to go into deficit in countries with more liberalised financial markets. To this effect, Maudos and Fernandez (2004) argue that acquisitions can increase banking concentration but that they reduce the quality of loans. In addition, Alencar and Nakane (2004) observe that competitiveness makes the economy more sensitive to interest rates.

The second trend supports the proposition that competitiveness mitigates the impact of monetary policy shocks by either diminishing or maintaining the credit supply. This can improve loan quality and does not attract risky, bad borrowers. Within this paradigm, Chen and Haller (2003) and Dermigug-Kunt and Detragiache (2002) demonstrate that liberalisation better controls monetary policy shocks by further diversifying banking products. This makes up for intermediation losses with the profits from specialisation and accordingly makes it easier to control credit risk. In addition, Stiglitz and Greenwald (2003) use the mean-variance approach to analyse the banking system mechanism under the risk-averse constraint. They find that the increase in the interest rate applied to credits in a regulated market is particularly important in a competitive market and that this increase leads to lower deposits that can reduce credit supply.

On the other hand, competiveness can reduce the effect of monetary policy shocks on credit supply, as demonstrated by Adams and Amel (2005), who use U.S. data to test the impact of bank concentration on the transmission of monetary policy. They find that the effect of monetary policy on bank loans is weaker in concentrated banking markets. Their analysis differs somewhat from ours in some key areas. For example, they use the Herfindahl Index as a measure of bank concentration, while we use an index of the degree of bank competition.

VanHoose (1985) shows that competiveness cannot have any effect on the relationship between monetary shocks and credit supply by arguing that if the central bank uses the monetary market security rate as a policy instrument, changes in bank competition will have no impact on monetary control.

On the other hand, the positive effect of monetray policy shocks on credit supply in the presence of competiveness can be neutralised by substituting the interest rate with the cutting score as a thresholder credit decision. Chen (2005) studies the change in borrowers' behaviour when moving from a monopolistic market (in which a single bank operates) to a more competitive one (in which a foreign bank joins its domestic counterpart to compete). The passage between the two markets is governed by the arbitration between the interest rate and the score threshold offered by banks. The authors show that as part of a monopolistic market before the entry of the foreign bank, the interest rate is lower than the one that may be charged as part of a duopoly market. On the other hand, income

volatility is higher after financial liberalisation. The function of the revenue is concave, so that the revenue increases to an optimal threshold and then decreases.

The same author continues his study in 2007 to check the evolution of credit supply following such a gap in competiveness. He conducts a survey of banks in the European Union after globalisation. The research finds that the interest margin decreased while the index of competitiveness increased, and consequently the quality of loans improved. This leads to a decrease in credit risk. After the liberalisation of the banking system the lender's interest rate decreases even though the monetary market rate increases and the interest volatility falls. This result reflects the cautious behaviour of the bank because it is not based on the interest rate; rather it is based on information technology and the increase of the score threshold.

The current study is closely related to the above studies; however, when analysing bank supply and monetary policy shocks we found no empirical analysis that considers the financial liberalisation effect. Unlike previous studies that focus exclusively on examining the relationship between monetary policy shocks and credit supply, we show how introducing the competitiveness of foreign banks into the analysis can affect this relationship.

The rest of this paper is structured as follows. Section 2 presents the model specifications. The methodology is described in section 3. The statistical analysis, namely results and diagnostic checks, are presented in section 4. Section 5 provides a conclusion.

2. MODEL SPECIFICATIONS

The model specifications are derived by adopting a three-step procedure. First, we estimate a VAR model to generate impulse responses to monetary policy shocks. Second, we test if the liberalisation of the financial markets affects the impact of monetary policy shocks on credit supply. Third, we estimate our model by deriving both optimal loan supply and competitiveness.

2.1. The VAR models

In all the following, let MMR, CRS, LIQ, and GDP be the monetary market rate, credit supply, liquidity, and gross domestic product, respectively. Following the methodology of Gunji and Miura (2017), we employ a VAR model of the following form.

$$\begin{bmatrix} MMR_t \\ CRS_t \\ LIQ_t \\ GDP_t \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{2} \alpha_i MMR_{t-i} + \sum_{i=1}^{2} \beta_i CRS_{t-i} + \sum_{i=1}^{2} \theta_i LIQ_{t-i} + \sum_{i=1}^{2} \lambda_i GDP_{t-i} \\ \sum_{i=1}^{2} \alpha_i CRS_{t-i} + \sum_{i=1}^{2} \beta_i LIQ_{t-i} + \sum_{i=1}^{2} \theta_i GDP_{t-i} + \sum_{i=1}^{2} \lambda_i MMR_{t-i} \\ \sum_{i=1}^{2} \alpha_i LIQ_{t-i} + \sum_{i=1}^{2} \beta_i GDP_{t-i} + \sum_{i=1}^{2} \theta_i MMR_{t-i} + \sum_{i=1}^{2} \lambda_i CRS_{t-i} \\ \sum_{i=1}^{2} \alpha_i GDP_{t-i} + \sum_{i=1}^{2} \beta_i MMR_{t-i} + \sum_{i=1}^{2} \theta_i CRS_{t-i} + \sum_{i=1}^{2} \lambda_i LIQ_{t-i} \end{bmatrix}$$

Christiano et al. (2014) show that placing the impulse response function of the MMR in front of other economic variables does not depend on the order of the variables to be imputed in the VAR model. The monetary policy shocks (MPS) are the result of an unexpected change in the monetary market rate (MMR) because of a sharp credit supply (CRS) shock (cf. Equation 1 in the VAR model). These shocks consist of fluctuations in the MMR not considered by the Tunisian Central Bank (TCB), but which can cause an excess of credit risk in Tunisian banks. The details of the estimated error response function of the VAR model are given in the methodology.

2.2. A model for banking competitiveness

Contrary to the classic concentration indexes of Herfindahl–Hirschman (HHI), which are mostly used in the literature, the concentration index used in this paper aims to measure the concentration of foreign banks through a competitiveness index. This index provides a solid measure of the degree of competitiveness linked to the entry of foreign banks. The lower the index, the more the market is concentrated and uncompetitive, and the higher the index, the more the market is liberalised and competitive.

The competitiveness index model uses the work of Panzar and Rosse (1987) and Yeyati and Micco (1987; 2007). The model used to generate a concentration index for each year takes the form

$$\text{Log}(\text{ROA}_i) = \beta_{0i} + \beta_{1i}\text{CE} + \beta_{2i}\text{SE} + \beta_{3i}\text{AC} + \beta_{4i}\text{SD} \quad (1)$$

The parameters of the model represented by Equation (1) are $\beta_i = (\beta_{0i}, \beta_{1i}, \beta_{2i}, \beta_{3i}, \beta_{4i})$, where β_{0i} is the intercept, β_{1i} is the regression coefficient corresponding to the cost of equity (CE), β_{2i} measures the effect of the share of equity (SE), β_{3i} corresponds to the asset costs (AC), and β_{4i} measures the effect share of deposits (SD). The variable of interest is economic performance, the return on assets (ROA). More importantly, β_k, k = (1, 2, 3, 4) measures the elasticity between each of the variables CE, SE, AC, and SD on the one hand and ROA on the other.

A parameter estimation of the model in Equation 1 is performed using the biannual data of 27 Tunisian banks over the period 1993–2016. The panel data set for each year is composed of 54 (27×2) observations. Consequently, we get 24 parameters β_{kt} (k = (1, 2, 3, 4); t = 1993, …, 2016)) for each variable over the period 1993–2016. The competitiveness index, the crux of our analysis, denoted as H, is the sum of the elasticities β_k for each year. Thus, the H-index can be computed as

$$H_{1993 \le t \le 2016} = \sum_{k=1}^{4} \beta_{kt}$$

Estimated parameters of the model are presented in Table 4, while competitiveness index H is displayed in Figure 2.

2.3. Deriving optimal banking competitiveness

Considering bank competitiveness in this study is important when the object is to test the effect of political monetary shocks on credit supply. Furthermore, we want to see how the effect of political monetary shocks imposed on the credit supply by the monetary rate market differs between monopolistic and liberalised markets. We also want to demonstrate the effect of liberalisation on the

relationship between credit supply and monetary policy shocks in Tunisian banks. Therefore, we consider an interactive model taking the form:

$$\text{Log(CRS)} = \alpha_0 + \alpha_1 \text{MPS} + \alpha_2 \text{MPS} \times \text{CPS} \quad (2)$$

As in the case of the VAR model, the credit supply (CRS) is expressed in logarithm, and the CSP variable represents banking competitiveness. The logarithm is used for standardisation reasons: it does not affect the logic but approximates the other variables just for the credit supply value expressed in Tunisian dinars, and consequently facilitates the interpretation of the results. As has been noted before, monetary policy shocks (MPS) are the response of the monetary market rate (MMR) when a credit supply shock (CRS) occurs.

Banking competitiveness allows splitting the effect of shocks on the interest rate in two ways: if the competitiveness index is low, shocks decrease the supply of credit. However, if competitiveness is high, monetary policy shocks are no longer regulated by the supply of credit. This is shown through the following relationship:

$$\frac{\partial \text{Log(CRS)}}{\partial \text{MPS}} = \alpha_1 + \alpha_2 \text{CPS} \quad (3)$$

The range at which the causal relation between MPS and CRS changes is $\frac{\partial \text{Log(CRS)}}{\partial \text{MPS}} = 0$. Namely, for $\text{CSP} = -\frac{\alpha_1}{\alpha_2}$, MPS causes an increase or decrease in the CRS. It should be noted that the shock introduced in model 2 is expansionary (positive shock), reflecting an unexpected increase in MMR faced with a shock on the CRS.

3. MATERIALS AND METHODS

3.1. Data

This study uses the balance sheets of the 27 universal (25) and business (2) banks in Tunisia covering the period January 1993 to December 2016. The variables in the balance sheets relevant to this study are the CRS, MMR, LIQ, and GDP. Data for these variables were collected directly from the International Monetary Fund

(IMF), available on the Tunisian Central Bank (TCB) website (International Financial Statistics). With regard to the bank's competitiveness, this paper examines if MPS transmission, embodied by the interest rate, affects CRS.

Table 1: Summary statistics of the variables included in the VAR model

Variable	Mean	Std. dev	Min	Max	Skewness	Kurtosis	J-Bera	N°of obs.
CRS	5.881	1.743	3.160	10.810	1.169	1.169	3.629	288
LIQ	9.329	0.720	8.167	10.381	–0.720	–0.720	9.329	288
MMR	10.044	0.685	8.987	11.202	0.050	0.050	8.790	288
GDP	3.906	2.006	–1.900	7.150	–0.840	–0.840	4.339	288

Source: Authors' computation

It is important to indicate that credit supply (CRS) and liquidity (LIQ) are expressed in logarithm, while monetary market rate (MMR) and gross domestic product (GDP) are expressed in percentages. Descriptive statistics of these macroeconomic variables, the data for which are available monthly, are presented in Table 1. Consequently, we obtain 288 observations (24 x12), which cover the period 1993 to 2016.

