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Table of Contents:

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A MODEL APPROACH TO UNDERSTANDING MONETARY AGGREGATES GROWTH IN SIERRA LEONE AND IMPLICATIONS FOR POLICY FORMULATION

Emerson Abraham JACKSON
Modelling and Forecasting Section
Research and Statistics Department
Bank of Sierra Leone, Sierra Leone
ejackson@bsl.gov.sl; emersonjackson69@gmail.com

Patricia Sarah VANDY
Acting Head, Financial Services Department
Institute of Public Administration and Management
University of Sierra Leone, Sierra Leone
patriciasarah18@gmail.com

Abstract

This study has adopted a model approach to developing an understanding of monetary aggregates (MA) growth in Sierra Leone, which certainly has implications for effective policy formulation by the central bank authority. In pursuance of this, we utilized the Autoregressive Moving Average (ARIMA) model with data spanning 2002M1 to 2021M12 to investigate the out-of-sample projection performance of the disaggregated components that makes up the MA for Sierra Leone – typically in this case Reserve Money (RMA), Currency-in-Circulation (CiC) and Reserve Money (RM). In our evidence from the empirical projection (covering the period 2022M1-2022M12), we observed that RM is projected to grow more than CiC over the observed period. Given RM being the operational target of the Bank of Sierra Leone, we believe that such an outcome is a promising indication particularly in ensuring the bank addresses its core mandates of monitoring price and financial stability. The increased scope of RM in the BSL system is a laudable outcome when it comes to meeting reserve requirements and also managing risks about price and financial stability. The study recommends that the BSL adopt innovation strategies concerned with FinTech and the emergence of the National Switch to effectively manage the MA portfolio in the entire banking system, which will also support the overall growth ambition of the central government.

Keywords: monetary aggregates; financial stability; price stability; growth; Sierra Leone.

JEL Classification: E47; E52; E58.

Introduction

Monetary aggregates by definition provide an indication of monetary stock in a country, which is considered critical to helping central banks monitor their role in supporting stable macroeconomic management, notably price and financial stability (Juhro and Rummel 2022). The process is managed differently by economies around the world depending on the complexity of central banks' monetary

operational system. Typically, in a country like Sierra Leone and specific to this study, the process of monetary aggregates is done by computing the end of the monthly stock of components of money, which incorporates Reserve Money (M0), Broad Money (M2), and Currency in Circulation (CiC).

The concept of monetary aggregates is very important in supporting the role of central banks to discharge their core mandates. Therefore, in discharging the role of monetary issuance in an economy, central banks normally ensure that monetary aggregates computation are very well coordinated in supporting the smooth running of economic activities, which also has huge implications for stabilising the financial system, while at the same time ensuring price control system is effectively monitored to address stable economic well-being for citizens. An understanding of monetary growth, which has been explored through various forms of empirical research operations is very essential in ensuring a trade-off or a balance is realised between inflation and economic growth in an economy (Garratt, Koop, Mise and Vahey 2009).

Effective monitoring of Monetary aggregates is considered very important for economies, particularly in a country like Sierra Leone where Reserve Money (RM) is the operational target for effective monetary policy operations (Jabbie and Jackson 2020; Jackson and Jabbie 2019). Monetary aggregates are a very important engine that supports the operation of monetary policy, which also impacts economic activities and employment in the short run and as a means for taming inflationary pressure in the long run (Labonte 2009; Currie 1956). Reserve Money, also referred to as '*high-powered money, base money, and central bank money* typically suggests that its maintenance and monitoring are highly important for a country like Sierra Leone. Given its relevance as the monetary target for a country like Sierra Leone, it also makes it possible for the country to own up to its international commitments, while also anchoring high scope for maintaining stable foreign exchange reserves to support uneventful concerns arising from both internal and external shocks.

It is therefore essential that stable monetary aggregate growth is maintained by the central bank, with good predictive power in a bid to monitor risks to price and financial instability. It is with this focus in mind that this study has carved its impetus to produce a model approach that will help understand the direction of monetary aggregates (specifically Reserve Money as the operational target) in Sierra Leone, which is thought to have implications for effective policy formulation. Sierra Leone is a rich and endowed nation, but equally challenged with a plethora of concerns that include a long battle against civil unrest in the 1990s that almost brought the country to a standstill, and also external shock owing to its weak real sector operations (Jackson, Barrie and Johnson 2021; Jackson and Tamuke 2021; Jackson, Tamuke and Sillah,2021). As stressed by Friedman (1970) from his monetarist view of inflation, *"Inflation is perceived to be everywhere and more so a monetary concern, which is said to be due to an increase in the quantity of money outstripping output"*. Therefore, on reflection of Fisher's (1936) version of the Quantity Theory of Money (MV=PT)[1], it is hereby believed that effective control of the money supply (in this case the Reserve Money component of the Monetary Aggregates) will help anchor reasonable level of inflationary pressure, regardless of the low state of real sector operation as currently witnessed in the case with Sierra Leone.

To empirically explore the topic, the researchers have set themselves the onus of answering the highlighted research question: *What is the importance of Monetary Aggregates in addressing effective monetary operations by a central bank?* To address the highlighted research question, the following research objectives are hereby set in place as the milestone to achieving the overall focus of the study: (i) To provide a background understanding of Monetary Aggregates concerning its operational target focus by the Bank of Sierra Leone. (ii) To utilise a univariate ARIMA model to project outlook for Reserve Money (RM) as the operational target. (iii) To proffer sound recommendations, which are consistent with the objective focus of the Bank of Sierra Leone.

The remaining sections of the paper cover the following: Section Two provides an overview of Stylised facts about monetary aggregates in Sierra Leone. Section Three addresses the literature review, divided into two parts (namely theoretical and empirical reviews), while Section Four provides a

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[1] Where: M is Money Supply; V is Velocity of Circulation; P is Price level; and T is Transaction

snapshot of a simplified short-term model to project the outlook of components of the monetary aggregates. Section Five provides an analysis of the results, while Section Six concludes with proffered pointers for effective policy recommendations.

1. Stylised Facts about Monetary Aggregates in Sierra Leone

Figure 1 above illustrates a succinct historical outlook of monetary aggregate components for Sierra Leone within the period 2002M1 to 2021M12 – this includes indicators like Reserve Money (RM) as the operational target for Sierra Leone, Broad Money (BM), and Currency in Circulation (CiC). Given the nature of the Sierra Leone economy, which is currently managed as a highly cash-based system, it is apparent to infer those monetary aggregates and particularly CiC could potentially manifest some level of risks to the system, particularly when it is shown to be higher than the monetary base or simply put, reserve money. In general, several studies have also shown that a high level of informality in the entire economy of Sierra Leone is exposing the system to pumping more money into circulation (CiC), which also poses risk to the entire financial system's stability (Jackson, 2020; Jackson and Jabbie, 2019). An expanded CiC in itself has the capability of inducing inflationary pressure on an economy, which as shown has become a concern for Sierra Leone, in addition to the fact that the country's real sector is currently not very well functional to support a healthy domestic economy.

Figure 1. Monetary Aggregates for RM, BM, and CiC
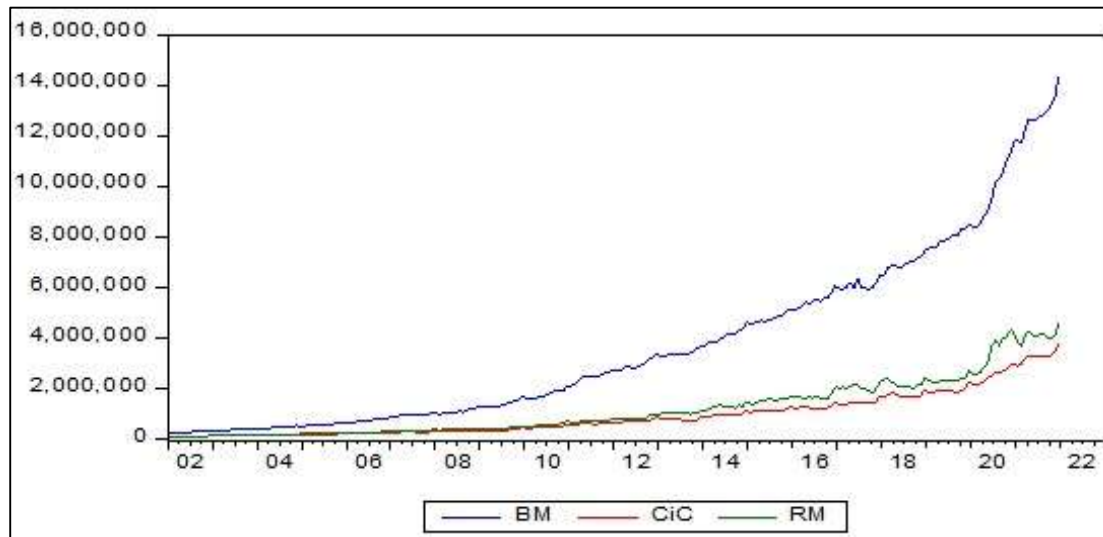
Source: EVIEWS Output

Given the above trajectory of the historical position of monetary aggregates in the Sierra Leone economy, there is certainly a need for the move towards the redenomination of the Leone currency and also backed by the emerging launch of a National Switch, which will help to monitor cash usage in the domestic economy, while also increasing surveillance of illegal financial transactions – an implied disincentive to foreign investments. As seen, Broad Money (BM) component in the Monetary Aggregates is high, which is the totality of all forms of money in the financial system – this includes items like notes and coins and other operational deposits held in the central bank and also savings at commercial banks or other depository corporations. More surprisingly, BM also incorporates Treasury Bills securities, which makes it quite obvious as the highest component when compared to the other components that make up the monetary aggregates.

2. Literature Review

This section explores the literature on monetary aggregates, with attention focused on the theory of money and empirical works already produced over the past decade in a bid to develop our approach to carving the methodology and outcome for this study.

2.1. Theoretical Review

Theoretically, the concept of Monetary Aggregates (MA) is considered very important, both in terms of its economic linkage and also the role it plays in addressing both price and financial stability in a county. Since the 1980s, advocates of MA have been faced with a deterioration in the traditional relationship between money and financial innovation, while the consequential impact on the velocity of money is fully explained on account of the associated relationship with the highlighted factors (Estrella and Mishkin 1996). As emphasized by the authors, changes in the velocity of money could be explained in part by regime shifts in policies and also through financial innovations introduced more recently with the emergence of systems like FinTech and the National Switch platform. As utilised by many economies around the world, and particularly in terms of its operational anchor for monetary policy, the use of MA could be assessed as an informational source in effecting sound policy formulation and also in signaling central banks' intention to monitor their core objectives of maintaining price and financial stability, and for some central banks anchoring nominal income growth (ibid).

The relevance of MA is growing with prominence given its relationship with economic growth in a country (Labonte 2009). As already identified, the conduct of monetary policy decisions is very critical to addressing economy-wide confidence in MA as a tool for stabilising prospects for growth and economic well-being. Money supply, a component in the MA needs to be monitored and central banks are considered very critical in ensuring the components are effectively managed through the adoption of firm policy measures in a bid to affirm confidence in a financial system. Effective management of MA normally helps central banks to anchor sound monetary policy and financial stability targets, which are considered very important to ensure inflationary pressure is contained. For instance, an uncontrolled level of CiC may result in inflationary pressure and as highlighted by Estrella and Mishkin (1996), the use of a firm policy stance backed by innovative measures is also considered helpful in reducing risks of instability to an economy.

2.2. Empirical Review

Elgar, Jones & Nilsson (2006) investigated out-of-sample forecasting performance for different monetary aggregates in four models that include real output growth, inflation, interest rate, and the nominal money growth during the period 1992 to 2004. The model uses vector autoregressive (VAR) and regime-switching (RS) VAR models. The authors also made use of Divisia and monetary aggregates like M1, M2M, M2, and M3. There was not enough evidence to prove that any of the methods (aggregation method or level of aggregation) impact the forecast performance of the models, particularly when it comes to inflation and output growth. The VAR model outcome when utilised with monetary aggregates made very little improvement on the RMSE when compared to the VAR models that did not incorporate money growth. The outcome also proved that RS-VAR models show improvement in one-quarter forecasts when equated to the VAR models, but also performed worse when the inflation forecast is done for four-quarters periods.

Garratt *et al.* (2009) carried out an empirical study by exploring real-time prediction with UK Monetary Aggregates in the presence of model uncertainty. It was perceived that the demise of the U.K.'s monetary targeting regime in the 1980s was to be blamed on the fluctuating predictive relationships between broad money and inflation and real output growth. The paper particularly investigated predictive relationships for indicators like inflation and output growth by using both real-time and heavily revised data. The authors made use of a large set of recursively estimated vector autoregressive (VAR) and vector error correction (VECM) models – the models are thought to differ in terms of their lag length and the number of cointegrating relationships. They also made use of Bayesian model averaging (BMA) to establish real-time issues that monetary policymakers faced in the presence of model uncertainty. In-sample prediction of money fluctuated in the 1980s on account of data revisions in the presence of model uncertainty – it was proven that the feature is more seeming with real-time data, while heavily revised data was said to be incomprehensible with the observed fluctuations. On the other hand, Out-of-Sample predictive evaluations seldom advocate that money matters for either

inflation or real output. The study finally concludes that both data revisions and model uncertainty contribute to an obstacle to the U.K.'s monetary targeting regime.

Bošnjak, Novak & Krišto (2018), produced an empirical study to explore the determinants of Croatian current account dynamics with the use of a monetary and absorption approach. The study made use of the Non-linear Auto-Regression Distributed Lag (NARDL) approach, incorporating nonlinear and asymmetric relationships for the Croatian current account and other determining factors. The study utilised quarterly data ranging from 2000Q1 to 2017Q2 and revealed that the Croatian current account with the framework of both monetary and absorption systems. Variables used as determinants to assess the Croatian current account include "*Domestic demand, real exchange rate index, loans to the private sector and monetary aggregates M4*". The outcome shows that monetary aggregates M4 are found to provide the chief explanatory power of the other monetary variables used. The main findings of the paper recommend the need for fiscal policy among many other measures while calming down constraints about liquidity constraints exporters as considered necessary to obtain external balance.

Dinh (2019) made use of the ARIMA model to forecast domestic credit growth in China and Vietnam. The model was then fitted using time series data, with two motives in mind; notably, to develop an understanding of the data used and also to forecast future point series. The specific model used is based on the best fit for Vietnam as ARIMA (2,3,1) and that of China, which ARIMA (2,3,5). The sample data used for analysis ranged from 1996 to 2017 and statistical significance was proven for the fitted sample. The out-of-sample forecast was done for one year. The outcome shows that both Vietnamese and Chinese purported as open economies possess domestic credit that greatly contributes to economic growth. The results are generally consistent with the central bank's approach to formulating effective policy that impacts domestic credit growth and GDP for the two countries.

Shaibu and Osamwonyi (2020) utilise Autoregressive Integrated Moving Average (ARIMA) model that was developed by Box-Jenkins (1976) for money demand in Nigeria, with quarterly data from 1986 to 2018. The study made use of correlogram, specifically Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) under the first-order difference of money demand series in a bid to identify and estimate a parsimonious ARIMA model. The ARIMA (3, 1, 2) model was identified as the best model with the criteria of identification, selection, parameter estimation, diagnostic checking, and forecast evaluation. The outcome from the results suggested that its adequacy was based on the Ljung-Box Q-statistic, considered most efficient in the forecasting of demand for money based on the RMSE and MAE values. Statistical significance was found to be found for lagged values of money demand in explaining actual broad money demand in Nigeria during the observed estimation period. The outcome also shows that inferences from previous values of money demand also affect present values of money demand. To achieve the stable and sustained function of Broad Money in Nigeria, the study recommends that the monetary authority should manifest a high level of transparency in monetary policy formulation, presentation, implementation, and control.

Srinivasan & Arora (2020) empirically tested to see if the addition of monetary aggregates with inflation forecasting models contributes toward enhancing forecast outcomes or not. The estimates were done using the P-star model and Divisia M2, Divisia M3, simple sum M2, and simple sum M3 together with Phillips curve and ARIMA models to forecast inflation for India from the period April 1994 to December 2016. The outcome shows the inflation forecastability of the Divisia monetary aggregate model and m1onetary aggregates to be the same. Even though Divisia was considered to fit better than the simple sum from 1993 to 2013, Divisia's model outcome seems not to explain the behaviour of inflation after the year 2013. The final takehome for policy recommendations is that reliance on Divisia alone may not help in producing reliable conclusions for policy formulation - it is, therefore, suggested its use is done together with the ARIMA model for consistent inefficient policy formulation.

Given the above-mentioned review of the theoretical and empirical literature, it is obvious to note the relevance placed on MA in monitoring the stability of a financial system and inflationary pressures. The addition to knowledge acquisition for this study is its niche in disaggregating the identified monetary

aggregates for Sierra Leone (Reserve Money, Currency in Circulation, and Broad Money) to understand their projected outlook, which is critical to anchoring a stable domestic economy.

3. Theoretical Framework and Model Specification

The model utilizes the previous past movement of variable(s), particularly Reserve Money (RM) as the operational target in predicting future values/events. This is a time series model, with data spanning from 2002M1 to 2021M12. Reliability of the outcome is focused on the out-of-sample forecast performance of the series (Stock and Watson 2003; Jackson 2018; Jackson, Tamuke and Sillah 2018). Times series models in particular are normally expressed in Autoregressive Moving Average (ARMA) form (Slutsky 1927 and Wold 1938), which is simplified in the following equation statements:

$$Y_t = e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \theta_3 e_{t-3} - \ldots - \theta_q e_{t-q} \qquad 3.1$$

The above series is referred to as a moving average of order **q**, with the nomenclature MA**(q)**; where Y_t is the original series and e_t as error term in the series. As presented by Pankratz (1983), the autoregressive process of the moving average series can be expressed as:

$$Y_t = \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \varphi_3 Y_{t-3} + \ldots + \varphi_p Y_{t-p} + e_t \qquad 3.2$$

It is assumed that t, is independent of $Y_{t-1}, Y_{t-2}, Y_{t-3}, ... Y_{t-q}$.

The model is based on the Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) format and it is a generalised form of the non-stationary ARMA model that represents the form ARMA(p,q):

$$Y_t = \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \varphi_3 Y_{t-3} + \ldots + \varphi_p Y_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} \ldots - \theta_p e_{t-p} \qquad 3.3$$

Where, Y_t is the original series, for every t.

We assume that is independent of $Y_{t-1}, Y_{t-2}, Y_{t-3}, …, Y_{t-p}$.

Based on Hamjah (2014: 170-171 (Jackson 2021; Jackson 2018; Jackson and Tamuke 2018), the procedure for this study is based on the undermentioned procedure:

▪ Check normality assumption, which makes use of the "Jarque-Bera" test, typically perceived to measure the goodness of fit.

▪ Check to make sure that is no evidence of autocorrelation with the residuals.

▪ Ensure features like Autocorrelation Function [ACF] and Partial Autocorrelation Function [PAC] are utilised to discover of Stationarity situation.

▪ Use of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) for model selection criterion.

More simplistically, this study, and particularly the program codes as shown in Appendix 1 are created in EVIEWS, with attention focused on the above procedure(s) to evaluate outcomes from the ARIMA model. This takes into consideration steps connected with unit roots, which are integrated within the codes, stability outcome as identified in the best model, and identification of AIC, Durbin-Watson, and R^2 values. These are required to produce the projection for Reserve Money (in short, the monetary base) and other components of the MA (See Table 1).

4. Discussion of Empirical Results

Based on the automated codes as shown in Appendix 4, each index has been modelled to reproduce its unique feature by incorporating constant, lag structure(s), first difference, and seasonal adjustment[s], as documented in similar research estimation outcomes (Jackson 2021; Jackson and Tamuke 2020). Specific to this research paper, the univariate Box-Jenkins model examined the characteristics of each component's projection process, with a unique best estimation output as shown in Table 1. The equations for the estimation were derived through an automated process by selecting the best three models through several iterated processes (see Appendix 1 for the complete codes).

Appendix 2 shows descriptive statistics of Monetary Aggregates for Sierra Leone as extracted for the study period. Technically, the summary statistics for the mean provide indicative information about the average of the series, while the median provides an expression of the median value in the series after ordering them in order of size or magnitude. Both minimum and maximum values indicate the lowest and highest of the monetary aggregate series during the observed period. Standard deviation in the series shows the level of dispersion or spread of the series and the Skewness is indicative of the symmetry of the distribution of all the series around the mean value. The Kurtosis value, which is 3.64 indicates that the distribution has a fatter tail. The Jarque-Bera value indicates the goodness-of-fit as to whether the data sample possesses skewness and kurtosis. The distribution in Appendix 2 indicates that the hypothesis of normal distribution at 1% and 5% significant levels is rejected, which means that the distribution is not normal.

Equally, we also provided in Appendix 3 the correlogram (otherwise known as the Autocorrelation Function) of the residuals. Supposedly, this makes it relevant to check the randomness of the data set – in other words, it explains how to well the present value of the series is related to previous or past values. In this situation, movements around the residual plot show that the data set is not random. The model's stability was also determined through the AR root value, indicated as 0.80 and backed by the AIC and Schwarz criterion values, which eventually determine its best feature for projecting the out-of-sample range in determining components of the monetary aggregates, which depicts the action of efficient monetary policy formulation that is consistent with the Bank of Sierra Leone's (BSL's) mandate – in this case, ensuring price and financial stability are consistently monitored.

Table 1. Model 3 (Best Model Outcome)

Dependent Variable: D(RM_3)
Method: ARMA Maximum Likelihood (BFGS)
Included observations: 239
Convergence achieved after 52 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.014630	0.000253	57.93917	0.0000
AR(1)	0.826794	0.041421	19.96092	0.0000
MA(1)	0.974588	0.74696	17.028779	0.043771
SIGMASQ	0.002357	0.002053	1.148127	0.2521

|				
R-squared	0.087579	Mean dependent var		0.015108
Adjusted R-squared	0.075931	S.D. dependent var		0.050935
S.E. of regression	0.048963	Akaike info criterion		-3.165679
Sum squared resid	0.563379	Schwarz criterion		-3.107496
Log-likelihood	382.2987	Hannan-Quinn criter.		-3.142233
F-statistic	7.518812	Durbin-Watson stat		2.096848
Prob(F-statistic)	0.000080			
Inverted AR Roots	.83			
Inverted MA Roots	0.92			

Source: EVIEWS Output

As we know from theory, failure to stabilise Monetary Aggregates in the system, with difficulty in curtailing CiC to a low level can also catalyse inflationary risk in the domestic economy. Consistent with the BSL mandates, and in particular identifying an operational target of building a good Reserve Money buffer, can also add pressure to financial instability, which in itself could instigate inflationary pressure.

For this study, the best ARIMA model as depicted in Table 1 has produced an out-of-sample projection (2022M1-2022M12) for all of the Monetary Aggregates (Reserve Money, Broad Money, and Currency-in-Circulation). Please note that there are several models, but the automated system provided us with the three best models, Model 1 as shown in Table 1 above is considered the best based on the properties (RMSE, Durbin-Watson, AR/MA Root Values) that are provided Appendix 1. This is the best model outcome when compared to the Models 1 and 2 as shown in Appendix 1, which also have the lowest Durbin Watson (indicating the absence of autocorrelation) and Root Mean Square Error (RSME) value – this, therefore, indicates that it is well fit to be chosen as the model for the forecast outcome.

Figure 2 below shows the actual position of all projected MA components. Broad Money (BM) is projected to be the highest, which is normal as it encompasses all of the components that make up the indicators of MA in an economy. Reserve Money (RM) typically considered the operational target for the BSL is also projected to rise during the cause of the year, which is well in place to surpass Currency-in-Circulation (CiC). Consistent with the BSL's mandate of maintaining single-digit inflation, a low projection will allow the financial system to be effectively balanced assuming other conditions are held constant.

Figure 2. Graph Showing Monetary Aggregates Projection
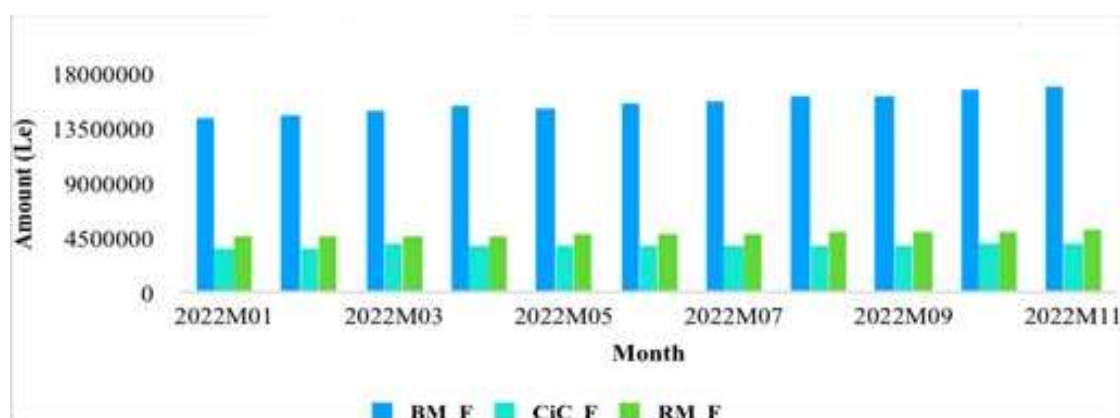
Source: EVIEWS Estimation Output

Conclusion and Recommendations

In conclusion, this study has brought to the fore, the importance of applying the STIF / univariate ARIMA model to project disaggregated components of Monetary Aggregates as applied to Sierra Leone. This is an innovative approach, which can also be combined with other econometric models to anchor effective monetary policy decision-making, aimed at achieving a single-digit inflation target. The use of an ARIMA model has made it possible for policymakers to become proactive in their approach to monitoring risks to the financial system, while at the same time preventing anything that may instigate inflationary pressures. Given the independent role of the central bank in providing policy advice to the government, the outcome of this research has paved the way to ensure effective advice is provided to capacitate the real sector, which will motivate high scope for generating revenue from PAYE and other forms of tax revenues - typically linked with the notion of reducing government borrowing normally channelled through the money market or Treasury Bills auction l.

The advantage of this study and particularly the methodology of ARIMA is its predictive power of evoking salient means of inspiring the central bank authority to continuously monitor price and financial stability. With the planned launch of the National Switch and the redenomination exercise, it is possible that the authority could be inclined to introduce financial innovation approaches (notably FinTech and electronic payment systems) to reduce people's perpetual habit of carrying huge sums of money

around. In a nutshell, people also can divert their attention towards the high usage of automated/electronic means of settling payments. Future studies of this nature could benefit from extensive use of a combination of macroeconomic variables to effectively influence the monetary policy approach in monitoring the dynamics of monetary aggregates needed to effectively address the BSL's core objectives.

