

IBN HALDUN UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF FINANCIAL ECONOMICS

MASTER THESIS

**THE NEXUS BETWEEN THE YIELD CURVE AND
ECONOMIC ACTIVITY: EMPIRICAL EVIDENCE
FROM EMERGING MARKETS (EMs)**

AYATULLAHI SEIDU

THESIS SUPERVISOR
ASSIST. PROF. ASAD UL ISLAM KHAN

ISTANBUL, 2023

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by

AYATULLAHI SEIDU

**A thesis submitted to the School of Graduate Studies in partial
fulfillment of the requirements for the degree of Master of Science
(MSc.) in Financial Economics**

**THESIS SUPERVISOR
ASSIST. PROF. ASAD UL ISLAM KHAN**

ISTANBUL, 2023

APPROVAL PAGE

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of master of science in Financial Economics.

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This is to confirm that this thesis complies with all the standards set by the School of Graduate Studies at Ibn Haldun University.

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I hereby declare that the information in this document has been presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have cited and referenced all material and results that are not original to this work.

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ÖZ

GETİRİ EĞRİSİ VE EKONOMİK FAALİYET ARASINDAKİ BAĞ: GELİŞEN PİYASALARDAN (GOÜ) EMPİRİK KANITLAR

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Getiri eğrisi yaygın olarak ekonomik faaliyetlerin güçlü bir belirleyicisi olarak kabul edilmektedir. Bu çalışma, öncelikle dokuz (9) MSCI Gelişmekte Olan Piyasayı incelemek için gizli faktör yaklaşımını kullanarak getiri eğrisi ve ekonomik faaliyet arasındaki bağı incelemektedir. Çalışmada Kasım 2007 - Haziran 2022 (2007:M11 - 2022:M06) dönemini kapsayan aylık veriler kullanılmıştır. Temel amaç, getiri eğrisi ile ekonomik faaliyet arasındaki ilişkiyi incelemektir. Spesifik hedefler arasında, örneğin, Tüm Hisse Senetleri Endeksi (ASI) veya Bileşik Endeks (CI) gibi yerel hisse senedi piyasaları kontrol edildiğinde, spread'in ekonomik faaliyeti nasıl etkilediği; iShares MSCI Gelişmekte Olan Piyasalar Endeksi (MSCI) gibi uluslararası bir hisse senedi piyasası endeksi kontrol edildiğinde spread'in ekonomik faaliyeti nasıl etkilediği; ve West Texas Intermediate (WTI) gibi küresel petrol fiyatı gibi alternatif bir uluslararası veya küresel gösterge kontrol edildiğinde spread'in ekonomik faaliyeti nasıl etkilediği yer almaktadır. Getiri eğrisi ve ekonomik faaliyet arasındaki uzun dönemli heterojen ilişkiyi test etmek için sırasıyla Tam Modifiye OLS (FMOLS), Dinamik OLS (DOLS) ve Kanonik Eşbütünleşik Regresyon (CCR) tahmincileri kullanılmıştır. Bütün bunların yanında yayılmanın sanayi üretim endeksi ile temsil edilen ekonomik faaliyetle negatif ilişkili olduğu bulunmuştur, bu da uzun vadede ters bir getiri eğrisinin MSCI Gelişmekte Olan Piyasaların ekonomik faaliyetini geciktirdiğini göstermektedir. Sonuç hem uluslararası hisse senedi endeksine hem de küresel petrol fiyatına karşı dayanıklıdır. Diğer hususların yanı sıra, MSCI Gelişmekte Olan Piyasaların ekonomik faaliyetlerini tahmin etmede getiri

farkının dođruluđunu kontrol etmek iin 10 yıllık uzun vadeli tahvil oranının 5 yıllık uzun vadeli tahvil oranı ile deđiřtirilmesi nerilmektedir.

Anahtar Kelimeler: Ekonomik Faaliyet, Getiri Eđrisi, MSCI Gelisen Piyasalar, Panel Verisi, Uzun Dnem İliřkisi.



ABSTRACT

THE NEXUS BETWEEN THE YIELD CURVE AND ECONOMIC ACTIVITY: EMPIRICAL EVIDENCE FROM EMERGING MARKETS (EMs)

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The yield curve has been widely considered a powerful predictor of economic activity. This study primarily looks at the nexus between the yield curve and economic activity, using the latent factor approach, to study nine (9) MSCI Emerging Markets. Monthly data, covering the period from November 2007 to June 2022 (2007:M11 to 2022:M06), are employed. The main objective is to study the relationship between the yield curve and economic activity. The specific objectives include, for instance, how the spread impacts economic activity when controlled for the local stock markets, i.e., the All Share Index (ASI) or Composite Index (CI); how the spread impacts economic activity when controlled for an international stock market index, i.e., the iShares MSCI Emerging Markets Index (MSCI); and how the spread impacts economic activity when controlled for an alternative international or global benchmark like the global oil price, i.e., the West Texas Intermediate (WTI). The Fully-Modified OLS (FMOLS), Dynamic OLS (DOLS), and Canonical Cointegrating Regression (CCR) estimators are respectively employed to test for the long-run heterogeneous relationship between the yield curve and economic activity. Among other things, it is found that the spread is negatively related to the economic activity, which is represented by the industrial production index, suggesting that, in the long run, an inverted yield curve retards the economic activity of the MSCI Emerging Markets. The result is robust to both the international equity index and the global oil price. Among other things, it is recommended that the 10-year long-term

bond rate could be replaced with the 5-year long-term bond rate to check the accuracy of the yield spread in predicting the economic activity of the MSCI Emerging Markets.

Keywords: Economic Activity, Long-run Relationship, MSCI Emerging Markets, Panel Data, Yield Curve.



DEDICATION

I dedicate this thesis work to my family, friends, and loved ones, and to the entire Ibn Haldun University community.



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LIST OF SYMBOLS AND ABBREVIATIONS

ADF	Augmented Dickey-Fuller
ADJ	Adjusted
CADF	Cross-Sectional Augmented Dickey-Fuller
CCR	Canonical Cointegrating Regression
CD	Cross-Section Dependence
CDS	Credit Default Swaps
CIPS	Cross-Sectional Augmented Im-Pesaran-Shin
CPI	Consumer Price Index
DM	Developing Markets
DOLS	Dynamic Ordinary Least Squares
EHT	Expectations Hypothesis Theory
EMs	Emerging Markets
EXCH	Exchange
EMU	European Monetary Union
FMOLS	Fully-Modified Ordinary Least Squares
GIIPS	Greece, Ireland, Italy, Portugal, Spain
HAC	Heteroscedasticity and Autocorrelation Consistent
INDP	Industrial Production
JG	Job Guarantee
MCMC	Monte Carlo Markov Chain
MSCI	Morgan Stanley Capital International
OLS	Ordinary Least Squares
POL	Policy
PP	Phillips-Perron
QE	Quantitative Easing
S	Share
TSY	Treasury
VAR	Vector Autoregression
WTI	West Texas Intermediate
WWII	World War II
YCC	Yield Curve Control
α	Alpha

β	Beta
δ	Delta
ε	Epsilon
γ	Gamma
λ	Lamda
μ	Mu
ν	Nu
ω	Omega
ψ	Psi
Σ	Sigma
υ	Upsilon



CHAPTER I

INTRODUCTION

1.1. Background of the Study

Since the last quarter of the 20th century, globalization has made it, somewhat, possible for a certain degree of international flow of capital mainly through the global financial system. It was not, however, until the gradual integration of the global economy through the financial system, which ushered in a new, post-War macro super-cycle. As such, due to the integration of the global financial ecosystem, it is no surprise that a country's financial market strength indicates whether that market is a developed, an emerging, or a frontier market. Be that as it may, the yield curve has emerged as a powerful indicator to measure economic activity in these markets (Harvey, 1988; Peel and Taylor, 1998; Duarte et al., 2005; Botha and Keeton, 2014; Hvozdenka, 2015b; Boukhatem and Sekouhi, 2017). Despite having several second-order effects on the economy, the yield curve functions primarily in the bond market; this market is popularly known as the market of interest rates, and has increasingly become the core component of financial market development across the world. This research is, therefore, aimed at exploring the nexus between the curve and economic activity, with the Morgan Stanley Capital International (MSCI) Emerging Markets (EM) group as the case in point.