3.2. Methodology

Based on the VAR model, we generate the impulse responses of the variables in MMR_t to monetary policy shocks, which are identified by imposing a triangular orthogonalization. However, first the stationarity[1] and the optimal lag order of the VAR model are checked. The issue of lag-length[2] selection is examined based on the Augmented Dickey-Fuller test and Akaike, Schwarz, and Hannan-Quinn Information Criterions.

[1] Stationarity model VAR is verified but does not appear in the paper.

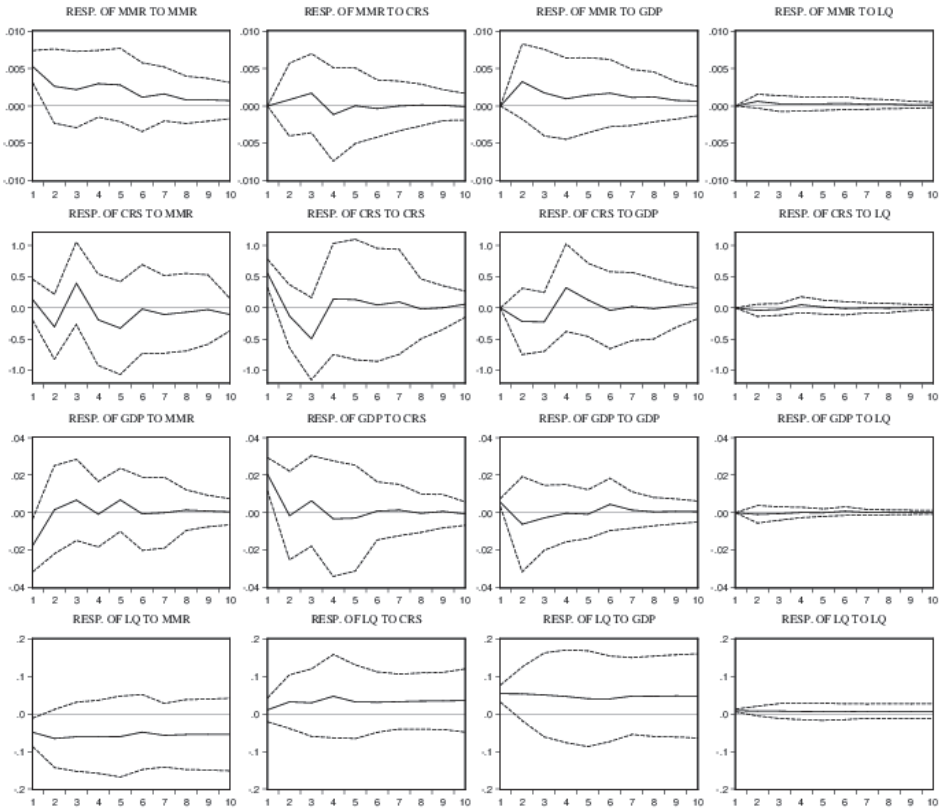
[2] The lag order selection criteria of the VAR model are verified but do not appear in the paper.

Table 2: Stationarity of VAR model

Variable	ADF statistics	Test critical values	Probability
MMR	–3.4271	–3.1449	0.0315
CRS	–4.3672	–3.1753	0.0078
LIQ	–3.4462	–3.2126	0.0353
GDP	–3.1478	–3.1199	0.0477

Table 2 shows that all used variables introduced in the VAR model are stationary at a 5% significance level (p-value < 0.05). Only the first lag is significant and turns out to dominate the others in size.

Figure 1: Empirical Impulse Responses



Note: Orthogonalized error responses to monetary policy shocks. The solid line displays empirical error responses. The dashed lines are 90% error bounds.

Figure 1 clearly shows that the impulse response of credit supply (decrease/increase) resulting from a monetary policy shock is significant. The solid line that displays error responses is well within the 90% confidence interval. Therefore, bank loans decline persistently for the first year and then increase gradually for about two years. The drop-in bank loans continue after around three years, reach a peak after four years, and subsequently return to the baseline. This result shows that the credit supply is highly sensitive to unexpected fluctuations in the MMR. Furthermore, a shock in the MMR results in an immediate and automatic adjustment of the credit supply. Moreover, the monetary policy shocks of the TCB are resolved by adjusting the credit supply to the economy. The effect of the monetary policy shocks reflects the sensitivity of certain economic agents – including borrowers – which are faced with systematic risk. Therefore, an unexpected change in interest rates affects the solvency and the behaviour of borrowers.

Table 3: Summary statistics

Variable	Mean	Std. dev.	Min	Max	Skewness	Kurtosis	J–Bera	N°of obs.
CA	0.0063*	0.0023	0.0038	0.0104	0.4776	1.9270	0.8598	1296
CE	0.3525*	0.0879	0.1537	0.4450	–1.3250	3.6949	3.1272	1296
SE	0.0139*	0.0024	0.0100	0.0176	0.0032	1.8563	0.5450	1296
SD	0.5393*	0.0911	0.3246	0.6493	–1.2912	4.1920	3.3706	1296
ROA	0.0081*	0.0032	0.0042	0.0150	0.8039	3.2219	1.0975	1296

*Mean is statistically not different from zero at the 5% significance level.

Source: Authors' computation

Now, we estimate Equation (1) for each year, to obtain an annual concentration index H. Consequently, we get 24 models for each year, and each model is for 27 banks and two semesters. We obtain a panel data set of 27 banks and 2 semesters over the 1993–2016 period. Descriptive statistics of the variables considered by the Equation (1) model are presented in Table 3.

Table 4 presents estimates of concentration indexes, represented by the coefficients in Equation (1). As defined by Panzar and Rosse (1987), if the concentration index is negative ($H \leq 0$) the market is monopolistic; if the concentration index is between 0 and 1 ($0 \leq H \leq 1$) the market is semi-

competitive; and if the concentration index is equal to unity (H = 1) the market is perfectly competitive.

Table 4: Estimation of the concentration index†

Year	β_0	β_1	β_2	β_3	β_4	R-squared	Fisher	DW
1993	–0.004	–0.003	–0.854	–0.233	–0.042	0.513	0.006	2.010
	(–2.084)	(–2.018)	(–2.131)	(–2.048)	(–2.290)			
1994	–0.001	–0.019	–0.175	0.019	0.024	0.481	0.004	2.610
	(–2.084)	(–2.018)	(–2.031)	(–2.278)	(–2.409)			
1995	–0.001	–0.087	–2.879	–0.491	–0.005	0.767	0.036	2.172
	(–2.040)	(–6.395)	(–3.613)	(–2.333)	(–2.167)			
1996	0.020	–0.078	–1.929	–0.049	0.027	0.981	0.046	2.835
	(–4.849)	(–8.364)	(–9.105)	(–17.963)	(–3.742)			
1997	0.005	0.033	–1.429	–0.113	–0.036	0.949	NA	NA
	(–2.200)	(–5.263)	(–4.771)	(–2.494)	(–5.262)			
1998	0.018	–0.021	–0.959	–1.156	0.008	0.711	0.003	2.040
	(–2.688)	(–2.528)	(–2.762)	(–2.715)	(–2.999)			
1999	0.032	–0.026	–1.141	0.274	0.007	0.708	0.013	2.314
	(–6.201)	(–2.712)	(–3.288)	(–2.880)	(–2.801)			
2000	0.031	–0.032	–1.210	0.826	0.007	0.798	0.001	2.705
	(–6.223)	(–4.992)	(–4.735)	(–3.501)	(–2.387)			
2001	0.0266	0.026	–1.114	0.947	0.007	0.981	0.007	2.250
	(–45.135)	(–23.122)	(–18.312)	(–5.393)	(–7.957)			
2002	0.026	–0.040	–1.329	0.473	0.019	0.916	0.007	2.153
	(–5.040)	(–5.998)	(–5.635)	(–2.267)	(–2.679)			
2003	0.025	–0.033	–1.567	0.512	0.020	0.931	0.019	2.367
	(–4.381)	(–6.342)	(–7.379)	(–2.426)	(–3.130)			
2004	0.032	–0.050	–1.597	0.923	0.014	0.881	9.234	2.469
	(–4.161)	(–4.557)	(–6.746)	(–2.395)	(–2.237)			
2005	0.042	0.049	–1.089	–0.080	–0.002	0.921	0.006	2.773
	(–4.480)	(–9.9132)	(–4.277)	(–2.832)	(–2.255)			
2006	0.030	–0.190	–0.058	–5.945	0.094	0.975	0.016	2.206
	(–2.770)	(–10.026)	(–2.350)	(–4.524)	(–2.501)			
2007	0.024	–0.030	–0.063	–0.127	0.006	0.915	0.001	2.246
	(–6.092)	(–5.483)	(–2.207)	(–2.019)	(–2.211)			
2008	0.012	–0.014	–0.285	0.328	0.007	0.532	0.001	2.050
	(–3.992)	(–4.062)	(–2.511)	(–2.356)	(–2.920)			
2009	0.028	–0.029	–0.944	0.325	0.005	0.553	0.000	2.749
	(–7.331)	(–5.533)	(–5.006)	(–2.211)	(–2.894)			
2010	0.0327	–0.057	–0.074	–0.227	–0.007	0.742	0.000	2.333
	(–6.015)	(–6.350)	(–2.313)	(–2.658)	(–2.937)			

2011	0.017	–0.003	–0.506	0.509	0.006	0.982	0.006	2.196
	(–4.121)	(–3.663)	(–2.367)	(–2.742)	(–2.664)			
2012	0.019	–0.021	–0.613	0.543	0.006	0.892	0.007	2.142
	(–4.618)	(–3.611)	(–2.631)	(–1.780)	(–2.545)			
2013	0.013	–0.016	–0.272	0.509	0.006	0.681	0.050	2.127
	(–2.925)	(–2.591)	(–2.075)	(–2.597)	(–2.466)			
2014	0.008	–0.015	0.079	0.734	0.001	0.872	0.055	2.056
	(–2.622)	(–2.054)	(–2.247)	(–2.935)	(–2.169)			
2015	0.011	–0.0$16	–0.170	0.627	0.005	0.612	0.054	2.043
	(–2.320)	(–2.363)	(2.618)	(–2.838)	(–2.179)			
2016	0.027	–0.047	–0.066	–0.1574	–0.004	0.963	0.000	2.407
	(–6.340)	(–6.193)	(–2.238)	(–2.231)	(–2.650)			

†The Hausman test accepts the fixed effect for all models.