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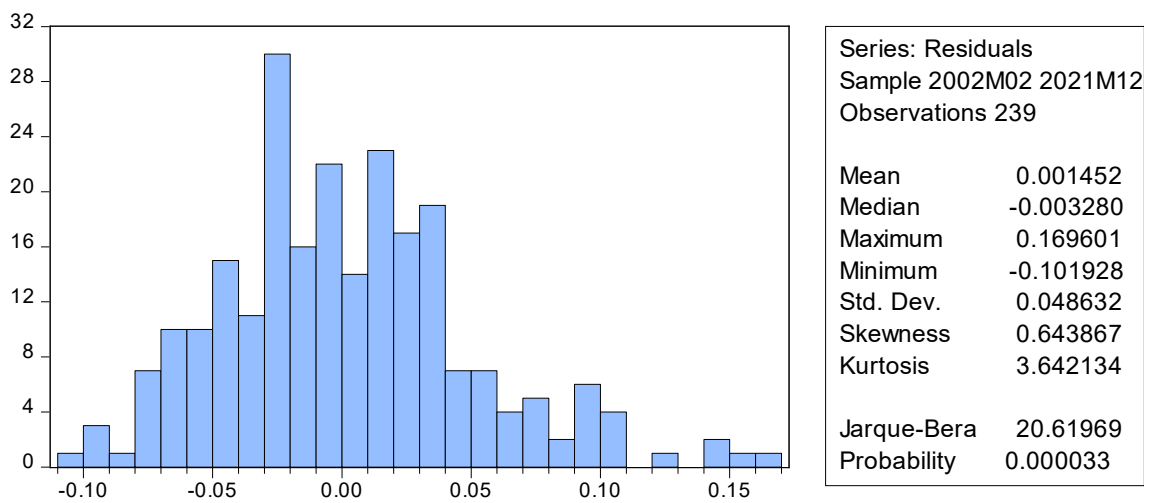
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Appendix 1. Best Model Outlook

Component	Best Model	Durbin-Watson	MAE	RMSE	Stability Condition
Monetary Aggregate Model	Model 1	2.15	5.64	13.76	AR<1 MA>1
	Model 2	2.13	5.21	11.05	AR<1 MA>1
	Model 3	2.09	5.22	11.23	AR<1 MA<1
Source: EVIEWS Output					

Appendix 2: Statistical Analysis of Output

Series: Residuals Sample 2002M02 2021M12 Observations 239	
Mean	0.001452
Median	-0.003280
Maximum	0.169601
Minimum	-0.101928
Std. Dev.	0.048632
Skewness	0.643867
Kurtosis	3.642134
Jarque-Bera	20.61969
Probability	0.000033

Source: EVIEWS Output

Appendix 3. Correlogram of Residuals

obs	Actual	Fitted	Residual	Residual Plot
2002M02	0.04689	0.01606	0.03083	
2002M03	0.04457	0.01317	0.03140	
2002M04	-0.01908	0.00819	-0.02728	
2002M05	0.08045	0.01537	0.06508	
2002M06	-0.05441	0.00426	-0.05867	
2002M07	-0.00924	0.01358	-0.02282	
2002M08	-0.02897	0.01568	-0.04465	
2002M09	0.04266	0.02251	0.02015	
2002M10	-0.01656	0.01730	-0.03386	
2002M11	0.04504	0.02240	0.02264	
2002M12	0.19137	0.02177	0.16960	
2003M01	-0.06677	-0.00625	-0.06052	
2003M02	-0.00948	0.00615	-0.01563	
2003M03	0.03514	0.01051	0.02463	
2003M04	0.02414	0.00779	0.01635	
2003M05	-0.00431	0.00626	-0.01057	
2003M06	0.01556	0.00946	0.00610	
2003M07	-0.00023	0.00924	-0.00946	
2003M08	0.04228	0.01217	0.03011	
2003M09	0.02304	0.00814	0.01490	
2003M10	0.00576	0.00691	-0.00116	
2003M11	0.03113	0.00878	0.02235	
2003M12	0.10869	0.00781	0.10088	
2004M01	-0.05401	-0.00766	-0.04635	

Source: EVIEWS Output

APPENDIX 4

```
'Eviews Version 10 code: ARMA selection

'Code for selecting optimal lag lengths for ARMA models

smpl @all 'Set sample period
scalar n1=@obs(rm) 'Number of observations of RM data
scalar components = 3 'Number of RM components, including aggregate index
scalar maxar = 11
scalar maxma = 11

'Rename series
series rm_1 = bm
series rm_2 = cic
series rm_3 = rm

'Seasonally adjust data
for !i = 1 to components
rm_!i.x12(mode=m) rm_!i
next

'For each component produce ARMA(a,m) with varying orders
for !i = 1 to components
    for !a = 1 to maxar '12
        for !m = 1 to maxma '12

        smpl 2002m1 2022m1+n1-1
        equation arma_!i_!a_!m.ls d(rm_!i_sa) c ar(1 to !a) ma(1 to !m)

        next
    next
next

'Identify the ARMA for each component with the optimal AR and MA orders according to the Akaike
Information Criterion.  Change to @schwarz or @hq for Schwarz and Hannan-Quinn criteria.
for !i = 1 to components
!mininfocrit = 9999
    for !a = 1 to  maxar '12
        for !m = 1 to maxma '12

        if arma_!i_!a_!m.@aic<!mininfocrit then
        !besta = !a
        !bestm = !m
        !mininfocrit = arma_!i_!a_!m.@aic
        endif
        next
    next

'Save the equation with the best order structure
smpl 2002m1 2022m1+n1-1
equation arma_best_!i.ls d(rm_!i) c ar(1 to !besta) ma(1 to !bestm)

smpl 2002m1+n1 2022
arma_best_!i.forecast rm_forecast_!i
```

```
next

'Show best ARMA models for selected components
for !i = 3 to 3
show arma_best_!i
next

show exp(rm_forecast_3)/exp(rm_forecast_3(-12))*100-100
show exp(cic_forecast_2)/exp(cic_forecast_2(-12))*100-100
show exp(bm_forecast_1)/exp(bm_forecast_1(-12))*100-100
'
```

CSR VS. VALUE CREATION: WHAT RELATIONSHIP? AN OVERVIEW OF THE LITERATURE

Lamia EL BADRI
Research Laboratory in Economic Competitiveness and Managerial Performance,
Faculty of Law, Economic and Social Sciences - Souissi,
Mohammed V University, Rabat, Morocco
lamia.elbadri@gmail.com

Mohammed Rachid AASRI
Research Laboratory in Economic Competitiveness and Managerial Performance,
Faculty of Law, Economic and Social Sciences - Souissi,
Mohammed V University, Rabat, Morocco
rachisaasri@yahoo.fr

Abstract:

Social and Environmental Responsibility represent nowadays an opportunity to be seized by a Companies to improve their competitive market position and to achieve their best level of performance and thereby create value. This article aims to analyze the different approaches that have demonstrated the existence of a link between CSR (Corporate Social Responsibility) and value creation, through a literature review and a conceptual framework.

Introduction

Evolving in a globalized environment where the notion of borders is only perceptible in its cartographic aspect, companies act and operate according to a transversal scheme involving a confrontation, more and more dogmatic, which associates performance, profit, and socio-environmental impact. If the concept of Corporate Social Responsibility (henceforth CSR) has taken root following a collective awareness of environmental concerns and the testing of governments' ability to manage natural disasters, this approach is now a lever for value creation and growth sine-qua-non for economic actors, especially with the advent of the Covid-19 pandemic that has put the entire global ecosystem to the test.

CSR is a relatively recent concept. It first appeared in the mid-1950s with the publication of the book "Social Responsibilities of the Businessman" written by Howard R. Bowen, but it only really developed in the 1990s. This concept, which originated because of ethical and moral concerns about the behavior of entrepreneurs, has over time become a strategic notion for companies, which are required to assume their social role towards the society to which they owe their survival.

1. Evolution of the CSR Concept

Nowadays CSR is an essential strategic approach necessary for companies to comply with the requirements of the current economic context and to face globalization and the various market evolutions. It is based on ethical business practices and promotes dialogue and transparency between the stakeholders of companies Kaptein, Van Tulder (2003); Tokoro (2007). It insists on increasing the qualitative economic value of companies and plays a primordial role in improving their image and reputation Tazi & Ibenrissoul (2020). In this sense, the classic status of "capitalist" companies has evolved to a more modern status, that of "responsible" companies.

Generally, responsibility can be seen as an obligation on the part of a person to answer for his or her actions by virtue of the role, the burdens that he or she must assume and to bear all the consequences[2]. This definition refers, de facto, to the environmental disaster Probo Koala, where the Dutch company responsible for this tragedy had to pay, as compensation, more than forty million dollars to the victims, following the pressure exerted by Amnesty International, which says a lot about the suitability of the process that is hardly part of the approach of value creation. Unlike the Moroccan company Maroclear, which obtained the renewal of its CSR label following the renewal of its ISO27001 certification in November 2020 and the ISO 9001 version 2015 certification in May 2021, and whose market share continues to increase.

To this end, the questioning of the causal link between value creation and CSR has been the subject of several studies and research projects, without any agreement from the scientific community. The analysis of the conclusions of existing studies reveals a certain paradox. On the one hand, there are those who acknowledge the positive repercussions of CSR on the financial performance of companies Allouche and Laroche (2005); Mikołajek-Gocejna (2016), and on the other hand, those who justify a negative or zero link Fernández-Guadaño and Sarria-Pedroza (2018), Balabanis, Phillips and Lyall (1998). There are even those who consider the link too weak or non-existent Cochran and Wood (1984), Surroca, Tribó, and Waddock (2009).

However, according to Simpson and Kohers (2002), listed companies have a competitive advantage with potential investors. The same is true for companies that integrate social responsibility into their strategies (even unlisted companies), the risk that they will perform poorly in the long term is rare.

Indeed, a company that does not manage to have a socially responsible reputation imperatively jeopardizes its profitability (in the medium and long term), hence the need for managers and shareholders to agree on the opportunity to implement a responsible strategy for value creation in order to avoid a potential loss of value. The interest, then, lies in the adaptation of a managerial spirit that works to satisfy all the economic, social and financial partners of the company, which may be called "stakeholders" Larbi and Ohanessian (2008). Without a remuneration scheme and attractive working conditions, it would be unreal to believe that a company could be capable of creating value, so it must be assiduously attentive to the market in order to satisfy the expectations of its customers at competitive prices.

According to Vatteville (2008), the acceptance of sustainable value creation in association with the company's partnership network could only lead to a rational and promising framework of analysis. The partnership and shareholder approaches are therefore not independent of each other; on the contrary, they complement each other, even if they are based on the dogmas of different cultures.

This article proposes a reading that aims to detect the causal link that stems from the relationship between CSR and value creation and will be organized as follows: sections 3 and 4 will respectively focus on a clarification of CSR and value creation based on a historical and conceptual analysis. The last section will present an analysis of the results of the different research conducted to study this issue.

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[2] https://www.cnrtl.fr/definition/responsabilit%C3%A9

2. The Emergence of CSR in Corporate Strategy: A Historical Overview

The emergence of social and environmental challenges and their imminence with respect to the well-being of populations has raised the need for a profound change in economic paradigms that, in many respects, were subject to reflection. In this perspective, the conception of growth as it has been approached in the context of sustainable development, combines economic greed with the environmental imperative.

The transposition of the concept of sustainable development to the corporate level has been corroborated by the declination of several variables related to ethics, social and environmental, which are now suitable for measuring Corporate Social Responsibility (CSR). The development of this concept is due to the mobilization of civil society actors, with an ecological and humanitarian vocation, who demanded that companies, especially industrial companies, take responsibility for the impact of their activities on society and the environment.

Indeed, corporate social responsibility is not a recent concept. In the early 1990s, paternalistic managers provided education for their employees' children and took charge of their health care, to curb social movements with protesting policies and to anticipate any intention to make demands Peeters (2004).

This practice was amplified during the 20th century. Some companies in the United States have adopted, in their management methods, behaviors that come under the practices of CSR in a framework where the absence of public powers is almost total in their activity Schwartz and Carroll (2003). It was therefore a question of priming the best skills by presenting services which, in the European framework at that time, were provided by the public authorities. According to Mercier (2001), it was during this period that some theorists, such as Theodore Kreps and Richard Bowen, were the first to teach CSR in universities.

The book "Social Responsibilities of the Businessman" by the American Howard R. Bowen is recognized as one of the founding theoretical works on the notion of CSR Latapí Agudelo, Jóhannsdóttir and Davídsdóttir (2019). This work has a strong historical resonance on social responsibility and prefigures a series of subsequent research works. It is thanks to BOWEN that the concept of CSR emerged in the modern era of management.

From the beginning of the 1920s, most managers began to adopt a responsible discourse towards their company, which was marked by concepts with religious connotations of "trusteeship" and "public service" that implicitly state a contract characterizing the relationship between the society and the firm Acquier and Aggeri (2015). And it is only since the 1950s that formalization work has emerged by separating religion from economics and management.

Thanks to the "Business and Society" current, CSR became a research subject interested in the links between business and society Acquier and Aggeri (2015), which gradually became stronger from the 1960s onwards. Since then, CSR has been the subject of several debates between practitioners, researchers and actors of modern society throughout the world. And by the mid-1980s, research on CSR had diminished in intensity and its concept had mutated into others, such as the corporate citizenship or stakeholder approach Caroll (1999); Acquier and Aggeri (2015). However, this approach was only applicable to the American context and clashed with the economic model of the time, which advocated and prided itself on economic liberalism.

Since the mid-1990s, European companies have begun to give importance to CSR following the actions taken by civil society and its organizations against large companies that have caused environmental, societal and social harm. On the other hand, interest in the United States increased in the early 2000s following the financial scandals of its major groups (Worldcom, Xerox, Enron, Arthur Andersen...). Without a doubt, these years represent the reign of saturn for CSR both in the research work carried out and in the managerial methods used.

3. CSR: Conceptualization

If we take stock of corporate social responsibility (CSR) from its emergence to the present day, we can only observe a remarkable evolution and a generalized interest on the part of companies, governments, civil society and international organizations. The concept of CSR, which occupies an important and growing place in the business world, has developed from its American roots to include other economic, managerial and even political meanings. The result of this evolution is a complex concept that is not unanimously accepted and that does not spread in the same way in different geographical areas. Thus, the definitions that have been attributed to CSR are different and vary according to the authors and approaches.

It is defined by the European Commission (2001) as being the responsibility of companies with regard to the effects they have on society, that is to say "the voluntary integration of social and ecological concerns of companies in their commercial activities and their relations with their stakeholders. Being socially responsible means not only fully meeting applicable legal obligations, but also going beyond them and investing "more" in human capital, the environment and stakeholder relations" Green Book on Corporate Social Responsibility 2001.

For its part, the ISO (International Organization for Standardization) defines, following the ISO 26000 standard (2010), the social responsibility of organizations as "the responsibility of an organization with regard to the impacts of its decisions and activities on society and the environment, resulting in transparent and ethical behavior that contributes to sustainable development including the health and well-being of society. This behavior must also take into account the expectations of stakeholders and respect the laws in force. Furthermore, it must be compatible with international standards, integrated throughout the organization and implemented in its relationships.

According to these two definitions, CSR focuses on the social and environmental aspects of corporate activity and also advocates ethical business practices. In this context, it:

▪ Promotes dialogue and transparency between the company's stakeholders (customers, suppliers, shareholders, financial institutions, the State, the international community, etc.);

▪ Insists on increasing the qualitative economic value of the company (partners, reputation, ethics, information system, human capital, environmental capital, etc.) to the detriment of the quantitative economic value (turnover, cash flow, assets, etc.);

▪ Plays an essential role in improving their image and reputation Fombrun and Shanley (1990);

▪ Participates in the improvement of their managerial skills and knowledge of the company's environment and its actors Russo and Pogutz (2009).

For Friedman (1962), the social responsibility of the company is to increase its profits, D'Arcimoles and Trébucq (2003). His fundamental thesis is that the manager has an implicit contract with the shareholder to use the company's resources to increase wealth and profit. This contract constitutes his responsibility to the shareholders who do not give him the freedom to act according to his personal preferences or to invest resources in social and environmental actions. This can be seen as a breach of trust or a charitable expenditure, not a set of values to which the firm adheres.

There are many who oppose Friedman's view. According to the stakeholder theory, a company can no longer function or loses its legitimacy when the contract that exists between it and society is broken. According to Freeman and McVea (2001), it is responsible to all its stakeholders.

Mc Williams and Siegel (2001) draw their definition from studies conducted on companies practicing CSR, and according to them, it is a set of actions aimed beyond the interest of the firm, the social good. McGuire (1963), Davis (1973), define CSR as the recognition by a company of its responsibilities towards society and the taking into account of its problems that go beyond its legal and economic obligations.

Carroll A. B. (1979) did not limit the responsible company to a few possible fields of action. She defined CSR according to four types of obligations: economic (to make a profit, to produce according to quality standards...), legal (to respect regulations and laws...), ethical (to act according to the moral principles of society) and philanthropic (to act with charity and benevolence). A definition that was

refined in 1991 by Wood, who defines corporate responsibility on three levels: legitimacy, public accountability and managerial discretion. Carroll and later Wood, proposed a definition that goes beyond the previously supported approaches, systematizing the results of previous research and determining the fields of analysis of CSR.

According to all these definitions and approaches mentioned above, a socially responsible company can only be defined as one that achieves its financial goals in conjunction with the interests of all its stakeholders in compliance with regulations and laws.

4. Implementing CSR: Stakeholder Theory

Stakeholder theory has played a crucial managerial role in the implementation and conceptualization of CSR within companies since the 1970s until the early 1980s. According to Callon, Lascoumes, Barthe (2001), the concept of stakeholders was not limited to the entrepreneurial fabric. It spread, following the rise of participatory democracy, to the whole of society.

Acquier and Aggeri (2005), have developed a model from the theory of stakeholders according to four principles:

- Stakeholders have demands on the company.
- Stakeholders do not have the same impact or level of influence on the company.
- The company can only prosper if it has the capacity to respond to the needs of influential stakeholders (responsiveness);
- Taking into account and arbitrating is the ultimate function of management to deal with the contradictory demands of stakeholders.

This research work refers to the "stakeholders project" set up within the Applied Research Center of the Wharton School in 1977, the objective of which was to bring together several currents of thought and to put in place a theory of management that would enable managers to formulate strategies in turbulent environments Freeman and Reed (1983). These approaches aim to include at the heart of their analyses, what Voguel (1978) has called "adversarial groups".

In this sense, a stakeholder can be defined according to Freeman and McVea (2001) as a set of actors whose independent collective behavior can affect the prosperity of a company. The stakeholder theory is therefore a strategic managerial tool. Its interest is important when it is linked to the objectives set by the firm.

The multitude of research works carried out, allowed the differentiation between the external and internal stakeholders of the company, and proposes to classify the stakeholders according to categorical bases:

- Internal stakeholders (employees, shareholders and unions);
- Operational partners (customers, suppliers, insurers, etc.)
- The social community (public authorities, professional unions, NGOs, civil society).

Stakeholders constitute a central element of a company's intangible capital which, as a result, represents on the one hand, an essential determinant in the development of a socially responsible company, and on the other hand, a key asset for differentiation, productivity gains and value creation.

5. Concept of Value Creation

The concept of the creation of value has considerably strengthened over the years to the point of being a decision-making criterion for economic operators Denglos (2003). It is in this sense that the creation of value has become an end in itself for the company which requires the activation of several levers leading to growth.

While the principle of value creation has been widely accepted as a way of assessing corporate performance, the concept is nevertheless fraught with ambiguity. Often used in reference to financial aspects, value creation in its restricted sense would mean generating profits through improved profitability and thus increasing the wealth of managers and shareholders. However, this definition remains rather limited to the scope of value creation, which has a broader managerial dimension.

In order to understand this concept, it is necessary to briefly address its different aspects. From a financial point of view, the company that wants to create value seeks to invest in projects whose rate of return exceeds that required by the risk inherent in the project. In addition to the financial aspect, value can take several forms:

Business value is similar to utility value. According to the economist Michael Porteur, value is what customers are willing to pay. It is obtained by applying a strategy of cost domination based on lower prices than the competition, or by adopting a strategy of differentiation which consists of distinguishing oneself from the competition by offering the customer what no other operator is willing to provide, following which, he will bear the extra cost without any reservation.

The book value of a company is the sum of its assets minus its liabilities. There are several procedures for valuing a company, including the asset-based, return-based and goodwill-based methods.

The indicators for measuring the performance of a company have evolved. If in the past profitability was measured, without question, by the analysis of the return on investment, nowadays, the creation of value has taken its place as the indicator par excellence, allowing to estimate the growth rate of the company. According to Jaquet (1997), it is by measuring the capacity of the company to create value that one will be able to inquire about the efficiency of its financial policy. This primordial role that the creation of value plays as a tool of evaluation of the company, makes it essential to consider it in the process of decision-making, that is to say for the choice of the investment projects.

On another note, Remaud (2001) and Albouy (1999) agree on the principle that a company only creates value when it manages to achieve a cash flow that is sufficient, on the one hand, to remunerate its investors and, on the other, to cover the sums dedicated to future investments. It is in this perspective that the financial aspect linked to the creation of value becomes an essential tool for the evaluation of a company.

There are several methods of assessing value creation. The classical indicators such as turnover, added value, reinvestment of profits, net result..., which are less and less used, have given way to more modern methods such as EVA (Economic Value Added) and MVA (Market Value Added), Jakub, Viera and Eva (2015).

6. Indicators for Measuring Value

The classic indicators make it possible to measure the performance of a company according to its accounting summary statements. This approach is based solely on the analysis of the company's financial indicators such as:

The added value of a company is obtained after subtracting the intermediate costs from the turnover, in other words, it is the difference between the selling price and the cost of raw materials necessary for production. Remaud (2001) links value added to the capacity of the firm to create a surplus for society, notably through its contribution to GDP. Simple to analyze, value added makes it possible to measure the wealth produced before its distribution to stakeholders, notably managers, employees, investors and the administration (the principle of sharing value added).

The net result represents the wealth created by the company. It is the total of its income minus its expenses over a defined period. According to Ben Larbi and Ohanessian (2008), this indicator, which measures the gains generated (positive net income) or the losses incurred (negative net income) by the firm, serves as a basis for capital providers to set their remuneration. It should be noted that a negative net result does not necessarily mean that the company is unable to create value, because in these cases, other criteria can be studied, such as the accounting and commercial values of the company.

There are a multitude of so-called classical indicators that can be used in the evaluation of the company, including Earnings before Interest, Taxes and Amortization (EBITA), turnover, debt, etc. However, the fluctuations in the business world have led to an innovation in the basic dogmas and the introduction of new instruments, such as the economic added value, the market added value, the free cash flow...

The accounting net profit is not sufficient as the only indicator of the value of a company, since it is a result of accounting data that does not represent the economic reality. Some analysts, such as Charreaux and Desbrieres (1998); Caby, Clerc-Girard and Koehl (1996), sought to find indicators that considered the notion of risk, results and growth and that examined the conformity of accounting data with economic reality. It was during the 1920s that the concept of "value creation" appeared in the USA. It was conceptualized according to numerous methods and by multiple researchers, namely the: Total Shareholder Value (TSR), Free Cash-Flows (FCF), Economic Value Added (EVA), Market Value Added (MVA); Obaidat (2019).

Total Shareholder Return (TSR):

The total shareholder return (TSR) proposed by the Boston Consulting Group (BCG, 1996-2016) is the rate of return to a shareholder taking into account the realized appreciation of the share and dividends paid for a given period Faverjon and Marion (2005),This, is because dividends do not in themselves constitute wealth for the shareholder, as long as the shareholder is only recovering a portion of his or her assets in cash.

According to the Commission des Opérations de Bourse (COB, 2001), now the AMF, the TSR is equal to the ratio between, on the one hand, the adjusted share price at the end of the period, to which the distributed dividend is added. And on the other hand, the adjusted price at the end of the previous period. It must be indicated in this case whether the TSR is calculated on a net basis (subtracting the capital gain and the dividends) or on a gross basis, and whether or not the tax point is taken into account.

The Free Cash-Flow method

The availability of cash flows in a company demonstrates its ability to finance itself. Therefore, the Free Cash Flow (FCF) determines the cash flows that are available after deduction of taxes. This is the excess cash flow that remains available in a company once all of its NPV (net present value of expected cash flows from an investment project) projects have been financially supported.

The FCF approach was introduced with the air of modern finance between the 1950s and 1960s under the guidance of "Modigliani F. and Miller M." Rochmah and Ardianto (2020). Its calculation formula is as follows:

FCF = Gross Operating Surplus - Capital Investment of the period - Net Operating Income

Economic Value Added (EVA):

EVA is a concept that was created by the firm Stern, Stewart & Co, covering all aspects of management Jakub, Viera and Eva (2015), Faiteh and Aasri (2022).

Contrary to the classic indicators of profitability, according to Costin (2017), EVA considers the costs of achieving the desired results, which is close to the concept of performance, which implies both return on investment and cost optimization.

According to Mottis and Ponssard (2002), some companies have moved from the margin objective to the current result before tax objective and thus to the logic of the rate of return on investment (ROI) and finally to EVA. It is a performance measurement tool that takes into consideration the requirements of investors. Charreaux (1998) defines it as the difference between the cost of capital invested and the economic result after tax. Thus, the formula of the EVA according to him is the following one:

EVA = Ka. VC - CMP.VC = (Ka - CMP). VC

Ka represents the economic rate of return measured in an accounting manner (profit after tax / assets). The calculation of the Weighted Average Cost (WAC) is based on traditional methods.

Indeed, the EVA is calculated according to a complex formula, which can be summarized as follows:

EVA = Invested capital x (return on invested capital - weighted average cost of capital employed)

The EVA, according to Charreaux (1998) is a decentralized measurement key that allows to measure at all levels of a firm, the performance of an entity by requiring an individual rate of profitability that it compares to the performance achieved.

Market Value Added (MVA)

Market Value Added (MVA) according to Charreaux (1998) is the market value of the invested capital MV (equity and financial debts) minus the book value of the same invested capital CV.

MVA = MV (equity and debt) - CV

The creation of wealth for shareholders is now proportional to the market value added (MVA). In this case, a negative MVA shows that the value of the capital attributed by the financial markets to a company is more important than that attributed to the shares and investments, Obaidat (2019).

On the other hand, MVA has certain limitations when it is considered by a company as the ultimate indicator of its value creation, since it does not include the costs of capital invested. Unlike EVA, it cannot be measured in the different business lines of the company.

However, MVA and EVA have been the subject of several criticisms. In particular, they have been criticized for their method of calculating the cost of equity Charreau (1999). Moreover, both measures are based on theoretical foundations that presume the efficiency of financial markets, which is far from being the case for markets in less developed countries.

The methods of measuring value creation that we have presented above are not exhaustive. Other indicators are also used, including return on investment (ROI), price earnings ratio, return on equity (ROE), return on assets (ROA), the Sharpe index and many others.

7. The Link between CSR and Value Creation

Studying the impact of CSR on value creation is not always obvious. It is important to assess the impact of CSR on overall performance, in order to measure the extent of compatibility between the value created and the company's societal objective.

Value creation is an indicator of overall performance in its various facets, namely societal, economic and financial performance. The link between CSR and value creation, however close, is far from being unanimously accepted by researchers, particularly in terms of economic and financial performance. On the one hand, there are those who admit the existence of this link and differ on its content (positive or negative) and on the other hand, those who dispute any connection between the two concepts.

CSR has a negative impact on the company:

According to Friedman (1962 - 1970), CSR is an additional expense that the company does not have to bear, due to the fact that its only responsibility should be limited to the exploitation of its resources to make the maximum profit. Friedman's discrediting of the CSR approach is explained by what he calls the negative consequences of integrating CSR into the decision-making process, which would result in a reduced return on investment.

In the same vein, certain theses from the neoclassical school of thought support the handicap of CSR in terms of making profits, because even if a gain is made, it is less than the expenses incurred. This shortfall in terms of profitability rate is not well perceived from the shareholders' point of view. Aupperle, Carroll and Hatfield (1985), disavow CSR by arguing that the costs incurred by a company in the context of social actions (donations, environmental protection and aid to populations) diminish its wealth, and confront it with competitors who are not very socially responsible, with whom it is at a disadvantage.

Many authors adhere to this ideology, according to which financial assistance for CSR prevents the company from directing its investment choices towards more profitable projects, Balabanis, Phillips and Jonathan (1998). The same is true for some researchers who rely on financial performance indicators to justify the negative impact of CSR on the company's accounting results Griffin and Mahon (1997).

It should be noted that the research that has highlighted a negative relationship between CSR and value creation is limited (08 studies out of 127 revealing the negative aspect according to Margolis and Walsh (2003). Moreover, they have been conducted at various intervals on samples that are, for the most part, small in size.

However, another observation can be deduced from these studies, namely the non-existence of a relationship between CSR and value creation.

CSR has no impact on the company:

The separatist theory of CSR and value creation brings a neutrality between the two concepts. Thus, any link that might unite them would only be fortuitous, being the product of several intermediary variables that rule out any direct connection between these two concepts A.A. Ullmann (1985).

The multitude of mechanisms of operability of CSR and the complexity of their standardization to disparate environments (notably from a geographical, cultural and human point of view), makes causality almost absent Waddock and Graves (1997).

While several researchers, including Aupperle, Carroll and Hatfield (1985) or Balabanis, and Jonathan (1998), consider the link between CSR and value creation to be zero or even negative, others, such as Cochran and Wood (1984), describe it as weak or non-existent.

In contrast, the work of Margolis and Walsh (2003) has proven the positive impact between CSR and value creation.

CSR has a positive impact on the company:

This theory is supported by stakeholders who affirm the positive impact of CSR on the overall performance of the company and favor the integration of this approach at a strategic level with a view to increasing profitability. The impact appears directly in the behavior of customers who are more and more sensitive and attracted by socially responsible companies.

Improved financial results; 2. Reduced operating costs; 3. Improved image and reputation; 4. Increased sales and customer loyalty; 5. Productivity and quality gains; 6. Ability to attract and retain labor; 7. Relaxation of administrative control.

Freeman (1984) in turn has discussed the positive and varied impact of corporate CSR implementation and its effectiveness as a process that can meet the different needs of stakeholders.

For Waddock and Graves (1997), a socially responsible company can gain profitability (CSR contributes to value creation) as well as lose profitability (CSR can impede value creation).

On the other hand, McWilliams and Siegel (2000) & Abraber and Biyad (2019), consider CSR to act on the competitiveness of the company, allowing it to gain market shares at the expense of its competitors and to gain maximum profits.

Several studies demonstrating the beneficial contribution of CSR to value creation have been published. Allouche and Laroche (2005) cite 75 studies out of a total of 82, confirming the positive relationship, while Margolis and Walsh (2003) count 54 out of a total of 127. Moreover, the geographical contextualization of these studies is questionable, in the sense that they would have gained in consistency if they were focused on a given territory.

Conclusion

Today, the company is more and more confronted with the different pressures of the market exerted by its employees, shareholders, customers, and legal framework. Its economic, environmental, and social performances must be defined in a way, that they converge in the same direction of the inharmonious interests of its stakeholders. It must manage its operations in such a way that it stimulates economic growth, strengthens its competitiveness and creates value, while being a responsible and environmentally friendly company.

The causal link between CSR and value creation is a problem that has been the subject of several studies, although the results of these studies have not been agreed upon within the scientific community. The analysis of these results, through this literary review, presents, on the one hand, the existence of a positive influence of CSR on the creation of value, in fact, the satisfaction of the objectives of the stakeholders by the company, favors the improvement of its economic and financial performance (Freeman 1984), and on the other hand, the perception of a fragile or even non-existent link, asserted by the companies that achieve the best social performance but record poor economic and financial results.

Notwithstanding the divergence of theories on the nature of the link between CSR and value creation, contemporary economics is increasingly oriented towards highlighting the benefits of a socially responsible approach on the performance of the firm, on the one hand, and on the global ecosystem, on the other. Moreover, theoretical analysis alone cannot confirm the tendency of economic actors to favor CSR, hence the need for an empirical study in which the impact of social and environmental responsibility would be measured and confronted with current structural, economic, political and health conditions.

The search for a global explanation of the link between corporate social responsibility and corporate finance remains a difficult, if not impossible, objective. The development of knowledge requires the recognition and identification of the multiple contingency factors affecting the interaction. The evaluation of performance remains to be done, stakeholder by stakeholder, and these are not identically sensitive to each aspect of social responsibility.