The yield curve represents different interest rates on assets, with varying horizons (Huse, 2011; Boukhatem and Sekouhi, 2017; Avdoulas et al., 2019). For a long time, the yield curve has become a potent source of information about future macroeconomic developments (Harvey, 1988; Estrella, 2005; Dewachter et al., 2014). Given that monetary shocks are passed onto the economy via interest rates (Asgharian et al., 2018), a good chunk of theoretical and empirical literature has resorted to the yield curve to explain recessions or expansions (Boukhatem and Sekouhi, 2017). The influence of the curve on economic activity is mainly reflected

by the spread. About three key explanations of why the yield spread predicts future economic output stand out (Idilbi-Bayaa and Qadan, 2022): One such explanation is related to the expectation theory of Muth (1961); another one is the countercyclical monetary policy, as described by Kozicki and Tinsley (2001), Svensson (2003), and Bernanke et al. (2005); and the other explanation relates to the intertemporal consumption model of Harvey (1988).

Generally, the forward-looking feature of the yield curve is assumed to be explained by the expectations hypothesis theory (EHT) (Dewachter et al., 2014). This means the slope moves purely in response to market expectation about future inflation. Arguably, the expectation theory can be technically understood using the relatively more complex Fisher identity or relation. In equilibrium, according to Fisher (1907), the movement in interest rates relative to income levels under certain economic conditions can be explained by the information contained in current real rates (Harvey, 1988). This is, in part, a result of the general, particularly neoclassical, economic consensus that government spending has an inherent inflation risk. A strong empirical support for this is Kiani (2009), who sheds further light on Summers's (1983) previous position about post-World War II (WWII) interaction of interest rates and inflation. However, a study like Avdoulas et al. (2019) contests that the Fisher condition requires some adjustment once uncertainty emerges in the analysis.

The next point has to do with the countercyclical monetary policy dimension. Ullah et al. (2014) empirically indicate that monetary policy is a major factor in the movements of the yield curve. Among all the macroeconomic factors that influence the curve, Ullah et al. (2014) and Hvozdenska (2015b) remind us that monetary policy stands out. Initial credit for incorporating this theoretical position into the yield curve is given to Kozicki and Tinsley (2001), Svensson (2003), and Bernanke et al. (2005) even though the viewpoint is critically challenged by the earlier EHT of Muth (1961) when put into the strong-form Fisher (1907) identity. Ullah et al. (2014) further responds, stating that even a small or negative slope inversion, in some respect, signals a slow-growing economy, but also a decline in future inflation.

The intertemporal model of Harvey (1988) is an asset-pricing model, which provides yet another popular explanation of the behavior. Compared to other studies on the consumption-based model, Harvey (1988) approaches the subject quite differently in a simple term structure model with consumption growth: a) Expected returns and expected consumption growth correlate, and b) expected treasury bill returns, if they can be estimated, should contain information about expected consumption growth. In Suimon et al. (2020), for instance, we have learned that when an economy is active, both investment capital and household consumption are also active, increasing the demand for funds despite an equally high cumulative cost of capital. Same such phenomenon can happen to a country's or company's credit risk. In simple terms, according to Idilbi-Bayaa and Qadan (2022), the tendency for people to consume in expansionary periods is stable rather than high whereas in contractionary periods, due to falling income, the tendency for people to consume reduces. This means that in Harvey (1988)'s intertemporal model, people have the incentive to save in long-term instruments today to stabilize their incomes, which will, in turn, smoothen their consumption next year when they are, for instance, hit by a recession (Idilbi-Bayaa and Qadan, 2022).

In a nutshell, the yield curve has gained global critical acclaim due to its importance in predicting economic activity. As such, this study adds to the ongoing conversation, and increasing volume of literature, using the MSCI EM group.

1.2. Problem Statement

Since 2008, the global economy has witnessed several financial crises—the 2007-2008 GFC, Greece debt crunch, and COVID-19 pandemic—that crippled the world. While significant signs of recovery have merged, and supply-side disruptions have been gradually easing, the challenge of global policymakers, as has always been the case according to Junttila and Vataja (2018), is to design the best possible policies to arrest the problems. It is no surprise that over the past few months, global central banks have been engaged in a game of competitive rate hikes of a sort in trying to bring inflation back to their respective targets. This action has not come problem-free. While the US and European markets have been struggling to recover from the recent bond market contagion, which has swept through their financial sectors, EM

economies have equally been dealing with various threats of technical recession, including credit defaults. In a time like this, therefore, the yield curve ultimately becomes the easy go-to indicator for policymakers and market participants alike in determining whether or not there is a possibility of soft-landing.

While some studies use state-space, observable macroeconomic variables (Sowmya and Prasanna, 2018; Huse, 2011) to model such macro-financial relationship, others utilize the widely acclaimed unobservable latent factors (Kiani, 2009; Matsumura et al., 2011; Botha and Keeton, 2014; Hvozdenska, 2015a; Hvozdenska, 2015b; Cascaldi-Garcia, 2017; Junttila and Vataja, 2018; Avdoulas et al., 2019) to achieve a similar end. For parsimony, the dominant empirical proxies are those of Nelson and Siegel (1987) and Diebold et al. (2006), which have been later appropriated by Hännikäinen (2017). Recently, given the rise of machine learning models, some studies have resorted to using the support vector machine (Gogas et al., 2015) and the autoencoder-based neural network (Suimon et al., 2020) factor models to generate the three features that describe the shape of the curve. Despite several different approaches, the best way forward is to keep the process as simple as possible (Hvozdenska, 2015a). We also adopt the 10-year treasury rate to represent the empirical level, but only for estimation, as our main target variable is the spread. We do not, however, include the empirical curvature in our analysis.

Most notably, like several other concepts or ideas, the aforementioned approaches to modeling the yield curve, especially the EHT, have been called to question by Ullah et al. (2014) and Dewachter et al. (2014), and, more recently, Boukhatem and Sekouhi (2017) and Suimon et al. (2020). In part, this is arguably linked to the failed outcomes of many years of unconventional monetary policy experiment that has hit the global financial system, especially from the developed markets through the emerging and frontier markets. Take, for instance, the case of Harvey (1988)'s intertemporal consumption model; this model ideally fits a standard Walrasian equilibrium situation under a no-exogenous shock system, which only suits a typically normal US business cycle. That is very much so because, as Avdoulas et al. (2019) recently indicated, Harvey (1988) can be viewed as having provided an extension of the Fisher (1907) condition, which ceases when uncertainty emerges in the market. It can be also argued that the EHT works better under an efficient market

hypothesis, which has also, unfortunately, witnessed major decays over the years due to the hurdles of globalization. For obvious reasons, the EM economies form a critical part of the network of global shock transmission channels. These reasons include, for instance, concerns about policy credibility, exchange rate, stock market, and oil price fluctuations. Hence, there is a reasonable basis to study the behavior of the yield curve, especially in the EMs.

1.3. Research Objectives

The study aims at investigating the nexus between the yield curve and the economic activity of the MSCI EM group of economies. Therefore, we specifically:

- i. Examine the effect of movements in the yield spread on the industrial production indexes of MSCI EMs when controlled for changes in the local stock market indexes.
- ii. Assess the effect of movements in the yield spread on the industrial production indexes of MSCI EMs when controlled for changes in an international stock market index.
- iii. Assess the effect of movements in the yield spread on the industrial production indexes of MSCI EMs when controlled for changes in global oil prices.

