

Journal of Economic Cooperation & Development

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ISSN 1308 – 7800

Volume 45, No. 3 September 2024

J o u r n a l o f E c o n o m i c C o o p e r a t i o n & D e v e l o p m e n t



**Statistical Economic and Social Research
and Training Centre for Islamic Countries
(SESRIC)**

Contents

Mirajul Haq, Muhammad Luqman and Iftikhar Ahmad

Capital Account Liberalization, Institutions and Economic Growth:
Evidence from Selected Asian Countries..... 1

Suada A. Džogović and Zijad Šabotić

Geopolitical Tensions and their Impact on the International Economy:
A Case Study of the Russian-Ukrainian Conflict 31

Jarita Duasa and Rafia Afroz

Efficiency of Rice Production with Environmental Consideration..... 65

KCHIKECHE Ahmed and MAFAMANE Driss

Examining the interactions of economic growth and bank credit to the
private sector in Morocco: a causality analysis..... 89

Haleema Sadia, Jawad Ahmad Azeez and Eatzaz Ahmad

Do Country Characteristics and International Linkages Foster Financial
Stress Transmission in Emerging Economies? 117

Katria Davina Paramastuti and Muhammad Sri Wahyudi Suliswanto

Determinants of Household Consumption Expenditure in the Middle
East 145

Norman Mohd Saleh, Md Shafiin Shukor, Azizah Abdullah, Mohamat Sabri Hassan, Romlah Jaffar, Sarah Aziz Abdul Ghani Aziz, Noradiva Hamzah, Zaini Embong, Zahir Dahari, Romaizah Abdul Kadir

Are Board-Managed Cooperatives Efficient? When Monitors become
Managers 169

Taha Eğri, Mehmet Çanakçı, and Canan Özge Eğri

Economic Openness and Growth in MENA: Evidence from Dynamic Heterogenous Panel Models..... 199

Augustine Adebayo Kutu and Abieyuwa Ohonba

Exploring the Interactions between Monetary and Macro-prudential Policies for Output Growth in South Africa 225

Manjeet Kaur Harnek Singh, Bawani Lelchumanan, Noorasiah Sulaiman and Zaheer Anwer

The Role of the Health-Care Sector in Malaysia's National Economy: An Input-Output Analysis 255

Editorial

Contemporary frameworks and curriculums require increasing advents and adaptations in theoretical foundation as well as expanded case studies and professional exposures to prepare the next generation (Next Gen Alpha, Gen Z) to shape the future. The last several decades have seen global economies rapidly grow with expansion of interlinkages between businesses and markets. The growth is also coupled with new and complex obstacles that stem from the overarching macroeconomic model to localized case studies. As such, educational reform is a primary transformation to revolutionize the current Islamic finance industry. Reforms must emphasize the parallels between Islamic finance ethical implications and modern economic goals in economic growth, sustainability, technology, and regulatory policy. Academics and industry professionals must append curriculums to meet the evolving needs of businesses and institutions; schools and universities need equitable funding to provide students with tools and knowledge that underline 21st century innovative principles, technological and financial literacy, and ethical sustainability guidelines. In summary, individuals, firms, and governments should proactively adapt existing institutions and systems to foster profound education for future generations; the next generation must prioritize cooperation, sustainability, ethics, and developmental initiatives when they become leaders of the world to come.

Current behavioral trends show a strong level of tradeoff understanding as individuals pressure firms and institutions to avert away from some of the traditional means of optimizing financial returns towards innovative and true economic means that benefit the environment and society. Within the dynamic environment of media, governments are pressured on wealth enhancing and economic development policies. Firms must uphold transparency and accountability as they shift investments into green, innovative, and equitable avenues. The historical disparity in theory versus application in much of the last century has created and continues to exacerbate contemporary ecological and socioeconomic metrics to highlight increasing demographic wealth and equity gaps. Our issue picks publications that delve empirically into specific shortcomings across various research scopes of finance and economics.

This recent issue includes ten papers from researchers who then provide policy recommendations based on substantial backing based on robust

empirical backing. These papers observe several economies as specific as select Asian nations, select emerging economy nations, select Middle East nations, Malaysia, Morocco, and South Africa. The papers expand focus to topics such as uncertainty within the current Russian-Ukrainian conflict, capital account balance, institutional quality, bank stability, domestic production, inflation, corporate governance, public health, and monetary policy. Lastly, our diverse selection in this issue collectively highlights the importance of reforming regulative bodies, various institutions, and education systems.

Haq et. al's paper, "Capital Account Liberalization, Institutions and Economic Growth: Evidence from Selected Asian Countries," adapts the neoclassical growth model to separately investigate the allocative and productivity channels of capital account liberalization through which it affects economic growth within a panel of 14 Asian countries. Findings reveal that the pace of economic growth has a corresponding movement with capital account liberalization; and institutional quality is a positive and significant driver of capital account liberalization. The study also expands on the moderating role of institutions in the interlinked relationship between capital account liberalization and economic growth.

Džogović and Šabotić's paper, "International Economy: A Case Study of the Russian-Ukrainian Conflict," delivers a novel perspective of the economic impact of the Russian-Ukrainian war on international economies. This article uses the trend method to monitor the movement of GDP at the global level, the measures of international trade policy under the auspices of the war in Ukraine, the migration of war refugees from Ukraine, and the movement of financial stress (FSI). They find significant and increasing variability, which indicates caution in global financial frameworks. However, much of the uncertainty surrounding the economic prospects are contributed to uncertainty of war duration.

Duasa and Afroz's paper, "Efficiency of Rice Production with Environmental Consideration," investigates the impact of environmental factors on the efficiency of rice production in two distinct farming states of Malaysia. The Cobb–Douglas stochastic production frontier function is used to estimate the production frontier 'with' and 'without' the environmental variables. The findings from the study indicate the average technical efficiency for the sample farmers is 62.9% which implies that on

the average, the farmers are able to obtain 62.9% of potential output from a given mix of production inputs as well as environmental consideration.

Ahmed and Driss' paper, "Examining the interactions of economic growth and bank credit to the private sector in Morocco: a causality analysis," examines the relationship between bank credit to the private sector and economic growth in Morocco. In the short run, they provide robust evidence for a one-way causal impact of bank credit to the private sector on economic growth. Whereas in the long run, they display a feedback relationship between bank credit and economic growth. Ultimately, foreign direct investment contributes most to explaining the forecast errors of bank credit intensity to the private sector and nonagricultural GDP.

Sadia et. al's paper, "Do Country Characteristics and International Linkages Foster Financial Stress Transmission in Emerging Economies?" suggest that the financial crises from advanced countries transmit strongly and rapidly to emerging economies. Further, the extent of the transmission of financial stress is related to the depth of financial linkages between advanced and emerging economies. Positive current account and fiscal balances do little to insulate emerging economies of this transmission. The study highlights the design of coordinated emerging economies' policies and the necessity to monitor fiscal imbalances and recessionary trends.

Paramastuti et. al's paper, "GDP per capita, population, and inflation," delves into the influence of GDP per capita, population, and inflation on household consumption. The paper found a positive and significant relationship between the expenditure of household consumption and GDP per Capita and population. Additionally, it upholds a significant and negative relationship between inflation and the expenditure of household consumption in the Middle East.

Saleh et. al's paper, "Are Board-Managed Cooperatives Efficient? When Monitors become Managers," examines whether board-managed cooperatives (with significant agency costs) are less efficient than other cooperatives in Malaysia. The analysis shows that board-managed cooperatives are less efficient than cooperatives with an appointed manager. Moreover, the efficiency of a cooperative is related to the number of its charitable funds and members. Although cooperatives lack the resources to appoint a manager, the efficiency that results from such an investment could lead to higher revenues and returns to members.

Eğri et. al's paper, "Economic Openness and Growth in MENA: Evidence from Dynamic Heterogenous Panel Models," explores the impact of openness on economic growth in MENA countries to find higher domestic capital stock and school enrollment contribute to the region's economic growth. However, the empirical results support a weak indirect association between economic performance and openness of MENA countries using different globalization measures. The findings support that MENA countries have limited economic growth gains from globalization.

Kutu and Ohonba's paper, "Exploring the Interactions between Monetary and Macro-prudential Policies for Output Growth in South Africa," examines the macroeconomic effects of policy shocks on output growth in South Africa to show that tighter monetary and macro-prudential policies contain inflation and credit growth while also displaying a declining effect on output growth. Further, interest rate shock reduces inflation while money supply increases inflation in the economy and the macro-prudential policy shock of an increase in the capital-based reduces the bank credits. Therefore, policy should form a two-step initiative to stimulate output growth while reducing recessionary factors.

Singh et. al's paper, "The Role of the Health-Care Sector in Malaysia's National Economy: An Input-Output Analysis," disaggregates health-care into private and public sectors to then assess inter-industry linkages, employment, value-added, and output multipliers. The analysis reveals that between 2010 and 2015, the contributions that an additional MYR 1 million investment in public health grew from MYR 1.4405 million to MYR 1.4539 million. Private health investments showed similar trends, with contributions increasing from MYR 0.9558 million to MYR 0.9693 million over this time. The health-care sector demonstrates increasing forward linkages and positive economic growth through supply chain value-add and employment multipliers.

I hope you will enjoy reading the articles of current issues.

H.E. Zehra Zümrüt Selçuk
Editor-in-Chief

Capital Account Liberalization, Institutions and Economic Growth: Evidence from Selected Asian Countries

Mirajul Haq¹ Muhammad Luqman² and Iftikhar Ahmad³

ABSTRACT

The neoclassical growth model predict that capital account liberalization is beneficial for economic growth as capital diffuse from abundant country to those having scarcity. This study separately investigates the allocative and productivity channels of Capital account liberalization (CAL) through which it affects economic growth of a country. The study estimated three different dynamic models using GMM technique. The study utilizes panel data of 14 Asian countries for the analysis covering the period 1980 to 2019. Findings of the study reveal that pace of economic growth have a corresponding movement with capital account liberalization. Touching upon the role of institutions, results of the study shows that institutional quality enhances the positive impact of capital account liberalization and hence accelerate economic growth in the sample countries. The contribution of this study lies in two ways. Firstly, we develop a theoretical model based on neoclassical growth model that permit us to evaluate the effects of CAL on economic growth. Secondly, unlike existing empirical literature on the subject, the study investigates the moderating role of institutions in interlinked relationship between CAL and economic growth.

ملخص

يتوقع نموذج النمو الكلاسيكي الجديد أن تحرير حساب رأس المال يعود بفائدة على النمو الاقتصادي حيث ينتقل رأس المال من الدول التي تشهد وفرة إلى تلك التي تعاني من ندرة. تستقصي هذه الدراسة بشكل منفصل قنوات التخصيص والإنتاجية لتحرير حساب رأس المال (CAL) التي تؤثر من خلالها على النمو الاقتصادي في بلد ما. قامت الدراسة بتقدير ثلاثة نماذج ديناميكية

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مختلفة باستخدام تقنية طريقة اللحظات المعممة (GMM). تستخدم الدراسة بيانات لوحة تشمل 14 دولة آسيوية للتحليل الذي يغطي لفترة من 1980 إلى 2019. تكشف نتائج الدراسة أن وتيرة النمو الاقتصادي لها حركة مقابلة مع تحرير حساب رأس المال. وبالتطرق إلى دور المؤسسات، تُظهر نتائج الدراسة أن جودة المؤسسات تعزز الأثر الإيجابي لتحرير حساب رأس المال وبالتالي تسرع من النمو الاقتصادي في بلدان العينة. وتكمن مساهمة هذه الدراسة في ناحيتين. أولاً، قمنا بتطوير نموذج نظري يستند إلى نموذج النمو الكلاسيكي الجديد يسمح لنا بتقييم آثار تحرير حساب رأس المال على النمو الاقتصادي. ثانياً، وخلافاً للأدبيات التجريبية الموجودة حول هذا الموضوع، تبحث الدراسة في الوسيط للمؤسسات في العلاقة المترابطة بين تحرير حساب رأس المال والنمو الاقتصادي.

RÉSUMÉ

Le modèle de croissance néoclassique prévoit que la libéralisation du compte de capital est bénéfique pour la croissance économique car le capital se diffuse des pays abondants vers ceux qui sont en pénurie. Cette étude examine séparément les canaux d'allocation et de productivité de la libéralisation du compte de capital (CAL) par lesquels elle affecte la croissance économique d'un pays. L'étude a estimé trois modèles dynamiques différents en utilisant la technique GMM. L'étude utilise des données de panel de 14 pays asiatiques pour l'analyse couvrant la période de 1980 à 2019. Les résultats de l'étude révèlent que le rythme de la croissance économique a un mouvement correspondant avec la libéralisation du compte de capital. En ce qui concerne le rôle des institutions, les résultats de l'étude montrent que la qualité institutionnelle renforce l'impact positif de la libéralisation du compte de capital et accélère donc la croissance économique dans les pays de l'échantillon. La contribution de cette étude est double. Premièrement, nous développons un modèle théorique basé sur le modèle de croissance néoclassique qui nous permet d'évaluer les effets de la CAL sur la croissance économique. Deuxièmement, contrairement à la littérature empirique existante sur le sujet, l'étude examine le rôle modérateur des institutions dans la relation interdépendante entre l'accès aux marchés et la croissance économique.

Keywords: Capital Account Liberalization, Economic Growth, Institutional Quality

JEL Classification: O4, O19, F21, C23

1. Introduction

Economic liberalization broadly categories into current account and capital account liberalization (CAL). As for as the current account liberalization is concerned, opinions seem to generally converge around its positive effects on economic growth. However, in case of CAL, estimations are still ambiguous about its positive effects on economic growth. Works in favor of CAL explains their arguments in terms of both accumulation and productivity channels. Some studies argued for the allocation effects of CAL as it allows for risk diversification across countries ([Obstfeld & Rogoff, 1994](#); Soto, 2003; [Baltagi, Egger, & Pfaffermayr, 2007](#)); reduce cost of capital ([Bekaert & Harvey, 1995](#); [Henry, 2007](#)); generate international competition ([Rogoff, 1999](#); Summars, 2000), and improve domestic financial system ([Klein & Olivei, 1999](#); [Levine, 2001](#); [Soto, 2003](#); Samouel, 2008; Zenasani & Behabibi, 2012), hence, foster allocative efficiency. However, some other studies propose that capital CAL enhance economic growth not only by the enhancing of allocative efficiency but it also promote productivity growth ([King & Levine, 1993](#); [Acemoglu & Zilibotti, 1997](#); [Beck et al., 2000](#); [Acemoglu et al., 2001](#); [Aghion, Bloom, Blundell, Griffith, & Howitt, 2005](#), [Henry & Sasson, 2008](#); Bekaet et al., 2010). These studies argued that financial liberalization develop domestic financial system, which in turn minimize financial constraints and therefore provide incentive for invention, innovation, and technological development.

Similarly, works in against of the CAL also explains their arguments in the accumulation and productivity perspective. For instance, [Lucas \(1990\)](#) forwarded the claim that CAL cannot improve global allocative efficiency, and argued that less developed technology, low human capital, and weak institutions in developing countries overlap the positive affect of higher marginal productivity of capital, hence instead of capital inflow, CAL leads flight of capital from developing countries. In similar line, [Stiglitz \(2000\)](#) argued that due to weak macroeconomic policies of developing countries, CAL could exacerbate its financial crisis, creates vulnerability that in turn reduce investment and hence output growth in developing economies. Schmuckler (2001); [Eichengreen & Leblang \(2003\)](#); and [Tornell, Westermann, & Martinez \(2004\)](#) came with similar findings and argued that generally capital account would tend to aggravate investment and productivity growth because it may trigger financial risks and economic vulnerability. As stated earlier, the empirical literature is

still away from consensus. Conceivably, the one key reason is the lack of evidences on the allocative and productivity effects of CAL on economic growth.

In this study, we investigated separately the allocative and productivity channels of CAL through which it affects economic growth of a country. These channels are postulated from two groups of growth models. The allocation effect is hypothesized from the neo classical growth model of [Solow \(1956\)](#) and [Swan \(1956\)](#) predicted that because of the removal of restrictions from capital, it spillovers from capital abundance countries (developed) to capital scarce countries (developing), consequently affect global allocation of resources. The neo classical growth framework explains such movement of capital in terms of marginal productivity of capital, and put forward the claim that as marginal productivity of capital is higher in developing countries as compare to their developed counterpart. On the other hand, the productivity effect is postulated from the second generation of endogenous growth model, which based on creative destruction idea of Schumpeter (1934) and argued that endogenous technological change is the sole determinant of economic growth ([Romer, 1990](#)); ([Grossman & Helpman, 1990](#)); ([Howitt & Aghion, 1998](#)); (Lucas, 1993; Acemoglu et al. 2005; Aghion, et al. 2005b). According to this framework, financial liberalization minimizes financial constraints, consequently providing financial space for invention, innovation, and technological development that in turn enhance productive capacity.

To assess empirically both allocation and productivity effects of CAL on economic growth we develop a theoretical model, presented in section 2. Our theoretical model is mainly based on neo-classical growth model; however, some aspects of endogenous growth model have been incorporated. The end result of the model indicate that steady state growth rate of output is positively related with Total Factor Productivity (TFP) growth (technological progress), and proportion of output that is tended towards investment; whereas the margin of financial intermediation is negatively related to steady state growth of output. The allocative effect of CAL is captured though the proportion of output that tended towards saving, and the margin of financial intermediation. The basic depiction is that more liberalize capital account increases the accumulation of physical capital, and creates competition among financial intermediaries that in turn reduce margin of the financial intermediation. The productivity effect

is capture through the growth of TFP, the idea is that CAL minimize financial constraints and therefore provide incentive for invention, innovation, and technological development that sequentially enhances productive capacity.

The empirical analysis, carried out at country level on a panel of 14 Asian countries, covers the fundamental measures from 1980 to 2019⁴, not like the prevailing investigations on the topic, that have explored the impact of CAL on simply pace of economic process. We estimate three entirely different dynamic models using generalized method of moments (GMM). The primary model investigates the impact of CAL on pace of economic process while the alternative models examine the impact of CAL on the sources of economic growth process particularly physical capital accumulation, and growth of total factor productivity (TFP). Secondly, unlike existing empirical literature on the subject, the study investigates the moderating role of institutions in interlinked relationship between CAL and economic growth.

After discussing introduction in section 1, this study is structured as follows. Section 2 presents the theoretical underpinning for the empirical model which shows that explain economic growth with the channel of the marginal productivity of capital and through financial intermediation. Section 3 illustrates empirical models. Section 4 presents methodology that covers detailed discussion about variables under consideration, data and data sources, sample and sample selection criteria, and estimation technique. Section 5 presents findings and discussions. Finally, study concludes in section 6.

2. Theoretical Framework

“Capital account liberalization (CAL) and pace of economic growth moves parallel” is the hypothesis that would be tested in this study. Before an empirical investigation of our hypothesis, we develop a theoretical underpinning for our empirical model. We start our model with the usual consumer’s utility maximization problem (as specified by Ramsey (1928); Cass (1965); and Koopmans (1965)). We assume that an economy has identical consumers, that holds factors of production, and have infinite time horizon. The number of consumers in the economy is N_t , which

⁴See appendix A for the list of selected Asian countries.

increase over a time at an exogenous rate n_t , therefore, $N_t = N_0 e^{n_t}$. All these consumers own same unit of physical capital, have identical production ability and have same preferences about current and future consumption (saving). We assume no age limit for the labor market, hence population equal to labor supply $N_t = L_t$, L_t denotes labor supply.

Assuming constant relative risk aversion preferences (Iso-Elastic Utility Function) the utility maximization problem is to maximize the discounted aggregate utility, subject to aggregate resource constant in the economy,

$$Max U_0 = \int_{t=0}^{\infty} \frac{C_t^{1-\sigma} - 1}{1-\sigma} e^{-\theta t} dt \quad (1)$$

Where $U(.)$ is the instantaneous utility function, which gives each member utility at a given date. θ is the discount rate, $e^{-\theta t}$ is the value of consumption at t in term of consumption at time zero. $U(C_t) = \frac{C_t^{1-\sigma}}{1-\sigma}$ is constant relative risk aversion utility. We assume perfect foresight, where σ determines the consumer willingness to shift consumption between different periods.

The budget constraint for this utility maximization problem is,

$$\int_{t=0}^{\infty} e^{-Rt} V_t dt + \int_{t=0}^{\infty} e^{(n+g)t} W_t dt - \int_{t=0}^{\infty} e^{-Rt} e^{(n+g)t} C_t dt \leq 0 \quad (2)$$

V_t is financial intermediation, r_t is the rate of interest, one unit investment of financial intermediary at time zero should yield e^{-rt} is the present value of continuously compounding interest over the time. W_t is the labor income, and C_t is consumption that accumulating over the period at constant rate. With Hamiltonian,

With Hamiltonian,

$$\begin{aligned}
H = e^{-\theta t} & \left(\frac{C_t^{1-\sigma} - 1}{1-\sigma} \right. \\
& + \lambda \left[\int_{t=0}^{\infty} e^{-rt} V_t d_t + \int_{t=0}^{\infty} e^{(n+g)t} W_t d_t \right. \\
& \left. \left. - \int_{t=0}^{\infty} e^{-Rt} e^{(n+g)t} C_t d_t \right] \right)
\end{aligned} \tag{3}$$

The first order conditions,

$$\begin{aligned}
\frac{\partial H}{\partial C_t} = 0 & \Rightarrow e^{-\theta t} C_t^{-\sigma} \\
& = \lambda e^{-rt} e^{(n+g)t}
\end{aligned} \tag{4}$$

Taking log,

$$\begin{aligned}
-\theta_t - \delta \ln C_t & = \ln \lambda - r_t \\
& + (n+g)_t
\end{aligned} \tag{5}$$

Taking derivate with respect to t ,

$$\begin{aligned}
-\theta - \delta \frac{\dot{C}_t}{C_t} \\
= -r_t + (n+g)
\end{aligned} \tag{6}$$

$$-\delta \frac{\dot{C}_t}{C_t} = -r_t + (n+g) + \theta$$

$$\begin{aligned}
\frac{\dot{C}_t}{C_t} \\
= -\frac{1}{\delta} (-r_t + (n+g) \\
+ \theta)
\end{aligned}$$

$$\begin{aligned}
\frac{\dot{C}_t}{C_t} & = \gamma_{c_t} \\
& = -\frac{1}{\delta} (-r_t + (n+g) \\
& + \theta) \quad \forall t
\end{aligned} \tag{7}$$

Consumption will grow if $r_t(\text{return}) > (n + g) + \theta$, decreasing otherwise.

Next, we introduce firms; we assume that an economy has identical firms, that produce output with three inputs of production, labor, capital, and knowledge. The production function takes the following form:

$$Y_t = F(A_t, K_t, L_t) \quad (8)$$

Where, Y_t is the level of an output produced, A_t is knowledge, K_t is stock of physical capital, and L_t is the size of labor force. In Cobb-Douglas specification it appears as:

$$Y_t = (A_t K_t)^\alpha (L_t)^{1-\alpha} \quad (9)$$

Population N_t is growing with a constant “n” rate. $L_t = N_t \Rightarrow L_0 e^{nt} = N_t e^{nt}$. Similarly, technology “ A_t ” is assumed to grow at constant rate “ g_t ”, i.e. $g_t = A_t e^{nt}$.

In per worker terms equation 9 can be written as;

$$\frac{Y_t}{L_t} = \left(\frac{A_t K_t}{L_t} \right)^\alpha \left(\frac{L_t}{L_t} \right)^{1-\alpha} \Rightarrow y_t = (A_t k_t)^\alpha \quad (10)$$

Equation 10 denotes that output per worker is a function of capital per worker. The accumulation of physical capital can be depicted as;

$$\frac{dK_t}{dt} = I = S = s.Y_t \Rightarrow \dot{K}_t = s.Y_t \quad (11)$$

Further, we introduce financial sector in the economy. Financial sector mobilize consumers’ saving and advancing the loans to firms in the form of capital that firms use and invest. We assume that liberalization of financial sector (capital account) enhances mobilizing capacity of financial sector that in turn increases proportion of saving funded towards investment thus increase the accumulation of physical capital. In order to analyze the impact of CAL on the dynamic of physical capital and hence on growth rate of output we have to derive marginal productivity of capital. As the growth of knowledge and labor are constant, hence the

dynamic of the economy depends on the dynamic of capital (k). In per capita from equation 11 follows as:

$$\frac{\dot{K}_t}{L_t} = s \cdot \frac{Y_t}{L_t} \Rightarrow \frac{\dot{K}_t}{L_t} = s \cdot y_t \quad (12)$$

Taking derivative of the left hand side with respect of t , we get:

$$\frac{d\dot{K}_t}{L_t} / d_t = \dot{k}_t + nk_t$$

Putting the values in equation 12, we get:

$$\dot{k}_t + nk_t = s \cdot y_t \quad (13)$$

Solving the equation for $\dot{k}_t$ and put $y_t = f(k_t)$, equation 6 take the following form:

$$\dot{k}_t = sf(k_t) - nk_t \quad (14)$$

At the steady state, equation 14 implies $sf(k_t) = nk_t$ and $k_t = \frac{sf(k_t)}{n}$ where 's' is the portion of output that is save; as we assume that population grow at constant rate (i.e. $n = 1$), hence k_t equal to $k_t = sf(k_t)$, put the value of k_t in equation 10 and take first derivative with respect to k_t .

$$\hat{f}(k_t) = \alpha \cdot A \cdot (s \cdot f(k_t))^{\alpha-1} \quad (15)$$

Equation 15 states that portion of output that is save ' $sf(k_t)$ ' and technological progress A explains marginal productivity of capital. As we assume that producers operate in a perfectly competitive environment, hence the rate of return to capital ' R_t ' is equal to marginal productivity of capital. Therefore, equation 15 takes the following form;

$$R_t = \hat{f}(k_t) = \alpha \cdot A \cdot (s \cdot f(k_t))^{\alpha-1} \quad (16)$$

As earlier discussed, that R_t represents net marginal productivity of capital and equal to $R_t = r_t(1 + i_t)$. Whereas r_t represent the real interest

rate and i_t is the financial intermediation. Incorporating these information equation 16 take the following form:

$$r_t(1 + i_t) = \alpha \cdot A \cdot (s \cdot f(k_t))^{\alpha-1} \quad (17)$$

Solve equation 17 for r_t .

$$r_t = \alpha \cdot A \cdot (s \cdot f(k_t))^{\alpha-1} / (1 + i_t) \quad (18)$$

Put the value of r_t in equation 7

$$\frac{\dot{C}_t}{C_t} = -\frac{1}{\delta} \left[-\frac{\alpha \cdot A \cdot (s \cdot f(k_t))^{\alpha-1}}{(1 + i_t)} + (n + g) + \theta \right] \quad (19)$$

Since at the steady state $\frac{\dot{C}}{C} = \frac{\dot{k}}{k} = \frac{\dot{y}}{y}$, hence;

$$\frac{\dot{y}_t}{y_t} = -\frac{1}{\delta} \left[-\frac{\alpha \cdot A \cdot (s \cdot f(k_t))^{\alpha-1}}{(1 + i_t)} + (n + g) + \theta \right] \quad (20)$$

Equation 20 implies that at steady state growth of output is positively related to technological progress A_t and proportion of output that tended towards to saving $s \cdot f(k_t)$. Whereas; the margin of financial intermediation ' i ' is negatively related to steady state growth of output. In this framework capital account liberalization, affect steady state output growth through i_t . The idea is that a more liberalize capital account creates competition among financial intermediaries and hence reduce margin of financial intermediation i_t and thus affect positively growth of output.

3. Model Specification and Estimation Strategy

As mentioned earlier that this study aims to investigate how CAL affect long run growth process through its effects on accumulation of capital and productivity growth. In this context, we estimate two empirical models. The first, empirical model capture the impact of CAL on long run economic growth process that measures with growth of GDP per capita. The second model capture the impact of CAL on the sources of economic growth that is total factor productivity growth. Our empirical approach is based on a dynamic panel data of 14 Asian countries with annual observations spanning from 1980-2019. To get the purposed research exercise, following base line models have been empirically tested:

$$\begin{aligned} \text{GPCI}_{it} = & \beta_0 + \beta_1 \text{GPCI}_{it-1} + \beta_2 \text{CAL}_{it} + \beta_3 X_{it} + \mu_i + \alpha_t \\ & + \varepsilon_{it} \end{aligned} \quad (21)$$

$$\begin{aligned} \text{GTFP}_{it} = & \beta_0 + \beta_1 \text{GTFP}_{it-1} + \beta_2 \text{CAL}_{it} + \beta_3 X_{it} + \mu_i + \alpha_t \\ & + \varepsilon_{it} \end{aligned} \quad (22)$$

Where in our first empirical model (eq.21) the outcome variable is growth of GDP per capita GPCI_{it} observed at time t in country i . Among the explanatory variables GPCI_{it-1} is the lag of GDP per capital growth and CAL_{it} is our variable of interest. X_{it} is “vector of control variables”⁵. μ_i is the country-specific fixed effect that captures heterogeneity in the determinants of productivity specific to country i . α_t is the time-specific intercepts, which captures those changes in productivity that are common

⁵See appendix B for the definition and construction of variables while appendix C presents summary statistics

to all countries, ε_{it} is residual error term⁶. In our second empirical model (eq. 22) the outcome variable is the growth of total factor productivity $GTFP_{it}$, where, $GTFP_{it-1}$ is lag of dependent variable, the variable of interest is capital account liberalization CAL_{it} and X_{it} is vector of control variables.⁷

3.1 Estimation Methodology

In order to use appropriate estimation technique, we used the serial correlation test to ascertain whether serial correlation exists. In each specification “the results of the serial correlation check suggest the rejection of the null hypothesis of no serial correlation”. Keeping visible the results of all specifications, we tend to safely conclude that our model is dynamic in nature. To estimate a dynamic panel model, the appropriate estimation technique is GMM. Roodman (2007) argued that GMM developed by Arellano and Bond (1991) and Arellano and Bover (1995) is the estimation technique that is acceptable for dynamic model estimation. In case of panel data, GMM estimators has advantage over other estimators from three different aspects. First, GMM estimators handle the issues of serial correlation, and heteroskedasticity, hence provides efficient estimation than the simple Pooled OLS or 2SLS estimators (Soderbom, 2009). Second, GMM estimators capture the unobserved effects through regression differences or through instruments, therefore overcoming the problem of omitted variable bias. Third, it also utilize internal instruments using lag of dependent and previous observations of explanatory variables, and hence

⁶ μ_i, α_t , and ε_{it} holds same interpretation in all our empirical models.

⁷ Both empirical models have their own control variables.

avoiding endogeneity problem. Equations 21 and 22 can be written as follows after accounting for time specific effects:

$$GPCI_{it} = \alpha GPCI_{it-1} + \eta' CAL_{it} + \gamma' X_{it} + \eta_i + \varepsilon_{it} \dots \dots \dots (23)$$

$$GTFP_{it} = \alpha GTFP_{it-1} + \eta' CAL_{it} + \gamma' X_{it} + \eta_i + \varepsilon_{it} \dots \dots \dots (24)$$

The process of estimation evolves by taking first differences which will remove the unobserved period and country specific effects, hence ruling out the possibility of omitted variable biasness therefore equations 23 and 24 take the following form;

$$\begin{aligned} & GPCI_{it} - GPCI_{it-1} \\ &= \alpha(GPCI_{it-1} - GPCI_{it-2}) + \eta'(CAL_{it} - CAL_{it-1}) + \gamma'(X_{it} - X_{it-1}) \\ &+ (\varepsilon_{it} - \varepsilon_{it-1}) \dots \dots \dots (25) \end{aligned}$$

$$\begin{aligned} & GTFP_{it} - GTFP_{it-1} \\ &= \alpha(GTFP_{it-1} - GTFP_{it-2}) + \eta'(CAL_{it} - CAL_{it-1}) + \gamma'(X_{it} - X_{it-1}) \\ &+ (\varepsilon_{it} - \varepsilon_{it-1}) \dots \dots \dots (26) \end{aligned}$$

We assume that the new error term $(\varepsilon_{it} - \varepsilon_{it-1})$ is not serially correlated and the GMM dynamic panel estimator have the following moment conditions

$$E[GPCI_{it-2} \cdot (\varepsilon_{it} - \varepsilon_{it-1})] = 0 \dots \dots \dots (27)$$

$$E[GTFP_{it-2} \cdot (\varepsilon_{it} - \varepsilon_{it-1})] = 0 \dots \dots \dots (28)$$

$$E[CAL_{it-2} \cdot (\varepsilon_{it} - \varepsilon_{it-1})] = 0 \dots \dots \dots (29)$$

$$E[X_{it-2} \cdot (\varepsilon_{it} - \varepsilon_{it-1})] = 0 \dots \dots \dots (30)$$

For $t = 1 \dots \dots T$ as we have a short sample size of cross-sectional, hence we have restricted our moment conditions to three only. Roodman (2007) argued that so many moment conditions should create over fitting bias. The GMM estimators based on equations 4, 5, and 6 are called the difference GMM estimators, however the difference GMM estimator has some important shortcomings as specified by Alonso-Borrego and Arellano (1999), and Bond et.al (2001). That are, in case of difference regression equation lagged level of variables are weak instruments that in turn causes biasness and inefficiency in the estimated regressions. Hence, to reduce the potential pitfall in difference estimator, we use the system GMM. The moment conditions for the regression in levels are given as:

$$E[GPCI_{it} \cdot (\eta_i + \varepsilon_{it})] = 0 \dots \dots \dots (31)$$

$$E[GTFP_{it} \cdot (\eta_i + \varepsilon_{it})] = 0 \dots \dots \dots (32)$$

$$E[GL_{it} \cdot (\eta_i + \varepsilon_{it})] = 0 \dots \dots \dots (33)$$

$$E[X_{it} \cdot (\eta_i + \varepsilon_{it})] = 0 \dots \dots \dots (34)$$

Using moment conditions presented in equations 27 to 34 we can generate GMM estimates by the following formula developed by Arellano and Bond (1991), and Arellano and Bover (1995).

$$\hat{\theta} = (X'Z\hat{\varphi}^{-1}Z'X)^{-1}X'Z\hat{\varphi}^{-1}Z'\bar{S} \dots \dots \dots (35)$$

Where θ is the vector of parameters to be estimated, X is the matrix of explanatory variables including lag of dependent variable Z is the matrix of instruments, φ is the constant estimate of the variance-covariance matrix of the moment conditions. $\bar{S}$ is the dependent variable fixed both in differences and levels. To test the validity of instruments, we use two specification tests suggested by Arellano and Bover (1995). The first is the Sargan test to check validity of all instruments used. The Sargan test examines the “null hypothesis of validity of over identifying instruments against its invalidity”. The second test is the test of serial correlation to test whether error terms are second order serial correlated or not.

4. Empirical Findings

As we have two empirical models, therefore we approach the empirical findings with different subsections. The first subsection 5.1 presents findings of our first empirical model where growth of GDP per capita is our dependent variable. The second subsection 5.2 presents findings of our second empirical model where the dependent variable is growth of TFP. Finally, subsection 5.3 presents robustness of proposed empirical models.

4.1 Capital Account Liberalization and Growth of Real GDP Per Capita

Table 1 shows the estimated results of our proposed empirical model 1, where we regressed growth of GDP per capita ($GPCI_{it}$) on capital account liberalization (CAL_{it}) along with a set of control variables. Table presents

estimated results of different specifications of our extended growth equation. Among the explanatory variables, lagged dependent variable (*Lag Dep.*), physical capital ($PHYC_{it}$), human capital (HC_{it}), inflation (INF_{it}) and population growth ($POPG_{it}$) are common to all specifications. Whereas, capital account liberalization (CAL_{it}) is our variable of interest, institutional quality (IQ_{it}) is channel variable, and $(CAL * IQ)_{it}$ is the interaction term, which show the conditional effect of capital account liberalization on dependent variable i.e. growth of GDP per capita.

The estimated results show that in all specifications the variable of interest capital account liberalization (CAL_{it}) holds positive sign that is statistically significant, which indicates its beneficial impact on economic growth of the sample countries. The following reasons may explain why. First, capital account liberalization should carry allocation effects as specified in received literature on the subject, such as it allows for risk diversification across countries indicated by ([Obstfeld & Rogoff, 1994](#)); ([Soto, 2003](#)); ([Baltagi, Egger, & Pfaffermayr, 2007](#)); reduce cost of capital ([Bekaert & Harvey, 1995](#)); ([Henry, 2007](#)); generate international competition ([Rogoff, 1999](#)); and ([Summars, 2000](#)), improve domestic financial system ([Klein & Olivei, 1999](#)); and ([Levine, 2001](#)); ([Soto, 2003](#)); ([Samouel, 2008](#)); ([Zenasani and Behabibi, 2012](#)), hence fostering allocative efficiency. Second, capital account liberalization should prove beneficial for economic growth in the sample countries as it develop domestic financial system, which in turn minimize financial constraints providing incentive for invention, innovation, and technological development, hence promote productivity growth ([King & Levine, 1993](#)); ([Acemoglu & Zilibotti, 1997](#)); ([Beck et al., 2000](#)); ([Acemoglu et al., 2001](#)); ([Aghion, Bloom, Blundell, Griffith, & Howitt, 2005](#)), ([Henry & Sasson, 2008](#)); ([Bekaet et al. 2010](#)). Third, comparable with standard neoclassical theory of investment, liberalization of capital account shrink cost of capital, ease private investment and therefore stimulate growth process ([Arteta et al., 2001](#)); ([Bussiere & Fratzscher, 2008](#)); ([Rehman & Hayat, 2017](#)); ([Obstfeld, 2007](#)); ([Rodrik, 1998](#)).

Table 1: Estimated Results of Empirical Model 1 (Dependent Variable is Growth of GDP Per Capita)

Variable	Spec_1	Spec_2	Spec_3
Lag Dep.	-0.1155*** (0.006)	-0.1443*** (0.001)	-0.1118*** (0.004)
PHYC _{it}	0.0151*** (0.000)	0.0158*** (0.000)	0.0185*** (0.000)
HC _{it}	0.0085** (0.041)	0.01152* (0.060)	0.0103*** (0.000)
INF _{it}	-0.0014*** (0.000)	-0.0025*** (0.000)	-0.0017*** (0.000)
POPG _{it}	-0.0094*** (0.001)	-0.0118*** (0.000)	-0.0136*** (0.000)
CAL _{it}	0.0046*** (0.001)	0.0052*** (0.000)	0.0063*** (0.000)
IQ _{it}	-----	0.0017*** (0.001)	0.0094*** (0.000)
(CAL * IQ) _{it}	-----	-----	0.0571** (0.021)
No of Obs.	546	546	546
No. of Inst.	126	126	124
P. Value of Auto-Corr.	0.33	0.94	0.78
Sargan Test	323.41	292.93	305.21
P-value	0.33	0.39	0.38

Note: P-value is in parenthesis, ***, **, * shows level of significance at 1%, 5%, and 10% respectively

In specification 2 (column 3), we include institutional quality (IQ_{it}) as an explanatory variable, which have positive sign and statistically significant. The results indicate that country having own relatively sound institutions enjoy higher economic growth. Touching the role of institutions in the capital account liberalization and economic growth nexus, in specification 3 (column 4) the interaction term of capital account liberalization and institutions ($CAL * IQ$)_{it} used as a regressor. The basic motivation behind the conditional effect is to check Lucas (1990)

paradox, which forward the claim that capital account liberalization cannot improve global allocative efficiency, and argued that weak institutions in developing countries overlap the positive affect of higher marginal productivity of capital, hence instead of capital inflow, capital account liberalization leads flight of capital from developing countries. However, in our case the interaction term enters the model positively and significantly, indicates that in the sample countries capital account liberalization can do best in the rise of the growth of GDP per capita when the country holds strong institutions. The results of interaction term point toward the inference that in the existence of strong institutions, developing countries adores marginal productivity of capital, as a result of capital account liberalization capital influx instead flight from developing countries.

Control variables physical capital ($PHYC_{it}$), human capital (HC_{it}), inflation (INF_{it}) and population growth ($POPG_{it}$) are common to all specifications. Results presented in table 1 reveals that in all specifications physical capital ($PHYC_{it}$) is statistically significant with expected positive sign which substantiate the fact that physical capital plays a significant role in the growth process of the selected Asian countries. Similarly, human capital (HC_{it}) also enters the model significantly and with positive sign, indicate that country enjoy higher economic growth that holds higher level of human capital. Our next control variable inflation (INF_{it}) holds negative sign that is statistically significant. This implies that economic growth of the sample countries gets shrink as inflation surges. The variable population growth ($POPG_{it}$) which is significant with expected negative sign is according to the neoclassical growth model that higher the population growth lower would be the steady-state value of per capita income. This result is also in line with extended neoclassical growth model of Mankiw et al. (1992).

In all specifications, the coefficient of lag dependent variable ($LagDep.$) is negative and statistically significant. This implies that in the sample countries there is a tendency for poor countries to grow faster on average than their rich counterparts.

4.2 Capital Account Liberalization and Growth of TFP

As discussed prior in the introductory section that along with the effect of CAL on economic growth, the study is devoted to analyze its impact on

sources of economic growth. In this context, the section of the study presents estimated results and interpretation of our second empirical model, where dependent variable is growth of TFP. Table 2 presents estimated results of our second empirical model, in the table among the explanatory variables, lagged dependent variable (*Lag Dep.*), Imported Technology (*IMPTECH_{it}*), Human Capital (*HC_{it}*), Financial Sector Development (*FD_{it}*), Infrastructure (*INFRAS_{it}*) and Capital Intensity Deeping (*CADEEP_{it}*) are control variables that are common to all specifications. Whereas, capital account liberalization (*CAL_{it}*) is our variable of interest, institutional quality (*IQ_{it}*) is channel variable, and (*CAL * IQ*)_{it} is the interaction term, which show the conditional effect of capital account liberalization on dependent variable, growth of TFP.

Table 2: Estimated Results of Empirical Model 2 (Dependent Variable is TFP Growth)

Variables	Spec_ 1	Spec_2	Spec_ 3
Lag Dep.	0.6272*** (0.000)	0.5502*** (0.000)	0.5574*** (0.000)
HC _{it}	0.0424** (0.041)	0.0160 (0.391)	0.0074 (0.684)
IMPTECH _{it}	0.0002** (0.034)	0.0037** (0.031)	0.0036** (0.042)
FD _{it}	0.0025* (0.057)	0.0028** (0.012)	0.0026** (0.022)
INFRAS _{it}	0.0039** (0.000)	0.0025** (0.024)	0.0025** (0.021)
CADEEP _{it}	0.0041*** (0.000)	0.0045*** (0.000)	0.0049*** (0.000)
CAL _{it}	0.0014** (0.024)	0.0038** (0.022)	0.0053*** (0.001)
IQ _{it}	-----	0.0014*** (0.001)	0.0076*** (0.008)
(CAL * IQ) _{it}	-----	-----	0.0513*** (0.000)
No of Obs.	412	394	394
No. of Instruments	128	129	128
P. Value of Auto-Corr.	0.87	0.42	0.55
Sargan Test	260.52	240.61	241.91
P-value	0.61	0.52	0.51

Note: P-value is in parenthesis, ***, **, * shows level of significance at 1%, 5%, and 10% respectively.

The estimated results presented in Table 2 show that in all specifications the variable of interest capital account liberalization (CAL_{it}) holds positive sign that is statistically significant, which indicates its beneficial impact on the growth of TFP in the sample countries. The result should be justified with productivity channel as stated in the existing literature ([Acemoglu et al., 2001](#)); ([Aghion et al., 2005](#)); ([Henry & Sasson, 2008](#)); Bekaet et al. 2010). Such as ([Acemoglu et al., 2001](#)) and ([Aghion et al., 2005](#)) argued that financial liberalization develop domestic financial system, ease invention, innovation, and technological development that in turn enhance growth of TFP. Similarly, ([Henry & Sasson, 2008](#)) argued that capital account liberalization minimize financial constraint and therefore encourage production units to rotate reasonable resources towards R&D and human capital accumulation that sequentially boost productivity growth.

In specification 2 (column 3), we include institutional quality (IQ_{it}) as an explanatory variable, which have positive sign and statistically significant. The result indicates that country having own relatively sound institutions enjoy higher growth of TFP. Touching the role of institutions in the capital account liberalization and TFP growth nexus, in specification 3 (column 4) the interaction term of capital account liberalization and institutions ($CAL * IQ$)_{it} use as a regressor. The interaction term enters the model positively and significantly, indicates that in the sample countries capital account liberalization can do best in the rise of the growth of TFP when the country holds strong institutions. The result of interaction term indicate that institutional quality play a complementary role in the capital account liberalization and economic growth nexus. The result point towards the fact that sample countries can reap potentially the positive impact of capital account liberalization in the TFP growth process by improving quality of its institutions.

Control variables Human Capital (HC_{it}), Imported Technology ($IMPTECH_{it}$), Financial Sector Development(FD_{it}), Infrastructure ($INFRAS_{it}$)and Capital Intensity Deeping ($CADEEP_{it}$) are control variables that are common to all specifications. Results presented in table 2 reveals that in all specifications Imported Technology ($IMPTECH_{it}$), holds positive sign which is statistically significant. The result indicate that country exercising trade policies that encourage import of technology can improve growth of TFP. Similarly, domestic financial sector development (FD_{it}) also enters the model significantly and with positive

sign, point toward the outcome that country enjoy higher TFP growth that holds sound financial sector. Similarly, our next control variable infrastructure ($INFRAS_{it}$) enters the model positively that is statistically significant. This implies that in the sample countries growth of TFP increase as infrastructure developed. Lastly, the significant and positive coefficient of the lag dependent variable ($LagDep.$) indicates that growth of TFP is positively associated with its lag value.

4.3 Robustness Checks

Keeping in view nature of our empirical models that are dynamic in nature, hence we used GMM estimation technique for our empirical estimations. We use Sargan test to check the validity of instruments. As the null hypothesis of Sargan test is “*over identifying restrictions are valid*”. In all specifications of both empirical models (Table 1 and 2) the P values of Sargan test shows that null hypothesis is not rejected, implies that in all specifications the instruments are correctly specified. Moreover, the P value of second-order serial correlation presented in Tables 1 and 2 indicates that the null hypothesis “*no serial correlation*” is not rejected. Hence we cannot reject the validity of the proposed instrument (one lag of dependent variable is valid instrument) and cannot allow for higher order lags of the dependent variable.

5. Conclusion

Key objective of the study is to explore the impact of capital account liberalization on the pace of economic growth. Unlike the received literature on subject, the contribution of this study lies in two ways. Firstly, we develop a theoretical model grounded in the neoclassical growth framework, allowing us to assess the effects of CAL on economic growth. Secondly, unlike existing empirical studies, we examine the impact of CAL on both economic growth and its underlying sources. In both estimates, findings of the study reveal that in the sample countries that growth of GDP per capita and growth of TFP moving parallel with CAL. This indication moved toward our result that in both empirical models the variable of interest (CAL) holds positive sign that are statistically significant.

Touching upon the role of institutions, results of the study shows that in the sample countries institutional quality enhance the positive impact of

CAL on the pace of economic growth and TFP growth. This signal catches up on the findings that in both empirical models, the interaction term enters the model significantly and with positive sign. The positive and significant coefficients of interaction terms validate the complementary role of institutional quality in the growth effectiveness of capital account liberalization in case of selected Asian countries. Define it alternatively, country that own relatively sound institutions can potentially reap the benefits of CAL in the form of high pace of economic growth and TFP growth.

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Appendices

Appendix A: List of Selected Asian Countries

Bangladesh	Indonesia	Nepal	Sri Lanka
Bhutan	Korea, Rep	Pakistan	Thailand
Hong Kong	Malaysia	Philippines	
India	Maldives	Singapore	

Appendix B: Definitions and Constructions of Variables under Consideration

Variables	Description	Definition and Construction	Source
Dependent Variable	GDP per capita growth ($GPCI_{it}$)	In our first empirical model “the dependent variable is growth of GDP per capita which is measured with Log differences of real GDP per capita”	Penn World Table 9.0
Dependent Variable	Total Factor Productivity ($GTFP_{it}$)	In our second empirical model the dependent variable is growth of total factor productivity. TFP generally estimated with two different methods. One is Solow residual approach that is statistically calculated by the decomposing of the variance of output into that referable to the conventional factors of production and that attributable to others factors See for example Kelewow&Ridrugyez-Clare (1997). Second, is the “Hall and Jones (1999) approach of the decomposition of output that made some assumptions about the production function and its parameters Assume constant returns to scale and perfect competition. In this study, we used the second method to estimate TFP. Assume the Cobb-Douglas production technology	Authors’ own collocation using Penn World Table 9.0 data set.

		with two factors of production, physical capital stock K, and human capital augmented labour HL“. The production function takes the following form. $Y = \varphi(K^\alpha HL^{1-\alpha})^\beta$ Where“φ is TFP, α, and $1 - \alpha$ measure the share of physical capital stock and human capital augmented labor respectively. β measure of returns to scale in this we assume constant returns to scale. Taking log and differentiating equation 1 with respect to time“. We get. $\begin{aligned} \ln Y &= \ln \varphi \\ &+ \beta[\alpha \ln K \\ &+ (1 - \alpha) \ln HL] \end{aligned}$ $\frac{d \ln Y}{dt} = \frac{d \ln \varphi}{dt} + \beta \left[\alpha \frac{d \ln K}{dt} + (1 - \alpha) \frac{d \ln HL}{dt} \right]$ $\begin{aligned} gY &= g\varphi \\ &+ \beta[\alpha gK \\ &+ (1 - \alpha)gHL] \end{aligned} \quad (3)$ $\begin{aligned} g\varphi &= gY \\ &- \beta[\alpha gK \\ &+ (1 - \alpha)gHL] \end{aligned} \quad (4)$ Where $g\varphi$ is growth of TFP (Solow residual) which is equal to growth rate of output gY minus the weighted growth rates of capital stock gK and human capital augmented labor gHL.	
Independent Variable	Capital Account Liberalization (CAL_{it})	“Chinn and Ito (2006) developed an index to measure a country’s degree of capital account openness“. The index is de-jure in nature as it based on reported	The updated index of Kaopen is available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm

28 Capital Account Liberalization, Institutions and Economic Growth:
Evidence from Selected Asian Countries

		restrictions. The index value is normalized between zero and one, value closer to one indicates more openness of a country to cross border capital transactions. Updated by Chinn and Ito (2017).	
Control Variable	Population Growth (POPG _{it})	Adjusted Population growth rate with technological progress rate and depreciation rate.	Population annual (%) is taken from WDI, World Bank (2017) and adjusted with technological progress (2%), and depreciation (5%).
Control Variable	Human Capital (HC _{it})	Index of average years of schooling and the return to education.	Data on human capital is taken from Penn World Table 9.0 data set developed by
Control Variable	Inflation (INF _{it})	Inflation is measured by the Consumer Price Index (CPI)	The data of CPI is taken from WDI, World Bank (2019)
Control Variable	Institutional Quality (IQ _{it})		World Governance Indicators, World Bank
Control Variable	Financial Sector Development (FD _{it})	Composite index of Money supply (M3), Bank credit to private sector, and Stock market capitalization	Author own calculation, using principal component analysis
Control Variable	Imported Technology (IMPTECH _{it})	Imports of machinery and transport equipment as a percent of total imports.	UN COMTRADE Statistics
Control Variable	Capital Intensity Deeping (CADEEP _{it})	Capital per GDP or Investment Rate	WDI, World Bank
Control Variable	Physical Infrastructure (INFRAS _{it})	Composite index of different indicators of transport and telecommunication	WDI, World Bank

Appendix C: Descriptive Statistics of Variables under Consideration

Variables	Mean	Std. Dev	Min	Max
GPCI _{it}	.0566	.0379	-.1407	.2727
TFP _{it}	.89936	.14202	.523137	1.2460
HC _{it}	1.93945	.58336	1.0444	3.5936
INF _{it}	7.9089	6.974	-23.822	58.3870
IQ _{it}	57.9146	20.6275	20	100
FD _{it}	-.10914	1.3748	-3.5585	4.33306
POPG _{it}	.64438	.51047	-1.5767	1.6848
CAL _{it}	.40968	.29480	.16480	1
CADEEP _{it}	4.90512	6.1572	-7.699	33.9548
PHYC _{it}	28.09148	10.1780	.79419	60.7819
IMPTECH _{it}	13.777	14.537	.35389	57.3961
INFRAS _{it}	.04406	1.85605	-4.5201	5.4146

Geopolitical Tensions and their Impact on the International Economy: A Case Study of the Russian-Ukrainian Conflict

Suada A. Džogović¹ and Zijad Šabotić²

ABSTRACT

The Russian-Ukrainian crisis is a tragedy for the Ukrainian people, but also for Europe and the whole world in general. We will all feel its consequences, although what we see cannot be compared to the suffering of innocent civilians. This study aims to assess the current situation and examine the economic impact of the war on the international economy. Since Russia is one of the world's largest gas and oil exporters, while Ukraine and Russia are also a large producer of goods and raw materials for everyday needs, it is clear that no financial market is independent of current movements and events. This article uses the trend method to monitor the movement of GDP at the global level, the measures of international trade policy under the auspices of the war in Ukraine, the migration of war refugees from Ukraine, and the movement of financial stress (FSI). Based on the results, we observe variability with an increasing trend, which indicates caution in global financial frameworks. However, it should be emphasized that the uncertainty surrounding the economic prospects is great because it is unknown how the war will continue.