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FOREIGN TRADE AND MACROECONOMIC EFFECTS OF EXPORTS

Tamara TODOROVA
American University in Bulgaria, Bulgaria
ttodorova@aubg.edu

Abstract:

We find that the IS-LM model and the national income model reinforce each other in the context of exports and the export multiplier. Using simple differentiation techniques, we derive several relationships with respect to foreign trade. As predicted by Keynes, exports have a favorable effect on national income and the interest rate. Exports also increase the average price level and the exchange rate in the country. Through the mechanism of the export multiplier exports increase imports, savings, and consumption. A higher propensity to import reduces national income and fosters a negative trade balance. Similar is the effect of a higher exchange rate which discourages exports and encourages imports.

Keywords: export multiplier; propensity to import; interest rate; exchange rate; IS-LM model; national income model.

JEL Classification: E12; E21; E43; F40.

Introduction

According to King (1998) Giblin (1930) was the first to imply the export multiplier in discussing the effect of a decrease in export demand on Australia's national income. He had also estimated the Australian export multiplier as early as 1929. Harrod (1933) developed the idea that the level and growth of output given a balance of payment constraint depend on the foreign trade multiplier. The multiplier was later called an export multiplier. Harrod's idea of the foreign trade multiplier lies at the basis of the Keynesian investment multiplier which was the core of the *General Theory* advanced by Keynes (1936). Sordi and Vercelli (2012) maintain that the *General Theory* investment multiplier became the building block of the *IS-LM* model in what is a standard version of the Keynesian static model. This intertwined the *IS-LM* model with the national-income model in its various versions. Our paper delineates some of the main forms of both models illustrating that the effect of exports on different macroeconomic variables, but particularly on national income and equilibrium interest rate, is identical.

According to King (1998) Harrod's trade multiplier works in many countries and differences in export performance are an important source of international growth rate differences. Kaldor (1975) claims that Keynes's idea of unemployment in a recession diverted the attention from the foreign trade multiplier which in a dynamic setting is far more important in explaining the growth and pace of industrial development. Bairam (1993) suggests that Harrod's foreign trade multiplier is larger for developing countries than for developed ones and that the value of the multiplier is related to the stage of development of the respective country.

Robinson (1952) presents the foreign trade multiplier graphically whereas Metzler (1942) and Machlup (1943) apply algebraic and arithmetic models to depict its effect. Similar is the treatment of the Harrod foreign trade multiplier provided by Kennedy and Thirlwall (1979) and Thirlwall (1982). Our

research gravitates to this second type of methods. It applies neither graphical, nor empirical testing of the export multiplier and the various effects of exports on the macroeconomy. We use a purely theoretical, mathematical approach applying implicit differentiation. The first part examines general functions and is, in this sense, an illustration of implicit differentiation and the implicit-function theorem. The part which follows uses simple definite functions seeking thus equilibrium values and tracing the effect of exports on those. In addition to exports, we investigate the role of imports, the exchange rate, the propensity to import, etc. The paper is theoretical, rather than empirical using a simple setting of the major macroeconomic functions and variables.

Some of our key findings are that exports affect national income and the interest rate favorably. We find this both in the context of the national-income model and the *IS-LM* model. Through the export multiplier exports affect positively imports, savings, and the average price level in the country. We also study the influence of the exchange rate on national income, interest rate and the average price level. We demonstrate mathematically how a higher exchange rate can discourage exports and encourage imports stimulating thus a negative trade balance. In the context of definite functions, we also find the effect of the marginal propensity to import on national income. In the context of the mutual trade between two countries we find their interdependence. The exports of each country are assumed to be a share of its aggregate investment where the exports of one country, Home, are imports for the other one, Foreign, and vice versa. We derive that the exports of Home are positively related to Foreign's investment and those of Foreign to Home's investment.

Part 1 is an introduction and a brief literature review. We do not aim a complete literature review of the history of the export multiplier. Part 2 discusses foreign trade in a general-function setting. Part 3 introduces some simple definite-form functions. The paper ends with conclusions.

1. Macroeconomic Effects of Exports in the Context of General Functions

In the standard *IS-LM* model we have equilibrium on two markets, the capital market and the money market. In the capital market aggregate investment equals savings while in the money market money demand equals money supply. This is reflected by the following equilibrium equations.

$$I(i) = S(Y,i) \qquad\qquad \frac{dI}{di} = I' < 0 \qquad 0 < S_Y < 1 \qquad S_i > 0$$

where investment is a decreasing function of the interest rate and savings increase with national income and the interest rate, with S_Y being the marginal propensity to save. On the money market money demand equals money supply, or

$$M_{so} = L(Y,i) \qquad\qquad L_Y > 0 \qquad\qquad L_i < 0$$

The liquidity function is positively related to national income (transaction demand for money) and negatively to the interest rate while money supply is assumed to be exogenously determined since it depends on the monetary policy of the central bank. Accounting for equilibrium in foreign trade,

$$X_o = M(Y) \qquad\qquad 0 < M' < 1$$

where $\dfrac{dM}{dY} = M'$ is the marginal propensity to import and exports are exogenously determined.

Adding the last equation to the capital market identity gives the following form of the *IS-LM* model.

$$I(i) + X_o = S(Y,i) + M(Y)$$

$$L(Y,i) = M_{so}$$

Solving in the form of implicit functions,

$$I(i) + X_o - S(Y,i) - M(Y) = 0$$

$$L(Y, i) - M_{so} = 0$$

gives rise to the Jacobian

$$|J| = \begin{vmatrix} -S_Y - M' & I' - S_i \\ L_Y & L_i \end{vmatrix} = -L_i(S_Y + M') - L_Y(I' - S_i) > 0$$

Writing off the implicit-function theorem with respect to exogenous exports,

$$\begin{bmatrix} -S_Y - M' & I' - S_i \\ L_Y & L_i \end{bmatrix} \begin{bmatrix} \dfrac{dY}{dX_o} \\ \dfrac{di}{dX_o} \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \end{bmatrix}$$

Solving for the two comparative-static derivatives,

$$\frac{dY}{dX_o} = \frac{\begin{vmatrix} -1 & I' - S_i \\ 0 & L_i \end{vmatrix}}{|J|} = \frac{L_i}{L_i(S_Y + M') + L_Y(I' - S_i)} > 0$$

$$\frac{di}{dX_o} = \frac{\begin{vmatrix} -S_Y - M' & -1 \\ L_Y & 0 \end{vmatrix}}{|J|} = \frac{L_Y}{L_Y(S_i - I') - L_i(S_Y + M')} > 0$$

The export multiplier $\dfrac{dY}{dX_o}$ is positive since exports increase national income. We can also see the positive effect of exports on the interest rate. This is achieved through the liquidity function where exports increase income and the transaction demand for money grows which ultimately leads to higher interest rates. Figure 1 demonstrates this graphically.

Figure 1. Effect of increased money demand (due to increased exports) on equilibrium interest rate
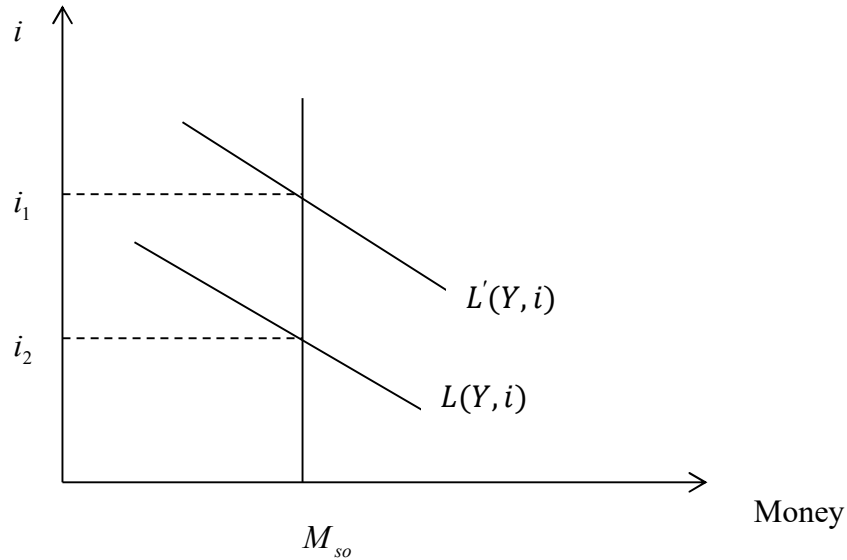
As exports increase national income, the transaction demand for money shifts outwards from $L(Y, i)$ to $L'(Y, i)$. This increases the equilibrium interest rate from i_1 to i_2. Additionally, we can find a set of auxiliary derivatives.

$$\frac{dM}{dX_o} = M' \frac{dY}{dX_o} = \frac{M'L_i}{L_i(S_Y + M') + L_Y(I' - S_i)} > 0$$

$$\frac{dI}{dX_o} = I' \frac{di}{dX_o} = \frac{I'L_Y}{L_Y(S_i - I') - L_i(S_Y + M')} < 0$$

$$\frac{dS}{dX_o} = S_Y \frac{dY}{dX_o} + S_i \frac{di}{dX_o} = \frac{S_Y L_i - S_i L_Y}{L_i(S_Y + M') + L_Y(I' - S_i)} > 0$$

By increasing national income exports allow the nation to consume more foreign goods. Exports also have a favorable effect on aggregate savings since they increase both national income and the interest rate. The effect on aggregate investment is adverse since exports raise the interest rate.

We can check the validity of the *IS-LM* model and the effect of exports on national income, interest rate, investment, etc, using the standard national-income model. Comparing the results ensures their robustness. We assume the following national-income model.

$$Y = C(Y, i) + I(i) + X_o - M(Y) \quad 0 < C_Y, M' < 1 \qquad L_Y > 0 \quad I', C', L' < 0$$
$$kY + L(Y, i) = M_{so} \qquad\qquad\qquad k = \text{positive constant}$$

where Y, C, I, X_o, M, L and M_{so} stand for national income, consumption, investment, exports, imports, money demand and money supply, respectively. All derivatives are assumed to be continuous. Solving,

$$Y - C(Y, i) - I(i) - X_o + M(Y) = 0$$
$$kY + L(Y, i) - M_{so} = 0$$

Writing off the implicit-function theorem with respect to exogenous exports,

$$\begin{bmatrix} 1 - C_Y + M' & -C' - I' \\ k + L_Y & L' \end{bmatrix} \begin{bmatrix} \dfrac{dY}{dX_o} \\ \dfrac{di}{dX_o} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$|J| = L'(1 - C_Y + M') + (k + L_Y)(C' + I') < 0$$

The implicit function theorem holds, and we find the effect of exports on national income and the interest rate.

$$\frac{dY}{dX_o} = \frac{\begin{vmatrix} 1 & -C' - I' \\ 0 & L' \end{vmatrix}}{|J|} = \frac{L'}{L'(1 - C_Y + M') + (k + L_Y)(C' + I')} > 0$$

$$\frac{di}{dX_o} = \frac{\begin{vmatrix} 1 - C_Y + M' & 1 \\ k + L_Y & 0 \end{vmatrix}}{|J|} = -\frac{k + L_Y}{L'(1 - C_Y + M') + (k + L_Y)(C' + I')} > 0$$

Increased exports again increase national income and the interest rate. The results reaffirm the *IS-LM* model. It is interesting that exports again increase national income through speculative demand for money while the interest rate through the transactional demand for money.

$$\frac{dY}{dX_o} = \frac{\begin{vmatrix} -1 & I' - S_i \\ 0 & L_i \end{vmatrix}}{|J|} = \frac{L_i}{L_i(S_Y + M') + L_Y(I' - S_i)} > 0$$

$$\frac{di}{dX_o} = \frac{\begin{vmatrix} -S_Y - M' & -1 \\ L_Y & 0 \end{vmatrix}}{|J|} = \frac{L_Y}{L_Y(S_i - I') - L_i(S_Y + M')} > 0$$

An expanded national-income model is one which accounts for the price level where p is the level of domestic prices and net exports are the difference between exports and imports. We can find not only the effect of exports on national income and the interest rate but on the price level as well.

$$Y = C(Y, p) + I(Y, i) + G_o + X_o - M(Y, p) \qquad 0 < C_Y, M_Y < 1 \qquad C_p, I' < 0$$

$$\frac{M_{so}}{p} = L(Y, i) \qquad\qquad I_Y, M_p > 0 \qquad L_Y > 0 \qquad L_i < 0$$

$$p = p_o + g(Y) \qquad\qquad g_Y > 0$$

Rewriting the model in an implicit form,

$$Y - C(Y, p) - I(Y, i) - G_o - X_o + M(Y, p) = 0$$

$$L(Y, i) - \frac{M_{so}}{p} = 0$$

$$p - p_o - g(Y) = 0$$

$$\begin{bmatrix} 1 - C_Y - I_Y + M_Y & -I' & -C_p + M_p \\ L_Y & L_i & \frac{M_{so}}{p^2} \\ -g_Y & 0 & 1 \end{bmatrix} \begin{bmatrix} \dfrac{dY}{dX_o} \\ \dfrac{di}{dX_o} \\ \dfrac{dp}{dX_o} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

$$|J| = I'\left(L_Y + g_Y \frac{M_{so}}{p^2}\right) + L_i\big[1 - C_Y - I_Y + M_Y - g_Y(C_p - M_p)\big] < 0$$

Since C_Y, I_Y are marginal propensities, respectively, to consume and to save where investment equals savings in equilibrium, their sum should not exceed 1. It follows that the second parenthesized term is positive, and the Jacobian is negative.

$$\frac{dY}{dX_o} = \frac{\begin{vmatrix} 1 & -I' & -C_p + M_p \\ 0 & L_i & \frac{M_{so}}{p^2} \\ 0 & 0 & 1 \end{vmatrix}}{|J|}$$

$$= \frac{L_i}{I'\left(L_Y + g_Y \frac{M_{so}}{p^2}\right) + L_i\big[1 - C_Y - I_Y + M_Y - g_Y(C_p - M_p)\big]} > 0$$

$$\frac{di}{dX_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y + M_Y & 1 & -C_p + M_p \\ L_Y & 0 & \frac{M_{so}}{p^2} \\ -g_Y & 0 & 1 \end{vmatrix}}{|J|} =$$

$$= -\frac{L_Y + g_Y \frac{M_{so}}{p^2}}{I'\left(L_Y + g_Y \frac{M_{so}}{p^2}\right) + L_i\big[1 - C_Y - I_Y + M_Y - g_Y(C_p - M_p)\big]} > 0$$

$$\frac{dp}{dX_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y + M_Y & -I^{'} & 1 \\ L_Y & L_i & 0 \\ -g_Y & 0 & 0 \end{vmatrix}}{|J|} =$$

$$= \frac{L_i g_Y}{I^{'}\left(L_Y + g_Y \dfrac{M_{so}}{p^2}\right) + L_i\left[1 - C_Y - I_Y + M_Y - g_Y(C_p - M_p)\right]} > 0$$

As usual, exports stimulate national income through speculative demand and the interest rate through transactional demand. Furthermore, exports increase domestic prices by increasing national income. A country that exports heavily eventually achieves a higher standard of living. We can redefine the model to check the effect of national imports, assuming they are exogenous.

$$Y = C(Y,p) + I(Y,i) + G_o + X(Y,p) - M_o \qquad 0 < C_Y < 1 \qquad C_p, I^{'}, X_p < 0$$

$$\frac{M_{so}}{p} = L(Y,i) \qquad\qquad I_Y, X_Y > 0 \qquad L_Y > 0 \qquad L_i < 0$$

$$p = p_o + g(Y) \qquad\qquad g_Y > 0$$

This time we find the effect of imports on the endogenous variables. Rewriting in an implicit form,

$$Y - C(Y,p) - I(Y,i) - G_o - X(Y,p) + M_o = 0$$

$$L(Y,i) - \frac{M_{so}}{p} = 0$$

$$p - p_o - g(Y) = 0$$

With respect to exogenous imports,

$$\begin{bmatrix} 1 - C_Y - I_Y - X_Y & -I^{'} & -C_p - X_p \\ L_Y & L_i & \dfrac{M_{so}}{p^2} \\ -g_Y & 0 & 1 \end{bmatrix} \begin{bmatrix} \dfrac{dY}{dM_o} \\ \dfrac{di}{dM_o} \\ \dfrac{dp}{dM_o} \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}$$

$$|J| = I^{'}\underbrace{\left(L_Y + g_Y \dfrac{M_{so}}{p^2}\right)}_{-} + L_i\underbrace{\left[1 - C_Y - I_Y - X_Y - g_Y(C_p + X_p)\right]}_{-} < 0$$

Given that the sum of the propensities C_Y, I_Y is less than 1, the second parenthesized term is positive and so the Jacobian is negative. This allows solving for the following comparative-static derivatives.

$$\frac{dY}{dM_o} = \frac{\begin{vmatrix} -1 & -I^{'} & -C_p - X_p \\ 0 & L_i & \dfrac{M_{so}}{p^2} \\ 0 & 0 & 1 \end{vmatrix}}{|J|} =$$

$$= -\frac{L_i}{I^{'}\left(L_Y + g_Y \dfrac{M_{so}}{p^2}\right) + L_i\left[1 - C_Y - I_Y - X_Y - g_Y(C_p + X_p)\right]} < 0$$

36

$$\frac{di}{dM_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y - X_Y & -1 & -C_p - X_p \\ L_Y & 0 & \frac{M_{so}}{p^2} \\ -g_Y & 0 & 1 \end{vmatrix}}{|J|} =$$

$$= \frac{L_Y + g_Y \frac{M_{so}}{p^2}}{I'\left(L_Y + g_Y \frac{M_{so}}{p^2}\right) + L_i\left[1 - C_Y - I_Y - X_Y - g_Y(C_p + X_p)\right]} < 0$$

$$\frac{dp}{dM_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y - X_Y & -I' & -1 \\ L_Y & L_i & 0 \\ -g_Y & 0 & 0 \end{vmatrix}}{|J|} =$$

$$= -\frac{L_i g_Y}{I'\left(L_Y + g_Y \frac{M_{so}}{p^2}\right) + L_i\left[1 - C_Y - I_Y - X_Y - g_Y(C_p + X_p)\right]} < 0$$

Interestingly, the effect of imports is opposite to that of exports. Imports reduce national income through speculative demand, the interest rate through transaction demand and domestic prices through the effect on national income. A country whose imports grow disproportionately with exports would eventually experience a declining living standard and falling prices. This is also consistent with the price-specie flow mechanism by which, as the country consumes more foreign goods and becomes indebted, it experiences lower prices and interest rates which eventually can stimulate exports. In this context, it is good to analyze the exchange rate in relation to exports. If the exchange rate e is considered, the national-income model could take the form

$$Y = C(Y) + I(Y) + G_o + X_o - M(Y, e) \quad 0 < C_Y, M_Y < 1 \qquad I_Y, L_Y > 0$$

$$M_s(e) = L(Y) \qquad\qquad M_e = \frac{\partial M}{\partial e} > 0 \qquad M'_s = \frac{\partial M_s}{\partial e} > 0$$

The country's imports increase with an increase in the exchange rate. Solving by implicit differentiation,

$$Y - C(Y) - I(Y) - G_o - X_o + M(Y, e) = 0$$

$$M_s(e) - L(Y) = 0$$

$$\begin{bmatrix} 1 - C_Y - I_Y + M_Y & M_e \\ -L_Y & M'_s \end{bmatrix} \begin{bmatrix} \dfrac{dY}{dX_o} \\ \dfrac{de}{dX_o} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$|J| = M'_s(1 - C_Y - I_Y + M_Y) + L_Y M_e > 0$$

We find the effect of exports on Y and e as

$$\frac{dY}{dX_o} = \frac{\begin{vmatrix} 1 & M_e \\ 0 & M'_s \end{vmatrix}}{|J|} = \frac{M'_s}{M'_s(1 - C_Y - I_Y + M_Y) + L_Y M_e} > 0$$

$$\frac{de}{dX_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y + M_Y & 1 \\ -L_Y & 0 \end{vmatrix}}{|J|} = \frac{L_Y}{M_s'(1 - C_Y - I_Y + M_Y) + L_Y M_e} > 0$$

National income increases as the nation exports more. The exchange rate also increases with exports. As the nation exports more, its currency appreciates relative to other currencies. As a secondary effect this increase in the exchange rate can stimulate imports and discourage exports. To demonstrate this, we modify the national-income model.

$$Y = C(Y) + I(Y,i) + G_o + X(e_o) - M(Y,e_o) \qquad 0 < C_Y, M_Y < 1 \qquad I_Y, L_Y, M_e > 0$$

$$M_{so} = L(Y,i) \qquad\qquad X_e, I', L_i < 0$$

Rearranging,

$$Y - C(Y) - I(Y,i) - G_o - X(e_o) + M(Y,e_o) = 0$$

$$L(Y,i) - M_{so} = 0$$

$$\begin{bmatrix} 1 - C_Y - I_Y + M_Y & -I' \\ L_Y & L_i \end{bmatrix} \begin{bmatrix} \dfrac{dY}{de_o} \\ \dfrac{di}{de_o} \end{bmatrix} = \begin{bmatrix} X_e - M_e \\ 0 \end{bmatrix}$$

$$|J| = L_i(1 - C_Y - I_Y + M_Y) + L_Y I' < 0$$

$$\frac{dY}{de_o} = \frac{\begin{vmatrix} X_e - M_e & -I' \\ 0 & L_i \end{vmatrix}}{|J|} = \frac{L_i(X_e - M_e)}{L_i(1 - C_Y - I_Y + M_Y) + L_Y I'} < 0$$

$$\frac{di}{de_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y + M_Y & X_e - M_e \\ L_Y & 0 \end{vmatrix}}{|J|} = -\frac{L_Y(X_e - M_e)}{L_i(1 - C_Y - I_Y + M_Y) + L_Y I'} < 0$$

The exchange rate would lower national income. If the exchange rate is maintained continuously high, this will affect national income adversely since exports would be reduced and the nation will continue to import, which will most likely lead to a negative trade balance. National income and the interest rate fall. Since a high exchange rate stimulates imports and discourages exports, the effect on net exports and the trade balance is negative.

$$NX = X(e_o) - M(Y,e_o)$$

$$\frac{dNX}{de_o} = \frac{d[X(e_o) - M(Y,e_o)]}{de_o} = \frac{dX}{de_o} - \frac{dM}{de_o} < 0$$

The national income-model can further be expanded by the level of domestic prices p.

$$Y = C(Y,p) + I(Y,i) + G_o + X(e_o) - M(Y,e_o) \qquad 0 < C_Y, M_Y < 1 \qquad C_p, I', X_e < 0$$
$$I_Y, M_e > 0$$

$$M_s(p) = L(Y,i) \qquad\qquad L_Y > 0 \qquad M_{sp}, L_i < 0$$

$$p = p_o + g(Y) \qquad\qquad g_Y > 0$$

Rearranging the system,

$$Y - C(Y,p) - I(Y,i) - G_o - X(e_o) + M(Y,e_o) = 0$$

$$M_s(p) - L(Y, i) = 0$$

$$p - p_o - g(Y) = 0$$

Solving for the effect of the exchange rate on the endogenous variables Y, p, i,

$$
\begin{bmatrix}
1 - C_Y - I_Y + M_Y & -C_p & -I' \\
-L_Y & M_{sp} & -L_i \\
-g_Y & 1 & 0
\end{bmatrix}
\begin{bmatrix}
\dfrac{dY}{de_o} \\
\dfrac{dp}{de_o} \\
\dfrac{di}{de_o}
\end{bmatrix}
=
\begin{bmatrix}
X_e - M_e \\
0 \\
0
\end{bmatrix}
$$

$$|J| = -g_Y(C_p L_i + M_{sp} I') + L_i(1 - C_Y - I_Y + M_Y) + L_Y I' < 0$$

$$\frac{dY}{de_o} = \frac{\begin{vmatrix} X_e - M_e & -C_p & -I' \\ 0 & M_{sp} & -L_i \\ 0 & 1 & 0 \end{vmatrix}}{|J|} = \frac{L_i(X_e - M_{se})}{-g_Y(C_p L_i + M_{sp} I') + L_i(1 - C_Y - I_Y + M_Y) + L_Y I'}$$

$$< 0$$

$$\frac{dp}{de_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y + M_Y & X_e - M_e & -I' \\ -L_Y & 0 & -L_i \\ -g_Y & 0 & 0 \end{vmatrix}}{|J|} =$$

$$= \frac{g_Y L_i(X_e - M_e)}{-g_Y(C_p L_i + M_{sp} I') + L_i(1 - C_Y - I_Y + M_Y) + L_Y I'} < 0$$

$$\frac{di}{de_o} = \frac{\begin{vmatrix} 1 - C_Y - I_Y + M_Y & -C_p & X_e - M_e \\ -L_Y & M_{sp} & 0 \\ -g_Y & 1 & 0 \end{vmatrix}}{|J|} =$$

$$= \frac{(X_e - M_e)(g_Y M_{sp} - L_Y)}{-g_Y(C_p L_i + M_{sp} I') + L_i(1 - C_Y - I_Y + M_Y) + L_Y I'} < 0$$

This expanded national-income model augmented by the price level reaffirms the results of the effect of the exchange rate on the macroeconomy. A higher exchange rate reduces national income, the average price level, and the equilibrium interest rate. A negative trade balance stimulated by a higher exchange rate reduces national income and lowers the standard of living in the country – both the interest rate and the price level fall.

3. Foreign Trade in the Context of Definite Functions

A standard national-income model includes the size of trade occurring between the country and the world. The model can be presented using definite, rather than general, functions. Net exports are the difference between the total exports and imports of the country. The simplest possible export multiplier can be expressed as follows.

$$Y = C + I_o + G_o + X_o - M$$

$$C = \alpha + \beta Y \qquad\qquad \alpha > 0$$

$$M = M_o + \mu Y \qquad\qquad 0 < \beta, \mu < 0$$

For equilibrium national income we have

$$\bar{Y} = \frac{I_o + G_o + X_o + \alpha - M_o}{1 - \beta + \mu}$$

Hence, the export multiplier is

$$\frac{d\bar{Y}}{dX_o} = \frac{1}{1 - \beta + \mu} > 0$$

Since $1 - \beta > 0$, the multiplier is positive. At the same time, this multiplier is smaller than the one without imports, i.e., if the nation follows protectionism and only exports without importing.

$$\frac{d\bar{Y}}{dX_o} = \frac{1}{1 - \beta} > 1$$

$$\frac{d\bar{Y}}{d\mu} = -\frac{I_o + G_o + X_o + \alpha - M_o}{(1 - \beta + \mu)^2} = -\frac{\bar{Y}}{1 - \beta + \mu} < 0$$

The marginal propensity to import μ has a negative effect on equilibrium national income. The more inclined the nation is to import, the lower its national income will be. A more complex export multiplier is one incorporating a tax rate τ.

$$Y = C + I_o + G_o + X_o - M$$

$$C = \alpha + \beta(1 - \tau)Y \qquad\qquad \alpha > 0 \qquad\qquad \beta, \mu, \tau \in (0,1)$$

$$M = \mu(1 - \tau)Y$$

X_o are the exogenous exports of the country and M are its imports. Consumption and imports are both considered functions of disposable income that is left after a tax rate of τ is imposed. Again, the marginal propensity to consume is β and μ denotes the marginal propensity to import. The export multiplier is easy to find. Substituting consumption and imports into the national-income equation,

$$\bar{Y} = \frac{\alpha + I_o + G_o + X_o}{1 - (\beta - \mu)(1 - \tau)}$$

We expect national income to be positive, thus, $1 - (\beta - \mu)(1 - \tau) > 0$.

$$\frac{dY}{dX_o} = \frac{1}{1 - (\beta - \mu)(1 - \tau)} > 0$$

The export multiplier is positive, *i.e.,* exports increase national income. Since it is expected that $\beta > \mu$, that is, the nation has a greater propensity to consume domestic, rather than foreign goods, the value of the export multiplier exceeds 1 and exports, indeed, have a multiplying effect on national income. At the same time, a higher tendency to consume foreign goods given by the marginal propensity to import has a negative effect on national income.

$$\frac{dY}{d\mu} = \frac{-(\alpha + I_o + G_o + X_o)(1 - \tau)}{[1 - (\beta - \mu)(1 - \tau)]^2} = \frac{-\bar{Y}(1 - \tau)}{1 - (\beta - \mu)(1 - \tau)} < 0$$

A slightly modified national-income model accounting for both trade and government produces similar results.

$$Y = C + I_o + G + X_o - M$$

$$C = \alpha + \beta(1 - \tau)Y \qquad\qquad \alpha > 0 \qquad\qquad \beta, \gamma, \mu, \tau \in (0,1)$$

$$G = \gamma Y$$

$$M = \mu(1 - \tau)Y$$

This time the value of equilibrium national income is

$$\overline{Y} = \frac{\alpha + I_o + X_o}{1 - \gamma + (\mu - \beta)(1 - \tau)}$$

We expect national income to be positive. This gives the value of the export multiplier.

$$\frac{dY}{dX_o} = \frac{1}{1 - \gamma + (\mu - \beta)(1 - \tau)} > 0$$

The export multiplier is positive for positive national income. Furthermore, the effect of exports on imports is given by a chain derivative.

$$\frac{dM}{dX_o} = \frac{dM}{dY}\frac{dY}{dX_o} = \frac{\mu(1 - \tau)}{1 - \gamma + (\mu - \beta)(1 - \tau)} > 0$$

By exporting more, the country accumulates more income and can afford to import more. At the same time, a higher propensity to import and a stronger inclination to consume foreign goods reduces national income.

$$\frac{dY}{d\mu} = \frac{-(\alpha + I_o + X_o)(1 - \tau)}{[1 - \gamma + (\mu - \beta)(1 - \tau)]^2} = -\frac{\overline{Y}(1 - \tau)}{1 - \gamma + (\mu - \beta)(1 - \tau)} < 0$$