1.4. Research Questions

The following are the questions:

- i. Do movements in the yield spread influence the industrial production indexes of MSCI EMs when controlled for changes in the local stock market indexes?
- ii. Do movements in the yield spread influence the industrial production indexes of MSCI EMs when controlled for changes in an international stock market index?
- iii. Do movements in the yield spread influence the industrial production indexes of MSCI EMs when controlled for changes in global oil prices?

1.5. Research Hypothesis

This study tests the hypothesis that movements in the spread do not affect economic activity in the MSCI EMs. The alternative hypothesis is that movements in the spread affect economic activity in the MSCI EMs.

1.6. Contribution of the Research

Generally, from the literature, a bulk of the studies have been identified to be concentrated on the developed markets, i.e., the US, UK, Canada, developed Europe (European Monetary Union—EMU), and, in some cases, Japan, and G7 countries. Very few studies like Matsumura et al. (2011), Botha and Keeton (2014), Yan and Guo (2015), Yan and Guo (2016), Boukhatem and Sekouhi (2017), Altay and Onyibor (2018) and Sowmya and Prasanna (2018) have turned their focus to the MSCI EMs, even then only in the pre-COVID-19 era, and were largely in time series, creating both sampling and methodological gaps.

We filled these gaps by employing the dynamic panel data models; namely, the Fully-Modified Ordinary Least Squares (FMOLS), the Dynamic Ordinary Least Squares (DOLS), and the Canonical Cointegrating Regression (CCR) models to investigate the long-run relationship between the yield curve and economic activity of the MSCI EM group, in particular. In short, the thesis is a heterogeneous panel application. The sample period used is also interesting because it extends to the post-COVID-19 period. Specifically, we resorted to these heterogeneous dynamic panel models because, despite passing the cross-section dependence test, the data failed the assumption of slope homogeneity test, which was a prerequisite to estimating a cross-sectionally augmented autoregressive distributed lag (CS-ARDL) model.

1.7. Research Structure

We begin by introducing the study, describing the research objectives and research questions, stating the hypothesis, and providing the research contribution. Chapter two centers on a review of theories and empirical studies, conceptual framework, and some terms, depicting their relevant graphs. Chapter three addresses the

methodology and data issues. Chapter four involves the analysis of the results and examination of the findings therein. Chapter five concludes the research, providing a summary of the main findings, highlighting the research limitations, and proposing some possible recommendations.



CHAPTER II

LITERATURE REVIEW

2.1. Theoretical Background

Generally, some macro-finance studies use observable state variables (Huse, 2011), otherwise known as macro variables, to generate the different components of the yield curve, but Botha and Keeton (2014), Hännikäinen (2017), among others, use the latent factors or components (i.e., the level, slope or spread, and curvature) to achieve a similar ending. Hence, the common observation in the literature is that there is no single universal way of generating the different components of the yield curve. However, for empirical estimations, the dominant proxies are the 10-year treasury bond rate representing the “level” (Botha and Keeton, 2014; Hvozdenka, 2015a; Hvozdenka, 2015b, etc.), the difference between the 10-year treasury bond and the 3-month treasury bond rates representing the “spread” (Botha and Keeton, 2014; Hvozdenka, 2015a; Hvozdenka, 2015b, etc.), and the “curvature” is empirically defined as twice the 2-year treasury rate minus the sum of the 3-month and 10-year yields (Hännikäinen 2017).

It must be noted that while all three latent factors are theoretically obtained from different market interest rates (short and long-term market interest rates), they are empirically used to represent and explain different yield curve dynamics. Again, since different countries may have different types of treasury bond rates at different times, in cases where similar treasury bond rates cannot be obtained for different countries, Hvozdenka (2015a) and Hvosdenka (2015b) suggest all available interest rates—from short-term to long-term treasury rates—be employed to model the yield curve. For the purpose of this thesis, however, only two latent factors of the yield curve—i.e., the level and spread—are employed. Similarly, the empirical “level” and “spread” of Botha and Keeton (2014), Hvozdenka (2015a) and Hvosdenka (2015b) are adopted, with the spread being the target variable.

Several studies attest to the power of the yield spread in determining economic activity (Botha, 2014; Boukhatem and Sekouhi, 2017; Idilbi-Bayaa and Qadan, 2022, among others). However, three popular theoretical explanations are offered to this effect: One such explanation is related to the expectation theory of Muth (1961); another is the countercyclical monetary policy, as described by Kozicki and Tinsley (2001), Svensson (2003), and Bernanke et al. (2005); and the other is the intertemporal model of consumption growth (Harvey, 1988).

Based on the expectation theory, the yield spread is determined by a variety of factors—micro and macro factors. Traditionally, for this macro-financial dynamic, however, the spread is determined by the relationship between nominal interest rates (yields on the different maturities) and inflation (Fisher, 1907; Avdoulas et al., 2019). Nominal interest rates here imply both short-term and long-term nominal rates, otherwise known as treasury bond rates, where the difference between the nominal long term and short-term rates gives the expected change in economic conditions (Avdoulas et al., 2019). Therefore, we obtain the following function for the spread;

$$Spread = f(\text{interest rates, inflation}) \quad \text{Eqn. 2.1}$$

Similarly, according to Hvozdenka (2015), the widely used empirical proxies for the spread is the difference between the 10-year and 3-month treasury bond rates. From Eqn. 2.1, we derive the spread as;

$$Spread = f(TSY_{10YR} - TSY_{3MONTH}) \quad \text{Eqn. 2.2}$$

Where TSY_{10YR} and TSY_{3MONTH} represent the long-term and short-term treasury bond rates respectively. Hence, taking the inflation component into consideration, we then have;

$$Spread = f[(TSY_{10YR} - TSY_{3MONTH}) + CPI] \quad \text{Eqn. 2.3}$$

Where CPI is the inflation, as represented by the consumer price index.

Furthermore, the ability of the spread to determine the direction of economic activity depends on monetary policy response. This position is supported by the countercyclical monetary policy approach, as proposed by Kozicki and Tinsley (2001), Svensson (2003), and Bernanke et al. (2005). The policy rate is generally regarded as influencing the spread because, apart from being the widely used benchmark short-term rate, it drives all other short-term rates. For instance, when the policy rate increases, there is a corresponding increase in other short-term rates, and vice-versa. As a result, the spread may eventually rise (steepen) or fall (invert), given the reaction of monetary policy. In this case, therefore, we have an augmented function as follows;

$$Spread = f(\text{interest rates, inflation, policy rate}) \quad Eqn. 2.4$$

Hence, extending Eqn. 2.3 to capture monetary policy, we obtain;

$$Spread = f[(TSY_{10YR} - TSY_{3MONTH}) + CPI + POL] \quad Eqn. 2.5$$

Moreover, Botha (2014) and Boukhatem and Sekouhi (2017) attested that economic activity, i.e., output growth is determined by the spread. Junttila and Vataja (2018) added that the spread and the stock market are determinants of economic activity. Kuosmanen et al. (2015) earlier confirmed this, stating that economic activity is also determined by financial variables such as interest rates and stock returns. These views are also consistent with Harvey's (1988) intertemporal model of consumption growth, which adopts a linear relationship between expected returns and expected consumption growth in the economy. Note that consumption growth is a component of output growth, and the tendency to consume may be influenced by the business cycle (Idilbi-Bayaa and Qadan 2022). For instance, if people expect a decline in economic activity in future, they tend to save in long-term assets like bonds or stocks to stabilize their income during the recessionary period (Idilbi-Bayaa and Qadan 2022), and the opposite is the case when they expect an increase in economic activity. Therefore, estimating these returns should provide information about future economic activity (Harvey, 1988). From here, we can deduce the following function;

$$gdp = f(\text{interest rates, inflation, policy rate, stock returns}) \quad Eqn. 2.6$$

In estimating this macro-financial dynamic, however, exchange rate is regarded as having a pass-through for interest rates, which, in turn, affects economic activity (Yung, 2021). Hence, controlling for the exchange rate, we end up with the following augmented function;

$$gdp = f(\text{interest rate, inflation, policy rate, exchange rate, stock return}) \text{ Eqn. 2.7}$$

Therefore, taken all the above theoretical transformations of the yield curve into consideration, we obtain the reduced form equation for each country as;

$$\begin{aligned} \ln INDP_{it} = & \alpha_{i0} + \beta_i \ln TSY_10YR_{it} + \beta_{i2} SPREAD_{it} + \lambda_{i3} POL_{it} + \lambda_{i4} CPI_{it} \\ & + \lambda_{i5} \ln EXCH_{it} + \lambda_{i6} \ln S_{it} + \varepsilon_{it} \end{aligned} \quad (2.8)$$

Where INDP is the industrial production index, which is a proxy for gross domestic product, TSY_10YR is the 10-year nominal long-term treasury bond rate, which represents the empirical level of the curve (see Botha, 2014; Hvozdenka, 2015), SPREAD is the yield spread, which is the difference between the 10-year and 3-month treasury bond rates (see Botha, 2014; Hvozdenka, 2015), POL is the monetary policy rate, CPI represents the consumer price index, EXCH represents the nominal exchange rate, S is the local share or benchmark equity market index.