ملخص

إنَّ الأزمة الروسية-الأوكرانية مأساة للشعب الأوكراني، ولكن أيضًا لأوروبا والعالم بأسره بشكل عام. سنشعر جميعًا بعواقبها، على الرغم من أن ما نراه لا يمكن مقارنته بمعاناة المدنيين الأبرياء. تهدف هذه الدراسة إلى تقييم الوضع الحالي وفحص التأثير الاقتصادي للحرب على الاقتصاد الدولي. بما أن روسيا واحدة من أكبر مصدري الغاز والنفط في العالم، في حين أن أوكرانيا وروسيا أيضًا منتجين رئيسيين للسلع والمواد الخام الضرورية للاحتياجات اليومية، فمن الواضح أن أي سوق

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مالي ليس مستقلاً عن التحركات والأحداث الجارية. يستخدم هذا المقال طريقة الاتجاه لرصد حركة الناتج المحلي الإجمالي على المستوى العالمي، ومقاييس سياسة التجارة الدولية في ظل الحرب في أوكرانيا، وهجرة لاجئي الحرب من أوكرانيا، وحركة الضغط المالي (FSI). استناداً إلى النتائج، نلاحظ تبايناً مع اتجاه متزايد، مما يشير إلى توشي الحذر في الأطر المالية العالمية. ومع ذلك، يجب التأكيد على أن حالة عدم اليقين التي تحيط بالآفاق الاقتصادية كبيرة لأنه من غير المعروف كيف ستستمر الحرب.

RÉSUMÉ

La crise russo-ukrainienne est une tragédie pour le peuple ukrainien, mais aussi pour l'Europe et le monde entier en général. Nous en subissons tous les conséquences, même si ce que nous voyons n'est pas comparable à la souffrance des civils innocents. Cette étude vise à évaluer la situation actuelle et à examiner l'impact économique de la guerre sur l'économie internationale. La Russie étant l'un des plus grands exportateurs de gaz et de pétrole au monde, tandis que l'Ukraine et la Russie sont également de grands producteurs de biens et de matières premières pour les besoins quotidiens, il est clair qu'aucun marché financier n'est indépendant des mouvements et des événements actuels. Cet article utilise la méthode des tendances pour suivre l'évolution du PIB au niveau mondial, les mesures de la politique commerciale internationale sous les auspices de la guerre en Ukraine, la migration des réfugiés de guerre en provenance d'Ukraine et l'évolution du stress financier (FSI). Selon les résultats, nous observons une variabilité avec une tendance à la hausse, ce qui indique une certaine prudence dans les cadres financiers mondiaux. Toutefois, il convient de souligner que l'incertitude entourant les perspectives économiques est grande car on ne sait pas comment la guerre va se poursuivre.

Keywords: Russian-Ukrainian Crisis, Consequences, International Economy, Perspectives, Financial Stress, The Growth Trend

JEL Classification: F01, F4, F5, F51

1. Introductory considerations

Back in 2021, Russia began to build up military forces near the eastern border with Ukraine. This act of Russia certainly caused concern in Ukraine, Europe, and the world, and all possible scenarios were considered. Russian President Vladimir Putin on February 21, 2022,

according to the previously adopted decision of the Lower House of the Russian Parliament a week earlier, decided to recognize the areas of the Ukrainian administrative regions of Donetsk and Luhansk as independent and began to send the army to those areas massively.

The Russian invasion of Ukraine, which began on February 24, 2022, is still ongoing and has various consequences for Ukraine and society in the world. These consequences are visible in a large number of dead and wounded, the destruction of Ukrainian regions, and the refugee and humanitarian crisis. At the same time, the consequences of the conflict are felt in all spheres - health, security, and of course, the global economy.

The commencement of the Russian invasion of Ukraine can be traced back to 2014, marked by the Russian assault on Crimea, which subsequently resulted in a significant refugee crisis. According to data provided by the Internal Displacement Monitoring Centre (IDMC, 2022), over 8.4 million Ukrainians sought refuge outside their homeland, leading to the displacement of nearly one-third of the country's population. In parallel with the annexation of Crimea, supported by separatist factions aligning with Russia, the occupation extended to a portion of the Donbas region situated in the southeastern part of Ukraine.

The specificity of the new situation is complicated because Europe and the world have not recovered from the consequences of the COVID-19 pandemic. The Russian invasion of Ukraine caused numerous consequences, although the international community has given great support to this country and condemned the crimes that are taking place on its territory. But despite introducing various sanctions against Russia, which also affected its economy and development, the conflicts continue in full swing. Almost ten years ago, on March 27, 2014, at the 80th plenary session of the 68th session of the UN General Assembly, Resolution A/RES/68/262 was adopted to resolve the armed conflict and the Russian occupation. (The New York Times, 2014)

The global economy and society, in general, have been affected by the COVID-19 pandemic in the last two years before the conflict in Ukraine, and numerous lockdowns and restrictions have further shaken society and its growth. The world economy had not recovered when the Russians launched their invasion in February 2022, nor was it at pre-pandemic levels. Problems at the global level concerning the economy and price

increases are accompanied by pressures and concerns for the safety of investors, but also consumers, which resulted in a lack of investment/purchases, and a decrease in global demand for imports not only in the affected regions of Ukraine but also at the world level.

In response to the invasion, European countries, members of the European Union, and other countries of the world (primarily America, Japan, etc.) launched numerous initiatives. They decided to sanction and punish Russian policies and prevent the worsening humanitarian, security, and economic crises.

Thus, immediately after learning about the Russian attacks, the Council of the European Union on February 23 adopted the first package of sanctions against Russia to pressure this country to end the conflict with Ukraine. These measures initially included targeted sanctions against members of the Russian parliament, restrictions on certain manufacturers, etc.

The agreed package includes targeted sanctions against 351 members of the Russian State Duma and 27 other individuals, restrictions on economic relations with areas of Donetsk and Lugansk regions that are not under government control, restrictions on Russia's access to capital and financial markets, and EU services. (Council of the European Union, 2022a)

During the Council of the European Union convening on February 24, 2022, a resolution was passed, urging the Russian Federation to promptly cease all military operations in Ukraine. The Council emphasized the imperative for the withdrawal of military personnel and equipment from Ukrainian territory, underscoring the vital principles of respecting Ukraine's territorial integrity, sovereignty, and adherence to international law. Simultaneously, the Council called for an end to disinformation campaigns and cyberattacks targeting Ukraine.

Regrettably, the directives mentioned failed to elicit compliance, as President Putin persisted in deploying military forces to Ukraine. Consequently, in response to the escalating crisis, the international community found it necessary to institute additional sanctions. It is

noteworthy that these sanctions, akin to the ongoing conflict, are poised to exert a profound impact on the global economy.

In March 2022, the fourth set of sanctions was introduced, which was the most severe until then and included: a ban on the import of certain metal products; a ban on new tariffs for the Russian energy sector, with limited exceptions for civilian nuclear power and transport of other energy sources to the EU; the ban on the export of luxury goods from the EU; as well as restrictions on EU agencies in assessing the credit rating of Russia and Russian companies and providing rating services to Russian clients. (Radiosarajevo, 2022)

This set of sanctions constitutes merely a singular aspect within a more extensive array of measures. The Council of the European Union, in conjunction with other nations, will continuously scrutinize the dynamic situation, imposing supplementary sanctions as deemed requisite. Particularly noteworthy is a paramount and intricate economic sanction on a global scale about the governance of gas and energy resources.

At the convened session of the Council of the European Union on June 23, 2022, Ukraine achieved the status of a candidate country for European Union membership. The Council reaffirmed its resolute dedication to furnishing steadfast assistance to Ukraine across diverse domains, including military, financial, humanitarian, and political dimensions. This support framework operates in synergy with coordinated endeavors to impose sanctions on Russia, thereby aiming to halt the persisting hostilities against Ukraine.

Efforts to enhance the enforcement of sanctions will persist. The European Council appeals to all nations, with a particular emphasis on candidate countries, to adhere to the sanctions imposed by the European Union (EU). Furthermore, EU leaders attribute responsibility to Russia for exacerbating the global food crisis and utilizing it as a weapon. They urge Russia to promptly cease targeting facilities related to food production in Ukraine and to lift the blockade on Black Sea ports, thereby facilitating the export of grain. (Council of the European Union, 2022b)

Other countries also continue to consistently provide ongoing support and assistance to Ukraine. "The United States thus provided Ukraine with military aid worth 24 billion euros, 9 billion in humanitarian aid, and 10 billion in financial aid." (...) In addition to the USA, the British also sent large military aid to Ukraine." (Asipi, 2022) Beyond the contributions from the United States and the United Kingdom, countries such as France, Estonia, Poland, Canada, Norway, Sweden, and numerous others have similarly extended aid to Ukraine in various forms.

The primary focus of this paper is to investigate the Russian-Ukrainian conflict and its potential impact on the global economic system. The research questions of this study delve into the intricate dynamics of the conflict and its far-reaching implications. The chosen methodology for this exploration is trend analysis, with a specific emphasis on employing the semi-average technique across all four iterations of the application.

Through the systematic application of the semi-average technique, this research aims to meticulously scrutinize the evolving dynamics of phenomena influenced by persistent factors. Moreover, the method is strategically employed to adjust and forecast time series, offering valuable insights into the subject matter. This approach enables a comprehensive understanding of the ongoing developments in the Russian-Ukrainian conflict and their potential ramifications for the global economic landscape.

In the initial instance, global Gross Domestic Product (GDP) evolution is systematically monitored, regardless of conflict-related events, along with examining the counterfactual scenario in which no conflict occurred. The subsequent case involves the analysis of measures about international trade policy within the context of the Russian-Ukrainian conflict. The third case investigates the migratory patterns of refugees immediately preceding and concurrent with the initiation of aggression against Ukraine. In contrast, the fourth case observes the worldwide fluctuations in the Financial Stress Index (FSI).

The specific objective of this investigation is to employ the gathered data for the identification of high frequencies capable of detecting subsequent changes in the financial market and to provide timely alerts to the market during impending periods of stress.

The article initiates an examination of the worldwide economic crisis, commencing with an evaluative discourse on the conflict within the geographical confines of Ukraine and the consequential ramifications of global sanctions imposed upon Russia. Subsequently, an exploration ensues into the broader global repercussions stemming from the aforementioned conflict, focusing on the economic fortitude exhibited by Ukraine and its consequential influence on the global milieu. Ultimately, the narrative culminates in a meticulous scrutiny of data and an ensuing discourse, concluding with a comprehensive conclusion.

2. Literature review

The geopolitical turmoil arising from the conflict in Ukraine, coupled with international sanctions on Russia, has triggered a multifaceted crisis with far-reaching implications for the global economy. As the Council of the European Union collaborates with nations worldwide to enforce sanctions, Russia's integration into the global market undergoes variable degrees of isolation. This scenario unfolds against the backdrop of the lingering effects of the COVID-19 pandemic, exacerbating challenges in the world economy. With Russia's significant role in producing and exporting goods and energy products, the impact resonates through disrupted supply chains, escalating prices, and a discernible deceleration in global economic growth. This part of research delves into the intricate dynamics and repercussions of these developments, shedding light on the interconnectedness of economic systems on an international scale.

2.1. The Global Economic Crisis: Analyzing the Conflict in Ukraine and the Implications of International Sanctions on Russia

The Council of the European Union, in collaboration with the international community comprising individual nations, has consistently implemented sanctions since the onset of the conflict. These sanctions have variably isolated Russia from the global market. Concurrently, the repercussions of these measures reverberate profoundly throughout the world economy, which is grappling with the lingering effects of the COVID-19 pandemic. This impact is particularly pronounced due to Russia's significant role in the production and exportation of goods and energy products.

The cumulative effect of these developments has given rise to a multitude of disruptions and challenges, most notably manifesting in the global supply chains of goods. Observable consequences include shifts in prices, exemplified by the escalation of goods prices. These dynamics contribute to a discernible deceleration in global economic growth and prosperity. Importantly, this phenomenon extends beyond the conflict-ridden regions of Ukraine and other parts of Europe, casting its influence on a global scale.

Warnings also come from the Research Service of the US Congress (CRS) that additional sanctions could worsen the economic situation at the global level "resulting in different economic blocs, but also in schisms that could undermine international rights based on the economic order defined after the Second World War." (Congress Research Service [CRS], 2022a)

The reports of the International Monetary Fund from May 2022 are not at all optimistic. An analysis conducted within the framework of the International Monetary Fund (IMF) indicates that global economic growth will slow down from 6.1% in 2021 to 3.6% in 2022. (Al Jazeera, 2022a) According to Markus (2022), Russia's biggest economic partner was the European Union, and Europe itself is dependent on energy imports from Russia (especially gas). The author claims that not only war but also Western sanctions will have a major impact on world trade.

As the producer of 11% of the world's oil and 25% of the world's oil and natural gas reserves, Russia will continue to influence the energy market. Meanwhile, a growing boycott of Russian energy could create losses for companies like BP and Shell, raising prices and fueling global inflation. Sanctions are also accelerating structural shifts toward renewables and liquefied natural gas, especially in Europe. (Markus, 2022: 11)

However, oil or gas prices are not the only problems, because Russia is the largest producer of precious metals, the third largest exporter of metals in the world, and the sale of fertilizers.

(...) whereby many developing countries in Africa, Latin America, and Asia rely on Russia for affordable harvests. Disruptions in these trade flows, combined with a decline in Ukrainian agricultural exports, mainly grains and vegetable

oils, threaten global food markets. Separately, the restriction of Russian airspace (to the ban on Russian airlines by Western countries) for 38 countries—including the entire EU, Great Britain, and Canada—will increase costs for airlines, as they have to take other routes. (Markus, 2022: 15)

All other industries also suffer major negative implications. Markus (2022) analyzes the sanctions, including the automobile industry, and observes that large companies are going through problems and disruptions, especially those that have their production facilities in Russia. "More seriously, the Russian government has threatened to nationalize assets left in the country by Western multinationals." At the same time, the revenues of global players in Russia are relatively low, since Russian consumers represent only a fraction of the global market. (Markus, 2022: 17)

Ellyatt (2022) states that the war in Ukraine causes large negative changes in total debt, distorting global growth potential and causing significant changes in exchange rates.

Global economic growth in 2023 will be at least 1 percentage point lower than projected, while global inflation could rise even more by around 2.5%. The price increases due to the conflict are increasing the debt burden, reducing the development budget of many countries already affected by the COVID-19 pandemic. These economic impacts reinforce the vicious cycle of indebtedness and low productivity. (Ellyatt, 2022)

According to Redeker's (2022) analysis from March 2022, there are two ways in which countries will be affected by the war in Ukraine in the context of the global economy. "First, this will be reflected through direct dependence on the Russian market in the context of energy imports. The second segment will be reflected in the rising gas, oil, and coal prices in global energy markets due to the current conflict." (Redeker, 2022: 2)

We are witnessing these processes and phenomena today. Redeker (2022) believes that this unequal distribution of economic difficulties among the members of the European Union (but also the rest of Europe or the world) represents not only an economic problem but also a political one.

This phenomenon can be attributed to the inherent economic disparities and varying levels of societal prosperity among European nations. The imposition of sanctions and the broader conflict in Ukraine will not exert uniform effects across these countries. Consequently, their capacities to adapt to ongoing processes and transformations will differ significantly. The resultant divergence in outcomes can potentially accentuate existing disparities, thereby eroding the unity of Europe. Even the more economically advanced member states are not immune to encountering challenges amid such circumstances. Adapting to these new conditions will be contingent upon microelements and microeconomic factors, elucidating how individual countries navigate and adjust to the evolving situation. This intricate interplay of microeconomic dynamics will shape the diverse responses and impacts experienced by European nations in the face of the concurrent challenges posed by sanctions and the conflict in Ukraine. Therefore, the central and eastern parts of Europe will be particularly vulnerable parts of Europe. Redeker (2022) believes that this problem primarily involves "dependence on exports, reliance on energy imports from Russia, and exposure to a general increase in energy prices." (Redeker, 2022: 4) In essence, the challenges posed by sanctions and the conflict in Ukraine will have a nuanced and varied impact on European nations, with the potential to deepen existing economic disparities.

Germany and Italy are highly dependent on Russian gas, but equally, energy price growth varies between EU members and the world due to state intervention. Redeker (2022) believes that, under the imperative of preserving the political unity of the European Union, it will be necessary to "balance between the developed western and eastern parts in terms of helping not only Ukraine but also less advanced parts of Europe to preserve its unity." (Redeker, 2022: 5)

Bluszcz and Valente (2019) comprehensively analyzed Ukraine's Gross Domestic Product (GDP) after the Russian military invasion of Crimea in 2014. The primary objective of their study was to assess the extent to which the prevailing wartime conditions influenced the aggregate value of final goods and services produced within the country. The temporal scope of their investigation spanned from 2013 to 2017, revealing a substantial decrease in Ukraine's GDP by 15.1%. (Bluszcz & Valente, 2019)

This downturn in Ukraine's GDP engendered a ripple effect, contributing to a state of instability not only within Europe but with ramifications reverberating globally. In addition to examining the economic impact on GDP, the researchers conducted an in-depth analysis of how the military invasion influenced the profitability of Russian and Ukrainian stocks from November 21, 2013, to September 29, 2014. Their empirical findings disclosed a discernible deceleration and reduction in stock returns. Furthermore, the post-war period witnessed a more nuanced and intricate transformation in economic dynamics, suggesting a complex shift in the aftermath of the conflict.

Balbua, Eshov & Ismailova (2022) state that since the beginning of the war in Ukraine, most Western countries have suddenly imposed economic sanctions against Russia that target the main parts of key sectors that are responsible for Russia's economic development, but which directly leave consequences for the global economy. The authors observe them through four represented categories: the banking and financial sector, energy, the military, and the economy. (Balbua, Eshov & Ismailova 2022: 6)

Sanctions related to the banking and financial sector included banning certain Russian banks from using SWIFT. Hotten (2022) states that SWIFT is in fact "a global financial artery that enables the smooth and rapid transfer of money across borders. Banks now [during the war in Ukraine, op. a.] must "deal with each with other" directly, resulting in delays and additional costs." (Hotten, 2022) So, the economic sanctions levied by a majority of Western nations upon Russia, with a specific focus on pivotal sectors encompassing banking, finance, energy, military, and the overarching economy, have notably impeded the trajectory of Russia's economic development. The proscription of select Russian banks from accessing SWIFT, a pivotal global financial conduit, has precipitated direct interbank transactions, engendering delays, and augmented fiscal encumbrances, thereby exerting profound repercussions on both the Russian economy and the global economic landscape.

In response to the war, the US is also preventing Russian banks and the Russian Central Bank from accessing dollar reserves. "A ban on transactions with the Central Bank of Russia and the Fund will significantly hinder their ability to do so and prevent their access to assets worth hundreds of billions of dollars." (Powell, 2022)

Balbaa, Eshov, and Ismailova (2022) state that the European Union has banned "the listing of shares of Russian state entities on EU trading markets and blocked Russian deposits of more than €100,000 in EU banks in Russian accounts with central depository papers and securities, while Switzerland and Japan froze the funds of some Russian individuals deposited in Swiss and Japanese banks, as well as Great Britain." (Balbaa, Eshov & Ismailova, 2022: 7)

In May 2022, the European Union considered procedures for financing the reconstruction of Ukraine with money representing Russian foreign exchange reserves.

Josep Borrell said that EU members should consider the option of financing the reconstruction of Ukraine with "frozen" Russian foreign exchange reserves. Borrell said that the option of using Russian money in the reconstruction of Ukraine is very real, and he compared this move to the practice that the United States of America used in Afghanistan. (KLIX, 2022)

The next category that Balbaa, Eshov & Ismailova (2022) problematizes is the energy sector. Germany has suspended the approval of the Nord Stream 2 gas pipeline project for the distribution of energy in Europe. (Balbaa, Eshov & Ismailova, 2022) In this sense and the European context, Russia is the first oil producer, and the second in the world. Forecasts were such that European oil traders, that is, oil companies, would have difficulties in distributing oil and problems with procuring energy from Russia. The suspension of the North Stream 2 gas pipeline project, which is a key oil distribution project, caused Europe, along with sanctions, concern about Russian gas because the construction of the 11 billion euro gas pipeline was intended to double "Russian gas deliveries from Russia to Germany." (Vijesti.me, 2019)

At the same time, the European Union and the USA banned the sale, supply, transfer, and processing of oil coming from Russia, while Great Britain announced that it would gradually stop using Russian oil by the end of 2022. This was done to exclude Russia and pressure it to stop the war, and according to Russian President Vladimir Putin's decision that Russia's gas and oil will be paid exclusively in rubles, the Russian government has ordered to stop receiving payments in dollars or euros for the energy sources mentioned.

These measures refer to the so-called "enemy states" from the Russian blacklist, which includes: all EU members, USA, Canada, Great Britain, Albania, Andorra, Australia, Great Britain, Iceland, Liechtenstein, Micronesia, Monaco, New Zealand, Norway, South Korea, San Marino, North Macedonia, Singapore, Taiwan, Ukraine, Montenegro, Switzerland, and Japan. This announcement by Moscow immediately strengthened the ruble, and the decision of the West to freeze Russian funds abroad also contributed to this, which strengthened the ruble against the dollar by 5.5 percent. The Government of Russia and the Central Bank have until the end of March to determine all the necessary modalities for the transition from payment to rubles. On the other hand, the decision that the ruble is the only currency to pay for Russian gas and oil (made on March 23) caused a drop in indices on European stock markets and Wall Street. (Serbian Chamber of Commerce, 2022)

So, these events confirm the complex interplay of geopolitical tensions, economic measures, and responses between Russia and Western nations. The actions taken by both sides have immediate consequences on energy markets, currency values, and international relations, with potential long-term implications for global trade and economic stability.

Before Russia invaded Ukraine, energy prices rose due to several factors, including the COVID-19 pandemic, lack of energy supplies, and increasing tensions between Russia and Ukraine. Before the invasion, oil prices were relatively stable, between \$80 and \$95 per barrel. However, after the conflict in Ukraine, oil prices rose to over \$100 a barrel, marking the highest price in 14 years, according to previous analysis.

When it comes to direct energy dependence on Russia, the problems are mainly concentrated in the central and eastern parts of Europe, Italy, and Germany. However, the global nature and limited resources of energy markets have implications for the overall economy and markets. Oil and natural gas prices have risen sharply, "and according to the European Central Bank (ECB), energy price inflation will become one of the main economic challenges arising from the war. Therefore, the key question is to what extent EU members differ in their exposure to rising energy prices." (Redeker, 2022)

The next category presented by Balbaa, Eshov & Ismailova (2022) is the military sector, where sanctions were introduced to weaken the Russian military forces. Namely, countries like New Zealand have banned the export of goods to Russia or are directly aimed at weakening the Russian military forces. On the other hand, the USA prohibits the source of war technology, lasers, sensors, and telecommunication tools in Russia. This limits her ability to advance on the ground and in the air. "Foreign-made microelectronics are critical to Russia's advanced fighter jets and ships and advanced munitions." (Al Jazeera, 2022b)

The cessation of European Union airspace accessibility to all Russian aircraft, coupled with the prohibition of port access for ships from Russia and Belarus, exerts a consequential impact on economic dynamics and conditions. Concurrently, sanctions have been instituted against Russia, manifesting as the suspension of activities undertaken by media enterprises "perceived to disseminate war propaganda." (Council of the European Union, 2022a)

Kammer et al. (2022) state that Russia and Ukraine are the main producers of goods and raw materials for food. War events and disruptions in the supply chain have led to a spike in global prices, especially oil and natural gas. As a result, the costs of necessities of life, especially food, have skyrocketed. "(...) and wheat, for which Ukraine and Russia account for 30 percent of world exports, reached a record." (Kammer et al., 2022)

Simultaneously, the escalation in pricing within the supply chain engenders an augmentation in indebtedness and associated burdens, thereby constraining the potential for growth and prosperity in the impacted regions. The insufficiency of sustenance and essential food commodities additionally precipitates social instability, as evidenced by a surge in social unrest among the populace in recent times.

It is noteworthy that Russia and Ukraine collectively contribute approximately one-third of the global wheat exports. Moreover, "the Middle East and North African nations heavily rely on the aforementioned region for over fifty percent of their grain provisions", as documented by the International Fund for Agricultural Development. (IFAD, 2022)

Eighty-five percent of Egypt's wheat imports come from the Red Sea region alone. Rising prices due to a lack of exports

threaten to worsen the problem of hunger. Lebanon imports 80 percent of its wheat from Russia and Ukraine, and an additional problem is the destruction of the main grain silo in the country, caused by an explosion in the port of Beirut in 2020. For these reasons, Lebanon can store wheat for about a month. In the Sahel, in countries such as Niger, Chad, Burkina Faso, and Mali, up to fifty percent of the population lives in extreme poverty, whose situation has been exacerbated by the Russian-Ukrainian conflict combined with trade barriers, climate issues, and the impact of COVID-19, creating additional food insecurity in this region. (IFAD, 2022)

Furthermore, perturbations in the worldwide supply chains of agricultural commodities, along with disruptions in the availability of fertilizers and gas, engender enduring adverse repercussions for small-scale producers. This is primarily attributed to their inherent incapacity to adapt to fluctuations in fuel prices and general cost escalations. The pronounced escalation in fuel prices has resulted in substantial increments in electricity and transportation expenses, significantly jeopardizing the economic standing of small-scale producers and placing them in an exceedingly disadvantageous position.

World markets also present a very specific and complex problem. Their current focus is on war and war events, while investors and potential investors are worried about rapid inflation that is negatively affecting global growth. The International Monetary Fund predicts that the inflation rate in the US "will reach 7.7% this year and 5.3% in the Eurozone. Concerns about rising prices are forcing investors to sell bonds, driving up yields; The yield on the benchmark 10-year government bond reached 2.94%, a level not seen since late 2018." (Ellyatt, 2022)

Rising food prices and problems in food distribution and supply can result in numerous deaths and social and political unrest. Ellyatt (2022) says that six granaries that together supply approximately 60 to 70% of global agricultural products have just been affected by the events. "The Ukraine-Russia region is responsible for approximately 30% of global wheat exports and 65% of sunflower exports, in a context where these markets are increasingly tight and interconnected – so a small disruption in supply creates a huge price impact." (Ellyatt, 2022)

Immediately after the invasion, financial conditions were tightened for emerging markets and developing countries. So far, that repricing has been mostly orderly. However, several risks of financial instability remain, raising the prospect of a sharp tightening of global financial conditions, as well as capital outflows. The depth of the impact on the global economy of course depends on how long the war lasts, as well as the extent of the destruction and disruption it causes. (Ellyatt, 2022)

Ellyatt's study demonstrates that military strikes can precipitate inflation, sector-specific disruptions, and financial instability within global markets. Consequently, it is imperative to assess the potential economic repercussions thoroughly before engaging in military actions.

Kammer et al. (2022) believe that countries with direct trade, tourism, and financial ties to Russia and Ukraine feel additional pressure. "Economies that rely on oil imports will have larger fiscal and trade deficits and higher inflationary pressures, although some exporters such as those from the Middle East and Africa may benefit from higher prices." (Kammer et al., 2022)

Adnan Mazari (2022) tells Al Jazeera that different countries and regions of the world perceive war events and their consequences differently, but globally speaking, the war contributed to the rate of inflation growth with a significant increase in prices.

This prompted strong interventions by major central banks around the world, such as the US Federal Reserve Bank and the European Central Bank. These institutions have new roles, which puts them in a very difficult position. All this was accompanied by great pressure on central banks to raise interest rates, to face the rising inflation rate. At the same time, central bank officials should ensure that high interest rates do not cause a decline in development and slow down economic activity. (Mazari, 2022)

Consumers exhibit an observable trend of increased expenditure on a reduced spectrum of commodities, exacerbated by ongoing conflicts that contribute to heightened prices within the oil, gas, and food sectors.

Consequently, developing nations are compelled to bear elevated costs for energy imports, resulting in augmented local fuel and food prices, coupled with a comprehensive escalation in commodity imports, notwithstanding static income levels. This phenomenon precipitates inflationary pressures, influencing both the general cost of living and, on a global scale, contributing to an overarching state of inflation.

In response to the exigencies of the crisis impacting the Ukrainian labor market and analogous challenges faced by developing nations, the International Labor Organization proffers a suite of imperative measures. These recommendations encompass the implementation of:

- *Encouraging the initiatives of employers and workers to provide humanitarian aid and ensure the continuation of work, where possible;*
- *Individual and joint efforts of social partners can contribute positively to cohesion and encourage inclusive economic, social, and political development;*
- *Provide targeted employment support in relatively safe areas of Ukraine, including building on the ongoing government-sponsored relocation program for workers and businesses;*
- *Local Employment Partnerships (LEPs) supported by the ILO can help create employment opportunities;*
- *Support the social protection system in Ukraine to ensure that it continues to pay benefits, including newly established cash transfers, to (former and new) beneficiaries;*
- *Prepare for a post-conflict reconstruction strategy that encourages the creation of decent and productive jobs through employment-intensive investments.* (International Labor Organization [ILO], 2022)

The ILO further recommends that in many high-income countries, which have recently witnessed signs of a stronger labor market recovery, the consequences of the Ukrainian crisis could worsen labor market conditions and reverse some of the gains made. "The situation is particularly difficult in low- and middle-income countries, many of which have not been able to recover from the impact of the COVID-19 crisis fully." (International Labor Organization [ILO], 2022)

In conclusion, the current situation arising from the conflict in Ukraine and the global sanctions imposed on Russia has led to a multi-faceted economic cycle, which has had significant implications for the international economy. The ongoing COVID-19 pandemic has only exacerbated the issue, causing supply chain disruptions, price volatility, and an apparent economic slowdown. The repercussions of this situation go beyond the energy and geopolitical markets and extend to global food markets, resulting in inflationary trends and complex dynamics within individual economies. For this reason, nations must prioritize international cooperation and work together to implement adaptive strategies to address the interconnected economic consequences of global conflicts and sanctions.

2.2. The Global Consequences of Conflict: Ukraine's Economic Resilience and its Impact on the World

When considering Ukraine's position in the global economy, the devastation wrought by the war has exacted a substantial toll. Ukraine requires significant financial support and assistance to sustain its economy. According to the United States Congressional Research Service [CRS] (2022a), the war has led to the closure of 50% of Ukrainian companies, with an additional 50% compelled to operate below capacity. The United Nations Development Programme [UNDP] estimates, as reported by the United States Congressional Research Service (2022a), that should the conflict intensify and persist, "up to 90 percent of Ukraine's population could face poverty." (The United States Congressional Research Service [CRS], 2022b)

The World Bank Group is promptly initiating measures to assist the residents of Ukraine. According to the Congressional Research Service (CRS, 2022b), before the invasion, central banks were anticipated to implement monetary policy tightening to mitigate inflation. However, it is noted that "a rise in interest rates at this time could further exacerbate rising production and production costs." (Congressional Research Service [CRS], 2022b)

The economic effects of the crisis in Ukraine and its consequences are felt around the world. Along with Russia and Ukraine, Belarus, Kyrgyzstan, Moldova, and Tajikistan are also expected to fall into recession, while growth projections for all economies have been reduced due to "weaker-

than-expected growth in the eurozone and commodity, trade and financial shocks." (World Bank, 2022a)

As the crisis unfolds, a surge in uncertainty, coupled with inflationary pressures and escalating prices of energy and raw materials, presents formidable challenges that hinder the developmental trajectory of the world economy. These multifaceted hurdles demand concerted efforts and strategic interventions to mitigate the far-reaching consequences and foster sustainable economic progress on a global scale.

The profound economic impact resulting from the conflict in Ukraine is evident through extensive business closures and the imposition of operational constraints. Projections outlined by the United Nations Development Programme (UNDP) and the Congressional Research Service (CRS, 2022b) highlight the imminent threat of widespread poverty, underscoring the urgent need for substantial financial support. While recognizing the proactive measures implemented by the World Bank Group, careful attention is warranted due to the cautioned delicate equilibrium in monetary policy. (CRS, 2022b) Consequently, the far-reaching international economic repercussions extend beyond Ukraine's borders, casting an impact on a multitude of nations. The challenges posed, including heightened uncertainty, inflation, and the surge in resource prices, stand as formidable impediments to global economic development, as highlighted by the insights provided by the World Bank (2022a). Therefore, addressing these challenges requires joint and concerted efforts at the international level to address the complexity and promote sustainable economic resilience across diverse economies.

3. Research methodology

The central methodological framework of our approach involves systematically observing the global economic ramifications stemming from the Russian-Ukrainian conflict. This objective is attained through the application of the trend method, specifically utilizing the semi-average in four distinct versions of its application. Functioning as a dynamic average, the trend encapsulates the evolving mean value by computing the average state of the phenomenon during each observed period. The trajectory delineates the temporal movement of the phenomenon, embodying a sequence of averages intrinsic to the observed phenomenon. The original data manifests fluctuations around the trend

line, exhibiting either regular (seasonal and cyclical fluctuations) or irregular (random or residual fluctuations).

Drawing insights from empirical observations, the trend emerges as particularly efficacious for dynamic analyses conducted over a one-year temporal span. Furthermore, the rational employment of a trend is substantiated when predictions concerning the occurrence of the observed phenomenon are contingent upon it. In the execution of trend analysis, there are no prescriptive guidelines dictating the precise number of data points to be considered; rather, an adequate volume of data is imperative for gaining a comprehensive understanding of the temporal dynamics and configuration of the phenomenon's movement.

In the initial scenario, the trajectory of global Gross Domestic Product (GDP) is observed independently of conflict-related events. Subsequently, an inquiry is made into the hypothetical scenario of GDP on an international scale in the absence of conflict. The dataset for this investigation encompasses the pertinent GDP figures and states spanning from 2012 to 2021, as carefully documented in the sources referenced within this article.

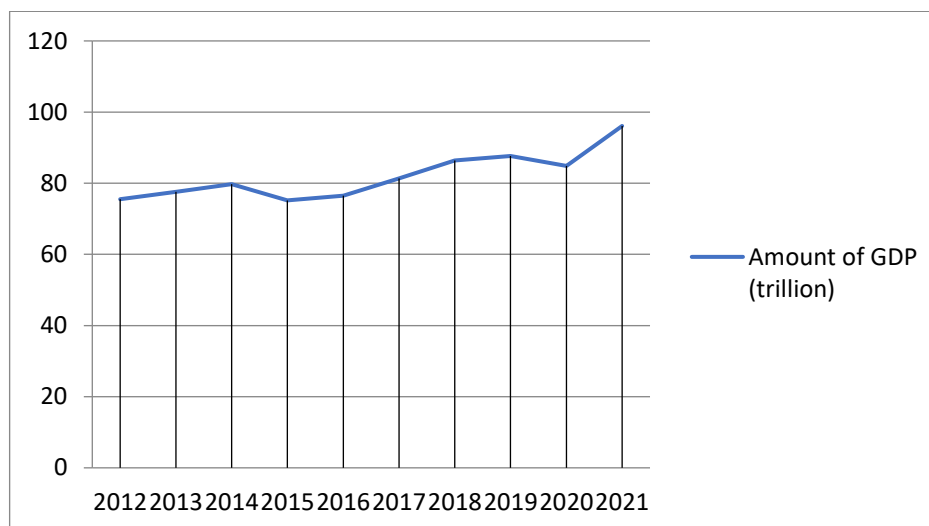
In the second scenario, scrutiny is directed towards the measures associated with international trade policy amid the context of the conflict in Ukraine. The dataset employed in this analysis encompasses the preceding seven months, coinciding with the activation of conflict hotspots.

The third scenario involves an investigation into the dynamics of war-related refugee movements both before the onset of aggression against Ukraine and during the initial stages of the conflict.

Lastly, the fourth scenario entails the monitoring of the global-level trajectory of the Financial Stress Index (FSI).

4. Data analysis and discussion

The first component of the research follows the movement of GDP at the global level for the period from 2012 to the end of 2021, and then for the next three years (2022, 2023, and 2024) in the circumstances that there was no escalation of the conflict in Ukraine.

Figure 1: Amount of GDP (trillion)

Source: World Bank, n. d.

Table 1: Available data on GDP for the period 2012-2021 as a function of trend

YEARS	Y	x
2012	75,49	0
2013	77,61	1
2014	79,71	2
2015	75,18	3
2016	76,47	4
2017	81,4	5
2018	86,41	6
2019	87,65	7
2020	84,91	8
2021	96,1	9

The average value of the first half of the data is between 2012 and 2013 and is 76.89 dollars (US), while the average value of the second half is between 2018 and 2019, that is, 2020 and 2021, and is 87.29 dollars (US).

Based on the semi-average trend line, the following values can be determined:

$$76,89 = a + b$$

$$87,29 = a + 5b$$

By solving the given system of equations (a system of two equations with two unknowns), we get the following values $a=74,29$ and $b=2,6$.

Based on the above, the trend line has the following form of the equation:

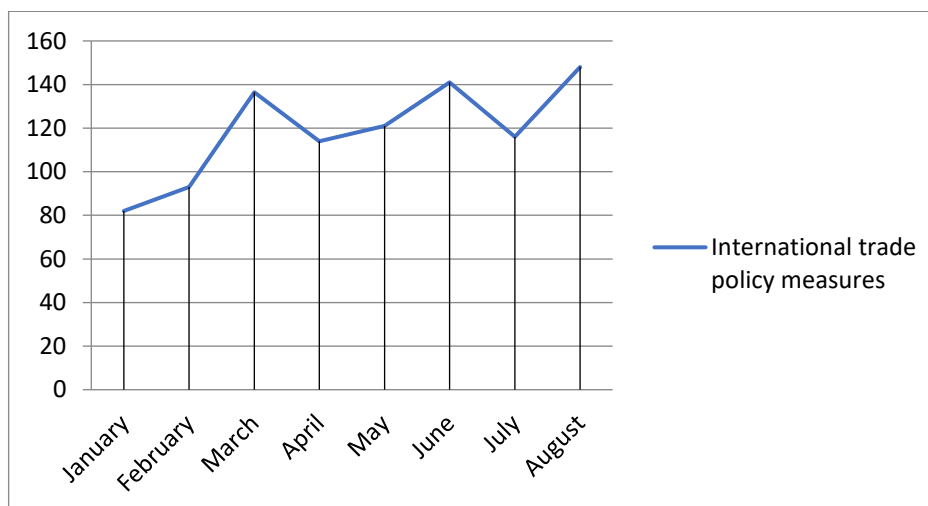
$$y_t = 74,29 + 2,6 \cdot x$$

Table 2: Predicted values of GDP growth for the period 2022-2024

YEARS	y	X
2022	100,29	10
2023	102,89	11
2024	105,49	12

Looking at Table 2, we see that the new numbers are linear and there is a noticeable growth in global GDP over the next three years. In addition, for 2022, the value of GDP is 100.29 trillion, which is an increase of 4.72% compared to the previous year of observation. Table 2 shows further GDP growth, which is higher by 2.53% for 2023 and 2.47% for 2024.

The second component of the research follows measures of international trade policy at the world level for the period January-July 2022, and then in the context of the Russian-Ukrainian conflict for four months until the end of the current year (September, October, November, and December).

Figure 2: International trade policy measures

Source: World Bank, 2022b

Table 3: Available values of trade policy measures as a function of the trend

<i>Month(s)</i>	Y	x
January	82	0
February	93	1
March	136,5	2
April	114	3
May	121	4
June	141	5
July	116	6
August	148	7

The average value of the first half of the data is between February and March 2022 and is \$106.4 (US), while the average value of the second half is between May and June, that is, July and August 2022, and is \$131.5 (US).

Based on the semi-average trend line, the following values can be determined:

$$106,4 = a + b$$

$$131,5 = a + 4b$$

By solving the given system of equations, we get the following values $a = \$98,03$ (US) and $b = \$8,37$ (US). Based on the above, the trend line has the following equation form:

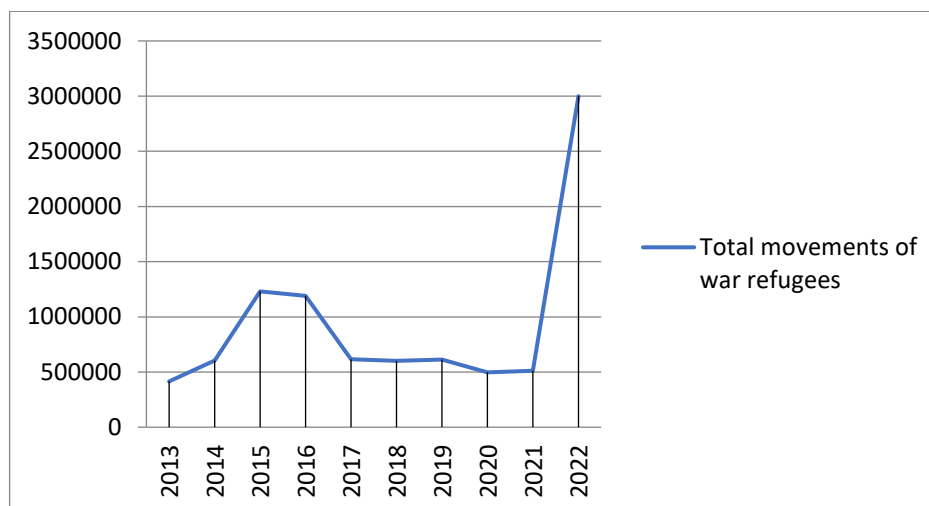
$$y_t = 98,03 + 8,37 \cdot x$$

Table 4: Predicted growth values of trade policy measures for the next four months

Month(s)	Y	X
September	164,99	8
October	173,36	9
November	181,73	10
December	190,1	11

Table 4 provides a predictive analysis of the trajectory of trade policy measures, exhibiting a discernible linear trend, as illustrated by the trend line. This realistic forecast is substantiated by the conspicuous inflationary trends observed globally. In the absence of proactive, concerted efforts by individual economies and collaborative initiatives on a global scale, the imperative emerges regarding the strategies and mechanisms to curtail the escalating inflationary pressures.

The third research component of the study tracks the migration patterns of war refugees on a global scale, encompassing periods preceding the crises in Ukraine and subsequently during the unfolding events of the Russian-Ukrainian conflict.

Figure 3: Total movements of war refugees

Source: OECD, n. d.

Table 5: Available values of the total movement of war refugees as a function of the trend

YEARS	y	x
2013	415.000	0
2014	605.000	1
2015	1.230.000	2
2016	1.190.000	3
2017	615.000	4
2018	602.000	5
2019	614.000	6
2020	498.000	7
2021	510.000	8
2022	3.000.000	9

The average value of the first half of the data is between 2014 and 2015 and is \$811,000 (US), while the average value of the second half is between 2021 and 2022 and is \$1,044,820 (US).

Based on the semi-average trend line, the following values can be determined:

$$811.000 = a + b$$

$$1.044.820 = a + 5b$$

By solving the given system of equations (a system of two equations with two unknowns), we obtain the following values $a=752.545$ and $b=58.455$.

Based on the above, the trend line has the following equation form:

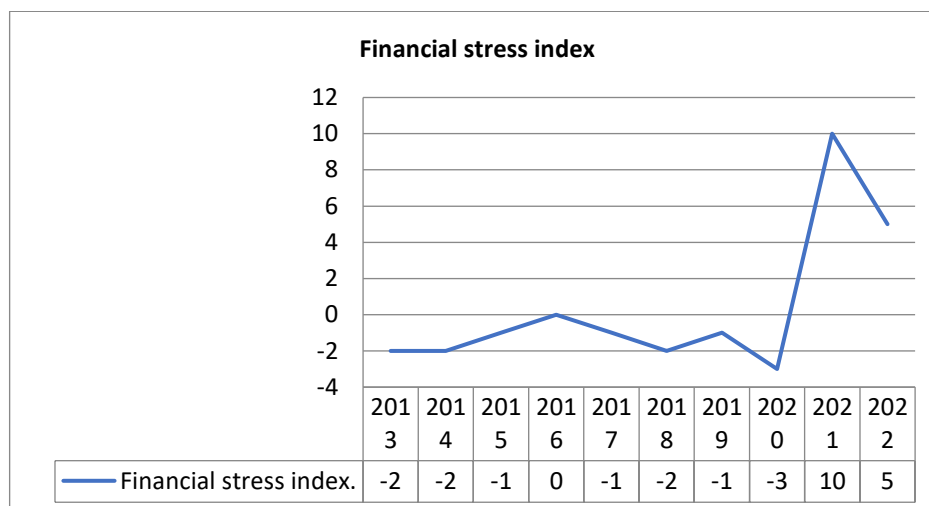
$$y_t = 752.545 + 58.455 \cdot x$$

Table 6: Forecasted values of the movement of war refugees for the period 2023-2025

YEARS	y	x
2023	1.337.095	10
2024	1.395.559	11
2025	1.454.005	12

The projected displacement values of war refugees show a linear increase, evident from Figure 3 and Table 6.

The fourth component of the research follows the movement of the financial stress index (FSI) at the global level.

Figure 4: Financial stress index (FSI)

Source: Rojas-Suarez & Fiorito, 2022

Table 7: Available values of the financial stress index as a function of the trend

YEARS		y	x
2013		-2	0
2014		-2	1
2015		-1	2
2016		0	3
2017		-1	4
2018		-2	5
2019		-1	6
2020		-3	7
2021		10	8
2022		5	9

The average value of the first half of the data is between 2015 and 2016, that is, 2016 and 2017, and is -\$1.2 (US), while the average value of the second half is between 2021 and 2022 and is \$1.8 (US).

Based on the semi-average trend line, the following values can be determined:

$$-1,2 = a + b$$

$$1,8 = a + 5b$$

By solving the given system of equations, we get the following values $a = -\$1.95$ (US) and $b = \$0,75$ (US)

Based on the above, the trend line has the following equation form:

$$y_t = -1,95 + 0,75 \cdot x$$

Table 8: Predicted values of the movement of the financial stress index for the next three years

YEARS	y	x
2023	$5,55 \approx 6$	10
2024	$6,3 \approx 6$	11
2025	$7,05 \approx 7$	12

As widely acknowledged, financial markets are intricately linked to global movements and events. This study aimed to forecast future trends by leveraging established financial stress index indicators. The incorporation of high-frequency data enables the identification of specific fluctuations in financial markets, offering timely warnings to the market regarding potential periods of stress. Building on our well-established understanding of the consequences arising from the coronavirus pandemic in 2021, we recognize a moderate decline in 2022 but with uncertain future trends. Additionally, we have identified fluctuations that indicate an upward trend.

5. Conclusion

The protracted and intense conflict between Russia and Ukraine has engendered profound and extensive ramifications, permeating both local and global spheres. This geopolitical upheaval has disrupted the

anticipated post-pandemic economic resurgence, instigating discernible repercussions across diverse domains, particularly within international trade policy measures. Concurrently, the inflationary trajectories observed in numerous global economies have compounded these effects, thereby impinging upon the stability of the overarching world economic order.

Of paramount concern is the discernment of the trajectory associated with the movement of war refugees, a dimension that carries implications for the foreseeable future. Forecasts indicate a disconcerting linear increment of 4.02% in the growth of war refugees until 2025, contingent upon the persistent continuation of the conflict. This projection underscores the exigency for comprehensive strategies and interventions to ameliorate the ensuing humanitarian crisis and mitigate potential geopolitical ramifications.

Further scrutiny of market dynamics, specifically encapsulated by the financial stress index, unveils a discernible degree of variability. This volatility is notably pronounced when scrutinizing the comprehensive temporal spectrum from 2013 to 2021, as analyzed in this study. Even the forecasted values for the forthcoming triennium do not instill optimism, and the prevailing sentiment within global financial frameworks is one of caution, highlighting the complex and intricate challenges precipitated by the Russo-Ukrainian conflict.

In synthesis, the economic reverberations of the Russo-Ukrainian conflict transcend regional boundaries, exerting a profound influence on international trade policies, inflationary trends, and the movement of war refugees. The forecasted trajectory, fraught with uncertainties, mandates a circumspect approach to navigating the global financial frameworks, emphasizing the exigency of diplomatic resolutions to foster economic stability on a global scale.

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Efficiency of Rice Production with Environmental Consideration

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ABSTRACT

The present study attempts to investigate the impact of environmental factors on the efficiency of rice production in Malaysia. The Cobb–Douglas stochastic production frontier function is used to estimate the production frontier ‘with’ and ‘without’ the environmental variables using primary data from the survey on farmers from two states in Malaysia, which are Kedah and Perlis. The findings from the study indicate that average technical efficiency for the sample farmers is 62.9% which implies that on the average, the farmers are able to obtain 62.9% of potential output from a given mix of production inputs as well as environmental consideration.

ملخص

تحاول هذه الدراسة التحقيق في تأثير العوامل البيئية على كفاءة إنتاج الأرز في ماليزيا. تم استخدام دالة حدود الإنتاج العشوائية كوب-دوغلاس لتقدير حدود الإنتاج 'مع' و'بدون' المتغيرات البيئية باستخدام البيانات الأولية من المسح على المزارعين من ولايتين في ماليزيا، وهما كيدا وبرليس. تشير نتائج الدراسة إلى أن متوسط الكفاءة الفنية للمزارعين في العينة يبلغ 62.9%، مما يعني أن المزارعين قادرون في المتوسط على تحقيق 62.9% من الإنتاج المحتمل من مزيج معين من مدخلات الإنتاج وكذلك من الاعتبارات البيئية.

RÉSUMÉ

La présente étude tente d'examiner l'impact des facteurs environnementaux sur l'efficacité de la production de riz en Malaisie. La fonction de frontière de production stochastique Cobb-Douglas est

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utilisée pour estimer la frontière de production « avec » et « sans » les variables environnementales en utilisant les données primaires de l'enquête sur les agriculteurs de deux États de Malaisie, Kedah et Perlis. Les résultats de l'étude indiquent que l'efficacité technique moyenne des agriculteurs de l'échantillon est de 62,9 %, ce qui signifie qu'en moyenne, les agriculteurs sont en mesure d'obtenir 62,9 % de la production potentielle à partir d'une combinaison donnée d'intrants de production et de considérations environnementales.

Keywords: Climate change, Food security, Efficiency, Stochastic frontier, Malaysia.

JEL Classification: C51, Q18, Q54

1. Introduction

Rice production has long been documented as the main economic activity of the rural community in Malaysia, with an average production area of 651,600 ha for the combination of main and off season in the years of 1900's. Yet, there is a steady decline in terms of production area annually. At national level, the production of rice can only accommodate 71.4% of their own domestic needs. Poor productivity compare to other countries has resulted in low incomes for farmers, with average earning of RM1,400 per month. With rural areas accounting for 35 percent of Malaysia's population and agriculture accounting for 43.7 percent of rural employment, improving agriculture productivity is critical to close the rural-urban income gap, which was 1.00:1.82 in 2009.

There are many factors that directly make rice production rate declining. These factors include a variety of aspects such as its fertilizing cycle, soil physical-chemical properties, crop cultivate, pesticide and environment (Toriman et al., 2013). Among all the contributing factors, the environment is a factor that is beyond human control and could only be mitigated after certain events. In Malaysia, among the environmental factors, flood, rainfall, temperature, and humidity are affecting the rice production. In the past 30 years, floods have caused the worst damage to Malaysian economy. In 2007, the economic damage caused by floods amounted to 0.1% of the country's Gross Domestic Products (GDP). UNISDR (2012) reported that during the flood of December 2006, losses in agricultural sector were estimated to amount to USD 18.8 million

involving 6,797 farmers and 8,322 ha of arable lands. farmers and 8,322 ha of arable lands. Nonetheless, over the past few decades, Malaysia has experienced a growing warm temperature. The Malaysian Agricultural Research Institute (MARDI) has estimated that a 1°C increase in daily average temperature reduces 10% of the rice yield in peninsular Malaysia (Abdullah, 2007).

Studies on rice efficiency in Malaysia are highly limited (e.g., Ahmed et al., 1999) compared to other developing countries, such as Pakistan (Battese & Coelli, 1995), India (Singh et al., 2019), and Iran (Bakhsoodeh & Thomson, 2001). Masud et al. (2014), for example, only explored the relationship between climate changes and farmer's net income from rice production using the Ricardian model. Toriman et al. (2013) showed the impact of climate change variation on rice production in Selangor, Malaysia but not analyzing the efficiency of production. Zainal et al. (2014) investigated the economic impact of climate change on rice production, again not on the efficiency of production, in Malaysia using the time series data. On the other hand, Mailena et al. (2014), Ghee-Thean et al. (2012) and Radam and Shamsudin (2001) focused on efficiency of rice production using the stochastic frontier model (SFM) and data envelopment analysis (DEA) but with no consideration on environmental factors. No study, to the knowledge of authors, investigates the impact of environmental factors such as soil type, land type, temperature, rainfall and flood on the efficiency of rice production in Malaysia. Thus, the current study is undertaken to fill this gap with the intention to help the farmers to allocate their scarce resources more efficiently and to assist policy makers to design and formulate agricultural policies as regard to rice in Malaysia.

2. Methodology

2.1 Theoretical Background

Two of the most popular functional forms in the economics literature are Cobb- Douglas (C-D) and the transcendental logarithmic (TL) functions. The first one is easy to interpret and estimate but imposes important restrictions on the technology such as scale and output elasticities that do not vary with input or output levels and substitution elasticities among inputs are all equal to unity. The trans log, on the other hand, is a flexible form in the sense that it can provide a local, second order approximation

to any function, but it is more difficult to estimate due to the large number of parameters and the problem of multicollinearity among the regressors (Irz & McKenzie, 2003). In this study, the general form of the Cobb–Douglas stochastic production frontier function is used. The Cobb–Douglas stochastic production frontier function is an extension of the traditional Cobb–Douglas production function, incorporating a stochastic term to account for random errors and inefficiency in the production process. This model is widely used in econometrics to analyze the efficiency of production units, such as firms or industries.