Note: t-statistics are in parentheses.

Source: Authors' computation.

Figure 2 describes the evolution of the degree of liberalisation of Tunisian banks. Concentration indexes between 1997 and 2013 are less than zero, indicating that despite the entry of foreign banks, the interbank market remains monopolistic and Tunisian banks are rather concentrated. Therefore, most capital shares are held by the same people, which represent private institutions, industrial owners, and public institutions, with the state as controller.

Figure 2: Annual change in concentration indexes (H-Statistic) of Tunisian banks

The deconcentration shows that when the Tunisian banking sector is liberalised, the market changes from monopolistic to imperfect competition by differentiating banking products or substituting the increasing interest rate with the cutting score, as showed by Chen (2005). The concentration indexes were positive from 2013 to 2015, to decrease again in 2016, showing the outflow of foreign capital in the recent period.

4. STATISTICAL ANALYSIS

4.1. Results

Once the monetary policy shocks and concentration index have been estimated using the VAR model and the Equation (1) model respectively, they are included in the Equation (2) model to estimate their effect on credit supply. Descriptive statistics of the variables credit supply, monetary policy shocks, and competitiveness (H-index) retained in model (2) are presented in Table 5. Table 6 reports the estimates results using Least Square (LS) methodology for 288 time observations.

Table 5: Summary statistics of the effect of monetary policy shocks and competitiveness on credit supply

Variable	Mean	Std. dev.	Min	Max	Skewness	Kurtosis	J–Bera	N°of obs.
CRS	5.881	1.743	3.160	10.810	1.169	3.672	3.629	288
MPS	0.000	0.180	1.824	0.473	–5.103	44.910	2.354	288
H-index	–0.918	1.451	–6.192	0.797	–2.242	8.606	1.553	288

Source: Authors' computation

From Table 6 we can see that monetary policy shocks (MPS) have a significant negative effect on the credit supply. This result shows that in the event of exogenous monetary policy shocks by the TCB, the Tunisian banks reduce their credit supply to the economy to avoid the suspension of payments by taxpayers.

Table 6: Estimation of monetary policy shocks and bank's competitiveness effects on credit supply

Variable	α_0 – Intercept	α_1 – MPS	α_2 –MPS*CPS	R^2 (%)	F-statistics	DW
	16.607	–0.111	21.767	49.97	8.290	2.174
	(32.600)	(–2.572)	(2.420)		0.000†	

†The Hausman test accepts fixed effects for all models.

Note: *t*-statistics are in parentheses

Source: Authors' computation

The decrease in credit supply is the result of the increased refinancing cost of Tunisian banks. Thus, this drop-in credit supply ensures solvency between the TCB and banks on the one hand, and between banks and borrowers on the other hand, thus mitigating the the credit risk. Unlike what happens in a crisis, when facing a probable monetary policy shock, Tunisia might mitigate the credit risk by reducing the supply of credit to the economy. However, competitiveness allows splitting the effect of interest rate shocks in two ways. If the competitiveness index is low, shocks decrease the supply of credit. However, if competitiveness is high the monetary policy shocks are no longer regulated by the supply of credit. This is shown by the following equation:

$$\frac{\partial logCRS}{\partial MPS} = -0.111 + 21.767CPS = 0$$

As a result, if competitiveness is less than the value of 0.005 (α_1/α_2), clearly there is a significant negative relationship between credit supply and monetary policy shocks. However, this relationship changes from negative to positive if competitiveness exceeds the value of 0.005. Therefore, when the market is monopolistic ($H \leq 0$), interest rate shocks are regulated by reducing the supply of credit.

With the entry of foreign banks, the Tunisian bank market changed from being monopolistic to competitive. It therefore remains to be seen whether Tunisian banks operate within a framework of pure and perfect competitiveness. To do this, we follow Palma's approach, which shows that in an imperfect competition market the interest rate rises and does not fall.

Finally, we check the correlation between the concentration indexes and the interest rate for the 2013 to 2016 period, when the concentration index became positive. The correlation measured between the two variables is positive. Thus, when foreign banks enter the Tunisian banking market the interest rate rises and does not fall. This result is consistent with Gapalan and Rajan's (2017) findings, which report that with lower banking competition the interest rate declines, but with high competition the interest rate rises and enhances pass-through.

Accordingly, we conclude that when banking competitiveness is enhanced, the interest rate rises and systematically the credit supply rises also. In this sense, banking liberalisation leads to an increase in interest rate shocks and does not decrease the supplied credit (Gunji et al. 2009).

4.2. Diagnostic checks

All our results hinge on a string of three estimations: the VAR model, Equation (1), and Equation (2). Accordingly, a sequence of diagnostic checks must be initiated at each step and for each model. Our diagnostic checks are based on the Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC), Log-likelihood (LV), and Hausman test. These tests help us to select which of the different models are significant. When test conditions are met, a null hypothesis can either be accepted, or rejected in favour of an alternative hypothesis.

The parameters αs, βs , θs, and λs in the VAR model are estimated using Ordinary Least Square (OLS) on each equation. However, first we need to select the optimal lag lengths *p,* since inference is dependent on the correctness of the selected lag order (Hacker and Hatemi, 2008). We get the following results.

Table 7: Model selection criterion of the VAR model

Order	LV	AIC	BIC
P = 1	1043.54	−11.56*	−11.44
P = 2	1045.48*	−11.54	−11.46*
P = 3	1040.12	−11.53	−11.33
P = 4	1036.52	−11.42	−11.25
P = 5	1033.69	−11.36	−11.15
P = 6	1030.54	−11.32	−11.10
P = 7	1028.24	−11.25	−11.05
P = 8	1021.27	−11.12	−11.02

* indicates the lag order selected by the criterion

Table 7 presents the LV, AIC, and BIC values for VARs with one to eight lags. These should be interpreted as fit statistics that describe the improvement in the log-likelihood, penalised for the additional lags. Smaller values of AIC and BIC fit statistics are better because they are based on the negative of the log-likelihood. However, higher values of LV fit statistics are retained. Referring to Table 7, the lowest AIC and BIC criterion is given for the lags of order 1 and 2 respectively. However, the highest LV criterion is given for the lag of order 2. A case could be made for 2 lags in view of the time coincidence between BIC and LV criteria, versus 1 lag for only the AIC criterion. Consequently, we will choose 2 lags for the lagged variables.

Table 8: VAR Model Estimation

	MMR	CRS	LIQ	GDP
MMR (−1)	0.777635 (0.53553) [2.45210]	−84.46201 (58.1543) [−2.45238]	0.865632 (7.60355) [2.11385]	−0.964185 (2.80596) [−5.34362]
MMR (−2)	0.188366 (0.52718) [3.35731]	63.38030 (57.2475) [3.10713]	−1.483116 (7.48499) [−2.19815]	1.609473 (2.76221) [2.58268]
CRS (−1)	0.003289 (0.00311) [2.05665]	−0.231271 (0.33803) [−3.68417]	−0.014252 (0.04420) [−2.32248]	0.001417 (0.01631) [3.08686]

CRS (–2)	0.001739 (0.00281) [2.61925]	–0.166084 (0.30490) [–1.54471]	0.003579 (0.03987) [3.08977]	0.011968 (0.01471) [1.81348]
LIQ (–1)	0.068463 (0.04938) [2.38644]	–4.204576 (5.36240) [–1.78408]	0.838212 (0.70112) [2.19553]	–0.108774 (0.25874) [–2.42041]
LIQ (–2)	–0.073409 (0.05045) [–3.45510]	5.795224 (5.47843) [2.05783]	0.175530 (0.71629) [2.24505]	0.097699 (0.26434) [3.36960]
GDP (–1)	–0.084729 (0.14313) [–2.59199]	2.023397 (15.5424) [2.13019]	1.536162 (2.03214) [1.75593]	–0.059935 (0.74993) [–2.07992]
GDP (–2)	–0.051611 (0.10021) [–2.51504]	–13.90551 (10.8818) [–2.27787]	–0.059891 (1.42277) [–2.04209]	0.146714 (0.52505) [3.27943]
R-Squared	0.927029	0.841547	0.987464	0.722001
Adj. R-squared	0.927029	0.841547	0.987464	0.722001
F-Statistic	0.005246	0.569643	0.074480	0.027485
Log-likelihood	7.259471	3.034873	45.01251	0.271388
Akaike IC	52.56864	3.682636	20.73118	32.69362
Schwarz IC	–7.428107	–1.947106	–2.121863	–4.115604
Log-likelihood		1047.5907		
Akaike Information Criterion		–19.26512		
Schwarz Information Criterion		–17.97204		
Number of coefficients		32		

Standard errors in ( ) & *t*-statistics in [ ]

Recall that our VAR specification has four ($k = 4$) endogenous variables, MMR, CRS, LIQ, and GDP, and includes lags 1 to 2 ($p = 2$). Thus, there are ($kp = 8$) regressors in each of the four equations in the VAR. The coefficient results are displayed in Table 8. Each column in the table corresponds to an equation in the VAR, and each row corresponds to a regressor in the equation. Note that the regressors are grouped by variable, so that all the lags for the first variable, here

MMR, are followed by all the lags for the second variable, CRS, and so on. The exogenous variables appear last.

For each right-hand-side variable, Table 8 reports the estimated coefficient, its standard error, and the t-statistic. For example, the coefficient for MMR (–1) in the GDP equation is –0.964185, the standard error is 2.80596, and the corresponding t-statistic is –5.34362. The table also displays additional information below the coefficient results. This information concerns summary statistics for the VAR system. These statistics include the determinant of the residual covariance, log-likelihood and associated information criteria, and the number of coefficients.

Looking a little more closely, we note that all the estimated coefficients in the VAR model are correctly signed and statistically significant, with an error probability of 5%. We accept the hypothesis that the defining variable is significant, since the result of the Student test is greater than +/– 1.96, (cf. t-statistics in [] in Table 8). Furthermore, the adjustment quality of the VAR model as measured by the determination coefficient (R^2 adjusted) is quite high, standing at 92%, 84%, 98%, and 72% for the MMR, CRS, LIQ, and GDP equations respectively.

5. CONCLUSION

In this article we consider a sample of Tunisian banks during the 1993 to 2016 period. The variables of interest consist of the concentration index for deposit banks, and the monetary policy shocks in the monthly data of 27 universal and business banks covering the same period. The credit supply was selected from the general balance sheet of all banks each month during the 24 years from 1993 to 2016. The concentration index and the monetary policy shocks were measured. The concentration index was calculated for each year for a panel-data set of 27 banks and 2 semesters over the 1993–2016 period. The monetary policy shocks are associated with the monetary market rate residual function issued by the VAR model.