The greater the propensity to import, the smaller the national income. Using the chain rule again, we find the effect of exogenous exports on aggregate consumption. Since consumption is a share of national income, exports stimulate both national income and consumption.

$$\frac{dC}{dX_o} = \frac{dC}{dY}\frac{dY}{dX_o} = \frac{\beta(1 - \tau)}{1 - \gamma + (\mu - \beta)(1 - \tau)} > 0$$

When the nation exports more, it can afford to consume more of both foreign and its own goods. It could be considered that the value of exports depends on aggregate investment. When firms invest more, they are likely to produce more and consequently export more abroad. This can be presented as

$$Y = C + I_o + G_o + X - M$$

$$C = \alpha + \beta(1 - \tau)Y \qquad\qquad \alpha > 0 \qquad\qquad \beta, \mu, \tau, x \in (0,1)$$

$$X = xI_o$$

$$M = \mu(1 - \tau)Y$$

where exports X depend on the level of investment of the country and M are its imports. Consumption and imports are both considered functions of disposable income that is left after a tax rate of τ is imposed. This gives

$$\bar{Y} = \frac{\alpha + (1 + x)I_o + G_o}{1 - (\beta - \mu)(1 - \tau)}$$

The value of the investment multiplier is greater than 1 consistent with Keynesian theory.

$$\frac{dY}{dI_o} = \frac{(1 + x)}{1 - (\beta - \mu)(1 - \tau)} > 1$$

Furthermore, we see that national income is positively related to the likelihood of firms to invest and the share of exports x in investment, since

$$\frac{dY}{dx} = \frac{I_o}{1 - (\beta - \mu)(1 - \tau)} > 0$$

Furthermore,

$$\frac{dY}{d\mu} = \frac{-(1 - \tau)[\alpha + (1 + x)I_o + G_o]}{[1 - (\beta - \mu)(1 - \tau)]^2} = \frac{-(1 - \tau)\bar{Y}}{1 - (\beta - \mu)(1 - \tau)} < 0$$

The more likely the nation is to import, the lower the national income would be. Again, in the context of investment we can demonstrate the interplay between exports (imports) of one country and investment in another country. This time we introduce two countries trading with each other. Their economies are described by the following two national-income models.

$$Y_1 = C_1 + I_{1o} + X_1 - M_1 \qquad\qquad Y_2 = C_2 + I_{2o} + X_2 - M_2$$
$$C_1 = \alpha + \beta Y_1 \qquad\qquad C_2 = \gamma + \delta Y_2 \qquad\qquad \alpha, \gamma > 0$$
$$M_1 = \mu Y_1 \qquad\qquad M_2 = \lambda Y_2 \qquad\qquad 0 < \beta, \delta, \lambda, \mu < 1$$

Home's exogenous investment is I_{1o}, and that of Foreign is I_{2o}. With mutual trade the exports of Home are imports for Foreign and vice versa. Since the exports of Home are imports for Foreign and vice versa, we have $X_1 = M_2$ and $X_2 = M_1$. Substituting in the two national-income identities,

$$Y_1 = \alpha + \beta Y_1 + I_{1o} + \lambda Y_2 - \mu Y_1$$

$$Y_2 = \gamma + \delta Y_2 + I_{2o} + \mu Y_1 - \lambda Y_2$$

Rearranging and solving in a matrix form,

$$(1 - \beta + \mu)Y_1 - \lambda Y_2 - \alpha - I_{1o} = 0$$

$$-\mu Y_1 + (1 - \delta + \lambda)Y_2 - \gamma - I_{2o} = 0$$

Written in a matrix form,

$$\begin{bmatrix} 1 - \beta + \mu & -\lambda \\ -\mu & 1 - \delta + \lambda \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} \alpha + I_{1o} \\ \gamma + I_{2o} \end{bmatrix}$$

$$|J| = (1 - \beta + \mu)(1 - \delta + \lambda) - \lambda\mu = (1 - \beta)(1 - \delta + \lambda) + \mu(1 - \delta) > 0$$

$$\bar{Y}_1 = \frac{(\alpha + I_{1o})(1 - \delta + \lambda) + \lambda(\gamma + I_{2o})}{(1 - \beta)(1 - \delta + \lambda) + \mu(1 - \delta)} \qquad \bar{Y}_2$$

$$= \frac{(\gamma + I_{2o})(1 - \beta + \mu) + \mu(\alpha + I_{1o})}{(1 - \beta)(1 - \delta + \lambda) + \mu(1 - \delta)}$$

The two national outputs are assumed to be positive where $0 < \beta, \delta, \lambda, \mu < 1$. Home's investment has a multiplying effect on the exports of Foreign and vice versa.

$$X_1 = M_2 = \lambda\bar{Y}_2 = \frac{\lambda[(\gamma + I_{2o})(1 - \beta + \mu) + \mu(\alpha + I_{1o})]}{(1 - \beta)(1 - \delta + \lambda) + \mu(1 - \delta)}$$

$$X_2 = M_1 = \mu\bar{Y}_1 = \frac{\mu[(\alpha + I_{1o})(1 - \delta + \lambda) + \lambda(\gamma + I_{2o})]}{(1 - \beta)(1 - \delta + \lambda) + \mu(1 - \delta)}$$

It is easy to see the interplay between the two economies – the exports of Home depend on the investment in Foreign and, vice versa, the exports of Foreign are positively related to Home's investment. The exports of each country are also a function of its own aggregate investment.

Conclusion

Using the tools of implicit differentiation, we derive a set of relationships with respect to foreign trade. The national-income model and the *IS-LM* model advanced by Keynes reinforce each other since exports have a favorable effect on national income and the interest rate. Exports also increase the average price level and the exchange rate – as the nation exports more, it tends to become richer but also enjoys a higher standard of living. Through the export multiplier exports increase imports, savings, and the average price level. As the nation exports more, it can afford to consume more foreign goods and save more. On the other hand, if the nation has a stronger propensity to consume foreign, rather than domestic, goods, it tends to lose national income and incur a negative trade balance. Such a higher inclination for consuming foreign goods affects the trade balance adversely, as it discourages exports, while encouraging imports. The same effect is achieved by a higher exchange rate. We derive that a higher exchange rate reduces national income, the equilibrium interest rate, and the average price level in the country. In the context of definite functions, we also find the effect of the marginal propensity to import on national income. With the mutual trade between two countries, we find their interdependence. The exports of each country are assumed to be a share of its aggregate investment where the exports of one country, Home, are imports for the other one, Foreign, and vice versa. We derive that the exports of Home are positively related to Foreign's investment and those of Foreign to Home's investment.

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THE EFFECT OF REGULATIONS IN AN ENDOGENOUS GROWTH MODEL WITH RESEARCH AND DEVELOPMENT

Aleksandar VASILEV
University of Lincoln, United Kingdom
avasilev@lincoln.ac.uk

Abstract:

We utilize a relatively standard endogenous growth model with intermediaries and research and development (R&D). We augment the setup with government regulations to study the effect of regulations on aggregate allocations. The novelty is that we endogenize the problem of the regulator, so the number of regulations is determined within the model. Next, we solve the model and derive some comparative static results. The qualitative results confirm that more regulation leads to a lower number of intermediaries, but each of those is now larger. Investment in physical capital is higher, but that comes at the expense of lower investment in R&D, lower consumption, lower output, and lower welfare. Overall, the intuition that regulation is bad for the economy is confirmed.

Keywords: endogenous growth model; regulation; intermediate goods; welfare.

JEL Classification: E60; L50.

Introduction

In this paper we start with a relatively standard endogenous growth model, as in Vasilev (2017), where growth is driven by research and development. More specifically, successful inventions lead to the production of new intermediate goods, which are then immediately incorporated as essential inputs into the production of final output. The novelty in this paper is the inclusion of government sector, which is in charge of issuing and implementing different regulations, which ultimately affect investment and innovation. Focusing on the social planner model, and assuming that government spending is financed through lump-sum taxes, we derive some important comparative static results. In particular, we show that more regulations positively affect investment in capital, but that happens at the cost of decreasing investment in R&D. The decrease in the number of intermediate goods negatively affects aggregate output and leads to lower consumption. Since consumption is the variable that households are maximizing over time, increase in regulatory activity decreases welfare. Overall, the simple model confirms the basic intuition that more regulation has an adverse effect for aggregate economic activity.

1. Model Setup

The model setup consists of preferences, technology and resources, which are described in turn.

Preferences: There is a representative household, which is infinitely lived and maximizes the stream of discounted utility

$$\sum_{t=0}^{\infty} \beta^t \ln(c_t), \tag{1.1}$$

where $0 < \beta < 1$ is the discount factor, and c_t denotes consumption in period t.

Technology: the production technology is as follows: Final output, y_t, is produced by combining labor, h_t, and specialized inputs, z_{it}, which will be produced by intermediaries, or:

$$y_t = \int_0^{N_t} z_{it}^{\alpha} h_t^{1-\alpha} di, \tag{1.2}$$

where N_t denotes the measure of intermediaries.

Next, each intermediate good *i* is produced using physical capital k_{it} as follows:

$$z_{it} = k_{it} - \bar{k}_t, \tag{1.3}$$

where $\bar{k}_t$ is a time-varying regulatory cost. An alternative interpretation is one of "dead capital," or that some resources cannot be fully utilized. In order to produce positive output, each intermediary needs to invest in physical capital stock that exceeds the regulatory cost, expressed in terms of capital.

Aggregate physical capital in period *t* is then expressed as

$$k_t = \int_0^{N_t} k_{it} \, di. \tag{1.4}$$

The law of motion for aggregate physical capital is

$$k_{t+1} = i_t^k + (1 - \delta)k_t, \tag{1.5}$$

where i_t^k denotes investment in physical capital, and $0 < \delta < 1$ is the depreciation rate.

Next, the mass of intermediate firms evolves according to the following law of motion:

$$N_{t+1} = N_t + i_t^N,$$

where i_t^N denotes investment in R&D ("ideas"). It takes resources to develop a profitable project, but once implemented, that knowledge is always available.

Finally, the resource constraint is as follows:

$$y_t = c_t + i_t^k + i_t^N + g_t, \tag{1.6}$$

where g_t is the government production of regulation, which is going to be financed through the imposition of lump-sum taxes, τ_t. To abstract from debt, the government will be assumed to run a balanced budget in each time period

Resources: The economy starts with $k_0 > 0$ units of physical capital, and $N_0 > 0$ intermediate goods. Time endowment in each period is normalized to unity. (Given that the consumer does not value leisure, all time will be spent working in equilibrium.)

Regulator problem: The government ("the regulator") chooses $\bar{k}_t$ in each period to maximize

$$g_t - \tau_t^2 = (\bar{k}_t)^{\theta} - \tau_t^2, \tag{1.7}$$

subject to the budget constraint

$$r_t \bar{k}_t = \tau_t, \tag{1.8}$$

where r_t denotes the real interest rate, parameter $0 < \theta < 1$ captures some decreasing returns in the "production function of regulations," while the quadratic form for taxes aims to capture the fact that varying taxes over time is costly. Next, plugging the budget constraint into the objective function, and maximizing with respect to the choice variable yields

$$\bar{k}_t = \bar{k} = [2/\theta]^{2-\theta}, \tag{1.9}$$

where without any loss of generality we have normalized the real interest rate to unity. The interesting result is that the amount of regulation will be constant over time.

A Social planner will then maximize 1.1 subject to 1.2 – 1.6 and the initial conditions. Given that all intermediaries use the same production function, this will imply that capital will be allocated evenly (symmetrically) across intermediaries, *i.e.*

$$y_t = \int_0^{N_t} (k_{it} - \bar{k})^\alpha h_t^{1-\alpha} di = h_t^{1-\alpha} \int_0^{N_t} (\frac{k_t}{N_t} - \bar{k})^\alpha di = \int_0^{N_t} (\frac{k_t}{N_t} - \bar{k})^\alpha di = N_t^{1-\alpha} (k_t - N_t \bar{k})^\alpha$$
1.10

In equilibrium, the optimality conditions produce a balanced growth path (BGP), or:

$$\frac{1}{\beta}(1 + g) = \alpha (k_t - N_t \bar{k})^{\alpha-1} N_t^{1-\alpha} + (1 - \delta),$$
1.11

and

$$\frac{1}{\beta}(1 + g) = (1 - \alpha)(k_t - N_t \bar{k})^\alpha N_t^{-\alpha} + 1,$$
1.12

where g denotes the growth rate in the economy. Equalizing the left-hand sides of 1.11 and 1.12, it can be easily established that there is only one pair of initial conditions that makes those two equations hold.

Next, totally differentiating one of the two equations describing the BGP, *e.g.* 1.11, and applying the Implicit Function theorem, we can derive that

$$\frac{dk_t}{d\bar{k}} > 0,$$
1.13

or, in other words, aggregate capital increases with regulations. However, at the same time

$$\frac{dN_t}{d\bar{k}} < 0,$$
1.14

i.e., more regulations lead to less intermediate goods, or less variety ("variety effect"). Each surviving intermediary will have more capital, and thus will be larger than before ("size effect"), in order to overcome the "dead capital effect"/regulatory cost and produce positive output. Combined, the two effects produce a lower growth rate in the economy ("growth effect"). Indeed, a simple application of the envelope theorem produces

$$\frac{dy_t}{d\bar{k}} < 0,$$
1.15

which means that more regulation has an adverse effect on aggregate final output, and that effect works through the negative effect on the number of intermediaries. In this setup, aggregate output positively depends on innovation, as each new intermediate good is immediately absorbed as an input into the production of the final good. Similarly, we can show that

$$\frac{di_t^N}{d\bar{k}} < 0,$$
1.16

or that regulation supresses innovation, while it increases physical investment

$$\frac{di_t^k}{d\bar{k}} > 0,$$
1.17

as the planner substitutes investment in ideas for investment in physical capital. It is also straightforward that

$$\frac{dg_t}{d\bar{k}} > 0,$$
1.18

as more regulation requires more funding through lump-sum taxes to finance government spending. From the resource constraint it then follows (straightforward to show) that

$$\frac{dc_t}{d\bar{k}} < 0,$$
1.19

or that consumption is lower with regulation, despite the increase in physical investment. In an economy driven by innovation, more regulation is bad for both final production and final consumption, and thus is bad for aggregate welfare. Testing these effects using data is straightforward and could be done along the lines of Stankov and Vasilev (2019). This empirical part is left outside the scope of the paper.

Conclusion

In this paper we extend an endogenous growth model, where growth is driven by investment in R&D, with government regulations. More specifically, successful inventions lead to the production of new intermediate goods, which are then immediately incorporated as essential inputs into the production of final output. We show that more regulations positively affect investment in capital, but that is at the cost of decreasing investment in R&D. In turn, the decrease in the number of intermediate goods negatively affects aggregate output, and leads to lower consumption and welfare. Overall, the setup confirms the intuition that more regulation has an adverse effect for aggregate economic activity.

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ANALYSIS OF ENVIRONMENTAL DEGRADATION AND ITS DETERMINANTS IN NIGERIA: NEW EVIDENCE FROM ARDL AND CAUSALITY APPROACHES

Wasiu ADEKUNLE
Nigerian Economic Summit Group (NESG), Lagos, Nigeria
wasiuademola10@gmail.com

Beatrice. O. OMO-IKIRODAH
University of Benin, Edo State, Nigeria
bomoikirodah@gmail.com

Olutosin COLLINS
BOWEN University, Osun State, Nigeria
olutosinonyeka@gmail.com

Andrew ADENIYI
University of Ibadan, Oyo State, Nigeria
adeniyi.andrew@gmail.com

Abubakar BAGUDO
Kebbi State University of Science and Technology, Kebbi State, Nigeria
abuhjoa@gmail.com

Risikat O. MOSOBALAJE
Emmanuel Alayande College of Education, Oyo State, Nigeria
mosobalajero@yahoo.com

Safiyyah OLADEPO
University of Ibadan, Oyo State, Nigeria
safiyyaholadepo@gmail.com

Abstract:

This paper extends the previous studies to re-examine the functional relations and causal links between environmental degradation and its possible determinants in Nigeria, covering 1977 to 2015. With the aid of ARDL model estimation, the study found a positive relationship between economic growth and environmental degradation (measured by carbon emission). A positive relation was also established between energy consumption and carbon emission. Similarly, this study reported a positive relationship between transport services in the import and export sectors and carbon emission. Through the Granger causality test, the study established a unidirectional causality running from carbon emission to economic growth. Similarly, there was a unidirectional causality running from economic growth to transport services in the export sector. Based on these findings, there is an increasing need for the authorities to regulate economic activities that directly and indirectly contribute to systematic environmental degradation in Nigeria.

Keywords: environmental degradation; transport services; economic growth; ARDL; Granger causality.

JEL Classification: C22; O13; O44.

Introduction

Globally, issues around environmental degradation have taken the centre stage in qualitative and quantitative studies attributable to the recent challenge of climate change. Air, water pollution and global warming are mostly traced to unpredictable activities of man at various economic development stages, such as, the pre-industrial, industrial and services-driven stages (Ejuvbekpokpo 2014). It is a commonplace to attribute environmental degradation to fossil fuel or carbon emission, otherwise known as CO2. Sanglimsuwan (2011) viewed carbon emissions as organic matters that stem from fossil fuel and manufacturing activities' combustion. Half of the world's fossil fuel escape into the atmosphere, thereby responsible for the increase in global temperature, while the natural land and ocean carbon reservoirs had absorbed the other half (Putman *et al.* 2016). According to Garber (2011), the take-off stage of a country towards development into a more industrialized economy contributes significantly to environmental degradation. In essence, the greater the consumption of natural resources using outdated and energy-intensive technologies, the higher the rate of environmental pollution.

Meanwhile, environmental degradation is one of the factors that significantly contribute to economic growth and development. For instance, Xie *et al.* (2017) argued that China's growth and development in recent years has contributed significantly to carbon emissions across the globe. Concerning the issues around the correlation between economic growth and environmental quality in Nigeria, Alege and Ogundipe (2013) submitted that air pollution (mainly caused by smoke and noise), loss of forest areas, municipal waste problems, habitat destruction, threats to biodiversity, global greenhouse gases and the resource depletion are not unconnected to economic growth. The authors further argued that environmental degradation in Nigeria could be traced to the era of crude oil discoveries. The oil-induced economic performance has heightened the depth of environmental degradation, especially in the major oil-producing areas in the Niger-Delta region. Oil spillage by multinationals operating in the region has resulted in socioeconomic deprivation for farmers and traders without adequate compensation to the affected groups and communities. Despite the growth of natural resource endowment in most African countries, poor institutional quality, absence of accountability and weak rule of law, as well as, endemic corruption have, in most part, been responsible for environmental degradation on the continent (Simulders 2000).

Considering the relationship between transportation services and environmental degradation, a handful of the literature has only focused on private transport means, such as car traffic, aviation and freight transports (Tanczos and Torok 2007; Riha and Honcu 2012; Saidi and Hammami 2017). Stern (2006) opined that all types of transportation means were responsible for 14% of the world's total CO2 emission in 2000 and has the tendency of increasing its level if appropriate measures are not taken very urgently. According to World Bank (2017), CO2 emission from transport services in Nigeria accounted for 51% of the overall fossil fuel combustion between 2000 and 2005 and 36% between 2006 and 2014.

Saidi and Hammami (2017) submitted that the nexus between transport, economic growth and environmental degradation has been treated along the three strands of the extant literature. First and in no particular order, is the relationship between income and freight transportation, with particular focus on the issue of coupling/decoupling freight transportation (Joignaux and Verny 2004; McKinnon 2007; Mraihi 2012; Meersman and Van de Voorde 2013). Second is the nexus between economic growth and the efficiency of energy use, with particular reference to the Environmental Kuznets Curve (EKC) or the Pollution-Haven hypothesis (Borhan *et al.* 2012; Zhu *et al.* 2012; Chandran and Tang 2013; Omri *et al.* 2014; Magazzino 2014; Shahbaz *et al.* 2015; Dogan and Turkekul 2016). The third strand of the literature examined the direction of causality between transport services and carbon emission (as an indicator for environmental degradation). The last strand has increasingly spurred researchers' interest in identifying the other important factors contributing to environmental degradation (see, Léonardi and Baumgartner 2004; Tanczos and Torok 2007).

Studies on Nigeria have also exhausted these three strands of the literature (see Saidi and Hammami 2017). They include, among others, Ejuvbekpokpo (2014); Asaju and Arome (2015); Mesagan (2016); Otene, Murray and Engine (2016); Agarana, Bishop and Agboola (2017); Appiah *et al.*

(2017); Onokala (2017). Although their findings have been largely inconclusive, they have equally been too biased, because they failed to take into account the probable influences of other factors (such as, transport services) that contribute to CO2 emission in the economy. This paper, therefore, extends the previous studies on Nigeria with a focus on re-examining the functional relation and the causal link between environmental degradation and its supposed determinants in Nigeria. The rest of the study is structured as follows. Section 2 takes account of the empirical literature. Section 3 entails theoretical framework and methodology. While Section 4 is devoted to empirical analysis and discussion of results, Section 5 summarizes the findings and concludes the study.

1. Empirical Literature Review

The extant empirical literature review was carried out under three subheadings, namely: Carbon Emission and Economic Growth; Transportation and Carbon Emission; Economic Growth, Transportation, and Carbon Emission. Most of the literature on Carbon Emission and Economic Growth nexus reported a robust bidirectional relationship between the two variables. With respect to Transportation and Carbon Emission, there appears to be a consensus that the former strongly impacts the latter. Besides, most studies on the nexus among Economic Growth, Transportation, and Carbon Emission established a strong linkage among the three key variables and thus, confirmed the EKC's existence for both country-specific and multiple countries cases. Table 1 summarizes the empirical literature across these three strands. The recent study corroborates the co-existing literature by re-examining the functional and causal relationship between environmental degradation and the possible determinants in Nigeria using ARDL and Granger causality approaches.

Table 1. Summary of the Empirical Literature

S/N	Author(s)	Title of article	Variables	Methodology	Results and findings	Conclusion
			Nexus between carbon emission and economic growth			
1	Azomahou *et al.* (2005)	Economic Development and CO_2 Emissions: A Nonparametric Panel Approach	CO_2 emission per capita, real GDP per capita,	Nonparametric panel model, OLS	There is a significant relationship between carbon emissions per capita and Gross Domestic Product (GDP) per capita.	There is a static link between carbon emissions and GDP per capita.
2	Grubb *et al.* (2007)	Analysis of the Relationship between Growth in Carbon Dioxide Emissions and Growth in Income	Population, National Income, carbon emissions, and GDP per capita	Trend Analysis Approach	Established that an increase in economic growth does not relate with an increase in carbon emissions	carbon emission does not have a significant relationship with income per capita
3	Akpan and Akpan (2012)	Electricity Consumption, Carbon Emissions and Economic Growth in Nigeria	Carbon dioxide emissions, index of electricity consumption, real income per capita, and real income square.	Autoregressive Distributed Lag (ARDL) and Multivariate Vector Error-Correction Model (VECM)	Electricity consumption and carbon emission significantly influence growth in the short-run and long-run	There is a need for efficient energy products.
4	Borhana *et al.* (2012)	The Impact of CO_2 on Economic Growth in ASEAN 8	GDP per capita, carbon emission, labour, physical capital, government spending, foreign direct investment, net export, population density, GDP	Fixed Effect Panel Regression Model.	There is a simultaneous relationship existing between carbon emission, population density, and income	Even though growth in population leads to carbon emission, carbon emission reduces population density and income
5	Essien (2012)	The Relationship Between Economic Growth and CO_2 Emissions and the Effects of Energy Consumption on CO_2 Emission Patterns in Nigerian Economy	Real GDP Per Capita (RGDPPC), Carbon dioxide Emissions (CE), Electricity Consumption (EC), Natural Gas (NG), Crude Oil (CO), Fuel	Standard Version of Granger, Vector Error Correction Model, Generalized Impulse Response and Variance	Real GDP, carbon emissions, electricity consumption, natural gas, crude oil, fuelwood, and solid biomass are all cointegrated.	There is a need to designed policies to reduce carbon emissions.

		Wood (FW) and Solid Biomass (SB).	Decompositions		
6	Alege and Ogundipe (2013)	Environmental quality and economic growth in Nigeria: A fractional cointegration analysis	Carbon emission, trade openness, control of corruption, and population density.	Fractional Integration and Co-integration.	No significant evidence to support the existence of Environmental Kuznets Curve in Nigeria,	EKC proposition is not real in Nigeria.
7	Kulionis (2013)	The relationship between renewable energy consumption, CO2 emissions and economic growth in Denmark	GDP per capita, carbon emissions per capita, and renewable energy consumption per capita.	Vector Auto-regressive (VAR) model, Unit Root Test, Co-integration, and Granger Causality.	GDP does not Granger cause carbon emissions.	There is no relationship between carbon emission and economic growth, as well as renewable energy consumption and economic growth
8	Alam (2014)	On the Relationship between Economic Growth and CO2 Emissions: The Bangladesh Experience	Value Added of GDP in Agriculture, Value Added of GDP in Industries, Value Added of GDP in Services, carbon emissions,	Trend Analysis Approach	An increase in the GDP contribution of industrial and services sectors increases carbon emission.	Environmental awareness, environmental policy, global cooperation, improved and polluting abatement technologies are the identifiable means of reducing carbon emissions.
9	Annicchiarico et al. (2014)	150 Years of Italian CO2 Emissions and Economic Growth	carbon emission per capita, and Gross Domestic Product (GDP) per capita	CVAR, Linearity Tests, MR-STAR, MS-VAR	The carbon emissions path is closely related to the income time path.	Confirmed EKC.
10	Ejuvbekpokpo (2014)	Impact of Carbon Emissions on Economic Growth in Nigeria	Gross Domestic Product, Emissions from Fossils fuel, Emissions from Gas fuels, Emissions from Liquid fuels, Emissions from solid fuels, Emissions from cement production	Ordinary Least Square Method.	Fossil fuels, gas fuels, liquid fuels, cement fuels have a significant impact on gross domestic product except for emission from solid fuels.	Carbon emissions reduce growth in Nigeria

11	Muftau, Iyoboyi, and Ademola (2014)	An Empirical Analysis of the Relationship between CO2 Emission and Economic Growth in West Africa	Gross Domestic Product (GDP), Money Supply (M2), Population size (POP), Domestic credit to the private sector (DC), Openness (OPN), and the square of Gross domestic product (GDP2).	Fixed Effect Panel Regression Model, and Vector Error Correction Model (VECM)	There is the existence of an N-shape relationship among the variables	Economic growth is liable for increases in carbon emission in West African Countries.
12	Palamalai *et al.* (2015)	Relationship between energy consumption, CO2 emissions, economic growth and trade in India.	energy consumption, CO2 emissions, Gross domestic product (GDP) and foreign trade	VECM	there is a long-run relationship between energy consumption, carbon emissions, GDP and trade, while in the short run, a causal relationship exists from carbon emissions to economic activities	It is necessary to implement energy efficiency measures to maintain sustainable growth and environmental quality.
13	Omri *et al.* (2015)	Financial development, environmental quality, trade and economic growth: What causes what in MENA countries	per capita GDP, per capita CO2 emissions, per capita total energy consumption, per capita gross fixed capital formation, domestic credit to the private sector, total trade, urban population, foreign direct investment net inflows, and consumer prices.	Panel Unit root test, GMM	A bi-directional causal relationship between carbon dioxide emissions and economic growth	Policy such as; energy-efficient technologies and adoption of trade liberalization should be taken to reduce carbon emissions.
14	Jong-Chao and Chih-Hsiang (2016)	Impact of population and economic growth on carbon emissions in Taiwan using	Carbon emission, total population, percentage of	ARDL and STIRPAT model	Positive logarithmic polynomial coefficients with respect to population, and negative	In the Year 2025, an inverted U-Shape will be identified.

		an analytic tool STIRPAT	non-independent population, per-capita GDP, percentage of the urbanized population, and industries-contributed per-capita GDP		logarithmic polynomial coefficients with respect to GDP per capita	
15	Mesagan (2016)	Economic Growth and Carbon Emission in Nigeria	carbon emission, economic growth, trade openness, and capital investment	Error correction model	Economic growth has a positive impact on carbon emission	Economic growth is an essential determinant of carbon emissions in Nigeria.
16	Mohiuddin *et al.* (2016)	The relationship between carbon dioxide emissions, energy consumption, and GDP: A recent evidence from Pakistan	CO2, EPC, EPG, EPL, EC, GDP	Co-integration, VECM, Augmented Dickey-Fuller, Phillips–Perron unit root tests, Granger-causality analysis, Generalized impulse response	evidence of long-run equilibrium relationship from energy consumption, electricity production from coal, electricity production from oil and GDP to carbon emissions	carbon emissions are fuel by energy consumption, energy production from gas, and GDP
17	Appiah *et al.* (2017)	Investigation of the Relationship between Economic Growth and Carbon Dioxide (CO2) Emissions as Economic Structure Changes: Evidence from Ghana	carbon emissions, GDP per capita	Ordinary Least Square (OLS)	There is a significant relationship between carbon emissions and economic growth.	There is a need for policy formulation towards the prevention of environmental degradation.
18	Misra (2017) The inter-relationship between economic growth and CO2 emissions in India			CO2 emissions, GDP, energy intensity, and electricity generation	ARDL model	GDP explains carbon emission at a 10% significance level	The relationship is a long-run phenomenon.
Transportation and Carbon Emission Nexus						

19	Timilsina & Shrestha (2008)	The Growth of Transport Sector CO2 Emissions and Underlying Factors in Latin America and the Caribbean	fuel switching, modal shifting, economic growth and changes in emission coefficients and transportation energy intensity	logarithmic mean Divisia index (LMDI) approach	Transport sector carbon emission growth is fuel by economic growth and transportation energy intensity in Latin American and Caribbean countries.	Both the economic activity effect and transportation energy intensity effect are found responsible for transport sector CO2 emissions growth.
20	AfDB (2010)	Reducing Carbon Emissions from Transport Projects in Asian countries	Production Input materials	MRT emissions model	Local pollution amount to carbon emission, in which expanded road capacity results in a long-term increase in carbon emissions and local air pollution. It increases the amount of traffic.	Construction of transport infrastructure; induced travelling; polluting trucks, cars, and small vehicles sets the carbon emission pace.
21	Makido *et al.* (2012)	Relationship between urban form and CO2 emissions: Evidence from fifty Japanese cities	BCI, CI, AWMPFD, Income, Pop, AveTemp, Urban, Indus CO2, Comm CO2, Resi CO2, Trans CO2, PassCar CO2, FreiCar CO2	Stepwise multiple linear regression, correlation analysis	Realize that per capita carbon emissions from transport sectors and residential of the Japanese cities have a significant relationship with urban form's spatial variables.	Denser settlement may lead to lower carbon emissions from the residential and passenger transport sector.
22	Chandran and Tang (2013)	The impact of transport energy consumption, foreign direct investment and income on carbon emissions in Asean-5 economies	per capita real GDP, per capita actual FDI, per capita carbon emissions, per capita energy consumption,	Co-integration, and Granger causality method.	In the long run, there is bi-directional causality between economic growth and carbon emissions in Indonesia and Thailand, while in Malaysia, there is evidence of bi-directional causality between energy consumption and economic growth.	Economic growth and road transport energy consumption produce higher carbon emissions.
23	Konur and Schaefer (2014)	Integrated inventory control and transportation decisions under carbon emissions regulations: LTL vs TL carriers	unit transportation cost and unit transportation emissions bt, per truck cost R and empty truck emission	LTL and TL transportation.	Emission generated through trucks consists of the majority.	Transportation costs are not the only factor influencing a retailer's preference, transportation emissions, and carbon emissions.

			bw			
24	Postorino and Mantecchini (2014)	A transport carbon footprint methodology to assess airport carbon emissions	average emissions due to ground access mode; average emissions due to energy production and consumption for airport terminal activities; average emissions due to landing, take-off and taxiing on-ground aircraft; average emissions due to handling vehicles and airport equipment	general approach	Emissions due to passenger to and from airports are one of the leading causes of airport-related environmental impacts.	Deducing that the airport's primary emissions are carbon emissions from ground access vehicles and the LTO cycle.
25	Wang *et al.* (2016)	Carbon emission and its decoupling research of transportation in Jiangsu Province	GDP, coal, coke, crude oil, kerosene, gasoline, diesel, fuel oil, LPG, natural gas, and electricity consumption	Tapio decoupling model	GDP and transportation in Jiangsu Province contribute massively to the increase in carbon emissions	There is a need for government policy tremendously in transportation development and depleted carbon emissions.
26	Agarana *et al.* (2017)	Minimizing Carbon Emissions from Transportation Projects in Sub-Saharan Africa Cities Using Mathematical Model: A Focus on Lagos, Nigeria	Electricity expenses	Linear Programming Model	Income is essential for electricity used.	However, the government should enhance quality fuel for transportation, good roads should be constructed, and other transportation means should be introduced.