2.2. Empirical Literature

The empirical literature is divided into two parts, with one part reviewing the international evidence and the other part focusing on the available empirical studies related to the MSCI EM countries.

2.2.1. International Evidence on the Yield Curve and Economic Activity

Globally, there is a huge chunk of literature about the yield curve and economic activity on the developed markets, i.e., the US, UK, Canada, developed Europe (European Monetary Union—EMU), and, in some cases, Japan, the G7, and the Nordic countries. For instance, Gambetti and Musso (2020) confirmed the significant

effect of monetary policy shock on real economic activity in the Eurozone due to the Quantitative Easing (QE) tool deployed during the COVID-19 period. Gambetti and Musso (2020) embarked on this study, knowing very much about the impact of monetary policy of whatever kind on the yield curve. Specifically, Gambetti and Musso (2020) discovered, *inter alia*, that transmission links such as portfolio rebalancing, exchange rate, and credit channels got activated. From a global monetary policy perspective, especially in this era of competitive rate hikes, Asgharian et al. (2018) also observed that the interplay between bank lending and long-term bonds attached the yield curves of the Euro area; however, the partitioning of GIIPS and Non-GIIPS countries decayed this relationship post-2008.¹ Similarly, the dispersion in sovereign-Credit Default Swaps (CDS)-spread showed diverging creditworthiness, which could be largely attributed to credit market frictions. This trend has unfortunately become the new normal due to the current competitive rate hikes' environment in global monetary policy.

Using a no-arbitrage model under complete markets, with a 3-factor model, Yung (2021) asked the question, "Can interest rate factors explain exchange rate fluctuations?" Yung (2021) found that interest rate factors significantly enable cumulative currency gains in carry-trade strategies. However, in a comparative study of the US and Brazil, Matsumura et al. (2011) found little effect, except for the equity index, when macroeconomic indicators are used under the constraint of no-arbitrage. Thus, the stock market index does better in capturing the yield dynamics. This finding is complimented by Junttila and Vataja (2018), who conducted a similar study on the UK and Euro area by including economic uncertainty measures.

In a study of four Nordic countries—Norway, Denmark, Finland, and Sweden, Kuosmanen et al. (2015) found that a strong nexus for Finland and Sweden. In emerging and developed Asia, the relationship is rather bi-directional Sowmya and Prasanna (2018). In particular, exchange rate depreciation positively affected the level in emerging Asia whereas a rise in the spread was a bad news for developed

¹ GIIPS refers to Greece, Ireland, Italy, Portugal, and Spain, which were tremendously hit by the 2009-2012 sovereign debt crisis. Non-GIIPS are those countries that did not go through same level of economic comatose during this period.

(Sowmya and Prasanna, 2018). On quite the other hand, China almost always presents a particularly unique scenario in the emerging Asian markets. In part, what accounts for China's uniqueness is that it is not only a key driver of global supply, it is also a key driver of global demand, given its huge consumer-dependent economy relative to its population. Yan and Guo (2015), for instance, found that the growth in money supply proves to be a more effective tool in controlling inflation in China than the traditional monetary policy tool, but disclosed the regulator does policy adjustment to control money supply. Again, Yan and Guo (2015) opined that investment is a critical measure in stimulating the Chinese economy even though, as consensus would have it, investment also raises money supply growth and, in turn, feeds into the inflation. Yan and Guo (2016) would soon follow up with another ground-breaking study on China, this time looking at the yield curve and fiscal behavior, and found the spread and level components positively impacting government expenditure, but these components rather reacted negatively to balanced budget. The latter scenario was seen in the US in an earlier study by Kiani (2009).

Even though high frequency data are always recommended for macro-financial studies such as this, there is a good number of relatively recent studies that have attempted to use quarterly and/or yearly data to engage the topic. Two such studies, for instance, are Hvozdenka (2015a), Hvozdenka (2015b), and Altay and Onyibor (2018). Perhaps, the restriction is that such studies could only represent economic activity with the gross domestic product, which is only traditionally measured and/or reported on a quarterly or yearly basis. The predominant factor here is that the studies generally use the commonest empirical proxies for the different latent elements of the yield curve, especially the spread.

Avdoulas et al. (2019) discovered nonlinearities in the yield curve even though the yields reflected the EHT. Besides, the yield curve's behavior changes, given varying economic conditions, as pointed out by Huse (2011) and Hännikäinen (2017). Hence, per the assessment of Botha and Keeton (2014), a false signal could even trigger a yield curve inversion due to severe weakness in the economy at a given period. Evgenidis and Siriopoulos (2014) also indicated the major decline in output in 2007 was not signaled by the linear models. Ullah et al. (2014) cautioned against relying on the spread alone in tracing the monetary shocks, but on the entire components.

Compared to previous eras, Giacomini and Rossi (2006) discovered that the yield curve had more positive news for US economic activity during the early part of the Greenspan era. Similarly, Joslin et al. (2014) revealed that, between 1985 and 2007, price risks accounted for a significant change, which hugely affected the level and slope factors.

Recently, Cascaldi-Garcia (2017) tried to associate the reaction of the spread to technologically-oriented monetary policy developments. However, in terms of portfolio management, when we take Chen and Tsang (2013) into consideration, we see that the strength of the yield curve is rather enhanced. Still, on portfolio management, the empirical work of Dewachter et al. (2014) also stood out, as they ascertained one component was enough to explain the behavior of the bond risk factors. Dewachter et al. (2014) added that a decomposition is important, at least, in forecasting inflation.

For some time now, there has been a growing trend among researchers to also study the yield curve, using neural network analysis tools. Gogas et al. (2015) found that both the probit model and the neural network methods used to study the US accurately predicted recessions. Suimon et al. (2020) employed a more advanced neural network model called the auto-encoder-based method and found the approach more reliable and effective for the valuation of long-term treasury bonds in Japan.

On the G7 countries, except for Italy, Kumar et al. (2021) found that the spread positively impacted the economies. Historically, for financial market significance, the yield curve was studied in tandem with business cycles, using an asset pricing model, due to the underlying risks for inflation-adjusted and/or nominal bonds (e.g., Labadie, 1994). Labadie (1994) stressed that while movements in the spread are not sufficient to separate real from nominal shocks, the variations in the yield differential would accurately signal expected inflation.

In the commodity market, Idilbi-Bayaa and Qadan (2021) found that the yield curve behaved inconsistently. For example, the forecasts were perfect from 1986 to the early 2000s, but the success vanished immediately. This point is confirmed in another study by Idilbi-Bayaa and Qadan (2022), which found that changes in the

spread also impacts the returns on the energy products in the short run. On the contrary, since 2004 when these products witnessed massive financialization, the relationship has remained rather stronger, strengthening the correlations between the commodity and equity markets (Idilbi-Bayaa and Qadan, 2022).