The Cobb-Douglas (C-D) production function is a particular type of production function. Cobb and Douglas (1928) posited that production is determined by the combination of labour and capital. They used the following function:

$$Y(L, K) = AL^{\beta} K^{\alpha} \quad (1)$$

where, Y is total production (the real value of all goods produced in a year, L is labour input (the total number of person-hours worked in a year, K is capital input (the real value of all machinery, equipment and building), A is total factor productivity, and α and β are the output elasticities of labour and capital, respectively. There are some assumptions of Cobb-Douglas Production Function. They are as follows:

- Constant Returns to Scale occur when the sum of α and β equals 1. The function assumes constant returns to scale, which implies that if all inputs are proportionally increased or decreased, the output will also be proportionally increased or decreased. However, it can also accommodate economies or diseconomies of scale if the sum of α and β is not equal to 1.
- Factor replacement refers to the ability to replace one input (such as labour or capital) with another to a certain degree. In the Cobb-Douglas function, this substitution is assumed to be possible, with a constant elasticity of substitution equal to 1.
- Positive and diminishing marginal returns refer to the phenomenon where each additional input contributes positively to the overall output, but the extent of this contribution gradually decreases. This implies that as the quantity of one input increases,

while keeping other inputs constant, the marginal output generated by each extra unit of input will eventually diminish.

- Technology change is typically captured by the constant A , representing total factor productivity, which can shift over time to reflect improvements in technology.

$$Y_i = A L_i^\alpha K_i^\beta e^{v_i - u_i} \quad (2)$$

where

Y_i is the output of the i -th production unit,

A is the technology parameter

L_i and K_i are labour and capital inputs for the i -th input

α and β are parameters to be estimated.

v_i is a symmetric random error term representing statistical noise (e.g., measurement error, external shocks) and u_i is a non-negative random variable representing technical inefficiency.

2.2 The Empirical Model

In this study, the general form of the Cobb–Douglas stochastic production frontier function is used. In order to determine the consequences of omitting environmental production conditions, we estimate the production frontier ‘with’ and ‘without’ the environmental variables. Hence, the conventional specification which omits the environmental variables is written as:

$$\ln Y_i = \alpha_0 + \sum_{j=1}^p \alpha_j \ln X_{ij} + \sum_{j=1}^p \beta_j D_{ij} + v_i - u_i \quad (3)$$

and

$$u_i = \delta_0 + \sum_{d=1}^p \delta_d Z_{id} + \zeta_i \quad (4)$$

where Y_i is the production of rice, X_{ij} is the j th input for the i th farmer, D_{ij} are the dummy variables used to account for values of input use, value of 1 if the j th input used is positive and zero otherwise, p is the total number of variables of each category, v_i is the two sided random error, u_i is the one sided half-normal error, $\ln$ is the natural logarithm, Z_{id} are the variables representing managerial and socio-economic characteristics of

the farm to explain inefficiency, Z_i is the truncated random variable, and α s, β s and δ s are the parameters to be estimated.

The full specification model which includes variables that represent environmental production conditions can be written as:

$$\ln Y_i = \alpha_0 + \sum_{j=1}^p \alpha_j \ln X_{ij} + \sum_{j=1}^p \beta_j D_{ij} + \sum_{k=1}^p \varphi_k E_{ik} + v_i - u_i \quad (5)$$

and

$$u_i = \delta_0 + \sum_{d=1}^p \delta_d Z_{id} + \zeta_i \quad (6)$$

where E_{ik} are the environmental production condition variables and φ_k is the parameter to be estimated. A total of eight production inputs (X), six environmental production condition variables (E), and eleven variables representing managerial and socioeconomic characteristics of the farmer (Z) are included in the inefficiency effects model as predictors of technical inefficiency in both short and full specifications. Table 1 presents the variables and their units of measurement. Several statistical tests were conducted for stochastic frontier model to select the preferred model. One of the tests is likelihood ratio test. Four model specifications were developed in which the first two equations are the specification models with no environmental variables included. The last two equations are the specification models with environmental variables are considered.

Table 1: Measurement of Variables in the SPF and Technical Inefficiency Model for Rice Production in Malaysia

Variables	Abbreviation	Measure
Input (X) and Output (y)		
Rice Output	Y	kg per farm/harvest
Land area (ha)	Land	Hectare (ha)
Seed	Seed	kilogram (kg)
Irrigation	Irr	time/year
Cost of Mechanical Power/machines	Cap	Ringgit Malaysia (RM)
Fertilizers	Fert	Kilogram (kg)
Cost of Pesticide	Pest	Ringgit Malaysia (RM)
Labour	Labor	unit
Environmental variables (E)		
Land type	Dummy_lndtype1	Indexed (1 = medium high land; 0 = otherwise, high land and low land)

	Dummy_lndtype2	Indexed (1 = high land; 0 = otherwise, medium high land and low land)
	Dummy_lndtype3	Indexed (1 = low land; 0 = otherwise, high land and medium high land)
Soil type	Dummy_soiltype1	Indexed (1= loamy ; 0 = otherwise, peat or organic and clay)
	Dummy_soiltype2	Indexed (1= peat or organic ; 0 = otherwise, loamy and clay)
	Dummy_soiltype3	Indexed (1= clay ; 0 = otherwise, peat or organic and loamy)
Rainfall	Rain	Mililitre (mm)
Average temperature	Temp	Celsius (⁰ c)
Flood	Dummy_flood1	Indexed (1 = 1—10% loss of crop yield, 2 = otherwise)
	Dummy_flood2	Indexed (1 = 11—20% loss of crop yield, 2 = otherwise)
	Dummy_flood3	Indexed (1 = 21—30% loss of crop yield, 2 = otherwise)
Drought	Dummy_drght1	Indexed (1 = 1—10% loss of crop yield, 2 = otherwise)
	Dummy_drght2	Indexed (1 = 11—20% loss of crop yield, 2 = otherwise)
	Dummy_drght3	Indexed (1 = 21—30% loss of crop yield, 2 = otherwise)
Managerial and Household Variables (Z)		
Age	Age	years
Education	Educ	Indexed (1=no formal education; 2=primary; 3=secondary; 4=pre-uni, STPM, diploma; 5=first degree; 6=master; 7=doctorate)
Experience	Exprc	Indexed (1= less than 1 year; 2= 1-2 years; 3= 2-5 years; 4=5-10 years; 5= more than 10 years)
State	Dummy_state	Indexed (1= Kedah; 0=Perlis)
Family size	Farmsize	unit
Marital status	Dummy_married	Indexed (1=married; 0=otherwise, single, divorce)
Gender	Dummy_male	Indexed (1=male; 0=otherwise)
Income per farming	Inc_perfarm	Ringgit Malaysia (RM)
Training	Dummy_notrain	Indexed (1=no training received; 0=otherwise, training received)

		received in the last 1, 2 or 5 years)
Frequency contact with agricultural officers	Dummy_nolink	Indexed (1=no contact at all; 0=otherwise, contact once a week, fortnightly, once per month and once per 3 months)
Source of agricultural information	Dummy_infoint	Indexed (1=information from internet; 0=otherwise, information from private and public bodies, seminars/workshops, electronic and published media)

2.3 Data

Cross-section data are used in the present study. The study is conducted through survey located in Kedah and Perlis in year 2020, which consists of 27 farmer organizations which is named Pertubuhan Peladang Kawasan, PPK (Regional Farmers Organisation that consist of 55,000 farmers. The survey is confined within Kedah and Perlis as it is the rice bowl of Malaysia. The data was collected through interviews with heads of households who all working as rice farmers. The area is located on the Muda Irrigation Scheme, which covers 125,155 hectares, of which 105,851 hectares are in the north-western part of the State of Kedah and 20,304 hectares are in the southern part of the State of Perlis. An estimated 76% (96,558 hectares) of the land is under rice cultivation. The number of respondents who responded to the survey is 89 based on convenience sampling.

The questionnaire consisted of two sections: A and B. Section A collected information on the farmers' socio-economic characteristics (i.e., household size, gender, ethnic group, religion, education level, income, farm size, family size etc.). Section B enquired as to their farm expenditure, inputs and output in farming activities. In this study, we also used secondary data for environmental condition. Data on environmental condition such as temperature and rainfall data were collected from the meteorological department. Details on the variables are displayed on Table 1.

3. Results and Discussion

Prior to analyzing data empirically, data from the survey are analyzed descriptively. The descriptive statistics are displayed on Table 2 and Table 3. Table 2 shows statistics for continuous data or variables, while Table 3 displays statistics for categorical data. From Table 2, it is reflected that the mean age of respondents or farmers in study is 51 years old with the minimum age is 22 years old and the maximum age is 83. As of family size, on average, farmers have quite big size of family, that is 4.5 or 5 members. Since most of farmers are Malay race which adopt traditional type of family with many children, the result is as expected. The maximum land area possessed by the respondents is 1000 hectare and the minimum is 0.4 hectare. On average, the land size area is 13.84 hectare.

Table 2: Descriptive Statistics of Continuous Variables

Variable	N	Min	Max	Mean	Std Dev	Skewness	Kurtosis
Age	87	22	83	51.31	13.9	0.106	-0.427
Family size (unit)	88	1	8	4.55	1.5	0.088	-0.244
Land area (hactre)	88	0.40	1000	13.84	106.4	9.356	87.67
Income per farming (RM)	89	1500	90000	11179.5	11726.02	4.459	25.726
Rice output (kg per farming)	89	100	52000	8534.83	7932.37	2.534	9.79
Seed (kg per farming)	89	10	2400	375	442.65	2.923	9.357
Machine's cost (RM per farming)	89	0	90950	5064.48	14602.49	4.281	19.155
Pesticide's cost (RM per farming)	89	0	21000	1040.11	24896.90	6.527	48.691
Labour (unit per farming)	89	1	28	2.966	3.284	5.570	39.136
Average temperature (Celsius) monthly	89	29	50	34.21	4.79	1.555	3.058
Rainfall (mm) monthly	81	10	500	180.43	133.68	0.646	-1.130

Having said this, the mean income obtained from the farming activities is RM11,179 per harvest with the minimum and maximum are RM1,500 and RM90,000, respectively. The rice output per farming is 52,000 kg the maximum and 100 kg the minimum, with the average of 8,535 kg per farming. The amount of seed used on average is 375 kg and the number

of labour used on average is 3 persons. The minimum number of manpower or labour used is one which probably involve small size of land area. The mean costs of machines and pesticides spent by farmers are RM5,064 and RM1,040 per farming, respectively. The minimum costs on these machines and pesticides are none as some farmers are fully subsidized by government. As for the environmental data, the average temperature of the area of study monthly is 34.2 degree Celsius with the mean rainfall of 180.43 mm. There were cases where the maximum temperature reach 50 degrees Celsius during drought season and rainfall of 500 mm which caused flood.

Table 3: Frequency of Categorical Variables

Variable		Frequency	Percent	Valid Percent
State	Perlis	26	29.2	29.2
	Kedah	63	70.8	70.8
	Total	89	100.0	100.0
Gender	Male	78	87.6	87.6
	Female	11	12.4	12.4
	Total	89	100.0	100.0
Educational level	No formal education	4	4.5	4.5
	Primary	17	19.1	19.1
	Secondary	39	43.8	43.8
	Pre-uni, STPM, diploma	18	20.2	20.2
	First degree	4	4.5	4.5
	Master	7	7.9	7.9
	PhD	0	0	0
	Total	89	100.0	100.0
Experience	Less than 1 year	0	0	0
	1-2 years	1	1.1	1.1
	2-5 years	12	13.5	13.6
	5-10 years	26	29.2	29.5
	More than 10 years	49	55.1	55.7
	Total	88	98.9	100.0
	Missing	1	1.1	
	Total	89	100.0	
Marital status	Married	75	84.3	84.3
	Single	6	6.7	6.7
	Widower	4	4.5	4.5
	Widow	4	4.5	4.5
	Total	89	100.0	100.0

From statistics on Table 3, the farmers or respondents in study are mainly from Kedah (70.8 percent). The rice farming activities are not only done

by male farmers (87.6 percent) but also by females (12.4 percent) and most of them are married (84.3 percent). Majority of farmers have moderate level of education with more than 50 percent of them achieve a maximum of primary or secondary level education. Nonetheless, more than 30 percent of respondents obtain tertiary education as the farming activities might be inherited from parents through land inheritance and difficulties to search for qualified jobs. Surprisingly, 55.7 percent of farmers are having more than ten years' experience in rice farming activities.

3.1. Technical Efficiency of Rice Farmers - The Stochastic Frontier Model

In order to identify the factors affecting rice yield and assess the technical efficiency of rice farmers in Kedah and Perlis, the stochastic frontier production function approach is applied. A Cobb-Douglas stochastic frontier production function is assumed to be the appropriate model for analysis. Several statistical tests of null hypotheses of interest for the stochastic frontier model were conducted using likelihood ratio test. These tests were used to select the preferred frontier models for the presentation of empirical results.

Economic efficiency refers to two components: technical efficiency and allocative efficiency. Technical efficiency can be defined as the ability to achieve a higher level of output, given a same level of production inputs. Both technical and allocative efficiency are necessary and sufficient conditions for achieving economic efficiency. It could be said that the estimated technical efficiency of farm production is able to find out the gap between the actual output level and potential output level.

The estimation is based on strict assumptions and due to limited sample size, precaution on the interpretation to the results of estimation is required. Consider the parameters lamda (λ) or sigma (σ) associated with the variance of the technical inefficiency effects in the stochastic frontiers in Table 4, they are significantly different from zero.

Table 4 shows the maximum likelihood estimates for parameters of the frontier production and inefficiency functions. In the pooled model, the variable of land was highly significant at 1% and showed the strongest positive effect on output per farm/harvest in equation 1, 2 and 4. This

clearly shows that land area is an important resource that led to higher technical efficiency to obtain more output. Based on equation 1 and 2, when environmental variables were not included in the model, a one percent increase in the number of hectares of land increased the value of output by 0.39% to 0.48%. Maintaining the same positive sign, however, the response to an increase in one percent of hectare of land only contributed to 0.06% of output with the environmental variables are taken as control variables (in equation 3 and 4). Previous study by Tinaprilla et al. (2013) reported that the level of technical efficiency in rice production in Java was 74.22 percent with the most sensitive land variable affecting rice production. In addition, Kusunadi et al. (2011), Nwaru and Iheke (2010), and Yoko et al. (2014) also marked high and positive elasticity between land area and rice production.

Table 4: Maximum Likelihood Estimates of the Stochastic Frontier Production Function

Variable	(1)	(2)	(3)	(4)
Stochastic frontier (dependent variable = $\ln y$)				
lland	0.394*** (1.8e+05)	0.483*** (9.4e+04)	-0.004 (-0.29)	0.062*** (18.26)
lseed	2.071*** (1.4e+04)	5.237*** (1.8e+04)	5.368*** (4.73)	5.086*** (46.33)
lirr	0.285*** 5.4e+04	0.251*** (3.4e+04)	-0.007 (-1.12)	-0.033*** (-6.33)
lcap	-1.927*** (-1.2e+04)	-5.165*** (-1.7e+04)	-5.309*** (-4.63)	-4.996*** (-43.25)
lfert	-0.027*** (-1.8e+04)	-0.004*** (-1524.3)	-0.067*** (-25.07)	-0.083*** (-61.83)
lpest	-0.149*** (-7.8e+04)	-0.022*** (-3498.2)	-0.059*** (-8.25)	-0.191*** (-46.16)
llabor	0.049*** (1.3e+05)	0.043*** (7.1e+04)	-0.045*** (-8.42)	-0.014*** (-7.48)
dum_lndtype3			-0.754*** (-25.71)	-0.477*** (-53.02)
dum_soiltype3			2.072*** (53.54)	1.687*** (83.92)
lrain			1.52e-06 (0.00)	0.009*** (6.03)
ltemp			-0.917*** (-46.07)	-1.457*** (-210.62)
dum_flood3			0.959***	1.157***

			(66.71)	(211.10)
dum_drht3			-0.166*** (-18.93)	-0.321*** (-77.60)
constant	8.978*** (3.6e+05)	8.595*** (2.4e+05)	11.778 (.)	14.194 (.)
Inefficiency model (dependent variable = Mu)				
exprc	-0.519 (-0.86)	-0.855 (-1.14)	-0.697 (-1.57)	-1.337* (-1.78)
lage	-2922 (-1.42)	-3.658 (-1.63)	-0.154 (-0.11)	-4.436** (-2.50)
educ	-1.625* (-1.78)	-1.487* (-1.67)	-0.365 (-0.71)	-0.789 (-1.16)
dum_gender	0.521 (0.42)	0.971 (0.71)	-0.045 (-0.05)	1.287 (1.02)
lfamsize	-0.296 (-0.24)	-1.131 (-0.80)	0.764 (0.75)	0.869 (0.55)
dum_state	10.000* (1.68)	13.322** (1.79)	34.136*** (3.15)	17.788** (2.50)
dum_married	-1.945 (-1.40)	-2.557 (-1.57)	-2.398** (-2.29)	-6.689*** (-2.91)
linc	-0.233 (-0.37)	0.054 (0.09)	-0.763 (-1.49)	-1.026* (-1.66)
dum_notrain		2.598 (1.36)		7.802** (2.48)
dum_nolink		-1.833 (-1.06)		-0.426 (-0.29)
dum_infoint		2.059 (1.39)		1.095 (0.89)
constant	10.934 (1.20)	8.075 (0.84)	-22.414 (-1.95)	10.687 (.)
<i>sigma_u</i>	1.798***	1.829***	1.423***	1.631***
<i>sigma_v</i>	6.44e-09	1.14e-08	0.0001	0.0003
<i>lamda</i>	2.79e+08***	1.60e+08***	13568.82***	5298.74***
<i>Log likelihood</i>	-51.1382	-48.8145	-19.3021	-17.0811
<i>Number of obs</i>	80	80	73	73
<i>Wald Chi-square (prob)</i>	2.21e+11 (0.000)	1.01e+11 (0.000)	2.06e+07 (0.000)	8.19e+06 (0.000)

Note: Standard errors are in parentheses; ***statistically significant at the 1% level;
 **5% level; *10% level.

Table 5: Descriptive Statistics of Technical Efficiency from Regression (4)

Variable	obs	Mean	Std. Dev.	Min.	Max.
Technical efficiency	73	0.629	0.340	0.0055	0.9993

The rice output per harvest increased by 2% to 5.3% with a 1% increase in seed rate, *ceteris paribus*. High elasticities were found in models which include environmental variables as compared to baseline models. Increasing the seed rate in a good environment can boost rice production by optimising plant density, improving resource utilisation, minimising weed competition, and enhancing yield components. Nevertheless, it is crucial to determine the ideal seed rate for particular circumstances in order to maximise these advantages while avoiding detrimental consequences resulting from excessive planting density (Sowmyalatha et al., 2011). In a study by Suphannachart (2013), it is also found that the positive determinant of rice production is the superior seed variable. As of irrigation, the positive coefficients are traced in two baseline equations with no environmental variables which indicate that a 1% increase in irrigation number per year, increased the output per harvest by 0.3%. The findings are supported by Puspitasari et al. (2019) which indicated that irrigation has an impact and can increase food crop production, particularly rice. Nonetheless, Muzdalifah (2014) also noted that irrigation has a major impact on lowland rice production. However, the impact was opposite (significant and negative with 0.03 of elasticity value) when the environmental factors were considered in equation 4. This clearly shows that environmental effect is significantly change the technical efficiency of producing the rice from higher production to low production through irrigation. This implies that irrigation procedures should be meticulously tailored to suit certain environmental circumstances to maximise rice production. The statement emphasises the significance of precision agriculture and site-specific water management systems in order to ensure that irrigation has a positive influence on crop output while avoiding any negative effects on the environment (Bouman, 2007).

Similarly, the coefficients of labour switch from positive to negative sign when environmental factors are included in the models. The positive coefficients in equation 1 and 2 of baseline models imply the important

of labour in technological efficiency of rice production. While all coefficients in all four equations were highly significant, the negative sign of labour coefficients appeared in equation 3 and 4, with environmental factors were treated as control variables. Since the environmental factors were temperature, rainfall as well as impact from flood and drought, they could indirectly cause negative impact on the productivity of labour toward producing more rice output.

The rice yield decreased by 0.004% (without environmental factors) and by 0.083% (with environmental factors) with a 1% increase in fertilizer dose. The negative signs of all coefficients construe the adverse impact of fertilizers on the technical efficiency of rice production in the Malaysian farms. The result is supported by the findings of Islam et al. (2004), Bäckman et al. (2011), Khan et al. (2010) in case of Bangladeshi farms using cost of fertilizer as an input of rice production and in a study by Gunawan et al. (2022) in the case of farms in Aceh, Indonesia. Government subsidy for fertilizer may encourage the farmers to use too much urea (low-cost fertilizer with the highest Nitrogen content) and it may have long term damaging effects on the long-term productivity of soil. Likewise, some of these studies also found that pesticide cost decreased output of rice including a study by Hasnain et al. (2015). This is similar to the results obtained currently where the coefficients of pesticide cost are negative and inelastic in all four equations shown in Table 4. The results might indicate that pesticides are being overused by the farmers in the study area possibly as an insurance premium against blast and other pests and diseases. It can also influence the environment negatively and therefore; it is suggested that they should use these inputs with appropriate dose. Agricultural policies devised to consider both the production and the environmental efficiency of chemical fertilizer may help the farmers to reduce production costs and conserve the environment (Tu et al., 2018).

The negative coefficients of cost of machines/mechanical power (lcap) in all models imply the higher the cost of machines used in the farming activities did not result in increased rice output yield. The presence of negative coefficients in the models indicates that after reaching a certain threshold, the benefits gained from adding more machinery or mechanical power diminish and may even become detrimental. This aligns with the concept of diminishing marginal returns. When technology is initially introduced in the setting of rice cultivation, it has the potential to greatly

enhance output by substituting manual labour and improving efficiency. With the addition of more machinery, the marginal advantage begins to diminish as the maximum level of mechanisation has already been achieved. Past a certain threshold, further investment in machinery can potentially result in inefficiencies, such as equipment congestion, underutilization, or heightened maintenance expenses. Beside this, if machinery is not utilised optimally, the expenses associated with machines can surpass the advantages. This encompasses incorrect functioning, insufficient training, and inadequate upkeep.

In addition, farmers need to choose the most appropriate power source for any operation depending on the work to be done. The level of mechanization should meet their needs effectively and efficiently. Putting together an ideal machinery system is not easy. Equipment that works best one year may not work well the next year because of changes in weather conditions or crop production practices. Decline in rice production due to high cost of machines used might source from the inefficiency use of capital, that is not using it at full capacity. Houssou and Chapoto (2015) also highlighted that in many African contexts, high machinery costs coupled with inefficiencies result in minimal productivity gains.

The inclusion of environmental factors into the basic stochastic frontier model has shown interesting findings in general (refer to equation 3 and 4 in Table 4). Almost all environmental variables are significant at 1 percent level. A dummy variable of land type3 (low land) is significant in both equations with negative sign implying that low land is producing less rice production than other types of land (medium or high land) in the case of Kedah and Perlis rice farms. The positive coefficients of soil type3 (clay) dummy variables, on the other hand, indicate the importance of clay as a soil to produce rice in the study areas as compared to other types of soils such as loamy and peat or organic. Nevertheless, rainfall contributes positively to the rice yield but high temperature decreases the rice production. Since high temperature is parallel to possible drought, a dummy variable of loss crop yield of 21% to 30% (dum_drgh3) also show negative sign in both equations. Meanwhile, a dummy variable of loss crop yield of 21% to 30% from flood (dum_flood3) was with positive sign which implies that large volume of rainfall or flood is not giving adverse impact to the rice production as compared to the drought season. Hence, if farmers want to increase technical efficiency in rice production, consideration of environmental issues such as temperature, rainfall, type

of land and soil should be taken into account. Less extreme high temperature, probably with more rainfall and clay soil might offers ample opportunities for more efficiency in rice production.

The coefficients associated with age of farmers and farming experience in the inefficiency function were both negative and statistically significant, implying that both older and more experienced farmers contribute to less technical inefficiency. As farmers gained more experience which normally among the older farmers, they became better equipped and more knowledgeable in rice farming. Thus, they were more efficient in the use of labour, seeds, and fertilizer inputs, which were more responsive to output. Similarly, the negative and significant coefficients of education variable in equation 1 and 2 clearly illustrate that those with higher education were performing better with less technical inefficiency. Farmer status of married as well as high income gained per farming also lead to less technical inefficiency and better performance of farmers. The dummy variable of state is significant in all equations with consistent positive sign which illustrates the inefficiency in rice production is obvious in Kedah as compared to Perlis. Nevertheless, the significant and positive dummy variable of 'no training received' construes the importance of training to farmers to reduce technical inefficiency in rice production.

The average technical efficiency for the sample farmers, using full specification (equation 4), is 62.9% (see Table 5) with minimum of 0.05% and maximum of 99.9%. This implies that on the average, the farmers are able to obtain 62.9% of potential output from a given mix of production inputs as well as environmental consideration. In the short-run, therefore, there is a scope for increasing rice production by 37.1% by adopting the technology and techniques used by the best practice rice or paddy farms. For farmers in the two states to attain 100% frontier output, they would have to close the gap between their current output and the maximum potential output. This would be plausible by addressing the determinants of inefficiency in rice production. One suggestion is that farmers should engage themselves in activities that would enable them to get more training from public or private institutions to improve rice production which could adopt to environmental changes such as high temperature. No doubt, this is also an indication for the need of governments and other relevant authorities to provide necessary rice production-related information to help reduce the gap (Alem et al., 2019; Lu et al., 2021a;

Manda et al., 2016; Mulungu & Tembo, 2015). Information may be provided through farmer trainings with a focus on relevant rice technologies, especially with the technologies that improve rice varieties, crop diversification, mixed cropping systems, and other sustainable land management strategies (Lu et al., 2021b; Masasi et al., 2020) that are associated with improved rice productivity for environments encountered by the farm areas.

4. Conclusion and Recommendations

The current study attempts to investigate the impact of environmental factors such as soil type, land type, temperature, rainfall and lost from flood and drought on the efficiency of rice production in Malaysia. The general form of the Cobb–Douglas stochastic production frontier function is used to estimate the production frontier ‘with’ and ‘without’ the environmental variables. Data were collected through interviews with heads of households who work as rice farmers and the survey is confined within states of Kedah and Perlis as the rice bowl of Malaysia. 89 responses were obtained from the survey at the farm areas. The findings from the study indicate that average technical efficiency for the sample farmers is 62.9% which implies that on the average, the farmers are able to obtain 62.9% of potential output from a given mix of production inputs as well as environmental consideration. There is a scope for increasing rice production by 37.1% in the areas of study. Among environmental variables, high temperature is found as a factor that decreases the rice production. Meanwhile, technical inefficiency in rice production is contributed by less experience and young farmers, no training received, and less educated farmers.

As policy recommendation, the effort by MAFI in drafting initiatives for the comprehensive transformation of the paddy and rice industry through the National Food Security Policy Action Plan (DSMN) 2021-2025, which is aimed at boosting paddy production and farmers’ incomes, should be enhanced to encounter the impact of climate change on the nation’s food security. The plan currently covers research and development efforts to enhance food production using climate-based technology. Various initiatives including cultivating paddy using the SMART Large-Scale Field concept; applying the site-specific nutrient management system; and utilising modern cultivation techniques such as drones for spraying pesticides and the latest machinery for planting and

harvesting purposes (Bernama, 2021). The government has also over the years been providing yearly allocations to build and improve irrigation systems in paddy fields. Tube wells and dams have been built for water storage considering that paddy cultivation is largely dependent on rainfall. Other measures to increase rice production are the implementation of the alternative wetting and drying (AWD) innovation, which is an irrigation scheduling technique to replace the continuous flooding (CF) irrigation system. The development and utilisation of seeds of paddy varieties that can withstand the effects of flooding and droughts (anaerobic and aerobic varieties) are also being done, as well as the introduction of agricultural insurance to mitigate the risks of climate change. MAFI is also supporting the National Water Balance Management System (NAWABS) program by the Ministry of Environment and Water for the effective development and management of the nation's water resources and which is being used as a reference in paddy cultivation management. Through this program, rain forecast data from Met Malaysia and data from the National Water Research Institute of Malaysia's Climate Change Impact research have been integrated to provide information on drought forecasts and availability of water resources two months in advance. Warnings will be issued as early as 14 days in advance to the relevant authorities in charge of water management at the state and federal levels. By using this system fully, state water management (authorities) can make decisions pertaining to irrigating paddy fields, such as suggesting procedures like cloud seeding in catchment areas around dams if it doesn't rain for days and the water level in a dam is decreasing. All these efforts are part of the recent 12th Malaysia Plan to boost the nation's self-sufficiency level in rice production to 75 percent by 2025. Besides, MAFI is also committed to addressing food security in other agro-food sectors such as fruits and vegetables, livestock, fishery, and aquaculture through the implementation of the National Agrofood Policy 2021-2030 (NAP 2.0) which is driven by five core pillars, including increasing modernisation and smart farming, strengthening the domestic market, and producing export-oriented products. Nevertheless, from factors exerting significant impacts on the performance of rice production, to the extent that these factors are subject to government influence, they can be manipulated to improve overall environmental performance such as introducing some interventions like farmers field schools or other training on how to manage the risk associated with different environmental condition.

Acknowledgements

This study is funded by the Fundamental Research Grant Scheme (FRGS), FRGS/1/2019/SS08/UIAM/01/1, Ministry of Higher Education, Malaysia. The authors would like to thank the Ministry for generously funding the research.

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Examining the interactions of economic growth and bank credit to the private sector in Morocco: a causality analysis

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ABSTRACT

Our paper examines the relationship between bank credit to the private sector and economic growth in Morocco during the period 2003-2020. We employ a VECM in an econometric framework that controls for the impact of structural breaks. In the short run, we provide robust evidence for a one-way causal impact of bank credit to the private sector on economic growth in Morocco. In the long run, we show a feedback relationship between bank credit and economic growth, which explains the concordance between the evolution of the two variables. Finally, our results show that foreign direct investment contributes most to explaining the forecast errors of bank credit intensity to the private sector and nonagricultural GDP. These results illustrate the impact of exogenous FDI shocks on output and credit in Morocco in the short run.

ملخص

تفحص ورقتنا العلاقة بين الائتمان المصرفي للقطاع الخاص والنمو الاقتصادي في المغرب خلال الفترة 2003-2020. نستخدم نموذج متجه تصحيح الخطأ (VECM) في إطار اقتصادي قياسي يتحكم في تأثير الفواصل الهيكلية. على المدى القصير، نقدم أدلة قوية على تأثير سببي أحادي الاتجاه للائتمان المصرفي للقطاع الخاص على النمو الاقتصادي في المغرب. أما على المدى الطويل، فنظهر وجود علاقة تغذية راجعة بين الائتمان المصرفي والنمو الاقتصادي، مما يفسر التطابق بين تطور المتغيرين. أخيرًا، تظهر نتائجنا أن الاستثمار الأجنبي المباشر يساهم أكثر في تفسير أخطاء التوقع في كثافة الائتمان المصرفي للقطاع الخاص والنتائج المحلي الإجمالي غير الزراعي. توضح هذه النتائج تأثير الصدمات الخارجية للاستثمار الأجنبي المباشر (FDI) على الإنتاج والائتمان في المغرب على المدى القصير.

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RÉSUMÉ

Notre étude examine la relation entre le crédit bancaire au secteur privé et la croissance économique au Maroc au cours de la période 2003-2020. Nous utilisons un VECM dans un cadre économétrique qui contrôle l'impact des ruptures structurelles. À court terme, nous fournissons des preuves robustes d'un impact causal unidirectionnel du crédit bancaire au secteur privé sur la croissance économique au Maroc. À long terme, nous montrons une relation de rétroaction entre le crédit bancaire et la croissance économique, ce qui explique la concordance entre l'évolution des deux variables. Enfin, nos résultats montrent que les investissements directs étrangers contribuent le plus à expliquer les erreurs de prévision de l'intensité du crédit bancaire au secteur privé et du PIB non agricole. Ces résultats illustrent l'impact des chocs exogènes d'IDE sur la production et le crédit au Maroc à court terme.

Keywords Bank credit, Economic growth, Causality, VECM

JEL Classification: C32; E44; G21

1. Introduction

The financial crisis of 2008 confirmed the crucial importance of the two-way interactions between the real economy and the financial sphere. Indeed, this crisis was a cruel reminder of the impact of fluctuations in asset prices, bank credit, and capital flows on economic growth. As a result, an old debate within the economic discipline has been revived, and macro-financial linkages have become a major concern of economists today.

For developing countries where the banking sector dominates, a solid and well-performing banking sector can contribute to long-term economic growth. In particular, it reduces transaction friction and thus contributes to improved economic performance. On the other hand, the role of the banking system in the creation, transmission, and amplification of macroeconomic shocks is well documented, making it essential to consider the impact of banking activity on economic performance (Levine, 1997). In this sense, it is necessary to understand how banking activity interacts with macroeconomic performance to ensure macroeconomic stability.

In a global context marked by uncertainty, the Moroccan economy has experienced a substantial slowdown in economic growth over the past ten

years, which coincides with an unprecedented reduction in bank credit granted to economic agents. Furthermore, the concordance between bank credit and economic growth in Morocco leads us to assume the existence of a causal relationship between these two variables. However, the verification of this hypothesis requires a detailed analysis of the economic literature on the subject and the development of a rigorous empirical analysis interested in detecting the causal relationship and identifying its meaning.

Given the limited role played by the stock market and nonbank financial intermediaries in financing the Moroccan economy, enhancing access to bank credit is essential to meet the financing needs of the private sector. In this context, it is necessary to analyze the causal relationship between bank credit and economic growth.

Based on the above, the following question seems relevant: is there a causal link between the slowdown in economic growth and bank credit?

We divide this paper into three sections to examine the causality between economic growth and bank credit. The first section analyzes the evolution of bank credit's role in Morocco's private-sector financing. Furthermore, the second section explores the theoretical underpinnings of the different hypotheses on the existence and direction of causality between bank credit and economic growth and the empirical studies that support each hypothesis. Finally, the third section presents an empirical study on the causal link between economic growth and bank credit to the private sector.

2. Bank credit as the main engine of private-sector financing in Morocco

Morocco has pursued multiple reforms of the banking system over the last three decades aimed at strengthening the role of private commercial banks in allocating financial resources, improving the ability of financial institutions to mobilize domestic savings, and enhancing competition in the banking sector to support the stability of financial intermediaries (Yu et al., 2014).

Multiple financial sector reforms were adopted, ranging from banking and capital market reforms to monetary policy tools and banking supervision.

The banking sector reforms included changes to the legislative framework governing the activities of commercial banks and the central bank's powers, strengthening prudential regulation in line with international standards, and deregulating banking activity (Bendouz, 2015).

In parallel with these reforms, the banking sector has seen a massive expansion of its branch network, from an annual average of 10.26 bank branches per 100,000 adults between 2003 and 2005 to 24.41 between 2019 and 2020, an increase of more than 100%. During the same period, ATMs per 100,000 adults increased from 11.6 to 28.60.

To illustrate the role of bank credit in financing the Moroccan economy, table 1 below shows that bank credit intensity to the private sector declined from 71.02 percent between 2009 and 2011 to 65.12 percent between 2018 and 2020.

Table 1: Evolution of types of financing in Morocco between 2003 and 2020

	03-05	06-08	09-11	12-14	15-17	18-20
Bank credit to the private sector (% of GDP)	48.15	64.10	71.02	69.29	63.53	65.15
Credit to the private sector by other financial institutions (% of GDP)	-	-	23.54	22.76	22.67	24.42
Stock market financing: IPOs and capital increases (as % of GDP)	4.62	2.85	1.50	0.57	0.61	0.53

Source: Authors' calculations based on Global Financial Development Database data.

Although the intensity of credit to the private sector has slowed over the past decade, bank credit remains the primary source of financing for the Moroccan economy. Indeed, comparing financing through bank credit, credit from other financial institutions, and stock market financing show that the banking sector is the primary financing provider to the private sector in Morocco.

A comparison of credit extended to the private sector by banks and other financial institutions as a percentage of GDP shows that the latter has not been dynamic over the past decade. Indeed, the average annual credit

intensity of other financial institutions to the private sector remained between 22 and 23 percent throughout 2010-2020. Moreover, the banking sector remains the source of most private-sector financing in Morocco. The intensity of bank credit to the private sector is almost three times greater than that of other financial institutions, constituting about three-thirds of credit financing to this sector.

Since 2000, the Casablanca Stock Exchange has undergone significant transformations in its operational framework (Bourse de Casablanca, 2022). However, despite these reforms, IPOs are characterized by their low contribution to the financing of the Moroccan economy. The figures in Table 1 show the stock market's low contribution to the Moroccan economy's financing. The causes of the weakness of IPOs are not only limited to economic and financial factors such as weak economic dynamism, the reduced number of listed companies, the instability of stock market returns, etc., but they are also due to the presence of institutional and socio-cultural factors such as the family character of SMEs, the lack of transparency and financial communication and the aversion of investors to risk (El M'Kaddem & El bouhadi, 2006). In addition, access to the stock market for SMEs is minimal. SMEs only have access to the third compartment of the IPO market (the growth market). However, the number of IPOs in this compartment remains very low (12 in 2018). This weakness is mainly due to the lack of tax incentives, restrictive conditions for issuance and listing, and high costs of issuing securities (Oudgou & Zeamari, 2018).

Based on the above, bank credit is crucial in financing the private sector in Morocco. Therefore, a slowdown in bank credit can have significant macroeconomic consequences, hence the importance of analyzing the fundamental relationship between bank credit and economic activity in Morocco.

3. The causal link between bank credit and economic growth: theoretical underpinnings and empirical evidence

3.1. Theoretical literature review

Abstracting economic analysis from financial considerations has been a lasting tradition in economic theory. Indeed, most traditional Classical, Keynesian, and Monetarist models are only interested in financial markets

and institutions as mere intermediaries for exchanging goods and services, neglecting their role as providers of financing (Gertler, 1988). This idea is mainly illustrated through the (Modigliani & Miller, 1958) theorem that suggests the independence of economic actors' decisions from financial structure (i.e., the sources of financing). The main advantage of this widely influenced idea is that it provided an elegant justification for economists to abstract from the complications that financial markets introduce to formal economic analysis (Gertler, 1988).

Since the seventies, the emergence of new literature on the impact of informational asymmetries on the well-functioning of financial markets, and credit markets in particular (see (Jaffee & Stiglitz, 1990) for a review) has led to an intense debate over the interactions between financial market performance and aggregate economic activity. This debate is more relevant for the case of countries where banks dominate the largely underdeveloped financial systems that characterize developed countries (Nyasha & Odhiambo, 2014).

This extensive debate over the causal nexus between financial development and economic growth reveals three possible directions of the causality between bank credit to the private sector and economic growth. First, the supply-leading hypothesis suggests that developing financial services (such as bank credit) promotes economic growth. Second, the demand-following hypothesis suggests that the development of financial services passively responds to growth in real activity. Third, the feedback hypothesis suggests that the relationship between the two phenomena is either bidirectional or time-varying (Nyasha & Odhiambo, 2018).

According to the proponents of the supply-leading hypothesis, the development of the financial sector stimulates economic growth by better allocating scarce financial resources toward their most efficient uses (Nyasha & Odhiambo, 2014). This hypothesis implies that banks can promote economic growth through maturity transformation and money-creation functions. Banks collect the liquidity necessary to manage extending loans to the private sector. Economic agents spend these loans on consumption and investment, contributing to economic growth.

This hypothesis is supported by (Schumpeter, 1934), who argues that financing commercial applications of innovative entrepreneurial ideas is vital in stimulating economic development. Accordingly, promoting bank

credit to the private sector is necessary to emerge new industries and stimulate economic growth. Also, (McKinnon, 1973; Shaw, 1973) supports the supply-leading hypothesis by arguing that banking system regulation through direct monetary policy intervention hinders economic growth.

The effect of bank credit on economic growth also works through the impact of the economy's financial structure on capital formation (Goldsmith, 1959; Greenwood & Smith, 1997), savings allocation efficiency (Zilibotti, 1994), and enhanced productivity (Greenwood & Smith, 1997).

Finally, (Levine, 1997)'s extensive literature review suggests financial development's impact on economic growth work through capital accumulation and technological innovation. In particular, the development of financial services enhances the accumulation and allocation of savings. Furthermore, financial development can also affect the rate of technological innovation by providing funds necessary for the emergence of risky and innovative sectors (Saint-Paul, 1992).

The demand-following hypothesis suggests that the development of financial services merely reacts to their existing demand (Patrick, 1966). Hence, bank credit follows the growth of real activity. In other words, the development of the financial system requires the existence of a demand for financing and financial intermediation, which in turn comes from the growth of real activity (Nyasha & Odhiambo, 2018).

This hypothesis is supported by (Robinson, 1952), who argued that financial services such as credit extension emerge to satisfy the demand for financial intermediation resulting from economic growth. Also, (Gurley & Shaw, 1967) suggests that financial development emerges primarily from the labor division. Financial development occurs as this division creates the need for monetization and debt. They also argue that the division in labor and production results in specialization in saving and investment.

Finally, (Patrick, 1966) suggests that the relationship between growth and finance is neither unidirectional nor static. He suggests that feedback mechanisms between the economy's growth and the financial sector's development could exist. Some theoretical arguments supporting the

bidirectional causality hypothesis were presented by (Blackburn & Hung, 1998; Greenwood & Jovanovic, 1990). For instance, (Greenwood & Jovanovic, 1990) argues that the extent of financial intermediation and economic growth rate are endogenously determined. Accordingly, financial intermediation promotes economic growth by improving the profitability of capital and, therefore, investment efficiency. Real activity growth, in turn, provides the necessary means for establishing financial structures.

Furthermore, (Blackburn & Hung, 1998) argues that there is a positive feedback relationship between the two dimensions as economic growth both promote and require the development of financial services such as credit. These authors also argue that creating loan contracts requires costly monitoring activities that lenders can undertake themselves or have delegated to a financial intermediary. Financial intermediaries such as banks are essential as delegated supervisory agencies that emerge endogenously to provide the most efficient means of channeling savings to investment. Thus, banks reduce the agency costs firms must pay to obtain loans.

(Patrick, 1966) also argue that the direction of the causality between economic growth and financial development can change over the stages of economic development. In particular, the supply-leading hypothesis is more valid in the early stage of economic development, while the demand following is more valid in the latter stages of this process.

3.2. Empirical literature review

Studies addressing the causality between economic growth and bank credit in a cross-country context are diverse. Panel data econometric methods widen the scope of analysis and increase the sample size and, consequently, the robustness of the results.

(Calderón & Liu, 2003; Zang & Kim, 2007) applied Geweke decomposition on large samples of developed and developing countries. (Calderón & Liu, 2003) tested the degree of linear dependence and feedback between economic growth and financial development for a large panel of countries. Their results show that the direction of causality from bank credit to growth dominates the linear dependence between the two variables. However, these authors show that the sample separation reveals

a feedback effect between the two variables where credit slightly dominates in the case of developing countries and growth slightly dominates in the case of developed countries. Using the same analytical framework, (Zang & Kim, 2007) found no empirical evidence of a unidirectional causality link from bank credit to economic growth. Furthermore, their study shows substantial evidence to support a causality from economic growth to bank credit.

Other studies have mobilized conventional Granger causality tests. For instance, (Rachdi, 2011) used the Granger test on a panel of OECD and 4 MENA countries, revealing a long-run causal relationship between economic growth and bank credit. In line with (Calderón & Liu, 2003), the result provided evidence of a bidirectional causality for developed countries. On the other hand, the causality test results for developing countries show that the direction is from economic growth to bank credit in line with the results of (Zang & Kim, 2007). Furthermore, (Acaravci et al., 2009; Swamy & Dharani, 2018) support the results of (Calderón & Liu, 2003) after sample separation providing evidence for a feedback relationship between economic growth and bank credit.

The results of the consulted panel data studies are contradictory. Admittedly, separating the sample into developed and developing countries allows for a better understanding of the direction of causality, which presumably depends on the degree of economic development and the country's financial structure. (Demetriades & Hussein, 1996), among others, argue that panel data methods are not appropriate to investigate causality for a group of countries with heterogeneous causality patterns. This problem is illustrated by examining the results of (Caporale & Helmi, 2018). These authors tested the causality between economic growth and bank credit in fourteen developing countries by dividing their sample into two sub-samples and mobilizing both time-series and panel data methodologies to test for causality and both short- and long-run. On the one hand, their tests on panel data show that the causality direction depends on the sub-sample. On the other hand, the tests on separate time series show different directions of causality for different countries.

These inconsistencies between panel data and time series results can be addressed by keeping the cross-country framework and using time series methods by limiting the analysis to case studies.

One of the first proponents of the first solution is (Demetriades & Hussein, 1996) who examined the direction of causality between economic growth and financial development in a sample of 16 developing countries to show that the direction of causality depends on the characteristics of each country. Similarly, (S. M. Ahmed & Ansari, 1998) examined credit-growth causality in India, Pakistan, and Sri Lanka and showed the existence of causality from bank credit to economic growth in all three countries. Finally, (Abu-Bader & Abu-Qarn, 2008b) analyzed the causality relationship between financial development and economic growth for six MENA countries using the procedure of (Toda & Yamamoto, 1995) and provided evidence for a unidirectional causal relationship from bank credit to private sector to economic growth in the case of Algeria, Egypt, and Tunisia, a causal relationship in the other direction in the case of Syria, and the absence of causality in the other two cases.

For developed countries, (J. Shan et al., 2001) provided evidence of a bidirectional causality in half of its case studies. (J. Shan & Morris, 2002) also examined the direction of causality for a sample of 20 advanced economies and showed that no causality exists between bank credit and economic growth for half of the sample and that credit causes economic growth in only 6 cases.

The synthesis of the empirical literature consulted to this point in Appendix 1 shows that the level of economic development moderates the direction of the causality between bank credit and economic growth. Most studies on developed countries support a bidirectional causal relationship between the two variables. The results of the studies on developing countries are less consistent and show that they differ depending on the case, which explains the choice of a large part of the studies to limit the analysis to a single country.

The results of the consulted studies confirm the absence of a consensus on the direction of causality between bank credit and economic growth in developing countries. However, most results (A. A. Ahmed, 2018; Ananzeh, 2016; Eita & Jordaan, 2010; K. Ghali, 1999; Odhiambo, 2004) confirm that bank credit causes economic growth. These results show the importance of bank credit for growth in developing economies where banks play a primary role in financing the economy and financial markets are as underdeveloped. Annex 2 presents a synthesis of the above studies.

For Morocco, (Alaoui Moustain, 2004) used the empirical approach proposed by (Demetriades & Hussein, 1996) to investigate the causal nexus for the 1970-200 period, showing the absence of cointegration between economic growth and bank credit, implying the nonexistence of a long-run relationship between the two variables. The use of the Granger test in the first difference shows the existence of a unidirectional causality of bank credit to economic growth in Morocco during the study period. The results of the causality test contradict this result according to the approach of (Toda & Yamamoto, 1995) developed by (Abu-Bader & Abu-Qarn, 2008b), which did not find a short-term causality relationship between the variables between 1960 and 2004 and those of (Menchif et al., 2020) which provide evidence for a causal impact of economic growth on bank credit during the study period.

These empirical studies of the Moroccan case suffer from significant shortcomings, namely, the study period, the sample size, and the choice of causality test. First, these studies cover the periods with the various reforms in the Moroccan banking sector without considering the impact of possible structural breaks that result. Second, the use of annual data significantly reduces the sample size; this problem is compounded in the case of dynamic models that require the estimation of coefficients on lags of variables. Finally, the causality test (Abu-Bader & Abu-Qarn, 2008b) and (Menchif et al., 2020) do not test for long-run causality.

More recently, (Kchikeche & Khallouk, 2021) provided more recent evidence on credit-growth causality. These authors studied the causality between bank-based financial development and economic growth in Morocco using quarterly data between 2002 and 2018. Their results provide evidence of a unidirectional causal effect of bank credit on economic growth in the short run and bidirectional causality between the two variables in the long run.

In the following section, we build on the work of (Kchikeche & Khallouk, 2021) by narrowing our focus on the causality between bank credit to the private sector and economic growth, extending the study period to include the post-COVID19 data and significantly improving the robustness of the results by accounting for the impact of structural breaks.

4. Data and Methodology

4.1. Empirical Methodology

The first step of our analysis is unit root detection by conducting the augmented Dickey-Fuller test described in (Dickey & Fuller, 1979). We will also use the unit root test in the presence of a structural break developed by (Perron, 1989).

If the series are integrated in the first order, we will test for cointegration using a VAR model as presented by (Lütkepohl, 1999) in equation 1 as follows:

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + u_t \quad (1)$$

To test for cointegration, we conduct the tests developed by (Johansen, 1995). Furthermore, we use the (Johansen et al., 2000) extension of the cointegration test to account for the impact of structural breaks by modifying the trace statistics in the standard cointegration test.

A cointegrating relationship between nonstationary variables may indicate a long-run relationship that we can formalize using a VECM (Engle & Granger, 1987). Thus, a long-term cointegrating equation can be estimated if a cointegrating relationship is detected. Therefore, causality tests could be conducted using a vector error correction model (VECM) that we present in equation 2 as follows:

$$\Delta y_t = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \dots + \Gamma_{p-1} \Delta y_{t-1} + u_t \quad (2)$$

Where $\Pi = -(I_K - A_1 - \dots - A_p)$ and $\Gamma_i = -(A_{i+1} + \dots + A_p)$ for $i = 1, \dots, p-1$.

The long-run component of the model is represented through the matrix Πy_{t-1} comprised of the cointegrating equations and the vector Π representing the error correction coefficients. The short-run component of the models is comprised of the autoregressive coefficients Γ_j .

Based on this VECM model, we conduct two causality tests. First, we conduct the short-run VEC-based Granger causality test developed by

(Granger, 1986, 1988). The granger causality test tests the joint significance of each block of short-run parameters Γ_j . Second, we test long-run causality using the weak exogeneity test. This test examines the significance of each element in Π and can be, in the presence of cointegration, evidence of causality in the long run (Hall & Milne, 1994).

4.2. Data and model specification

In line with (Kchikeche & Khallouk, 2021), our econometric model used in this study is a dynamic model incorporating our two variables of interest and two control variables. We measure economic growth in Morocco using nonagricultural GDP per capita. In addition, we use bank credit to the private sector to measure the effect of the essential function of the banking sector on economic growth.

We use foreign direct investment as a percent of GDP to control for confounding external macroeconomic variables. Indeed, in addition to their effects on output and employment, FDI stimulates investment in developing countries, which are characterized by a low savings rate and an underdeveloped financial system, and promotes the transfer of technology, which helps improve the productivity of domestic firms, and therefore stimulate growth (Lahlou, 2019). In addition, they contribute significantly to bank liquidity, facilitating credit provision.

On the other hand, we use government spending as a percent of GDP to control short-term internal macroeconomic dynamics. Keynesian theory suggests that government spending stimulates economic growth through two main channels. The former directly affects economic growth by increasing aggregate demand through expansionary fiscal policy, and the latter indirectly affects growth by providing the necessary infrastructure for private investment (Nyasha & Odhiambo, 2019).

Our sample extends from 2003, when data on FDI is first available, to 2020. We deflated all our variables using the CPI to control for inflation before adjusting them for seasonal variation using the X-13 procedure. Finally, the log transformation is used to unify the measurement scales, obtain more homogeneous variances, and make the distributions of our series more normal (Lütkepohl & Xu, 2012).

5. Empirical Results

5.1. Preliminary tests

The first step of our modeling exercise is the analysis of the stationarity of our variable. For robustness, we conduct two separate stationarity tests. Table 2 below presents the results of both the standard (Dickey & Fuller, 1979) unit root test and the unit root test of (Perron, 1989) in the presence of structural breaks.

Table 2: Unit root tests

Variables	ADF test			Perron test		
	Level	1 st difference	I(d)	Level	1 st difference	I(d)
GDP	1.320	-9.927***	I(1)	-3.894	-13.085***	I(1)
CDTP	-1.800	-7.374***	I(1)	-3.932	-7.997***	I(1)
GS	-2.470	-3.384***	I(1)	-2.656	-10.632***	I(1)
FDI	-0.356	-24.811***	I(1)	-9.212***	-	I(0)

Note: *, **, *** means that the test statistic is above the critical value at the 10%, 5%, and 1% thresholds, respectively.

The results of the ADF test indicate that the null hypothesis is not rejected for all variables. However, all series become stationary in the first differences. Therefore, the results of the stationarity test indicate that all series are first-order integrated. Furthermore, (Perron, 1989) 's test indicates the existence of a break in the trend and constant of the series during the third quarter of 2009, which coincides with the manifestation of the impact of the 2008 financial crisis on the Moroccan economy.

Overall, the results of both types of stationarity tests indicate that the two variables of interest, nonagricultural GDP per capita and private sector credit intensity, are integrated in the first order. The cointegration study is, therefore, necessary to verify the existence of a long-run relationship between the two variables.

We conduct the Johansen cointegration test using a VAR model with six lags. We also conduct the modified cointegration test of (Johansen et al., 2000) to account for the impact of structural breaks in the deterministic component of our VAR model.