27	Xie *et al.* (2017)	The effects of transportation infrastructure on urban carbon emissions	electric power, natural gas, liquefied petroleum gas, and transportation	STIRPAT model	Construction of transportation infrastructure, population size, per capita GDP, energy intensity, and industrial structure lead to rises in carbon emission and intensity.	Large-scale cities and transport infrastructure's construction positively affects urban carbon emissions and carbon intensity; transport infrastructure only increases carbon intensity in medium-scale cities. In small scale cities, transportation infrastructure construction has no significant effects on carbon emission and carbon intensity.
Nexus among Economic Growth, Transport and Carbon Emissions						
28	Gray *et al.* (2006)	Decoupling the link between economic growth, transport growth and carbon emissions in Scotland	GDP, Road traffic volume, carbon emissions, PM emissions, and NOx emissions	Decoupling method	The policy to reduce the transport sector's carbon emissions and increase the pace of economic growth in Scotland is constrained by political and social acceptability.	To get most of the transport sectors, there is a need to tackle political risk within transport and energy and inform the public of the nature of the problem and promote their lifestyle change to improve quality of life.
29	Říha and Honců (2012)	Transport Energy and Emissions and their Relation to Economic Output.	Total emissions, population, transport energy consumption, traffic output (vehicle. km), transport output (tkm), GDP, and GDP per capita	Kuznets environmental curve	The environmental Kuznets curve is invalid regarding carbon dioxide, whereas the environmental Kuznets curve is established for nitrogen emissions and some other pollutant from road transport.	Road transport leads to an increase in economic output, in which economic growth is believed to reduce emissions.
30	Atte-Oudeyi *et al.* (2016)	Road Transport, Economic Growth and Carbon Dioxide Emissions in the BRICS: Conditions For a Low Carbon Economic Development	Road Carbon emission, Per capita GDP, Population Density, Government Effectiveness Index	Fixed-effects and random-effects	Economic growth and carbon emissions per capita confirm the existence of an inverted U-shaped EKC due to road transport of BRICS countries, whereas, when Russia is absent from the group, EKC does not hold	That increasing per capita GDP level is not enough to reduce carbon emissions in BRICS countries.

31	Saidi and Hammami (2017)	Modelling the causal linkages between transport, economic growth and environmental degradation for 75 countries	GDP per capita, energy consumption, freight transport, carbon emissions, financial development, capital stock, trade openness, population, foreign direct investment, urbanization	Generalized Method of Moments.	There is the existence of a bi-directional causal relationship between freight transport and economic growth for four panels; unidirectional causality running from freight transport to environmental degradation for the four panels.	Transport positively relates to carbon emission and economic growth, i.e., an increase in transport service leads to increased environmental pollution and GDP growth.
32	Neves *et al.* (2017)	Is energy consumption in the transport sector hampering both economic growth and the reduction of CO2 emissions? A disaggregated energy consumption analysis	Gross Domestic Product per capita (GDP), TS fossil fuels (coal, crude, oil and natural gas) consumption per capita (FF), TS electricity consumption per capita (EL), TS renewable fuels consumption per capita2 (RES), total CO2 emissions from TS (CO2), total energy consumption in the economy minus that of the TS per capita (EN), and rail investment (RAIL).	Driscoll-Kraay fixed effects estimator; Autoregressive Distributed Lag (ARDL)	Railway investment did not reduce carbon emissions but increased electricity demand, thereby contributing to more significant carbon emissions.	Transport sector electrification harms economic growth and a positive effect on carbon emission
33	Mbarek and Zghidi (2017)	Dynamic links between ICT, transport energy, environmental degradation and growth: empirical evidence from Tunisia.	LICT, LGDP, carbon emissions, FFEC	Johansen cointegration analysis, Vector Error Correction Model	Transport energy increases carbon emission in Tunisia, while ICT has no significant relationship with carbon emissions.	Policy measures infer the use of railway transport to reduce carbon emissions on transport energy and attain economic growth.

			(VECM)		
34	Fan and Lei (2017)	Responsive Relationship between Energy-Related Carbon Dioxide Emissions from the Transportation Sector and Economic Growth in Beijing —Based on Decoupling Theory	CO_2 emissions, Energy consumption, net calorific value, traffic volume and GDP,	Tapio decoupling analysis	There was a complex decoupling relationship between carbon emissions from the transportation sector and economic growth, expansive negative decoupling, weak decoupling, and expansive decoupling.	Industrial operating efficiency and industrial development decoupling positively affect the decoupling situation between carbon emissions from the transport sector and economic growth.
35	Liang *et al.* (2017)	Factors Affecting Transportation Sector CO_2 Emissions Growth in China: An LMDI Decomposition Analysis	CO_2 from Energy Structure, CO_2 from Energy Efficiency, CO_2 from Transportation form, CO_2 from Transportation Development, CO_2 from Economic development, CO_2 Population size, GDP, energy consumption	decomposition model, Logarithmic Mean Divisia Index (LMDI) decomposition analysis technology and modified fixed growth rate method	The increment in transportation services in China has led to high growth speed in carbon emission.	Significant factors affecting transportation carbon emission growth are energy structure, energy efficiency, transport form, transportation development, economic development, and population size.
36	Danish and Baloch (2017)	Dynamic linkages between road transport energy consumption, economic growth, and environmental quality: evidence from Pakistan	GDP, Road Infrastructure, Road Transport Energy Consumption, Urbanization, and Sulfur dioxide emissions.	ARDL cointegration approach.	Long-run, road infrastructure, road transport energy consumption, urbanization, and economic growth are positively related whereas, economic growth and emissions are negatively related.	Expansion in road infrastructure, transport energy consumption and economic growth will worsen environmental quality.

2. Theoretical Framework & Methodology

2.1 Theoretical Framework

The IPAT model of Dietz and Rosa (1994) explains the impact of population, affluence and technology on the environment; where I is the environmental impact, P is population, A is per capita economic output (referred to as affluence), and T is the impact of per-unit activity (referred to as technology). The model is written as:

$$I = P^* A^* T \qquad\qquad 2.1$$

In specific application purpose, Dietz and Rosa (1994) explained that data are obtained on Impact, Population and Affluence to solve for T, which is the technology used. The model is specified as:

$$T = I/(P^* A) \qquad\qquad 2.2$$

Considering the importance of the stochastic term in the Model, Dietz (1994) reformulated the model in a stochastic form:

$$I = aP^b A^c T^d e \qquad\qquad 2.3$$

I, P, A and T remain environmental impact of population growth, per capita economic activity, and impact per unit economic activity. For the model, b, c, and d are the parameters, while a and e are residual terms. To estimate these parameters, Dietz and Rosa (1994) submitted that data on I, P, A and T can be used.

Xie *et al.* (2017) modified equation 2.3 by arguing that transportation infrastructure's construction affects urban carbon emissions through population scale, economic growth, and technological innovation. Therefore, they added the transportation infrastructure (Road) factor to the model. The logarithm of equation 2.3 was taken to present the linear form of the model. The model is reformulated as:

$$In\,I = \alpha_0 + \alpha_1 InRoad + \alpha_2 InP + \alpha_3 InA + \alpha_4 InT + \varepsilon \qquad\qquad 2.4$$

$\alpha_1 - \alpha_4$ are the coefficients of the parameters, ε is the error term, while α_0 is the intercept.

Xie *et al.* (2017) further decomposed and expanded the model to include other variables that contribute to environmental degradation and re-specified the model as:

$$In\,I_{it} = \alpha_0 + \alpha_1 InRoad_{it} + \alpha_2 InP_{it} + \alpha_3 InA_{it} + \alpha_4 InT_{it} + \alpha_5 InEI_{it} +$$
$$\alpha_6 InUrban_{it} + \alpha_7 InOpen_{it} + \alpha_8 InIndustry_{it} + \varepsilon_{it} \qquad\qquad 2.5$$

where i represents cities, t is year, α_0 is a constant term, and ε_{it} is an error term. I stands for carbon emissions and intensity, $Road$ is transportation infrastructure, P is the population size, A is affluence, T is technical progress, EI is energy intensity, $Urban$ is the urbanization level, $Open$ is the trade openness, $Industry$ is industrial structure and ε is the error term. For this study, we followed Xie *et al.* (2017) model, this is because the study included transportation infrastructure, which is similar to our study. We modified the model based on the proxy for transportation infrastructure, which contributed to environmental degradation and included some other variables contributing to Nigeria's environmental degradation.

2.2 Methodology

The study used the ARDL model and Granger causality test to analyze the study's two specific objectives. The ARDL model – developed by Pesaran *et al.* (2001) - is used to analyze the long-run and short-run relationships between the variables employed. In contrast, the Granger causality test – developed by Granger (1969) - is used to model the causal link between economic growth, transport services and environmental degradation.

2.2.1 ARDL Model Specification

$$LCO_{2t} = \alpha_0 + \beta_1 TR_t + \beta_2 LRPCI_t + \beta_3 (TR_t * LRPCI_t) + \beta_4 LEGY_t + \beta_5 TOP_t + \varepsilon_t \quad 2.6$$

$$TR_t = \{TR\_X_t, TR\_M_t\} \qquad\qquad\qquad\qquad 2.7$$

From equations 2.6 and 2.7, LCO_{2t} implies log form of carbon emissions, a proxy for environmental degradation, TOP_t is trade openness captured as the ratio of trade to GDP, $LRPCI_t$ is log form of real gross domestic product per capita, $LEGY_t$ is the log form of energy use in Kg oil equivalent per capita, TR_t is transport services decomposed into TR_X and TR_M, where TR_X_t is transport services as a percentage of commercial services export and TR_M_t is transport services as a percentage of commercial services import and ε_t is the error term. The data on the variables were obtained from the World Bank's World Development Indicators (2017 edition). t implies time period, α_0 is the model intercept, while $\beta_1 - \beta_5$ are the coefficients of the parameters.

The study reformulates equations 2.6 and 2.7 using ARDL model to capture the long-run and short-run impact of economic growth and transport on environmental degradation. The ARDL version is as follows:

$$\Delta LCO_{2t} = \vartheta_1 LCO_{2t-1} + \vartheta_2 TR_{t-1} + \vartheta_3 LRPCI_{t-1} + \vartheta_4 (LRPCI * TR)_{t-1} + \vartheta_5 TOP_{t-1} +$$

$$\sum_{k=1}^{n-1} \rho_{1k} \Delta LCO_{2t-k} + \sum_{k=0}^{n-1} \rho_{2k} \Delta TR_{t-k} + \sum_{k=0}^{n-1} \rho_{3k} LRPCI_{t-k} + \sum_{k=0}^{n-1} \rho_{4k} \Delta (LRPCI *$$

$$TR)_{t-k} + \sum_{k=0}^{n-1} \rho_{5k} \Delta TOP_{t-k} + \varepsilon_t \qquad\qquad 2.8$$

The error correction representation is derived as follows:

$$\Delta LCO_{2t} = \vartheta_1 \left(LCO_{2t-1} - \left[-\frac{\vartheta_2}{\vartheta_1} TR_{t-1} - \frac{\vartheta_3}{\vartheta_1} LRPCI_{t-1} - \frac{\vartheta_4}{\vartheta_1} (LRPCI * TR)_{t-1} - \right.\right.$$

$$\left.\left.\frac{\vartheta_5}{\vartheta_1} TOP_{t-1} \right] \right) + \sum_{k=1}^{n-1} \rho_{1k} \Delta LCO_{2t-k} + \sum_{k=0}^{n-1} \rho_{2k} \Delta TR_{t-k} + \sum_{k=0}^{n-1} \rho_{3k} LRPCI_{t-k} +$$

$$\sum_{k=0}^{n-1} \rho_{4k} \Delta (LRPCI * TR)_{t-k} + \sum_{k=0}^{n-1} \rho_{5k} \Delta TOP_{t-k} + \varepsilon_t \qquad\qquad 2.9$$

By letting,

$$ect = LCO_{2t-1} - \mu_1 TR_{t-1} - \mu_2 LRPCI_{t-1} - \mu_3 (LRPCI * TR)_{t-1} - \mu_4 TOP_{t-1} \quad 2.10$$

where,

$$\mu_1 = -\frac{\vartheta_2}{\vartheta_1}, \quad \mu_2 = -\frac{\vartheta_3}{\vartheta_1}, \quad \mu_3 = -\frac{\vartheta_4}{\vartheta_1}, \quad \mu_4 = -\frac{\vartheta_5}{\vartheta_1} \qquad\qquad 2.11$$

Eq. 2.9 is therefore re-written as:

$$\Delta LCO_{2t} = \vartheta_1 ect + \sum_{k=1}^{n-1} \rho_{1k} \Delta LCO_{2t-k} + \sum_{k=0}^{n-1} \rho_{2k} \Delta TR_{t-k} + \sum_{k=0}^{n-1} \rho_{3k} LRPCI_{t-k} +$$

$$\sum_{k=0}^{n-1} \rho_{4k} \Delta (LRPCI * TR)_{t-k} + \sum_{k=0}^{n-1} \rho_{5k} \Delta TOP_{t-k} + \varepsilon_t \qquad\qquad 2.12$$

Recall that, $\quad TR_t = \{TR\_X_t, TR\_M_t\}$

From equations 2.11 and 2.12, the Δ denotes the short-run variables' changes, n is the lag length, ε_t- error term at time t. The parameters μ_i ($i = 1, 2, 3, 4$) are the corresponding long-run multipliers, and the parameters $\rho_{ik} = (i = 1, 2, 3, 4, 5)$ are the short-run dynamics of the ARDL model. ϑ_1 is the adjustment parameter on the error correction term *etc*. The convergence criteria hold that the parameter must be negative, less than one in absolute value, and statistically significant at the conventional levels of 1%, 5%, and 10%. Based on eq. 2.12, the a priori expectations for the regression coefficients are as follows: $\rho_{1k}>$ or < 0; $\rho_{2k} > 0$; $\rho_{3k} > 0$; $\rho_{4k} < 0$ (depending on whether or not growth supports the use of energy-saving transportation technologies); $\rho_{5k} > 0$.

2.2.2 Granger Causality Test

The Granger causality enables endogeneity of variables; that is, it permits each variable to be assumed as the dependent variable. The causal link models from transport services (% of commercial exports and % of commercial imports) and economic growth to environmental degradation are specified as:

$$\Delta LCO_{2t} = \vartheta_0 + \sum_{q=1}^{n} \theta_{1t} \Delta LCO_{2t-k} + \sum_{q=1}^{n} \gamma_{1t} \Delta TR\_X_{t-k} + \sum_{q=1}^{n} \gamma_{2t} \Delta LRPCI_{t-k} \qquad 2.13$$

$$\Delta LCO_{2t} = \vartheta_0 + \sum_{q=1}^{n} \theta_{1t} \Delta LCO_{2t-k} + \sum_{q=1}^{n} \gamma_{1t} \Delta TR\_M_{t-k} + \sum_{q=1}^{n} \gamma_{2t} \Delta LRPCI_{t-k} \qquad 2.14$$

Transport services are decomposed into transport services as a percentage of commercial services from export and import.

$$\Delta TR\_M_t = \vartheta_0 + \sum_{q=1}^{n} \theta_{1t} \Delta LCO_{2t-k} + \sum_{q=1}^{n} \gamma_{1t} \Delta TR\_M_{t-k} + \sum_{q=1}^{n} \gamma_{2t} \Delta LRPCI_{t-k} + \varepsilon_{1t} \; 2.15$$

Equation 2.15 presents causality from economic growth, environmental degradation and transport services in the export sector to transport service in the import sector.

$$\Delta TR\_X_t = \vartheta_0 + \sum_{q=1}^{n} \theta_{1t} \Delta LCO_{2t-k} + \sum_{q=1}^{n} \gamma_{1t} \Delta TR\_X_{t-k} + \sum_{q=1}^{n} \gamma_{2t} \Delta LRPCI_{t-k} + \varepsilon_{1t} \; 2.16$$

Equation 2.16 presents the direction of causality from economic growth, environmental degradation and transport services in the import sector to transport service in the export sector;

$$\Delta LRPCI_t = \vartheta_0 + \sum_{q=1}^{n} \theta_{1t} \Delta LCO_{2t-k} + \sum_{q=1}^{n} \gamma_{1t} \Delta TR\_M_{t-k} + \sum_{q=1}^{n} \gamma_{2t} \Delta LRPCI_{t-k} + \varepsilon_{1t} \; .17$$

Equation 2.17 presents the direction of causality from transport service in the import sector and environmental degradation to economic growth.

$$\Delta LRPCI_t = \vartheta_0 + \sum_{q=1}^{n} \theta_{1t} \Delta LCO_{2t-k} + \sum_{q=1}^{n} \gamma_{1t} \Delta TR\_E_{t-k} + \sum_{q=1}^{n} \gamma_{2t} \Delta LRPCI_{t-k} + \varepsilon_{1t} \; .18$$

Equation 2.18 presents the direction of causality from transport service in the export sector and environmental degradation to economic growth.

3. Empirical Analysis & Discussion of Results

This section presents the results of empirical analysis ranging from preliminary analysis to model estimation and post-estimation tests.

3.1 Descriptive Statistics

Table 2 shows the summary of descriptive statistics on all variables used throughout this study over the period of 1977 and 2015, implying a total observation of 38 years.

Table 2. Summary of Descriptive Statistics

Variable	No of Observation	Mean	Maximum	Minimum	Standard Deviation
LCO_2	38	11.082	11.572	10.469	0.362
TR_X	38	42.135	93.352	2.879	28.785
TR_M	38	35.152	53.207	9.998	11.268
$LRPCI$	38	12.401	12.862	12.061	0.259
$LEGY$	38	6.566	6.682	6.455	0.057
TOP	38	50.626	81.813	21.124	16.015

Note: LCO2 – carbon emissions (log-levels); TR_X - transport services as % of commercial services export; TR_M - transport services as % of commercial services import; LRPCI - real GDP per capita (log-levels); LEGY - energy use in oil equivalent per capita (log-levels); TOP – trade openness defined as trade % of GDP.
Source: Authors' Computation

The average values of carbon emission (co2) (in log levels), transport services (% of commercial exports), transport services (% of commercial imports), real GDP per capita (in log levels),

energy use (in log levels), and trade openness are 11.08, 42.14%, 35.15%, 12.4, 6.57 and 50.63%, respectively. In terms of the spread of the series around its mean value, the most volatile series is transport services (% of commercial exports), with the highest standard deviation of 28.79% (corroborated by the most significant gap between the maximum and minimum values of the variable among others). In comparison, the least volatile series is the natural log of energy use with the lowest standard deviation of 0.06% (corroborated by the smallest gap between the maximum and minimum values of the variable, among others).

3.2 The Unit Root Test Result

Table 3 presents the result of the augmented Dickey-Fuller (ADF) unit root test for each variable to determine their stationarity status. It can be observed that all the variables become stationary only after first differencing, implying that they have to be differenced once before they become stationary. Hence, all variables are described as being integrated of order one: I (1).

Table 3. Result of ADF Unit Root Test

Variable	Level			First Difference			Remark
	A	B	C	A	B	C	
LCO_2	-1.742	-1.389	0.546	-6.099***	-6.188***	-6.204***	I(1)
TR_X	-1.841	-1.811	-0.823	-6.196***	-6.214***	-6.301***	I(1)
TR_M	-2.068	-2.031	-0.989	-6.146***	-6.214***	-6.300***	I(1)
$LRPCI$	-1.729	-0.122	0.518	-5.586***	-4.837***	-4.842***	I(1)
$LEGY$	-2.957	-1.451	1.593	-5.527***	-5.611***	-5.384***	I(1)
TOP	-0.876	-2.045	-0.719	-8.508***	-8.389***	-8.479***	I(1)

Note: *** indicates the rejection of the null hypothesis of a unit root at 1% level of significance; A, B and C denote models with intercept and trend, with intercept only and with none, respectively
Source: Authors' Computation.

3.3 The ARDL Bounds Cointegration Test Result

Table 4 shows the result of the autoregressive distributed lag (ARDL) bounds test for cointegration to check if there exists a long-run relationship between environmental degradation (measured by carbon emission) and its determinants. Two models are specified based on the measure of transport services used. Model 1 employs transport services (% of commercial exports) while Model II employs transport services (% of commercial imports). Since the associated F-statistics in both cases fall below the lower (I1) critical bound, it can be concluded that no long-run equilibrium relationship exists between environmental degradation (carbon emission) and its determinants in Nigeria irrespective of the measure of transport services used.

Table 4. Result of ARDL Bounds Cointegration Test

	Model I	Model II
F-statistic	0.572	1.599
Critical Values		
Significance levels	I1 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Authors' Computation

3.4 Discussion of Regression Results

The regression results, comprising the ARDL/short-run estimates of the relationship between environmental degradation and its determinants, as well as vital statistics (R2 and F-statistic) and post-estimation tests, are presented in Table 5. Two models are reported depending on which of the

two transport services used: while the Model I captures transport services (% of commercial exports), Model II captures transport services (% of commercial imports).

It can be observed that irrespective of the measures of transport services used, there is a positive association between carbon emission in the current period and its previous levels. The coefficients of autocorrelation (0.682 for Model I and 0.677 for Model II) are statistically significant at a 1% level of significance. This implies that the increasing carbon emission in the current period has precedents in the previous period. Also, in Model I, there is a positive relationship between transport services in commercial exports and carbon emission. The short-run impact coefficient (0.191) implies that every one percentage point increase in transport services leads to a (0.191*100) 19.1% increase in carbon emission on average, keeping other variables constant. The coefficient is also statistically significant at a 10% level of significance. The implication of this result is that increasing transport services with the attendant high fuel consumption contribute more to environmental degradation in terms of emission of poisonous gas (CO_2).

Similarly, in Model II, it can be observed the share of transport services in commercial imports has an overall short-run positive effect on carbon emission. However, carbon emission responds with some considerable lags to growing transport activities. Only the second leg of transport services (% of commercial imports) is statistically significant at the 5% level. In both models, real GDP per capita has positive effects on carbon emission. In Model I, the short-run impact coefficient (0.662) implies that for every 1% increase in real GDP per capita, carbon emission increases on average by 0.662%, whereas in Model II, 1% increase in real GDP per capita results in a 1.637% rise in carbon emission. This result implies that carbon emission is more associated with transport activities in the import sector than in the export sector. Both coefficients are statistically significant at the 10% level. This follows the a priori expectation that increasing economic activities drive up fuel consumption with the attendant higher carbon emission arising from greater industrial activities. The intensity of energy consumption has overall positive effects on carbon emission in both models, as the associated impact coefficients on the energy use variable take opposing signs across periods in both cases. Since the short-run impact coefficients of energy use in the current and previous periods for both models are statistically significant at 1% to 5% level of significance, it can be concluded that carbon emission responds instantaneously though positively to changes in energy use in the current period and with lags though negatively to changes in energy use in the previous period, thereby yielding an overall positive impact over the short-term period. This, therefore, indicates that increasing energy use in terms of fuel consumption for domestic and industrial purposes leads to increasing carbon emission. The short-run impact of energy use is even more significant when transport activity in the import sector is controlled for Model I than in Model II, where transport activity in the export sector is controlled.

Moreover, trade openness in both models, though they are having opposing effects on carbon emissions has no statistically significant impact coefficients at the 10% level. Considering the role of economic growth in carbon emission through the transport services in the export sector (Model I) and transport services in the import sector (Model II), it can be observed that a negative contribution exists in both cases. There is a possibility that the more modernized and technologically advanced a country is (that is, as the scope of economic activities expands), the more it switches to energy-saving means of transportation, with the attendant reduction in the rate of carbon emission. However, the interactive term's impact coefficient involving real GDP per capita and transport activity in the export sector in Model I (that is, -0.015) is statistically significant at the 10% level. However, the interactive term involving real GDP per capita and transport activity in the import sector in Model II (that is, -0.037) is not statistically significant at the 10% level.

The adjusted coefficients of determination show that approximately 80% (in the model) and 78% (in Model II) of the total variation in carbon emission is explained by transport services, real GDP per capita, energy use, and trade openness having accounted for the number of degrees of freedom. The F-statistics in both models (22.903 in Model I and 14.123 in Model II) indicate that the partial slope coefficients on the variables in the two models are jointly significant at a 1% level of significance since

the associated probability values are less than 0.01 (that is, $p < 0.01$). Lastly, the result of post-estimation tests shows the absence of specification error due to nonlinearity of the models, serial correlation in the residuals and non-equal residual variance in both models since the probabilities values associated with each of Ramsey RESET linearity test, Breusch-Godfrey serial correlation test and Breusch-Pagan-Godfrey heteroscedasticity test, respectively, are greater than 0.1 (that is, $p > 0.1$).

Table 5. ARDL/Short-run Estimates of Determinants of Environmental degradation

Dependent variable	LCO_{2t}	
	Model I	Model II
LCO_{2t-1}	0.682***(0.150)	0.677***(0.155)
TR_X_t	0.191*(0.094)	-
TR_M_t	-	0.449(0.267)
TR_M_{t-1}	-	-0.002(0.006)
TR_M_{t-2}	-	-0.008**(0.004)
$LRPCI_t$	0.662*(0.343)	1.637*(0.908)
$LEGY_t$	3.954***(1.083)	3.508**(1.362)
$LEGY_{t-1}$	-2.555***(0.834)	-3.124***(1.040)
TOP_t	0.001(0.002)	-0.005(0.003)
$LRPCI_t * TR\_X_t$	-0.015*(0.007)	-
$LRPCI_t * TR\_M_t$	-	-0.037(0.022)
C	-13.936*(7.578)	-18.319(12.395)
Adjusted R^2	0.806	0.782
F-stat	22.903[0.000]	14.123[0.000]
Ramsey RESET linearity test	0.751[0.459]	1.129[0.270]
Breusch-Godfrey serial correlation LM test	1.467[0.248]	0.072[0.931]
Breusch-Pagan-Godfrey heteroscedasticity test	0.484[0.838]	1.112[0.391]

Note: ***, **, * indicate the statistical significance of coefficients at 1%, 5% and 10%, respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities. Model I captures transport services (% of commercial exports) while Model II captures transport services (% of commercial imports).
Source: Authors' Computation

3.5 The Granger Causality. Short-Run Causality Result

Table 6 presents the Granger causality test result, also called the short-run causality, as the first differences of all variables are utilized since all the variables are only stationary in their first differences.