2.2.2. Empirical Studies on the Yield Curve and Economic Activity in the MSCI EMs

On the one hand, Boukhatem and Sekouhi (2017), for instance, using the maximum likelihood method to study the yield curve and Tunisia's economic activity between 2003M06-2014M01, found that the spread was a significant indicator of economic activity. On the other hand, Botha and Keeton (2014) studied the South African experience between 1981M01-2013M06, using the probit model, and discovered that the high short-term bond rate, which occurred due to a false signal and a decline in long-term bond rate, turned the yield spread negative, pointing to "official" economic downswings. Besides, Botha and Keeton (2014) did not recognize these downswings as a recession, citing a mistake in the calculation of the consumer price index coupled with South Africa's adoption of an inflation-targeting regime as the source of these downswings. However, another study on China by Yan and Guo (2016) between 2006M03-2014M03, using the vector autoregressive (VAR) system, revealed that the "spread" and "level" factors positively impacted government expenditure, but these components rather reacted negatively to a balanced budget.

In Sowmya and Prasanna (2018), a comparison was made among developed and emerging markets (DMs and EMs) between 2003M01-2013M12, using the VAR process in a state-space framework; the study found a bi-directional relationship between the yield curve and macro factors—for instance, while the increase in the "level" factor was associated with exchange rate depreciation in the EMs, the increase in the "spread" factor rather appreciated the exchange rate in the DMs. In an earlier comparison of the US and Brazil between 1987M01-2009M03 and 1999M01-2006M03, using a Bayesian Monte Carlo Markov Chain (MCMC) technique, Matsumura and Moreira (2011) discovered that the inclusion of the stock index, a financial variable, improved the forecasting accuracy of the yield curve even though the forecasting errors are much larger in the Brazilian market. Altay and Onyibor

(2018) did a new comparison among Japan, China and South Korea between 2003: Q1–2016: Q4, using both OLS (linear) and probit (nonlinear) models; they, however, found that the spread did not accurately predict the direction of future economic growth.

In a nutshell, these are the only available empirical studies that have turned their focus to the MSCI EMs group. However, their sample periods are limited to the pre-COVID-19 era, and they have been largely conducted in time series, creating both sampling and methodological gaps.

2.3. Terms and Definitions

The following terms describe different types of yield curves:

2.3.1. “Normal” Curve

During an expansion, the interest rates on the short-side increase faster than the interest rates on the long-side, but they decline quickly during recession. Hence, a period of steady economic growth produces a normal-shaped curve. In this case, there is little inflation pressure, the business cycle is relatively stable, a well-functioning market, and an overall healthy economy. This allows for a smooth adjustment and implementation of monetary policy.

2.3.2. “Steep” Curve

In this scenario, the short-rates are systematically adjusted to stimulate economic activity and to reflect the changing business cycle, i.e., economic expansion. This is almost synonymous with what is called “graduality” in central banking.

2.3.3. “Flat” Curve

A flattening yield curve implies positive economic growth turns negative. Here, strong credit demand in the short-term causes short-term interest rates to jump. It could also occur as a result of a period of monetary tightening in response to growing

inflation pressure, which could come out of credit market frictions. Here, all maturities tend to yield the same returns due to high levels of uncertainty.

2.3.4. “Inverted” Curve

The curve inverts when interest rates on the short-side are higher than those on the long-side. An inverted curve is characteristic of a period of aggressive and restrictive monetary policy aimed at fighting inflationary shocks. This inflationary shock may be transitory or persistent, but there is a sudden change in the business cycle when the slope turns negative, signaling the coming of a technical recession.

2.3.5. “Humped” Curve

A humped yield curve is an intermediate curve. This curve shows that medium-term bonds yield more expected returns than both short-term and long-term bonds.

CHAPTER III

DATA AND METHODOLOGY

3.1. Introduction

The study aims at investigating the nexus between the yield curve and economic activity among MSCI EM economies. This group of EM economies differs significantly from other EM classifications in the sense that it places more emphasis not just on a country's economic architecture, but also the country's degree of penetration or exposure to global spillovers or risks, i.e., how sophisticated the country's financial market and institutions are. However, this group of countries is also recognized by the World Bank.

Otherwise referred to as transition economies (Yilmazkuday, 2008), the MSCI EM group comprises twenty-five (25) emerging economies from different regions of the world. Five (5) countries come from the Americas; twelve (12) countries are located in Europe, the Middle East, and Africa; and eight (8) countries are located in Asia. Of the twenty-five (25) countries, only nine (9)—Czech Republic (CZE), Greece (GRC), Hungary (HUN), Korea (KOR), Mexico (MEX), Poland (POL), Colombia (COL), Indonesia (IDN), and South Africa (ZAF)—make it to the sample.² The choice of this sample is fundamentally informed by data availability, but partly due to the time constraint. What is unique about the sample, however, is the key characteristic of geographic representation and/or diversity.

Relevant panel data models are applied in the study. Several benefits make panel data analysis a powerful tool over conventional time series and cross-sectional data analyses. Among other things, in panel data analysis, the dynamic nature of many economic relationships requires a dynamic treatment (Baltagi, 2021). In a macro

² See Appendix II for their credit ratings.

panel, for instance, the cross-sections may differ in their geographical, political, social, and economic characteristics. Hence, panel data help to deal with this by reducing the individual slope heterogeneity. Similarly, unlike time series models, panel data models are better at reducing multicollinearity, improving efficiency, and allowing more degrees of freedom among variables (Brooks, 2019). Again, due to the financially-integrated global economic system, panel data models have increasingly proved more reliable at dealing with cross-section dependency than the traditional time series and cross-section models. Moreover, an appropriate panel data model helps to address the problem of omitted variable bias (Brooks, 2019). Panel data models also help to properly deal with critical cases of intricate, convoluted models such as “technical efficiency,” as it imposes fewer restrictions on distributed lag models (Baltagi, 2021).

We employ the panel cointegration model in this study. Testing for cointegration in panels is generally considered a complex one due to the possibility of cointegration across groups of variables, i.e., cross-sectional cointegration, and within the groups (Brooks, 2019). We, however, address these issues by conducting the cross-section dependence test. We, therefore, utilize the Fully-Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), and the Canonical Cointegrating Regression (CCR) estimators to investigate the long-run relationship between the yield curve and economic activity of the MSCI EMs. Efficiency is to FMOLS whereas robustness to misspecification is to DOLS (Baltagi, 2021). However, even though it is less sensitive to lag length, the CCR is largely considered the most robust (Baltagi, 2021).

The Stata software is the standard econometric tool largely used in panel data analysis. We, therefore, use Stata 17 to analyze the main dynamic panel cointegration models—FMOLS, DOLS, and CCR. All three models correct for the endogeneity problem. They are also generally better at accounting for serial correlation and heteroscedasticity problems. The Stata software is also used to conduct the pre-tests such as the cross-section dependence test, which checks the average cross-section dependency among the individual countries, the “second generation” unit root test, the cointegration test, and the slope homogeneity test.