The most interesting feature of this paper's analysis of the effect of monetary policy shocks on credit supply is its consideration of foreign banks. When foreign banks are present, the relationship between monetary policy shocks and credit

supply changes in form and significance. The change in the form of the relationship shows that two situations have to be selected. The first is when banks' competitiveness is less than the threshold value (0.005) that is obtained by taking the partial derivative of the credit supply function with respect to competitiveness: a monetary policy shock is significantly and negatively related to credit supply. However, this relationship changes from negative to positive if competitiveness exceeds the threshold of 0.005. This suggests that there are strong threshold effects, in that foreign bank entry tends to enhance interest rate pass-through. The paper also concludes that when foreign bank entry leads to greater banking concentration, the extent of interest rate transmission is significantly lowered.

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ARE FISCAL DEFICITS INFLATIONARY IN NIGERIA? NEW EVIDENCE FROM BOUNDS TESTING TO COINTEGRATION WITH STRUCTURAL BREAKS

ABSTRACT: *In this paper, we model the relationship between fiscal deficit and inflation for Nigeria using annual data from 1980 to 2016. We employ the linear ARDL approach and account for structural breaks using the Bai and Perron (2003) test that allows for multiple structural changes in regression models. The paper finds that the fiscal deficit is a major determinant of inflation along with other macroeconomic factors considered in the study. However, we observe that it may be necessary to pre-test for structural breaks when modelling the relationship between the fiscal deficit and the price level, as it performs better than when structural events are not considered. The results imply that a fiscal management process that does not encourage increased revenue and reduce fiscal deficits will further worsen the level of inflation in the country.*

KEY WORDS: *fiscal deficit, price level, ARDL cointegration, structural breaks*

JEL CLASSIFICATION: C32; E31; E62

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1. INTRODUCTION

The monetary authority in Nigeria has used two monetary policy frameworks to implement monetary policy: exchange rate targeting and monetary targeting. An exchange rate targeting framework was used between 1959 and 1973, while monetary targeting has been in use from 1974 to the present. The shift to monetary targeting was largely informed by the collapse of the Bretton Woods system of fixed exchange rates in 1974 and a change in strategy to demand management as a means of containing inflationary pressures and balance of payments imbalances. Monetary targeting involves the use of market-based instruments. The focus of monetary policy here is on controlling growth in the monetary aggregates, a policy based on the belief that inflation is essentially a monetary phenomenon.

The long-standing controversies between the monetarists and fiscalists on the theory of price level have received a tremendous amount of renewed interest in academic discussions as well as policy debates over the last decades. The monetarist school of thought regards the theory of price as a monetary phenomenon (see, inter alia, McCallum, 2003; Komulainen and Pirttila, 2002; Niepelt, 2004; Grauwe and Polan, 2005; Salami and Kelikume, 2013) and this has also been echoed by Friedman's (1951) statement that "inflation is always and everywhere a monetary phenomenon", providing an exclusive role for monetary policy regarding inflation dynamics. However, an influential strand of literature, inspired by the seminal contribution of Sargent and Wallace (1981), argues that the monetary authority's control over inflation is limited, and for this reason, fiscal policy can equally be a source of inflation (Hashem, 2017). Indeed, in a context of 'fiscal dominance', a loose fiscal policy can drive inflation because the central bank must ultimately monetize the public debt, consistently with the unpleasant monetarist arithmetic (Sargent and Wallace, 1981; Kwon et al., 2009). An alternative rationale, which is at the heart of the Fiscal Theory of the Price Level (see, inter alia, Cochrane, 2001; Sims, 2011; Bassetto and Cui, 2018) or, more broadly, of the literature on price level determinacy (see Woodford, 1994), is that under fiscal dominance, newly issued nominal government bonds will cause the price level to rise to meet the government's intertemporal budget constraint.

The structural characteristics of most developing countries have made the study of fiscal inflation quite intriguing and well studied in the literature, as these characteristics have created bottlenecks which include dynamic monetary policy inconsistencies as a result of the non-independence of central banks (see Minea et al., 2012), political instability (see Fischer et al., 2002; Vu, 2004; Catao and Terrones, 2005; and Wimanda et al., 2011), and poor tax systems (see Catao and Terrones, 2005) that tend to reduce seigniorage revenue and compel the government to increase dependence on inflation tax. Intuitively, the government can reduce budget deficits through the aggregate demand component either by increasing tax revenue or by decreasing expenditure. As an alternative way of financing fiscal deficits, the government can easily borrow from banks. If government finances budget deficits by selling government bonds to the public, then budget deficits will not create any inflation, as no new money is created in the process.

While numerous studies have been conducted, no consistent evidence exists for a significant relationship between fiscal deficit and inflation, in either a positive or a negative direction. Results and evidence differ by country/region, analytical method employed, and budget deficit categorisation. For example, empirical studies of the United States (Aksoy and Melina, 2011; Klein and Linnemann, 2020) and of other industrial or developed countries (Sahan and Bektasoglu, 2010; Catão and Terrones, 2005; Kliem et al, 2016) have not yielded conclusive results on the deficit–inflation relationship. Meanwhile, empirical studies of developing countries, such as those of Samimi and Jamshidbaygi (2011), Kia (2010), Loungani and Swagel (2003), Ahmed and Suliman (2011), and Jalil et al. (2014), generally indicate that the inflationary effect of deficit financing is significant, and also observe a strong causality of fiscal deficits on inflation in high-inflation countries.

The focus of this study is therefore to examine the relationship between fiscal deficit and inflation, rather than just monetary factors. Nigeria is a reliable candidate for evaluating the deficit–inflation nexus because the monetary authority in Nigeria has recently been pointing the finger at budgetary borrowing as the main source of inflation in the country. However, this area is not well researched in the case of Nigeria. Although a few studies have shown monetary policy to be behind the inflation in Nigeria (Olomola and Olagunju, 2004;

Umeora, 2010), these papers did not incorporate the fiscal side. There are a few studies, like Chimobi and Igwe (2010), Oladipo and Akinbobola (2011), and Dockery et al. (2012), which have shown conflicting results regarding the fiscal deficit–inflation relationship. Assessing the role of inflation in Nigeria is crucial, because as a developing country it has suffered inflation that may negatively affect the living standards and purchasing power of the vulnerable segments of society. Inflation also has a political cost, as governments cannot afford to allow an undue increase in prices, as this would have a negative impact on the voting attitude of the public during elections. This has induced the need to find the underlying causes of inflation in the Nigerian economy.

We find a positive relationship between inflation and fiscal deficit. In addition, the results seem to perform better when likely structural events are modelled with the nexus between budget deficits and inflation in Nigeria. Therefore, this paper calls for fiscal consolidation to bring down prices and dependence on less inflationary deficit-financing policies.

The remainder of the paper is organized as follows. Section two deals with the literature review. Section three pursues the methodological framework of the study, while the empirical results are discussed in section four. Section five presents the conclusion and policy implications of the paper.

2. LITERATURE REVIEW

The observed interactions between fiscal deficit and price level have spurred great interest among both academicians and policymakers. Theoretically, Friedman (1968), Sargent and Wallace (1981), and Miller (1983) widely discuss this link. Sargent and Wallace (1981) present a model where higher government deficits do not lead to higher taxes; rather, higher deficit or debt results in higher money growth in the current period or in the future, and thus leads to inflation. Dornbusch et al. (1990) assert that in economies where money creation is the only way to finance government budget deficits it becomes a principal determinant of money growth and inflation. Easterly and Schmidt-Hebbel (1993) argue that money creation is a cause of inflation. Critics also hold deficits responsible for crowding-out phenomena by affecting the interest rate. When fiscal deficits are financed by borrowing, governments' demand for credit increases and less remains for the private sector. Hence, the vast and voluminous theoretical

literature has created a broader line between the different schools of thought explaining the nexus between budget deficit and inflation, ranging from monetarists to Keynesians.

In recent years, several empirical studies have used both the time and cross-sectional dimensions of data (panel data) to examine the relationship between fiscal deficits and inflation in different countries, using different estimation procedures and theories and with varying findings and conclusions. The inferences drawn from these studies have also varied considerably depending on whether the countries involved are developed or developing. Thus, the link between fiscal deficits and inflation has been inconclusive.

Fluctuations in fiscal variables contain valuable information for predicting fluctuations in output and prices. State and federal fiscal variables help predict output and inflation respectively in the U.S. (Aksoy and Melina, 2011). As fiscal variables have been helpful in predicting inflation, Klein and Linnemann (2020) observe that fiscal spending increases lowered inflation in the first half of the post-war period, but have been inflationary from about 1980 onwards. In all Economic and Monetary Union (EMU) countries except Finland, evidence supports the sustainability of fiscal policy (Bajo-Rubio et al., 2009). The autonomy of monetary authorities and proactiveness of fiscal policy provides ample evidence of the relationship that might exist between budget deficit and price level. Kliem et al. (2016) observe that the low-frequency relationship between fiscal stance and inflation is low during periods of an independent central bank and responsible fiscal policy, and more pronounced in times of non-responsible fiscal policy and accommodative monetary authorities. Switches in the monetary–fiscal policy interaction and accompanying variations in the propagation of structural shocks can well account for changes in the low-frequency relationship between fiscal stance and inflation (Kliem et al., 2016).

The structure and inherent characteristics of an economy also provide significant details on the inflation–fiscal deficit nexus. Sahan and Bektasoglu (2010) observe no long-run relation between inflation and budget deficits, but the relationship changes depending on the developmental level and structural features of the economy. Hence, the financial structure of the economy becomes crucial in the analysis of the inflation–budget deficit nexus. Kwon et al. (2009) provide

empirical evidence that an increase in public debt is inflationary in countries with large public debt. The study finds that the relationship holds strongly in indebted developing countries and weakly in other developing countries, and does not hold in developed economies. The results suggest that the risk of a debt–inflation trap is significant in highly indebted countries and pure money-based stabilization is unlikely to be effective over the medium term. Deficits have an impact on inflation and such an impact is stronger in high-inflation or developing countries (Catão and Terrones, 2005). The deficit–inflation relationship is strong in high-inflation episodes due to the increase in money creation, and persistent fiscal deficits are inflationary in high and middle-inflation economies and less inflationary in low-inflation economies (Lin and Chu, 2013). In a study that accommodates asymmetry and suits the African countries, Ahmad and Aworinde (2019) also indicate that there is a long-run relationship between fiscal deficits and inflation and that fiscal deficit is inflationary.