The estimated VAR model is augmented with three exogenous dummies for three possible structural breaks. The first dummy variable is introduced to account for the impact of the 2008 financial crisis, taking the value of 1 from the second quarter of 2009 and 0 before that date. The second indicator variable representing the impact of the COVID-19 crisis takes the value one from the second quarter of 2020. The dates of these two breaks are chosen based on the two shocks' impact on economic growth dynamics and bank credit to the private sector in Morocco. Finally, the date of the third structural break is detected using the test developed by (Andrews & Ploberger, 1994) and takes the value one from the fourth quarter of 2012.

The rest of the two cointegration tests are presented in table 3 below.

Table 3: Cointegration tests

Test	(Johansen, 1995)		(Johansen, 2000)	
	Trace	Max-Eigenvalue	Trace	Adjusted critical value at 5%
$r = 0$	78.732**	35.332**	78.732**	74.200
$r \leq 1$	43.400**	25.761**	43.400	50.968
$r \leq 2$	17.639	17.291**	17.639	31.529
$r \leq 3$	0.348	0.348	0.348	15.772

Note: ** indicates the rejection of the null hypothesis at the critical value at the 5% thresholds.

The results of the above cointegration tests indicate the existence of at least one cointegrating equation between the variables. Notably, the Johansen cointegration test requires all variables to be integrated in the first order. The possible stationarity of the foreign direct investment variable could render the cointegration test results invalid. To further check the robustness of our results, we conduct the (Pesaran et al., 2001) causality test that allows for cointegration between stationary and nonstationary variables³. The results of this test are shown in Table 4 below.

³ We also checked for cointegration using a VAR model of the three nonstationary variables (GDP, Credit intensity, and government spending). The results of this test indicate the existence of 1 cointegration relationship.

Table 4: Cointegration test at the bounds

F-statistic value	Significance level	Lower bound	Upper bound
6.211	10%	2.37	3.2
	5%	2.79	3.67
	1%	3.65	4.66

To reject the hypothesis of cointegration, the F-statistic should be above the critical value of the upper bound $I(1)$. As the results show, we can reject the null of no cointegration at the 1% significance level. The above tests show robust evidence of cointegration among the four variables. Accordingly, we will use a VECM to capture the cointegrating relationships between our variables

5.2. Causality tests

Based on the tests above, we conclude that there is a long-run causal relationship between our variables in at least one direction. The short-run causal relationship can be captured using a Granger causality test based on the vector error correction model. We present the result of both short and long-run causality tests in table 5 below.

Table 5: Causality tests

Direction of causality	Granger causality test	Weak exogeneity test
GDP → CDTP	8.018	32.060***
CDTP → GDP	27.559***	23.176***
GS → CDTP	22.275***	2.008
GS → GDP	40.887***	
FDI → GDP	15.828***	0.776
FDI → CDTP	20.118***	

Note: *** indicates the rejection of the null hypothesis at the critical value at the 1% threshold.

The results of testing the joint significance of the coefficients (Γ_i) of each explanatory variable for each error correction equation do not reject the hypothesis that economic growth does not cause growth in private sector credit intensity. On the other hand, the results reject the null hypothesis that changes in private sector credit intensity do not cause short-term economic growth. Accordingly, these results show a unidirectional causal relationship in the short term from bank credit to the private sector toward the nonagricultural GDP. Moreover, the results show that FDI and government spending stimulate economic growth and private-sector credit in the short run.

While the results of the Granger causality test show the dynamics of the two variables of interest in the short term, they do not allow us to compare the effects of the explanatory variables on each variable to be explained.

In this sense, the forecast error variance decomposition measures the information contribution of each variable to the other variables in the model. More precisely, it allows us to calculate the contribution of the exogenous shocks of each variable in the model to the variance of the forecast error of the variable of interest (Lütkepohl, 2005).

Table 6 below presents the aggregated yearly average of each variable contribution to the GDP and credit intensity forecast error.

Table 6: Variance decomposition results

	Variance decomposition of GDP				Variance decomposition of CDTP			
	GS	CDTP	GDP	FDI	GS	CDTP	GDP	FDI
2-year average	2.9	10.0	57.3	29.8	5.1	75.8	1.7	17.4
5-year average	2.2	10.2	42.7	44.8	3.9	73.7	1.6	20.8
10-year average	1.9	12.5	32.2	53.5	3.3	73.2	1.7	21.9

The results of the Granger causality test show that all variables in the model cause nonagricultural GDP in the short run. However, their contributions to the error variance are significantly different. Being stock variables, nonagricultural GDP and bank credit are persistent and contribute significantly to their forecast variance after two years. Moreover, the variable that contributes most to explaining the forecast errors of the two variables of interest is FDI, which shows the impact of exogenous shocks on output and credit in Morocco in the short run.

In all, the results of the short-run causality test are consistent with the findings of (S. M. Ahmed & Ansari, 1998; Ananzeh, 2016; Caporale & Helmi, 2018; K. H. Ghali, 1999; Odhiambo, 2004) in the case of developing countries and (Alaoui Moustain, 2004) in the case of Morocco between 1970 and 2000. However, our results contradict the findings of (Acaravci et al., 2009; A. A. Ahmed, 2018; Araç & Özcan, 2014; Calderón & Liu, 2003; Demetriades & Hussein, 1996; Odhiambo, 2008; Rachdi, 2011) in the case of developing countries and those of (Menchif et al., 2020) in the case of Morocco between 1987 and 2017.

Our results suggest a strong impact of the opening of the Moroccan economy to foreign capital on the dynamics of bank credit to the private sector. The effect of external shocks goes through bank liquidity, affecting banks' balance sheet constraints and, subsequently, bank credit supply. The impact of FDI can also affect production, investment and employment, disposable income, and subsequently, economic agents' debt and repayment capacity, which will impact the demand for bank credit. The results of the Granger causality test show that the impact of external shocks is mainly through the bank liquidity channel and affects banks' ability to grant credit.

The use of the VECM model is not limited to testing short-term causality but also allows for testing long-term causality using the weak exogeneity test. Based on our results, we reject the hypothesis of the non-significance of the error correction terms in the equations of nonagricultural GDP per capita and bank credit to the private sector. However, we cannot reject the insignificance of government spending and FDI. Therefore, a long-run bidirectional causal relationship exists between nonagricultural economic growth and bank credit.

Our results are in line with the findings of (Araç & Özcan, 2014; Calderón & Liu, 2003; Ghali, 1999; Siddique, 2018) in the case of developing countries, but they contradict the results of (S. M. Ahmed & Ansari, 1998; Araç & Özcan, 2014; Caporale & Helmi, 2018; Eita & Jordaan, 2010; Odhiambo, 2004) that show the nonexistence of a causal impact of GDP on credit, those of (Demetriades & Hussein, 1996; Odhiambo, 2008; Rachdi, 2011) which show the inexistence of a causal impact of credit on GDP and the results of (Alaoui Moustain, 2004) which support the inexistence of a long run causality between the variables in the Moroccan case.

Thus, our results show a feedback relationship between bank credit and economic growth in the long run, which implies the importance of real activity growth for the development of the banking sector in the long run. Moreover, the contribution of the banking sector to the financing of the economy stimulates growth in the short and long run.

6. Conclusion

Our paper investigates the causality between economic growth and credit to the private sector in Morocco between 2003 and 2020. To do so, we used a VECM to conduct short-run and long-run causality tests.

We provide robust evidence for a one-way causal impact of bank credit to the private sector on economic growth in Morocco in the short run. Furthermore, the results show that FDI and government spending stimulate economic growth and private-sector credit only in the short run. Furthermore, we show that the variable that contributes most to explaining the forecast errors of bank credit intensity to the private sector and the nonagricultural GDP is foreign direct investment, which shows the impact of exogenous capital inflow shocks on output and credit in Morocco in the short run.

In the long run, we show a feedback relationship between bank credit and economic growth, which explains the concordance between the evolution of the two variables. These results could indicate the operation of the (Bernanke & Gilchrist, 1996)'s financial accelerator in the long run, which could explain the concurrent decline of the levels of economic growth and credit extension to the private sector during the study period.

Our results have significant implications for economic policy in Morocco. Indeed, Morocco has embarked on various structural reforms to develop its financial system. Nonetheless, the banking sector is still the primary financing provider to a significant portion of the private sector, as the contribution of the compartments of the nonbank segments of the financial sector to this process is still unsatisfactory. The existence of a robust causal impact of bank credit to the private sector on economic growth sheds light on the importance of stimulating bank credit to bank-dependent firms and households. While Bank Al-Maghrib started to experiment with nonconventional tools of monetary policy to stimulate credit to the private sector in 2012 and 2013 (Bank Al-Maghrib, 2014) and reinforced and extended their use in the aftermath of the COVID-19 crisis (Bank Al-Maghrib, 2021), the reach of these instruments should be further extended as they proved effective in promoting bank credit to medium and small firms (Queyranne et al., 2021).

One more significant implication of our result is that there is no long-run measurable benefit of the financial liberalization and the measures undertaken to attract foreign direct investment on either economic growth or bank credit to the private sector. However, as a source of bank liquidity, the resulting capital inflows strongly impact short-term bank credit. Based on these results and in the context of the growing openness of the Moroccan economy, external economic shocks will likely have an increasing impact on bank credit dynamics in Morocco.

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Appendices

Appendix 1: Summary of the empirical literature consulted on the causality between bank credit (C) and economic growth (Y) in a transnational context

Study	Full sample	Developed	Developing
(Calderón & Liu, 2003)	$C \rightarrow Y$ (81%)	$C \leftrightarrow Y$ (63%)	$C \leftrightarrow Y$ (60%)
(Zang & Kim, 2007)	$C \leftarrow Y$	No separation	No separation
(Rachdi, 2011)	NA	$C \leftrightarrow Y$	$C \leftarrow Y$
(Acaravci et al., 2009)	NA	Not included	$C \leftrightarrow Y$
(Swamy and Dharani, 2018)	NA	$C \leftrightarrow Y$	NA
(Caporale & Helmi, 2018)	-	Not included	$C \rightarrow Y$ (64% in SR, 86% in the LR)
(Demetriades & Hussein, 1996)	-	Not included	$C \leftarrow Y$ (56%)
(S. M. Ahmed & Ansari, 1998)	-	Not included	$C \rightarrow Y$
(Abu-Bader & Abu-Qarn, 2008)	-	Not included	$C \rightarrow Y$ (50%)
(J. Z. Shan et al., 2001)	-	$C \leftrightarrow Y$ (50%)	Not included
(J. Shan & Morris, 2002)	-	$C \leftrightarrow Y$ (50%)	Not included

Note 1: The column (Full Sample) shows the results of studies that do not separate the sample into developed and developing countries.

Note 2: The percentages in parentheses in the first row of the table show the contribution of bank credit to the causal relationship. However, this figure in the rest of the table is a percentage of cases that support a given hypothesis

Appendix 2: Summary of the empirical literature consulted on the causality
between bank credit (C) and economic growth (Y) in a domestic context

Study	Short-run causality	Long-run causality
(Ghali, 1999)	$C \rightarrow Y$	$C \leftrightarrow Y$
(Odhiambo, 2004)	$C \rightarrow Y$	$C \rightarrow Y$
(Odhiambo, 2008)	$C \leftarrow Y$	$C \leftarrow Y$
(Abu-Bader & Abu-Qarn, 2008a)	$C \leftrightarrow Y$	$C \leftrightarrow Y$
(Eita & Jordaan, 2010)	$C \rightarrow Y$	$C \rightarrow Y$
(Araç & Özcan, 2014)	$C \leftrightarrow Y$	$C \rightarrow Y$
(Ananzeh, 2016)	$C \rightarrow Y$	Not Tested
(A. A. Ahmed, 2018)	$C \leftrightarrow Y$	Not Tested
(Hondroyannis et al., 2005)	$C \leftrightarrow Y$	$C \leftrightarrow Y$
(J. Shan & Jianhong, 2006)	$C \leftrightarrow Y$	Not Tested
(Alaoui Moustain, 2004)	$C \rightarrow Y$	$C \leftrightarrow Y$
(Menchif et al., 2020)	$C \leftarrow Y$	Not Tested
(Kchikeche & Khallouk, 2021)	$C \rightarrow Y$	$C \leftrightarrow Y$

Do Country Characteristics and International Linkages Foster Financial Stress Transmission in Emerging Economies?

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ABSTRACT

This paper examines the role of country characteristics and international linkages in transmitting financial stress from advanced to emerging countries. The study considers a panel of 18 emerging countries from 2000 to 2019. We apply various panel data techniques to evaluate the conditional and unconditional effects of country characteristics and international linkages on financial stress in emerging economies. Findings suggest that the financial crises from advanced countries transmit strongly and rapidly to emerging economies. Further, we conclude that the extent of the transmission of financial stress is related to the depth of financial linkages between advanced and emerging economies. Positive current account and fiscal balances do little to insulate emerging economies from the transmission of acute financial stress from advanced economies. The study highlights the design of policies to strengthen the institutional setup in emerging economies. Further, coordinated policy responses may help these countries to mitigate FS through external factors. Besides that, a serious effort is desired to monitor fiscal imbalances and recessionary trends.

ملخص

تستعرض هذه الورقة دور الخصائص القطرية والروابط الدولية في نقل الضغوط المالية من البلدان المتقدمة إلى البلدان الناشئة. تتناول الدراسة مجموعة من 18 دولة ناشئة من عام 2000 إلى عام 2019. نطبق تقنيات مختلفة لبيانات اللوحة لتقييم الآثار المشروطة وغير المشروطة للخصائص القطرية والروابط الدولية على الضغوط المالية في الاقتصادات الناشئة. تشير النتائج

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إلى أن الأزمات المالية من البلدان المتقدمة تنتقل بقوة وبسرعة إلى الاقتصادات الناشئة. علاوة على ذلك، نستنتج أن مدى انتقال الضغوط المالية يرتبط بعمق الروابط المالية بين الاقتصادات المتقدمة والناشئة. إن وجود حسابات جارية وأرصدة مالية إيجابية لا تفعل الكثير لعزل الاقتصادات الناشئة عن انتقال الضغوط المالية الحادة من الاقتصادات المتقدمة. تسلط الدراسة الضوء على تصميم السياسات لتعزيز البنية المؤسسية في الاقتصادات الناشئة. علاوة على ذلك، قد تساعد الاستجابات السياسية المنسقة هذه البلدان على التخفيف من الضغوط المالية من خلال العوامل الخارجية. إلى جانب ذلك، من المطلوب بذل جهود جادة لرصد الاختلالات المالية واتجاهات الركود.

RÉSUMÉ

Cet article examine le rôle des caractéristiques des pays et des liens internationaux dans la transmission des tensions financières des pays avancés aux pays émergents. L'étude porte sur un panel de 18 pays émergents entre 2000 et 2019. Nous appliquons diverses techniques de données de panel pour évaluer les effets conditionnels et inconditionnels des caractéristiques des pays et des liens internationaux sur le stress financier dans les économies émergentes. Les résultats suggèrent que les crises financières des pays avancés se transmettent fortement et rapidement aux économies émergentes. En outre, nous concluons que l'ampleur de la transmission des tensions financières est liée à la profondeur des liens financiers entre les économies avancées et émergentes. Une balance courante et des soldes budgétaires positifs ne protègent guère les économies émergentes de la transmission de tensions financières aiguës en provenance des économies avancées. L'étude souligne la nécessité de concevoir des politiques visant à renforcer la structure institutionnelle des économies émergentes. En outre, des réponses politiques coordonnées peuvent aider ces pays à atténuer les tensions financières dues à des facteurs externes. En outre, un effort sérieux est nécessaire pour surveiller les déséquilibres budgétaires et les tendances à la récession.

Key Words: Financial stress, emerging economies, transmission, country characteristics, international linkages

JEL Classification: G01, G15, E44, F42

1. Introduction

The financial stress (FS hereafter) transmission from developed to emerging countries intensified after the global financial crisis of 2007 to 2009. The impact of global turmoil spillover to the emerging countries in the final quarter of 2008 when these economies experienced currency

depreciation, unsustainable levels of sovereign debt, falling reserves, and excessive volatility in stock markets. This crisis brought the worst global recession since the 1930s, besides elevating financial instability to unprecedented levels. This instability even surpassed the levels that prevailed during the Asian financial crisis. Emerging countries, characterized by less resilient financial systems and deep financial linkages with developed countries, experienced substantial FS transmission than developed countries (Balakrishnan et al., 2011).

Transmission of FS refers to the co-movements of asset prices and capital flows in periods of financial turmoil. This co-movement is explained either through strong trade and financial linkages between the countries, macroeconomic conditions, or herd behavior of the investors (Park & Mercado, 2014). Numerous studies construct financial stress indices (FSIs hereafter) and investigate the stress transmission process for emerging economies. For instance, Balakrishnan et al. (2011) analyzed FS transmission for 25 emerging and 17 developed countries. They show that FS transmits from developed to emerging countries during stressful periods rather than tranquil ones. Later on, Park and Mercado (2014) studied the transmission of FS using quarterly data from 1992 to 2012 for 25 emerging economies. They also find support for stress transmission from developed countries and emerging regions, such as Emerging Asia and Europe. Likewise, Fink and Schuler (2015) find significant stress transmission from the US financial shock to eight emerging countries through financial linkages channels.

This study claims that the extent of pass-through depends on the country characteristics of the emerging economies and the depth of international linkages between emerging and developed countries. An interesting research inquiry is to shed light on whether country characteristics and international linkages foster or mitigate the FS transmission process from developed to emerging economies. This study makes several contributions to bridge the gap in the existing literature on FS transmission. Specifically, we aim to evaluate the conditional effects of domestic vulnerabilities and linkages in the transmission of FS from developed to emerging countries. Also, the role of regional financial contagion and institutional efficacy is analyzed. This study builds a composite index to reflect the quality of institutions instead of incorporating multiple institutional variables.

The rest of the study is planned as follows. Section 2 explains the theoretical framework of FS transmission analysis. Section 3 explains

data and econometric methodology. The next section presents a detailed analysis of the results. The last section concludes the study and proposes policies that may help mitigate FS transmission.

2. Theoretical Framework

Following Park and Mercado (2014), this study reinvestigates the role of various country characteristics and linkages that interfere with the FS transmission process.

2.1 Country Characteristics and Linkages

The study considers four country characteristics and two linkages to analyze FS transmission. The first country's characteristic is a decline in the real GDP growth rate (GRY). Such an economic downturn raises vulnerability to FS as a financial crisis is generally preceded by slumps in economic activity followed by boom periods (Guru, 2016). The second factor is a deficit in the external account (CA), which compels countries to rely on foreign financing, thereby enhancing the exposure to sudden stops and FS (Claessens, Kose, & Terrones, 2009; Fratzscher, 2009). The third indicator is fiscal vulnerabilities, such as high fiscal deficits and government debt. A negative government balance (GB) magnifies FS as it limits the ability of fiscal authorities to enhance spending during periods of financial crisis. Fiscal deficit elevates concerns about roll-over risk. Debt sustainability problems create repercussions for the financial system through enhanced instability and FS (Afonso, Baxa, & Slavik, 2011; Cardarelli, Elekdag, & Lall, 2011). The fourth macroeconomic imbalance is a decline in the foreign exchange reserves (DRES) held by central banks. Before a financial crisis, Dwindling reserves exert pressure on the banking system and local currency as monetary authority fails to support domestic currency (Olafsson & Petursson, 2010). The study further looks into the role of financial and real linkages that affect the shock spillover from one country to another. A high degree of financial integration (FO) fosters the transmission of FS through capital outflows, reduction in trade credit, and foreign direct investment. These shocks spillover to the domestic economy through unfavorable shifts in the perception of international investors. Such portfolio rebalancing helps investors minimize exposure to portfolio risk but raises FS. Likewise, real international linkages, in terms of trade openness (TO), improve economic performance through trade diversification. This brings financial stability and reduces FS in the domestic economy. This study estimates

four models, each indicating an interaction of FSIA with these characteristics to gauge the conditional role of these preconditions in the stress transmission process. Further, a fifth and sixth model explores the conditional role of linkages in transmitting FS from advanced to emerging countries (Hwa, 2015; Park & Mercado, 2014).

2.2 Control Variables

To avoid specification issues, this study incorporates a few control variables. The first set of control variables are external factors. We take three external/global factors, namely, global interest rate (GIR), global output (GY), and global commodity prices index (GCP). Any rise in GIR suggests tight credit conditions in the global credit market. This limits foreign financing for local imbalances. Similarly, an increase in GY refers to a boom that magnifies FS. A rise in GY refers to favorable global demand conditions. The last factor, an adverse shock to GCP, raises the likelihood of a financial crisis through various channels, as Kinda, Mlachila, and Ouedraogo (2016) explained. Such shocks lower the export earnings and income of the domestic country. Further, falling GCP sores up fiscal deficits as revenues of commodity-exporting nations fell. A surge in bank withdrawals after falling GCP squeezes the liquidity of banks. The financial sector becomes fragile through all these channels, and the FS level increases.

Region-specific contagion is the next control variable. It refers to the spread of crisis within specific regions characterizing similar macroeconomic conditions and common creditors (including international commercial banks). The first channel of regional propagation is adverse shocks to banks located in interconnected regions. The second one is the exposure to a common lender channel. A common lender in regional countries is a common factor in the propagation of FS originating from one country. The heavy reliance of the domestic country on a regional lender raises the possibility of regional contagion (Arvai & Driessen, 2009; Park & Mercado, 2014).

The effectiveness of Political Institutions is the last control variable. Institutions play an essential role in minimizing systemic risk. The concept of institutions combines non-market factors, such as social norms and public relations, politics, legal systems, culture, and religion. In the economic context, institutions shape the behavior of economic agents and markets. The efficacy of political institutions ensures the stability of a financial system. Low-quality political institutions make a financial

system fragile. Institutional failure to regulate financial markets encourages excessive risk-taking behavior. The present study is unique in evaluating institutional effectiveness in assessing system-wide FS for emerging countries.

2.3 Model Specification

To evaluate the conditional and unconditional effects of country-specific characteristics and international linkages in FS transmission process, we estimate the following model:

$$FSIE_{i,t} = \beta FSIA_t + \delta_i CC_{i,t} + \sigma_i (FSIA_t \times CC_{i,t}) + \phi_i Lin_{i,t} + \eta_i (FSIA_t \times Lin_{i,t}) + \gamma G_t + \omega_i PRI_{i,t} + \theta_i RD_i + u_i + \varepsilon_{i,t} \quad (1)$$

where FSIE and FSIA indicate the FSIs for emerging and advanced countries, respectively. The average co-movement parameter (β) measures the intensity of the stress co-movement. *CC* refers to country characteristics, such as GRY, CA, GB, and DRES. These characteristics affect FSIE directly and indirectly. The direct and conditional effects of emerging countries' characteristics are captured through δ_i , and σ_i , respectively. *Lin* refers to international linkages such as TO, and FO. The direct and conditional effect of emerging countries' characteristics are captured through ϕ_i and η_i , respectively. *G* denotes global factors, comprising cGIR, GY, and GCP changes. The effectiveness of political institutions is measured through a political risk index (PRI) for emerging countries. Regional dummies (RD_i) account for regional financial contagion. This study incorporates three regional dummies: merging Asia (DA), Latin America (DLA), and Emerging Europe (DE). The country-specific effects are captured through unobservable time-invariant shocks (u_i). The subscripts i and t denote country and time, respectively.

3. Data and Methodology

This section explains data, variables, and econometric methodology for analyzing the role of country characteristics and international linkages in financial stress transmission in emerging countries.

3.1 Data

This study considers panel data for 18 emerging countries from 2000 to 2019, comprising 360 annual observations. The sampled countries are Argentina, Brazil, Chile, China, Colombia, Hungary, India, Indonesia,

Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Russian Federation, Thailand, Turkey, and Venezuela. Data availability at the measurement stage of FSIs remained the primary concern when selecting countries. Initially a large sample was selected that was later trimmed on consistent data availability. A list of variables, definitions, measurements, and data sources is given in Table A in the Appendix.

3.1.1 Measuring Financial Stress

This study constructs monthly FSIE and FSIA using PCA. The authors follow Sadia, Bhatti, and Ahmad (2019) for detailed procedures for constructing FSIs. For each group of countries, the authors consider three types of risks as components of FSIs. These are financial, economic, and political risks. These components are banking sector risk, stock market volatility, currency risk, sovereign risk, credit stress, output gap, and political risk. Finally, we take the period average to convert monthly FSIs into annual frequency.

3.1.2 Measuring Effectiveness of Political Institutions

The measurement of institutional factors did not receive considerable attention in the literature. Abdessatar and Rachida (2013) take various institutional factors as the regressors that affect FS. Following Sadia, Bhatti, and Azeez (2022), we apply the composite index approach to the International Country Risk Guide (hereafter ICRG) data. Composite PRI measures the effectiveness of political institutions. A high index value, which refers to low political risk, indicates that political institutions are strong enough to mitigate FS.

3.2 Econometric Procedure

Before estimation, the authors apply some diagnostic tests proposed by Das (2017) and check for the presence of outliers. The first diagnostic test for serial correlation rejects the null hypothesis of no first-order serial correlation and must accept the null hypothesis of no second-order serial correlation. The second test, Hansen J, for over-identifying restriction, accepts the null hypothesis of no correlation of instruments with the error term. This study applies Hampel Identifiers (hereafter HI) to control for the outliers in data (Wilcox, 2005). An observation would be declared as an outlier with a cutoff of 3.5. Bhatti, Haque, and Osborn (2014) elaborate on the procedures.

This study uses several econometric techniques for the robustness analysis while estimating equation (1). These techniques are Pooled Ordinary Least Square (POLS), Fixed Effects (FE), Two-Stage Least Squares (2SLS), system and difference GMM.

4. Empirical Results

The authors investigate the conditional effects of country characteristics and linkages in the transmission of FS from developed to emerging countries. They estimate both the static and dynamic models. Table 1 presents the estimation results using POLS for the equation (1). The authors estimate 6 models, each introducing the interaction of FSIA with one of the four country characteristics or two linkages. The findings reveal that the institutional factor is negative and statistically significant across all six models, confirming that political risk endangers the financial system's stability, thereby raising FSIE. Strikingly, a more pronounced role of global factors is observed in almost all the models. For instance, an adverse shock in global commodity prices enhances FS. However, the magnitude of this effect is negligible, but the effect is significant in almost all the models. Likewise, in 5 out of 6 models, high growth in the global economy significantly mitigates FSIE. Lastly, growth in the global interest rate is dropped out in all the specific models, except the first model, indicating that global credit conditions carry an insignificant impact on emerging economies. Regional dummies for Asia and Latin America indicate that FS goes down significantly in all six models if the region is Emerging Asia or Latin America compared to the European region's base category.

Table 1: Role of Country Characteristics and Linkages in Financial Stress Transmission, POLS

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
PRI	-0.083*** (0.000)	-0.068*** (0.000)	-0.085*** (0.000)	-0.073*** (0.000)	-0.079*** (0.000)	-0.071*** (0.000)	-0.084*** (0.000)	-0.073*** (0.000)	-0.087*** (0.000)	-0.068*** (0.000)	-0.084*** (0.000)	- 0.068*** (0.000)
FSIA	0.067** (0.017)	-0.268*** (0.000)	-0.0664 (0.187)	0.001 (0.973)	0.077 (0.194)	0.121*** (0.002)	-0.129 (0.107)	-0.032 (0.825)	-0.183** (0.042)	0.011 (0.766)	-0.076 (0.233)	0.0548 (0.207)
GRY	-0.074*** (0.004)	-0.053*** (0.000)	-	-	-	-	-	-	-	-	-	-
GRY*FSI A	-0.437*** (0.008)	0.046*** (0.001)	-	-	-	-	-	-	-	-	-	-
CA	-	-	0.043*** (0.000)	0.021*** (0.005)	-	-	-	-	-	-	-	-
CA*FSIA	-	-	-0.008 (0.403)	0.004 (0.620)	-	-	-	-	-	-	-	-
GB	-	-	-	-	-0.066*** (0.000)	-0.056*** (0.000)	-	-	-	-	-	-
GB*FSIA	-	-	-	-	0.055*** (0.002)	0.043*** (0.000)	-	-	-	-	-	-
DRES	-	-	-	-	-	-	-0.005* (0.082)	-0.004** (0.024)	-	-	-	-
DRES*F SIA	-	-	-	-	-	-	0.005 (0.156)	0.0034 (0.239)	-	-	-	-
TO	-	-	-	-	-	-	-	-	0.001 (0.398)	-0.001 (0.334)	-	-
TO*FSIA	-	-	-	-	-	-	-	-	0.002** (0.026)	0.001 (0.653)	-	-
FO	-	-	-	-	-	-	-	-	-	-	0.050** (0.003)	0.015** (0.036)

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
FO*FSIA	-	-	-	-	-	-	-	-	-	-	-0.011 (0.543)	0.001 (0.383)
GCPG	0.007*** (0.002)	0.005*** (0.001)	0.004** (0.025)	0.003*** (0.007)	0.006*** (0.001)	0.004*** (0.002)	0.006*** (0.004)	0.004** (0.027)	0.004** (0.019)	0.0026** (0.025)	0.005*** (0.016)	0.003** (0.025)
GYG	-0.044 (0.307)	-	-0.155*** (0.000)	-0.102*** (0.000)	-0.113** (0.010)	-0.095*** (0.000)	-0.123** (0.011)	-0.108*** (0.000)	-0.135*** (0.007)	-0.101*** (0.000)	-0.124** (0.011)	- (0.081*** (0.000))
GGIR	-0.001* (0.071)	-0.001*** (0.000)	0.0002 (0.420)	-	-0.0001 (0.692)	-	-0.0001 (0.660)	-	0.0001 (0.825)	-	0.0001 (0.832)	-
DA	-0.457*** (0.000)	-0.245*** (0.000)	-0.731*** (0.000)	-0.478*** (0.000)	-0.552*** (0.000)	-0.407*** (0.000)	-0.578*** (0.000)	-0.324*** (0.000)	-0.628*** (0.000)	-0.348*** (0.000)	-0.599*** (0.000)	0.349*** (0.000)
DLA	-0.165 (0.137)	-0.120** (0.036)	-0.157 (0.184)	-0.155** (0.010)	-0.101 (0.299)	-0.126** (0.034)	-0.129 (0.247)	-	-0.101 (0.405)	-0.151** (0.019)	-0.077 (0.481)	-0.137** (0.017)
Constant	5.826*** (0.000)	4.446*** (0.000)	6.173*** (0.000)	5.051*** (0.000)	4.273*** (0.000)	4.692 (0.000)	5.988*** (0.000)	5.009*** (0.000)	6.164*** (0.000)	4.663*** (0.000)	6.037*** (0.000)	4.626*** (0.000)
Obs	342	329	342	327	342	331	342	330	342	325	342	325
R ²	0.693	0.759	0.675	0.778	0.697	0.807	0.648	0.756	0.643	0.762	0.655	0.763
F Statistics	48.37*** (0.000)	83.16*** (0.000)	64.26*** (0.000)	108.87** * (0.000)	56.46 (0.000)	112.26 (0.000)	46.05 (0.000)	81.15 (0.000)	60.99 (0.000)	123.67 (0.000)	51.49 (0.000)	105.59 (0.000)

Note: GM and SM refer to general and specific models respectively. And the interaction between FSIA and the country characteristics (GRY, CA, GB, DRES), and FSIA and linkages (TO and FO) are introduced to trace out the conditional effect of FSIA on FSIE.

Further, these findings are consistent with Park and Mercado (2014), and UNCTAD (2019).

Next, we discuss the conditional effects of transmitting FS from developed to emerging countries. The first effect, growth in real output of the emerging countries, is documented in the first and second columns in Table 1. The findings suggest a negative and significant direct impact of a decline in real GDP (GRY) on FS. However, the transmission of FSIA to FSIE is conditioned upon growth in real output. This indirect impact turns out to be positive. This reflects that FSIA compliments FSIE if emerging countries face economic downturns. This effect is attributed to recessionary trends in major emerging countries since 2013, which makes a strong link between economic slowdown and heightened FS, as pointed out by UNCTAD (2019).

Next, columns (3) and (4) account for the stress transmission (from developed to emerging countries) conditional upon the current account balance of the emerging countries. In line with the baseline model, the direct effect of deterioration in the current account on FSIE is positive and statistically significant. Emerging European and Latin American countries explain most of this deterioration in the early 2000s. Although the indirect effect of CA is positive, the effect turns out to be statistically insignificant once again, reflecting weak complementarity. The next two columns (5 and 6) report the direct and indirect effects of government balance (GB) changes in the FS transmission. The direct effect is negative and statistically significant. Interaction terms show FSIA spillover to emerging countries if these economies experience a fiscal deficit. This effect is attributed to the sampled Latin American and leading Asian countries that faced persistent fiscal deficits. The fourth model (Columns 7 and 8) explores the direct and indirect role of FOREX changes on FSIE. Our model witnesses that a fall in reserves carries a negative and significant impact on FSIE. The indirect effect is, however, positive and insignificant, confirming a weak complementarity between FSIA and FSIE. The next four columns (columns 9 to 12) analyze the role of trade and financial openness in the FS transmission process, respectively. More open economies in terms of trade flows experience lesser FS as openness improves their competitive position and brings stability to financial markets. However, the findings reveal that deeper trade linkages contribute insignificantly to FS transmission. Likewise, a high degree of

financial openness makes emerging countries more vulnerable to adverse capital account shocks. This enhances FSIE. Nevertheless, countries that tend to be more open financially do not facilitate FS transmission from developed to emerging countries.

Overall, our results confirm that real economy macroeconomic fundamentals, such as a fall in real GDP and fiscal deficits, and political factors weigh more in the transmission of FS. This is further supported by the fact that 5 out of 7 selected Emerging Latin American and 3 out of 4 selected Emerging European countries are experiencing problems of twin deficits during the sample period. This finding sharply contrasts the previous studies of IMF (2009) and Balakrishnan et al. (2011). Across all six models, R^2 is considerably high indicating that the models explain well the variations in data. Further, F statistics reveal the overall significance of all the six models.

The authors re-estimate equation (1) using the FE and 2SLS methods for robustness checks. The estimation results are presented in Table 2 and Table 3, respectively. High political risk once again thwarts financial stability in both the tables and across all the models. The findings appear to be different in the FS transmission. We lack support for the FS transmission across all the models of both tables. All the other findings are robust to POLS, except that the direct effect of both trade and financial linkages is significant. Thus, we find evidence consistent with the notion that deeper trade, particularly between China, India, and the US, helps to mitigate FSIE. Likewise, high financial connectedness between developed and emerging countries facilitates FS transmission through bank lending channels and the high financial liabilities of emerging countries. This finding conforms to Balakrishnan et al. (2011).

Table 2: Role of Country Characteristics and Linkages in Financial Stress Transmission, FE Model

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
PRI	-0.038*** (0.000)	-0.039*** (0.000)	-0.048*** (0.000)	-0.050*** (0.000)	-0.049*** (0.000)	-0.047*** (0.000)	-0.041*** (0.000)	-0.045*** (0.000)	-0.052*** (0.000)	-0.050*** (0.000)	-0.045** (0.000)	-0.043*** (0.000)
FSIA	-0.310** (0.017)	-0.155* (0.094)	-0.084** (0.044)	-0.042 (0.317)	-0.0004 (0.996)	-0.004 (0.918)	-0.1083* (0.093)	-0.039 (0.554)	-0.202** (0.036)	-0.079 (0.249)	-0.142 (0.112)	-0.064 (0.331)
GRY	-0.092*** (0.000)	-0.061*** (0.000)	-	-	-	-	-	-	-	-	-	-
GRY*FSIA	-0.031 (0.139)	0.021* (0.083)	-	-	-	-	-	-	-	-	-	-
CA	-	-	0.037* (0.091)	0.011 (0.123)	-	-	-	-	-	-	-	-
CA*FSIA	-	-	-0.017 (0.217)	0.003 (0.669)	-	-	-	-	-	-	-	-
GB	-	-	-	-	-0.041 (0.197)	-0.028*** (0.003)	-	-	-	-	-	-
GB*FSIA	-	-	-	-	0.027 (0.199)	0.013* (0.097)	-	-	-	-	-	-
DRES	-	-	-	-	-	-	-0.002 (0.297)	-0.002 (0.498)	-	-	-	-
DRES*FSIA	-	-	-	-	-	-	0.002 (0.490)	0.0002 (0.934)	-	-	-	-
TO	-	-	-	-	-	-	-	-	-0.003 (0.117)	-0.003* (0.050)	-	-
TO*FSIA	-	-	-	-	-	-	-	-	0.002* (0.067)	0.001 (0.249)	-	-

130 Do Country Characteristics and International Linkages Foster Financial Stress Transmission in Emerging Economies?

FO	-	-	-	-	-	-	-	-	-	-	0.043* (0.094)	0.027** (0.023)
FO*FSIA	-	-	-	-	-	-	-	-	-	-	-0.024 (0.251)	0.009 (0.420)
GCPG	0.005*** (0.007)	0.003** (0.010)	0.003 (0.151)	0.003** (0.014)	0.004** (0.010)	0.003*** (0.003)	0.004** (0.029)	0.003** (0.011)	0.003** (0.021)	0.003*** (0.004)	0.003* (0.066)	0.003*** (0.007)
GYG	-0.04 (0.166)	-0.05** (0.020)	-0.17*** (0.003)	-0.09*** (0.000)	-0.14*** (0.001)	-0.09*** (0.000)	-0.14*** (0.003)	-0.096*** (0.000)	-0.15*** (0.004)	-0.09*** (0.000)	-0.15*** (0.004)	0.09*** (0.000)
GGIR	-0.0001 (0.615)	-	0.0003 (0.281)	-	0.0001 (0.554)	-	0.0001 (0.513)	-	0.0002 (0.432)	-	0.0002 (0.463)	-
Constant	2.844*** (0.000)	2.641*** (0.000)	3.547*** (0.000)	3.255*** (0.000)	3.358*** (0.000)	2.945*** (0.000)	3.600*** (0.000)	2.961*** (0.000)	3.891*** (0.000)	3.442*** (0.000)	3.368*** (0.000)	2.841*** (0.000)
Obs	342	325	342	320	342	314	342	320	342	309	342	310
R ²	0.5905	0.6784	0.675	0.778	0.6271	0.8021	0.5718	0.7185	0.5695	0.7623	0.5603	0.7092
F Statistics	97.91*** (0.000)	67.15*** (0.000)	16.87*** (0.000)	22.13*** (0.000)	14.32*** (0.000)	44.59*** (0.000)	16.28*** (0.000)	41.44*** (0.000)	18.51*** (0.000)	22.60*** (0.000)	17.62*** (0.000)	27.22*** (0.000)

Table 3: Role of Country Characteristics and Linkages in Financial Stress Transmission, 2SLS

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
PRI	-0.08*** (0.000)	-0.072*** (0.000)	-0.085* (0.091)	0.078*** (0.000)	-0.078*** (0.000)	-0.069*** (0.000)	-0.083*** (0.000)	-0.069*** (0.000)	-0.088*** (0.000)	-0.078*** (0.000)	-0.083** (0.000)	-0.07*** (0.000)
FSIA	-0.295 (0.523)	-0.134* (0.092)	-0.091 (0.646)	-0.035 (0.349)	0.131 (0.315)	0.092*** (0.007)	-0.288 (0.641)	0.061 (0.245)	-0.207 (0.337)	-0.094 (0.188)	-0.173 (0.579)	-0.018 (0.642)
GRY	-0.053* (0.051)	-0.065*** (0.000)	-	-	-	-	-	-	-	-	-	-
GRY*FSIA	0.047 (0.387)	0.021** (0.039)	-	-	-	-	-	-	-	-	-	-
CA	-	-	0.041*** (0.001)	0.024*** (0.000)	-	-	-	-	-	-	-	-
CA*FSIA	-	-	-0.006 (0.715)	-0.0003 (0.964)	-	-	-	-	-	-	-	-
GB	-	-	-	-	-0.052*** (0.000)	-0.061*** (0.000)	-	-	-	-	-	-
GB*FSIA	-	-	-	-	0.038 (0.126)	0.031*** (0.000)	-	-	-	-	-	-
DRES	-	-	-	-	-	-	-0.005 (0.586)	-0.001 (0.690)	-	-	-	-
DRES*FSIA	-	-	-	-	-	-	0.011 (0.655)	-0.003 (0.191)	-	-	-	-
TO	-	-	-	-	-	-	-	-	0.0014 (0.220)	-0.0004 (0.598)	-	-
TO*FSIA	-	-	-	-	-	-	-	-	0.002 (0.144)	0.001 (0.109)	-	-

132 Do Country Characteristics and International Linkages Foster Financial Stress Transmission in Emerging Economies?

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
FO	-	-	-	-	-	-	-	-	-	-	0.048** (0.029)	0.025*** (0.001)
FO*FSIA	-	-	-	-	-	-	-	-	-	-	-0.026 (0.642)	0.008 (0.434)
GCPG	0.003 (0.924)	-	0.010 (0.7561)	-	0.006 (0.807)	-	0.021 (0.634)	-	0.017 (0.629)	-	0.019 (0.600)	-
GYG	-0.001 (0.980)	-	-0.236 (0.656)	-	0.046 (0.913)	-	-0.360 (0.545)	-	-0.361 (0.537)	-	-0.352 (0.550)	-
GGIR	-0.0004 (0.286)	-	0.0001 (0.892)	-	-0.0003 (0.468)	-	-0.0001 (0.895)	-	0.0002 (0.833)	-	0.0001 (0.846)	-
DA	-0.41*** (0.000)	-	-0.661*** (0.000)	0.545*** (0.000)	-0.470*** (0.000)	-0.332*** (0.000)	-0.490*** (0.000)	-0.296*** (0.000)	-0.554*** (0.000)	-0.415*** (0.000)	-0.520*** (0.000)	-0.314*** (0.000)
DLA	-0.091 (0.303)	-	-0.112 (0.209)	-0.111* (0.083)	-0.042 (0.587)	-	-0.058 (0.538)	-	-0.029 (0.759)	-	-0.022 (0.806)	-
Constant	5.465*** (0.001)	4.656*** (0.000)	6.378*** (0.000)	5.048*** (0.000)	4.666*** (0.007)	4.129*** (0.000)	6.685*** (0.004)	4.307*** (0.000)	6.912*** (0.004)	4.918*** (0.000)	6.742*** (0.004)	4.422*** (0.000)
Obs	324	352	324	352	324	340	324	340	324	350	324	340
R ²	0.7124	0.7289	0.6985	0.7398	0.6823	0.8134	0.5785	0.7466	0.5986	0.7118	0.5977	0.7637
F statistics	47.8*** (0.000)	99.1*** (0.000)	62.2*** (0.000)	116.2*** (0.000)	60.1*** (0.000)	170.6*** (0.000)	34.4*** (0.000)	131.1*** (0.000)	42.6*** (0.000)	150.2*** (0.000)	36.3*** (0.000)	129.5*** (0.000)

Next, we document the results for conditional effects. Only two of 6 country characteristics play a significant role in FS transmission. The first is the direct and indirect effects of fall in GY, as shown in columns (1) and (2) in Table 2. A decline in real output carries a significant negative effect on FSIE. The indirect effect is once again positive as well as statistically significant. This reconfirms the findings in Table 1. The second significant conditional effect appears in columns (5) and (6) for changes in fiscal balance. We find a negative and statistically significant direct effect. Moreover, a positive indirect effect reveals that fiscal deficits tend to enhance the transmission of FSIA to FSIE. Leading Emerging Asian and most Latin American countries faced large fiscal deficits that fostered stress transmission. Our results are in sharp contrast to IMF (2009) and Balakrishnan et al. (2011) which state that none of the domestic vulnerability contributes to FS transmission from developed to emerging countries. This lack of evidence may be attributed to the sample, which did not fully capture the post-global financial crisis effects. Our unique finding enriches the existing evidence.

For 2SLS, we consider global factors as instruments. In all the models, global factors completely vanish out after removing outliers. Finally, we end up with OLS estimates. Once again, a fall in real output and fiscal deficits elevate FSIE directly and indirectly. We conclude that our findings for the conditional effect in Table 2 and Table 3 are robust to Table 1. The results further indicate that the two other direct effects are significant using 2SLS. First is a current account deficit that enhances the transmission of FSIA to FSIE. Second, financial openness speeds up the process of FS transmission. The bottom part of both tables reports the model's goodness of fit and overall significance. Both the models are a good fit as R^2 is reasonably high. F-statistics confirms the overall significance of regressors across all the models.

The conditional role of the country characteristics in the transmission of FS is also re-evaluated using the dynamic panel data models. We apply two variants of such models, namely System GMM and Difference GMM. Results are presented in Table 4 and Table 5, respectively. We confirm the presence of dynamic effects as the lagged value of FSIE is positive and statistically significant. The dynamic model also reconfirms the claim that political institutions are vital to financial stability. This finding provides support to the theoretical viewpoints of Waszkiewicz

(2017). We find that the co-movement parameter is positive across most of the models. This confirms the presence of non-regional financial contagion. This contagion, however, is statistically insignificant. Both the dynamic models acknowledge the role of global factors in the escalation of FSIE. These findings align with Park and Mercado (2014), and UNCTAD (2019).

Now we discuss the conditional effects using system GMM. Table 4 reports that a fall in real output helps raise FSIE. The interaction terms, although small in magnitude, are positive and statistically significant at 1 percent. The second significant characteristic is the deterioration in GB. The direct effect of fiscal deficit is not significant. When we incorporate the interaction of GB with FSIA, the coefficient becomes significant. Our findings are again robust to POLS, FE, and 2SLS models. It is interesting to observe that once we apply Difference GMM the results differ from all the previous models. Columns (3) and (4) in Table 5 report the conditional effect of the current account balance on FS transmission using difference GMM. This effect is negative and significant, pointing out that improved CA mitigates the transmission of FS. Similarly, the conditional effect of a fall in real output is positive and statistically significant, confirming the findings of previous models that the FS transmits from developed to emerging countries if emerging countries face a recession. All other conditional effects are insignificant for Difference GMM. The bottom part of Table 4 and Table 5 discuss the results of diagnostic tests. Test for serial correlation confirms the absence of second-order serial correlation as indicated by probability for AR(2) higher than 5 percent. The Hansen test for over-identifying restriction shows that instruments are valid in both models.

Table 4: Role of Country Characteristics and Linkages in Financial Stress Transmission, One Step System GMM

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
L.FSIE	0.524*** (0.000)	0.47*** (0.002)	0.515 (0.156)	0.38** (0.028)	0.821 (0.114)	0.58*** (0.007)	0.53** (0.011)	0.74*** (0.000)	0.274 (0.515)	0.474** (0.034)	0.084 (0.712)	0.41*** (0.00)
PRI	0.017 (0.781)	-0.04** (0.025)	0.01 (0.928)	-0.08*** (0.004)	-0.14 (0.181)	0.08*** (0.000)	-0.03 (0.024)	-0.03* (0.067)	0.06 (0.376)	-0.09** (0.027)	-0.07*** (0.007)	-0.06*** (0.000)
FSIA	-0.203 (0.503)	-0.353 (0.632)	0.123 (0.482)	0.076 (0.271)	1.534 (0.263)	0.418** (0.010)	0.050 (0.710)	0.202** (0.012)	-4.463 (0.543)	1.561 (0.293)	-0.435 (0.224)	0.251* (0.064)
GRY	-0.043** (0.025)	-0.031 (0.308)	-	-	-	-	-	-	-	-	-	-
GRY*FSIA	-0.033 (0.409)	0.046* (0.075)	-	-	-	-	-	-	-	-	-	-
CA	-	-	0.021 (0.855)	-0.003 (0.927)	-	-	-	-	-	-	-	-
CA*FSIA	-	-	-0.091** (0.017)	-0.001 (0.948)	-	-	-	-	-	-	-	-
GB	-	-	-	-	-0.0220 (0.902)	-0.028 (0.485)	-	-	-	-	-	-
GB*FSIA	-	-	-	-	0.8242 (0.147)	0.096*** (0.007)	-	-	-	-	-	-
DRES	-	-	-	-	-	-	-0.013** (0.016)	-0.013** (0.029)	-	-	-	-
DRES*FSIA	-	-	-	-	-	-	0.0024 (0.476)	-0.0004 (0.876)	-	-	-	-
TO	-	-	-	-	-	-	-	-	0.005 (0.931)	0.021 (0.365)	-	-
TO*FSIA	-	-	-	-	-	-	-	-	-0.064 (0.556)	-0.028 (0.272)	-	-

Table 5: Role of Country Characteristics and Linkages in Financial Stress Transmission, Difference GMM

Variables	GM (1)	SM (2)	GM (3)	SM (4)	GM (5)	SM (6)	GM (7)	SM (8)	GM (9)	SM (10)	GM (11)	SM (12)
L.FSIE	0.53*** (0.000)	0.61** (0.017)	0.122 (0.618)	0.39** (0.014)	0.59*** (0.001)	0.45** (0.030)	0.63** (0.016)	0.32** (0.028)	0.41** (0.018)	0.32*** (0.006)	0.38** (0.020)	0.24** (0.019)
PRI	0.011 (0.539)	-0.019 (0.347)	-0.058* (0.098)	0.056*** (0.004)	-0.078* (0.063)	0.101*** (0.001)	0.0236** (0.043)	0.042*** (0.000)	-0.030 (0.517)	-0.063** (0.050)	-0.034 (0.282)	-0.058** (0.010)
FSIA	- 0.565** (0.033)	-0.517* (0.097)	-0.088 (0.566)	0.086 (0.406)	0.190 (0.102)	0.207** (0.035)	0.1834 (0.357)	0.194 (0.211)	0.398 (0.171)	0.390 (0.154)	-0.062 (0.320)	0.0001 (0.999)
GRY	-0.105 (0.181)	-0.048 (0.533)	-	-	-	-	-	-	-	-	-	-
GRY*FSIA	0.076** (0.015)	0.088* (0.086)	-	-	-	-	-	-	-	-	-	-
CA	-	-	0.128*** (0.00)	0.090*** (0.00)	-	-	-	-	-	-	-	-
CA*FSIA	-	-	-0.051** (0.00)	0.045*** (0.00)	-	-	-	-	-	-	-	-
GB	-	-	-	-	-0.023 (0.597)	0.014 (0.697)	-	-	-	-	-	-
GB*FSIA	-	-	-	-	0.045 (0.225)	0.027 (0.307)	-	-	-	-	-	-
DRES	-	-	-	-	-	-	- 0.0179** (0.025)	-0.006 (0.370)	-	-	-	-
DRES*FSIA	-	-	-	-	-	-	-0.007 (0.371)	-0.010 (0.247)	-	-	-	-
TO	-	-	-	-	-	-	-	-	0.006 (0.702)	0.009 (0.579)	-	-
TO*FSIA	-	-	-	-	-	-	-	-	-0.005 (0.188)	-0.005 (0.166)	-	-

4.1 Comparison of Results

To compare the results, we reproduced the co-movement parameter, unconditional (direct), and conditional (indirect) effects from Table 1 to Table 5 in Table 6.

Table 6: Summary of Conditional and Unconditional Effects

Variables	POLS Table 1	FE Table 2	2SLS Table 3	System GMM Table 4	Difference GMM Table 5
FSIA	-0.268***	-0.155*	-0.134*	-0.353	-0.517*
GRY	-0.053***	-0.061***	-0.065***	-0.031	-0.048
GRY*FSIA	-0.046***	0.025*	0.021**	0.046*	0.088*
FSIA	0.001	-0.042	-0.035	0.076	0.086
CA	0.021***	0.001	0.024***	0.003	0.090***
CA*FSIA	0.004	0.003	-0.003	-0.001	-0.045***
FSIA	0.121***	-0.004	0.092***	0.418**	0.207**
GB	-0.056***	-0.028***	-0.061***	-0.028	0.014
GB*FSIA	0.043***	0.013*	0.031***	0.096***	0.027
FSIA	-0.032	-0.039	-0.061	0.202**	0.194
DRES	0.004***	0.002	-0.001	-0.013**	-0.006
DRES*FSIA	0.0034	0.0002	-0.003	-0.0004	-0.010
FSIA	0.011	-0.079	-0.094	1.561	0.390
TO	-0.001	-0.003*	-0.0004	0.021	0.009
TO*FSIA	0.001	0.001	0.001	0.028	-0.005
FSIA	0.0548	-0.064	-0.018	0.251*	0.001
FO	0.015**	0.027**	0.025**	0.020	0.045
FO*FSIA	0.001	0.009	0.008	0.083	-0.026

Note: The first value in every row indicates the co-movement parameter. The second and third values in every row measure the unconditional and conditional effects of country characteristics and linkages on FSIE. The dependent variable is FSIE. Significance levels at 1, 5, and 10 percent are represented by ***, **, and *, respectively.

The consolidated findings in Table 6 show that a fall in real output of the emerging countries has significant direct and indirect effects across all the models, except that the respective direct effect is not significant for System GMM. Similarly, the effects of the government balance on FSIE countries are significant in 4 out of 5 methods. For the fifth method, the Difference GMM, the effect of the current account balance is significant rather than the government balance. The coefficient estimates from system GMM are generally larger than the other models. Overall, our findings are robust to the estimation method applied.