Table 6. Result of Granger Causality Test

Null Hypothesis	Obs.	F-statistic	Prob.	Remarks
$\Delta LRPCI$ does not Granger-cause ΔLCO_2	32	1.377	0.273	No causality
ΔLCO_2 does not Granger-cause $\Delta LRPCI$		2.376	0.069*	Unidirectional causality
ΔTR_X does not Granger-cause ΔLCO_2	32	0.972	0.471	No causality
ΔLCO_2 does not Granger-cause ΔTR_X		1.078	0.410	No causality
ΔTR_M does not Granger-cause ΔLCO_2	32	0.858	0.553	No causality
ΔLCO_2 does not Granger-cause ΔTR_M		1.228	0.363	No causality
$\Delta LRPCI$ does not Granger-cause ΔTR_X	32	2.317	0.076*	Unidirectional causality
ΔTR_X does not Granger-cause $\Delta LRPCI$		0.319	0.919	No causality
$\Delta LRPCI$ does not Granger-cause ΔTR_M	32	1.115	0.413	No causality
ΔTR_M does not Granger-cause $\Delta LRPCI$		0.587	0.734	No causality

Note: * implies the rejection of the null hypothesis of no causality at 10% level of significance.
Source: Authors' Computation

It can be observed that there is a unidirectional causality running from carbon emission to per capita real GDP (a measure of increasing economic activities or economic growth) at a 10% level of significance since the p-value is less than 0.1. Similarly, real GDP per capita is found to Granger-cause the share of transport services in commercial exports at 10% level of significance since the p-value is less than 0.1. However, there is no causality between carbon emission and none of the transport services measures at a 10% level of significance since the p-value is greater than 0.1.

Summary of Findings and Concluding Remarks

This study investigated the direct and indirect impacts of economic growth and transport services on environmental degradation in Nigeria over the period of 1977 to 2015. The study found a positive relationship between economic growth (measured in terms of real GDP per capita) and environmental degradation (measured in terms of carbon emission). Similar studies in the past that have established similar findings include: Chandran and Tang (2013), Muftau *et al.* (2014), Mesagan (2016), Wang *et al.* (2016), and Xie *et al.* (2017). A positive relationship was also discovered between energy consumption and carbon emission, which parallels the findings of Mohiuddin *et al.* (2016). Similarly, this study established a positive relationship between transport and carbon emission, thereby lending empirical support to the previous findings of Chandran and Tang (2013), Wang *et al.* (2016), Danish and Baloch (2017), Liang *et al.* (2017), Mbarek and Zghidi (2017), Nerves *et al.* (2017), and Saidi and Hammami (2017). However, this study contrasts with the findings of Misra (2017) that a long-run relationship exists between economic growth and carbon emission.

Considering the role of economic growth in carbon emission through the transport services in the export sector and import sector sectors, it can be observed that a negative contribution exists in both cases over the short term. However, the interactive effects of the two variables are only statistically significant in the case of transport services in the export sector only. Similarly, our result differs with the findings of Kulionis (2013) that no causality exists between carbon emission and growth. Specifically, our study established a unidirectional causality running from carbon emission to economic growth through the Granger causality test. Also, there was a unidirectional causality running from real GDP per capita to transport services in the export sector. This result reinforces the fact that the indirect impact of economic growth on carbon emission significantly works through the transport services in the export sector channel.

Based on the key findings established in this study, policy recommendations would include: (1) the formalisation and regulation of activities that contribute significantly to environmental degradation; (2) the implementation of investment and environmentally friendly policy measures; (3) the promotion of the use of more energy-efficient products by households, business firms and the government, and (4) the introduction of reviewable policies that ensure efficient and effective land use. The realization of the Sustainable Development Goals (SDGs) would remain on hold as long as Nigeria fails to prioritize environmental quality on her path to achieving substantial economic progress. While it is non-contestable that a certain level of pollution, in whatever form, be it air pollution through carbon emission and mineral extraction, as well as, oil spillage which entirely causes water pollution, is compatible with some amount of economic progress and prosperity, efforts should be geared towards making compensations, continually, to victims who have had their sources of living and livelihood eroded by oil spillage particularly, in the oil-producing regions of Nigeria The Nigerian government has the herculean task of supporting a manufacturing model that is eco-friendly, considering successful case studies globally. To this end, further studies are encouraged in the specific area of determining the optimal level of environmental pollution that is compatible with high economic growth in Nigeria and globally.

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Data Summary

Year	Carbon Emission (kt)	Transport services (% of exports)	Transport services (% of imports)	Real GDP per capita (₦)	Trade (% of GDP)	Energy use (kg)
1977	50567.93	43.28859	40.11713	306647.6	47.39527	636.2368
1978	48294.39	60.12567	48.65252	280307.2	43.31484	645.8924
1979	70289.06	74.53226	37.79653	290461.2	43.8784	653.1639
1980	68154.86	80.89286	33.70242	294148	48.57131	665.1001
1981	65958.33	59.14336	45.299	248688.1	48.29332	676.3869
1982	65602.63	61.84211	43.7923	239747.2	37.7485	691.7809
1983	59929.78	60.92784	46.49189	221939.8	27.03717	693.5561
1984	69625.33	59.18675	45.51931	212022.2	23.60888	677.7652
1985	69893.02	73.97163	44.7112	223857.4	25.90006	682.8194
1986	73505.02	27.12984	38.93105	199011.9	23.71676	671.499
1987	59343.06	16.91111	41.08826	173011.9	41.64666	676.8561
1988	70747.43	36.30303	53.20724	181230	35.31198	678.8559
1989	42441.86	2.878937	43.68723	187975.1	60.39176	684.4483
1990	39196.56	3.856043	33.63058	206575.1	53.03022	697.1921
1991	42273.18	11.25681	45.19334	200138.6	64.8766	712.2482
1992	46614.9	14.59544	52.97629	196002.2	61.03097	721.9704
1993	45137.1	17.175	31.81481	195153.1	58.10985	715.4378
1994	35199.53	13.63079	25.29636	192079.8	42.30887	680.7101
1995	35841.26	16.40429	22.44111	186781	59.76783	682.2696
1996	39665.94	10.42017	9.998392	191288.7	57.69099	693.7783
1997	42328.18	11.54923	15.85573	191816.4	76.85999	699.6507
1998	37869.11	12.83536	17.3649	192178.7	66.17325	687.1179
1999	40285.66	12.03237	19.84588	188330.6	55.84639	694.1713
2000	76057.25	12.03001	19.84045	193442.4	71.38053	703.2447
2001	85734.46	12.02969	19.84045	196966.4	81.81285	720.0472
2002	93677.18	12.02999	19.84041	199331.7	63.38364	724.6113
2003	101616.2	10.40499	22.45994	214460.7	75.2189	746.6122
2004	104304.1	20.16828	0	279563.7	48.44813	748.3413
2005	106068	93.35171	44.10792	281813.2	50.74836	757.9587
2006	98891.66	88.82308	27.36251	297095.3	64.60931	744.5452
2007	95055.97	75.58768	32.156	309138.7	64.46291	750.7831
2008	96148.74	65.94274	30.60127	319934.3	64.97297	752.8598
2009	76735.64	62.41181	37.07634	333135.4	61.80285	721.4534
2010	91517.32	75.20162	42.80977	349791.6	42.65138	755.9892
2011	95694.03	68.60197	35.9234	357204.1	52.7941	778.4994
2012	98502.95	67.44708	43.44788	362648.1	44.38014	798.3031
2013	98136.25	57.35984	42.54531	372130	31.04886	779.8515
2014	96280.75	51.37027	37.88696	385227.6	30.88519	763.3914
2015	96026.26	67.63224	42.45132	385142	21.12435	775.2069

PRESERVATION, STANDARDIZATION AND INFORMATION TECHNOLOGY 4.0 OF TRADITIONAL GEDOG TUBAN BATIK TO BE COMPETITIVE IN MARKETING DURING COVID - 19

KARSAM
Universitas Dinamika Surabaya, Indonesia
karsam@dinamika.ac.id

Muslichah Erma WIDIANA
Universitas Bhayangkara Surabaya, Indonesia
erma@ubhara.ac.id

Anak Agung Sagung Alit WIDYASTUTY
Universitas PGRI Adi Buana Surabaya, Indonesia
sagungalit@unipasby.ac.id

Kusni HIDAYATI
Universitas Bhayangkara Surabaya, Indonesia
ibundaya@gmail.com

Abstract:

One of traditional batiks of Indonesia is Gedog Batik in Kerek District, Tuban. Gedog batik is made from handmade cloths. It makes the surface of the cloth is rough. The lines of the fabric are coarse clearly visible. Thus, the batik motifs tend to be geometrically patterned following the flow of the fabric. With these conditions, the researchers are worried that Gedog Tuban batik will not be able to compete in market. On this basis, this research was conducted to examine efforts to preserve, standardize, and IT 4.0 traditional batik/Gedog batik Tuban in order to be able to compete in today's marketing (COVID -19 pandemic era). The objective was to find ways to preserve, standardize and TI 4.0 traditional batik/Gedog Tuban batik to be able to compete in current marketing (during the COVID-19 pandemic). To answer problems above, the method used was descriptive qualitative. The results of the research showed that, first, several attempts to preserve Gedog Tuban batik in was loving gedog batik, improving the quality of the fabric, developing other functions by combining the batik with other materials, using technology for melting and drying colors to speed up production. Second, in order to be able to compete, it needed to be standardized. Batik standardization includes 7 aspects. Third, it needed to conduct online promotion and marketing with the right segmentation. This research is expected to be able be useful for readers, researchers, and Gedog batik craftsman.

Keywords: Batik Gedog; COVID-19; marketing; preservation; standardization.

JEL Classification: L15; M37; Z11.

Introduction

This research aims to find out the ways to preserve, standardize and Information Technology 4.0 Gedog Tuban batik in order to be able to compete in marketing during the COVID -19 pandemic. This is motivated by the increasingly left behind traditional works of art/traditional batik in this modern era in terms of quality of work and marketing. The current era well- known as RI 4.0 era, is an era where the use of information technology is increasingly advanced. The arts/crafts that are presented by hand are left behind. This condition is feared that it can eliminate works of art/handicraft that are traditional in nature, conducted from generation to generation by hand manually.

In 2009, UNESCO has recognized that batik is an intangible heritage belonging to Indonesia. Therefore, Indonesia is famous for its batik work. Based on the nature of the workmanship, Indonesian batik is divided into 2 (two) types, namely modern and traditional batik. One of the cities in Indonesia that produces modern batik and traditional batik is the Tuban City. In the book entitled *Kabupaten Tuban dalam Angka* 2000 (BPS, n.d.), Tuban Regency is located on the north coast of East Java, between $111,30^0$ - $112,35^0$ East Longitude and $6,40^0$ - $7,18^0$ South Latitude, about 100 km west of the city of Surabaya. Tuban has prominent cultural products, namely traditional Gedog Written Batik and traditional Gedog Tenun/Weaving.It is called traditional because the manufacturing process starts from making yarn from cotton, weaving, dyeing it until it becomes cloth. It is carried out manually by hand from generation to generation (traditional).

2. Maintext

Karsam (2005) explained that making batik is a work process following certain stages. When viewed from the nature of the batik and based on these stages, batik in Tuban can be categorized into 2 (two), there are traditional and modern batik.

1) Tradisional Batik Craftsmen, including:

a) Batik Craftsmen: people who prepare cloth, wax, melorod, wash and dry until the cloth is ready to use.

b) Trader/seller: buying and selling batik cloth, collecting unfinished batik cloth for diwedel.

c) Wedelist: works to dye the blue of the batik cloth. This work is usually conducted by men.

2) Modern Batik Craftsmen, including:

a) Batik Craftsmen: only preparing cloth and wax.

b) Dye (artisan coloring): dyeing, melting, washing and drying.

Explained in book entitles *Batik and its Kind* (Djumena 1990), Tuban batik is a coastal batik because Tuban is in coastal area. The characteristics of Tuban batik as coastal batik are stated below:

1) *Putihan* batik: it has a white background with dark blue or black motifs. This batik functions as clothing to repel reinforcements or prevent disease from the dangers of Satan.

2) *Bangrod* batik: It is from Javanese words, '**bang**' means brother/red, rod means **dilorod** or cleaned of wax. Bangrod batik has a red base. It serves for women who are not married. This is related to women's blood/menstruation.

3) *Pipitan* Batik: *Pipitan* means side by side. Pipitan batik is has a crushed base. *Remekan* is the background of a dicanting cloth full of hot wax. Before being colored, the wax is crushed or kneaded by hand so that the wax is cracked. The wax that breaks when it is dyed will enter the color. Pipitan batik is for married women. This batik is a symbol of the coexistence between husband and wife.

4) *Irengan* Batik comes from the word *ireng* means black. Irengan batik has a black pattern. This batik functions for the parents and the body cover. Irengan batik is sacred to reject reinforcements for the sake of the safety of the spirits who have died.

5) *Lurik* Batik; Lurik means patterned. Lurik batik is characteristic of Tuban batik. This batik is woven from Kerek District that is known as gedog batik. Lurik batik is a product known as lurik klontongan. *Lurik klontongan* is a striated fabric that uses black and white plaid/stripes motifs.

The process: it is a batik cloth with a dotted motif using wax, then dipped in red noni (morinda citri folia) then the wax is cleaned. Furthermore, the batik cloth becomes striated batik with white dots motif. The striated batik cloth functions as daily clothes for the people of Tuban.

In book entitled *Batik Gedog Tuban* (Bagian Proyek Pembinaan Permuseuman Jawa Timur 1993) explained that Gedog Batik is batik that uses cloth from the gedog weaving, white/brownish white. It is called *gedog* because during the process of weaving the thread into a cloth it sounds *dhog, dhog, dhog*. Karsam (2015) explained that the "batik ghedok/gedog" process is conducted in several stages, including:

A. Raw Material Processing

1) Yarn Making

a. Grinding the Cotton

The process is cleaning the cotton from the seeds. This work is called *blibis*. Then the cotton is milled called *musoni*.

b. *Musoni*

It is called musoni because the tool is called *puson*. This tool is assisted by another tool, named "*jedhul*" or *bethuk*.

After Musoni process, the cotton is rolled up to the size of the hand that is called *a pusuhan*. Furthermore, the cotton is ready to be picked up/weaved/spun.

c. *Mengantih* or Spinning

Mengantih is the process of making threads using a *jantra* tool. The essential parts of the *jantra* are the wheel, rope and grid. The grid is a tool for spinning. This tool is made of wood with a length of 20 cm in the shape of a cylinder. The front is 75 mm in diameter and the tip is pointed. The grid is connected to the enchantment wheel by means of a rope. Thus, when the spell is rotated the grid also rotates.

2) Weaving

Weaving begins with preparing the yarn into two parts. The thread that is perpendicular to the weaver is called *lungsen* and the thread parallel to the weaver is called *pakan*. The weaving process in Tuban is in Kerek Subdistrict in Beji and Margorejo Villages. These two villages produce Kerek weaving called "*Tenun Gedog*".

Karsam (2015) stated that Gedog weaving is conducted starting with preparing Lungsen Yarn and Feed Yarn with the following stages, as follow:

a. *Nyekuli* process

Nyekuli means to give *sekul* or rice (*nyekuli*) to the threads. Thus, the threads become stiff. So that the yarn is easy to weave.

b. Unraveling the Yarn

Preparing yarn for weaving using a tool called *ingan*. This tool is a wooden, rotating rectangular pyramid.

c. *Manen*

Preparing *pakan* and *lungsen* yarns.

3) Weaving Process

In general, the process of weaving Gedog batik is the same as the process of weaving cloth in other countries. The difference is that Gedog batik weaving is processed starting with making *pakan* conducted manually/by hand/not by machine. When the weaving process sounds *dhog dhog dhog*, the resulting cloth is called gedog woven cloth. The weaving process begins with the process of preparing *lungsen* and weft *pakan*. Karsam (2015) explains in full the stages of weaving below:

a. *Nyurup*

It is inserting the lungsen yarn between the spokes of the weaving comb.

b. *Ngelap*

It is arranging the lungsen threads on the part of the loom called gebeg or planks.

Furthermore, the weaving process is conducted like weaving in general, namely weaving lungsen and weft threads. The figure below is a picture of a person weaving and parts of a traditional loom.

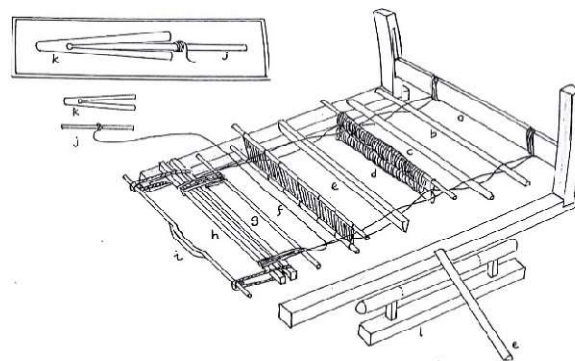Figure 1. A woman is weaving

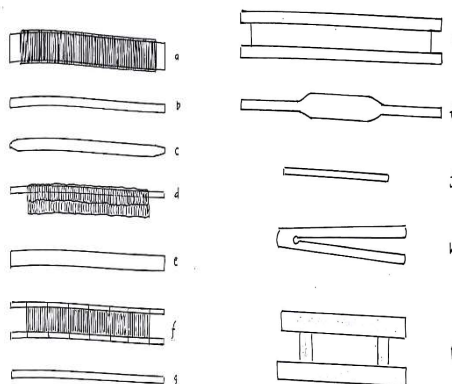Figure 2 The Loom
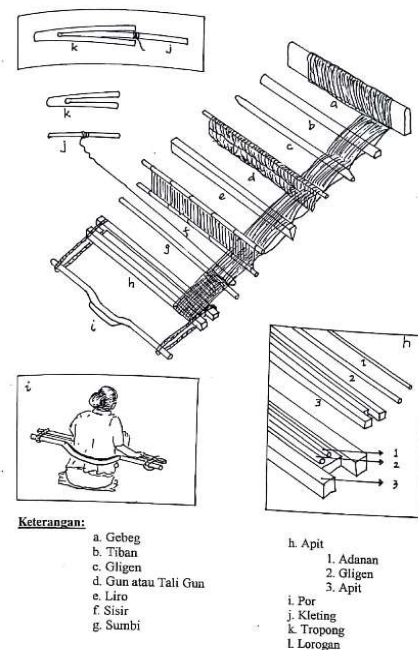

Figure 3. Names of Weaving Parts

Figure 4 Weaving Tools Parts

Keterangan:
a. Gebeg
b. Tiban
c. Gligen
d. Gun atau Tali Gun
e. Liro
f. Sisir
g. Sumbi

h. Apit
1. Adanan
2. Gligen
3. Apit
i. Por
j. Kleting
k. Tropong
l. Lorogan

4) Woven Result

The woven fabrics in Kerek can be categorized into 2 (two) fabrics, as follow:

a) *Gedog* woven fabric

Gedhok woven fabric has a unique pattern. It is because before weaving, the yarn used are already colored. The colors used are various according to the taste of the weaver/order. The yarn that has been colored, is woven based on the desired motif. Thus, after the fabric is finished, the fabric is automatically patterned.

b) *Gedog* batik fabric

Gedog batik cloth is a woven fabric produced in plain white/cream color. The color is white because prior to weaving, the threads used are still genuine/plain and have not been colored. Thus, the weave is a plain white sheet of cloth. This cloth is the basic material for batik. The resulting batik is known as Gedog Batik.

5) Process of Making Batik Gedog

Gedog batik can be divided into two, there are *Gedog Putihan/Irengan* batik and *Gedog Soga Pipit* batik (Karsam 2015). The stages in making batik are generally the same. While the gedog batik process, the stages are:

a) Preparation and *Ngetel*

The yarn to be woven is previously given rice/*sekul*. After it becomes a sheet of cloth, the rice that is stuck to the cloth is still attached. Before making the batik, the rice must be cleaned, so that when the cloth is dyed, the fabric can absorb the color properly. The process of cleaning rice marks on the cloth is called *ngetel* stage.

b) Making Motif

After setting it, the next step is to make the moti. Because the fabric is rough with stripes, the traditional gedog batik motifs tend to use geometric motifs.

c) *Ngengreng*

Ngengreng is press the hot wax on the fabric following the pattern/motif design. Pressing this candle usually begins with a large motif, that is commonly referred to as *mbaboni*. *Mbaboni* comes from the word "*babon*" that means the main hen/mother/base. *Mbaboni* means to make the main motive. The batik makers in Kerek do not go through the *mbaboni* stage, they go straight to the ngengreng stage. The *ngengreng/nglengreng* stage is the process of giving hot wax.

d) *Nerusi*

While *ngereng*, if the wax does not penetrate the back of the cloth, then the cloth has to be (*canting*) repeated from behind. This process is called *nerusi*. *Nerusi* stage often occurs because the Gedog batik cloth is used more coarsely so that the wax often does not penetrate the fabric.

e) *Isen-isen*

There is *ngengreng* process that has been explained above. This process usually produces motifs that tend to be large. Then the large motifs are filled with small motifs inside using hot wax. This process is called making *isen-isen*. In the Gedog Soga pipit batik, after *nerusi*, it is continued directly to *nembok*. After the *nembok*, the wax is *dicoblosi*. This technique is what became known as batik with the *cocohan* technique (Bramantijo et al. 2018) After *dicoblosi*, it is fiveb *isen-isen*. The blue dots on the background of Gedog batik in Figure 5 below are the result of the batik technique of *Cocohan*.

f) *Nembok*

Nembok is a continuation process of *ngengreng* and *nerusi* and coloring. *Nembok* is covered with hot wax on the motif to produce the second, third and so on. The walled/*nembok* motif will not get another color, when the fabric is dyed the second color.

g) *Nyoblosi*

It has explained about *nyoblosi/nyocohi*. *Nyoblosi* is making holes/small dots with a needle. When dyed indigo blue (wedel), the hole will be exposed to color. *Nyoblosi* is the opposite of *nyeceki*. *Nyeceki* gushes with hot wax, like dots so that it doesn't get stained. gedhok putihan/ irengan batik process is carried out after covering, while gedhok soga pipit batik stage is carried out after dyeing.

h) *Nyelup*

Nyelup means putting the cloth in color. Gedhok putihan/irengan batik uses blue/*gadung* (wedel) as the first color. Gedhok Soga Pipit Batik uses red as the first color.

i) *Nggadungi*

Nggadungi or *gadung* means blue. *Nggadungi* is also called *mbironi* or make blue colors. After dyed blue, Gedog putihan/irengan batik is dyed again to brown (soga) for the second color. The desired motif will be blue, so the motif must be covered/walled first. Therefore, after the process is complete, the resulting batik color is white, blue, dark blue/blackish blue (soga brown mixed with wedel blue). This batik is called batik gedog putihan/irengan.

While the gedog soga pipit batik, after dyeing it red, continued to *nyoblosi*, giving *isen-isen*, dyed blue (wedel), then *nyoga*. The resulting batik cloth is white, red, and dark blue/blackish blue.

j) *Nyoga*

Nyoga is dyeing cloth with brown/soga color. *Nyoga* is conducted to get a dark blue/blackish blue color.

k) Locking the Color (Fixation)

Fixation is to lock the color so that the color of the batik when washed does not fade. Traditional batik fixation in ancient times used *endut* (wet soil) by soaking for 24 hours. Now we can use alum, limestone and arbor.

l) *Nyaren/nyarena*

After fixing the fabric, it is washed, then dried, then it continues to be filtered. *Saren/nyaren* is the process of repeating colors so that the color is more mature/stronger. This re-dyeing can be carried out between 5-7 times.

m) *Nglorod*, Waching and Drying

The final process is *nglorod* batik, washing and drying. *Nglorod* is cleaning the wax attached to the batik fabric. After the cloth is washed clean, the batik process is complete. Figures 6 and 7 are examples of *tulis* gedog batik.

Table 1. Process of Making Batik Gedog

No	Process of Making Batik Gedog	A description
1.	A *ngengreng* process	Figure 5. Gedog Bati Using *cocohan/coblosan* Technique
2.	A *nglorod* process	Figure 6 *Ganggeng* Figure 7 Ganggel Liris Motif

6) Gedog Batik Staining Process

Karsam (2014) described that the process of coloring Gedog batik can be divided into two:

a) Natural Dyes

Natural dyes use soga (brown) and indigo/wedel (blue). Soga is made from bark and indigo is made from tom leaves..

b) Chemical Dyes

Chemical coloring is conducted in the same way as the traditional batik coloring process in other places. The colors used were Naptol and Naptol Salt. Figure 8-10 shows the Gedog Putihan/Irengan batik.

Table 2. Gedog Batik Staining Process

No	Gedog Batik Staining Process	A description
1	Chemical Dyes	Figure 8 Figure 9 Figure 10 Figure 8. Lokchan Motif Figure 9. Panjiori Coblosan Motif Figure 10. Lokchan Babar Motif

Based on the explanation above and seeing examples of gedog batik such as pictures 1 to 6, it is necessary to preserve gedog batik and meet the standardization as Indonesian batik. Thus, gedog batik can compete in the market.

Standardization is an effort to determine the rules/measures that must be followed in creating/ producing something (Fahrudin 2018). Standardization can also be interpreted as a standard-making process. The word standard comes from the word standard (standardization). In Indonesian, it is translated into standardization (Badan Standardisasi Nasional 2014).

As a form of empowerment in the marketing process, batik standardization can be categorized as Business Model Standardization. Standardization of the Business Model based on the Indonesian Academy Franchise (2020) can be categorized into two (2) parts, there are Standardization of Process and Standardization of Forms.

Standardization of process is divided into three (3) processes, as follow:

1) The marketing process, it consists of branding, promotion and sales.

2) Operational processes, it consists of service, transactions, production, customer acceptance, and maintaining customer relationships.

3) The process of financial management and administration consists of secretarial, HRD, and general affairs.

Meanwhile, the standardization form can be:
1) Legality and licensing
2) Design
3) Operational equipment
4) Equipment or attributes of the building/shop
5) Size of the building
6) Location criteria
7) Other things that are necessary before the business starts

Nowadays, what is known as the Industrial Revolution 4.0 is when information technology, and art are very developed, so, managing standardization of batik will not experience problems. Kemala (2018) explained that the notion of information technology (IT) according to Haag and Keen is that IT is a set of tools that can help humans work by using information to do their work related to information processing. Whereas in the Oxford English Dictonary dictionary, IT is hardware and software, that includes networking and telecommunications usually in a business context (Kemala 2018). The functions of TI are:

1) Capturing

Capturing means input for example, receiving input from a scanner, mic, keyboard, and others.

2) Processing

Processing input data to become information, can be in the form of analyzing, converting, and calculating (calculation).

3) Generating

It generates information in the form of a report that can be understood by others. Examples include tables, charts, reports, and pictures.

4) Storage

Recording data and information into a medium can be used for many purposes such as saving to flash disk, hard disk, tape, and others.

5) Retrival

It is browsing to retrieve information/copy stored data.

6) Transmission

Sending data or information through computer networks from location/place to another location.

One of the greatest inventions in the era of RI 4.0 is the internet and the development of smartphones. The internet makes IT grow. Based on the 6 IT functions mentioned above, by using IT

and the internet, marketing can be run quickly. The enlargement model using IT today is better known as Online Marketing/Sales. The development of science and technology does not all have a positive impact. Sometimes, it has a negative one. One of the negative impacts is the presence of a virus known as covid-19.

In https://covid19.go.id/ (Satuan Kerja Penanganan COVID - 19, 2020) it was explained that WHO (World Health Organization) on March 9, 2020 officially declared or declared a pandemic of the corona virus (COVID-19). The corona virus has spread throughout the world. The term pandemic refers to the widespread spread of the virus. The corona virus can cause symptoms such as fever, shortness of breath and cough. However, it can recover in a few weeks. However, it is at high risk for the elderly who have congenital diseases such as high blood pressure and heart disease.

With the COVID-19 pandemic around the world, it has caused restrictions on society in carrying out activities. All countries carry out PSBB (Large-Scale Social Restrictions). This social restriction has a negative impact on the economy of all countries. Sri Mulyani (Indonesian Minister of Finance) on the web https://www.cnbcindonesia.com/ (Mulyani 2020) stated that since the beginning of March 2020, the pandemic had a bad impact on the economy. In the second quarter of 2020, the economy immediately contracted to minus 5.32%.

Hawangga Dhiyaul Fadly and Sutama Sutama (2020) argued that the impact of the COVID-19 pandemic is the downturn in the world of economy and business. Therefore, marketers/entrepreneurs are obliged to find solutions in order to market their products/services to consumers. Businesspeople conduct digital branding and online marketing as a medium of communication for their target consumers.

Maskarto Lucky Nara Rosmadi (2021) revealed that business strategies that can be applied by MSME players, such as Micro, Small, and Medium Enterprises during the COVID-19 pandemic is through social media.

This research includes two fields, there are marketing and the field of art. (Rohidi and Rohendi 2011) explained that art data are generally in visual, auditory, and kinetic forms. However, it can be data that combines visual and auditory data or all three. The data are intra-aesthetic data that can be presented as facts accompanied by descriptive explanations. Meanwhile, data related to marketing can be presented in qualitative and quantitative forms.

The method used was direct exploration/practice and descriptive qualitative methods. The report was described in descriptive form. Data obtained were through observation, direct practice. Researchers acted as subjects and objects of research. Researchers were batik marketing actors and batik craftsmen. In addition, a literature review/internet source was also conducted, and in-depth observations were made. To find out the problems in sales, a direct practice method was carried out, such as product sales, development of motifs, development of fabric functions

3. Case Studies

In the era of the industrial revolution 4.0, this can be considered to be a modern era with the use of sophisticated technology tools. This condition harms the position of traditional products/services. This research would provide efforts to preserve, standardize, and TI 4.0 traditional batik/ gedog Tuban batik in order to be able to compete in marketing at this time (during the COVID-19 pandemic). The following will describe the results of research on efforts to preserve, standardize, and IT 4.0 traditional Gedog Tuban batik in order to be able to compete in marketing during the COVID-19.