Other studies provide support for the deficit–inflation relationship based on both panel and country-specific data. Nguyen (2015) empirically investigates the effects of fiscal deficit and broad money M2 supply on inflation in Asian countries. The study finds that fiscal deficit, government expenditure, and interest rate are the statistically significant determinants of inflation. Samimi and Jamshidbaygi (2011) strongly confirm a positive relationship between budget deficits and inflation in Iran. Lozano (2008) finds that a long-run relationship exists between deficit, money growth, and inflation in Colombia. Habibullah et al. (2011) confirm that a long-run relationship exists between deficits, money growth, and inflation for 13 Asian countries over the period 1950–1999. Ahmed and Suliman (2011) explore the long-run relationship between money supply, real GDP, and price level for the Sudanese economy, using annual data for the period 1960–2005.

The studies of the relationship between fiscal deficit and inflation in Nigeria are inconclusive. For instance, Oladipo and Akinbobola (2011) observe a causality running from fiscal deficit to inflation. Olusoji and Oderinde (2011) show no evidence of causality between fiscal deficit and inflation in Nigeria. Chimobi and Igwe (2010) show the presence of a positive long-term relationship between inflation and money supply. Ezeabasili et al. (2012) find a positive but insignificant long-run relationship between fiscal deficits and inflation. Also, the

impulse response and variance decomposition result does not support fiscal deficit as a significant contributor to inflationary trends in Nigeria. Wosowei (2013) reveals a negative but insignificant relationship between fiscal deficit and gross domestic product. On the direction of causality, a bi-directional relationship is reported between fiscal deficit and GDP and also between government tax and unemployment in Nigeria (see inter alia, Danlami et al. 2019; Tule et al. 2020). Danlami et al. (2019) reveal that fiscal deficit is inflationary in both the short run and the long run. Tule et al. (2020) indicate that while an expansionary monetary policy may have contemporaneous positive effects on the economy, expansionary fiscal policy does not automatically translate to growth. Fiscal expansion aggravates price level.

The implications of studies from other parts of the world, and especially as expressed by Kwon et al. (2009) for the Nigerian context, are therefore inherent in Nigeria's profile of burgeoning domestic and foreign debt, increasing price level, and inadequate financial infrastructure to finance growing expenditure.

3. DATA AND METHODOLOGY

3.1 Data

This study uses yearly data from 1980 to 2016 for the Consumer Price Index (CPI) used to measure inflation rate, Fiscal Deficit (FD) measured as a ratio of gross domestic product, Real Exchange Rate (EXR), Lending Interest Rate (LR), and Money Supply (MS). The data is sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin and the World Development Indicator (WDI) database.

This study further includes exchange rate and lending interest rate for better specification of the model. Exchange rate is measured in Naira (₦) per US dollar, meaning that an increase in the exchange rate refers to depreciation in the Naira, while a decrease means appreciation of the Naira. On the other hand, the lending interest rate is usually measured in percentage (%) and an increase (decrease) in this percentage denotes an increase (decrease) in the interest rate. The growth rate of M2 is taken as a measure of growth of the money supply, defined according to the following: "money and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time,

savings, and foreign currency deposits of resident sectors other than the central government" (CBN, 2017).

Table 1 highlights some of the statistical properties of the selected variables for this study over the period 1980–2016. The description in Table 1 reveals that the average percentage of inflation, fiscal deficit, lending interest rate, real exchange rate, and money supply between the years 1980 and 2016 was approximately 2.57%, –2.87%, 17.53%, 154.8%, and 48.59%, respectively. Over the period the values of CPI, FD, LR, EXR, and MS range between –0.895% and 5.21%, –6.73% and 0.79%, 8.43% and 31.65%, 33.06% and 546.04%, and 13.23% and 43.27%, respectively.

Table 1: Descriptive Statistics of Variables

	CPI	**FD**	**LR**	**EXR**	**MS**
Mean	2.574	–2.871	17.526	154.803	24.224
Maximum	5.214	0.794	31.650	546.038	43.266
Minimum	–0.894	–6.730	8.431	33.061	13.230
Skewness	–0.406	–0.306	0.149	1.607	0.812
Kurtosis	1.664	2.110	3.327	4.733	3.473
Jarque-Bera (probability)	3.764 (0.152)	1.799 (0.406)	0.304 (0.858)	20.568 (0.000)	4.412 (0.110)
Observations	37	37	37	37	37

Also, regarding the skewness statistics whose threshold value for symmetry (or normal distribution) is zero, none of the variables are exactly zero, although some are close to zero. While the skewness statistics of –0.41 and –0.31 for inflation rate and fiscal deficit show that both variables are negatively skewed (since they are less than zero), denoting that more of the inflation rate and fiscal deficit values fall on the left-hand side of the mean, lending rate, exchange rate, and money supply are positively skewed since their skewness statistics are greater than zero.

Furthermore, the kurtosis value, whose threshold is three, indicates that all variables are leptokurtic (highly peaked), with the exception of inflation rate and fiscal deficit, which are platykurtic (low-peaked). However, neither skewness nor kurtosis can singularly confirm the normality of a series. Hence, the Jarque-Bera

statistics provide more comprehensive information because they combine skewness and kurtosis properties . Since the Jarque-Bera probability values for the variables (with the exception of EXR) are less than 5% the hypothesis of normal distribution cannot be rejected and the series can be regarded as having a normal distribution. However, since the Jarque-Bera probability value for EXR is less than 5% the hypothesis of normal distribution is rejected for EXR. Thus, EXR is not normally distributed. The behaviour of the predictors in relation to fiscal deficit are presented in Figures 1 and 2.

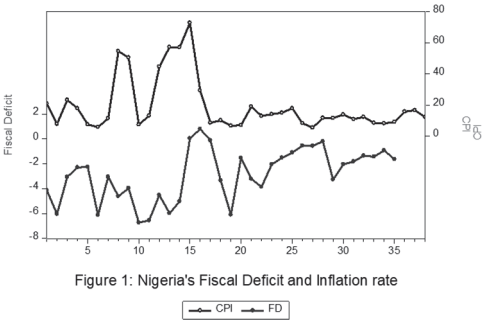
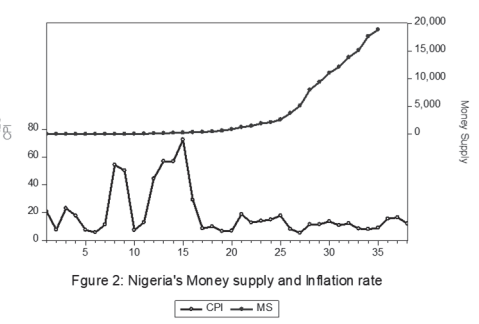


Figure 1: Nigeria's Fiscal Deficit and Inflation rate



Fgure 2: Nigeria's Money supply and Inflation rate

Figure 1 shows the trend and pattern of the relationship between inflation rate and fiscal deficit. It shows evidence of a positive relationship between fiscal deficit and inflation rate in Nigeria. Figure 2 shows the relationship between money supply and inflation rate.

3.2 Methodology

Following the literature, we present an econometric model that essentially is informed by standard economic theory as evinced in the Keynesian approach. The inflation–fiscal deficit function adopted in this model is:

$$logCPI_t = \alpha_0 + \alpha_1\left(\frac{FD}{GDP}\right) + \alpha_2 logLR_t + \alpha_3 logEXR_t + \alpha_4 logMS_t + U_t \qquad (1)$$

$$\alpha_1 > 0, \alpha_2 \langle 0, \alpha_3 \rangle 0, \alpha_4 > 0$$

To empirically analyse the relationship between fiscal deficit and inflation, the ARDL model specification – popularly known as the bounds test – is used to show both the short- and long-run relationships. This method is adopted for this study

for three reasons. First, compared to other multivariate cointegration methods, the bounds test is a simple technique because it allows the cointegration relationship to be estimated by OLS once the lag order of the model is identified. Second, adopting the bound testing approach means that a pre-test such as a unit root test is not required; i.e., the regressors can either be I(0), purely I(1), or mutually cointegrated. However, while the bounds test for cointegration does not depend on pre-testing the order of integration, to satisfy curiosity and quell the anxiety of getting a spurious result from the regression that is obtainable from regressing non-stationary series, and also to scrutinize the integrating level of the variables which is to ensure that the variables are not of order I(2), we decided to conduct the unit root tests. Following the study by Ouattara (2004), the computed F-statistics provided by Pesaran et al. (2001) are not valid in the presence of I(2) variables because the bounds test is based on the assumption that the variables are I(0) or I(1). Therefore, the implementation of unit root tests in the ARDL procedure might still be necessary in order to ensure that none of the variables are integrated of order 2 or beyond, but fall within the computed F-statistic range provided by Pesaran et al. (2001). Third, the long-run and short-run parameters of the models can be simultaneously estimated. The ARDL framework of Equation (1) is as follows:

$$\Delta lcpi_t = \beta_0 + \sum_{i=1}^{p} \psi_i \Delta lcpi_{t-i} + \sum_{i=0}^{p} \phi_i \Delta fd_{t-i} + \sum_{i=0}^{p} \nu_i \Delta lr_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta lexr_{t-i}$$
$$+ \sum_{i=1}^{p} \delta_i \Delta lms_{t-i} + \theta_1 lcpi_{t-1} + \theta_2 fd_{t-1} + \theta_3 lr_{t-1} + \theta_4 lexr_{t-1} + \theta_5 lms_{t-1} + u_t \qquad (2)$$

where β_0 is the drift component and U_t white noise. Furthermore, the terms with summation signs represented the error correction dynamics, while the second part of the equation with θ_i corresponds to the long-run relationship. This is an error correction representation, so the following error correction model is estimated in the third step.

$$\Delta lcpi_t = \beta_0 + \sum_{i=1}^{p} \psi_i \Delta lcpi_{t-i} + \sum_{i=0}^{p} \phi_i \Delta fd_{t-i} + \sum_{i=0}^{p} \nu_i \Delta lr_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta lexr_{t-i}$$
$$+ \sum_{i=0}^{p} \delta_i \Delta lms_{t-i} + \alpha ecm_{t-1} + u_t \qquad (3)$$

The error correction model result designates the speed of adjustment back to long-run equilibrium after a short-run shock**.** We extend the model in Equations (2) and (3) to include endogenous structural breaks. Neglecting structural breaks when they actually exist can bias the study findings (see Fasanya et al., 2018, 2019). In the case of modelling inflation, structural breaks have been observed as crucial in improving the inflationary behaviour of Nigeria (Fasanya and Adekoya, 2017). Hence, the model is then specified as below:

$$\Delta lcpi_t = \beta_0 + \sum_{i=1}^{p} \psi_i \Delta lcpi_{t-i} + \sum_{i=0}^{p} \phi_i \Delta fd_{t-i} + \sum_{i=0}^{p} \nu_i \Delta lr_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta lexr_{t-i}$$
$$+ \sum_{i=0}^{p} \delta_i \Delta lms_{t-i} + \theta_1 lcpi_{t-1} + \theta_2 fd_{t-1} + \theta_3 lr_{t-1} + \theta_4 lexr_{t-1} + \theta_5 lms_{t-1} + \sum_{r=1}^{s} D_r B_{rt} + u_t \quad (4)$$