5. Conclusion and Policy Recommendations

This study rigorously analyzes the FS transmission process from developed to emerging countries. The authors utilize a broader set of stress transmitters for a panel of 18 emerging countries from 2000 to 2019. The study provides enough evidence that country characteristics and international linkages help to foster FS transmission from developed to emerging countries. The authors estimate six conditional models using five different estimation methodologies. The study concludes that the vulnerabilities in the real economy play a significant role in fostering FS transmission rather than trade and financial linkages. The findings are robust to various estimation methods. The study highlights the importance of designing policies that strengthen the institutional setup in these economies. Further, coordinated policy responses may help these countries to mitigate FS through external factors. Besides that a serious effort is desired to keep an eye on fiscal imbalances and recessionary trends in these countries. This analysis can be further refined by exploring a better measurement of political risk and incorporating the interdependencies between monetary policy and FS in the context of emerging and developed countries.

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Appendix: Table A List of Variables, Measurement, and Data Sources

Variables	Measurement	Source
Financial stress index for developed economies	The weighted average of FSIA uses PPP-based GDP weights. The index is built by employing PCA on 7 components.	Author's calculation
Financial stress index for emerging economies	The weighted average of FSIE uses PPP-based GDP weights. The index is built by employing PCA on 7 components.	Author's calculation
Growth in real GDP	Annual percentage change in Real GDP	WDI, WB
Current account balance as a % of GDP	The ratio of the sum of exports and imports as a ratio of GDP	WDI, WB
General government overall balance as a % of GDP	General government expenditures net of taxes as a percent of GDP	WDI, WB
Change in foreign exchange reserves	Growth in the level of foreign exchange reserves	IFS, IMF
Global real interest rate	LIBOR (three months)	WEO, IMF
Global GDP	Growth in world output	WEO, IMF
Global commodity price index	Global Price Index of All Commodities Not Seasonally Adjusted	Fed Reserve Bank
Trade openness	The ratio of the sum of exports and imports to GDP	WDI, WB
Financial openness	The ratio of the sum of portfolio and foreign direct investment to GDP	WDI, WB
Regional financial contagion	Regional Dummies for Asia, Latin America, and Europe	Author's calculations
Effectiveness of Political Institutions	Political risk index constructed for 12 components of political risk	Author's calculations based on ICRG, PRS

Determinants of Household Consumption Expenditure in the Middle East

Katria Davina Paramastuti¹ and Muhammad Sri Wahyudi Suliswanto²

ABSTRACT

Household consumption and the variables that drive it have received widespread attention in economic literature. GDP per capita, population, and inflation are some of the macroeconomic variables that are usually considered to affect household spending. This study examines the influence of these macroeconomic variables on household consumption using multiple linear regression analysis models. The annual data used in this analysis covers the period 2010 to 2022. The paper found a positive and significant relationship between the expenditure of household consumption and GDP per Capita and population. As well as the significant and negative relationship between inflation and the expenditure of household consumption in the Middle East.

حظي استهلاك الأسر المعيشية والمتغيرات التي تدفعه باهتمام واسع في الأدبيات الاقتصادية. يُعتبر الناتج المحلي الإجمالي للفرد، والسكان، والتضخم من بعض المتغيرات الاقتصادية الكلية التي تُعتبر عادةً مؤثرة على إنفاق الأسر المعيشية. تفحص هذه الدراسة تأثير هذه المتغيرات الاقتصادية الكلية على استهلاك الأسر المعيشية باستخدام نماذج تحليل الانحدار الخطي المتعدد. تغطي البيانات السنوية المستخدمة في هذا التحليل الفترة من 2010 إلى 2022. وجدت الورقة علاقة إيجابية وهامة بين إنفاق استهلاك الأسر المعيشية والناتج المحلي الإجمالي للفرد والسكان. بالإضافة إلى العلاقة السلبية الهامة بين التضخم وإنفاق استهلاك الأسر المعيشية في منطقة الشرق الأوسط.

RÉSUMÉ

La consommation des ménages et les variables qui la déterminent ont fait l'objet d'une grande attention dans la littérature économique. Le PIB par habitant, la population et l'inflation sont quelques-unes des variables macroéconomiques

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généralement considérées comme influençant les dépenses des ménages. Cette étude examine l'influence de ces variables macroéconomiques sur la consommation des ménages en utilisant des modèles d'analyse de régression linéaire multiple. Les données annuelles utilisées dans cette analyse couvrent la période 2010-2022. L'étude a mis en évidence une relation positive et significative entre les dépenses de consommation des ménages, le PIB par habitant et la population. Il existe également une relation significative et négative entre l'inflation et les dépenses de consommation des ménages au Moyen-Orient.

Keywords: Household Consumption Expenditure, GDP per Capita, Population, Inflation

JEL Classification: C23 D12 O53

1. Introduction

Household consumption expenditure has an important role in the economy of a country. High household consumption can provide a significant boost to economic growth and national development. Dumitrescu et al. (2022) and Agarwala & Vasudevan, (2021) said in his research that high household consumption can contribute significantly to economic growth and national development. Understanding the factors influencing household consumption expenditure is essential to formulate effective economic policies, Thomas, (2013).

Wibowo & Airlangga (2020) and Çebi Karaaslan et al., (2022) Writing an analysis of household consumption expenditure factors can provide an overview of economic dynamics and consumer behavior in a particular region. These expenses are in the form of food, clothing, shelter, transportation, health, education, recreation, and other consumer goods. Household consumption expenditure is an important component in measuring a country's economic activity and can provide valuable information for people and related countries. The Middle East is a country with different levels of development, resources, and social systems.

Çebi Karaaslan et al., (2022) and Almalki et al., (2022), demonstrating the importance of understanding the factors influencing household consumption expenditure in the culturally rich and economically rich Middle East region, for governments, entrepreneurs, and academia. Countries with people who have a high level of income and expenditure

so that they have high economic potential. Most households in the region spend on expensive items such as cars, houses, and luxury goods. However, household consumption expenditure in the region can also vary significantly. These differences can be influenced by a variety of determinants such as average household income, price level, inflation, unemployment rate, and other social and demographic factors, Obinna, (2020).

Income levels in the Middle East can be a complex and multifaceted subject. Although the region is known for its oil wealth, per capita income and wealth distribution can vary greatly between countries and even within countries themselves. On the one hand, countries such as Qatar and Saudi Arabia have very high per capita incomes, due to their links to their natural resources, especially oil and gas and the presence of government subsidies and social benefits programs, Tapsin & Hepsag, (2014).

Then the Turkish country with a high level of income due to has a fairly diverse economy, including manufacturing, agriculture, tourism, and increased access to credit in Turkey, Çebi Karaaslan et al., (2022). On the other hand, there are Iran and Egypt which have lower per capita incomes. Because problems such as unemployment and poverty are still major challenges in the country.

Another factor that causes high household consumption expenditure is the price level. The price level also affects the consumption patterns of a society. Jan Brůha, Michal Hlaváček, (2017) and Çebi Karaaslan et al., (2022) said that when the overall price level rises, it will decrease the purchasing power of households. In the Middle East, if inflation is high, it can lead to an increase in the price of essential goods and services, such as food, housing, and transportation. In addition, many countries in the Middle East also rely on importing large amounts of consumer goods. High inflation in the home country can also increase the cost of imports and lead to an increase in the price of consumer goods in the domestic market, affecting their household consumption expenditure, Khan et al., (2021).

Then another factor that causes the increase in household consumption expenditure is demographic factors. Dumitrescu et al., (2022) The Middle East has a varied population, and every year it grows rapidly and significantly. Al-Khraif et al., (2020) Rapid population growth in some

Middle Eastern countries could increase demand for consumer goods and services, such as food, housing, education, and health services. This has led to an increase in household consumption expenditure to meet the needs of a growing population. Chai, (2018) It also states that household consumption expenditure is the amount of money used by households in buying goods and services to meet their needs and desires.

In general, previous studies used panel data analysis to determine the determinants of household consumption such as those conducted by Arapova, (2018) who examined household consumption from 13 countries in Asia and 110 other countries around the world, then by Shaikh et al., (2014) who examined household consumption expenditure in Pakistan using the range of 1985 – 2011 using foreign investment, household consumption, domestic savings, domestic savings, Value Added in the Industrial, Agricultural and Service sectors taken independently, Foreign Debt, Remittances, Gross Capital for research variables. Another researcher by Wibowo & Airlangga, (2020) who examined household consumption in Indonesia using data from 33 provinces in Indonesia, and a previous study Hone & Marisennayya, (2020) examined factors affecting consumption expenditure in Debrework City, Amhara Region, Ethiopia. The study found that GDP has a significant influence on household consumption expenditure in Ethiopian countries.

The scientific novelty and fundamental character of the study can be found. First, in a methodological approach, which is based on a comparative analysis of the determinants of final consumption expenditure and their influence on several countries in the Middle East. Second, the study attempts to combine various factors influencing macroeconomic household final consumption expenditure and population factors.

Therefore, this study contributes to the literature because it is conducted at the Country or cross-country level, especially in the context of middle and high-income countries in the Middle East. By using a random sample method (Purposive Sampling) of 5 countries in the Middle East and using panel data regression analysis. This study aims to uncover the determinants of household consumption expenditure (HFCE) in selected Middle Eastern countries. The determinants of HFCE were studied using multiple linear regression models applied to data in 5 countries in the

Middle East such as: Turkey, Egypt, Qatar, Iran, and Saudi Arabia, during 2010 – 2022. The determinants studied for their effect on HFCE consist of PBD per Capita, Population and Inflation Rate.

2. Literature Review

Consumption in economics is the selection, acquisition and use of goods and services for the purpose of desire satisfaction, Goodwin et al., (2020). Consumption can also refer to the overall lifestyle of individuals or groups of people to non-economic factors as well as economic factors that influence consumer behavior, Arapova, (2018). Schumpeter & Keynes, (1936), define consumption as directly influenced by income levels, but the emphasis is that consumption is not entirely dependent on current income alone; Anticipation of future earnings also has a significant impact. Therefore, in Keynesian theory, consumption is considered a sensitive response to changes in income, be it current income or future estimated income. It has an important role in explaining individual consumption behavior.

This theory was developed by Thore & Friedman, (1957) with the Life Cycle Hypothesis which put forward the permanent income hypothesis and emphasized that consumption is influenced by "income expected in the long run, not current income levels". The implications of the permanent income hypothesis were explored by Hall, (1988) and Macklem, (1998) who proved that current and expected future disposable income is a significant determinant of household consumption. Therefore, Habanabakize, (2021) said whatever the growth of absolute income, the consumption expenditure of an individual will remain constant if his personal absolute income increases but other members of the same society do not increase their income by the same proportion. Although there are variations in researchers' methods of measuring income and investigating its impact on household consumption, they occupy a leading position among factors affecting household consumption.

Some researchers are beginning to measure how income impacts household consumption expenditure. Arapova, (2018) cites Schumpeter & Keynes, (1936) about consumption and income known as "Keynesian Consumption Theory". In this theory, Keynes stated that the level of consumption is influenced by the level of income. Keynes suggested that people tend to consume some of their extra income, but not entirely. The

main concepts in this theory are the tendency to save (marginal propensity to save) and the tendency to consume (marginal propensity to consume). However, each of these variables takes into account income level as the main element that affects overall consumer spending, Ezeji & Ajudua, (2015). This income level can also be seen from the size of GDP per Capita in a region. GDP per capita can look at the average income generated by the population of a country in a given period of time, usually measured in years. GDP per Capita is calculated by dividing a country's GDP by its population, Katsaiti et al., (2017).

Due to the high contribution to GDP, consumption expenditure is taken into account in macroeconomic policy for fiscal planning. Policymakers try to predict how consumers will behave in the face of income fluctuations Dumitrescu et al., (2022). There have been many empirical studies on the effect of GDP on household consumption expenditure such as Bonsu & Muzindutsi, (2017), Demyanyk et al., (2019), Alp & Seven, (2019), Keho, (2019), and Obinna, (2020). Which proves that GDP has a significant effect on household consumption expenditure. Shaikh et al., (2014), concluded that if Pakistan's Gross National Expenditure, Export of Goods, Gross Savings and Final Consumption Expenditure have a positive influence on GDP. Similarly to Bangladesh, Final Consumption Expenditure has a positive and significant impact on the GDP of both countries.

Then another factor that causes an increase in household consumption expenditure is the population of a country. The second variable that can affect household consumption expenditure is because the more the population, the greater the likelihood of demand for goods and services, Hakib & Asdar, (2020). Empirical research on the influence of population on household consumption expenditure such as Addessi, (2018), Bromage et al., (2018), Cloyne et al., (2017) and Hone & Marisennayya, (2020). They proved in their research that population or family size can have a significant positive effect on household consumption expenditure. The larger the population, the higher the aggregate demand according to the idea put forward by Schumpeter & Keynes, (1936) As a result, households tend to spend more money on a variety of consumer products, such as food, clothing, housing, and transportation.

Although many studies show that population impacts have a significant effect on household consumption expenditure, it does not rule out the

opposite may happen. Like Keynes's (1936) theory of the Paradox of Thrift (Paradox of Saving) This concept assumes that as the population increases, increasing consumption expenditure is not effective. According to this theory, as the population increases, the ability to save and invest also increases, which can ultimately reduce the level of consumption expenditure. This is because households tend to be more concerned with saving for a more secure and stable future rather than spending all of their current income. Thus, proving that the population or population level is not in line with household consumption expenditure.

And the third variable, Inflation is a general and continuous increase in the prices of goods and services in an economic region within a certain period. Inflation increases the cost of living and reduces household purchasing power. Higher prices cause basic necessities, such as food, clothing, and housing, to become more expensive, affecting consumers' ability to purchase goods and services, Varlamova & Larionova, (2015). Keynes, (1936) in saying if household consumption expenditure is disrupted by inflation, it can hamper spending because households feel uncertain about the future of the economy, thus limiting their spending. Tokoya et al., (2022) ,Keho, (2019) examined the impact of inflation on household consumption. Their findings were that household consumption was significantly negatively impacted. Another significant study by inflation rate. Then there are other studies by Bonsu & Muzindutsi, (2017) and Obinna, (2020) finding evidence to the contrary.

3. Data and Methodology

3.1 Study Design

Descriptive statistics are important for quantitative analysis because they provide a numerical picture of the data and measurements used in a particular study, Bashtannyk & Hyndman (2001). This research is a quantitative approach that examines the determinants of household consumption expenditure, using the method *Purposive Sampling* by randomly taking countries in the Middle East considering the completeness of the data obtained per country. Such as Turkey, Egypt, Qatar, Iran and Saudi Arabia. This study places emphasis on the Keynesian consumption function as well as function modification by incorporating other variables. Data is sourced from secondary sources and analyzed using statistical software.

3.2 Model Specifications

The variables used in this study are Consumption, GDP per capita, Population, and Inflation. The statistics used include final expenditure data on household consumption per country in the form of billions per year, data on the level of GDP per capita for each country in the form of millions per year, data on the number of populations per country in the form of millions of people per year, and inflation rate data per country in the form of percentage data per year.

The relevance of factors affecting household final consumption expenditure was evaluated using the following estimation regression model specifications:

$$HFCE_{it} = \alpha + \beta_1 GDP \text{ per Capita}_{it} + \beta_2 Population_{it} - \beta_3 Inflation_{it} + e$$

Information:

$HFCE_{it}$ = Log level of household consumption expenditure in Country i at time t.
 α = Constant

$\beta_1 GDP \text{ per Capita}_{it}$ = Log rate of GDP per Capita in a Country i at time t.

$\beta_2 Population_{it}$ = Log rate of total population in a Country i at time t.

$\beta_3 Inflation_{it}$ = Log rate of Inflation in a Country i at time t.

e = Model error that includes omitted variables and unobserved state impacts.

3.3 Data Sources

Data for this study were obtained from a *World Bank* publication. Covering 2010 – 2022.

3.4 Data Analysis Techniques

Regression analysis of panel data with E-Views 0.9 is the analysis technique used. All data is transformed in the form of natural logarithms (ln) to provide valid and consistent results. The method combines cross section data with model estimation procedures that include common

effect, fixed effect, and random effect. There are various tests, such as the Chow test, Hausman test, and *LM* to select the best model. Test the Coefficient of Determination, Test (F), Test (t) and *R – Square* before testing the hypothesis.

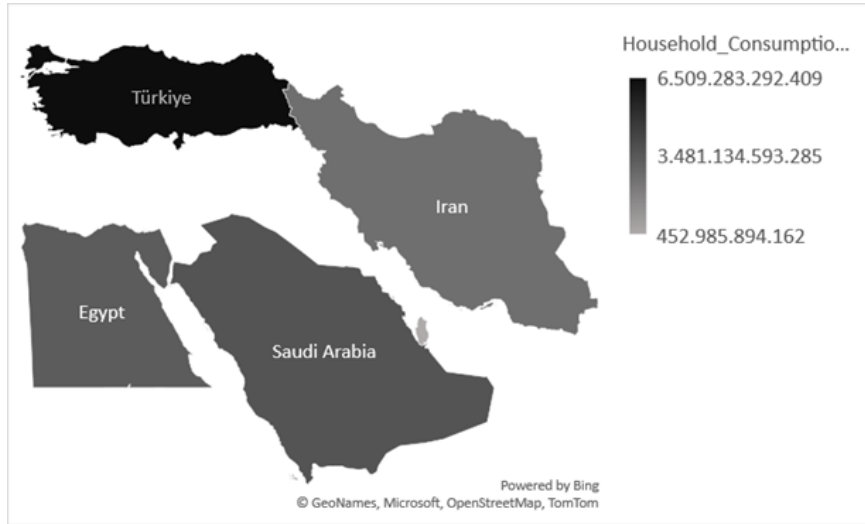
4. Results and Discussion

In this study took samples of 5 (five) countries in the Middle East region, including Turkey, Egypt, Qatar, Iran, and Saudi Arabia. Where the five countries have different levels of household consumption. Data analysis of household consumption levels covers from 2010 – 2022 in each of the five countries. Household consumption levels in Middle Eastern countries vary significantly, influenced by several factors including the economy, government policies, culture, and economic infrastructure at any given time.

The final household consumption rate is highest in Turkey, with an average over 12 years reaching US \$ 6,509 M. Household consumption is a major component of the economy in Turkey. Its contribution is 56% to GDP in 2022 (TUIK, 2023). The high level of consumption in the country is driven by the population, a growing middle class, and increased access to credit Çebi Karaaslan et al., (2022). Saudi Arabia, being the second country with the highest level of consumption. With a 12-year average of US\$3,661 M. Household consumption in Saudi Arabia contributes 38% to Saudi Arabia's GDP in 2022, (GASTAT, 2023). This high level of consumption is supported by oil revenues, government subsidies, and social benefit programs in Saudi Arabia. Egypt became the third country with the highest level of final consumption of household consumption expenditure. US\$3,374 M over the past 12 years. Household consumption contributes about 75% to GDP in Egypt in 2022 (World Bank, 2022).

Household consumption expenditure in Egypt is allocated to food, housing, and transportation. Iran, the fourth country with a household final consumption expenditure level of US\$2,678 M. Its contribution is 51% of GDP in Iran (Word Bank, 2022). Household final consumption expenditure is mostly allocated to food, housing, and transportation. Then Qatar, with household final consumption expenditure of US\$3,661 M. Its contribution amounted to 23% of GDP in 2022. (World bank, 2022). High levels of consumption are supported by high per capita income, and government subsidy programs Household in Figure 1.

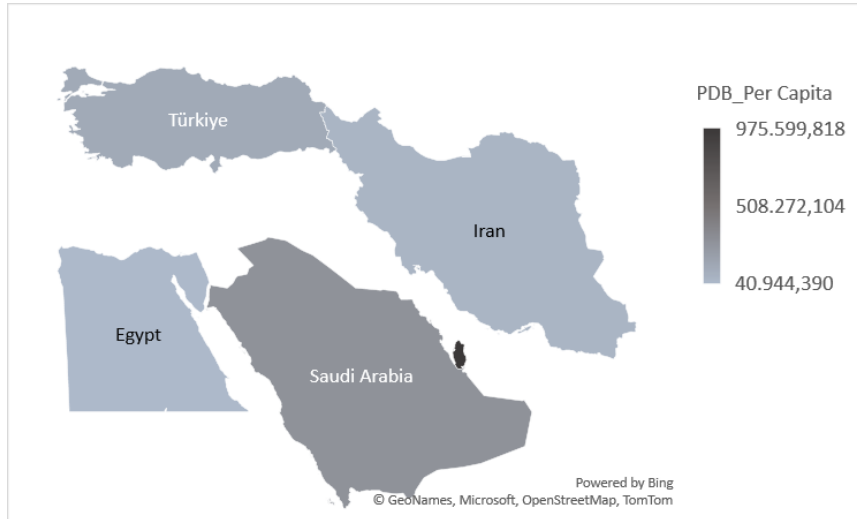
Figure 1: Map of the distribution of final expenditure levels of household consumption in 5 Middle Eastern Countries



Source: World Bank (2022)

GDP (Gross Domestic Product) or Gross Domestic Product in Middle Eastern countries has significant variations due to differences in economic sectors, natural resources, government policies, and political stability, (Çebi Karaaslan et al., 2022).

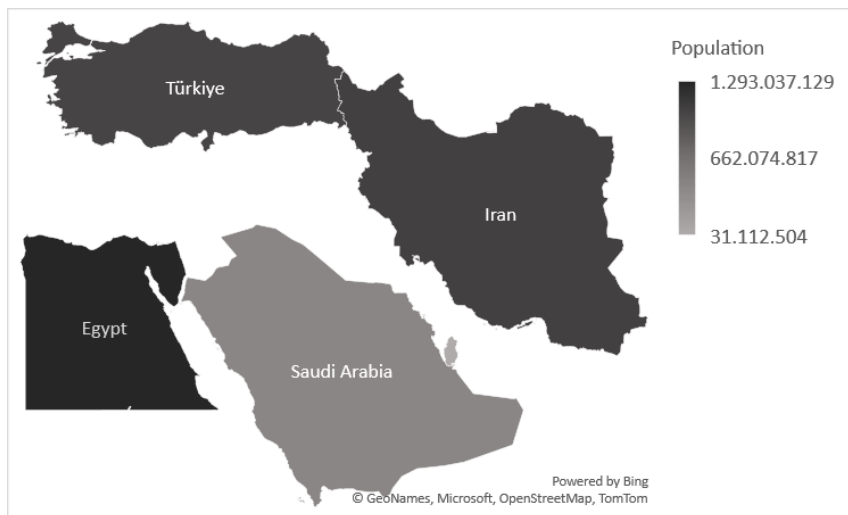
Of the 5 countries, the highest GDP per capita level is in the State of Qatar. With a 12-year average of US\$975,599 M, Qatar has the highest GDP per capita in the Region due to its abundant oil and natural gas resources. Saudi Arabia is the second country to have a high GDP per capita, amounting to US \$ 296,304 M. has the largest GDP per capita because Saudi Arabia is the main oil exporter in the world. Turkey, being the third country to have a high GDP per capita rate. US\$138,936 M. Turkey's economy experienced moderate money growth with GDP per capita steadily increasing in recent years. Iran. The fourth country with a GDP per capita level of US\$69,901 M. Iran's GDP per capita growth is hampered by international economic sanctions and domestic political instability. Then the last country, Egypt. Egypt's GDP per capita is US\$40,944 M. Although Egypt's GDP per capita is relatively low, it continues to show an increase in line with steady economic growth. PBD rate graph as shown in figure 2.

Figure 2. Distribution of GDP Levels per Capita in 5 Middle Eastern countries

Source: World Bank (2022)

Population refers to the total number of individuals living in a region or country at any given time. It not only refers to the number of people, but also involves various aspects related to the composition, distribution, demographic, and social characteristics of such people, Li et al., (2019).

Populations in Middle Eastern countries have diverse characteristics and are influenced by factors such as natural growth, migration, family policies, and socio-economic conditions. Turkey has a large and diverse population. The population growth is quite stable. Egypt is one of the countries with the largest population in the Middle East. Its population growth is quite fast and has significant urbanization which is explained in research by Abu Hatab et al., (2022). Qatar has a relatively small population, mainly due to its limited geographical size. Despite this, Qatar's population has seen a significant increase due to international migration for better work and life, Wawan & Hannase, (2022). Iran has a sizable population and is one of the most populous countries in the Middle East. Although its population growth has slowed in recent years, Iran still has family policies that support population growth and has ever-increasing urbanization. Izadi et al., (2023). Saudi Arabia has a large and growing population. The country has also seen significant urbanization, Aboukorin & Al-shihri, (2015). Population levels are described in figure 3.

Figure 3. Population Distribution of 5 countries in the Middle East

Source: World Bank (2022)

Inflation rates in Middle Eastern countries can vary widely, affected by a variety of factors including government economic policies, political stability, energy price fluctuations, as well as global market dynamics. Turkey has experienced high inflation rates in recent years. Factors such as currency devaluation, political instability, and aggressive monetary policy have affected the rising inflation rate in the country. The Inflation Rate reached 84.39% in November 2022, (*Tradingeconomics*, 2022). The government has been trying to control inflation with tighter economic policies, Coskun, (2023). Egypt also faces inflationary challenges. The inflation rate in Egypt reached 24.9% in December 2022, (*Tradingeconomics*, 2022). A number of factors such as rising fuel prices, subsidy removal policies, and currency fluctuations have affected the inflation rate in the country, Purnomo, (2017).

The inflation rate in Qatar tends to be lower compared to some other countries in the region. Iran has experienced quite high inflation in recent years. In 2022 the inflation rate in Iran reached 48.6%, (*Tradingeconomics*, 2022). Much of this is due to international sanctions that limit its access to global markets. The Iranian currency underwent a significant devaluation, triggering an increase in the prices of goods and services within the country, Ture & Khazaei, (2022). The inflation rate

in Saudi Arabia is usually lower compared to some other countries in the region. With an inflation rate of 3.1% at the end of 2022, (*Tradingeconomics*, 2022). The Saudi Arabian government has been trying to keep inflation low with various economic policies aimed at controlling consumer prices. The country's inflation rate is described in figure 4.

Figure 4. Rate %, Inflation of 5 countries in the Middle East



Source: World Bank (2022)

4.1. Panel Data Regression Model Selection

4.1.1. Chow Test, Hausman Test, and Lagrange Multiplier Test

Chow Test, Hausman Test, and Lagrange Multiplier Test to select the most correct model between Fixed Effect, Common Effect, and Random effect assuming H_0 is rejected if $\text{Pro. Cross Section } F \leq 0.05$.

Table 1. Best Model Selection Test Results

No.	Test	Prob	Information
1.	Chow	0.0000	FEM
2.	Hausman	0.0001	FEM

Source: Eviews 9 Data Processed, 2023.

It is possible to accept H1 and reject H0 based on the findings of the Chow Test, and the Hausman Test. Fixed Effect Test results are superior. Therefore, the Fixed Effect Model was chosen over the Common Effect and Random Effect Models.

4.2. Panel Regression Results

The Fixed Effect model was chosen as the appropriate model from the panel data regression significance test data, and a multiple linear regression equation model was created as follows:

Table 2. Fixed Effect Regression Test Results

Bound and Free Variables	Regression Coefficient	t-stat	Probability
C	-17.15977	-7.052679	0.0000
<i>GDP_PER_CAPITA</i>	0.911995	15.09921	0.0000
<i>POPULATION</i>	1.993293	15.82548	0.0000
<i>INFLATION</i>	-0.049774	-3.608402	0.0007
R-Square	0.991574		
Adjusted R-Square	0.990539		
F-Statistic	958.2367		
Prob (F-Statistic)	0.000000		

Source: Eviews 9, data processed 2024

The interpretation of the panel data regression model estimation is explained as follows:

A constant (α) of 2.00 with a significance level of 0.0000 explains that when GDP per capita, population, and inflation are equal to zero or constant, HFCE will increase by 2.00%.

β_1 (GDP_PER.) = 0.911995, variable regression coefficient
GDP amounted to 0.911995. It can be concluded that the positive influence

	between GDPs per capita towards HFCE (Y) of 0.911995. Assuming all other factors are constant, if GDP (X1) grew by 2%, HFCE will increase by 1%.
β_2 (population)	= 1.993293, variable regression coefficient population (X2) is 1.993293. It can be concluded that the positive influence between populations on HFCE (Y) amounted to 1.993293. Assuming all other factors remain constant, if the population (X2) rises by 4%, HFCE will rise by 1%.
β_3 (Inflation)	= -0.049774, variable regression coefficient Inflation (X3) of -0.049774. It can be concluded that the negative influence between the inflation rate on HFCE (Y) of -0.049774. Assuming all other factors remain constant, HFCE will grow by 1% if the inflation rate (X3) increases by 1%.

4.3. Hypothesis Testing

To find out whether the relationship between the independent factor and the dependent variable really affects it, either simultaneously or partially, hypothesis testing is carried out. A partial test (t-test) and a simultaneous test (F-test) are two different types of hypothesis testing.

4.3.1. Simultaneous F test

The F test is used to assess whether all independent factors, including GDP per Capita (X1), population (X2), and inflation (X3), simultaneously affect the dependent variable, HFCE (Y). F-statistical values are used to make decisions in this F test.

Value = $k - 1 = 3$ and $n - k = 8$ or $df(4.07)$ at $\alpha=0.05$ obtained the value of F-table 4.07 and the result of F-count obtained a value of $df_1 df_2$ 1519.824, so the value of F-calculate $(958.2367) \geq F\text{-table}(4.07)$. It can

be said that H1 is accepted and H0 is rejected, meaning that the independent variables of GDP per Capita, population, and inflation can have a simultaneous or simultaneous effect on the HFCE dependent variable in the Middle East from 2010 to 2022, simultaneously.

4.3.2. Partial Test (t Test)

The t-test compares the Prob (t-statistic) of each variable with degrees of freedom to determine the impact of each independent variable, such as, population, and inflation, on the dependent variable, i.e. HFCE 95% of the degree of freedom ($\alpha=0.05$) or by comparing t-count and t-table. Based on the results of data analysis using regression with Fixed Effect Model shows:

1. GDP per Capita

The t-count value of GDP per Capita is 15.09921 while the t-table is 2.306004, so the t-count value is $\geq$ the t-table value and probability value (0.0000). H1 is therefore accepted, meaning that the variable GDP per Capita has a Significant Impact on HFCE. The results show that HFCE increases when GDP rises. This shows how the direction of GDP is the same as HFCE.

2. Population

The t-count value of the population is 15.82548 while the t-table is 2.306004, so the t-count value $\geq$ the t-table value and probability value (0.0000). Thus, H1 is accepted and H0 is rejected, suggesting that population variables have a significant impact on HFCE. The data collected shows that HFCE increases with population growth. This suggests that the population is in line with HFCE.

3. Inflation

The calculated t-value of the Inflation variable is -3.608402, while the t-table is 2.306004, so the t-count value is $\geq$ t-table and the probability value is $0.0007 < \alpha=0.05$. As a result, H0 was accepted and H1 was rejected which shows that the inflation variable has a significant negative effect on HFCE. The results suggest that HFCE will decline as inflation rises. This indicates that inflation is moving in a different direction from the HFCE trend.

4.4. Coefficient of Determination (R^2)

The coefficient of determination is 0.991574 or 99%. This shows that from the dependent variable Household Consumption Expenditure (HFCE) which is 99% explained by the independent variable GDP per Capita, population, and inflation of 1% can be explained by other factors. (R^2)

4.5. Discussion

4.5.1. The Effect of GDP Per Capita (X1) on Household Consumption Expenditure (Y)

People's consumption tendencies are influenced by various factors. Factors that influence some consumption patterns are people's income levels. The study shows that while changes in GDP per Capita (X1) have a significant impact on household consumption expenditure in the Middle East, high GDP per capita in some Middle Eastern countries has enabled a well-off lifestyle for most households. This encourages higher spending on consumer goods, including luxury goods and imports. In countries such as Saudi Arabia and Qatar, revenues from the oil and gas sector are redistributed to communities in the form of subsidies, allowances, and other social assistance programs. This increases household income and encourages higher consumption. Based on Keynesian consumption theory, income levels are influenced by their income level. The higher the income, the higher the level of consumption.

This is in line with other research by Dilanchiev & Taktakishvili, (2021), Bonsu & Muzindutsi, (2017), Demyanyk et al., (2019), Alp & Seven, (2019), Keho, (2019) and Obinna, (2020). There is a correlation between income levels (GDP or GDP Per Capita) and favorable levels of consumption where households constantly increase their spending as their incomes rise.

4.5.2. Effect of Population Level (X2) on Household Consumption Expenditure (Y)

The results in this study show that population (X2) has a significant effect on household consumption expenditure. The region's population growth has increased every year, thus having a significant impact on the level of

household consumption. Many countries in the Middle East are experiencing high and significant population growth. A larger population means more people need goods and services for consumption, such as food, housing, clothing, transportation, and more.

Population size is also related to labor force and income. A large population creates greater market potential, enabling business growth, job creation, and increased income. This, in turn, can increase household consumption expenditure. This research is in line with research conducted by Addessi, (2018), Bromage et al., (2018), Cloyne et al., (2017) and Hone & Marisennayya, (2020), in his research the number of people in the population directly affects the demand for goods and services which can directly affect the amount of aggregate demand. The larger the population, the greater the potential for consumption. Population growth can increase demand for everyday goods such as food, clothing, and housing.

4.5.3. Effect of Inflation Rate (X3) on Household Consumption Expenditure (Y)

The results of this study show that the Inflation variable (X3) has a negative and significant effect on household consumption expenditure. Households will reduce the level of demand for goods and services when inflation increases. High inflation rates can cause distortions and uncertainty in the economy, which will reduce aggregate consumption. Inflation leads to an increase in the price of goods and services. In Middle Eastern countries that may depend on imports for certain consumer goods, rising import prices can creep into prices in the local market. This can make consumers' purchasing power decrease as the cost-of-living increases. These results are in line with research conducted by Tokoya et al., (2022), Keho, (2019) and Obinna, (2020), which indicates that rising inflation rates reduce the amount of goods and services households want to buy. These findings lend support to the real equilibrium effect of inflation.

5. Conclusion

The focus of this study was to examine the effect of GDP per capita, population and inflation on household consumption expenditure in 5 Middle Eastern countries from 2010 – 2022. Based on a detailed time

series involving the use of multiple linear regression techniques. The empirical results of this study can be concluded, *First*, the variable GDP per Capita has a significant positive contribution to household consumption expenditure, which indicates that any increase in the amount of income (GDP Per Capita) can lead to an increase in household consumption expenditure. This is because the average per capita income in some Middle Eastern countries is very high which leads to a well-off lifestyle for most households. That ultimately drives higher spending on consumer goods, including luxury goods and imports. Qatar, and Saudi Arabia are dominating countries with the highest GDP per capita among the five countries studied.

Second, population variables have a positive contribution to household consumption expenditure, which indicates that the more the population increases, the more household consumption expenditure increases. The Middle East experiences rapid and significant population growth every year. Therefore, the increase in consumption of daily necessities such as food, clothing, transportation, and others will also increase as the population increases. Egypt has the highest population rate among the five countries studied.

Third, the inflation variable has a significant negative contribution, which indicates that households tend to hold back non-primary consumption expenditures and only focus on basic needs when facing high economic uncertainty. Although Middle Eastern countries are rich in oil resources, high inflation can still suppress household consumption expenditure. Therefore, maintaining price stability is important to support sustainable purchasing power and consumption expenditure. Countries with the highest inflation rates among the five countries are Turkey and Iran. The country's government is still trying to control inflation with tighter economic policies.

The authors acknowledge that research on factors influencing final expenditure of household consumption in 5 Middle Eastern countries still has flaws. One of the limitations is the number of sample countries which is only 5 countries and the period of panel data used is relatively short, namely from 2010 – 2022. Therefore, for future research, it is recommended to expand the scope of the research area by increasing the number of countries and using a longer research time span by utilizing the latest data to produce more complete and comprehensive findings.

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Appendix A : fixed effect regression results

Dependent Variable: HOUSEHOLD_CONSUMPTION

Method: Panel Least Squares

Date: 06/24/24 Time: 22:13

Sample: 2010 2022

Periods included: 13

Cross-sections included: 5

Total panel (balanced) observations: 65

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.15977	2.433085	-7.052679	0.0000
GDP_PER_CAPITA	0.911995	0.060400	15.09921	0.0000
POPULATION	1.993293	0.125955	15.82548	0.0000
INFLATION	-0.049774	0.013794	-3.608402	0.0007

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.991574	Mean dependent var	25.95592
Adjusted R-squared	0.990539	S.D. dependent var	0.944536
S.E. of regression	0.091873	Akaike info criterion	-1.822011
Sum squared resid	0.481112	Schwarz criterion	-1.554394
Log likelihood	67.21535	Hannan-Quinn criter.	-1.716419
F-statistic	958.2367	Durbin-Watson stat	0.901564
Prob(F-statistic)	0.000000		

Appendix B: Chow test results

Redundant Fixed Effects Tests

Equation: Untitled

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	47.008204	(4,57)	0.0000
Cross-section Chi-square	94.792157	4	0.0000

Appendix C: Hausman test results

Correlated Random Effects - Hausman Test

Equation: Untitled

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	21.755066	3	0.0001

Are Board-Managed Cooperatives Efficient? When Monitors become Managers

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ABSTRACT

There is evidence of inefficiencies in cooperatives, but the literature does not adequately address this issue. In contrast to the previous literature on cooperative efficiency, we study the effects of cooperatives that are managed by the board of directors, a situation that is common among cooperatives. This study aims to examine whether board-managed cooperatives (with significant agency costs) are less efficient than other cooperatives. This study estimated the technical efficiency of cooperatives using stochastic frontier analysis on a sample of 378 medium, small and micro cooperatives in Malaysia. The analysis shows that board-managed cooperatives are less efficient than cooperatives with an appointed manager. This result is consistent with the agency-resource dependence perspective (an integration of monitoring and provision of resources). Moreover, the efficiency of a cooperative is related to the number of its charitable funds and members. The appointment of a manager in cooperatives should be encouraged. Although cooperatives lack the resources to appoint a manager, the efficiency that results from such an investment could lead to higher revenues and return to the members.

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ملخص

توجد أدلة على وجود عدم كفاءة في التعاونيات، لكن الأدبيات لا تعالج هذه القضية بشكل كافٍ. بخلاف الأدبيات السابقة حول كفاءة التعاونيات، ندرس آثار التعاونيات التي تُدار بواسطة مجلس الإدارة، وهي حالة شائعة بين التعاونيات. تهدف هذه الدراسة إلى فحص ما إذا كانت التعاونيات التي يديرها مجلس الإدارة (بتكاليف وكالة كبيرة) أقل كفاءة من التعاونيات الأخرى. قدرت هذه الدراسة الكفاءة الفنية للتعاونيات باستخدام تحليل الحدود العشوائية على عينة من 378 تعاونية متوسطة وصغيرة ومتناهية الصغر في ماليزيا. يُظهر التحليل أن التعاونيات المدارة بواسطة مجلس الإدارة أقل كفاءة من التعاونيات التي لديها مديرمعين. هذه النتيجة تتسق مع منظور الاعتماد على الوكالة والموارد (تكامل المراقبة وتوفير الموارد). علاوة على ذلك، ترتبط كفاءة التعاونية بعدد صناديقها الخيرية وأعضائها. وينبغي تشجيع تعيين مديري التعاونيات. على الرغم من أن التعاونيات تفتقر إلى الموارد لتعيين مدير، إلا أن الكفاءة الناتجة عن مثل هذا الاستثمار يمكن أن تؤدي إلى زيادة الإيرادات والعائدات للأعضاء.

RÉSUMÉ

Il existe des preuves de l'inefficacité des coopératives, mais la littérature n'aborde pas cette question de manière adéquate. Contrairement à la littérature précédente sur l'efficacité des coopératives, nous étudions les effets des coopératives gérées par le conseil d'administration, une situation courante dans les coopératives. Cette étude vise à examiner si les coopératives gérées par le conseil d'administration (avec des coûts d'agence significatifs) sont moins efficaces que les autres coopératives. Cette étude a estimé l'efficacité technique des coopératives en utilisant l'analyse des frontières stochastiques sur un échantillon de 378 moyennes, petites et micro coopératives en Malaisie. L'analyse montre que les coopératives gérées par le conseil d'administration sont moins efficaces que les coopératives dont le directeur est nommé. Ce résultat est cohérent avec la perspective de la dépendance à l'égard des ressources (intégration du contrôle et de la fourniture de ressources). En outre, l'efficacité d'une coopérative est liée au nombre de ses fonds caritatifs et de ses membres. La nomination d'un directeur dans les coopératives devrait être encouragée. Bien que les coopératives manquent de ressources pour nommer un directeur, l'efficacité qui résulte d'un tel investissement pourrait conduire à des revenus plus élevés et à une meilleure rentabilité pour les membres.

Keywords: Board, Cooperative, Efficiency, Malaysia, Manager, Stochastic Frontier Analysis, Resource-based View

JEL Classification: C23, R41 (up to 5 codes)

More than 12% of the world's population is a member of a cooperative (World Cooperative Monitor, 2021). As the third sector of the economy, cooperatives' contribution to poverty reduction, employment, and social integration is undeniable (United Nations, 2012). However, the governance of cooperatives has a multitude of problems that can affect their competitiveness vis-à-vis investor-owned firms (IOFs) (Galang et al., 2019). One important aspect that can increase the competitiveness of cooperatives is efficiency. Efficiency is defined as the relative outputs generated versus inputs, such as the invested capital and labor of a cooperative, determined based on a benchmark, that is, the efficient frontier (Guo et al., 2021).

An imbalance in the emphasis on cooperative efficiency and performance can be seen in the literature. For instance, Buang and Abu Samah (2020), Grashuis and Su (2019), Luo et al. (2020), McKillop et al. (2020), and Soero and Dias (2019) conducted a systematic literature review and bibliometric analysis of the literature on various factors related to cooperative performance. However, few studies identified the determinants of cooperative competitiveness and focused on efficiency (except Ahn, Brada & Mendez, 2012; Ariyatne et al., 2000; Galang et al., 2019; Grashuis, 2018; Huang et al., 2013; Krasachat & Chimkul, 2009). Despite the acknowledged importance of the top management team in organizational performance, productivity, and efficiency, a significant gap in the literature remains unaddressed: the impact of not appointing a manager (board-managed) on cooperative efficiency. A recent survey showed that in Malaysia, 56.5% of micro, small, and medium (MSM) cooperatives are run by a board (Jaffar et al., 2023). Thus, this study questions whether the board-managed approach (non-appointment of a manager) will affect the efficiency of a cooperative's accountability to its stakeholders. The findings of this study can be applied to enhance the capability and efficiency of cooperatives, aligning with the goals outlined in the Malaysia's Cooperative Policy 2030, which aims to support Malaysia in achieving a sustainable and inclusive economy (Dasar Koperasi Malaysia, 2023).

The inefficiency of a cooperative will cost consumers (high product and service prices) and its members (less benefits and low financial returns in the short or long run). Therefore, this study aims to test the relationship between board-managed cooperatives and cooperative efficiency.

This study uses the agency-resource dependence perspective (Hillman & Dalziel, 2003) to propose a relationship between board-managed cooperatives and cooperative efficiency. This study expects the role played by board members to manage the cooperative may have negative impacts on the operational efficiency of an organization due to the entrenchment effect and lack of independent monitoring. On the other hand, boards should focus on appropriate supervision and monitoring strategies that can improve cooperative efficiency. Consistent with this perspective, this study also tests the effect of the number of charity funds, cooperative members, female representation on the board, and cooperative age—as potential resources that could enhance monitoring for operational efficiency.

This study contributes to the literature in several ways. First, this study introduces the board-managed model (non-existence of a manager), involvement of women in the board of a cooperative, and the number of charity funds, in addition to other cooperative governance mechanisms from the literature, such as the age of a cooperative and the number of members (Gezahegn et al., 2018). The literature focused mainly on the effect of cooperative governance on cooperative performance. Different from popular measures of cooperative performance, technical efficiency (TE) can be estimated using stochastic frontier analysis (SFA), that is, the maximum output that a cooperative can produce using a given input. Second, though the appointment of a manager can be viewed as a cooperative resource, the costs associated with this type of appointment can be considered as a hindrance, particularly for small and micro-sized cooperatives. Thus, questioning whether the appointment of a manager can provide a competitive advantage to a cooperative is essential. This study extends the application of the resource-based view to the relatively unique context of cooperative efficiency.

This study analyzes the data of a sample of 378 MSM cooperatives in Malaysia to achieve its objective. The context of MSM cooperatives in Malaysia may be a natural laboratory for testing the proposition, as significant variations exist in cooperative governance implementation (Jaffar et al., 2023). The Cooperatives Commission of Malaysia, established under the Cooperatives Act 1993, oversees cooperative movements in Malaysia. The Commission has issued a Guide for the Governance of Cooperatives to be implemented by cooperatives starting in 2015. The guide highlights the principles and practices of good

governance with a "comply or disclose" approach. Second, inactive members of cooperatives in Malaysia, as reported in the literature (Mohd-Saleh & Hamzah, 2017), can serve as an important backdrop to clearly see the effect of a lack of a checks-and-balances mechanism in the board process. In addition, the MSM cooperatives, which constitute 98% of the total number of established cooperatives in Malaysia, contribute only 2% to the total revenue of all the cooperatives in the country. Clearly, the MSM cooperatives in Malaysia are faced with efficiency issues. This study calculates TE using SFA. The results lend support to the argument that the organizational resources used to appoint a manager (board-managed cooperative) in a cooperative will contribute to increasing (decreasing) cooperative TE.

1. Literature Review

Agency theory, as described by Jensen and Meckling (1976; 1979), assumes a manager manages a firm, separated from the owner. It does not represent the situation when the board members who are supposed to monitor the management on behalf of the owner run the business themselves. The theory describes conflicts between the agent who maximizes their utility vis-a-vis the principals who are the capital providers (Jensen & Meckling, 1976). The theory has been extended to describe productivity functions in a labor-managed system and cooperatives (Jensen & Meckling, 1979). While cooperatives are not considered labor-managed organizations, members usually have equal claims on assets and cash flows and suffer from common property and incentive problems (Jensen & Meckling, 1979). However, there are peculiar cooperative characteristics which are further discussed in this section.

Therefore, to investigate this issue further, we use the agency-resource dependence perspective, as suggested by Hillman and Dalziel (2003). The theories imply that the board's incentives and capital (ability to monitor) influences both monitoring activities and the allocation of resources. Board incentives include board dependence (in this study we use board run) and compensation (both can become moderating variables). While board capital includes expertise, experience, knowledge, reputation, and skills. The main idea emphasizes the ability to create a competitive advantage in the market, that is, to generate more value and lower costs compared with competitors (Peteraf & Barney, 2003; Stoelhorst, 2021).

Studies have examined the relationship between governance as resources (e.g., board competency, diversity, experience, and network) and corporate outcomes in the context of IOFs (for a review, see Khatib et al., 2021; Lu, Ntim, Zhang & Li, 2022; Nguyen et al., 2021). Consistent with the theory, resources are expected to be associated with superior corporate outcomes (competitive advantage, financial and nonfinancial performance, and efficiency). Extant studies on cooperatives have also characterized member participation as a resource (Becchetti, Castriota & Conzo, 2013).

Extending this view, this study uses the agency-resource dependence perspective (Hillman & Dalziel, 2003) to analyze the effect of lack of independence and resources on board-managed cooperatives. In other words, this study underscores the importance of a manager, to a cooperative.

Another research stream focused on the efficiency of cooperatives. Boyd (1988), Brada and King (1993), Carter (1984), and Galang et al. (2019) compared the TE of cooperatives and that of IOFs and found that the TE of cooperatives is lower than that of IOFs. Galang et al. (2019) found that the TE of cooperatives can be negatively affected by certain external factors, such as the political landscape.

Studies on the TE of cooperatives investigated demographic factors such as size (Ariyaratne et al., 2000; Schroeder, 1992), leverage (Ariyatne et al., 2000; Krasachat & Chimkul, 2009), cooperative age, output mixes, sector, location (Ahn, Brada & Mendez, 2012; Gezahegn et al., 2020; Krasachat & Chimkul, 2009), accounts receivable policy (Ariyaratne et al., 2000), cost efficiency, and tax advantage (Grashuis, 2018). Meanwhile, other studies found that corporate governance factors are important to increase efficiency, such as board size, training for members, asset ownership, regional development (Huang et al., 2013), board's educational background, chairman's age, members' participation, and compensation for committee members (Gezahegn et al., 2020). However, little effort has been exerted to determine the significance of manager appointment vis-a-vis board-managed cooperatives to cooperative efficiency. This governance set up is popular among MSM cooperatives in emerging economies. Moreover, except for several studies such as Ahn, Brada, and Mendez (2012); Huang et al. (2013); Krasachat and Chimkul (2009); and others, perspectives on cooperatives in emerging economies are few.

Many small and micro-sized cooperatives do not appoint a manager to run their operations owing to limited resources. Thus, such cooperatives are run by the chairman and/or board members. Board-managed cooperatives have costs and benefits. The main benefit of board-managed cooperatives is cost savings, which can entice most small-segment cooperatives to not appoint a manager. Giving returns to members in the form of dividends may have become the main reason for boards to self-run their cooperatives. In this paper, we call such cooperatives “board-managed cooperatives.”

Although this approach can avoid the cost of appointing a professional manager, it has several drawbacks. First, in IOFs, the number of owned shares corresponding to the amount of investments, is related to the voting power. Hence, with few exceptions, such as in pyramidal structure situations, the deviation between the control right and cash flow right is minimal. Conversely, cooperatives adhere to a one member-one vote principle (Section 30 (1) Cooperatives Act (1993) [Act 522]), emphasizing democratic governance. Regardless of the extent of a member's financial contribution, including investments in specific projects, only a single vote is permitted. This practice thereby prevents the emergence of dominant controlling or minority shareholders within cooperatives. Control within a cooperative can be exercised when a member assumes a board position, and this control is particularly pronounced when the same individuals manage the business without adequate oversight. In such instances, the disparity between control rights and cash flow rights is heightened, raising the risk of entrenchment. The practice of board managed cooperative is against the principle 3 of good governance as stated in GP27 (para 16 to 19).

Second, in line with the principle of cooperatives (democratically controlled by its members) and Section 42 Cooperatives Act 1993 [Act 522], the appointment of the board of cooperatives must be among its members in the Annual General Meeting. The approach leads to several problems. Depending on the requirement to become a member of certain cooperatives in by-laws (farmers, fishermen, general consumers, teachers, etc.), there is a high chance of appointing directors among those members who do not have appropriate expertise and experience. This practice could lead to inefficiency. In addition, in contrast to good governance practices in investment-owned firms, i.e., at least half of the board must be independent, all appointed board members are non-independent directors

since members are related to cooperatives. Thus, a lack of independent and expert monitoring could harm the internal control systems and heighten the risk of corruption.

Third, board-managed cooperatives have a very basic checks-and-balances mechanism for transactions, which may increase conflicts of interest. The board should perform a supervisory and monitoring role in managing the cooperative on behalf of its stakeholders. Thus, the “mediating hierarchy” in organizations that monitors the balance in stakeholders’ interests (Blair & Stout, 1999) is missing in board-managed cooperatives. Theoretically, the situation of board-managed cooperatives is not comparable to that of traditional firms (Alchian & Demsetz, 1972), in which the owner–manager–entrepreneur is the same entity, because not all the members are on the board.

Fourth, although one can argue that alignment of interests between members and managers as agent may be promoted in board-managed cooperatives, without a manager, there is no formal evaluation (self-evaluation) of management efficiency and effectiveness. A failure means re-election of a new board by members in an annual general meeting. The evaluation of former management (board members) is not discussed in detail due to (a) information asymmetry between the members and board (there is no formal paper that evaluates a person based on clear performance indicators for appointment or re-appointment), (b) lack of members’ activism, and (c) limited knowledge among members about performance management. This practice could lead to reduced accountability to members.

Fifth, there is a high likelihood of a lack of concentration as the chairman and board members overseeing a cooperative typically hold other full-time positions. In addition, the chairman’s and/or board members’ voluntary managerial work for the cooperative may reduce the likelihood of implementing an accountability process in annual general meetings. In other words, members will have limited opportunities to ask whether the chairman and/or board members performed their accountability function, as their work is voluntary. In addition, board members generally “sacrifice” their time to perform some of their duties in the day-to-day operation of the cooperative. Thus, the net benefits of board-managed cooperatives may be negative. This problem may be exacerbated by the fact that the members of such cooperatives are generally not well educated

or do not know what to expect or ask during annual general meetings. Thus, inefficiency may be a long-standing situation in such cooperatives. However, the problem may not exist in entities with aligned owner–manager interests, such as in small and medium-sized IOFs. Thus, based on the agency-resource dependence perspective (Hillman & Dalziel, 2003), the above arguments, and using an indicator whether there is an appointed manager as a reverse measure for board-managed cooperatives, the prediction is as follows:

H₁: There is a negative association between an appointed manager and technical inefficiency.

Consistent with the agency-resource perspective (Hillman & Dalziel, 2003), the number of charity funds, female representation on the board, and cooperative age are anticipated to potentially increase monitoring for operational efficiency, with an expected positive (negative) association with technical efficiency (inefficiency). The creation of charity funds, such as those directed towards children's education for members, offering charitable death benefits, and supporting community activities, could align cooperative operations with their initial purpose. In addition, the reserves formed by retaining surplus generated by the cooperative business, which are not immediately disbursed to its members can become additional capital that can be used for short term investment. Different from debt or equity financing, the reserve financing is free from cost of capital.