3.2. Cross-Section Dependence Test

First, we start by testing for cross-section dependency. Cross-section dependency checks the cross-correlations among individual entities over a certain time frame. A cross-section dependence test, for instance, checks whether one variable or more variables in one country say Greece, is sequentially correlated with another variable(s) in another country, say Poland. This is often present among countries that belong to the same economic or monetary block, or countries that share similar economic and/or financial architecture. In today's world, due to rapid financialization, it is relatively much easier to detect cross-sectional dependence, especially among developed and frontier or emerging markets. Thus, cross-sectional dependence is tested among the individual countries used in the study; the presence of which calls for the second-generation unit root test. When this feature is absent, the usual first-generation unit root test is then considered. Hence, conducting this test is currently a prerequisite to using the dynamic panel data models. In Stata, the command used to test for cross-sectional dependence when the time (T) dimension is larger than the individual dimension (N), i.e., $T > N$, is "xtttest2." The results obtained from using the "xtttest2" command are captured in Table 4.4 in Chapter IV. Under the null hypothesis of cross-section independence, the Pesaran (2004) CD test statistic is given by;

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \right) \text{asy} \sim N(0,1)_{i,j}$$
$$= 1, 2, 3 \dots N \quad (3.1)$$

3.3. Unit Root Test

Stationarity is tested using the second-generation unit root test. Usually, when cross-sectional dependence is strongly present in the residuals and variables, there is the need to utilize the second generation unit root test (Hussain et al., 2022) since the first generation unit root tests (Levin et al., 2002); (Im et al., 2003) prove incapable of capturing the cross-sectional dependence. Therefore, we employ the cross-

sectional augmented IPS (CIPS) second-generation unit root test (Pesaran, 2007). Mathematically, it is given by;

$$\Delta y_{i,t} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \bar{y}_t + \varepsilon_{i,t} \quad (3.2)$$

Where a_i is a deterministic term, \bar{y}_t is the cross-sectional mean at time t , and ρ is the lag order. $t_i(N, T)$ implies the corresponding t ratio of α_i , otherwise known as cross-sectional Augmented Dickey-Fuller (ADF) [CADF] (Pesaran, 2003).³ Therefore, the average of the t ratios gives the CIPS (Pesaran, 2007); (Hussain et al., 2022), as shown in Table 4.5 in Chapter IV. By definition, $CIPS = \frac{\sum_{i=1}^N t_i(N,T)}{N} = \frac{\sum_{i=1}^N CADF_i}{N}$ (Hussain et al., 2022).

3.4. Cointegration Test

The stationarity test is technically followed by a series of cointegration tests to examine the long-run relationship of the series. The Pedroni (1999), Kao (1999), and Westerlund (2005) cointegration tests are simultaneously utilized for robustness. The Westerlund test is in two forms; one has a null hypothesis of no cointegration in all panels while the other assumes that there is cointegration in, at least, some panels.⁴ Both Pedroni and Kao tests, however, have a null hypothesis of no cointegration.⁵ We, therefore, proceed to estimate the cointegration tests proposed by Pedroni (1999), Pedroni (2004) and Kao (1999). It must be pointed out that Pedroni (1999) and Pedroni (2004) test statistics are based on the residuals of the Engle and Granger (1987) cointegrating regression in a panel model, allowing for reasonable heterogeneity among the cross-sections by accommodating individual-specific fixed effects, slopes, and deterministic time trends for each cross-section (Afonso et al., 2018). This is estimated, using the regression equation below:

$$y_{it} = \gamma_i + k_{it} + \lambda_i x_{it} + \varepsilon_{it} \quad (3.3)$$

³ For the purpose of this study, only the CIPS is tested.

⁴ The Westerlund test uses the variance of the equations. See the appendix for more details.

⁵ Details of the results of the Pedroni and Kao tests are provided in the appendix.

where $t = 1, \dots, T$ and $i = 1, \dots, N$. In this case, the fixed effects and the slope coefficients may vary among the individual countries (Afonso et al., 2018). Again, using Eq. (3.3), the following test statistics are formulated:

$$\varepsilon_{it} = \psi_i \varepsilon_{it-1} + v_{it} \quad (3.4)$$

where ψ_i is the autoregressive coefficient of the residual ε_{it} in Eq. (3.3). (Pedroni, 1999); (Pedroni, 2004) test statistics can be broadly put into two groups: Group one, i.e., the “within-dimensions” tests, is comprised of four test statistics—panel-v, panel-p, panel-t non-parametric (PP) and panel-t parametric (ADF); group two, i.e., the “between-dimensions” tests, is made up of three test statistics—group-p, group-t non-parametric (PP), and group-t parametric (ADF) (Afonso et al., 2018). The average of the individual statistics gives the estimated test statistic, and the rejection of the null of no cointegration in heterogeneous panels suggests that cointegration holds for, at least, one individual (Afonso et al., 2018).

The null hypothesis of no cointegration of the “within-dimensions” statistics test is given by; $H_0: \psi_i = 1$ for all i against the alternative, $H_A: \psi_i = \psi < 1$ for all i . Similarly, the null hypothesis of no cointegration of the “between-dimensions” statistics test is given by; $H_0: \psi_i = 1$ for all i against the alternative, $H_A: \psi_i = \psi < 1$ for all i . According to (Pedroni, 1999); (Pedroni, 2004), the standardized statistic for the asymptotic normal distribution is given by; $K = \frac{(K_{N,T} - \mu(N)^{1/2})}{(V)^{1/2}} \Rightarrow N(0,1)$, where the critical values of μ and v for different values of a number of regressors in the cointegrating relationship are reported (Afonso et al., 2018).

Next, an OLS model is estimated for each panel cross-section to produce the panel cointegration vector based on the panel DOLS estimator. Kao (1999) and Kao et al. (1999) provide the DOLS estimator, β , as:

$$y_i = \mu_i + x'_{it}\beta_i + \sum_{k=-pi}^{pi} \delta_{ik}\Delta x_{it-k} + \varepsilon_{it} \quad (3.5)$$

where y represents the dependent variables, x is the matrix of the independent variables, Δ is the first-difference operator, pi is the lead and lag length. From the individual DOLS estimation in Eq. (3.5), we obtain the following panel cointegration

parameter and the associated t-ratio of the panel cointegration parameter, respectively:

$$\hat{\beta}_{PDOLS} = N^{-1} \sum_{i=1}^N \beta_{i,DOLS} \text{ and } t_{\hat{\beta}_{PDOLS}} = N^{-1/2} \sum_{i=1}^N t_{\hat{\beta}_{i,DOLS}}.$$

The OLS estimator is biased when used to estimate the long-run, i.e., cointegrating, relationship between the variables due to serial correlation and endogeneity (Aysu and Dökmen, 2011). Therefore, the FMOLS corrects the problems of serial correlation and endogeneity in the OLS estimator non-parametrically whereas the DOLS takes into account both future and past values of the differenced independent variables as additional regressors (Aysu and Dökmen, 2011). Overall, the dependent and independent variables are, thus, assumed to be integrated of order one, i.e., I(1).

3.5. Slope Homogeneity Test

After testing for cointegration, the slope homogeneity test is conducted to determine which estimators best fit the econometric models. In this case, we employ the Pesaran and Yamagata (2008) and Blomquist and Westerlund (2013) slope homogeneity tests. Accordingly, Pesaran and Yamagata (2008)'s test statistic is given by;

$$\tilde{\Delta} = \sqrt{N} \left(\frac{N^{-1}\bar{S}-k}{\sqrt{2k}} \right) \sim X_k^2 \quad (3.6)$$

$$\tilde{\Delta}_{adj} = \sqrt{N} \left(\frac{N^{-1}\bar{S}-k}{v(T,k)} \right) \sim N(0, 1) \quad (3.7)$$

On the other hand, (Blomquist & Westerlund, 2013) test statistic is given by;

$$\Delta_{HAC} = \sqrt{N} \left(\frac{N^{-1}\bar{S}_{HAC}-k_2}{\sqrt{2k_2}} \right) \quad (3.8)$$

$$(\Delta_{HAC})_{adj} = \sqrt{N} \left(\frac{N^{-1}\bar{S}_{HAC}-k_2}{v(T,k)} \right) \sim N(0, 1) \quad (3.9)$$

Specifically, $\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$ are the “simple” and “mean-variance bias-adjusted” slope homogeneity tests, respectively, whereas Δ_{HAC} and $(\Delta_{HAC})_{adj}$ are the “heteroscedasticity” and “autocorrelation consistent” versions of the “simple” and “mean-variance bias-adjusted” slope homogeneity tests (Hussain et al., 2022).