As shown in Equation (4), the breaks are captured with the inclusion of $\sum_{r=1}^{s} D_r B_{rt}$ where B_{rt} is a dummy variable for each of the breaks defined as $B_{rt}=1$ for $t > T_B$ and $B_{rt}=0$ otherwise. The time period is represented by t; T_B are the structural break dates where r =1, 2, 3,……., k, and D_r is the coefficient of the break dummy. All the other parameters have been previously defined. The Bai-Perron (2003) test is used to determine breaks endogenously. This test is relevant when dealing with models with probable multiple structural changes over time. Apart from its computational simplicity, the test allows for up to five breaks in the regression model and is therefore considered a more general framework for detecting multiple structural changes in linear models. We also test for the existence of a long-run relationship in the presence of structural breaks using the ARDL test. In essence, we are also able to determine long-run and short-run estimates for the fiscal deficit–inflation nexus in the presence of structural breaks. In addition, the results obtained are compared with those from Equation (5) to see if accounting for breaks in the regression is necessary. Subsequently, the Wald test is used to test for the joint significance of structural breaks in Equation (4). That is, we test $\sum_{r=1}^{s} D_r = 0$ against $\sum_{r=1}^{s} D_r \neq 0$. The rejection of the null hypothesis implies that the breaks are important and should be included in the model, suggesting the adoption of Equation 4, while the non-rejection implies that structural breaks do not matter in this case.

4. RESULTS AND DISCUSSIONS

This section presents the unit root tests to test the level of integration of the variables under consideration, and the estimation result of the ARDL with and without structural breaks.

Table 2: Unit Root Results

	Unit root without structural breaks						**Unit root with structural breaks**			
	ADF			**PP**			**Vogelsang-Perron SB test**			
Variable	Level	First Diff.	I(d)	Level	First Diff.	I(d)	Break Date	Coeff.	T-stat.	I(d)
CPI	–1.81[b]	–3.36[a**]	I(1)	–1.12[b]	–3.20[a**]	I(1)	1994	13.25[b***]	–7.139	I(0)
FD	–5.26[b***]	-------	I(0)	–5.42b***	-------	I(0)	1994	–5.84[b***]	–9.002	I(0)
LR	–1.12[b]	–6.43[a***]	I(1)	–1.27[b]	–6.45[a**]	I(1)	1994	–6.51[a***]	–11.056	I(0)
EXR	–1.70[b]	–5.42[a***]	I(1)	–1.95[b]	–5.42[a**]	I(1)	2016	–4.42[b**]	–4.169	I(1)
MS	–3.35[b*]	-------	I(0)	–2.20[b]	–5.45[a***]	I(1)	2006	–4.93[b***]	–6.290	I(0)

Note: [a] indicates constant without deterministic trend; [b] is the model with constant and deterministic trend as exogenous lags are selected based on Schwarz info criteria. *, **, *** imply that the series is stationary at 10%, 5%, and 1% respectively. ADF and PP denote Augmented Dickey-Fuller and Phillip-Perron Unit Root tests. The ADF test with structural breaks is determined using the Vogelsang (1993) asymptotic one-sided p-values. Critical values are from Vogelsang (1993), which are –4.04 and –4.44 for 5% and 1% levels of significance respectively.

All three specifications – with intercept and trend, with intercept only, and with none – outlined in ADF and PP are assessed to ensure a robust conclusion in Table 2. The ADF test result shows that fiscal deficit and money supply are stationary at their level form. However, inflation rate, lending rate, and exchange rate are rendered stationary at their first difference. This result is consistent with the PP test result, with the exception of money supply as it is rendered stationary at its first difference rather than in its level form, as reported in the ADF test result.

Regarding the structural break test, Bai and Perron (2003) advocate the determination of multiple breaks among series, rather than the conventional way of determining breaks individually among variables that post a challenge while estimating the variables or while trying to neutralize the effect of the breaks during estimation. The tests identified several breaks in the linear combination of

the variables used in this study. Table 3 shows selected dates from breakpoint least square results for four models: Model 5 is not presented in the table as no break dates are identified. The result shows the several breaks identified by the tests. Hence, with the existence of significant breaks in the models, the study compares each model with and without a structural break to investigate the consequence of the inclusion or exclusion of a break in the signs, magnitude, and significance of the model's explanatory variables.

Table 3: Bai-Perron Multiple Structural Breaks

Model	Breaks	Range	Signs
Inflation rate and fiscal deficit (1) *lcpi= f(fd)*	1988 1994 2004	1980 – 1987 1988 – 1993 1994 – 2003 2004 – 2016	+ – – –
Inflation rate, fiscal deficit, and real exchange rate (2) *lcpi=f(fd, exr)*	1987 1993 1999 2009	1980 – 1986 1987 – 1992 1993 – 1998 1999 – 2008 2009– 2016	– – + + +
Inflation rate, fiscal deficit, and lending interest rate (3) *lcpi= f(fd, lr)*	1993 2000	1980 – 1992 1993 – 1999 2000 – 2016	+ – –
Inflation rate, fiscal deficit, and money supply (4) *lcpi=f(fd, ms)*	1990 1998 2008	1980 – 1989 1990 – 1997 1998 – 2007 2008 – 2016	+ + + –

Note: ****, **, and * imply significance at 1%, 5% and 10% respectively*

The unit root test conducted above indicates that some of the variables are stationary I(0) while some variables are not stationary I(1). Thus, it is necessary to check whether similar trend properties exist between or among the series.. Hence, the Autoregressive Distributed Lag (ARDL) bounds test is employed, which allows for the combination of stationary and non-stationary series.

Table 4: ARDL Bounds Co-Integration Test Results (Without Breaks)

Model	F-statistic	Significance level	Critical Value I(0)	Bound I(1)
lcpi= f(fd)	4.708	10%	5.59	6.26
		5%	6.56	7.3
		1%	8.74	9.63
lcpi=f(fd, exr) lcpi= f(fd, lr) lcpi=f(fd, ms)	4.891	10%	4.19	5.06
	4.388	5%	4.87	5.85
	3.701	1%	6.34	7.52
lcpi= f(fd, exr, lr, ms)	4.717**	10%	3.03	4.06
		5%	3.47	4.57
		1%	4.4	5.72

Note: ****, ** and * imply significance at 1%, 5% and 10% respectively*

Table 5: ARDL Bounds Co-Integration Test Results (With Breaks)

Model	F-statistic	Significance level	Critical Value I(0)	Bound I(1)
lcpi= f(fd)	19.078***	10%	3.03	4.06
		5%	3.47	4.57
		1%	4.4	5.72
lcpi=f(fd, exr)	26.284***	10%	2.53	3.59
		5%	2.87	4
		1%	3.6	4.9
lcpi= f(fd, lr)	4.918**	10%	3.03	4.06
		5%	3.47	4.57
		1%	4.4	5.72
lcpi= f(fd, ms)	5.604***	10%	2.75	3.79
		5%	3.12	4.25
		1%	3.93	5.23
lcpi= f(fd, exr, lr, ms)	----------	----------	----------	----------
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Note: ****, ** and * imply significance at 1%, 5% and 10% respectively*

Table 6: Long-Run Model Estimation Results (Without Breaks)

Explanatory Variable	Model 1	Model 2	Model 3	Model 4	Model 5
FD	–1.508(–0.529)	0.098(0.78)	0.124(1.89)*	–0.751(–0.86)	0.016(0.299)
EXR	-------	–1.288(–1.82)*	-------	-------	0.54(1.83)*
LR	-------	-------	2.284(3.954)***	-------	2.55(4.599)***
MS	-------	-------	-------	–1.81(0.65)	0.469(1.467)
Constant	–3.29(–0.58)	7.58(1.59)*	4.76(–4.23)***	3.92(0.648)	–11.19(–3.28)***
@Trend	--------	0.119(2.735)***	0.117(5.816)***	0.211(3.54)***	0.158(13.9)***

Note: ****, ** and * imply significance at 1%, 5% and 10% respectively. T-statistics are presented in parenthess and probability values are presented in brackets.*

Table 7: Short-Run Model Estimation Results (Without Breaks)

Explanatory Variable	Model 1	Model 2	Model 3	Model 4	Model 5
D(CPI)(–1))	0.475(3.31)***	0.698(4.27)***	0.488(2.96)***	0.469(3.01)***	0.548(2.91)***
D(CPI)(–2))	-------	–0.488(–2.68)***	–0.426(–2.53)***	-------	-------
D(CPI)(–3))	-------	0.385(2.477)**	-------	-------	-------
D(FD)	0.004(0.434)	0.0083(0.784)	0.021(1.737)*	0.002(0.207)	0.004(0.293)
D(FD)(–1))	0.026(2.397)**	-------	-------	0.038(3.299)***	-------
D(EXR)	-------	0.012(0.254)	-------	-------	0.045(0.963)
D(EXR)(–1))	-------	-------		-------	0.036(0.505)
D(EXR)(–2))	-------	--------		-------	–0.196(–3.283)***
D(LR)	-------	-------	0.01(0.077)	-------	0.049(0.292)
D(LR)(–1))	-------	-------	–0.246(2.022)**	-------	–0.329(–2.158)***
D(LR)(–2))	-------	-------	-------	-------	–0.161(–0.979)
D(LR)(–3))	-------	-------	-------	-------	–0.028(–1.806)*
D(MS)	-------	-------	-------	–0.140(–1.227)	–0.028(–0.308)
D(MS)(–1))	-------	-------	-------	0.246(2.306)**	-------
@trend	--------	--------	--------	---------	---------
ECT(–1)	–0.025(–0.58)	–0.085(–2.017)*	–0.165(–3.35)***	–0.05(–1.01)	–0.265(–3.737)***
F-stat.	2295.12***	1753.98***	1963.8***	1698.1***	1227.48***
Adj. R^2	0.928	0.928	0.928	0.928	0.898
DW	1.759	1.907	1.752	1.716	2.169
Diagnostics tests					
J-B test	1.667[0.435]	5.039[0.080]	4.14[0.126]	1.666[0.435]	6.057[0.053]
ARCH-LM test:	0.007[0.934]	0.473[0.497]	0.394[0.535]	0.221[0.641]	0.299[0.589]
B-G LM test:	2.66[0.089]	0.077[0.926]	0.646[0.533]	1.204[0.318]	5.023[0.021]
RESET test	6.70[0.015]	7.57[0.011]	0.294[0.593]	5.299[0.030]	1.545[0.232]
CUSUM	stable	stable	stable	stable	stable
CUSUMSQ	stable	stable	stable	stable	stable

Note: ****, ** and * imply significance at 1%, 5% and 10% respectively. T-statistics are presented in parentheses and probability values are presented in brackets.*

Tables 4 and 5 show the co-integration test results for all five models with and without breaks. For the models without breaks, the statistical values of Models 1, 3, and 4 are lower than the I(0) critical value at the 5% chosen level of significance, signifying no long-run relationship. While the Model 2 result was found to be inconclusive, evidence of a long-run relationship was found in Model 5. However, with the inclusion of structural breaks, as specified in the Bai-Perron break test result in Table 3, the conclusion was completely reversed, as there was presence of a long-run relationship among the variables considered in the models. Following this result, the study examines both the short-run dynamics and the long-run relationship for all five models.