There are numerous studies on the benefits of female on board on corporate's (Ramly et al., 2017) and cooperative's efficiency (Hernández-Nicolás et al., 2019). Nevertheless, a counter argument posits that such inclusion may potentially result in organizational inefficiencies. Female directors are found to have more social orientation than male directors (Périlleux & Szafarz, 2015). Cooperatives led by women demonstrate a greater proportion of staffing expenses in relation to operational income, suggesting a stronger emphasis on cooperative principles and values over pure economic gains (Esteban-Salvador et al., 2019). So far, there has been limited research explicitly investigating the impact of female representation on cooperative efficiency.

The enhanced efficiency of a cooperative also related to its years of experience (age from establishment), enabling the acquisition of

advanced technology, investment in employee training, and implementation of other enhancements to optimize business operations.

2. Methodology

2.1.1. Data Analysis

This study employs the concept of TE as a measure of cooperative competitiveness. This study selects technical efficiency as a key measure due to its relevance in assessing the effectiveness of firms in utilizing their resources to generate output. By focusing on technical efficiency, the study aims to measure the extent to which firms optimize their production processes and allocate resources efficiently. Understanding technical efficiency is crucial for assessing competitiveness. TE is the maximum output that a firm can produce with a given input.

To assess the TE of cooperatives, SFA can be conducted to estimate the frontier production function (Aigner, Lovell & Schmidt, 1977; Meeusen & van den Broeck, 1977). In selecting SFM over Data Envelopment Analysis (DEA), several advantages are evident. SFM enables the estimation of technical inefficiencies and basic production boundaries, facilitating the differentiation between inefficiency and random performance fluctuations. Furthermore, SFM provides individual stochastic and heterogeneity errors, which effectively capture the complexity and uncertainty inherent in the cooperative environment. The stochastic frontier production function model is as follows:

$$, \quad \ln Y_i = \ln f(X_i, \beta) \exp^{(V_i - U_i)} \quad (1)$$

where Y_i and X_i indicate the output and input production vectors of the production of cooperative firm i , respectively; β is the unknown parameter coefficient vector to be estimated; $V_i - U_i$ is the error term of the production of firm i ; V_i measures the random errors that will determine the statistical noise; V_{jit} is distributed independently and identically to $N(0, \sigma_v^2)$; and U_i is independently and identically distributed and obtained via truncated distribution $N(0, \sigma_u^2)$.

To examine the determinants of TE, U_i is assumed to be a function of the explanatory variables, which can be defined as the technical inefficiency function model, as follows:

$$U_i = \mu_i = \delta_0 + \delta_1 Z_i + \delta_n Z_i + \omega_i, \quad (2)$$

where U_i is the technical inefficiency of firm i , Z_i is the vector of the explanatory variables of firm i , δ_1 and δ_n is the unknown parameter coefficient vector to be estimated. The parameters of the stochastic frontier function and technical inefficiency model are estimated simultaneously, as proposed by Battese and Coelli (1995). The estimates of the functions are obtained using the maximum likelihood method.

Next, SFA is conducted to evaluate the TE of a firm based on the distance between the firm's output and frontier, and as the distance decreases, the efficiency of the firm increases. A TE value of 1 indicates maximum efficiency. The TE of firm i is obtained, as follows:

$$TE_i = \frac{f(X_i, \beta) \exp(v_i - u_i)}{f(X_i, \beta) \exp(v_i)} = \exp(-u_i). \quad (3)$$

The validity of the technical inefficiency term and stochastic frontier production function can be tested by calculating the value of the gamma parameter (γ). The parameter must have a value between 0 and 1 and depends on two variance parameters of the stochastic frontier function. The variance parameters are defined as $\gamma = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$, and $\sigma^2 = \sigma_v^2 / \sigma_u^2$. If the value is close to 0, then the deviations of the stochastic frontier function can be ascribed to a random error. Meanwhile, a value close to unity indicates that the deviations are due to technical inefficiency. The hypothesis on the nature of technical inefficiency can be tested using the generalized likelihood ratio (LR) statistic λ given by

$$\lambda = -2\{\ln L(H_0) - \ln L(H_1)\}, \quad (4)$$

where $L(H_0)$ and $L(H_1)$ denote the value of the likelihood function under the null and alternative hypotheses, respectively.

3. Data and Empirical Model

In Malaysia, as of the end of 2021, there were 473 medium-sized, 1,343 small-sized, and 6,574 micro-sized cooperatives spread across 14 states. The sample size for this study, totaling 3,804 cooperatives, was determined based on proportional stratified sampling techniques using Krejcie and Morgan's (1970) method. Selection was systematic, in each category of size, and state. An online survey was distributed to board

members of these cooperatives from May 22, 2022, to June 29, 2022. To ensure distribution and timely collection, regional officers of the Cooperative Commission of Malaysia facilitated the survey. A briefing was conducted to explain the survey's purpose and ensure officers' understanding of questionnaire statements. Of the 971 responses collected, 593 responses were excluded due to missing data, outdated financial statements, and questionable financial information. This yielded a final usable sample of 378 cooperatives, representing approximately 9.94% of the identified sample.

While panel data analysis offers advantages in capturing dynamic changes over time, this study opted for a cross-sectional approach due to the data being derived from a cross-sectional survey. Secondly, the aim of this study is to provide a comprehensive snapshot of the current state of inefficiency and efficiency within the chosen context, rather than tracking its evolution over time. The main variables used in the frontier production model are the output and input variables (Table 1). The output variable is total revenue, which refers to the total revenue of the output produced by a firm. The input variable of capital is measured by calculating the value of the total assets. The input variable of number of board members of the cooperative is measured by calculating the number of the board members of the cooperative. The input variable of labor is measured by calculating the number of labor used.

Table 1 (Panel A) shows that the majority of the micro cooperatives (68.1%) is board run (did not appoint a manager). The table also shows that the number of cooperatives with an appointed manager increases as the size of the cooperative increases. Table 1 (Panel B) presents the descriptive statistics of the input, output, and tested inefficiency factors, such as the age of the cooperative since its establishment, proportion of female board members, number of charity funds, and number of members. Board membership ranges from 3 to 18 members; on average, the age of the cooperatives is 26 years; and around 38% of the board members are female. The average number of charity funds created by the cooperatives is around 3, with a maximum of 11 funds.

Table 1: Sample Variables and descriptive statistics of output and inputs of stochastic production frontier

Panel A	Frequency	Percent	Appointed a manager	Board run	Percent with a manager
Micro	226	60.3%	72	154	31.9%
Small	112	29.9%	49	63	43.8%
Medium	40	10.6%	25	12	67.6%
Total	378	100.0%			
Panel B	Variable	Mean	Standard deviation	Minimum	Maximum
Output	Revenue (RM; Y)	413,282	807,620	1,266	6,269,268
Input	Operational expenses (RM; E)	368,329	767,974	100	6,254,902
	Total assets (RM; TA)	1,477,744	4,586,305	461	44,600,000
	Number of cooperative board members (ALK)	12.34	14.60	3.00	18.00
	Number of labor (L)	2.56	4.01	-	30.00
Z	Age	26.59	18.14	3.00	92.00
	Ratio of female members to total number of cooperative board members (RF)	0.38	0.29	-	1.47
	Number of charity funds (T)	2.740	2.547	0	11
	Number of members (MC)	584	894	-	9,364
	Manager (Dummy_M) (Yes = 1, 0 = No)		Yes (229) No (149)		

RM = Malaysian ringgit.

The Cobb–Douglas production function is used in this study for the following reasons: first, the production function form is relatively simple; second, it can be transformed into a linear additive form; and third, it rarely causes problems.¹ The input variable in the production function is

¹ There are two main types of Cobb–Douglas production functions: the original model and the translog model. The Cobb–Douglas model is originally formulated as a linear

directly associated with the production process and is deemed the primary factor influencing the firm's output. Inputs typically constitute a substantial component or factor utilized within the production process. For instance, in manufacturing, common input variables include labor, capital, raw materials, and technology. These are regarded as the principal determinants of production levels (Model 5). In this study, to determine the stochastic effects of operational expenses (E), total assets (TA), number of cooperative board members (ALK), and number of labor (L) on total revenue (Y), the production function model is used, as follows:

$$\ln Y_i = \beta_0 + \beta_1 \ln E_t + \beta_2 \ln TA_i + \beta_3 \ln ALK_i + \beta_4 \ln L_i + V_i - U_i. \quad (5)$$

The inefficiency variables in the inefficiency function represent factors that can indirectly influence a firm's production but are not integral to the core production process. These variables capture deviations or inefficiencies in production that are not accounted for by the main input variable. Inefficiency variables include factors such as the age of the firm and the quality of management. It is believed that these variables affect the extent to which firms deviate from best practices or the most efficient production processes (Model 6). Therefore, to determine the technical inefficiency effect model, the following equation is used:

$$U_i = \delta_0 + \delta_1 Age_i + \delta_2 RF_i + \delta_3 T_i + \delta_4 MC_i + \delta_5 Dummy_M_i + \delta_6 G_i + \omega_i, \quad (6)$$

where Age_i represents the number of years since the cooperative's establishment; RF is the ratio of female board members to the total number of board members (Huang et al., 2013); T is the number of charity funds; MC is the number of members of the cooperative; $Dummy_M$ is 1 if firm i has a manager, and 0 otherwise; $\delta_1, \dots, \delta_5$ denote the estimated parameters of the inefficiency variable; and ω_i denotes a random variable.

The variable of interest is $Dummy_M$, which is predicted to have a negative relationship with inefficiency. Different from prior studies, the present study includes a new variable, that is, number of charity funds (T), in the estimation. Consistent with this study's general argument that

function, whereas the translog model represents a non-linear function. However, after testing, it has been found that the non-linear function does not accurately fit our data.

charity funds (e.g., funds for education of family members or specific activities) are resources that a cooperative can use to generate value efficiently, based on the resource-based view, T is expected to have a negative effect on inefficiency. The literature showed that entities with high CSR are associated with learning and innovation cycles that can improve competitiveness (Kapelko et al., 2021; Vilanova, Lozano & Arenas, 2009). In addition, the increased efficiency from MC, as it is related to the size of a cooperative, may come from economies of scale, improved human resources, and operational processes using technology. Governance (G) consists of six dimensions: cooperative board members' responsibilities, control system and performance, cooperative board competency, internal audit committee efficiency, management efficiency, and multiple cooperative board membership. These dimensions are measured on a scale from 1 to 5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree." These dimensions are then computed to obtain the governance factor.

The literature confirmed that such factors are important to improving TE (He et al., 2022; Muger et al., 2016; Regma et al., 2021; Pottier, 2011).

For robust analysis, this study calculates total factor productivity (TFP) using the following equation:

$$TFP = \frac{Y}{(E^{\hat{\beta}_1} * TA^{\hat{\beta}_2} * ALK^{\hat{\beta}_3} * L^{\hat{\beta}_4})} \quad (7)$$

Where $\hat{\beta}_1$ - $\hat{\beta}_4$ are coefficients that represent the elasticities of the respective inputs. Thereafter, to determine the TFP model using ordinary least square (OLS), the following equation is used:

$$TFP_i = \gamma_0 + \gamma_1 Age_i + \gamma_2 RF_i + \gamma_3 T_i + \gamma_4 MC_i + \gamma_5 Dummy_M_i + \gamma_6 G_i + \varepsilon_i \quad (8)$$

4. Results And Discussion

4.1.1. Correlation matrix

Table 2 presents the Pearson correlation matrix for the key variables utilized in the analysis. The correlation coefficients between the dependent variable and independent variables generally align with the expected signs. Notably, two independent variables (E=Operational

expenses and TA=Total assets) exhibit high correlations with the dependent variable (Y=Revenue). Additionally, significant correlations at the 1% significance level are observed between Revenue and three independent variables (E=Operational expenses, TA=Total assets, and L=Number of labor). Conversely, only ALK (Number of cooperative board members) demonstrates noteworthy correlations at the 1% significance level. Furthermore, the coefficients among the independent variables show low correlations (<0.85), indicating minimal collinearity issues.

4.1.2. Generalized (LR) Tests

The value of the generalized LR statistic for the parameters of the stochastic production function for total revenue is shown in Table 3. The null hypothesis stating that no technical inefficiency effect exists in the model is significantly rejected based on the LR value of 43.87. This result implies that the inefficiency effect is present in the model.

Table 2: Correlation matrix

Variable	Y	E	TA	ALK	L	Age	RF	T	MC	Manager	G
Y	1.000										
E	0.960*	1.000									
TA	0.705*	0.638*	1.000								
ALK	0.064	0.056	0.058	1.000							
L	0.477*	0.495*	0.354*	-0.201*	1.000						
Age	0.225*	0.169*	0.490*	0.042	-0.061	1.000					
RF	-0.036	-0.014	-0.258*	0.233*	-0.132	-0.265*	1.000				
T	0.182*	0.152*	0.110	0.169*	-0.076	0.018	0.372*	1.000			
MC	0.346*	0.335*	0.318*	0.155*	0.190*	0.194*	0.104	0.166*	1.000		
Manager	0.235*	0.242*	0.137*	-0.118	0.276*	-0.085	-0.059	-0.035	0.024	1.000	
G	0.099	0.088	0.075	-0.055	0.065	0.062	0.038	0.106	0.025	0.047	1.000

*Significance level of 1%

Table 3: Generalized LR test of null hypothesis for parameters of stochastic frontier production function for total revenue

Null hypothesis, H ₀	LR value	Critical value*	Decision
(No inefficiency effect)	46.62	12.592	Rejected
$\gamma = \delta_0 + \delta_1 + \delta_2 + \delta_3 + \delta_4 + \delta_5 + \delta_6 = 0$			

4.1.3. Production Function

The results of the analysis of the estimated model indicate that the coefficients of operational expenses are positive and statistically significant at the 1% level. The positive relationship between operational expenses and total revenue suggests that a 1% increase in the operational expenses would lead to a 0.770% increase in the total revenue. This result suggests that revenue can be increased by increasing operational expenses.

Moreover, the analysis of the estimated model indicates that the coefficient of total assets is positive and statistically significant at the 1% level. The positive relationship between total assets and total revenue suggests that a 1% increase in the total assets would lead to a 0.148% increase in the total revenue. This finding shows that the total assets is an important factor for generating revenue in MSM cooperatives. Meanwhile, the number of cooperative board members and number of labor are not statistically significant. This result reveals that both variables do not play an important role in generating revenue from production in MSM cooperatives.

Furthermore, the estimated value of gamma (γ) is obtained with a truncated normal model. Gamma (γ) is the variance ratio explaining the total variation in the output at the frontier level to the output attributed to TE. The estimated value of gamma (γ) refers to the ratio of the variance in the output due to TE for all the production functions. The statistic also indicates that the variance parameters of all the production functions differ significantly. The estimated value of gamma (γ) is 0.125, which indicates that the error terms are due to the technical inefficiency effect, which are under the control of each firm's production function. Thus, the estimates indicate the presence of technical inefficiency components in the error terms.

4.1.4. Technical Inefficiency Function

The variables influencing inefficiency are specified as those related to the characteristics of MSM cooperatives. The analysis of the technical inefficiency model shows that the sign and significance of the estimated coefficients have important implications on the technical inefficiency of the small and medium-sized cooperatives in Table 4.

The parameter estimates indicate that the coefficients of number of charity funds, number of cooperative members, and appointment of a manager have a negative and significant impact on technical inefficiency. Specifically, the coefficient of number of charity funds is negative and significant at the 1% probability level, which shows that the variable has a negative influence on technical inefficiency. This result means that increasing the number of charity funds will increase TE. This result is consistent with the argument that a high CSR is associated with high learning and innovation cycles that can improve competitiveness (Kapelko et al., 2021; Vilanova, Lozano & Arenas, 2009).

Moreover, the number of members of the cooperative is negative and has a significant effect on technical inefficiency. The negative sign of number of members of the cooperative indicates that an increase in the number of members of a cooperative will increase its revenue. This result may come from the improved selection of human resources to be involved in the operation from a large pool of members, as resources. The knowledge spillover effect from the talent flow may enhance innovation, technology, and organization processes that can improve efficiency. The result may also be caused by economies of scale, that is, the compliance costs of regulatory requirements and minimum operational structure can be widely distributed to an increased number of members (He et al., 2022). The literature confirmed that such factors are important to improving TE (Mugera et al., 2016; Regma et al., 2021; Pottier, 2011).

Furthermore, appointment of a manager is negatively related to technical inefficiency. The negative sign of appointment of a manager indicates that if a cooperative uses a manager for its production, then its inefficiency can be reduced by 49.6%. In other words, board-managed cooperatives are less efficient than manager-run cooperatives. The result suggests that in cooperatives, the benefits associated with the appointment of a manager outweigh managerial costs. MSM cooperatives should consider appointing a manager to improve their efficiency and thus generate increased revenue, dividends, and long-term benefits for their members. By contrast, board-managed cooperatives are inefficient by the same magnitude in terms of revenue generation. Therefore, the ability of board-managed cooperatives to pay dividend in the long run is questionable.

The results imply that the board's supervisory and monitoring role in the cooperative, balancing stakeholders' interests, maintaining checks and balances, and being responsible and accountable to the members in annual general meetings can be performed better if cooperative is run by a manager. The board of a cooperative is focused on supervisory and monitoring work, whereas managers perform managerial and operational duties. This is consistent with the board's ability to monitor and provision of resources as suggested by the agency-resource dependence perspective (Hillman & Dalziel, 2003). In cooperatives with an appointed manager, the key performance indicators will likely be related to compensation (incentive mechanism). In such cooperatives, managerial and operational tasks are not performed voluntarily and thus will be more likely subjected to detailed scrutiny.

Table 4: Results of maximum likelihood estimates for stochastic production frontier of null hypothesis for parameters of stochastic frontier

Ln (Revenue)	Coefficient	Standard error	Z score	Significance level	95% confidence interval	
Ln (Operational expenses)	0.773	0.017	45.870	0.000	0.740	0.806
Ln (Total assets)	0.148	0.015	9.750	0.000	0.118	0.178
Ln (Number of cooperative board members-ALK)	-0.009	0.064	-0.140	0.886	-0.134	0.115
Ln (Number of labor)	0.012	0.029	0.440	0.663	-0.044	0.069
Constant	1.160	0.240	4.830	0.000	0.690	1.630
Inefficiency						
Age	-0.006	0.005	-1.130	0.257	-0.016	0.004
Ratio of female board members to total number of cooperative board members (RF)	-0.301	0.399	-0.750	0.451	-1.083	0.481
Number of charity funds (T)	-0.275	0.108	-2.550	0.011	-0.486	-0.064
Number of cooperative members (MC)	-0.002	0.001	-2.180	0.029	-0.003	0.000
Manager (Yes = 1, 0 = No)	-0.496	0.232	-2.140	0.033	-0.951	-0.041
Governance (G)	-0.121	0.086	-1.410	0.159	-0.290	0.047
Constant	1.264	0.410	3.080	0.002	0.460	2.068
lnsigma2	-1.283	0.141	-9.080	0.000	-1.559	-1.006
ilgtgamma	0.247	0.318	0.780	0.437	-0.376	0.870
lnsigma2	0.277	0.039			0.210	0.366
ilgtgamma	0.561	0.078			0.407	0.705
sigma2	0.156	0.042			0.073	0.238
gamma	0.122	0.011			0.100	0.144
Number of observations	378					
Wald chi2 (4)	4858.19					
Log likelihood	-195.5289					
Prob > chi2	0.0000					

4.1.5. TE Distribution

The results from Table 5 display the frequency distribution of the TE (Technical Efficiency) estimates. The analysis indicates that micro, small, and medium-sized cooperatives operate at an average efficiency level of 85.5%. This suggests that, on average, these cooperatives utilize 85.5% of their potential output given their inputs. However, there exists a TE gap of approximately 14.5% in these cooperatives, signifying room for improvement. By enhancing their technical efficiency, these cooperatives could potentially increase their revenue by 14.5%, either by multiplying output levels or reducing input costs. Therefore, operating more efficiently could lead to a significant revenue increase for these medium, small, and micro-sized cooperatives. This finding implies that the small and medium-sized cooperatives in this study can increase their revenue by 14.5%, on average, by improving their TE. The majority of the small and medium-sized cooperatives belongs to the 0.800–1.000 efficiency level.

The results in Table 5 suggest that, on average, the efficiency of a cooperative will peak when it is between the ages of 81 and 100 years. In the aforementioned age category, cooperative efficiency is also the most stable, with the lowest standard deviation and highest minimum efficiency value (0.8826), compared with the other age categories. The least efficient cooperatives are in the youngest age category, whereas the most efficient cooperatives are in the age category that ranges from 41 to 60 years.

Cooperative efficiency is at the lowest average level in the membership category of less than 1,000 members, and the cooperatives with the lowest efficiency (0.2109) belong to this category. However, the cooperatives with the highest efficiency belong to the membership category with the largest number of members. In addition, the lowest efficiency value (minimum) in this category exceeds the minimum value in the other categories.

Table 5. Distribution of Technical Efficiency

a. Technical Efficiency	Frequency	Percentage (%)		c. Age category	Mean	s.d.	Min	Max
<0.199	0	0.00		1-20 years	0.828	0.140	0.220	0.977
0.200–0.299	1	0.26		21-40 years	0.882	0.091	0.529	0.982
0.300–0.399	3	0.79		41-60 years	0.880	0.120	0.312	0.989
0.400–0.499	6	1.59		61-80 years	0.833	0.128	0.579	0.978
0.500–0.599	11	2.91		81-100 years	0.924	0.043	0.893	0.954
0.600–0.699	22	5.82						
0.700–0.799	35	9.26		d. Membership				
0.800–0.899	124	32.80		1-1000	0.836	0.126	0.220	0.966
0.900–1.000	176	46.56		1001-4000	0.956	0.015	0.917	0.978
Total	378	100.00		4001-7000	0.982	0.000	0.982	0.982
Mean	0.855			7001-1000	0.989	0.000	0.988	0.989
Standard deviation	0.124							
Minimum	0.220			e. Charity funds				
Maximum	0.989			1 to 3	0.816	0.133	0.220	0.989
				4 to 6	0.930	0.027	0.843	0.978
b. Technical efficiency	Mean	s.d.		7 to 9	0.954	0.014	0.922	0.977
Manager appointed	0.885	0.089		10 to 12	0.960	0.010	0.945	0.971
Board run	0.836	0.140						
				f. Director's diversity				
				Low (<0.33)	0.819	0.137	0.220	0.989
				High (>0.34)	0.893	0.096	0.314	0.982

Among the cooperatives, the medium-sized cooperatives have the highest efficiency value, followed by the small cooperatives. The micro-sized cooperatives exhibit the lowest efficiency value, and the medium-sized cooperatives have the lowest standard deviation value. The cooperatives' efficiency value being proportional to their size is in line with the findings of past studies (Ariyatne et al., 2000) but contradicts those of Huang et al. (2013).

In addition, the greater the number of charity funds of a cooperative, on average, the more efficient the cooperative. The results reveal that the most inefficient cooperatives are those with the least number of welfare funds. This finding can be explained by several factors. First, the pattern is related to the accountability of the members of the cooperative, and the better the implementation of the accountability process, the more efficient the cooperative. Second, a reverse relationship between the two factors is possible, that is, the more efficient the cooperative, the more the funds generated to meet the needs of the members. This explanation can be tested only by using the data of the cooperatives for several years. Third, other factors may be able to explain the relationship. For example, if the number of charity funds is proportional to the size of the cooperative, then the reported increase in efficiency will likely be due to the size of the cooperative rather than to the number of charity funds for the members.

The descriptive statistics also show that, on average, the cooperatives with more female directors on the board have a higher efficiency value than those with fewer female directors. The cooperatives that demonstrate the lowest efficiency are also those in the group with a low proportion of female directors.

Table 6 provides the results of a regression analysis to determine the factors affecting Total Factor Productivity (TFP). The presence of a manager indicates a positive relationship and significant impact on TFP, while other variables show no significant impact. Model diagnostics indicate all VIFs are below 2, suggesting low multicollinearity. The overall model is significant, with an R-squared value indicating that 10.2% of the variability in TFP is explained by the model.

Table 6: Factors Determining Total Factor Productivity

TFP	Coefficient	Standard error	Z score		Significance level	95% confidence interval	VIF
Age	-0.003	0.002	-1.730	0.085	-0.006	0.000	1.17
Ratio of female board members to total number of cooperative board members (RF)	-0.129	0.116	-1.120	0.264	-0.357	0.098	1.29
Number of charity funds (T)	-0.018	0.013	-1.440	0.150	-0.043	0.007	1.21
Number of cooperative members (MC)	0.0005	0.0001	1.550	0.121	0.000	0.000	1.08
Manager (Yes = 1, 0 = No)	0.324	0.061	5.350	0.000	0.205	0.443	1.02
Governance (G)	0.041	0.035	1.160	0.245	-0.028	0.111	1.02
Constant	0.618	0.166	3.730	0.000	0.293	0.944	-
F(6, 371)	7.02						
Prob > F	0.0000						
R-squared	0.1020						
Adj R-squared	0.0875						

VIF=Variance Inflation Factor

5. Conclusion

The governance of MSM cooperatives has inherent problems that can affect their efficiency. Prior studies identified the determinant factors of cooperative efficiency but neglected to investigate the role of manager appointment in increasing cooperative efficiency. Although conventional wisdom suggests that the appointment of a manager can improve the performance of a cooperative, the appointment of a manager in small and micro-sized cooperatives is challenging owing to pressure to maximize their dividends for their members. Thus, the majority of the cooperatives in this category is run by a board of directors. This study aims to prove that board-managed cooperatives are less efficient than cooperatives with an appointed manager. In other words, cooperatives with an appointed manager are expected to be more efficient than board-managed cooperatives and hence will be able to generate higher value for their members after considering the associated costs.

The results suggest that cooperatives with an appointed manager are more efficient than other types of cooperatives. Moreover, the efficiency of a cooperative can be determined by the number of its charity funds and number of its members. The results imply that the efficiency of a cooperative can be explained by its agency and resources, which is consistent with the agency-resource dependence perspective. The absence of a manager negates the board's ability to leverage their incentives (such as compensation) and capital (including expertise, experience, knowledge, reputation, and skills) for effective management oversight. Instead, the operational competence of the appointed board is tested in running the cooperatives.

The obtained results have several practical implications. First, the appointment of a manager should be encouraged for small and micro-sized cooperatives. The original intention of a cooperative to not appoint a manager is to use the extra funds for dividends payment. However, when board-managed cooperatives are inefficient, they may not be able to attain their objectives. The inefficiency of a cooperative run by a board may challenge its survival in the long run. This evidence is valuable for cooperative boards to consider when strategizing how to persuade members to agree on appointing a manager, even if it means sacrificing short-term dividends. Second, as the efficiency of a cooperative is associated with the number of its charity funds and members, the

management and board should consider increasing the charity funds for the members and promoting membership. Such initiatives can increase member participation and cooperatives' efficiency and effectiveness.

However, the effectiveness of a manager in generating revenue and profits depends on their entrepreneurial and managerial skills, which is beyond the scope of this study. Sufficient investment is needed for managers with such skills. Furthermore, the time needed for investments to generate financial and nonfinancial returns for cooperatives remains unknown. Thus, such issues should be examined in future research. Secondly, with only cross-sectional data from a survey, robust testing for endogeneity is limited and often relies heavily on theoretical justification. Future studies could explore the intricate relationship between managerial characteristics and the causal impact of their appointment on cooperative efficiency, utilizing time series data.

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Economic Openness and Growth in MENA: Evidence from Dynamic Heterogenous Panel Models

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ABSTRACT

This paper explores the impact of openness on economic growth in MENA countries using a heterogeneous panel data approach over the period 1979-2019. We have found higher domestic capital stock and school enrollments to attribute to the region's economic growth. However, the empirical results support a weak indirect association between economic performance and openness of MENA countries using different globalization measures. Our findings support that MENA countries have limited economic growth gains from globalization.

ملخص

تستكشف هذه الورقة أثر الانفتاح على النمو الاقتصادي في بلدان الشرق الأوسط وشمال أفريقيا باستخدام نهج بيانات لوحة غير متجانسة خلال الفترة من 1979 إلى 2019. وقد وجدنا أن ارتفاع المخزون رأس المال المحلي والالتحاق بالمدارس يسهمان في النمو الاقتصادي للمنطقة. ومع ذلك، تدعم النتائج التجريبية وجود ارتباط ضعيف غير مباشر بين الأداء الاقتصادي وانفتاح بلدان الشرق الأوسط وشمال أفريقيا باستخدام مقاييس العولمة المختلفة. تؤيد نتائجنا أن دول الشرق الأوسط وشمال أفريقيا لديها مكاسب محدودة من النمو الاقتصادي من العولمة.

RÉSUMÉ

Cet article explore l'impact de l'ouverture sur la croissance économique dans les pays de la région MENA en utilisant une approche de données de panel hétérogènes sur la période 1979-2019. Nous avons constaté que l'augmentation

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du stock de capital domestique et des inscriptions à l'école contribue à la croissance économique de la région. Cependant, les résultats empiriques soutiennent une faible association indirecte entre la performance économique et l'ouverture des pays de la région MENA en utilisant différentes mesures de la mondialisation. Nos résultats confirment que les pays de la région MENA ont des gains de croissance économique limités grâce à la mondialisation.

Keywords: Openness, economic growth, cross-country growth regression, MENA, globalization

JEL Classification: C33, F02, F43, F62

1. Introduction

The relationship between economic openness and growth has been broadly discussed in the economics literature. However, these empirical and theoretical studies meet on common ground is hard to accept. On one side, the positive effect trade has on the economy is accepted by classical and neo-classical economists, yet some opponents claim inward-looking growth strategies to be superior, especially for developing countries. Nevertheless, although different opinions have arisen over time, the openness-growth relationship reached a consensus, arguing that real GDP per capita will consistently increase due to people seeking profits. Because profitability decreases as a result of competition, people will seek new products and technologies. This also means people will look for different trade venues or areas where they can do business. This main argument provides the basic principles within the consensus.

While the studies from Balassa (1978), Feder (1983), and Esfahani (1991) tested export-led growth assertions in particular, the focus in other research has shifted to openness and economic growth relations over time. Dollar (1992), Sachs & Warner (1995), Barro & Sala-i-Martin, (1997), and Rivera-Batiz & Romer, (1991) defended openness as having positive effects on economic growth through channels such as technological transfer, increased productivity, and effective resource use.

On the other side, Redding (1999), Young (1991), and Lucas (1988) asserted trade openness to slow down economic growth in the long run, contrary to expectations.

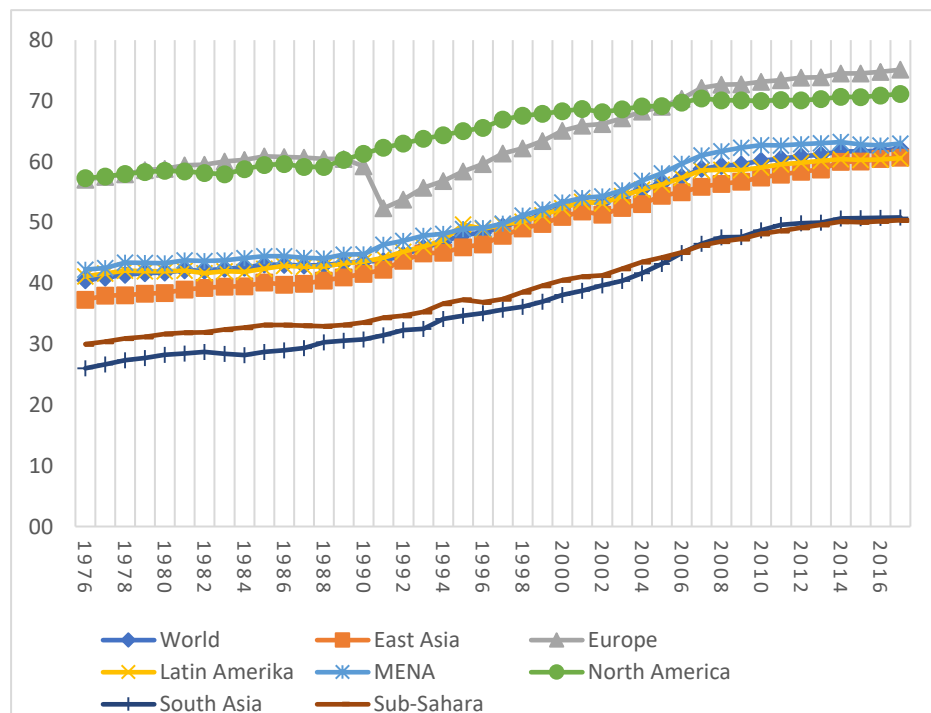
Empirical studies in the literature also have no common inference. Rodriguez and Rodrik's (2001) study put forth a new debate proposing no relationship to exist between trade openness and economic growth. Nevertheless, different results are still being obtained concerning studies' periodic and regional differences. While Ulasan (2015), Jalles (2012) and Musila and Yiheyis (2015) determined the relation between openness and economic growth to be insignificant and even negative, another research trend however argues increased trade openness to possibly be counterproductive to economic growth by increasing inflation and lowering exchange rates (Cooke, 2010; Jafari Samimi *et al.*, 2012). Trade openness can negatively impact economic growth for countries specialized in manufacturing low-quality products (Hausmann, Hwang, & Rodrik, 2007); Oskooee and Niroomand (1999), Chang *et al.*, (2009), Belazreg and Mtar (2019) and Darku and Yeboah (2018) arrived at positive conclusions claiming free trade to be one of the key drivers of economic development. Additionally, Omri *et al.* (2015) found economic growth and trade openness to be interrelated, claiming a bilateral relationship to exist between trade openness and economic growth. They stated the adoption of additional trade liberalization policies to support sustained long-term economic growth.

Meanwhile, some studies have claimed trade to enable developing countries' use of the technological facilities and knowledge available in developed countries. For instance, Abid (2019), and Mensi *et al.* (2018) claimed increased trade openness to stimulate technical progress for the selected industries; Ades and Glaeser (1999) and Hausmann (2001) showed the infrastructure of international transport infrastructure to be significant in increasing trade accessibility and supporting countries' economic growth. They also claimed landlocked countries to have decelerated economic growth due to being less exposed to the global economy.

When looking at the last decade, the economic performance of the Middle East and North African (MENA) countries has been very low and quite unlike other developing countries despite MENA's natural resources. This performance was observed to be partially due to political and social instability and wars and in particular to the cost of oil between 2008-2014, which led to improper policy choices. If sound macroeconomic and structural policies lead to reinforcing host economies' absorptive capacity, then foreign trade and investment will bring significant benefits

from enhanced economic and sustainable growth to job creation and innovation. MENA economies and international organizations (*e.g.*, OECD, WTO, IMF) share many goals, including the need to undertake ambitious and coherent structural reforms to retain growth, create jobs and achieve more inclusive and sustainable development models. They also have a shared interest in fostering growth and economic openness. Yet when looking into the MENA region's integration with the outside world, a different story emerges than the path of growth. When looking at the data in Figure 1, the MENA region can be seen to have a higher globalization score than all regions apart from North America and Europe. While a course is observed in parallel with the world average, the values exceed this average after 2008. The main question of this study is how much influence the increasing interaction with the outside world has had on growth in the context of the above-mentioned theories. Has increased globalization had a positive effect on growth in this region as the theories claim?

Figure 1: Regional KOF globalisation index.



This study aims to contribute to the literature by re-examining the growth-openness nexus for the MENA region as a whole, which has had steadily increasing globalization but weak economic performance over the last decade. Secondly, while most studies have mainly focused only on the economic dimension of openness, the current study covers different dimensions of globalization such as cultural and political using different types of openness measures. Lastly, this study applies the augmented mean group (AMG) estimator in accordance with Eberhardt and Bond (2009) for estimating Mankiw *et al.*'s (1992) neoclassical growth model in the dynamic panel data for the MENA region. This estimator helps predict long-term interactions among the variables by taking long-term intervals without data loss and allows long-term coefficients that differ across groups (or countries) to be obtained. Moreover, it is an efficient estimator in non-stationarity cases and is robust in terms of cross-sectional dependence.

While the study has found higher domestic capital stock and school enrollments to attribute to the region's economic performance, the empirical results however support a weak association for the relationship between MENA countries' growth and openness. Because globalization policies can differ in terms of practice, we have place de facto and de jure measures for the composite globalization index to address this issue. The de jure index, which captures the policies related to global integration, has been found significant but very small, while the de facto index has been found insignificant. Our finding implies the economic growth gains from globalization to be very weak for MENA countries.

The structure of this article will proceed with Section 2 presenting the empirical model, estimation procedure, and data used in the analysis; Section 3 reporting and discussing the empirical results; and Section 6 being the conclusion.

2. Empirical Methodology

2.1. Empirical Model and Estimation Procedure

The neoclassical augmented growth model developed by Mankiw *et al.* (1992) has been implemented to analyze the relationship between openness and economic growth. The model incorporated with openness for performing the panel data analysis is:

$$\begin{aligned} \log y_{i,t} &= \gamma_0 + (1 + \gamma_1) \log y_{i,t-1} \gamma_2 \log(p_{i,t} + t + \xi) + \gamma_3 \log s_{i,t,K} + \gamma_4 \log s_{i,t,H} \\ &+ \gamma_5 OP_{i,t} \\ &+ \varepsilon_{i,t} \end{aligned} \quad (1)$$

where y_i is the level of GDP per capita in country i and $(p_i + t + \xi)$ indicates the sum of population growth rates, level of technological progress, and depreciation. $s_{i,K}$, and $s_{i,H}$ denote the rates of physical and human capital accumulation for country i , respectively. Country i 's degree of openness is represented by OP_i . Lastly, $\varepsilon_{i,t}$ is the residual of the sum of time-constant country effect μ_i , a time-variant effect τ_t , and an idiosyncratic error term $v_{i,t}$ where $\varepsilon_{i,t} = \mu_i + \tau_t + v_{i,t}$.

Following Eberhardt and Bond (2009) and Eberhardt and Teal (2011), we have estimated the model using the augmented mean group (AMG) estimator, which takes into account the cross-sectional dependence and country-specific heterogeneity among the cross-section units in the macro panel data.¹ The model is given in the following equations:

$$y_{it} = \beta_i x_{it} + u_{it} \text{ where } u_{it} = \alpha_i + \lambda_i f_{t+} \varepsilon_{it} \quad (2)$$

$$x_{mit} = \pi_{mi} + \delta_{mi} g_{mt} + \rho_{1mi} f_{1mi} + \dots + \rho_{nmi} f_{nmt} + v_{mit} \quad (3)$$

$$\text{where } m = 1, \dots, k \text{ and } f_{mt} \subset f_t \text{ and } f_t = \varphi f_{t-1} + \varepsilon_t$$

$$\text{and } g_t = \kappa g_{t-1} + \varepsilon_t \quad (4)$$

where $i = 1, \dots, N$ and $t = 1, \dots, T$, x_{it} is a vector of the observable variable, β_i is the country-specific slope parameter for the observed regressor, u_{it} includes unobservable factors, ε_{it} contains the error terms, α_i is the combination of group-specific fixed effects, f_t is the set of common factors, and λ_i are the factor loads specific to the cross-section units. λ_i , δ_i and ρ_i are the country-specific factor loads. In Eq. (4), f_t and g_t are common factors that cannot be observed and affect all cross-sections. This equation provides an empirical representation of the κ

¹ Typical (micro) panel data have large cross-sections (N s) for short periods of time (T), whereas macro panel data have small N s for longer periods of time.

observable variables that are modeled of these common factors. Therefore, this model demonstrates the cross-section dependence in the observable and unobservable variables.

The estimate using the AMG estimator takes place in two steps (Eberhardt & Bond, 2009). The first step can be shown as:

$$\begin{aligned}\Delta y_{it} &= \mathbf{b}' \Delta x_{it} + \sum_{t=2}^T c_t \Delta D_t + e_{it} \\ \Rightarrow \hat{c}_t &\equiv \hat{\mu}_t^*\end{aligned}\quad (5)$$

In the first stage shown in Eq. (5), the model is estimated using the first differences of the variables. The reason is that the non-stationary variables and non-observable factors are assumed to be correlated in the estimates in the regression model with the variables at this level. Thus, the year dummy coefficients indicated by $\hat{\mu}_t^*$ are obtained.

In the second step, the estimated model is:

$$\begin{aligned}y_{it} &= \alpha_i + b_i' x_{it} + c_i t + d_i \hat{\mu}_t^* + e_{it} \\ \hat{b}_{AMG} &= N^{-1} \sum_i \hat{b}_i\end{aligned}\quad (6)$$

In the second step shown in Eq. (6), $\hat{\mu}_t^*$ is included in the regression of each cross-section unit. A linear trend term is also included in the regression. AMG estimates are derived as the average of individual country estimates.

We have applied the following procedure to determine the difficulties in the macro panel data before estimating the AMG model. We first tested the cross-sectional dependency among cross-section units using the Breusch and Pagan (1980) Lagrange multiplier (LM) test and Pesaran's (2004) cross-sectional dependence test. Investigating the cross-sectional dependency among the series is mandatory to avoid biased estimates and spurious relations (Breusch & Pagan, 1980; Pesaran, 2004; Chudik & Pesaran, 2013). Next, we examined the stationarity properties of the series using the panel unit root tests. Then to prevent biased and misleading estimates that could arise from using non-stationary series and thus avoid

spurious regressions, we employed panel cointegration tests to check for the long-term relationships among the series.

After identifying the long-term relationships among the variables, the long-term coefficients were finally estimated in the last step. Certain constraints should be taken into account in estimating the model. The possibility of slope parameter differentiations at the cross-section levels increase with larger time dimensions (t). In conventional pooled estimators, or more specifically, fixed- and random-effects estimators, the coefficients and error variances across groups are the same, but intercepts may vary across groups (Pesaran et al., 1999, pp. 621). The problem of being non-stationary is also possible with larger t s. If a correlation is found between the cross-section units, the preferred estimator should be robust in the cross-sectional dependence.

While the first-generation estimators such as the mean group estimator (MG; Pesaran & Smith, 1995; Pesaran et al., 1997) and the pooled mean group estimator (PMG; Pesaran et al., 1997) allow for heterogeneity of slope parameters in the panel time series analysis, they are not robust in cross-sectional dependence. For example, the idiosyncratic error terms must be serially uncorrelated for the GMM estimators to be valid. Moreover, GMM methodology does not allow for heterogeneous slope coefficients across units over time. When a cross-sectional dependency exists, correlations will be found in the variables and residuals due to general shocks or spillover effects. Cross-sectional dependence and slope heterogeneity in panel data may result in biased and inconsistent estimates, as well as in problems identifying relations (Comunale & Simola, 2016, p. 14). Eberhardt & Bond (2009) suggested heterogeneity, non-stationarity variables, and cross-sectional dependence to cause serious bias in standard panel estimators; various diagnostic tests have confirmed this claim.

The current study employs the estimator (AMG) method, a second-generation estimator, for accommodating the cross-sectional dependence and unit-specific heterogeneity among the countries' challenges that are present in the macro panel data for MENA.

2.2. Data

Data Table		
	<i>Data</i>	<i>Source</i>
lngdpe	Real GDP per capita	The Penn World Table
openness	Total export and import; % GDP	The Penn World Table
lnkn	log of Capital stock at constant 2011 national prices	The Penn World Table
lnlife	life expectation	The Penn World Table
KOFecGI	KOF Globalization Index	KOF Swiss Economic Institute
KOFecGI _{dj}	de jure KOF Globalization Index	KOF Swiss Economic Institute
KOFecGI _{df}	De facto KOF Globalization Index	KOF Swiss Economic Institute
edu	Gross enrolment ratio, primary	The Penn World Table
fdi	Foreign direct investment %GDP	The Penn World Table

The data for estimating the model summarized above have been retrieved from the Penn World Tables (Feenstra et al., 2015). Real GDP per capita has been used for the variable $y_{i,t}$, the log of capital stock at constant 2011 national prices has been used for the variable $s_{i,K}$, and life expectation data have been used for the variable $s_{i,H}$. Just as Mankiw et al. (1992) have shown, this study also accepts the sum of the rates of depreciation and technological progress to be constant across the countries at 0.05%. Population growth rates have been calculated from the Penn World Tables data.

Openness indexes are wide composite indicators that combine different variables and approaches into one final index. As such, four different types of proxies have been applied here to the openness variable. The proportion of real export and import, as calculated in the Penn World Table, to GDP is accepted as the first indicator. Meanwhile, the study also utilizes the overall, de jure, and de facto types from the KOF Globalization Index that focus on economic globalization (Gygli et al., 2019).

The balanced panel data set involving the 13 MENA countries from 1979 to 2019 has been composed in the light of available data.¹ A large number

¹ These countries are Algeria, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Morocco, Qatar, Saudi Arabia, Tunisia, Turkey, and United Arab Emirates. Saudi Arabia, United Arab Emirates, and Iraq have been excluded due to lack of data in the models where education is used as a variable.

of countries with insufficient data due to the turmoil and civil wars in the region have been excluded from the analysis.

Correlation				
Probability	OPENNESS	KOFE CGIDJ	KOFE CGIDF	KOFE CGI
OPENNESS	1.000000			

KOFE CGIDJ	0.411444	1.000000		
	0.0000	-----		
KOFE CGIDF	0.513996	0.866984	1.000000	
	0.0000	0.0000	-----	
KOFE CGI	0.463070	0.984826	0.940256	1.000000
	0.0000	0.0000	0.0000	-----

3. Empirical Results

3.1. Testing Macro Panel Data

The results from the cross-sectional dependence and slope homogeneity tests are shown in Table 1, and the three tests indicate a strong correlation to exist between the cross-section units for the panel models. Also, the results from the slope homogeneity test are shown in Table 1 to reject the null hypothesis, thus confirming the presence of heterogeneity.

Table 1: Results from the Cross-Sectional Dependence and Slope Homogeneity Tests

	Cross-sectional dependence test				Slope homogeneity test	
	Breusch-Pagan LM	Pesaran Test	CD	Pesaran scaled LM	Δ	Δ_{adj}
Panel I	438.429***	-0.821		50.08 ***	21807.73* **	439.11** *
Panel II	468.377***	0.710		48.94***	7370.19	860.015
Panel III	410.573***	4.326***		52.87 ***	17652.56* **	503.998* **
Panel IV	408.967***	2.505**		44.95***	83093.17* **	224.271* **
Panel V	473.705***	1.545		72.77 ***	22185.31* **	439.876* **

Note: ***, ** indicates significance at the 1% and %5 level; the null hypothesis of the cross-sectional dependence test has no cross-sectional dependence, and the null hypothesis of the slope homogeneity test has slope homogeneity.

Table 2 shows the results from the second-generation unit root test proposed by Pesaran (2007). The null hypothesis has been rejected for all variables. In other words, the first difference in the variables is stationary at a 1% level of significance (i.e., I (1)).

Table 2: Results from the Cross-Sectional Dependence and Slope Homogeneity Tests

	Cross-sectional dependence test				Slope test	homogeneity test
	Breusch-Pagan LM	Pesaran Test	CD	Pesaran scaled LM	Δ	Δ_{adj}
Panel VI	746.479***	7.693***		22.44***	29.422***	31.985** *
Panel VII	791.167***	8.569***		29.04***	27.679***	30.090** *
Panel VIII	766.111***	11.747***		36.01***	27.416***	29.805** *
Panel IX	704.988***	5.826***		32.85***	28.729***	31.232** *
Panel X	539.960***	1.928**		196.9***	29049.70* **	1698.76* **

Note: ***, ** indicates significance at the 1% and %5 level; the null hypothesis of the cross-sectional dependence test has no cross-sectional dependence, and the null hypothesis of the slope homogeneity test has slope homogeneity.

Table 2: Results from the Pesaran CIPS Panel Unit Root Test

	<i>Level</i>	<i>First Difference</i>
Lngdpe	-1.024	-4.828***
Openness	-1.817	-5.662***
Lncn	-0.533	-2.358**
Lnlife	-0.685	-2.353**
KOFecGI	-2.077	-5.443***
KOFecGIdj	-2.03	-5.736***
KOFecGIdf	-1.83	-5.276***
Edu	-1.494	-4.575***
fdi	-3.728***	

Note: *** denote statistical significance at the 1% and ** at the 5% level. The critical values for the model with intercept from Pesaran are -2.44 (1%), -2.25 (5%), and -2.14 (10%).

Step 3 investigates the presence of a long-term relationship among the variables using the panel LM co-integration test with multiple structural breaks as developed by Westerlund (2006) because it takes into account cross-sectional dependence and slope heterogeneity in estimating long-term cointegrated relationships among variables where traditional tests do not. Furthermore, breaking points stemming from the political developments and economic crises in MENA countries are predicted to occur over the long run.

Table 3: Results from the Westerlund Panel Cointegration Test

	LMstat	<i>p</i> -value ^a	<i>p</i> -value ^b
Panel I	-2.459	0.993	0.931
Panel II	-0.523	0.699	0.907
Panel III	-2.607	0.995	0.905
Panel IV	-0.590	0.722	0.805
Panel V	-2.050	0.980	0.954

^a The *p*-value is based on the asymptotic normal distribution.

^b The *p*-value is based on the bootstrapped distribution.

Trade openness, KOF overall economic globalization index, economic globalization, de facto and economic globalization, de jure and rate of FDI indices have been applied respectively as openness indicator in panel models VI, VII, VII, IX, and X .

The test's null hypothesis is that all units in the panel are cointegrated, while the alternative is that at least one country is found for which cointegration does not hold. The results in Table 3 show the null hypothesis to be acceptable for all four-panel models with respect to the bootstrap *p*-values. As a result, a long-term relationship is seen to occur among the variables in all models.

3.2. Growth Regression Results

Table 4: Results from the Westerlund Panel Cointegration Test

	LMstat	<i>p</i> -value ^a	<i>p</i> -value ^b
Panel VI	-1108.254	1.000	0.984
Panel VII	206.094	0.000	0.138
Panel VII	171.989	0.000	0.191
Panel IX	171.989	0.000	0.191
Panel X	0.066	0.474	0.933

^a The *p*-value is based on the asymptotic normal distribution.

^b The *p*-value is based on the bootstrapped distribution.

Trade openness, KOF overall economic globalization index, economic globalization, de facto and economic globalization, de jure and rate of FDI indices have been applied respectively as openness indicator in panel models VI, VII, VII, IX, and X .

The Results from the Augmented Mean Group (AMG) Estimator					
	I	II	III	IV	V
openness	-0.154 (0.326)	0.0012 (0.006)	-0.007* (0.004)	0.006** (0.003)	-0.004 (0.024)
lnedu	0.002 (0.004)	0.007* (0.004)	0.009** (0.004)	0.003 (0.005)	0.006 (0.004)
lnen	0.534*** (0.064)	0.519*** (0.062)	0.490*** (0.053)	0.453*** (0.046)	0.509*** (0.051)
lnfixed	-0.099 (0.173)	0.053 (0.075)	-0.016 (0.046)	0.031 (0.063)	-0.060 (0.129)
_cons	-4.870*** (1.622)	-4.948*** (1.408)	-3.734*** (1.269)	-3.168** (1.238)	-4.497** (1.256)

Note: *** denote statistical significance at 1%, ** at 5%, and * at 10%. Trade openness, KOF overall economic globalization index, economic globalization, de facto and economic globalization, de jure and rate of FDI indices have been applied respectively as openness indicator in panel models I, II, III, IV, and V.

The empirical results for growth regression based on a novel AMG estimator are presented in Table 4. It shows higher domestic capital stock to lead to higher growth rates, as expected. Growth rates are higher with higher school enrollment, whereas the effect of life expectancy as another human capital measure has not been found to be significant.

We have found no significant effect from openness to have occurred on economic growth in MENA countries. Statistically significant coefficients have been obtained only when differentiating while implementing the *de jure* and *de facto* economic globalization indexes. However, the value of the coefficient is too small (nearly zero) to be considered seriously. Choosing different openness indexes results in different findings being obtained regarding the openness-economic growth nexus (Quinn *et al.*, 2011). Globalization indexes are composite indicators that combine various variables to measure different aspects of globalization (*e.g.*, economic, social, and political dimensions) into one final index. They are very useful but oversimplifying them may lead to globalization being misinterpreted.

To address this issue, we have placed the *de facto* and *de jure* measures from the KOF index to differentiate activities (output) and policies (inputs), as Martens *et al.* (2015) recommended. We have found the *de facto* index to result in a negative and statistically estimated coefficient when entered into the growth regression, whereas the *de jure* index, which

measures variables representing policies, resources institutions enabling actual flow, and activities in countries, to be positive and statistically significant. The estimated values of the openness coefficients are very close to zero, which implies a weak association between openness and growth for MENA countries.

This finding implies a policy proposed on paper to be different in actual practice. In other words, integration into the global world on paper may be different than how it occurs in practice. For example, some countries have strict capital controls on paper but are toothless in practice (Kose *et al.*, 2009). This may explain why different signals have occurred regarding the relationship between globalization and economic growth.

The weak relationship between openness and growth supports the idea of growth benefits being indirectly achieved by opening an economy. The capital flows from industrial economies to developing countries simply cannot generate welfare gains and technology spillovers; they are unable to increase productivity and investment, and as a result, growth. Interactions among openness, education, and capital have been enabled in our model for analyzing the impact openness has on growth through human and physical capital.⁶ All resulting coefficients are seen to be insignificant. However, having insignificant coefficients does not necessarily mean openness has no influence on human and physical capital in MENA countries. Opening an economy to the world probably leads to more investments; trade; technology transfer; and the spread of ideas, information, and reforms and as a result promote more productive capital.