Generally, all the tests have a null hypothesis of homogeneity, suggesting that in the long-run, the slope coefficients are homogeneous in the null. If the null is rejected, suggesting that there is heterogeneity in the long run, it provides a valid case for, or reasonable ground to proceed with, FMOLS, DOLS, and CCR. If otherwise, then we revert to the cross-sectionally augmented distributed lag (CS-DL), given the presence of cross-section dependence. Note, however, that panel data models are better able to control for idiosyncratic or country-specific factors that impact long-run relationships among different economic variables, i.e., heterogeneity, in FMOLS, DOLS, and CCR (Baltagi, 2021).

3.6. Econometric Model

The heterogeneous long-run relationship is constructed from the following primary model:

$$u_{it} = \alpha_i + \beta_i k_{it} + \lambda_i' x_{it} + w_{it} \quad (3.10)$$

where u_{it} is the economic activity, proxied by the industrial production index (INDP), in country i and month t ($i = 1, \dots, N$; $t = 1, \dots, T$), k_{it} represents the target variables, i.e., the 10-year nominal long-term treasury yield (TSY_10YR) and the slope of the yield curve (i.e., the yield spread) (SPREAD)⁶ obtained from the difference between the 10-year nominal long-term treasury rate (TSY_10YR) and 3-month nominal short-term treasury rate (TSY_3M),^{7,8} and x_{it} is a vector of control variables, which includes the policy rate (POL), inflation rate based on the consumer price index (CPI), nominal exchange rate (EXCH), the local stock market index based on the all-share or composite index (S), the international stock market index from the iShares MSCI EM index (MSCI), and global oil prices (OIL) represented by the West Texas Intermediate (WTI). On the other hand, α_i ($i = 1, \dots, N$) is the unknown intercept for each entity (N entity-specific intercepts), β_i and λ_i are the coefficients of the regressors, and w_{it} describes the error term. The primary model in

⁶ For simplicity, the yield spread will be used hereon.

⁷ The 3-month nominal short-term treasury rate is only used for the computational benefit of deriving the yield spread.

⁸ See (Hännikäinen, 2017) for the widely used empirical proxies for the “level,” “spread,” and “curvature.”

Eq. (3.10) above is then estimated in three separate equations, controlling for the local stock market index (S), the international stock market index (MSCI), and global oil prices (OIL), respectively, as follows:

$$\begin{aligned} \ln INDP_{it} = & \alpha_{i0} + \beta_i \ln TSY_10YR_{it} + \beta_{i2} SPREAD_{it} + \lambda_{i3} POL_{it} + \lambda_{i4} CPI_{it} \\ & + \lambda_{i5} \ln EXCH_{it} + \lambda_{i6} \ln S_{it} + \varepsilon_{it} \end{aligned} \quad (3.11)$$

$$\begin{aligned} \ln INDP_{it} = & \alpha_{i0} + \beta_i \ln TSY_10YR_{it} + \beta_{i2} SPREAD_{it} + \lambda_{i3} POL_{it} + \lambda_{i4} CPI_{it} \\ & + \lambda_{i5} \ln EXCH_{it} + \lambda_{i6} \ln MSCI_{it} + \varepsilon_{it} \end{aligned} \quad (3.12)$$

$$\begin{aligned} \ln INDP_{it} = & \alpha_{i0} + \beta_i \ln TSY_10YR_{it} + \beta_{i2} SPREAD_{it} + \lambda_{i3} POL_{it} + \lambda_{i4} CPI_{it} \\ & + \lambda_{i5} \ln EXCH_{it} + \lambda_{i6} \ln OIL_{it} + \varepsilon_{it} \end{aligned} \quad (3.13)$$

where INDP is the industrial production index, TSY_10YR is the 10-year nominal long-term bond yield, SPREAD is the yield spread, POL is the monetary policy rate, CPI represents the consumer price index, EXCH represents the nominal exchange rate, S is the local share prices or benchmark equity market index, MSCI is the international benchmark equity market index, OIL is the global oil prices. INDP, TSY_10YR, EXCH, S, MSCI, and OIL are in natural logarithms.

3.7. Data

The following tables describe the variables used in the analysis:

Table 3.1. Variables and Data

No.	Name	Unit	Frequency	Data Source
1	Industrial Production Index	2015 base year	Monthly	OECD
2	10-year Long-Term Treasury bond	Percentage	Monthly	OECD and Investing.com
3	Yield Spread	Percentage	Monthly	OECD and Investing.com
4	Policy Rate	Percentage	Monthly	BIS

Table 3.1. (cont.)

5	Consumer Price Index	Growth rate; 2015 base year	Monthly	OECD
6	Exchange Rate	Local currency/USD	Monthly	Thompson Reuters
7	Stock Market Indices	2015 base year	Monthly	OECD
8	MSCI Emerging Market Index	USD	Monthly	Thompson Reuters
9	Oil prices	USD/barrel	Monthly	Federal Reserve Bank of St. Louis

Source: Author's Tabulation, 2023

Table 3.2. Definition of Variables

No.	Type	Name	Abbreviation	Description
1	Dependent	Industrial Production Index	INDP	Industrial production index as a proxy for economic activity
2	Independent	10-year Long-Term Treasury bond	TSY_10YR	Nominal government bonds maturing in ten (10) years; represent the “empirical level”
3	Independent	Yield Spread	SPREAD	Also known as the “empirical slope,” the yield spread is the difference between the 10-year long-term treasury bond and the 3-month short-term treasury bond
4	Independent	Policy Rate	POL	The central bank's monetary policy rate

Table 3.2. (cont.)

5	Independent	Consumer Price Index	CPI	Inflation is expressed as the consumer price index
6	Independent	Exchange Rate	EXCH	Nominal exchange rate (spot rate)
7	Independent	Stock Market Indices	S	Closing prices of the local benchmark stock market index
8	Independent	MSCI Emerging Market Index	MSCI	iShares MSCI EM index
9	Independent	Oil prices	OIL	Global oil prices (WTI)

Source: Author's Tabulation, 2023

Table 3.3. Variables and Expected Impact

No.	Variable	Expected Impact	Studies
1	Industrial Production Index		
2	10-year Long-Term Treasury bond	Positive and negative, depending on the direction of the curve	(Hännikäinen, 2017; Yan and Guo, 2016)
3	Yield Spread	Positive and negative, depending on the "level"	(Hännikäinen, 2017; Yan and Guo, 2015; Yan and Guo, 2016; Kiani, 2009; Botha and Keeton, 2014; Evgenidis and Siriopoulos, 2014; Altay and Onyibor, 2018; Joslin et al., 2014; Suimon et al., 2020; Kumar et al., 2021)
4	Policy Rate	Negative	(Yan and Guo, 2015)

Table 3.3. (cont.)

5	Consumer Price Index	Positive and negative, depending on the economic cycle	(Yan and Guo, 2015)
6	Exchange Rate	Positive and negative, depending on whether a currency depreciation or appreciation	(Yung, 2021)
7	Stock Market Indices	Positive	(Matsumura et al., 2011; Kuosmanen et al., 2015)
8	MSCI Emerging Market Index	Positive	(Matsumura et al., 2011; Kuosmanen et al., 2015; Junttila and Vataja, 2018)
9	Oil prices	Positive and negative, depending on whether a net exporter or a net importer and also financialization	(Abdul-Rahman et al., 2023; Idilbi-Bayaa and Qadan, 2021; and Idilbi-Bayaa and Qadan, 2022)

Source: Author's Tabulation, 2023

CHAPTER IV

RESULTS AND DISCUSSION

4.1. Introduction

This section provides and discusses the results of the study. It generally describes the dataset in descriptive statistics. It prepares the dataset for analysis by conducting correlation, cross-section dependence, unit root, cointegration, and slope homogeneity tests. The section closes by presenting the results of the FMOLS, DOLS, and CCR models respectively.

4.2. Descriptive Statistics

The descriptive statistics summarize the nature of the variables used in the study. The variables are macro-finance variables, which differ in units of measurement, as they are obtained from different secondary sources. Therefore, the monthly log returns of the financial series as well as the macro-monetary series, with relatively larger values, have been particularly taken before conducting the descriptive statistics.