A. Preservation of Batik Gedog

In 2015, researchers/writers haD conducted research with the title *Batik Tulis Gedog Tuban: Pelestarian dan Ekspansi Pasar Untuk Menghadapi Masyarakat Ekonomi Asean* (Karsam 2015). From this research, it is explained that efforts in the preservation of Gedog Tuban batik are:

1) Loving and willing to wear batik made in Indonesia.

2) Supporting government efforts to wear batik on Fridays. Thus, Tuban can also conduct this by using gedog batik.

3) Increasing the use of batik materials/improving the quality.
4) Making motifs according to the global market
5) Holding promotion or exhibition

Besides those described above, one of the efforts to preserve the Gedog Tuban batik is to develop the benefits or functions of the Tuban gedog batik. Researchers know that in the field, in Kerek District, many woven fabrics for gedog batik fabric were not used properly by batik craftsmen. Based on this condition, the researchers tried to use the cfabric for other objects.

In 2017, researchers conducted Community Service with the title *Tote Bag Berbahan Tenun Gedog Sebagai Produk Penunjang Bagi UKM Tenun dan batik Gedog Tuban* (Bramantijo, Karsam, and Totok 2017). The results of this dedication was extraordinary, the community is actively making Tote Bags not only using Gedog batik but also using Gedog woven cloth which is still plain. The result was able to increase the economic value of the Kerek community.

Other efforts that can be made to preserve or develop Tuban Gedog batik are *Pemberdayaan Ukm Batik Melalui Pengembangan Desain Motif Berbasis Kearifan Lokal* (Empowerment of SMEs Batik through the Development of Motif Designs Based on Local Wisdom).

In 2017 researchers have carried out Community Service with the title Empowerment of Batik SMEs Through the Development of Motive Designs Based on Local Wisdom: Efforts to Build a Jombang Batik Brand Image (Wibowo *et al.* 2019). From the results of this Community Service, this can be done by training and empowering batik craftsmen who join SME. Researchers provided training to develop local wisdom-based motifs. In addition, it was developed to use a batik pelorod machine. In which this *pelorod* machine did not reduce the values of traditional batik art. Community service was then developed towards accelerating production. During the rainy season, the batik craftsmen couldn't produce because there is no heat from sun. To overcome this case, the researchers made one effort. It was the creation of a batik oven room (Wibowo *et al.* 2020). After the creation of the oven room with a size of 3m x 3m, it was able to produce batik cloth quickly. How much is the number of increments depends on how much space the oven is made and the amount of labor of the batik craftsmen.

After the Gedog batik fabric could be preserved and in order to be able to compete with other batik, the Gedog batik cloth must meet the standards as batik made in Indonesia, such as batikmark made in Indonesia.

B. Batik Standardization

In 2019-2020, researchers had conducted research entitled *Batik Standadization as Batik Artisan Empowerment Model For Marketing Process* (Widiana, Karsam and Hidayati 2020), In this research, we have found a strategies to standardize batik. The strategies are:

1) Organization/Association/Group Formation
In quality assurance, we need a quality assurance agency/organization of a product/service.

To find out the quality of a batik product that meets the standardization of batik as "Indonesian batik, it must be tested in a lab." In Indonesia, batik quality assurance organization is managed by the Yogyakarta Batik and Craft Center (BBKBY).

2) Preparation of Standard Operating Procedures (SOP)
After quality assurance is carried out through a quality assurance organization, it is necessary to have a Standard Operating Procedure (SOP) that functions for the management and preservation of batik.

3) Licensing or Legality (Trademark and SIUP)
Directorate General of Intellectual Property, Ministry of Law (HKI) and Human Rights of the Republic of Indonesia (Direktorat Jenderal Kekayaan Intelektual Kementerian Hukum dan HAM Republik Indonesia 2020) explains that a Mark/Trademark is a sign/symbol embodied in the form of words, graphics in the form of names, logos, images, letters, numbers, color arrangements, in 2 (two) dimensional and/or 3 (three) dimensional forms can be in the form of sound, holograms. A

person/business entity conducting trade is required to have a business identity. This business identity is in the form of a trademark. With the existence of this Trademark or identity, business entity that has a trading business is expected to be able to safeguard the IPR of another person/ business entity.

4) Quality assurance

Customer satisfaction is the most important factor in creating customer relation that affects the success of the company (Jurnal manejemen 2019). The quality of products and services can affect customer satisfaction. Therefore, to be able to compete with other batik, the quality assurance of Gedog Batik must always be conducted. Quality assurance includes quality assurance of designs, services, infrastructure, and others. Quality assurance in this research is the quality assurance of batik cloth products. The quality assurance of batik cloth products can be presented by obtaining a batik label, namely "batikmark". In 2021, there are 3 types of Indonesian batik products that meet SNI as the Indonesian Batik Standard, such as written batik, printed batik and combination batik. This Indonesian batik standard label is known as the Batikmark. It is a sign that shows the identity/characteristics of batik made in Indonesia. The following figures of the batikmark label (Karsam 2019).

Figure 11. *Tulis/Handmade* Batik batikmark label

Source: Karsam 2019

Figure 12. Batik cap batikmark label

Source: Karsam 2019

Figure 13. Combined batik batikmark label

Source: Karsam 2019

5) Identification/labeling

After getting the Batikmark label, the label must be attached to the batik cloth to be sold.

The purposes of labeling batik products (Nugroho 2017) are:

a) Consumers know/recognize that the product is Indonesian batik.

b) Consumers are not wrong in choosing batik products

c) Giving a guarantee of customer satisfaction

d) Able to protect Indonesian products from IPR

e) Giving confidence and comfort to consumers on the quality/image of Indonesian batik in the international level.

6) Socialization and promotion

There is a socialization about Batikmark to the Indonesian people. In accordance with the current era of 4.0, the socialization of batik marks is very easy to do. This socialization can be via the internet, whatsapp, web, youtube, TV, Instagram, Facebook, government regulations, and others.

The purpose of the socialization is to make Indonesian people know about batik "Indonesian batik". In addition to the business socialization that must be done is promotion.

7) **Supervision of government, employers/private organizations**

Government Regulation in lieu of Law Number 8 Year 1962 concerning Trade in Goods Under Supervision (Peraturan Pemerintah Pengganti Undang-Undang Nomor 8 Tahun 1962, n.d.). Article 5 paragraph (1) With/based on a Government Regulation it is stipulated that supervision can be controlled and undertaken by:

a) Ruler;
b) Joint rulers with entrepreneurs/private organizations;
c) Entrepreneurs/private organizations.

For those who violate the Trade Law, their SIUP or business license certificate will be revoked and will be sanctioned. This is conducted with the aim of the marketing/trading process in Indonesia running smoothly. It has been explained above that various efforts to bring gedog Tuban batik to be competitive, is to preserve and standardize. Thus, the next step is to do promotion and marketing.

C. Online Promotion and Marketing

One of the efforts that can be made in increasing the marketing of batik cloth to be able to compete is through online promotion and marketing.

In 2017, researchers conducted research with the title The *Image Product of The Locality and Product Branding Towards Tuban Gedog Handmade Batik Trough Packaging* (Bramantijo, Hidayat, and Karsam 2017). In this research, it was explained that in order for batik to be sustainable and able to compete in market, it is necessary to have promotion and good batik packaging. Under no circumstances must promotion be carried out in marketing, especially in the Covid-19 pandemic. Promotion must be presented in a digital way (Fadly,Hawangga Dhiyaul Sutama 2020). Online promotion and marketing can be done using applications such as the web, facebook, instagram, whatsapp, and line.

At present, the international world is facing the same thing called the covid-19 pandemic. Pandemic limits the movement or activities of all humans in this world. Even though human biology needs to live (eat). The need for food is related to economic needs, so the economy must continue to run during this Covid-19 pandemic.

Denny Santoso as Founder and CEO Tribelio.com in liputan6.com (Santoso 2020) stated that in pandemic conditions, businesses are more encouraged to optimize their online/digital sales. For online businesses, the right marketing strategy is needed in order to attract customers. In the marketing strategy, entrepreneur must pay attention to Segmentation, Targeting, and Positioning (STP).

Gedog Tuban Batik is a traditional batik with certain characteristics and characteristics. Batik Gedog Tuban has a clear Unique Selling Preposition (USP). Not everyone likes batik with this condition, so marketers/craftsmen must market intelligently. The segmentation or the target market/ consumer must be right on target.

Conclusion

The results of the research can be concluded that in order to examine the efforts to preserve, standardize, and IT 4.0 traditional batik/ gedog Tuban batik to compete in marketing (the COVID-19 pandemic era), it needs some efforts as follow

1. To preserve gedog Tuban batik, it can be run in a way:
a. Loving the gedog batik
b. Improving the quality of the fabric
c. Developing other functions by combining with other materials
d. Using technology such as machines for melting and color drying to speed up production
2. Standardizing the Gedog Tuban batik fabric consists of 7 aspects:
a. Organization/Association/Group Formation

    b. Preparation of Standard Operating Procedures (SOP)

    c. Licensing or Legality (Trademark and SIUP)

    d. Quality assurance

    e. Identification/labeling

    f. Socialization and promotion

    g. Supervision of government, employers / private organizations

    3. During the COVID-19 pandemic, marketing must be presented using digital promotion and online marketing with the right STP.

Acknowledgement

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UNIVERSITY-BUSINESS COOPERATION AS A KEY FACTOR IN INNOVATIVE ECONOMIC DEVELOPMENT IN KAZAKHSTAN

Baurzhan ISSABEKOV
L.N. Gumilyov Eurasian National University, Kazakhstan
baurjani@mail.ru

Aigerim BAYANBAYEVA
University of Bristol, United Kingdom
di18366@bristol.ac.uk

Bakhyt ALTYNBASSOV
University of Bristol, United Kingdom
gr19948@bristol.ac.uk

Yerbolat BARLYKOV
Turan-Astana University, Kazakhstan
erbolat_barlykov@mail.ru

Abstract:

The aim of this article is to study the role of university-business cooperation in innovative economic development in Kazakhstan. It was considered some issues related to the creation of research universities, the development of innovative activities and university-business cooperation. The study revealed that the creation of the partnership between universities and technology parks is beneficial from an economic perspective. This interaction provides high-quality training for experts focused on innovation in priority areas of science, engineering, and technology development. Moreover, these integration structures are expected to have a significant impact on the socio-economic development of the region, specialized industries, and the higher education system. It was suggested a set of interacting organizational and economic components aimed at creating incentives and interests for investing in small innovative enterprises at research universities. The principal research method used in this study was a documentary analysis method. The state programmes and regulations of the Republic of Kazakhstan in the field of science, education and innovation were examined. International articles and monographs were reviewed, which were conducted based on the empirical research methods and statistical data. The results of empirical studies conducted by national scholars over the last few years were used as secondary data.

Keywords: university; business; cooperation; innovation; high-tech parks; Kazakhstan.

JEL Classification: I23; I28; K15; L30; L33; R11.

Introduction

In Kazakhstan's strategic and other key documents education is set as a top priority for national development. To date, the key task of education reforms in Kazakhstan is the adaptation of the

education system to the new socio-economic conditions (Smagulov *et al.* 2017). The important step was the adoption of the State Programme for the Development of Education of the Republic of Kazakhstan for 2020-2025, that focused on the development of human capital and the provision of opportunities for higher quality education (State Programme, 2019). In this regard, government aims to create research universities that can provide the national economy with qualified employees and facilitate implementation of innovative ideas in real economic sectors. The experience of world-class universities has clearly shown that modern research universities can establish mutually beneficial cooperation with businesses and industrial companies. Small and large high-tech companies, technology parks and business centres are set up in research universities. Cooperation between universities and businesses promotes innovation and the knowledge society by transferring knowledge and technology (Orazbayeva and Plewa 2020). The purpose of this article is to study the role of university-business cooperation in innovative economic development in Kazakhstan. In particular, some issues related to the creation of research universities, the development of innovative activities and university-business cooperation will be addressed below. This topic has relevance for discussions among researchers, that will be considered in the literature review chapter.

1. Literature Review

Innovation and higher education are now widely recognized as key drivers of economic development and competitiveness for national economies (Lo and Tang 2020; Thomas and Paul 2019). Studies from different parts of the world indicate the growing importance of university-business collaboration. For instance, Wedekind and Mutereko (2016) have examined the longstanding partnership between the pulp and paper industry and the technology university in South Africa and stated that the benefits of this partnership expressed in targeted training of skilled workers and high employment rates for graduates. Hou *et al.* (2021) have analysed the efficiency of university-industry collaboration of 71 Chinese leading universities and found that the efficiency of such collaboration varies depending on university's characteristics, governmental funding of the research and regional economic status. An international review of seven case study countries (Canada, France, Israel, Japan, Singapore, South Korea, and the United Kingdom) by Dollinger et al. (2018) shows the differences between university-industry collaboration in different contexts. The authors have conducted national-level international comparison through three dimensions – environmental, technical, and managerial, and stressed the importance of transparent intellectual property rights and policies and multi-disciplinary programs in advancing university-industry collaboration.

Siegel (2010, 57) explores university motivations for participation in a network that includes business organizations and highlighted that "the restructuring of higher education organizations to better address contemporary challenges and opportunities may involve a "radical" reconfiguration in the form of interorganizational relationships that effectively create a new interstitial form". The most effective form of integration of science, education and production in developed countries is science and technology parks (Malairaja and Zawdie 2008; Poonjan and Tanner 2020). On the other hand, universities and industry often face problems and impediments in engaging with each other (Azman *et al.* 2019; Dollinger *et al.* 2018). The findings of the study by Azman *et al.* (2019) have revealed that in Malaysia university-industry collaboration experiences six primary barriers, including organisational cultural differences, differing priorities and perspectives, lack of clearly defined organisational policies and strategies, lack of reputation and expertise, lack of trust and issues of intellectual property rights. Nevertheless, Muscio and Vallanti (2014, 426) analyzed obstacles in university-industry collaboration in Italy and pointed out that "the effect of perceived obstacles on the intensity of collaboration is less clear-cut. This apparently surprising result can be interpreted as evidence that even if academic researchers recognize that there are barriers to collaborating with firms, these obstacles do not matter once the department has accumulated collaboration experience with industry".

To sum up, the literature reviewed provides evidence that partnerships between universities and industrial enterprises have overall positive impact on all players (Thune 2011; Wedekind and Mutereko

2016). Studies have indicated that companies with university links tend to perform better than comparable companies without such links while universities that established partnerships with industry have better scientific performance (Garcia *et al.* 2020; Malairaja and Zawdie 2008).

2. Methodology

The principal research method used in this study was a documentary analysis method. The state programmes and regulations of the Republic of Kazakhstan in the field of science, education and innovation were examined. Furthermore, international articles and monographs were reviewed, which were conducted based on the empirical research methods and statistical data. The results of empirical studies conducted by national scholars over the last few years were used as secondary data. The materials gathered were analysed using the content analysis method. Content analysis results have been reflected in charts to improve visibility. International experience in the development of research universities has been studied using a comparative historical research method.

3. Findings and Discussion

Research universities

It is worth noting that in Kazakhstan's universities, research has never been their competitive advantage. Since the existence of the USSR, universities have primarily been a place of study, but not for conducting scientific research (Sarinzhipov 2013). The latter function has been assigned to the state academies system. A characteristic feature of university research was its indirect connection with the educational process. In the 1990s, the number of universities increased, but the number of staff engaged in research and development, especially in the scientific departments of universities, was declining. During the first years of the independence of Kazakhstan in 1990s, science remained poorly integrated into the new economy and its tasks did not always coincide with the needs of the development of society (Amandykova *et al.* 2016). Moreover, science was artificially distanced from the higher education system, which fundamentally contradicted the modern experience of developed countries. Therefore, it was necessary to improve the research potential of universities and to strengthen collaboration with external stakeholders, that is, to establish national research universities.

Research universities have characteristics that are easily formalized by a number of parameters and that other universities may focus on. In addition, they are characterized by informal features (prestige, the presence of leaders, a management system that stimulates constant development) (Mammadov and Aypay 2020). In this regard, the formation of a research university is a lengthy process that results from the interplay of several factors. It should also be borne in mind that most foreign research universities have land and real estate at their disposal, so they are largely financially independent (Piqué *et al.* 2020). Other authors suggest that in order to create modern research universities, they need a large piece of land that they own and that facilitates the cooperation with high-tech companies (Altynbassov *et al.* 2021). For example, the Stanford University campus was built on a city site of 8,180 acres (33.1 square kilometres or 3,310 acres) on a farm in Palo Alto. For comparison: the largest campus of the University of Kazgugrad in Kazakhstan is located on 90 hectares, which is 36 times smaller than the area of Stanford University. Stanford University is located in the U.S., approximately 60 km southeast of San Francisco. Although more than one hundred and thirty years have passed since the opening of Stanford University, the area of land owned by the university has not decreased by more than one meter and remained the same - 8 180 acres. It is known that Silicon Valley was established on the ground at Stanford University, where Stanford Industrial Park is located with world-class offices. Eastman Kodak, General Electric, Hewlett-Packard and other large companies are located on campus, among others. The property is owned by the Stanford University campus and is leased by local shopping malls, high schools, and other organizations. That is, the entire proceeds of the land lease will go to the endowment fund of the university. Today, Stanford University has endowment fund with $28.9 billion, with $6.6 billion in annual expenditures (Stanford University Endowment fund, 2021). The total number of students at the

university is 18 thousand, with a teaching staff of about 2.3 thousand. This figure means that the university has a very high financial capacity.

The policy of assigning universities the category of "national research university" implemented in Russia is based on the concept of strengthening existing universities through temporary additional budget injections, rather than the permanent cultivation of research universities (Arutyunov 2018). Of course, such an approach has the right to exist. However, in order to achieve the parameters specific to the world's research universities, in addition to funding, it would be necessary to create conditions which regulate the work of universities. This includes opportunities for attracting foreign teachers and students, campus construction, etc. On the other hand, we think there is another approach that might be more effective. With this approach, the state provides favorable conditions for the work of any universities, including for the development of research while universities on a competitive basis will apply for budget funding for research projects. In other words, universities will receive extra funding, according to their potential. As a result, an "elite" group will gradually form from the general mass of universities, which will be a natural result of development in conditions of competition and equal opportunities.

In the context of Kazakhstan, research universities will develop according to special target programs approved by the government and will also support high-level research activities and use its results in practice. A university of such model - Nazarbayev University - becomes not only a university with training at the level of world standards, but also an international research center (Tengelbay *et al.* 2021). Such a university is focused on the synthesis of three important components: education, science, and innovation. In this regard, the government is carrying out a large-scale reform of public universities, changing their organizational and legal status. According to the State Programme on Education for 2016-2019 was launched which argues for the creation of non-profit joint-stock companies with 100% state participation based on state and national universities (State Programme 2016). Therefore, relevant amendments were introduced to the Civil Code and Law on Non-profit organizations to state that "joint-stock companies may be established in the form of non-profit organizations". Currently, the 25 public universities have been converted into joint stock companies with a corporate governance system that allows them to operate as businesses and attract external funding (Altynbassov *et al.* 2020). There is an expectation that public universities will be more flexible in implementing and commercializing their innovative ideas.

### *University-business cooperation*

The efficiency of the national innovation system, which ensures a greater competitiveness of the economy, is directly related to the creation of favorable conditions for the development of high-tech small and medium-sized enterprises, increasing the scientific and engineering potential of the country. At the same time, within the context of globalization of the world economy, Kazakhstan faces a number of challenges, one of which is the lack of an efficient link between science and production and the lack of funding for research. It is obvious that the path towards innovation and technological modernization of the Kazakhstan's economy requires both the training of staff with new skills and the formation of a powerful source of innovative ideas and technologies in the higher education system. This means that to strengthen the competitiveness of the economy, it is necessary to accelerate the processes of integration of science, education, and production, to involve the results of intellectual activity into economic turnover.

According to the Law "On Science" (2011), in the future, science, innovation and educational activities will become the main activities of universities. To date, the scientific community has come to understand the need to combine the efforts of higher education, science, and entrepreneurship. The state considers higher education as the most important tool for the implementation of regional economic strategies and a supplier of new ideas and knowledge for the development of the economy (Iskakova *et al.* 2021). Without a strategic partnership with the business environment, these objectives are not achievable. According to Orazbayeva and Plewa (2020, 1), university-business cooperation

"encompasses a wide range of collaborative activities related to research and teaching, valorisation and governance, while the term 'business' solely used for simplicity, with the sense that it can embrace a variety of organisations and institutions that might benefit from engaging with universities and that are not themselves research organisations, including for-profit and non-profit firms, governments, and associations, to name a few". When developing relationships with business environment, the university should take the position of an equal and strong partner with significant resources. It seems that the partnership should be considered much broader than the relationship in the "client-supplier" system, in which the university is a supplier, and the company is a consumer of qualified personnel (van der Walt *et al.* 2011). The most reasonable interaction scenario should be based on the formula "university plus enterprise equals new enterprise". For the university, this approach offers the opportunity to develop new popular products and services. If we compare the general tone of the positions of the business community and the university, we can observe a relatively high degree of business passivity. The position of modern enterprises is more consumer-oriented, expecting certain advantages of the university and being reluctant to invest their efforts in the overall result.

Perhaps it is because of the lack of interest on the part of companies in establishing partnerships with the university in general. After all, the managers of national companies do not see the specific direct and "fast" benefits of this partnership, which they will be able to receive in the foreseeable future. Managers and business owners, recognizing the need to focus their interests on quick benefits, account for this lack of predictability in the economy.

Figure 1. Activities of the university to develop partnership with enterprises
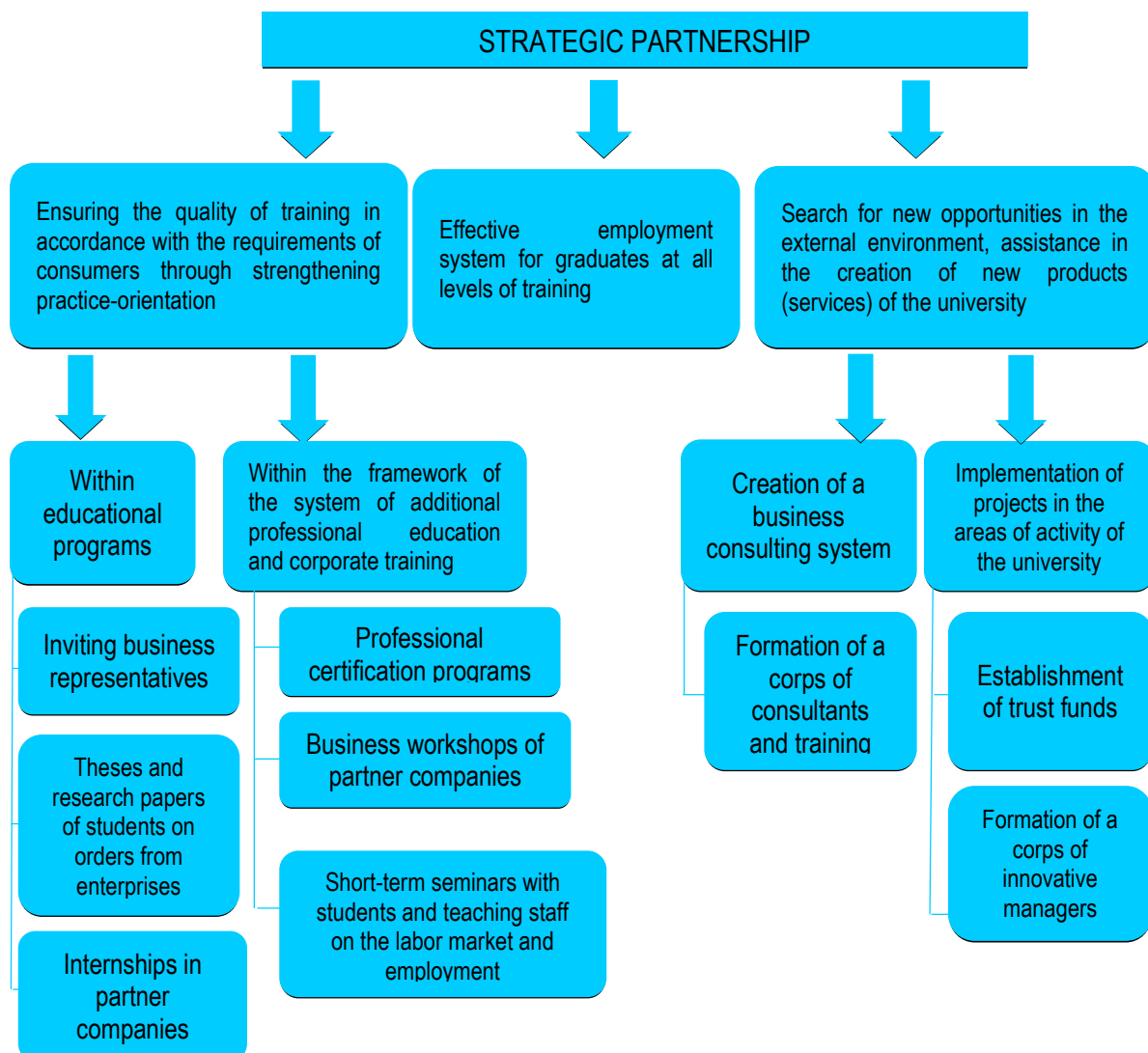
Unfortunately, we have to state the fact that today in the triad "university-science-business" potential partners do not have a conscious common goal that would be attractive to each of the parties. It is logical to assume that this situation is due to the current situation in the economy, as well as the peculiarities of the regional business environment, among which the following seem significant:

1) poorly expressed innovative nature of the national economy, insufficiently developed production sector;

2) the absence, in most cases, of long-term business strategies, especially with regard to business development in the region;

3) a small proportion of large companies that may act as serious business clients for the university and have the prospect of establishing long-term stable relationships;

4) the absence in some regions of the largest "city-forming" enterprises and industries, the dynamics of development and the nature of production would allow them to act as major customers of targeted training and research;

5) the presence of certain nuances of the consumer position on the part of universities, which prefer to regard the business environment not as partners, but as sponsors.

The proposed structure of the university's activities to develop partnership with the business environment is presented in Figure 1. When selecting the forms of cooperation of a particular university, the primary focus must be on sectoral and regional needs. The problem of the orientation of educational programs to the formation of applied skills can be solved primarily through the mechanism of participation of enterprise specialists in the educational process, the organization of internships for students in partner companies, as well as the implementation of project and research work by students on the orders of enterprises.

The purpose of inviting representatives of the business (practitioners, entrepreneurs) is their participation in the educational process and correction of classes from a purely theoretical direction to a theoretical and applied approach. On the one hand, it widens the university's links in the external environment, and on the other hand, it raises the prestige of the educational institution, has a positive effect on the employment of its graduates and on attracting students. At the same time, such an approach promotes the cooperation of the teaching staff with practitioners. At the same time, participants in the innovation system can include: higher educational institution; specialized public authorities; innovative companies - partners; elements of supporting innovation infrastructure (business incubators, technology parks, etc.); financial structures, including business angels, seed, venture funds.
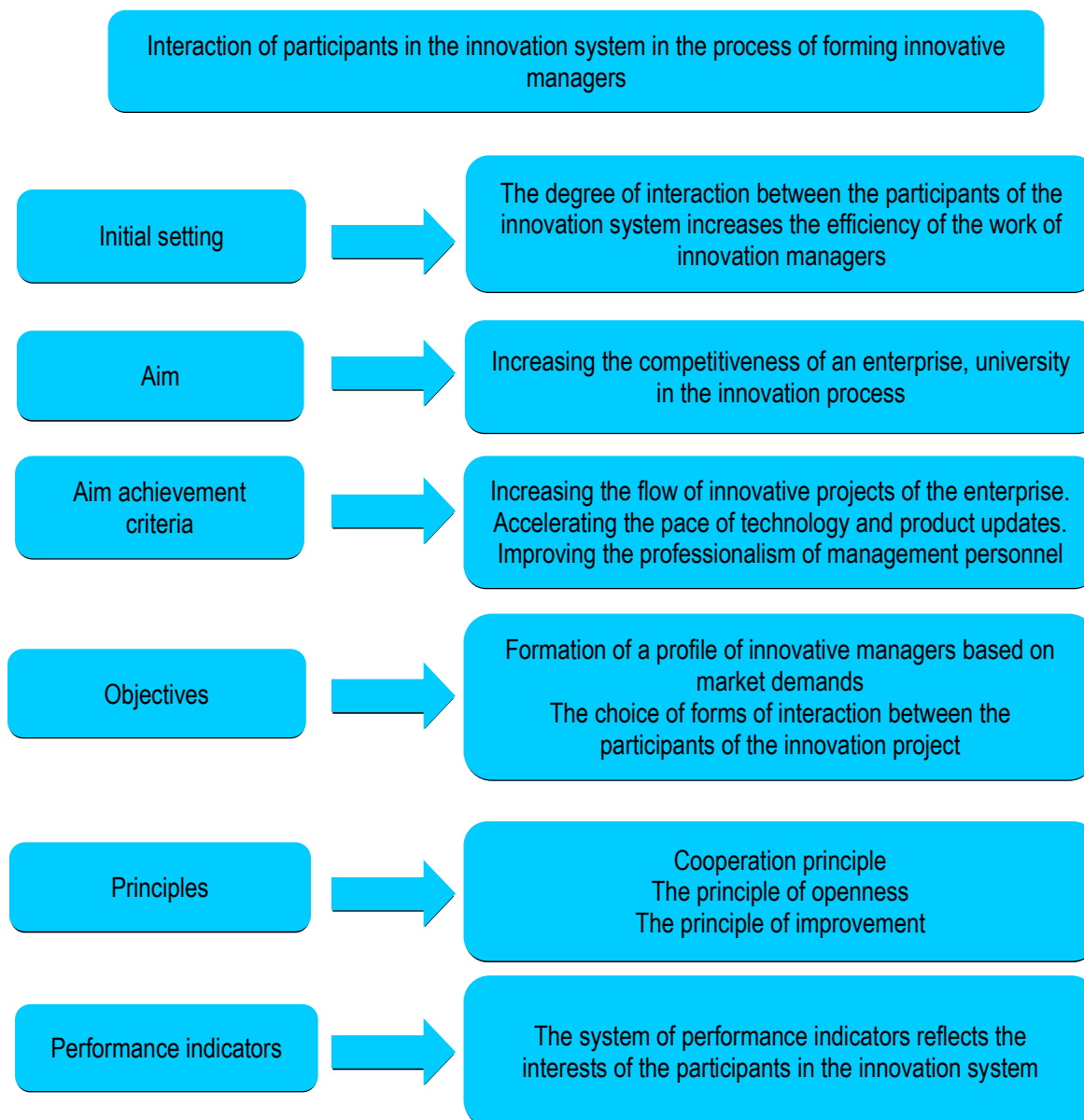
As the experience of developed countries shows, in the conditions of modern dynamic competition, only professionally trained managers can ensure the successful transformation of scientific and technical developments into an innovative product (Xiao *et al.* 2020). It should be noted that Kazakhstani universities work according to the industrial model of education, which assumes that professional subject teachers work with students and during their studies they study a certain number of academic disciplines. During such training, students' knowledge is repeatedly transformed, distorted and outdated, which makes their application in real life problematic.