In summary, our study finds MENA countries to have not benefitted from globalization, which is contrary to what the canonical theoretical models predict.

⁶ These results are available upon request.

Table 5: The Results from the Augmented Mean Group (AMG) Estimator

	VI	VII	VII	IX	X
openness	-0.067 (0.075)	0.0012 (0.004)	-0.004 (0.005)	0.004** (0.002)	0.0005 (0.006)
lnlife	7.091 (5.699)	7.849 (5.169)	10.041 (6.266)	5.371 (5.399)	4.901 (4.943)
lncn	0.448*** (0.109)	0.435*** (0.113)	0.409*** (0.131)	0.436*** (0.112)	0.436*** (0.092)
lnfixed	-0.046 (0.085)	-0.004 (0.051)	-0.030 (0.065)	-0.003 (0.075)	0.056 (0.053)
_cons	-32.082 (22.283)	-34.954* (20.677)	-43.352* (24.618)	-24.736 (21.736)	-22.931 (18.825)

Note: *** denote statistical significance at 1%, ** at 5%, and * at 10%.

Trade openness, KOF overall economic globalization index, economic globalization, de facto and economic globalization, de jure and rate of FDI indices have been applied respectively as openness indicator in panel models VI, VII, VII, IX, and X .

4. Conclusion

The relationship between openness and economic growth has led to numerous debates in the literature for MENA countries between 1979 and 2019. Many studies in the literature have centered on various countries and used specific narrow measures for openness such as trade or trade liberalization scores range for estimating this relationship. Their empirical findings are ambiguous and vary over different countries and periods.

This study has estimated the next-generation augmented mean group estimation model using four different openness measures to test the long-term relationship between openness and economic activity. Our empirical results suggest no significant relationship to exist between openness and economic growth. The relationship the MENA region has with the external world may be concluded to not contribute to MENA's economic performance as natural resources-rich region. Having natural resources may eliminate incentives to develop other economic areas that are potentially more important for long-term economic growth.

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Appendix:

Panel unit root tests

In the panel unit root tests, the first-generation tests assume no correlation between the cross-section units. Therefore, in the case of a cross-section dependence, the first-generation tests are accepted as not providing reliable results. This study uses the unit root test proposed by Pesaran (2007), which takes cross-section dependence into consideration.

Pesaran's (2007) unit root test is one of the second-generation tests frequently used in the literature. For this test, Pesaran (2007, p. 265) developed a test "where the standard ADF regressions are augmented with the cross-section averages of lagged levels and first differences of the individual series." This test is called the cross-sectionally augmented Dickey-Fuller test (CADF). The simple average CADF statistics is a cross-sectionally augmented IPS test (CIPS; Pesaran, 2007, p. 267).

If residuals are not serially correlated, the cross-sectionally augmented DF (CADF) regression that is used for i^{th} country is as follows:

$$\Delta y_{it} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + e_{it} \quad (1)$$

where $\bar{y}_{t-1} = \left(\frac{1}{N}\right) \sum_{i=1}^N y_{i,t-1}$ and $\Delta \bar{y}_t = \left(\frac{1}{N}\right) \sum_{i=1}^N \Delta y_{i,t}$ (Hurlin & Mignon, 2007, p. 19). In order to test the unit root hypothesis, the t -ratio obtained from the OLS estimate of $b_i(\hat{b}_i)$ in the CADF regression (1) is used (Pesaran, 2007, p. 269). The t ratio $t_i(N, T)$ from the regression is as follows:

$$t_i(N, T) = \frac{\Delta y_i' \bar{M}_w y_{i,-1}}{\hat{\sigma}_i (y_{i,-1}' \bar{M}_w y_{i,-1})^{1/2}} \quad (2)$$

where

$$\Delta y_i = (\Delta y_{i1}, \Delta y_{i2}, \dots, \Delta y_{iT})', y_{i,-1} = (y_{i0}, y_{i1}, \dots, y_{iT-1})'$$

$$\bar{M}_w = I_T - \bar{W}(\bar{W}'\bar{W})^{-1}\bar{W}', \bar{W} = (\tau, \Delta \bar{y}, \bar{y}_{-1}) \quad \text{and} \quad \hat{\sigma}_i^2 = \frac{\Delta y_i' \bar{M}_{i,w} \Delta y_i}{T-4} \quad (\text{Pesaran, 2007, pp. 270}).$$

The Pesaran (2007, p. 276) CADF test is based on the individual CADF statistics. The average of the individual CADF statistic is the CIPS statistics, a modified version of the IPS test (Im et al., 2003). The CIPS statistic is as computed as follows:

$$CIPS(N, T) = \bar{t} = N^{-1} \sum_{i=1}^N t_i(N, T) \quad (3)$$

Pesaran (2007) presented the critical values for individual CADF distributions and critical values for the average of individual CADF distributions. The obtained CADF and/or CIPS statistics are then compared with the critical value in these tables. If the absolute value of the CADF and/or CIPS statistic is greater than the absolute value of the critical value, the unit root hypothesis is rejected. In this case, the series is accepted as being stationary.

Panel Cointegration Test

Finding a correlation between cross-section units affects which cointegration test gets selected. First-generation cointegration tests are considered to be unreliable in the case of cross-section dependence. Therefore, second-generation cointegration tests should be preferred if a correlation occurs between the cross-section units.

Westerlund's (2006) panel LM cointegration test with multiple structural breaks is used to examine the presence of a long-term relationship among the variables because it takes into account cross-sectional dependence and slope heterogeneity when estimating the long-term cointegration relationship among variables where traditional tests do not.

Westerlund (2006) proposed a simple test for the null hypothesis of cointegration that accommodates structural changes in the deterministic component of a cointegrated panel regression. The test is based on McCoskey and Kao's (1998) LM test and can provide a constant for n numbers of breaks and the trend for individual regressions that are observable at different times for different units. The test statistics are derived when the locations of the breaks are known *a priori* and are determined endogenously from the data. The test statistics are also derived when no break occurs yet the deterministic component includes individual-specific constant and trend terms. Westerlund evaluated the

small-sample performance of the test using Monte Carlo simulations. The results suggest the test to have small size distortions and reasonable estimating power (Westerlund, 2006, p. 102).

Consider the multidimensional time-series variable y_{it} observable for the cross-section $I = 1, \dots, N$ and time series $t = 1, \dots, T$. The data generating process (DGP) for y_{it} is given by the following system of equations:

$$y_{it} = z'_{it}\gamma_i + x'_{it}\beta_i + e_{it} \quad (4)$$

$$e_{it} = r_{it} + u_{it} \quad (5)$$

$$r_{it} = r_{it-1} + \phi_i u_{it} \quad (6)$$

- a) where $x_{it} = x_{it-1} + v_{it}$ is a K -dimensional vector for the regressions and z_{it} is a vector for the deterministic components. The corresponding vectors for the parameters are denoted β_i and γ_i respectively. The index of $j = 1, \dots, M_i + 1$ is used to denote structural breaks where M_i is the maximum number of breaks; in other words, it has $M_i + 1$ regimes found for the dates $T_{i1}, \dots, T_{iM_i}$, where $T_{i0} = 1$ and $T_{iM_i+1} = T$. Furthermore, the initial value of r_{it} is assumed to be zero, which entails no loss of generality as long as z_{it} includes an individual-specific intercept. For convenience in constructing the test and in deriving its asymptotic distribution, we have assumed vector $w_{it} = (u_{it}, v'_{it})'$ to be cross-sectionally independent and to follow a general linear process (Westerlund, 2006, p. 103).
- b) The processes driving the unit root and stationary components of the composite error term in Eq. (5) are assumed to be highly correlated with the parameter ϕ_i , which reflects their relative weight. Thus, the null hypothesis that all individual units of the

panel are cointegrated can be stated equivalently as (Westerlund, 2006, p. 105):

$$H_0 = \phi_i = 0 \text{ for all } i = 1, \dots, N$$

as opposed to

$$H_1 = \phi_i \neq 0 \text{ for all } i = 1, \dots, N \text{ and } \phi_i \neq 0 \text{ for } i = N_1 + 1, \dots, N$$

The panel LM test statistic is defined as follows:

$$Z(M) \equiv \sum_{i=1}^N \sum_{j=1}^{M_i+1} \sum_{t=T_{ij}+1}^{T_{ij}} (T_{ij} - T_{ij-1})^{-2} \hat{\omega}_{i1.2}^{-2} S_{it}^2 \quad (7)$$

Where

$$\hat{\omega}_{i1.2}^2 = \hat{\omega}_{i11}^2 - \hat{\omega}_{i21}' \hat{\Omega}_{i22}^{-1} \hat{\omega}_{i21} \text{ and } S_{it} = \sum_{k=T_{ij-1}}^t \hat{e}_{ik}^* \text{ with } \hat{e}_{it}^* \text{ being any efficient estimate of } e_{it}.$$

According to the results obtained from the test, the cointegration relationship behaves in accordance with the presence of a cross-section dependency among the countries in the panel. If no cross-section dependency occurs among the countries, the asymptotic probability values of the test are taken into consideration, whereas in the case of a cross-section dependency, the bootstrap probability values of the test are checked. Both asymptotic and bootstrap probability values are compared at a significance level of $p < 0.05$ to determine the presence of cointegration at a 5% significance level. If the probability value of the calculated test is greater than 0.05, a cointegration relationship is assumed to be present between the series, thus accepting H_0 .

Estimating the Panel Cointegration Coefficients

When a cointegration relationship is present between variables, the next step is to estimate the long-term coefficients between these variables. Some considerations are important in choosing the estimator to be used for this. First, the probability of the slope coefficient being different for the cross-section units increases for larger time durations (T). Choosing among the conventional methods (*e.g.*, fixed effects, random effects)

implies the slope parameters being the same for all cross-section units, as these estimators only allow for differentiating the intercepts when all other coefficients and error variances are the same across groups (Pesaran et al., 1999, p. 621). The problem of non-stationarity is also possible with larger T durations. The second important issue is the presence of a cross-section dependence. If a correlation exists between cross-section units, the preferred estimator should be robust against cross-section dependence.

Although first-generation estimators such as the mean group estimator (MG; Pesaran & Smith, 1995; Pesaran et al., 1997) and the pooled mean group estimator (PMG; Pesaran et al., 1997) allow for heterogeneous slope parameters in the panel time series analysis, they are not robust to cross-section dependence. The augmented mean group (AMG) estimator (Eberhardt & Bond, 2009; Eberhardt & Teal, 2010) is one second-generation estimator that eliminates these constraints. Eberhardt & Bond (2009) suggested heterogeneity, non-stationary variables, and cross-sectional dependence to cause serious bias in standard panel estimators, and various diagnostic tests have confirmed this claim. Therefore, they recommended the AMG estimator as a two-step method. The model proposed by Eberhardt & Bond (2009) is as follows:

$$y_{it} = \beta_i' x_{it} + u_{it} \quad u_{it} = \alpha_i + \lambda_i' f_t + \varepsilon_{it} \quad (8)$$

$$x_{mit} = \pi_{mi} + \delta_{mi}' g_{mt} + \rho_{1mi} f_{1mt} + \dots + \rho_{nmi} f_{nmt} + v_{mit} \quad (9)$$

$$m = 1, \dots, k \text{ and } f_{mt} \subset f_t$$

$$f_t = \phi' f_{t-1} + \varepsilon_t \quad \text{and} \quad g_t = \kappa' g_{t-1} + \varepsilon_t \quad (10)$$

where $i = 1, \dots, N$ and $t = 1, \dots, T$, x_{it} is a vector of the observable variable. β_i' is the country-specific slope parameter over the observed regressor; u_{it} includes what is unobservable and ε_{it} are the error terms. α_i is the combination of group-specific fixed effects, f_t is the set of common factors, and λ_i are the factor loads specific to the cross-section

units. λ_i , δ_i , and ρ_i are the country-specific factor loads. Eq. (10) shows f_t and g_t to be the non-observable common factors affecting all cross-sections. This equation provides an empirical representation of k observable variables modeled from these common factors. Therefore, this model demonstrates the cross-section dependence present in the observable and non-observable variables.

The estimate using the AMG estimator occurs in two steps (Eberhardt & Bond, 2009). The first step can be shown as:

$$\begin{aligned}\Delta y_{it} &= b' \Delta x_{it} + \sum_{t=2}^T c_t \Delta D_t + e_{it} \\ \Rightarrow \hat{c}_t &\equiv \hat{\mu}_t^*\end{aligned}\quad (11)$$

The first step in Eq. (11) estimates the model by using the first differences between the variables, the reason being that the non-stationary variables and non-observable factors are assumed to have biases with the variables at their level in the regression model estimates. Thus, the dummy coefficients for year (indicated by $\hat{m}_t$) are obtained.

In the second step, the estimated model is calculated as follows:

$$\begin{aligned}y_{it} &= \alpha_i + b_i' x_{it} + c_i t + d_i \hat{\mu}_t^* + e_{it} \\ \hat{b}_{AMG} &= N^{-1} \sum_i \hat{b}_i\end{aligned}\quad (12)$$

The second step shown in Eq. (12) includes $\hat{m}_t$ in the regression for each cross-section unit. A linear trend term is also included in the regression. AMG estimates are derived as the average of estimates for the individual countries.

224 Economic Openness and Growth in MENA: Evidence from Dynamic Heterogenous Panel Models

Globalisation Index, de facto	Weights	Globalisation Index, de jure	Weights
<i>Economic Globalisation, de facto</i>	33.3	<i>Economic Globalisation, de jure</i>	33.3
Trade Globalisation, de facto	50	Trade Globalisation, de jure	50
Trade in goods		Trade regulations	
Trade in services		Trade taxes	
Trade partner diversity		Tariffs	
		Trade agreements	
Financial Globalisation, de facto	50	Financial Globalisation, de jure	50
Foreign direct investment		Investment restrictions	
Portfolio investment		Capital account openness	
International debt		International Investment	
		Agreements	
International reserves			
International income payments			
<i>Social Globalisation, de facto</i>	33.3	<i>Social Globalisation, de jure</i>	33.3
Interpersonal Globalisation, de facto		Interpersonal Globalisation, de jure	
International voice traffic		Telephone subscriptions	
Transfers		Freedom to visit	
International tourism		International airports	
International students			
Migration			
Informational Globalisation, de facto		Informational Globalisation, de jure	
Used internet bandwidth		Television access	
International patents		Internet access	
High technology exports		Press freedom	
Cultural Globalisation, de facto		Cultural Globalisation, de jure	
Trade in cultural goods		Gender parity	
Trade in personal services		Human capital	
International trademarks		Civil liberties	
McDonald's restaurant			
IKEA stores			
<i>Political Globalisation, de facto</i>	33.3	<i>Political Globalisation, de jure</i>	33.3
Embassies		International organisations	
UN peace keeping missions		International treaties	
International NGOs		Treaty partner diversity	

Source: <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>

Overall indices for each aggregation level are calculated by the average of the respective de facto and de jure indices.

Exploring the Interactions between Monetary and Macro-prudential Policies for Output Growth in South Africa

Augustine Adebayo Kutu¹ and Abieyuwa Ohonba²

ABSTRACT

Given the framework of an economy where the policies target both the price and financial stability objectives, this study examines the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. Using the Vector Autoregression (VAR) model and quarterly time series data spanning the period 2008Q1 – 2023Q4, we show that tighter monetary and macro-prudential policies used to contain inflation and credit growth have also had a declining effect on output growth in the country. Consistent with economic theory, we also find that interest rate shock reduces inflation while money supply increases inflation in the economy. In the same way, the macro-prudential policy shock of an increase in the capital-based reduces the bank credits. Regarding the interaction and coordination of the two policies, we reveal that macro-prudential policy could interact with the monetary policy. As a result, we recommend that macro-prudential policy should continue to have a distinctive policy target different from monetary policy. It should be made a second mandate to work with the monetary policy to stimulate output growth in the country.

ملخص

بالنظر إلى الإطار أو الاقتصاد حيث تستهدف فيه السياسات كل من الأهداف المتعلقة باستقرار النظام المالي والأسعار، تفحص هذه الدراسة الآثار الاقتصادية الكلية لصدمة السياسة النقدية والسياسة الاحترازية الكلية على نمو الناتج في جنوب إفريقيا. باستخدام نموذج الانحدار الذاتي المتجه (VAR) وبيانات السلاسل الزمنية الفصلية التي تغطي الفترة من الربع الأول من عام 2008 إلى الربع الرابع من عام 2023، نظهر أن السياسات النقدية والاحترازية الكلية الأكثر تشددًا المستخدمة لاحتواء التضخم ونمو الائتمان قد أثرت أيضًا سلبًا على نمو الناتج في البلاد. واتساقًا مع النظرية الاقتصادية، نجد أيضًا أن صدمة سعر الفائدة تقلل من

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التضخم بينما يزيد المعروض النقدي من التضخم في الاقتصاد. بنفس الطريقة، تؤدي صدمة السياسة الاحترازية الكلية المتمثلة في زيادة رأس المال إلى تقليل الائتمانات المصرفية. فيما يتعلق بالتفاعل والتنسيق بين السياستين، نكشف أن السياسة الاحترازية الكلية يمكن أن تتفاعل مع السياسة النقدية. ونتيجة لذلك، نوصي بأن تستمر السياسة الاحترازية الكلية في أن تكون لها أهداف سياسة متميزة تختلف عن السياسة النقدية. يجب أن تكون بمثابة ولاية ثانية للعمل مع السياسة النقدية لتحفيز نمو الناتج في البلاد.

RÉSUMÉ

Dans le cadre d'une économie où les politiques visent à la fois les objectifs de stabilité des prix et de stabilité financière, cette étude examine les effets macroéconomiques des chocs des politiques monétaires et macroprudentielles sur la croissance de la production en Afrique du Sud. En utilisant le modèle d'autorégression vectorielle (VAR) et des séries chronologiques trimestrielles couvrant la période 2008T1 - 2023T4, nous montrons que les politiques monétaires et macroprudentielles plus strictes utilisées pour contenir l'inflation et la croissance du crédit ont également eu un effet décroissant sur la croissance de la production dans le pays. Conformément à la théorie économique, nous constatons également que le choc des taux d'intérêt réduit l'inflation tandis que la masse monétaire augmente l'inflation dans l'économie. De la même manière, le choc de politique macroprudentielle d'une augmentation de la base de capital réduit les crédits bancaires. En ce qui concerne l'interaction et la coordination des deux politiques, nous révélons que la politique macroprudentielle pourrait interagir avec la politique monétaire. Par conséquent, nous recommandons que la politique macroprudentielle continue à avoir un objectif politique distinct de la politique monétaire. Elle devrait avoir pour second mandat de travailler avec la politique monétaire pour stimuler la croissance de la production dans le pays.

Keywords: Monetary Policy, Macro-prudential Policy, Output Growth, VAR Model

JEL Classification: E52; E61; E23; C22

1. Introduction

Before the 2008/2009 global financial crisis, policymakers focused on achieving price stability objectives without aiming at achieving financial stability. However, the aftermath of the financial crisis revealed that financial instability can hurt output growth and the economy's growth. For instance, financial instability with an increase in interest rate will lead to a decline in money supply, which will, in turn, increase the moral hazard

and problems in financial markets (affects borrower's ability due to high interest rate) and causes a further contraction in economic activity (see Smets, 2018). Because of this problem, central banks were pressed to re-examine their objectives in the use of monetary policy and additionally or simultaneously pursue a macro-prudential policy to achieve financial stability and stimulate output growth. The main issue in this approach is how to ensure the additional or simultaneous use and interaction of the two policies in achieving price stability and financial stability without harming output growth and economic activity in the country.

It is important to note that although macro-prudential policy seems to be relatively new, many emerging countries like South Africa have embraced it by establishing more dedicated decision-making frameworks (IMF-FSB-BIS, 2016), appointing a prudential authority to oversee the conduct of macro-prudential policy (SARB, 2024) and introduced a framework for using a countercyclical capital buffer to prevent the build-up of systemic risks and mitigate the real costs of the financial crisis.

According to Kahou and Lehar (2017), macro-prudential policy refers to prudential tools for curbing the build-up of asset price bubbles, preventing financial vulnerabilities, and safeguarding the financial system, while on the other hand, monetary policy involves the use of monetary policy tools to achieve price stability and sustainable economic growth (Chugunov et al., 2021). Given the framework or an economy where the policies target both the price and financial stability objectives, this study, therefore, seeks to examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. As a significant contribution to the field of research, this study seeks to shed light on how these policies interact, how they ought to be best combined or coordinated, and their impacts on output growth in the country. To the best of the researchers' knowledge, no study has been done in this area in South Africa, especially in determining the effects of macro-prudential policy shocks on output growth in the country.

Unlike monetary policy, which has a wide range of economic impacts of stabilising prices and output growth, the macro-prudential policy specifically targets the financial sector to achieve financial stability (Ntwaepelo, 2021). This means that macro-prudential policy seeks to maintain the financial sector's resilience to economic shocks and ensures that banks perform their lending function optimally. However, both

policies interact to contribute to the growth of the economy (Lima et al., 2024). Given these policy interactions, especially the use of macro-prudential policy tools to complement monetary policy with the overall objectives of achieving output growth through price stability and financial stability, there has been a growing debate on the simultaneous use of both policies. The debate revolves around the interactions and coordination strategies since monetary policy shocks (changes in interest rate) affect the cost of credit and, subsequently, the demand for credit (affects the lending power of banks). In the same way, the effect of macro-prudential policy instruments on financial stability may affect other segments of the economy, such as inflation and output growth. Hence, this imposes many challenges for policymakers in the country to effectively implement and coordinate macro-prudential and monetary policies to achieve an appropriate policy mix.

Despite the increasing literature in this research area globally, there is still no consensus about the macroeconomic effects of the two policies (effects not well understood), especially in South Africa and other emerging market economies where research has been limited. Against this background, we decided to carry out this study to unravel the effects of both policies on the growth of output in the country and contribute to the body of literature and the IMF's agenda on an integrated policy framework (see IMF, 2020). To the best of our knowledge, this is the first study that seeks to establish these effects in South Africa.

Following this introduction, the rest of the paper is organized into five sections. Section 2 briefly overviews South Africa's economy and policy plans. A discussion of the various divergent empirical and theoretical literature on how the monetary policy and macro-prudential policy affect economic activity is presented in Section 3, followed by an outline of the methodology used to examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in the country in Section 4. Section 5 is a discussion of the study results. A summary and conclusion conclude the paper in Section 6.

2. An Overview of South Africa's Economy and Policy Plans

The South African economy is open to industrialization in achieving output growth and development; the government's transformation agenda is thus achievable if policies are well coordinated and implemented.

Guided by the National Industrial Policy Framework (NIPF) adopted in 2007 by the Cabinet, the industrial policy for output growth and development was set out in the Industrial Policy Action Plan (IPAP 1) to generate a new industrialization path, increase total output production, promote a labour-absorbing industrial sector and intensify the sector's contribution to ensuring that South Africa becomes a knowledge economy. As revealed by Mbatha (2018), The IPAP 2 for 2010/11 – 2012/13 was adopted in 2010. It set out critical interventions over a three-year rolling period, updated annually, with a 10-year outlook for desired output growth and economic outcomes (Molekwa, 2018).

The government's (policymakers including the monetary authorities) contribution to output growth and job creation has been to develop a policy package to facilitate employment and promote an environment for private sector growth and investment to stimulate output. The government also directly contributes through public-sector hiring and targeted job-creation programs. The New Growth Path (NGP) launched by the Ministry of Economic Development in November 2010 aims to stimulate output growth, create 5 million jobs over 10 years, and broaden the market for South African goods and services. The following sector targets for output growth and job drivers are identified in this document:

- Infrastructure development and housing – 250 000 jobs a year by 2015;
- Agriculture and agro-processing – 500 000 jobs per year by 2020;
- Mining – 140 000 jobs per year by 2020;
- Manufacturing (IPAP) – 350 000 jobs per year by 2020;
- Tourism – 225 000 jobs per year by 2020;
- “Green economy,” “knowledge economy,” and “social economy” – 660 000 jobs per year by 2020;
- Health, education, and policing – 100,000 jobs per year by 2020;
- Regional integration – 150,000 jobs per year by 2020.

Furthermore, the IPAP 3 was launched to contribute to output growth through industrial development in Africa, focusing on infrastructure, productive capacity, and regional integration (Mosehla, 2019 and; Moyo, 2020). It is informed by the long-term vision of the National Development Plan (NDP) and complemented by a key pillar of the programs set out in a series of ‘drivers’ and ‘packages’ in the NGP. Government policies set out in the IPAP and other documents include:

- diversify the economy: provide strong support for value-added output growth in the manufacturing sector;
- Promote a labour-absorbing industrialization path with systematic output growth and employment-creating linkages;
- An industrialization model focused on the inclusion of historically disadvantaged people and regions;
- Contribute to industrial development in Africa, focusing on infrastructure, output productive capacity and regional integration;
- Long-term intensification of South Africa's industrialization process and movement towards a knowledge-based economy.

Given the various policy measures and plans toward achieving output growth and industrialized the country, South Africa's industrial output production, as reported by Statistics South Africa, averaged 1.7% growth in May 2013, after reaching an all-time high of 10.4% in May 2002, and a record low of -23.2% in April 2009 due to the global recession. The data averaged 2.6% between 2014 and 2019 and reached an all-time high of 104% in April 2021 after a record low of -53.6% in April 2020 due to the COVID-19 pandemic (CEIC Data, 2023). Given this, there is a need for comprehensive and strategic policy implementation and coordination to overcome the challenges of the simultaneous use of monetary and macro-prudential policies. According to Kim et al. (2019) and Borio et al. (2023), "combining both policies is more effective in enhancing the overall economic stability, especially when there are financial shocks in the economy."

3. Literature Review

3.1 Empirical Literature

Several studies, like Lamers et al. (2019) and Fouejieu et al. (2019) have emphasised that there is a trade-off between price stability and financial stability. The trade-off occurs because reducing inflation (price stability) requires an increase in interest rate (contractionary monetary policy), which increases the cost of borrowing and results in financial imbalances. Kim and Mehrotra (2017) revealed that an increase in the interest rate to achieve price stability might affect an individual's or entrepreneur's risk-taking attitude, thereby reducing their optimistic economic expectations of the future and, thus, causing financial imbalances. In the same way, a contractionary macro-prudential policy may increase the cost of credit

and limit its growth below desirable levels, generating macroeconomic instabilities (Ozkan and Unsal, 2014). This means a tighter macro-prudential policy can cause agents to postpone spending due to the high cost of borrowing and discourage aggregate demand (Aikman et al., 2019), which may lead to deflationary pressures.

Given the trade-off between both policies, there are three main divergent views on the link between monetary and macro-prudential policies in the economy: first, both monetary and macro-prudential policies are countercyclical tools aimed at preventing systematic risks, with monetary policy mainly focused on price and output stability and macro-prudential policy focused on financial stability (Glocker and Towbin, 2012; Agenor and da Silva, 2019). Empirical studies conducted by Wright (2015) and Ozkan and Unsal (2014) back up this view among others.

The second view suggests that monetary and macro-prudential policies are substitutes instead of complements. For example, Cecchetti and Kohler (2012) developed a macroeconomic model showing that economic and macro-prudential policies can achieve price and financial stability. According to these authors, by delivering price stability, monetary policy directly reduces financial volatility. Similarly, when capital adequacy requirements reduce financial vulnerabilities, they inevitably deliver macroeconomic stability. This is in line with the study conducted by Aikman et al. (2019), which found that these two policy instruments operate similarly. Hence, monetary and macro-prudential policies are substitutes.

The third view submits that a relationship does not exist between monetary and macro-prudential policies. For instance, Svensson (2018) argues that monetary policy should never respond to financial threats; and macro-prudential policy should never respond to price stability. Moreover, separate entities should conduct these policies and not be coordinated. According to Svensson, this is because monetary policy cannot achieve both price and financial stability. Given these divergent views, knowledge of how monetary and macro-prudential policies affect the objective of the other and the effects on output growth is necessary to stimulate the growth of the country's economy.

While looking at the side effects of the interaction between monetary and macro-prudential policies on output, Nier and Kang (2016) reveal that a tightening of policy tools could have dampening “side effects” on output.

Although the study showed that the effects of macro-prudential policies depend on the tool considered as adjustable loan-to-value (LTV) ratios do affect the composition of both output and overall output growth, capital requirement and reserve requirement are not statistically significant, suggesting no effects on output. On the other hand, Kim and Mehrotra (2022), in their study, reveal that a contractionary macro-prudential shock leads to a decline in output (real GDP), price level, and credit, similar to the monetary policy shock. This means that the relative responses of credit and real GDP, as well as credit and the price level, are not significantly different for the monetary policy and the macro-prudential policy shock. Thus, there is no significant difference in the relative effectiveness of the two policies in stabilising output and prices.

Kim and Mehrotra (2017) also reveal that complementary use of monetary and macro-prudential policies could create challenges for policymakers, especially during times when low inflation coincides with buoyant credit growth. This is because the effects of monetary policy and macro-prudential policy shocks are closely related. For instance, the policy authority may face a dilemma when using one instrument or both instruments in the same direction, which would only stabilise one target variable, while using both in opposite directions would possibly result in the two instruments working at cross-purposes.

While investigating the three alternative institutional arrangements on the simultaneous use of monetary and macro-prudential policies, Agenor and Flamini (2016) talk about the goal-distinct mandate – whereby monetary policy is only concerned with output and price stability, and macro-prudential policy is only concerned with financial stability. In this arrangement, there is no coordination between monetary and macro-prudential authorities, and separate institutions conduct monetary and macro-prudential policies. However, the study concluded that monetary and macro-prudential policies can be used simultaneously.

In contrast, Stein (2013) posits that monetary policy can affect all corners of the economy, including the financial sector, implying that monetary policy can target both price stability and financial stability. Hence, it does not see the need for macro-prudential policy since raising the interest rates in response to inflationary pressures will result in both lower inflation and, at the same time, discourage the growth of credit. Given all these different opinions in the body of literature, there is a need to carry out a study to

examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. To the best of our knowledge, no study seeks to establish these effects in South Africa.

3.2 Theoretical Literature

This study is rooted in the McKinnon and Shaw Hypothesis Theory due to its optimum rule that best fits the economic or financial liberalization and policy formulation strategy adopted by the policymakers. According to the theory, improved economic/output growth can be achieved through financial sector reforms and other policy actions taken by policymakers. As revealed by the theory, financial repression hinders financial deepening and, thus, adversely affects economic/output growth. McKinnon and Shaw (1973) contend that financial repression using interest rate ceilings (monetary policy), high reserve requirements (macro-prudential policy), credit, exchange rate, and control on the source of finance of banking institutions will have a dampening effect on the economy.

Keynesian theory is of the view that low interest rates would stimulate investment spending and economic/output growth. Nevertheless, McKinnon and Shaw (1973), who provide a rationale for liberalization to promote financial development and hence economic/output growth, opposed this. McKinnon and Shaw (1973) further reveal that the cost of capital does not constrain investment in financially repressed economies; instead, it is the availability of finance. This theory is of the view that economic organizations or entities are self-financed and that money is fiat money issued by the public sector. It further reveals that most developing countries have fragmented economic conditions (due to various international trade restrictions) and inefficient financial systems, hence needing good policy formulation, implementation, and coordination. McKinnon (1973), therefore, put forward that complementarity exists between policies (in this case, monetary and macro-prudential policies) to stimulate demand and investment (output growth).

Shaw (1973) believes that as the amount of money stock relative to economic activity increases, the level of intermediation between savers and investors through the financial system becomes greater. At this point, it is debated that a higher interest rate is needed to attract savings. He further notes that increasing interest rates would improve the quality of investments undertaken. With an increase in interest rates, previously

unfunded or underfunded projects with high economic returns will be funded by banks because they enjoy economies of scale in collecting and processing information of the borrowers.

In conclusion, McKinnon and Shaw (1973) advocate for financial liberalization and well-coordinated policies. Liberalizing financial markets in a well-coordinated manner allows financial deepening by encouraging savings in the form of various financial assets, reducing constraints on capital accumulation, and improving allocative efficiency since investors are now undertaking projects with higher expected rates of return. Financial deepening reflects an increasing use of financial intermediation by savers and investors and monetization of the economy. It allows an efficient flow of resources among people and institutions over time.

4. Methodology

4.1. Data Description and Data Sources

We base our analysis on quarterly data from 2008Q1 - 2023Q4 to examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in the country. The starting date corresponds to the period of the 2008/2009 global financial crisis, while the cut-off date is dictated by data availability and an attempt to stay current. The data used in this paper is sourced from various sources such as Statistics South Africa (Stat. SA), Quantec Database, South African Reserve Bank (SARB), the World Bank's World Development Indicators (WDI), IMF's International Financial Statistics (IFS) and the Federal Reserve Bank of St. Louis. The variables employed for the analysis are output variables (proxied by Real GDP growth rate), monetary policy variables (interest rate and money supply), macro-prudential variables (counter-cyclical capital buffer and capital requirements), and target variables (inflation and credit). All these variables are rooted in past empirical studies like Madya (2018), Machirinani et al. (2020), Ntwaepelo (2021), and Nyati et al. (2023), among others.

4.2. Definition and Description of Variables

- The output variable: the real GDP growth rate, which reflects the inflation-adjusted value of goods and services, is employed in this study to capture output growth in the country. This is in line with

Ntwaepelo (2021), who studied the effects of macro-prudential and monetary policy shocks in BRICS countries. Given that the GDP measures the final goods and services produced in a specific period by a country, it is employed to proxy output growth in the country.

- Monetary policy variables: monetary policy involves the use of interest rate (IN) and money supply (MS) by the monetary authority to achieve broader objectives of price stability and output growth (high employment). These variables are rooted in Effiong and Okon (2020) and Ntwaepelo (2021), who carried out a study to investigate the effectiveness of monetary policy in stimulating real sector output in Nigeria.
- Macro-prudential variables: as defined by Kahou and Lehar (2017), macro-prudential policy involves using prudential tools to curb the build-up of asset price bubbles, prevent financial vulnerabilities, and keep the financial system stable. Following Ntwaepelo (2021) and Makrelov et al. (2023), the actual counter-cyclical capital buffers (CCB) provided by the South African Prudential Authority and capital requirements (CR) are employed in this study as a macro-prudential tool used by policymakers to prevent system-wide risk that can build up within a financial system.
- Target variables: the target variables are inflation (INF) and credit (C). Using the monetary policy, the monetary authority aimed at targeting the price level to keep inflation in check (price stability) and achieve output growth, while bank credit is usually the immediate target of macro-prudential policy to achieve a stable financial system (Basu, 2015). Ntwaepelo (2021) also reveals that while monetary policy targets price stability and output growth to achieve its objective, macro-prudential primarily targets credit to achieve financial stability. Both policies are based on the stable relationship between money, output, and prices.

4.3 Empirical Model

4.3.1 Model Specification

Borrowing from the theoretical framework and the empirical studies of Kim and Mehrotra (2017), Machirinani et al. (2020), and Ntwaepelo (2021), this study employs a Vector Autoregression (VAR) model to examine the macroeconomic effects of monetary and macro-prudential

policy shocks on output growth in South Africa. The choice of the VAR model over other methods is because it can accommodate both stationary and non-stationary variables and does not require pre-filtering (Taylor and McNabb, 2007). The model is suitable for dynamic impact analysis with the ability to capture the intertwined nature of time series data (Zivot and Wang, 2006). Additionally, the model is flexible and does not require identification restrictions for Structural Vector Autoregression (SVAR) and other models (Elbourne and de Haan, 2009). Finally, it can accommodate up to six and seven variables without running out of a degree of freedom due to its systematic and flexible approach to capturing complex real-world behaviour (see Giordano et al., 2007 and George et al., 2008 Hill et al. (2017) reveal that several studies have used VAR model to test for the interaction between a set of variables since it can be employed to study multivariate time series data and also account for dynamic properties and interactions among variables.

Given the above advantages of using the VAR model, suppose South Africa's economy can be represented in the following relationship model:

$$\Phi Y_t = \alpha_o + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + B \varepsilon_t \quad (1)$$

where Φ is a $(k \times k)$ matrix describing the contemporaneous relationship among the variables; Y_t is a $(k \times 1)$ Vector of endogenous variables that range from $Y_{t-1}, Y_{t-2}, \dots, Y_{t-p}$. α_o is a $(k \times 1)$ vector of constant variables; A_1 to A_p are $(k \times k)$ coefficients of lagged endogenous variables; B is a $(k \times k)$ matrix whose non-zero off-diagonal elements allow for the direct effects of some shocks on more than one endogenous variable in the system and ε_t is the error terms or structural disturbances in the model.

The VAR in equation (1) cannot be estimated because it is a long-form VAR, and there is a contemporaneous feedback inherent in it (Enders, 2004). In addition, since the endogenous variables are allowed to affect each other in the current and past realisation time path of ΦY_t , This makes it impossible to estimate the equation. Nevertheless, the VAR can be transformed from its long form into a reduced-form equation (see Ngalawa and Viegi, 2011). To transform the equation, we pre-multiplying it (equation 1) by an inverse of the matrix Φ which gives:

$$Y_t = \emptyset^{-1} \alpha_o + \emptyset^{-1} A_1 Y_{t-1} + \emptyset^{-1} A_2 Y_{t-2} + \dots \emptyset^{-1} A_p Y_{t-p} + \emptyset^{-1} B \varepsilon_t \quad (2)$$

One can denote $\emptyset^{-1} \alpha_o = \beta_o$, $\emptyset^{-1} A_i = \beta_i$ for $i = 1 \dots \dots p$ and $\emptyset^{-1} B \varepsilon_t = \mu_t$.

Therefore, equation (2) becomes:

$$Y_t = \beta_o + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots \dots \dots + \beta_p Y_{t-p} + \mu_t \quad (3)$$

As revealed by Ngalawa and Viegi (2011), equation (3) is a reduced form VAR or a VAR in a standard form that can now be estimated because there is no contemporaneous feedback inherent in it (no variable has a direct contemporaneous (immediate) effect on another in the model) and all the right-hand side variables are predetermined at time t . In addition, the vector error term (μ_t) is a composite of shocks in Y_t (Enders, 2004). Equation (3) can further be simplified and rewritten as:

$$Y_t = G(L)Y_t + \mu_t \quad (4)$$

Where Y_t is a vector of the South African endogenous variables used in the study (see section 4.2); $G(L)$ is a matrix polynomial lag that captures the relationship between the endogenous variables. $\mu_t = \emptyset^{-1} B \varepsilon_t$ is a vector of random disturbances.

4.3.2 The Identification of the Recursive VAR Scheme

Following Cheng (2006), this study employs the Cholesky factorization scheme with the ordering of variables given by equation (4) and shown in equations (5). GDP is ordered first because it is the most endogenous variable in the VAR model. The ordering and position of the other variables are shown in the matrixes equation 5. Theoretically, this amounts to estimating the reduced form VAR and then computing the Cholesky factorization of the reduced form VAR covariance matrix as given by Cheng (2006).

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 & 0 & 0 & 0 \\ f_{41} & f_{42} & f_{43} & 1 & 0 & 0 & 0 \\ f_{51} & f_{52} & f_{53} & f_{54} & 1 & 0 & 0 \\ f_{61} & f_{62} & f_{63} & f_{64} & f_{65} & 1 & 0 \\ f_{71} & f_{72} & f_{73} & f_{74} & f_{75} & f_{76} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{GDP} \\ \mu_t^{INF} \\ \mu_t^C \\ \mu_t^{CCB} \\ \mu_t^{CR} \\ \mu_t^{MS} \\ \mu_t^{IN} \end{bmatrix} = \begin{bmatrix} b_1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_7 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{GDP} \\ \varepsilon_t^{INF} \\ \varepsilon_t^C \\ \varepsilon_t^{CCB} \\ \varepsilon_t^{CR} \\ \varepsilon_t^{MS} \\ \varepsilon_t^{IN} \end{bmatrix} \quad (5)$$

Therefore, the relationship between the reduced-form errors and the structural disturbances is given by the following scheme in Equation 5 above.

The way variables affect each other in the model is based on economic theory and also depends on their position in the identification scheme. The non-zero coefficients (f_{kj} , which is captured by $f_{21} - f_{76}$) in the matrices indicate that variable j effects variable k instantaneously while the zeros (0) represent sluggish responses. For example, row 1 measures the GDP. The GDP is ordered first because it is the most endogenous variable in the VAR model (see Cheng, 2006, Naraya et al., 2008 and Tiwari, 2011). The second and third rows represent the target variables (inflation and credit). The fourth and fifth rows characterize the macro-prudential tools (counter-cyclical capital buffer and capital requirements), while money supply and interest rate are the monetary policy tools that are captured in the sixth and seventh rows.

Intuitively, it assumes that inflation has a sluggish effect on output (GDP), credit (C) has a sluggish effect on inflation and GDP, and counter-cyclical capital buffer (CCB) has a sluggish effect on GDP, inflation, and credit. In addition, capital requirements (CR) have a sluggish effect on GDP, inflation, credit and counter-cyclical capital buffer. Money supply (MS) has a sluggish effect on GDP, inflation, credit, counter-cyclical capital buffer, and capital requirement, while interest rate (IN) has a sluggish effect on GDP, inflation, credit, counter-cyclical capital buffer, capital requirement, and money supply. “Technically, this amounts to estimating the reduced form, then computing the Cholesky factorization of the reduced form VAR covariance matrix” (Cheng, 2006:12).

4.4 Robustness Checks

4.4.1 Unit Root Test

To carry out an effective estimation and efficient analysis, a robustness check is conducted on the VAR model to ensure the stationarity of the dataset. The essence of this is to help the study prevent spurious results. To achieve this, this study follows Nwakanma and Ibe (2014) and Cheng et al. (2014) to conduct a unit root test on the dataset. The robust version of Phillips Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests are employed to ensure consistency and obtain valid results. It also

allows the study to compare the results of the two unit root tests and ensure the efficiency and stability of the model.

4.4.2 Analytical Tests

To further enhance the robustness and reliability of the model, serial correlation, heteroscedasticity, and normality tests are carried out on the VAR model. These three tests are conducted to ensure that the model is consistent, reliable and favourable (i.e., free from serial correlation, heteroscedasticity, and non-normality of the residuals) in examining the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. The benchmark null hypotheses that are tested for the serial correlation, heteroscedasticity, and normality tests are:

- $H0: \alpha = 1$, there is no serial correlation or heteroscedasticity, and the residuals are normally distributed.
- $H1: \alpha \neq 1$, there is a serial correlation, heteroscedasticity, and non-normality of residuals.

4.4.3 Stability Test

To investigate the stability or instability of the VAR model (given that the sample period included the global recession and COVID-19 periods), the study employs the Cusum test to estimate the coefficients in the model. The benchmark hypothesis observed for the study is whether the VAR model is stable over the sample period without structural breaks. Following Leipholz (2013) and Bose et al. (2017), the study employs the roots of the characteristic polynomial of the coefficient matrix A , as in the example in equation 4, using the cusum test graphical approach.

5 Empirical Study Results and Analysis

5.1 The Unit Root Test Result

Based on the result derived from the Phillips Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests, Table 1 shows that at a 5% significant level, all the variables in the model were not stationary in levels ($I(0)$), but after first differencing ($I(1)$).

Table 1: Unit Roots Test Results on the Model Variables

Variable	Philip's Peron (P-P)			Augmented Dickey-Fuller (ADF)		
	Order of integration	t-Statistics	P-Value	Order of integration	t-Statistics	P-Value
GDP	I(1)	-3.9442	0.0419	I(1)	-4.4491	0.0000
INF	I(1)	-2.3602	0.0277	I(1)	-8.3036	0.0000
C	I(1)	-2.2137	0.0033	I(1)	-3.6215	0.0471
CCB	I(1)	-3.6631	0.0056	I(1)	-8.0726	0.0000
CR	I(1)	-2.0138	0.0009	I(1)	-7.4137	0.0000
MS	I(1)	-3.5731	0.0144	I(1)	-5.7351	0.0000
IN	I(1)	-2.6107	0.0475	I(1)	-6.3374	0.0000

Therefore, the main reason for ensuring the stationarity of the dataset in preventing spurious results and misleading/unreliable regression results has been achieved. This result satisfies the view of Taylor and McNabb (2007), who revealed that the VAR model can accommodate both stationary and non-stationary variables. However, there are other studies like Sims et al. (1990) and Enders (2015) that recommended against differencing even if the variables contain a unit root. According to them, "VAR analysis is to determine the interrelationships among the variables, not to determine the parameter estimates". In addition, their recommendation against differencing is to prevent the loss of information that is associated with a differenced VAR. Nevertheless, studies like Hwang (2017:583) revealed that "this differing nature may not matter much in short-horizon forecasting as first difference will improve the small-sample performance of the estimates and may eliminate all the nonstandard asymptotic theories associated with unit-root data."

5.2 Lag Length Selection

In estimating a VAR model, the selection of an optimal lag is important to prevent a lapse of time when variables respond to each other. For example, too many lags can lead to a loss of a degree of freedom, cause multicollinearity, serial correlation in error, and misspecification errors, while shortening the estimation sample too much with a small lag can

compromise the degrees of confidence (Kim and Lee, 2019). Borrowing from Coibion (2012), this study tests for various lag lengths using the five different lag selection criteria: the Akaike Information Criteria (AIC), Final Prediction Error (FPE), Sequential Modified LR test, Schwarz Information Criterion (SC) and the Hannan-Quinn information criterion (HQ). Five different lag selection criteria are used to select the best result, allow for adjustments in the model, and attain well-behaved residuals. Based on the result derived from the analysis and as shown in Table 2, the VAR model is estimated using 2-lags as chosen by the majority decision of AIC, SC, and HQ. The 2-lag optimal selection offers more accurate and robust dynamics because it prevents an unnecessary shortening or widening of the estimation sample, which would compromise the degrees of confidence. This conforms to Ngalawa and Vieg (2011), who carried out a study on the dynamic effects of monetary policy shocks in Malawi.

Table 2: Lag Length Selection

Lag	Log L	LR	FPE	AIC	SC	HQ
0	- 2894.339	NA	2.01e+35	98.31658	98.52786	98.39905
1	- 2486.762	718.4410	6.86e+29	85.72075	96.74371	86.29806
2	- 2424.843	96.55157	2.96e+29	83.23382*	87.19967*	85.56281*
3	- 2379.431	61.57630	2.37e+29	83.50098	87.58871	86.09006
4	- 2313.279	76.24263*	1.14e+29	84.52307	88.53730	86.11406
5	- 2269.398	41.65008	1.04e+29*	84.84214	88.78285	86.41055

5.3 The Presentation of the VAR Results and Analysis

To analyse the response of the economy (output growth) to the shocks from monetary and macro-prudential policies, an impulse or a shock of one standard deviation is applied. Since this study focuses on the macroeconomic effects of monetary policy and macro-prudential policy shocks on output growth, the impulse response functions of GDP (which captured output growth) to the tools of these policies are presented in Figure 1. In addition, since this study employs quarterly data, the impulse response functions are divided into periodical bases covering 3 years (as shown on the horizontal axis) in order to achieve a suitable analysis and

flexible interpretations of the response of the economy (output) to the shocks that occur through the process.

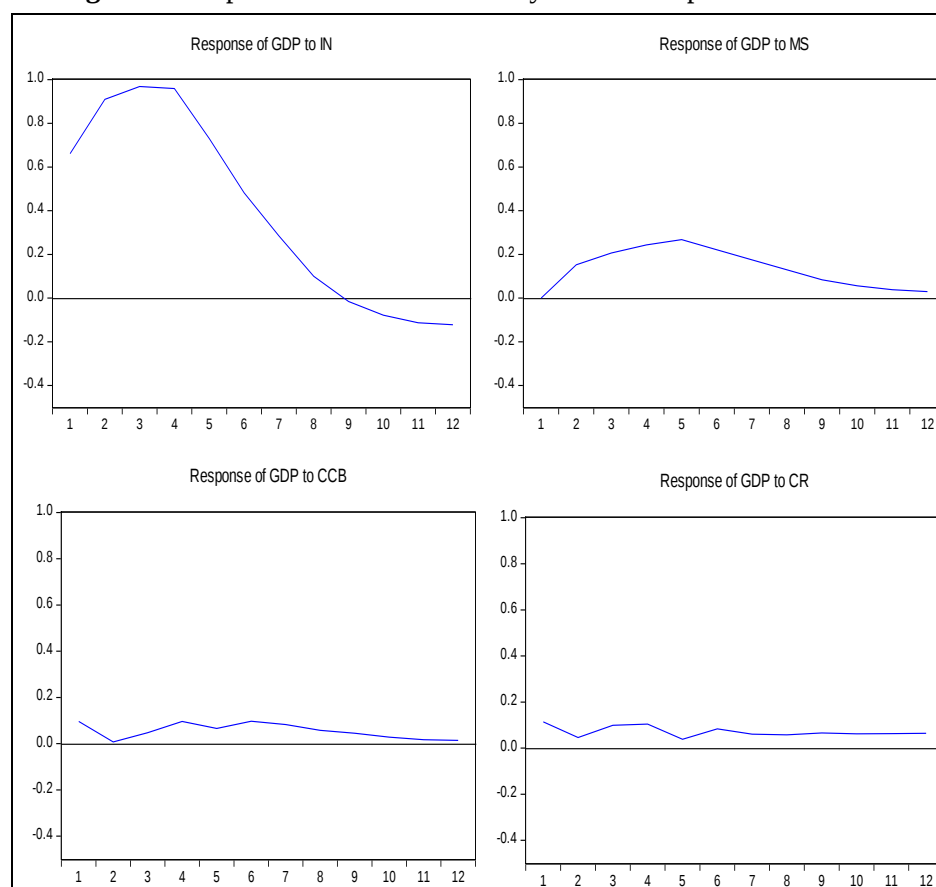
The response of GDP to monetary policy shock shows that a one standard deviation shock from interest rate negatively contracts output in the end while the money supply increases and stabilizes output growth in the long run. For example, the figure shows that GDP initially responds to an interest rate shock; it starts increasing, albeit marginally, reaching the peak in the third period and thereafter decreasing rapidly over a relatively long period and significantly contracting to a negative level for the remaining periods. The initial increase in GDP (output growth) observed is, nevertheless, surprising. A likely explanation is that following a rise in the expected rate of return (reflected by the increase in interest rates), South Africa's economy starts to attract capital inflows which trickle to the different sectors of the economy (including the industrial sector), hence, increase output production, the impact of which shows at the beginning. The persistent response (decline) that follows is consistent with the findings of Adelakun and Yousfi's (2020) and Ndou's (2023) study of monetary policy and output in South Africa. Both studies reveal that monetary policy shocks significantly explain a large portion of declines in output growth in the country.

In addition, a monetary policy shock characterized by an unexpected shock in money supply significantly causes output to initially increase and later decrease, bottoming out after eight periods. Thereafter, output remains generally constant for the entire period. This outcome may be due to the slight differences in the use of interest rates and money supply, as policymakers are always conscious or mindful of inflation when increasing the money supply in the economy. This finding conforms to Tumala et al. (2021) that expansionary monetary policy shock has a positive and stable effect on output growth. Overall, it can be inferred that monetary policy is capable of achieving the broader objective of price stability and output growth/stability in the economy. This is in line with Stein (2013), who states that monetary policy can affect all corners of the economy, including output and prices.

On the other hand, the macro-prudential policy shocks slightly and significantly affect output growth in the country. The two policy tools (counter-cyclical buffer (CCB) and capital requirements (CR)) show a slight and significant contraction or impact (when compared to monetary

policy) on output growth in the country. This might not be unconnected to the fact that banks in South Africa are well-capitalized, and an increase in the capital-based instruments does not drastically affect the performance of the banking sector; hence, they are still able to perform their function and contribute to the overall growth of the economy. This finding conforms to Mareedza (2016), Hollander and Havemann (2021), and van Heerden et al. (2022), who reveal that South Africa's banking sector is properly regulated, well-developed, well-capitalized, and supported by a good legal framework. Our finding is in line with Kim and Mehrotra (2017), who reveal that the impacts of monetary and macro-prudential policy shocks on key macro variables are similar, with both contractionary policy shocks leading to a decline in real GDP.