Tables 6 and 7 present the long-run and short-run estimation results between inflation rate and the other explanatory variables. In the long run, the result shows that the coefficient of fiscal deficits exerts a positive relationship in all regressions except for Models 1 and 4. However, in Model 3, fiscal deficits are seen to be significantly positive. Specifically, the coefficient 0.124 implies that a 1% increase in fiscal deficit may increase inflation by 0.12%. The positive relationship between fiscal deficit and inflation follows the proposition of the fiscal theory of price level, which attributes inflation as a fiscal phenomenon (Woodford, 1995; Cochrane, 2001; Sims, 2011). Our result that the fiscal deficit affects inflation positively in Nigeria is also corroborated in earlier results by Oladipo and Akinbobola (2011), who finds positive and significant results. The result also shows that the real exchange rate is significantly positive in influencing the rate of inflation. A unit change in the percentage of the exchange rate results in only a 1.29% total variation in the rate of inflation in Model 2 and a 0.54% total variation in the rate of inflation in Model 5. With the increase in the exchange rate, inflation increases moderately.

In the short run, the result shows that inflation has a significantly positive relationship with past fluctuations. The significance of lagged inflation indicates that the inflationary process in Nigeria has been influenced by its past behaviour. Lagged inflation explains stickiness in prices, with periods of high inflation tending to persist and, conversely, periods of low inflation also persisting. The error correction coefficient also shows that there is 26.5% speed of adjustment from short-run to long-run equilibrium.

The adjusted R-squared indicates that 92.8% of variation in the inflation rate is explained by fiscal deficit, real exchange rate, lending interest rate, and money supply. The F-stat also indicates that each of the estimated models is statistically significant, implying that at least one of the explanatory variables in each case is statistically significant. The Durbin-Watson statistic reported in each case also reveals that the models do not suffer from autocorrelation.

Table 8: Long-Run Model Estimation Results (With Breaks)

Explanatory Variable	Model 1	Model 2	Model 3	Model 4
FD	0.001(2.01)***	0.058(0.01)	0.11(2.05)***	0.46(1.952)**
EXR	-------	–0.53(0.107)	-------	-------
LR	-------	-------	1.376(0.359)	-------
MS	-------	-------	-------	– 1.344(1.906)**
D_{1987}	-------	0.078(1.881)*	-------	-------
D_{1988}	1.103(0.169)	-------	-------	-------
D_{1990}	-------	-------	-------	2.256(0.528)
D_{1993}	-------	1.85(0.101)	0.968(1.824)*	-------
D_{1994}	1.01(0.165)	-------	-------	-------
D_{1998}	-------	-------	-------	2.63(0.52)
D_{1999}	-------	–0.699(0.149)	-------	-------
D_{2000}	-------	-------	–0.425(0.196)	-------
D_{2004}	0.06(4.051)***	-------	-------	-------
D_{2008}	-------	-------	-------	1.646(0.439)
D_{2009}	-------	0.159(0.06)	-------	-------
Constant	–0.81(0.066)	2.99(0.696)	–3.18(0.526)	6.03(1.694)**

Note: ****, ** and * imply significance at 1%, 5% and 10% respectively. T-statistics are presented in parenthesesand probability values are presented in brackets.*

Table 9: Short-Run Model Estimation Results (With Breaks)

Explanatory Variable	Model 1	Model 2	Model 3	Model 4
D(CPI(–1))	0.688(3.98)***	0.004(0.07)	0.13(0.96)	–1.08(–2.32)*
D(CPI(–2))	-------	–0.423(–9.57)***	–0.57(–3.81)***	–1.07(–1.59)
D(CPI(–3))	-------	-------	-------	–0.40(–0.98)
D(FD)	0.000(0.09)	0.026(6.31)***	0.03(3.18)***	0.009(0.54)
D(FD(–1))	-------	-------	-------	0.13(4.67)**
D(FD(–2))	-------	-------	-------	0.08(1.99)**
D(FD(–3))	-------	-------	-------	0.08(2.30)**
D(EXR)	-------	–0.064(–4.07)***	-------	-------
D(LR)	-------	-------	0.104(0.87)	-------
D(MS)	-------	-------	-------	0.13(0.617)
D(MS(–1))	-------	-------	-------	0.17(1.30)
D(MS(–2))	-------	-------	-------	–0.42(–2.31)*
$D(D_{1987})$	-------	–0.25(–7.958)***	-------	-------
$D(D_{1987}(-1))$	-------	–0.114(–3.06)***	-------	-------
$D(D_{1988})$	0.33(9.129)***	-------	-------	-------
$D(D_{1988}(-1))$	0.144(1.92)*	-------	-------	-------
$D(D_{1988}(-2))$	–0.26(–3.81)***	-------	-------	-------
$D(D_{1988}(-3))$	–0.25(–5.61)***	-------	-------	-------
$D(D_{1990})$	-------	-------	-------	–0.29(–1.31)
$D(D_{1990}(-1))$	-------	-------	-------	0.60(1.88)
$D(D_{1990}(-2))$	-------	-------	-------	0.16(1.13)
$D(D_{1990}(-3))$	-------	-------	-------	0.199(1.59)
$D(D_{1993})$	-------	0.248(6.554)***	0.12(1.50)	-------
$D(D_{1993}(-1))$	-------	–0.284(–6.67)***	–0.29(–2.35)**	-------
$D(D_{1993}(-2))$	-------	-------	0.237(2.28)**	-------
$D(D_{1994})$	0.17(2.17)**	-------	-------	-------
$D(D_{1994}(-1))$	0.103(1.205)	-------	-------	-------
$D(D_{1994}(-2))$	–0.11(–1.32)	-------	-------	-------
$D(D_{1994}(-3))$	–0.104(–2.44)**	-------	-------	-------
$D(D_{1998})$	-------	-------	-------	0.17(1.72)
$D(D_{1998}(-1))$	-------	-------	-------	0.84(3.32)**

$D(D_{1998}(-2))$	-------	-------	-------	0.70(2.51)*
$D(D_{1998}(-3))$	-------	-------	-------	0.25(1.65)
$D(D_{1999})$	-------	–0.098(–3.06)***	-------	-------
$D(D_{1999}(-1))$	-------	–0.143(–6.06)***	-------	-------
$D(D_{2000})$	-------	-------	–0.16(–3.00)***	-------
$D(D_{2004})$	0.04(1.095)	-------	-------	-------
$D(D_{2008})$	-------	-------	-------	–0.24(–1.47)
$D(D_{2008}(-1))$	-------	-------	-------	0.19(2.19)
$D(D_{2008}(-2))$	-------	-------	-------	0.14(0.7)
$D(D_{2008}(-3))$	-------	-------	-------	0.408(3.03)*
$D(D_{2009})$	------	0.07(3.12)***	-------	-------
@trend	0.061(3.05)***	0.04(7.896)***	0.047(2.97)***	0.07(2.25)*
ECT(–1)	–0.57(–3.03)***	–0.44(–10.04)***	–0.38(–2.94)***	0.70(2.44)*
F-Stat	7133.9***	21417.7***	2767.6***	2755.8***
Adj. R^2	0.912	0.913	0.929	0.899
DW	1.799	2.108	1.915	2.65
J-B test	1.054[0.591]	11.491[0.003]	0.935[0.627]	25.83[0.000]
ARCH-LM test:	1.758[0.195]	0.143[0.708]	0.943[0.339]	3.756[0.062]
B-G LM test:	1.471[0.416]	0.463[0.639]	0.532[0.597]	3.134[0.371]
RESET test	2.951(0.264)	2.31[0.149]	0.000[0.987]	1.026[0.418]
CUSUM	stable	stable	stable	stable
CUSUMSQ	stable	stable	stable	stable

Note: ****, ** and * imply significance at 1%, 5% and 10% respectively. T-statistics are presented in parentheses and probability values are presented in brackets.*

Table 8 reveals that the coefficient of fiscal deficit is positive in all regressions, but the level of significance and magnitude of the coefficient differs in the models. Real exchange rate and lending interest rate are significantly positive in Model 2 and Model 4 respectively. Extensively, the long-run result shows that exchange rate and lending interest rate are positively and negatively related to inflation rate. The results also provide evidence of a positive long-run relationship between money supply and inflation in the Nigerian economy over the study period.

In the short run (see Table 9), the significance of lagged inflation indicates that the Nigerian inflationary process has been influenced by its past behaviour. The results also show that the coefficient of fiscal deficits exerts a positive influence in all the estimated models. Specifically, fiscal deficit is statistically significant in Model 2 and Model 3, and in Model 4 lagged by one year when money supply is incorporated into the model. The adjusted R-squared indicates that around 93% of variation in the inflation rate is explained by fiscal deficit, real exchange rate, lending interest rate, and money supply. The F-stat also indicates that each of the estimated models is statistically significant, implying that at least one of the explanatory variables in each case is statistically significant. The Durbin-Watson statistics reported in each case also reveal that only Model 3 suffers from autocorrelation.

5. CONCLUSION AND POLICY IMPLICATIONS

This study assesses fiscal deficits and inflation in Nigeria, using yearly data for the period 1980–2016. The unit root test reveals that the series are integrated of order 1 and 0, and as a result a dynamic model that incorporates fractionally integrated series is employed. Specifically, five models are estimated using the Autoregressive Distributed Lag Model. Furthermore, given the importance of structural breaks in the behaviour of these series over time, a multiple structural break test is adopted, such as that suggested by Bai-Perron (2003). Thus, both the ARDL with structural breaks and without structural breaks are estimated. The results show that fiscal deficit, exchange rate, lending rate, and money supply affect the inflation rate in both the short run and the long run, both with and without structural breaks. Specifically, in the short run, expected inflation positively affects current inflation. The significance of inflation expectation indicates that the inflationary process is influenced by its past behaviour. Expected inflation explains stickiness in prices, with periods of high inflation tending to persist and, conversely, periods of low inflation also persisting. The long-run estimates show that fiscal deficits have a positive impact on inflation along with other variables, taking into account only Model 3. However, when structural breaks are considered, the coefficient of fiscal deficit becomes positive in all regressions where only Models 2, 3, and 4 are significantly positive. All other variables also have a significant influence on the inflation rate, taking into account the various models.