In addition, the current education system has some issues: the non-conformity of most programs with the principles of an effective educational model; lack or restricted application of the competency-based approach; lack of innovative infrastructure of the educational process (business parks of projects, business incubators, technology parks); lack of programs with the possibility of a budgetary basis of training. Hence, it becomes obvious the need to bridge the gap between the theoretical knowledge of students and their skills in the organization, the need to implement collective and individual empirical research projects in the field of innovation management and venture business. All this is evidence of the need to modify the forms, teaching methods and management of education systems.

Obviously, the interaction of participants in the innovation system is mutually beneficial: the university receives platforms where students develop professional skills and leave the higher

education institution more prepared; the partner enterprise, attracting young managers to its innovative projects at the stage of their training, receives young, qualified personnel; business incubator – new ideas, projects, as well as potential employees for resident companies (OECD, 2019). The effective functioning of the proposed model, the project-based teaching method based on the principle of "doing - knowing" and allowing to minimize the gap between the theoretical and practical knowledge of students is appropriate, which makes it possible to bring training closer to the needs of employers. The effectiveness of an innovative company's operation is largely dependent on the number of innovative projects successfully implemented. Experts believe that the training system for innovation management specialists does not meet the needs of the market. In this regard, it appears necessary to examine in detail the issues of improving the training of management staff for the implementation of innovative activities. Leadership is also considered as a key element in the successful functioning and transformation of higher education institutions and enterprises as well as effective leadership can bring change to an organisation through improvement and innovation (Bayanbayeva & Altynbassov 2020).

Figure 2. Model of interaction of participants in the innovation system

Interaction of participants in the innovation system in the process of forming innovative managers

| Initial setting | → | The degree of interaction between the participants of the innovation system increases the efficiency of the work of innovation managers |

| Aim | → | Increasing the competitiveness of an enterprise, university in the innovation process |

| Aim achievement criteria | → | Increasing the flow of innovative projects of the enterprise. Accelerating the pace of technology and product updates. Improving the professionalism of management personnel |

| Objectives | → | Formation of a profile of innovative managers based on market demands
The choice of forms of interaction between the participants of the innovation project |

| Principles | → | Cooperation principle
The principle of openness
The principle of improvement |

| Performance indicators | → | The system of performance indicators reflects the interests of the participants in the innovation system |

Innovation environment within the local context

A review of the economic literature shows that in the definition of the concept of the "innovative environment of the enterprise" there is no clearly formed opinion. Some authors define the innovative environment as a set of innovative enterprises, innovative infrastructure objects, institutions and mechanisms that offer favourable conditions for the implementation of innovations. Others believe that the innovative environment consists of the innovation potential of the company and the innovation climate of the external environment, which interact closely and complement one another (Illiashenko *et al.* 2018). The innovative environment of the organization (enterprise) is considered as a set of elements of the internal and external environment, the interaction of which forms the process of the emergence of innovations. This allows to evaluate the quality of interaction according to the criteria for the effectiveness of creating, implementing, and promoting new products, and organizational, process or marketing changes carried out by the organization. In this regard, the innovative environment of the enterprise should be understood as a system of internal, regional, sectoral, and national institutions involved in the innovative process.

At the same time, the following tools should be used in the training of innovative managers:

1. A combination of practical work and theoretical knowledge. Training should be based on the correlation between educational and practical elements, which can be obtained through business cooperation with educational institutions. The practical component is integrated into the educational process to ensure that work on an innovative project continues throughout the training period. This allows students to acquire practical skills, and the partner company to form a low-budget innovation team.

2. Teamwork. In theoretical classes and during the implementation of projects, it is necessary to apply team forms of work. In theoretical classes, this happens mainly in the format of business games and trainings. Working on the project, students either become team members or are project managers and themselves form a project team. In addition, the university becomes a platform for conducting field schools, seminars with the participation of employees of the enterprise.

3. Work with mentors. The mentors are employees of the partner enterprise, representatives of interested innovative structures (venture funds, business incubators) (Cencič 2020).

When analyzing the factors of the external innovative environment, the issue of the aggregation of influencing factors is important. Aggregated and measurable factors should be understood as: provision of innovative activity with specialized equipment, materials, tools and raw materials; availability of external sources of financing and the magnitude of innovative financial risks; the level of development of the elements of the supporting infrastructure: business incubators, technology parks, business associations, technology transfer agencies; readiness of potential consumers to purchase innovative products of the enterprise; the presence of competitors in the relevant market segment for the dedicated innovative product; the degree of training and qualification of scientific, technical and managerial personnel.

In the real sector of the economy of Kazakhstan, despite the huge resource potential of raw materials industries, the possibilities of increasing production due to extensive factors have been largely exhausted. As part of the entry into a new technological order for Kazakhstan, an outstanding opportunity for accelerated development, as well as modernization of industries such as the electronic, nuclear, electrical industry, opens up. To this end, the country has a number of relevant so-called auxiliary elements in the form of human resources, as well as a significant scientific and technical base.

It should be noted that abroad small innovative enterprises at universities have been successfully operating since the middle of the last century. This process is most successful, for example, at universities in Germany, Sweden and the United States. For instance, German universities establish their own centres to support small business. Four major German research organizations – the Max Planck Society, the Fraunhofer Society, the Leibniz Society and the Helmholtz Society – have respective units that support scientists in the implementation of scientific results at

universities and research institutes (Isabekov and Mukhambetova 2017). The services provided by universities include advising and helping to set up an innovative company and preparing a business plan. Currently, approximately 300 technology innovation centers provide support to start-up entrepreneurs focused on creating technological innovation firms research and educational institutions (Isabekov and Mukhambetova 2017). Preference is given to works in the field of information and communication, optical and laser technologies, materials science, biotechnology, and medical technology, as well as energy-saving technologies and environmental protection.

Small innovative enterprises at universities can apply for support to the HTGF (High-Tech Grunderfonds), which was created for the founders of enterprises working in the field of high technologies. The fund, created by the Federal Ministry of Economics and Technology of Germany, invests venture capital in young enterprises.

Sweden implements a model that combines the freedom of universities in the commercialization of the results of intellectual activity created by them with tools aimed at obtaining the state's return on the created developments. Forms of cooperation between universities and business can be different: the creation of special units in universities engaged in the commercialization of research results; establishment of special consulting organizations and forums for cooperation with external market participants; creation of specialized units advising on economic and legal issues; establishment of holding companies whose main tasks include the ownership, disposal and management of shares in companies whose purpose is to facilitate the commercial dissemination of research results at the relevant university. To date, the Government of Sweden has established 14 companies at universities (Isabekov and Mukhambetova 2017).

Another form of cooperation between business, government and universities is centers of expertise, which act as a link in the framework of cooperation between several research groups from the university and several partners from the industry. The main task of the Center of Expertise is to contribute to the conduct of problem-oriented interdisciplinary research, as well as the transformation of new knowledge and competencies into new products, processes and services. In addition, in Sweden, transfer technology centers are being created at universities, the main task of which is to assist in drawing up a business plan, expertise innovative projects, and provide consultants for the entire period of formation of a small innovative enterprise.

In the United States, the principle of functioning of small innovative enterprises at universities is a triad: from fundamental university knowledge through national laboratories to the commercialization of technologies. At leading universities, large national laboratories are founded, around which the so-called belt of small and medium-sized enterprises operates. Universities supply innovative projects to private laboratories and industrial enterprises. It should be noted that a large number of scientific discoveries and inventions are made in small innovative enterprises at universities. At the same time, the authors of scientific discoveries and inventions were often the founders of small innovative enterprises and acted as entrepreneurs.

In our opinion, the use of the experience of foreign countries in local context is possible with a certain adaptation of the models of functioning of small innovative enterprises at local universities:

1. Creation of centers of expertise of innovative projects on the basis of universities to identify the relevance of the idea at the earliest stage, which will significantly reduce the share of inefficient and unpayable projects.

2. Establishment of transfer technology centers at universities of Kazakhstan with a wider range of opportunities: assistance in establishing contact with partner enterprises, assistance in finding personnel, formation, and maintenance of a client base at the earliest stage of development of a small innovative enterprise.

3. Organization of holding companies at universities. The establishment of this structure at universities will help to streamline and coordinate the activities of smaller units at universities that support small innovative enterprises (Son *et al.* 2022).

4. Application of the US experience in creating large university research laboratories, through which communication is carried out in the chain "University - small innovative enterprise" (Zakirova 2020).

However, when creating small innovative enterprises at universities, a number of problems may arise, the solutions to which should be foreseen in advance. In particular, renting of premises and scientific equipment may become a problematic issue. It seems that the creators of a small innovative enterprise should be exempt from paying rent for the premises used during the first two years of their activity. Payment of rent in subsequent years can be carried out according to the following scheme: the 3rd year - 10% of the commercial value, the 4th year - 20%, the 5th year - 30% (Isabekov and Mukhambetova 2017).

At the same time, questions could arise when budget organizations issue patents for inventions and other results of intellectual activity. It is advisable to take into account the experience of developing the commercialization of technologies abroad, where the assignment of intellectual property rights to developer organizations is essential in the development of a mechanism for introducing into economic circulation the results of scientific and technical activities and intellectual property objects created at the expense of public funds is.

In innovative small businesses, a staff problem can become relevant. The emergence of the problem is predetermined by such factors as: lack of personnel, low professional quality of the young intelligentsia, lack of opportunities for young people to realize creative abilities in conditions of financial deficit, unwillingness of the younger generation to connect their lives with science. There is therefore another problem - the interest of students in research at the initial stages of education. It is necessary, in our opinion, to invest in updating the renewal of research and library collections, Internet equipment for workshops, educational, experimental, and scientific work, as well as to maintain cooperative ties with scientific institutions on the basis of which training can be conducted.

Perhaps a major problem is the lack of financial support and the lack of real financial and lending mechanisms to provide such support. Small innovative enterprises in universities with high intellectual potential may not have an expensive material and technical base for prototyping. In this case, it is necessary to intensively attract sources of external financing of small innovative enterprises to universities, by developing modifications, venture financing schemes for innovative projects, a business angel network, encouraging the participation of innovative enterprises at universities in international projects.

Innovative model of universities

Current state policy in higher education of Kazakhstan puts forward one of the predominant forms of arrangement of higher educational institutions the so-called innovative model of universities. Universities should become educational organizations of the entrepreneurial type, whose main objective is to increase their competitiveness in relevant segments of the national economy. In turn, the development of entrepreneurial universities has also significant technological, managerial, and organisational implications for the economy (Forliano *et al.* 2021). The activities of universities should be restructured in the direction of their commercialization and the creation on their basis of innovative competitive business structures that interact with employer enterprises and strategic partners of universities in educational, research, development, and production activities.
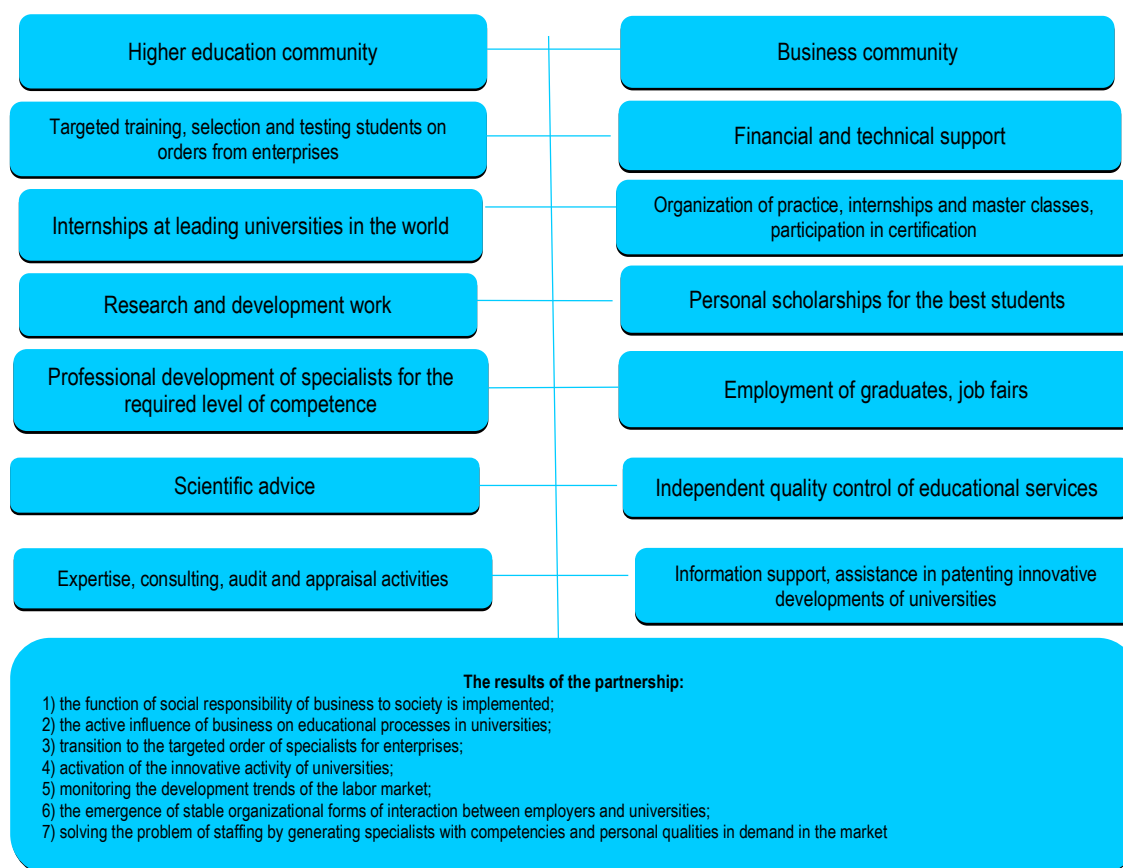
The creation of higher educational institutions of an innovative model is possible when combining their activities in the scientific and technical sphere with a technopark (Baldyniuk *et al.* 2021). The technopark will create an environment in which the main links of the innovation cycle of creating innovations can be implemented in practice. In other words, the technopark serves as a structure that combines scientific research, innovation, and the market of innovations in the scientific and technical sphere. The partnership of universities with technology parks is beneficial from an economic perspective and achieves a dual goal. On the one hand, such interaction provides high-quality training of innovation-oriented specialists in priority areas of development of science,

engineering, and technology on the basis of a single process of obtaining, disseminating and applying new knowledge. On the other hand, such integration structures should have a significant impact on the socio-economic development of the region, specialized industries, and the system of higher professional education. Based on the experience of technoparks at universities in the United States and Great Britain, researchers have concluded that the creation of technoparks at universities in Kazakhstan can really strengthen the university's partnership with industry and business (Altynbassov *et al.* 2021). In addition, there is a real possibility of setting up university campuses in the southern regions of Kazakhstan. The geographic and climatic situation of the region and the proximity of countries with high population density have a positive impact on the development of this project. In addition, the growth of population and economic in certain parts of the country can positively affect the development of the tourism industry in this region (Altaibayeva *et al.* 2020).

To develop effective solutions for managing the activities of integration structures, it is necessary to develop methods for optimizing the interaction of the technopark and the university. At the same time, the degree of effectiveness of their activities should be determined based on a system of indicators. Rating criteria can act as a system of indicators. Rating criteria for assessing the activities of technology parks and universities will contribute to the fact that technoparks together with universities will achieve maximum performance in the rating. The technopark structure in this case acts as a link between higher professional education and industry. From an economic perspective, the integration of science, business and higher education is an accumulation of resources for the development of the knowledge economy. Structurally, tripartite integration is the formation of educational, scientific and production complexes as centers of innovation.

According to Figure 3, the interaction between higher education and the business community is a kind of innovative, but at the same time mutually beneficial process for the Kazakhstan's economy.

Figure 3. Effectiveness of social partnership of higher education and entrepreneurship

Higher education community	Business community
Targeted training, selection and testing students on orders from enterprises	Financial and technical support
Internships at leading universities in the world	Organization of practice, internships and master classes, participation in certification
Research and development work	Personal scholarships for the best students
Professional development of specialists for the required level of competence	Employment of graduates, job fairs
Scientific advice	Independent quality control of educational services
Expertise, consulting, audit and appraisal activities	Information support, assistance in patenting innovative developments of universities

The results of the partnership:
1) the function of social responsibility of business to society is implemented;
2) the active influence of business on educational processes in universities;
3) transition to the targeted order of specialists for enterprises;
4) activation of the innovative activity of universities;
5) monitoring the development trends of the labor market;
6) the emergence of stable organizational forms of interaction between employers and universities;
7) solving the problem of staffing by generating specialists with competencies and personal qualities in demand in the market

The figure shows the contribution of higher education and entrepreneurship to bridging the gap between scientific, educational and production complexes in order to increase the economic efficiency of production.

At the same time, higher educational institutions of Kazakhstan can use various integration options:

1) creation of the "University - Enterprise" system for the training of specialists in accordance with the needs of the regional labor market;

2) the university complex, which implements the model of continuing education. At the same time, two development options are possible: the first is the inclusion in the university complex of not only postgraduate, but also pre-university training, the second is the inclusion in the university complex of only postgraduate vocational training and retraining;

3) creation of innovative educational, scientific and production complexes capable of actively influencing the economic policy of the region;

4) formation of an innovative scientific and educational complex, organically embedded in the international scientific and educational space;

5) creation of a multidisciplinary network research university complex for the development of new scientific areas and training of unique specialists.

Figure 4. The mechanism of interaction of higher education institutions with partners in the framework of the integration of science, education, and production
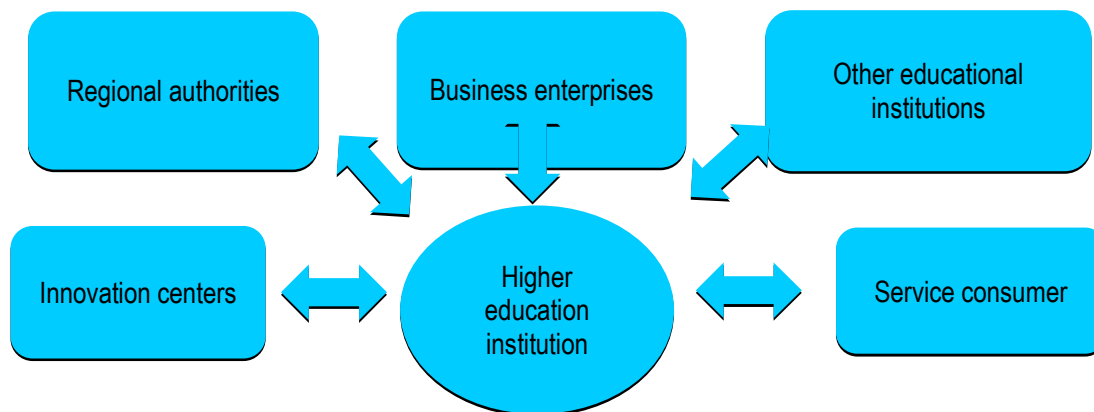

Figure 4 indicates that equal partners for the university are vocational education institutions of various levels, state authorities, sectoral unions of entrepreneurs and employers. The criteria for integrative interaction are: maximum employment of graduates of a particular vocational education institution; the number of long-term cooperation agreements; the availability of additional sources of financing; coordination of the activities of business structures, research projects and educational programs; creation of effective economic structures of small science-intensive; creation of educational-scientific-production centers of support; personalized programs and technologies for training young professionals; development of innovative technologies in education, science, and business.

Partnership cooperation is becoming an organizational form of interaction between regional educational and production systems on the terms of joint use of the resource potentials of partners. The mechanism that unites the efforts of representatives of business, science, and the state in organizing joint activities for research and development, as well as for their implementation, is the creation of technological platforms. The technology platform is a communication tool aimed at intensifying efforts to create promising commercial technologies, new products (services), to attract additional resources for research and development based on the participation of all stakeholders (business, science, state). The implementation of these tasks is entrusted to innovation centers. Innovation centers in the region are designed to create conditions for the development of scientific, technical and innovation policies and to increase the efficiency of interaction between scientific, technical, educational, and industrial complexes.

The activities of innovation centers will contribute to increasing innovative activity in the region, the growth and development of firms, and the establishment of cooperation between researchers and industry. In addition, innovation centers will provide high-quality training of innovative managers, contribute to the acceleration of real economic development through the creation of regional and international networks for the exchange of information and cooperation between enterprises. Innovation centers will enable enterprises in the production sector to reduce the cost of finding innovations, reduce the time for their implementation and thereby improve product quality and competitiveness.

The main areas of cooperation between universities and enterprises of the business community can be the transition of innovative enterprises along the chain from research institutes and universities to innovation centers, then to a business incubator, then to a technopark. Legal support for investment and innovation activities is provided by state structures and departments. Innovations created in various institutes and laboratories from different sectors of the economy should be financed by state grant programs for research and development. They should be located on the territories of research institutes, universities, innovation and technological centers, various laboratories, where there are all conditions for conducting the necessary research. Financing can be attracted by participating in various competitions of innovative projects. If the necessary financing is obtained, a small enterprise can be placed in a business incubator.

In addition to financing, some developing enterprises have a need for production facilities. At this stage, the project is moving into an industry technopark, created on the principle of public-private partnership. Moreover, specialized technology parks should be created in the region that have the necessary infrastructure for a particular industry. The company, being in the technopark, can receive investments for expansion from venture funds. On the basis of the product created in the technopark, mass production is created, financed by direct investment funds or corporate investors. In modern conditions, the competitiveness of both regions and individual industrial facilities is often determined by mastered and implemented technological innovations. In this regard, it is important not only to anticipate what the interaction of suppliers and consumers of production and technological innovations will be, but also to ensure the sustainability of the interaction of science, higher education and business. The mechanism of interaction between scientific teams and business entities allows its participants to receive high economic incomes based on unequal access to intellectual resources in the form of advanced scientific achievements.

Conclusion

The literature review showed that the most important factor determining the possibilities of innovative development of any economic system is the cooperation between the research-oriented higher education system and business. The universities play an active role in the process of innovative development of economic entities, in terms of providing them with various kinds of innovations, including innovation-oriented specialists and products of intellectual activity. Meanwhile, the transition to an innovative education model, will increase the competitiveness of the university and prepare qualified innovative specialists who meet market requirements and are able to develop an innovative economy. In cooperation with the business environment, the university should take the position of an equal and strong partner with substantial resources based on the principle of "university plus enterprise equals new enterprise". However, in the context of Kazakhstan, the parties to the University-Science-Enterprise Partnership are not interested in shared goals that could appeal to each party.

The creation of entrepreneurial universities has become increasingly relevant for improving their competitiveness in the real sectors of the national economy. It has been argued that the partnership between universities and technology parks is beneficial from an economic standpoint. This interaction provides high-quality training for experts focused on innovation in priority areas of science, engineering, and technology development. Moreover, these integration structures are expected to

have a significant impact on the socio-economic development of the region, specialized industries, and the higher education system.

The experience of Germany, Sweden and the United States illustrated that small innovative enterprises at universities have been successfully operating since the middle of the last century. To increase the investment attractiveness of small enterprises that would be engaged in the development and implementation of various kinds of innovations, this article proposes an organizational and economic mechanism, understood as a set of interacting formalized organizational and economic components aimed at creating incentives and interests for investing in small innovative enterprises. However, it is argued that the context of Kazakhstan, small innovative companies usually suffer from a qualified personal problem and a lack of financial assistance that could have a negative impact on their operations.

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THE MARSHALL LERNER CONDITION AND MONEY DEMAND: A NOTE

Alessandro SACCAL
Independent Researcher, Italy
saccal.alessandro@gmail.com

Abstract:

What are the respective effects of a unit increase in money demand on the real exchange rate and on the current account, all else equal? The real exchange rate is known to appreciate, but the current account need not deteriorate, as the canonical Marshall Lerner condition instead seems to suggest. As this work presents, the current account deteriorates by virtue of a real exchange appreciation due to a fall in the real money supply, all else equal, and vice versa; it further specifies that the current account improves by virtue of a real exchange rate appreciation due to a rise in money demand, all else equal, and vice versa.
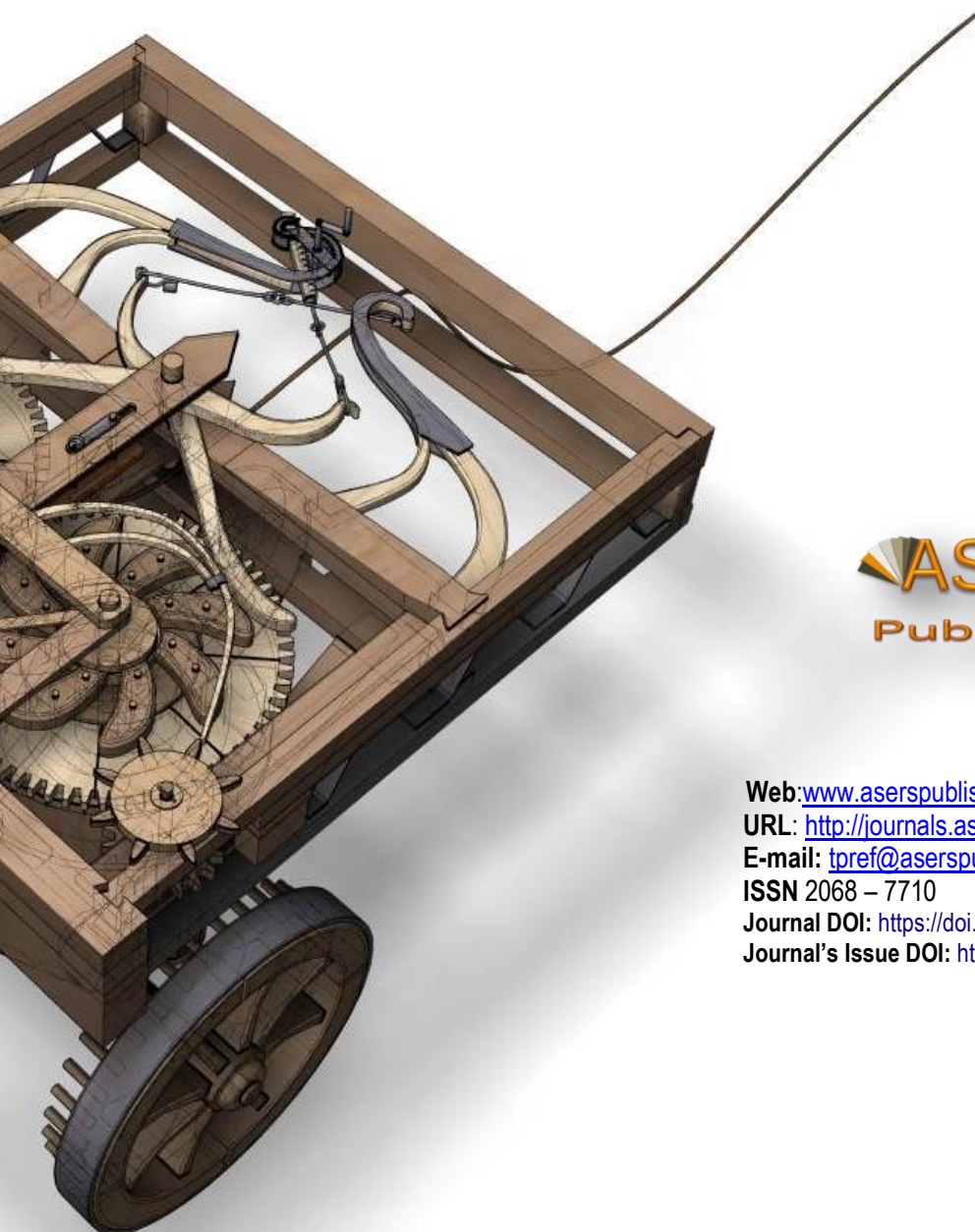
Conclusion

What are the respective effects of a unit increase in money demand on the real exchange rate and on the current account, all else equal? The real exchange rate is known to appreciate, but the current account need not deteriorate, as the canonical Marshall Lerner condition instead seems to suggest. Indeed, an outward application thereof dictates a current account deterioration by virtue of a real exchange rate appreciation. A noumenal application thereof, which this work has presented, by contrast clarifies that thecurrent account deteriorates by virtue of a real exchange appreciation due to a fall in the real money supply, all else equal, and *vice versa;*it further specifies that the current account improves by virtue of a real exchange rate appreciation due to a rise in money demand, all else equal, and *vice versa.*

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