Figure 1: Response of GDP to Monetary and Macro-prudential Shocks



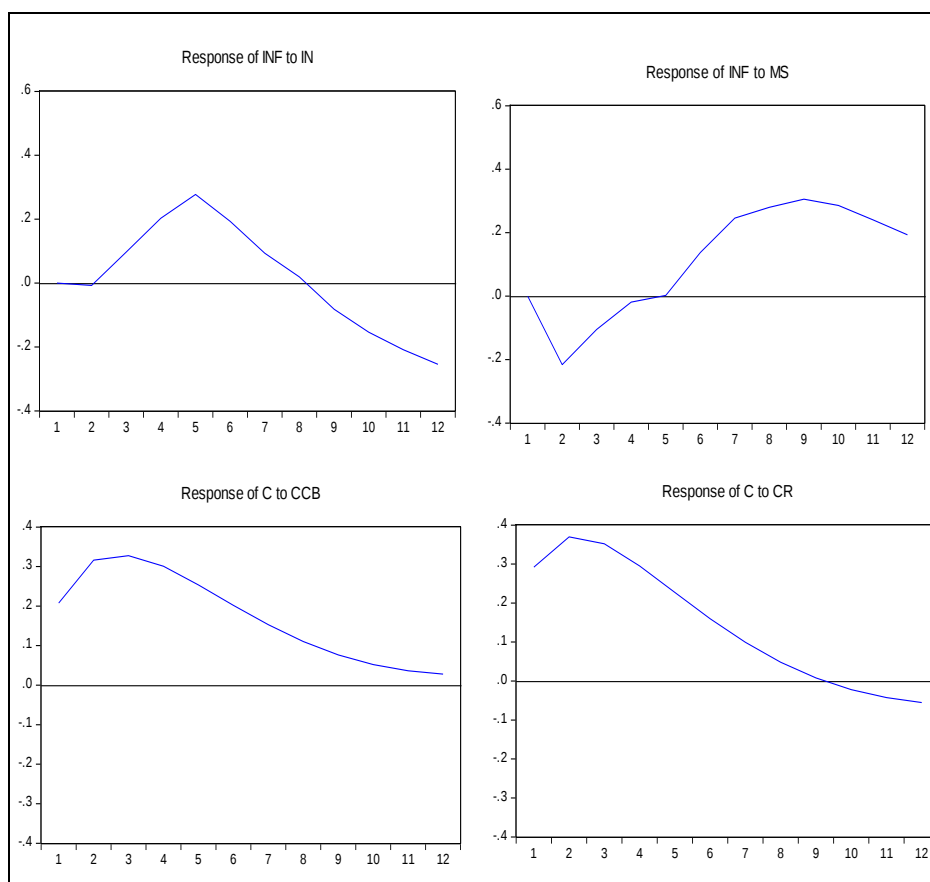
Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

Given the above findings from the macroeconomic effects of monetary and macro-prudential policy shocks on output growth, this study further investigates the effect of the policies on their primary targets. We test the view canvassed by Ntwaepelo (2021) that while monetary policy targets price stability to achieve its objective of stimulating the economy, macro-prudential policy primarily targets credit to achieve financial stability. This argument is also in line with the view expressed by Svensson (2018) that monetary policy should never respond to financial threats, and macro-prudential policy should never respond to price stability. As shown in Figure 2, an interest rate shock significantly reduces inflation, while money supply significantly increases inflation in the economy. In the same way, macro-prudential policy shocks of an increase in the capital base significantly reduce the bank credits. This shows that both the monetary policy and macro-prudential policies are strong and capable of achieving their targets. That is, monetary policy has a wide range of economic impacts of stabilising prices to achieve output growth, and macro-prudential policy has the impact of targeting the financial sector to achieve financial stability and increase the resilience of the financial system as well as supporting the monetary policy in achieving output growth through the indirect impact of credit on the economy. Therefore, we support the view of Kim and Mehrotra (2019) that the use of both policies will be more effective in enhancing the overall economic stability in South Africa.

In terms of the interaction and coordination of the two policies, it can be concluded that the macro-prudential policy could interact with the monetary policy function based on their impact on GDP (output). Although these policies pursue different objectives of financial and price stability, respectively, there is a possibility or likelihood of spillover effects as macro-prudential policy shocks were found to have a marginal but significant impact on output growth in the country. This is because; a strong and well-developed financial sector can indirectly contribute to the growth of output through the availability of credit to the investors. However, the preliminary deductions about how they should be set and coordinated are that macro-prudential policy should continue to have a distinctive policy target different from monetary policy. This is because macro-prudential policy shocks were found to strongly reduce credit, as shown in Figure 2. Therefore, making it a second mandate to work with the monetary policy will help to stimulate output growth in the economy. This means that the two policies should be conducted by SARB and not

by separate entities. Since both policies are interconnected, policymakers (monetary authorities) need to coordinate them effectively to achieve the optimal policy mix for stabilising the economy.

Figure 2: Response of the Target Variables to Monetary and Macro-prudential Shocks



Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

5.4 Robustness Checks

The results presented in Tables 3 and 4, as well as Figure 3, are the various tests conducted on the VAR model to test its consistency, reliability, and normality. While Tables 3 and 4 present the results of the test for serial correlation and heteroskedasticity, Figure 3 presents the normality test results, respectively. Based on the results derived from the analysis, the p-value results of the three tests show that the model is free from serial

correlation, heteroscedasticity, and non-normality of the residuals. Given the benchmark null hypothesis that was tested for the model at a 5% level of significance, we do not have sufficient evidence to reject the null hypothesis of no serial correlation, no heteroskedasticity in the model, and the residuals being normally distributed.

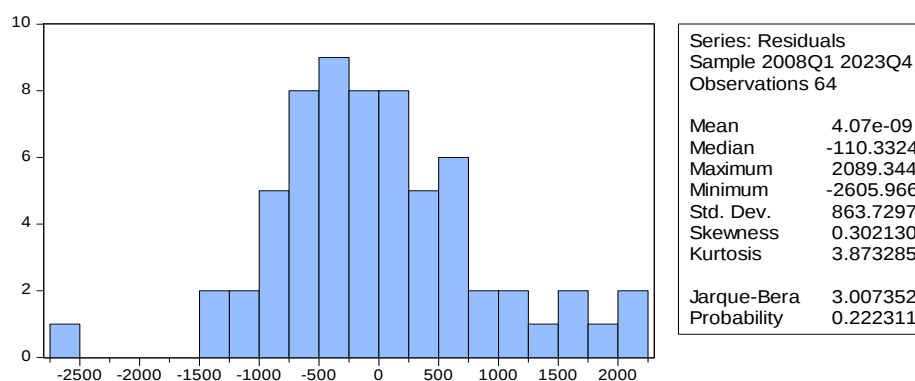
Table 3: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.015171	Prob. F(2,56)	0.3689
Obs*R-squared	2.239206	Prob. Chi-Square(2)	0.3264

Table 4: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	3.57342	Prob. F(8,84)	0.1418
Obs*R-squared	24.91137	Prob. Chi-Square(8)	0.1331
Scaled explained SS	16.71094	Prob. Chi-Square(8)	0.1571

Figure 3: Normality Test



Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

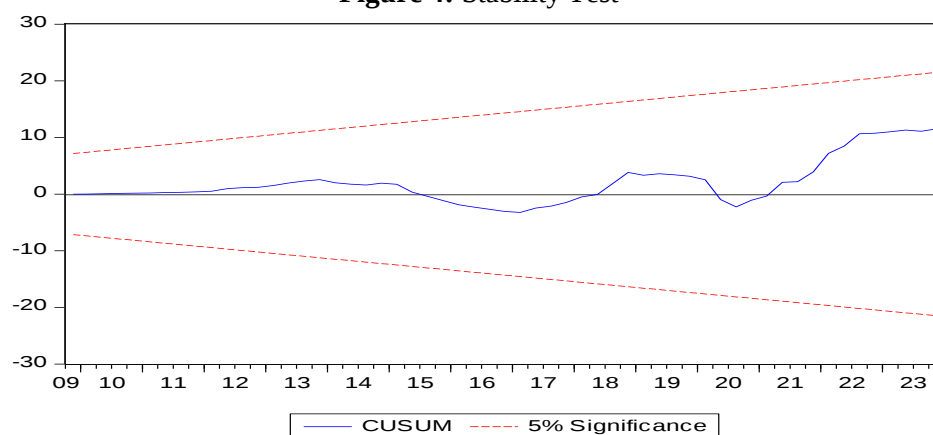
This means that the null hypothesis of no serial autocorrelation, no heteroscedasticity, and residuals are normally distributed is accepted for the Godfrey LM test, Breusch-Pagan-Godfrey test, and normality test for all lags since their p-values are greater than the significance values of 0.05 (5%). In line with Islam and Erum (2019), these results show that our

model is consistent, reliable and favourable in examining the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa.

5.5 Stability Test

Figure 4 presents the result of the stability test conducted on the VAR model. The stability test investigates the stability or instability of the estimated coefficients in the model using the roots of the characteristic polynomial of the coefficient matrix A. The Recursive Chow test suggests that the benchmark VAR model will be stable over the sample period with no structural breaks.

Figure 4: Stability Test



Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

The graphical Cusum test approach is employed for the stability test. Based on the result presented in Figure 4, since the line capturing our data passes within the 5% confidence interval, it means that our model is stable. The null hypothesis that the benchmark VAR model has no structural breaks, with sequential break dates starting from 2008 (and covering the period of COVID-19), shows that the model is stable over the time horizon. Given that the p-value is significantly higher than 5%, the null hypothesis of stability is accepted and cannot be rejected in line with Aastveit et al. (2017). The global financial crisis and COVID-19 do not constitute threats or create any structural breaks to the data. Hence, our model is stable and has no structural breaks in examining the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa.

5. Summary, Conclusion and Recommendation

This study examined the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa using a VAR model and data that span from 2008Q1 – 2023Q4.

As shown by the impulse response functions, the main findings suggest that monetary and macro-prudential policy shocks have a significant impact on output growth in South Africa. Based on the results derived from the VAR analysis, a contractionary monetary and macro-prudential shock leads to a significant decline in output (real GDP), price level, and credit, similar to the findings revealed by Kim and Mehrotra (2017) that carried out a study on the effects of monetary and macro-prudential policies in the Asia-Pacific region. The contractionary effects can be due to the impacts of macro-prudential policy on lending by banks, investors, and household borrowing (impact on total credit), with the transmission indirectly affecting the level of output. Similarly, changes in the monetary policy interest rate significantly affect prices and output growth in the country. Interest rate shock was found to negatively contract output while the money supply increases and stabilizes output growth in the long run. Consistent with several studies like Adelakun and Yousfi's (2020) and Ndou's (2023), among others, monetary policy shocks to the interest rate significantly explain a large portion of declines in output growth while money supply helps to stimulate the economy.

While pursuing their specific objective, we find that an interest rate shock significantly reduces inflation while the money supply increases inflation in the economy. In the same way, the macro-prudential policy shock of an increase in the capital-based significantly reduces the bank credits. This is evidence that monetary policy and macro-prudential policies are capable of achieving their targets of price and financial stability, respectively. A contraction of monetary and macro-prudential policy will significantly reduce growing inflation and excess credit in the economy. Hence, helps to stabilize output growth and increase the resilience of the financial system in the country.

In terms of the interaction and coordination of the two policies and as policy suggestions and recommendations from this study, we revealed that macro-prudential policy could interact with the monetary policy based on its impact on output growth. The evidence from the VAR analysis reveals that there is a likelihood for spillover effects as macro-

prudential policy shocks were found to have a significant and marginal impact on output growth in the country. As a policy suggestion/recommendation, macro-prudential policy should continue to have a distinctive policy target different from monetary policy and should be made a second mandate to work with the monetary policy to stimulate output growth in the country. This invariably suggests that both policies should be conducted by SARB and not by separate entities because each policy cannot be conducted in a vacuum due to the spillover effects of both of them on the economy. Given that monetary policy enhances the effectiveness of macro-prudential policy to achieve the financial stability objective and macro-prudential policy also enhances the effectiveness of monetary policy to achieve the price stability objective, the two policies should be pursued jointly by the policymakers to simultaneously achieve stability in both the real sector and the financial sector.

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The Role of the Health-Care Sector in Malaysia's National Economy: An Input-Output Analysis

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ABSTRACT

Driven by rising non-communicable diseases and demographic changes, Malaysia's growing health-care demand and the unprecedented challenges of the COVID-19 pandemic necessitate a greater focus on the sector. Yet, the economic impact of the sector remains underexplored. In this study, we estimate the economic importance of the health-care sector in the Malaysian economy. Utilizing Malaysia's input-output tables for 2010 and 2015, the study disaggregates health-care into private and public sectors and assesses inter-industry linkages, employment, value-added, and output multipliers. The analysis reveals that an additional MYR 1 million investment in public health contributed MYR 1.4405 million to the national economy in 2010, increasing to MYR 1.4539 million by 2015. Private health investments showed similar trends, with contributions increasing from MYR 0.9558 million to MYR 0.9693 million. The health-care sector demonstrates increasing forward linkages and positive economic effects through value-added and employment multipliers, indicating its potential to significantly contribute to Malaysia's economic growth. These insights underscore the need for policies that support health-care investment, highlighting its pivotal role in economic development.

ملخص

مدفوعًا بزيادة الأمراض غير السارية والتغيرات الديموغرافية، فإن الطلب المتزايد على الرعاية الصحية في ماليزيا والتحديات غير المسبوقة لجائحة كوفيد-19 تستلزم تركيزًا أكبر على هذا القطاع. ومع ذلك، لا يزال التأثير الاقتصادي للقطاع غير مستكشف بشكل كافٍ. في هذه الدراسة، نقدر

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الأهمية الاقتصادية لقطاع الرعاية الصحية في الاقتصاد الماليزي. باستخدام جداول المدخلات والمخرجات للماليزيا لعامي 2010 و2015، تصنف الدراسة الرعاية الصحية إلى القطاعين الخاص والعام وتقيّم الروابط بين الصناعات والتوظيف والقيمة المضافة ومضاعفات الانتاج. يكشف التحليل أن استثمارًا إضافيًا بقيمة مليون رينغيت ماليزي في الصحة العامة أسهم بمقدار 1.4405 مليون رينغيت ماليزي في الاقتصاد الوطني في عام 2010، وزاد إلى 1.4539 مليون رينغيت ماليزي بحلول عام 2015. أظهرت الاستثمارات الصحية الخاصة اتجاهات مشابهة، حيث زادت المساهمات من 0.9558 مليون رينغيت ماليزي إلى 0.9693 مليون رينغيت ماليزي. يظهر قطاع الرعاية الصحية روابط متزايدة للأمام وآثار اقتصادية إيجابية من خلال مضاعفات القيمة المضافة والتوظيف، مما يدل على إمكاناته الكبيرة في الإسهام بشكل ملحوظ في نمو الاقتصاد الماليزي. تؤكد هذه الرؤى على الحاجة إلى سياسات تدعم الاستثمار في الرعاية الصحية، وتسלט الضوء على دورها المحوري في التنمية الاقتصادية.

RÉSUMÉ

Sous l'effet de l'augmentation des maladies non transmissibles et des changements démographiques, la demande croissante de soins de santé en Malaisie et les défis sans précédent posés par la pandémie de COVID-19 nécessitent une plus grande attention à ce secteur. Pourtant, l'impact économique de ce secteur reste sous-exploré. Dans cette étude, nous estimons l'importance économique du secteur des soins de santé dans l'économie malaisienne. En utilisant les tableaux d'entrées-sorties de la Malaisie pour 2010 et 2015, l'étude décompose les soins de santé en secteurs privé et public et évalue les liens interindustriels, l'emploi, la valeur ajoutée et les multiplicateurs de production. L'analyse révèle qu'un investissement supplémentaire d'un million de MYR dans la santé publique a contribué à hauteur de 1,4405 million de MYR à l'économie nationale en 2010, pour atteindre 1,4539 million de MYR en 2015. Les investissements privés dans le secteur de la santé ont connu des tendances similaires, avec des contributions passant de 0,9558 million de MYR à 0,9693 million de MYR. Le secteur des soins de santé présente des liens croissants vers l'avant et des effets économiques positifs grâce à la valeur ajoutée et aux multiplicateurs d'emploi, ce qui indique qu'il peut contribuer de manière significative à la croissance économique de la Malaisie. Ces observations soulignent la nécessité de mettre en place des politiques qui soutiennent les investissements dans le secteur des soins de santé, en mettant en évidence son rôle essentiel dans le développement économique.

Keywords: Input-Output analysis, health-care, multipliers, Malaysia

JEL Classification: C67, I15, I18

1. Introduction

The importance of health-care to the global economy has never been greater since the coronavirus outbreak put the health-care systems under enormous strain two years ago. Global health spending had been steadily increasing even prior to the COVID-19 pandemic, reaching US\$8.5 trillion in 2019, accounting for 9.8% of global GDP (WHO,2021). As a result of the COVID-19 pandemic, health spending increased significantly in 2020, more than in prior years, culminating in the greatest growth rates in a decade¹. Consequently, health spending as a share of GDP in 17 high-income nations grew from 9.2 percent in 2019 to 10.1 percent in 2020 on average. Because of the COVID-19 pandemic, policymakers now recognise the importance of health-care systems and the consequences of their failure. Countries ought to learn from the pandemic experience and implement significant reforms, particularly in strengthening their primary health-care (World Bank, 2022).

The growing trend in health spending is transforming health-care into a significant sector in economies, creating an even stronger connection with economic growth. Due to their vast size, health-care systems are becoming major macroeconomic drivers with significant macroeconomic effects, such as on output and employment (Darvas et al., 2018). The increased spending in health-care is able to increase the economy's output through its positive impact on labour productivity as a result of improved health (Bloom et al., 2004). The health-care industry has a significant job-creation potential as well. The number of persons employed in the health-care sector increases along with their total income as a result of increasing health spending, would in turn stimulate overall spending and aggregate demand.

Like other countries, Malaysia has seen a continuous increase in health spending over the recent decades. Total expenditure on health in Malaysia ranged from RM8,550 million in 1997 to RM64,306 million in 2019, leading to more than double rises in per capita health expenditure from RM706 in 1997 to RM1,974 in 2019 (MOH,2021). In the first year of the pandemic, the total expenditure on health rose by 4.2% to RM67.02 billion and totalled 4.7% of gross domestic product. In its 12th Malaysia

¹ Based on preliminary estimates provided by 22 countries, mainly high-income economies. World Health Organization. (2021). Global expenditure on health: public spending on the rise?

Plan, the Malaysian government is committed to improving the health-care system in order to maintain a productive and healthy population in light of the potential for a COVID-19 mutation and the growing prevalence of non-communicable diseases (NCDs). The government has allocated the Health Ministry (MOH) RM32.4 billion for operations and development costs in Budget 2022, second largest after the education sector, in order to prioritise public health-care and increase national resilience in the face of COVID-19's endemic phase (MOF, 2021). These developments imply the necessity to quantify the impact of health-care sector on the development of the national economy.

To assess the impact of the health-care sector on the economic development, the interaction between the health-care sector and other economic sectors need to be examined. The most widely used model for assessing these relationships empirically is input-output (IO) analysis, which was developed by Professor Wassily Leontief in the late 1930 (Baumol, 2000). An input-output model is a set of linear equations that, taken together, represent how the output of one industry is distributed across the economy (Miller & Blair, 2022). The IO model has been used extensively globally for many years and is still useful in analysing the interdependence of industries in an economy. However, IO analysis has not been used widely in evaluating the roles of the health-care sector in national economies particularly for emerging countries like Malaysia. Studies in Korea (Kim et al., 2017) and Japan (Yamada & Imanaka, 2015) revealed that the health-care sector has a significant production-inducing effect. Additionally, for European nations, the value of income and the multiplier for value added are higher than the national average, favourably affecting economic growth (Bekő et al., 2019; Jagrič et al., 2021). In a recent study on European Union by Gutiérrez-Hernández and Abásolo-Alessón (2021), the health-care sector has lower direct backward and forward linkages implying lack of dependence from the rest of the productive structure in the region. To the best of our knowledge, the health-care sector of the Malaysian economy has not yet been the subject of an input-output framework analysis.

2. Overview of the health-care sector in Malaysia.

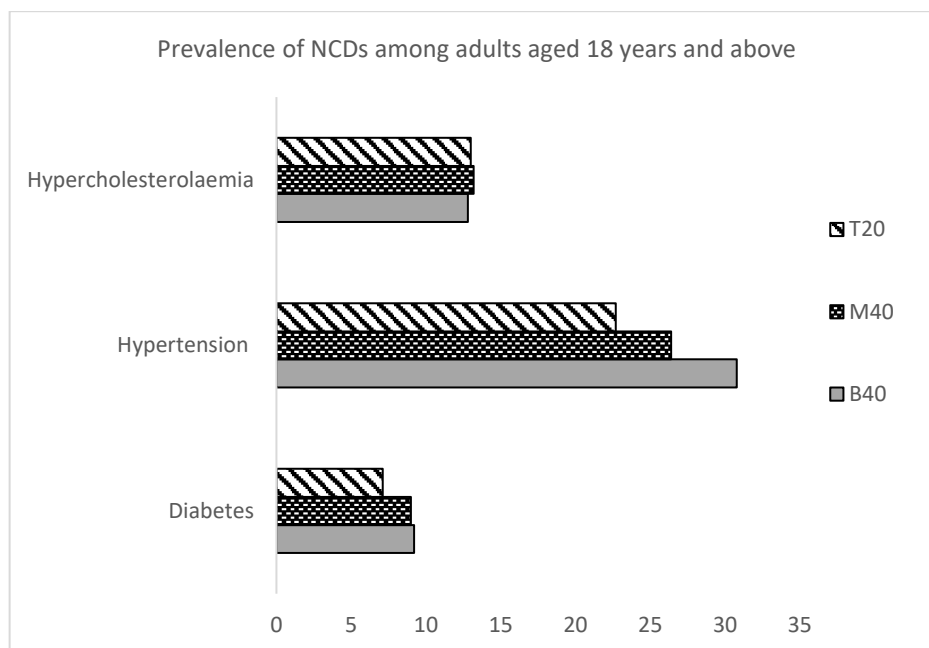
The health-care system in Malaysia operates as a dual-tiered model, comprising a government-funded public sector and a growing private

sector. The government has played a crucial role in delivering affordable and accessible health-care, particularly for the economically disadvantaged, leading to significant improvements in public health over recent decades. From 1970 to 2021, the average lifespan increased by 11.6 years for males and 12.7 years for females. Additionally, infant mortality has decreased by over 90%, from 6.4 deaths per 1,000 live births in 2019, and the maternal mortality ratio has dropped significantly, from 140.8 deaths per 100,000 live births in 1970 to 21.1 deaths per 100,000 live births in 2019—an 85% reduction. These advancements are attributed to intensive immunization and health programs, as well as improvements in child nutrition, immune system strength, and environmental conditions.

Despite these achievements, Malaysia faces escalating health expenditure driven by a surge in non-communicable diseases (NCDs) and deteriorating health conditions. Rapid urbanization, population ageing, and changes in societal behavior are significant contributors to this trend. While NCDs affect countries at all income levels, over 75% of global NCD deaths occur in low and middle-income countries. The economic loss from premature NCD deaths over the next twenty years is projected to exceed USD 30 trillion, nearly half of the global GDP in 2010 (Bloom et al., 2012).

Malaysia reflects this global trend, with NCDs accounting for 74% of total deaths, predominantly from cardiovascular diseases (WHO,2018). Alarmingly, 35% of these deaths occur among the working-age population, and more than 60% of adults aged 18 and above have at least one NCD risk factor (IPH,2015). High rates of undiagnosed NCD risk factors, especially among the B40 income group, exacerbate these issues, leading to late diagnoses and increased health-care costs. Figure 1 illustrates the prevalence of diabetes, hypertension, and hypercholesterolemia across different household income groups. The National Health Morbidity Survey 2019 highlights Malaysia's growing diabetes incidence and high prevalence of hypertension and hypercholesterolemia, raising concerns about the nation's ability to meet United Nations Sustainable Development Goal 3.4, which aims to reduce premature mortality from NCDs (IHSR,2020).

Figure 1: Prevalence of NCDs among adults aged 18 years and above



Note: The Household Income and Basic Amenities Survey conducted in 2016 by the Department of Statistics of Malaysia describes an M40 household as one with a median monthly household income of RM6,275, while the Bottom 40% (B40) households have a median monthly household income of RM3,000 and the Top 20% (T20), RM13,148

Source: National Health and Morbidity Survey (NHMS) 2019

In comparison to other regional nations, Malaysia's health indicators reflect both achievements and challenges. Health indicators in Malaysia are comparable with those of neighboring countries such as Indonesia, the Philippines, and Thailand. Table 1 provides intercountry comparisons of current health expenditure (CHE) per capita and life expectancy. In 2021, Malaysia's per capita health-care expenditure was \$487, surpassing only by Singapore, which spent \$3,970. However, Malaysia's life expectancy is lower than Thailand's and similar to Vietnam's, despite their lower health-care spending.

Table 1: Current Health Expenditure (CHE) per capita and life expectancy

Country	Life expectancy, Male (Years)	Life expectancy, Female (Years)	Life expectancy, Average (Years)	Health-care spending per capita (US dollar)
Malaysia	72.6	77.1	74.7	487.0
Singapore	81.0	85.5	83.2	3,970.0
Indonesia	69.4	73.3	71.3	160.6
Philippines	67.4	73.6	70.4	203.2
Thailand	74.4	81.0	77.7	364.4
Vietnam	69.6	78.1	73.7	172.6

Therefore, given the recent issues of rising expenditures, an ageing population, and increasing rates of NCD prevalence, Malaysia needs to reform its health-care system (Aspalter et al., 2017). The country's public health system was jolted by the COVID-19 outbreak in early 2020, prompting the government to reassess its public health-care spending. During the first year of the pandemic, the health system struggled with a lack of designated hospital beds, manpower shortages, and inadequate personal protective equipment (PPE) supplies. Additionally, a lack of psychological support at work and direct involvement in COVID-19 screening or treatment contributed to high burnout rates among health-care professionals (Roslan et al., 2021). Although the health-care system managed to control the disease's spread, minimize fatalities, and reduce risk through vaccination, there are still important lessons to be learned from COVID-19. The government is committed to implementing medium to long-term reforms in the health-care system while gradually increasing health-care spending each year.

3. Data and Methodology

3.1. Data sources

To investigate the contribution of Malaysia's health-care sector, we utilise Malaysia's Input-Output tables for 2010 and 2015, compiled by the Department of Statistics Malaysia (DOSM) every five years. The sector rankings have been adjusted based on the ranking on the 2010 and 2015 I-O table and the Standard of Industrial Classification of All Economic Activities (ISIC) 2008 revised version 4. Additionally, commodities adhere to the Malaysia Classification of Products by Activity (MCPA) 2009 aligned with the Central Product Classification (CPC) Version 2.0. The I-O tables distinguished into 125 sectors, with the health-care sector further disaggregated into public and private health. This detailed disaggregation in the 2010 and 2015 Malaysian I-O tables is crucial for our impact study. The data complies with the Malaysian Standard Industrial Classification (MSIC) 2008. This study has aggregated the I-O table into 23 sectors for straightforward analysis.

Another key data source is the Labour Force Survey for 2010 and 2015 with detailed labour market information based on educational attainment. The labour market data is disaggregated into local and foreign according to the Malaysian Standard Classification of Occupations (MASCO) 2013. Skills are classified into three types of skills, skilled or professionals, semi-skilled and low-skilled. Disaggregating the labour market data helps identify the quantity, quality and stability of employment in various sectors, particularly in health-care sector.

3.2. Methodology

Input-Output analysis focuses on the interdependencies among production sectors within an economy. The Input-Output (I-O) Table, updated every five years, provides a comprehensive view of the demand and supply for goods and services across the economy. The I-O table details the purchases made by each sector to produce their own output, including domestically produced inputs, imported commodities and factors of production such as labour and capital. The I-O analysis facilitates the allocation of economic-wide impacts along the production and supply chain to the final demand component. It stands as the primary empirical method for addressing large-scale, multi-sectoral problems.

This analysis is not only widely used by researchers and academicians globally, but also extensively employed by planning agencies in numerous countries. Notably, organisations such as the World Bank and United Nations rely on I-O analysis for planning and policy-making.

3.2.1. General framework of the I-O model

In the Input-Output table, the rows represent the demand for inputs from other sectors, while the columns represent the demand from the sectors for the outputs (Miller and Blair, 2022). Assuming an I-O table able to categorises n sectors within the economy, b_i denotes the total output for sector i ; f_i represent the total final demand for sector in sector i . The variables x_{ij} denotes the sector-between direct input coefficients matrix (from each sector i to each sector j); m_{ij} denotes the sector-between direct output coefficient matrix (from each sector i to each sector j). Additionally, a_j denotes the total output value of sector j ; and v_j denotes the added value of sector j . The key assumption is linked to the basic Leontief model, which can serve as an index to evaluate the contribution of a specific sector over a particular period. The I-O models can be expressed as follows (Wang & Wang, 2019):

$$X_i = \sum_{j=1}^n x_{ij}a_j + f_i \quad (1)$$

$$X_j = \sum_{i=1}^n m_{ij}b_i + v_j \quad (2)$$

There are no distinct health sub-sectors in Malaysia's 124 sector I-O table, which is publicly available for download. To analyse the I-O model of the health-care industry, we need to disaggregate the two major health sub-sectors from the I-O table. We have collected comprehensive statistical data for these two health sub-sectors from the Department of Statistics Malaysia. The disaggregated data, which includes the proportions of each health sub-sectors' added values in its and other affiliated sectors, is utilised to compute the I-O model analysis. The value-added multiplier, as detailed in Table 2, illustrates the multipliers for production and value added within its affiliated sector.

3.2.2. Inter-industry linkages model

A complete industrial demand and supply chain, industrial linkages can be analysed within the input-output framework. There are two kinds of interdependence measures which are the backward and forward linkages. For example, when there is an increase of demand from sector j (purchaser) on the sectors where goods are used as inputs in the production j , it's identified as backward linkages. Meanwhile, an increase in the output of sector j means additional amounts of product j are available and will increase supplies from sector j (seller), termed as forward linkages.

The index is to measure the backward linkages in equation (3) and forward linkages in equation (4) as follows (Bekő et al., 2019; Miller & Blair, 2022; Wang & Wang, 2019):

$$B_i = \left(\frac{(1/n) \sum_i l_{ij}}{(1/n^2) \sum_i \sum_j l_{ij}} \right) \quad (3)$$

$$F_i = \left(\frac{(1/n) \sum_i b_{ij}}{(1/n^2) \sum_i \sum_j b_{ij}} \right) \quad (4)$$

Where n is the number of sectors (in this study is 124 sectors), $\sum_i l_{ij}$ and $\sum_i \sum_j l_{ij}$ represent the column of sum for sector j and the sum of elements of the Leontief inverse matrix. Meanwhile, $\sum_i b_{ij}$ and $\sum_i \sum_j b_{ij}$ denotes the row sum for sector j and the elements of Ghoshian inverse matrix. If both the forward and backward linkages indices with greater than value one, the sector is considered as a key sector¹.

3.2.3. Demand-driven model

The relationship between the output, intermediate inputs and final demand are involved in the demand-driven model. The equation (5) shows that the total output of sectors is equivalent to the intermediate input and final demand.

¹ A key sector is a sector which largely dependent on other industries and plays important roles in supporting and boosting other sectors in a region (Saari, 2014).

$$x = Z_i + (c + i + g + e) = Z_i + f \quad (5)$$

Where x is the vector of gross output. Z_i is the summation vector for intermediate matrix input, f is the vector for the final demand. Meanwhile, the economy components are private consumption (c), investment (i), government (g) and exports (e).

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_{10} \end{bmatrix}, Z = \begin{bmatrix} Z_{1,1} & \dots & Z_{1,10} \\ \vdots & \ddots & \vdots \\ Z_{10,1} & \dots & Z_{10,10} \end{bmatrix}, f = \begin{bmatrix} f_1 \\ \vdots \\ f_{10} \end{bmatrix} \quad (6)$$

Indicating, Z is the matrices, x and f are the vectors as well as x, z, f as the scalar. The diagonal matrix with the elements of a vector, x on the main diagonal and other entries are equal to zero. Moreover, the summation of the vector is represented by i . Therefore, the summation of intermediate input Z is written as

$$Z_i = \begin{bmatrix} Z_1 \\ \vdots \\ Z_{10} \end{bmatrix} \quad (7)$$

As in model, assumption related to production is needed. Therefore, endogenous component in the input-output is the intermediate input meanwhile the exogenous component is the final demand. The standard input-output model is,

$$x = A_x + (c + i + g + e) = A_x + f \quad (8)$$

Where A is the input-output coefficient. Equation (8) is then transformed into (9).

$$x = (I - A)^{-1} = Lf \quad (9)$$

Where I is the identity matrix and $(I-A)^{-1}$ is known as the Leontief inverse matrix. Overall, it shows that output is obtained by multiplying the endogenous matrix of the Leontief inverse matrix with the exogenous vector of the final demand. Therefore, model (8) and (9) is the core model of input-output of the analysis of this study.

3.2.4. Decomposition of multiplier model

Since the input-output model is linear, thus this allows for a decomposition analysis. As mentioned, the Leontief inverse matrix shows the total effects of any final exogenous demand, therefore, if Leontief inverse matrix is decomposed into several effects, the effects of output, value-added and employment can be separated. To decompose the multiplier effects, the Leontief inverse matrix is expanded through a power series approximation approach (Miller & Blair, 2009) in equation (10).

$$(I - A)^{-1} = (I + A + A^2 + A^3 + \dots)f \quad (10)$$

which equals to,

$$(I - A)^{-1} = f + Af + A^2f + A^3f + \dots = f + Af + A(Af) + A(A^2f) \quad (11)$$

This interactive approach is a detailed approach of obtaining the total effects of the exogenous final demand that increases when the output increases as well, with the different sectors. Therefore, equation (10) and (11) is furthered simplified as,

$$(I - A)^{-1} = L^{-ini} + L^{-dir} + L^{-ind} \quad (12)$$

where, $L^{-ini} = I$ that gives the initial effects, $L^{-dir} = A$ is the direct effects and $L^{-ind} = A^2 + A^3 + \dots$ is the sum of all the indirect effects. The Leontief inverse matrix is decomposed into direct and indirect effects as the initial effects are equal to the final demand. Thus, the decomposition of multipliers equals to:

$$\Delta x^{-dir} = A\Delta f \quad (13)$$

$$\Delta x^{-ind} = (I - A)^{-1}\Delta F - A\Delta F \quad (14)$$

3.2.5. Employment-inducing model

The most important indicator of economic impacts determined by a change of exogenous demand leading into physical employment effects on production. Employment coefficients represent direct jobs created to produce the specific output industry. Therefore, the coefficient explores the impact of local and foreign labour employment in terms of jobs, rather than simply gross output by industries. The number of employees for n sectors as:

$$e' = [e_1 \dots, e_n] \quad (15)$$

The vector of employment coefficient is obtained between the number of employees in a specific sector and total output in the base year, as equations (16) and (17). The employment coefficient is treated in a partly similar way to output multipliers.

$$\text{Vector of employment coefficient} = \frac{\text{base year employment}, n}{n's \text{ base year output}} \quad (16)$$

$$\acute{e}_c = \left[\frac{e_1}{x_1^0} \dots \frac{e_n}{x_n^0} \right] = [e_{c1} \dots e_{cn}] \quad (17)$$

Firstly, both Leontief's inverses should be obtained and pre-multiplied by the employment coefficient. Then, $\varepsilon = \acute{e}'_c x^1 = \acute{e}'_c L f'$ denotes the total labour for each sector with new exogenous final demand.

$$\varepsilon = \begin{bmatrix} e_{c1} & 0 \\ 0 & e_{cn} \end{bmatrix} \begin{bmatrix} x_1^1 \\ x_n^1 \end{bmatrix} = \begin{bmatrix} e_{c1} & x_1^1 \\ e_{cn} & x_n^1 \end{bmatrix} \quad (18)$$

Besides, the skill-by-industry detailed by matrix, P , with P_{ij} is the proportion of sector j employment that is in skill i , then $\tilde{\varepsilon} = p\acute{\varepsilon}$ given the matrix of employment by sector and skill type.

$$P = \begin{bmatrix} P_{11} & P_{1n} \\ \vdots & \vdots \\ P_{k1} & P_{kn} \end{bmatrix} \quad \text{and,}$$

$$\tilde{\varepsilon} = P\hat{\varepsilon} = \begin{bmatrix} P11e_{c1}x_1^1 & P1ne_{cn}x_n^1 \\ \vdots & \vdots \\ Pk1e_{c1}x_1^1 & Pkne_{cn}x_n^1 \end{bmatrix} \quad (19)$$

For example, k refers to the skill group by sectors based on educational attainment. In equation (19), the column vector would categorise the total employment utilised by sectors. Meanwhile, the row vector indicates the total employment of a particular skill group across all sectors. Therefore, the $P\hat{\varepsilon}$ shows the employment by skills category, disaggregated among sectors.

The proper functioning of multipliers is achieved by 'initial effects,' which ensures multipliers to become dimensionless. Concerning the employment multiplier, initial effects are equal to 1. The purpose of the multiplier effect is to simulate the outcome of the sectors to marginally enlarging into total effects. Therefore, we investigate the impact of employment on the j -th sector. The simple employment is calculated by using the vector $\hat{h}_c$ which represents the row vector of the employment coefficient. The economic impact of new final demand is measured by jobs created and concerned with the employment multiplier. Using the labour-input coefficient in person-years per unit output is the direct approach to calculating labour dependency in each industry. The difference between the employment coefficient and the multiplier is termed the indirect effects supporting the industries.

Let, $\hat{h}$ (for households) denotes row vector.

$\hat{h} = [Z_{n+1}, 1 \dots, Z_{n+1,n}]$ measures the number of workers in each sector in the base year.

Then, $\hat{h}_c = \hat{h} \hat{x}^{-1}$ is the row coefficient refers to input household coefficients.

Therefore, $\Delta f = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ would find the output effects in the first column of $L = \begin{bmatrix} l_{11} \\ l_{21} \end{bmatrix}$.

The employment is represented by $m(h)_{ij}$ in equation (20) indicates the number of workers employed by skill i and sector j . The multipliers in the employment element in the L matrix is within the household exogenous factors. The employment multiplier measures the impact of changes in the number of employees if the demand changes.

$$L = m(h)_{ij} = \sum_{i=1}^n a_{n+1,i} l_{ij} \quad (20)$$

If the element in L as the total (direct + indirect + induced) is weighted in equation (20), the employment multiplier is obtained according to the skill group. Derived from L as parallel to $m(h)_{ij}$ in equation (21).

$$\bar{L} \approx \bar{m}(h)_{ij} = \sum_{i=1}^{n+1} a_{n+1,i} l_{ij} \quad (21)$$

Where l_{ij} measures the total (direct, indirect, induced) effect on skill i worth new demand for sector j output.

Thus, $\bar{l}_{n+1,j}$ defines the total employment needed by sectors.

The total employment multiplier is:

$$\bar{m}(h)_j = \bar{l}_{n+1,j} \quad (22)$$

4. Results and Discussion

The study provides new insights into the economic impacts of changes in health subsectors, the public and private health on national economy. The I-O analysis includes inter-industry linkages effects, production-inducing effects, employment-inducing effects and total contribution effect. The expected result and hypothesis are whether the public and private health shares the common positive economic impact and plays an important role to the overall Malaysia's national economy. Health subsectors marked differently according to the share of public and private financing of health-care services. This pattern is investigated to understand the relationship in the awareness of promoting health subsectors, particularly

in terms of their services and products' contributions to the national economy.

4.1. Inter-industry linkage effect

Table 3 reveals the inter-industry forward and backward linkage effects of the Malaysian sectors in 2010 and 2015. The average of the backward linkages of the sectors fluctuates between 0.6742 and 0.9047 compared to the forward linkages that fluctuates between 0.6271 and 0.9177. It can be seen that the overall Malaysian sectors have strong backward linkage and forward linkage. Given the health subsectors, the average of backward linkages fluctuates between 0.5939 and 0.7085. The average of forward linkages fluctuates between 0.5502 and 0.8987. Thus, it can be deduced that the health subsectors have a stronger forward linkage compared to the backward and are more essential to the Malaysian economy through health research and development. Given the health structure, public and private health have strong forward linkages as many of these subsectors belong to downstream sectors. Thus, it can be inferred that these subsectors belong to the intermediate primary input.

Table 2: Added value multiplier of sectors and subsectors of health-care sector in 2010 and 2015

No	Sector/subsector	2010	2015
1	Agriculture, forestry and fishing	0.7320	0.8892
2	Mining and quarrying	0.6414	0.7986
3	Manufacturing	0.4498	0.6070
4	Electricity, gas, steam and air conditioning supply	0.5959	0.7531
5	Water supply; sewerage, waste management and remediation activities	0.7025	0.8597
6	Construction	0.5305	0.6877
7	Wholesale and retail trade; repair of motor vehicles and motorcycles	0.6733	0.8305
8	Transportation and storage	0.6329	0.7901
9	Accommodation and food service activities	0.6630	0.8202
10	Information and communication	0.6626	0.8198
11	Financial and insurance/takaful activities	0.7164	0.8736
12	Real estate activities	0.6972	0.8544
13	Professional, scientific and technical activities	0.6733	0.8305
14	Administrative and support service activities	0.7060	0.8632
15	Public administration and defence; compulsory social security	0.6483	0.8055
16	Education	0.7376	0.8948
17	Public health	0.0472	0.2044
18	Private health	0.2561	0.4133
19	Arts, entertainment and recreation	0.0516	0.2088
20	Other service activities	0.6389	0.7961
21	Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use	0.7361	0.8933
22	Activities of extraterritorial organizations and bodies	0.6464	0.8036

Table 3: Inter-industry effects of the health-care sector

No	Sector/subsector	Backward linkage		Forward linkage		Summary
		2010	2015	2010	2015	
1	Agriculture, forestry and fishing	0.5180	0.7660	0.7689	1.0508	FL
2	Mining and quarrying	0.5507	0.7986	1.0602	1.3421	FL
3	Manufacturing	0.8062	1.0541	0.7082	0.9901	BL
4	Electricity, gas, steam and air conditioning supply	0.6765	0.9244	1.0262	1.3081	FL
5	Water supply; sewerage, waste management and remediation activities	0.7518	0.9997	1.0343	1.3162	FL
6	Construction	0.9001	1.1480	0.5167	0.7986	BL
7	Wholesale and retail trade; repair of motor vehicles and motorcycles	0.6313	0.8792	0.8518	1.1337	FL
8	Transportation and storage	0.7424	0.9903	0.8457	1.1276	FL
9	Accommodation and food service activities	0.7717	1.0196	0.4989	0.7808	BL
10	Information and communication	0.7740	1.0219	0.7304	1.0123	FL & BL
11	Financial and insurance/takaful activities	0.6302	0.8781	0.8607	1.1426	FL
12	Real estate activities	0.6202	0.8681	0.5423	0.8242	-
13	Professional, scientific and technical activities	0.6975	0.9454	0.7643	1.0462	FL
14	Administrative and support service activities	0.6502	0.8981	0.3951	0.6770	-
15	Public administration and defence; compulsory social security	0.7855	1.0334	0.3186	0.6005	BL
16	Education	0.5996	0.8475	0.3186	0.6005	-
17	Public health	0.8911	0.9390	0.9502	1.1321	FL
18	Private health	0.7606	0.8085	0.7028	0.8547	-
19	Arts, entertainment and recreation	0.7364	0.9843	0.3428	0.6247	-
20	Other service activities	0.7023	0.9502	0.5902	0.8721	-
21	Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use	0.8458	1.0937	0.2999	0.5818	BL
22	Activities of extraterritorial organizations and bodies	0.3339	0.5818	0.2999	0.5818	-

4.2. Production effect

Table 4 summarises the sectoral implications of health investment. In 2010, the overall production-inducing impact of health-care sector investments were MYR 13.58 million. Public health showed a significant impact with MYR 0.2561 million, while private health had a relatively lower impact at MYR 0.0516 million. This indicates a stronger dependency of the economy on public health investments during this period. The total production-inducing impacts of public and private health-care sector investments were calculated to be MYR 20 million in 2010, highlighting the substantial role of health-care sector investments in stimulating economic activity.

By 2015, the overall production-inducing impact increased to MYR 17.20 million, reflecting an enhanced economic response to health-care sector investments. Public health's impact rose to MYR 0.4133 million, while private health's impact increased to MYR 0.2088 million. This notable increase in both public and private health impacts suggests an overall improvement in the health-care sector's contribution to the economy. The total production-inducing impacts for 2015 were calculated to be MYR 47 million, demonstrating the growing importance of health-care sector investments in driving economic growth.

Comparing the two periods, public health consistently had a higher production-inducing impact compared to private health. In 2010, the production-inducing impact of public health was nearly five times that of private health. By 2015, although both subsectors saw growth, public health's impact remained approximately twice that of private health. This consistent trend underscores the critical role of public health investments in driving economic growth. Additionally, the percentage change in production-inducing impacts between 2010 and 2015 reveals a significant increase, highlighting the growing economic importance of both public and private health-care sectors. Supporting these results, Chakroun (2024) indicates that improved health outcomes contribute to economic growth by enhancing productivity and reducing health-care costs.

4.3. Employment-effect

Table 5 demonstrates direct and indirect employment-inducing impacts of all sectors. The result shows a significant downward trend, and it means

Table 4: Production effects of the health-care sector

No	sector	2010	2015
1	Agriculture, Forestry and Fishing	0.7320	0.8892
2	Mining and Quarrying	0.6414	0.7986
3	Manufacturing	0.4498	0.6070
4	Electricity, Gas, Steam and Air Conditioning Supply	0.5959	0.7531
5	Water Supply; Sewerage, Waste Management and Remediation Activities	0.7025	0.8597
6	Construction	0.5305	0.6877
7	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	0.6733	0.8305
8	Transportation and Storage	0.6329	0.7901
9	Accommodation and Food Service Activities	0.6630	0.8202
10	Information and Communication	0.6626	0.8198
11	Financial and Insurance/Takaful Activities	0.7164	0.8736
12	Real Estate Activities	0.6972	0.8544
13	Professional, Scientific and Technical Activities	0.6733	0.8305
14	Administrative and Support Service Activities	0.7060	0.8632
15	Public Administration and Defence; Compulsory Social Security	0.6483	0.8055
16	Education	0.7376	0.8948
17	Human Health and Social Work Activities	0.0472	0.2044
18	Public health	0.2561	0.4133
19	Private health	0.0516	0.2088
20	Arts, Entertainment and Recreation	0.6389	0.7961
21	Other Service Activities	0.7361	0.8933
22	Activities of Households as Employers; Undifferentiated Goods-And Services-Producing Activities of Households for Own Use	0.6464	0.8036
23	Activities of Extraterritorial Organizations and Bodies	0.7497	0.9069

Table 5: Employment effects of the health-care sector

No	Sector	Local labour		Foreign labour	
		2010	2015	2010	2015
1	Agriculture, Forestry and Fishing	0.5670	0.7970	0.2663	0.4963
2	Mining and Quarrying	0.6862	0.9162	0.0507	0.2807
3	Manufacturing	0.5898	0.8198	0.2080	0.4380
4	Electricity, Gas, Steam and Air Conditioning Supply	0.7525	0.9825	0.0080	0.0380
5	Water Supply; Sewerage, Waste Management and Remediation Activities	0.6840	0.9140	0.1476	0.1776
6	Construction	0.5354	0.7654	0.5415	0.7715
7	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	0.6863	0.9163	0.1741	0.4041
8	Transportation and Storage	0.7233	0.9533	0.1462	0.1762
9	Accommodation and Food Service Activities	0.6624	0.8924	0.1818	0.3118
10	Information and Communication	0.7140	0.9440	0.0607	0.1907
11	Financial and Insurance/Takaful Activities	0.5817	0.8117	0.0388	0.0688
12	Real Estate Activities	0.7550	0.9850	0.0256	0.1556
13	Professional, Scientific and Technical Activities	0.7549	0.9849	0.0592	0.0892
14	Administrative and Support Service Activities	0.6095	0.8395	0.2707	0.4007
15	Public Administration and Defence; Compulsory Social Security	0.7694	0.9994	0.0007	0.0017
16	Education	0.7580	0.9880	0.0470	0.0530
17	Human Health and Social Work Activities	0.0357	0.2657	0.0062	0.0122
18	Public health	0.5003	0.7303	0.0332	0.0392
19	Private health	0.2569	0.4869	0.0201	0.0261
20	Arts, Entertainment and Recreation	0.7277	0.9577	0.1696	0.1756
21	Other Service Activities	0.3133	0.5433	1.0168	1.0228
22	Activities of Households as Employers; Undifferentiated Goods-And Services-Producing Activities of Households for Own Use	0.7700	1.0000	0.0686	0.0746
23	Activities of Extraterritorial Organizations and Bodies	0.7678	0.9978	0.1132	0.1192

that the labour force of Malaysia's health-care sectors' development is downward trend for local labour due to high skilled employment with technology intensive. Additionally, it can be estimated that the number of local people employed in health-care sector is 277,514 people (year 2010) and 557,198 people (year 2015) correspondingly, the proportions of which 65% (high skilled), 30% (semi-skilled) and 5% (low-skilled), respectively.

Compared to the foreign labour, the number is much lesser at 2,459 people (year 2010) and 15,871 people (year 2015), the proportions of which 10% (high skilled), 60% (semi-skilled) and 30% (low-skilled), in that order. The health subsectors observed to be a significant impetus to improve employment through advanced technology and expertise, nurturing the support of sustainable development. The exact contribution and distribution of new careers across the health subsectors is not revealed, but rather evidence the growth demand and supply of total employment to grow more intensively.

4.4. Total contribution effect

Table 6 illustrates the temporal comparisons of the total contribution of health subsectors in Malaysia, highlighting their economic impacts in 2010 and 2015. Examining the contributions across sectors for each year, public health investments consistently had a higher economic impact than private health investments. In 2010, a MYR 1 million investment in public health generated MYR 1.4405 million in economic contributions, compared to MYR 0.9558 million for private health. This trend continued in 2015, with public health contributing MYR 1.4539 million versus MYR 0.9693 million for private health per MYR 1 million invested. These figures demonstrate the substantial role of public health investments in driving economic growth each year.

Gupta and Mitra (2004) suggested that improved health outcomes contribute to economic growth by enhancing productivity and reducing health-care costs. Furthermore, a review by Pintor et al. (2024) found that healthier populations tend to have higher labour market participation and greater economic output. These findings align with our results, emphasizing the importance of health-care sector investments in driving economic development. This study suggests that strategic investments in public and private health-care services and products can serve as effective

economic policy tools to stimulate growth, especially during economic downturns. Enhanced spending on health-care not only improves public health outcomes but also supports economic resilience by fostering a healthier, more productive workforce.

Table 6: Total contribution effects of Malaysia's health subsectors

No	sector	2010	2015
1	Agriculture, Forestry and Fishing	1.3641	1.3775
2	Mining and Quarrying	1.7445	1.7580
3	Manufacturing	1.8822	1.8956
4	Electricity, Gas, Steam and Air Conditioning Supply	1.6489	1.6623
5	Water Supply; Sewerage, Waste Management and Remediation Activities	1.7844	1.7978
6	Construction	2.0511	2.0645
7	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	1.5677	1.5812
8	Transportation and Storage	1.8628	1.8763
9	Accommodation and Food Service Activities	1.6436	1.6570
10	Information and Communication	1.8212	1.8346
11	Financial and Insurance/Takaful Activities	1.5657	1.5791
12	Real Estate Activities	1.5478	1.5612
13	Professional, Scientific and Technical Activities	1.6867	1.7001
14	Administrative and Support Service Activities	1.6017	1.6151
15	Public Administration and Defence; Compulsory Social Security	1.6622	1.6757
16	Education	1.5107	1.5241
17	Human Health and Social Work Activities	0.4712	0.4846
18	Public health	1.4405	1.4539
19	Private health	0.9558	0.9693
20	Arts, Entertainment and Recreation	1.7566	1.7700
21	Other Service Activities	1.6953	1.7088
22	Activities of Households as Employers; Undifferentiated Goods-And Services-Producing Activities of Households for Own Use	1.9533	1.9668
23	Activities of Extraterritorial Organizations and Bodies	1.4796	1.4930

5. Conclusion

The importance of the health-care sector has become more prominent since the onset of COVID-19. It is now gradually becoming a crucial sector that contributes to economic growth by extending life expectancy and enhancing the quality of life. Healthier individuals can work longer and contribute to the economy for a more extended period. To evaluate the importance of the health-care sector in Malaysia's national economy, this study disaggregated the health-care sector into private and public health-care and analysed Malaysia's input-output tables for 2010 and 2015 to determine the production and employment inducing effect as well as the inter-industry linkage effect. Due to its nature of disaggregated data, this study is able to distinguish between public and private health financing schemes. As a result, the findings are able to illustrate how increased expenditure on health-care goods and services from different sources has an impact on national economies.

Public health consistently had a higher production-inducing impact than private health, with a significant increase between 2010 and 2015. This highlights the critical role of public health investments in driving economic growth, as improved health outcomes enhance productivity and reduce health-care costs. With regards to the inter-industry linkage, the findings show that both the health subsectors are more essential to the Malaysian economy through health research and development with a greater forward linkage than backward. Our study strongly suggests that increased expenditure on health-care in both the public and private sectors should be prioritised. As Malaysia faces an increasing trend for all NCD risk factors, the government must assure effective health-care investment and better access to high-quality health-care. This could greatly boost economic productivity by cultivating a workforce that is healthier and more productive (Bloom et al., 2004). In addition, the health subsectors were found to provide a substantial stimulus for improving employment through improved technology and expertise, hence fostering support for sustainable development.

In conclusion, our results offer useful insights and economic grounds for future decisions on raising the spending for public as well private health-care services. The data used for this analysis were sourced from Malaysia's official input-output tables for the years 2010 and 2015, ensuring a robust and reliable basis for our conclusions. This study

underscores the vital role of the health-care sector in enhancing national productivity and population well-being. Specifically, the output, income, employment, and import multipliers were significant, illustrating the sector's profound impact on economic growth and stability. Broader policy implications suggest that increased investment in health-care can lead to sustainable economic development by not only improving health outcomes but also fostering technological advancements and expertise. Future research could explore the long-term effects of health-care expenditure on other sectors and investigate the potential benefits of various health financing schemes. By prioritizing health-care investment, Malaysia can pave the way for a healthier, more productive workforce and a more resilient economy.

Funding

This work was supported by Sunway University [Grant No. GRTIN-KSGS-09-2021].

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