Given the above findings, it is imperative that Nigeria provides an enabling environment for industries and firms to thrive, as this will help check the extensive homemade inflation; the regulatory authorities should also pursue a contractionary monetary policy to check money-induced inflation, and the price regulatory bodies should be fully equipped to function effectively, in order to address the impact of expected inflation. To bring about a realistic fiscal surplus, the fiscal operations of the Nigerian government should be very transparent. When a fiscal surplus is recorded it should be channelled to productive investments like road construction and electricity provision, which would incentivize productivity by attracting foreign direct investment and reduce inflation. In addition, regarding the fiscal deficit–inflation nexus, the prime concern of policymakers should not necessarily be the level of fiscal deficits but the channels through which the deficits are financed, and the ability of the productive economic base to absorb the impact of such financing. A fiscal management process that does not encourage increased revenue and reduce fiscal deficits in Nigeria will further worsen the level of inflation in the country.

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*Milutin Ješić**

BOOK REVIEW: An Introduction to Computational Macroeconomics, by Anelí Bongers, Trinidad Gómez and José L. Torres Willmington, DE: Vernon Press 2020.

JEL CLASSIFICATION: Y30

1. INTRODUCTION

Although computational macroeconomics is a relatively new economic discipline, it is one of the fastest-developing. In recent times the field of macroeconomics has been extended in many directions. One direction is making macroeconomics compatible with a broad array of IT development paths. Computational macroeconomics is now at the core of high-quality graduate courses in macroeconomics. There are many reasons for this, but only the two most important will be mentioned here. First, macroeconomic models, both theoretical and applicative, can hardly be solved without using computational tools. Their complexity requires using software packages, and sometimes even that is not enough to solve the model quickly, escpecially when it incorporates many state variables. Second, the possibilities of using computational tools for macroeconomic analysis are extensive, in a way that was unthinkable in the past.

An Introduction to Computational Macroeconomics deals with core macroeconomic problems from a computational perspective, which is the most important angle; and therefore it represents a significant contribution to the presentation of macroeconomic models to academics, the scientific community, and the general public. The book consists of three parts and an appendix. In

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the first section, dedicated to Basic Dynamic Systems, the authors analyse topics such as the dynamic IS-LM model and the exchange rate overshooting model. The second section analyses Macroeconomic Dynamic General Equilibrium, and readers are introduced to the consumption–savings decision, the role of fiscal policy in firms' investment decisions, and the basic dynamic general equilibrium model. The third section focuses on Economic Growth, paying special attention to the neoclassical growth model and Ramsey's optimal growth model. In the appendix the authors provide replication codes for the exercises in the main part of the book, written in MATLAB and/or DYNARE.

2. INTRODUCTION TO BASIC DYNAMIC SYSTEMS

The first chapter of the book introduces dynamic systems through exercises based on a general model that consists of difference equations. The authors make readers familiar with basic dynamic modelling concepts, in particular steady state and impulse response functions. Special attention is paid to stability analysis. In macroeconomics not all trajectories lead to equilibrium, i.e., global stability. The common situation is the presence of a saddle point when only a few routes lead to a steady state, while the others do not. Of course, global instability of the economic system is also a possibility.

The second chapter is dedicated to the IS-LM model, one of the greatest tools of macroeconomic analysis. The model has been modified, and the authors analyse the dynamic version. One of the crucial assumptions of the static IS-LM model is constant prices. In a dynamic environment this assumption has to be relaxed. The authors assume that prices evolve over time but that there is some degree of price rigidity, which has consequences for the monetary neutrality proposition, which holds in the long run. After solving the baseline model, the authors additionally perform shock analysis (increase in money supply) and sensitivity analysis (change in the elasticity of money demand with respect to output).

The third chapter of the first section describes the exchange rate overshooting model. This well-known model by Dornbusch explains the response of small open economies to different shocks through exchange rate adjustment. The model consists of two equations, one describing the evolution of the nominal exchange rate, and the other the inflation path.

3. INTRODUCTION TO GENERAL EQULIBRIUM

The first chapter of the second part of the book deals with households' optimal consumption–savings choice, which is one of the fundamental problems in macroeconomics. The assumption of the representative agent is common in this area of macroeconomics. The authors explain the basis of the problem, starting with the maximization of the utility function subject to budget constraint. They present a detailed numerical solution to the problem. As in the previous cases, additional sensitivity and shock analyses are performed.

The following chapter extends the previous one by introducting the consumption–leisure choice by which households determine their optimal labour supply. It should be emphasised that in the analysis, labour supply is a static decision (Bongers, Gómez, and Torres, 2020, p. 95).

One chapter in this part of the book analyses the role of government and the implications of fiscal policy. Various aspects of fiscal policy are analysed, such as the implications of income tax in the framework of the household optimization problem, the effect of changes in tax rates, and the difference between distortionary and non-distortionary taxes.

Firms and investment decisions are analysed in a separate chapter in this part of the book. This is important, since households and firms are the two main agents that influence the economy through their behaviour, i.e. the economy is micro-founded, and firms maximize their profit function subject to the production function.

Finally, a chapter is dedicated to the basic general equilibrium model. A crucial proposition of dynamic general equilibrium models is that they are micro-founded (Bongers, Gómez, and Torres, 2020, p. 163). This is especially important, as nowadays they usually form the basis for all modelling.

4. ECONOMIC GROWTH

The last part of the book analyses an important topic in macroeconomics: economic growth. It is very important to develop macroeconomic models that are related to the long-run stance of the economy, and dynamic general equlibrium models can be used to describe both the short-run and the long-run dynamics of the economy.

The first chapter of this part of the book deals with the neoclassical growth model. Growth is treated as exogenous. The authors use the neoclassical growth model in discrete time and simulate the Solow-Swan model.

The second chapter is dedicated to Ramsey's optimal growth model. The assumptions used are discrete time and infinite lived households. After the numerical solution of the model, shock analysis is performed in order to investigate the effects of permanent change in total factor productivity. Sensitivity analysis is then conducted to analyse the effects of changes in the discount rate.

5. THE SCIENTIFIC CONTRIBUTION OF THE BOOK AND CONCLUDING REMARKS

In the authors' view of macroeconomics, the central problem is finding new and simple ways to solve models using computational tools. This is important, since computational macroeconomics constitute a new framework for macroeconomic analysis and introduce a necessary change in the way students are familiarised with contemporary macroeconomic problems. The authors provide scientific validity by relying on well-structured macroeconomic theory and rigorous mathematical derivations of the models' solutions.

The key features of this book are simple solutions, even for complex macroeconomic models, based on spreadsheets and codes. The authors have developed an easy way to solve macroeconomic models using Microsoft Excel and/or MATLAB and DYNARE, which is a unique way to present models' solutions. This provides a good basis for the further development of macroeconomic models. Exercises are provided at the end of the each chapter to help readers deepen their knowledge of the particular models.

The possible modifications of the models in the future are certain, but as Galí (2015) concludes it is certain that quantitative macro modeling will be present in the process of the economic policymaking, and therefore this book is an excellent starting point for computational macroeconomic analysis. Bearing all this in mind, this review aims to bring this valuable book to the atttention of potential interested readers.

I would encourage all researchers in this area to read this book because of its contribution to economic theory. Its synthesis of concepts from economic theory,

economic policy and mathematical economics will awake the interest of readers for this extraordinary publication among economic literature.

A more specific motive for reviewing this book is that it will be key reading material on the newly established *Applied Macroeconomics* course at the University of Belgrade's Faculty of Economics. It will be used to show that seemingly complex problems can have relatively simple solutions.

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INSTRUCTIONS TO AUTHORS

Economic Annals is an international professional journal published quarterly by the Faculty of Economics, University of Belgrade. It publishes research in all areas of economics and business administration, particularly for transition and emerging economies. The journal encourages the submission of original unpublished works, not under consideration by other journals or publications. Contributions written in English and in electronic form should be forwarded to: ea@ekof.bg.ac.rs.

The journal maintains high scientific standards. Papers submitted for publication should be original, relevant and scientifically accurate. Authors are expected to provide new information or analysis and should present a summary of the conclusions they draw, maintaining coherence and compactness of their reasoning. The originality of the work is subject to test by iThenticate crosscheck. The texts should also follow appropriate technical standards and stylistic criteria. UK spelling (specialisation, labour, etc.) should be used, while both UK and US abbreviations are acceptable.

All submitted papers will undergo a double-blind refereeing process. An anonymous version of the paper should be submitted along with a separate cover page, containing the article's title, author's name and affiliation, e-mail address, and a suggested running head (an abbreviated form of the title of no more than 50 characters with spaces). The cover page should also should contain a short abstract of between 100 to 200 words, summarising the major points and conclusions of the paper, a list of up to five keywords and up to five two-digit codes in accordance with the Journal of Economic Literature (JEL) classification (https://www.aeaweb.org/econlit/jelCodes.php).

Papers should be prepared as a single file (including text, notes, references, figures, and tables) in MS-Word. Papers should be submitted in A4 page format (21×29.7 cm), left and right margins cm, top and bottom 4.5 cm, in font Times New Roman 12, single line spacing. There should be no tabs in paragraphs and a single line spacing should separate paragraphs and titles. Tables, figures and footnotes should be included as they are intended to appear in the final version. Footnotes (in font 10) should be kept to a minimum and numbered as superscripts. Papers which do not conform with the above instructions will not be taken into consideration.

As a rule, submitted articles should not exceed 8,000 words. All pages apart from the first one should be numbered. Subtitles should be concise, clearly marked in bold, and numbered (up to two levels of numbering). No other entries should be bolded. Formulae should be numbered on the right-hand side of the page. In case of long proofs, these should be inserted in a separate Appendix, following the References. Tables and Figures must not use colour, and should be in a format easy to edit, for instance they should take half a page (or a full page) within the indicated margins. They should be clearly labelled at the top, with a legend at the bottom, and should be logically ordered, using Arabic numerals. Sources of the data should be given below tables and figures.

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Rodrik, R., Subramanian, D., & Trebbi, F. (2004). Institutions rule: the primacy of institutions over geography and integration in economic development. *Journal of Economic Growth*, 9(2), 131-165.

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Acemoglu, D., & Robinson, J.A. (2006). *Economic Origins of Dictatorship and Democracy*. Cambridge: Cambridge University Press.

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