Table 4.1. Descriptive Statistics

Variable	Obs.	Mean(%)	SD	Min	Max
LNINDP	1584	4.593	0.138	3.87	5.047
LNTSY_10YR	1584	1.596	0.699	-1.386	3.6
SPREAD	1584	2.2	3.184	-3.05	35.543
POL	1584	3.598	2.682	0	12
CPI	1584	3.393	2.552	-2.853	17.188
LNEXCH	1584	4.372	3.004	.052	9.7
LNS	1584	4.629	0.350	3.242	6.536
LNMSCI	1584	3.709	0.162	3.049	4.01
LNOIL	1584	4.22	0.358	2.832	4.898

Source: Author's analysis using STATA 17, 2023

Table 4.1 depicts the relevant descriptive statistics. The monthly percentage changes in the industrial production index (i.e., economic growth) for the MSCI EM economies is approximately 4.59%, with about 0.14% dispersion from the mean. The 10-year long-term treasury bond, the empirical level of the yield curve, has a monthly mean return of approximately 1.60% and a standard deviation of about 0.70%. On average, the monthly percentage change in the spread (i.e., the slope of the yield curve) is 2.2%, with a 3.18% dispersion from the mean. The monthly policy rate has a mean of about 3.60%, with a standard deviation of 2.68%. At the same time, the monthly consumer price index has a mean of 3.39% and a standard deviation of 2.55%. The monthly mean returns of the exchange rates, local stock market indexes, international stock market index, and oil prices are 4.37%, 4.63%, 3.71%, and 4.22%, with standard deviations of approximately 3%, 0.35%, 0.16%, and 0.36% respectively.

4.3. Preliminary Test

The general description of the dataset is chronologically followed by various pre-tests, including correlations, cross-section dependence, unit root, cointegration, and slope homogeneity tests.

4.3.1. Correlations Tests

Table 4.2. Matrix of Correlations

Variables	Lnindp	Lntsy_10yr		Spread	Pol	Cpi	Lnexch	Lns	Lnmsci	Lnoil
Lnindp	1.000									
Lntsy_10yr	-0.343	1.000								
Spread	-0.009	0.403		1.000						
Pol	-0.346	0.641		-0.294	1.000					
Cpi	-0.050	0.422	-0.207	0.686	1.000					
Lnexch	-0.100	0.122	-0.237	0.300	0.169	1.000				
Lns	0.587	-0.199	0.105	-0.416	-0.168	-0.057	1.000			
Lnmsci	0.346	-0.114	0.032	-0.175	-0.005	0.002	0.380	1.000		
Lnoil	-0.162	0.277	0.077	0.190	0.280	-0.034	0.032	0.372	1.000	

Source: Author's analysis using STATA 17, 2023

Table 4.2 presents the results of the correlation matrix. It can be observed that there are no perfect (positive or negative) correlations among the variables. For instance, there are weak negative correlations between the 10-year treasury bond, the slope of the yield curve, policy rate, consumer price index, exchange rate, oil price, and industrial production index whereas both local and international stock market indexes show some weak positive correlations with industrial production. On the other hand, the correlations between the slope of the yield curve, consumer price index, exchange rate, oil price, and the 10-year treasury bond are relatively weaker, but positive, except for the policy rate, which shows a stronger but moderate, positive correlation, whereas those of the local and international stock market indexes are relatively weaker and negative against the 10-year treasury bond. Again, the policy rate, consumer price index, and exchange rate show some weak negative correlations with the slope of the yield curve against the local and international stock market indexes and oil prices, which show some weak positive correlations with the slope of the yield curve. Similarly, there is a moderately strong, positive correlation between the consumer price index and policy rate and a moderately weak, positive correlation between the exchange rate and policy rate as well as the correlation between oil price and the policy rate. However, the opposite can be said of the correlations between the local and international stock market indexes and policy rates, showing weak, negative linear relationships. The exchange rate and oil price are positively correlated with the consumer price index whereas the stock market indexes are negatively correlated with the consumer price index. Except for the international stock market index, which is positively correlated with the exchange rate, the local stock market index and oil price are negatively correlated with the exchange rate. While both the international stock market index and oil price are positively correlated with the local stock market index, the oil price is also positively correlated with the international stock market index.

4.3.2. Pairwise Correlation

Table 4.3. Matrix of Correlations with Significance Level

Variables	Lnindp	Lntsy_10yr	Spread	Pol	Cpi	Ln exch	Lns	Ln msci	Lnoil
Lnindp	1.000								
Lntsy_10yr	-0.343 (0.000)	1.000							
Spread	-0.009 (0.726)	0.403 (0.000)	1.000						
Pol	-0.346 (0.000)	0.641 (0.000)	-0.294 (0.000)	1.000					
Cpi	-0.050 (0.047)	0.422 (0.000)	-0.207 (0.000)	0.686 (0.000)	1.000				
Lnexch	-0.100 (0.000)	0.122 (0.000)	-0.237 (0.000)	0.300 (0.000)	0.169 (0.000)	1.000			
Lns	0.587 (0.000)	-0.199 (0.000)	0.105 (0.000)	-0.416 (0.000)	-0.168 (0.000)	-0.057 (0.023)	1.000		
Lnmsci	0.346 (0.000)	-0.114 (0.000)	0.032 (0.210)	-0.175 (0.000)	-0.005 (0.854)	0.002 (0.944)	0.380 (0.000)	1.000	
Lnoil	-0.162 (0.000)	0.277 (0.000)	0.077 (0.002)	0.190 (0.000)	0.280 (0.000)	-0.034 (0.177)	0.032 (0.201)	0.372 (0.000)	1.000

Table 4.3 above is an extension of Table 4.2 and depicts the results of the pairwise correlations for the MSCI EM economies used in the study. It can be observed that, with the exceptions of the slope and industrial production index; the slope and international stock market index; the consumer price index and international stock market index; the exchange rate against both the international stock market index and oil price; and the local stock market index against oil price, all other pairwise correlations are either positive or negative and strongly significant at either 1% or 5%.

4.3.3. Cross-Section Dependence

Table 4.4. Cross-Section Dependence Test Results

Test	Residuals		Weighted Residuals	
	Statistic	Prob.	Statistic	Prob.
Breusch-Pagan LM	1582.255	0.0000	168.8074	0.0000
Pesaran scaled LM	182.2279	0.0000	15.65150	0.0000
Pesaran CD	30.89950	0.0000	3.811671	0.0001

Source: Author's analysis using STATA 17, 2023

Table 4.4 depicts the cross-section dependence tests for the residuals and weighted residuals across cross-sectional units. In the residuals' cross-section dependence test, all three tests, as explained by Breusch and Pagan (1979), Pesaran (2004); and Pesaran et al. (2008), are found to be statistically significant at the 1% level of significance. Similarly, in the weighted residuals' cross-section dependence test, which utilizes Zellner's seemingly unrelated regression estimator (Zellner, 1962; Pesaran, 2015), all three tests also indicate high statistical significance at the 1% level of significance. Both the former and the latter have a null hypothesis of no cross-section dependence. Given that the p-values are highly significant at the 1% level of significance, we reject the null hypothesis and conclude that there is cross-sectional dependence among the individual countries. The same Pesaran (2004) test, has been checked in the variables, under the null hypothesis of cross-section independence, and we reject the null hypothesis.⁹ Therefore, the second-generation unit root test is employed. While the Pesaran scaled LM test is a scaled version of the Breusch-Pagan LM test, which is suitable for a large time dimension, the Pesaran CD test, which is also suitable for a large individual dimension, generally tests for weak cross-sectional dependence, and uses the average of the correlations in the sample. Both tests, however, account for autocorrelation and confirm the presence of cross-sectional dependence in the residuals and weighted residuals of the estimable models. Hence, a cross-section dependence is established among the individual series, which gives rise to the second-generation unit root test.

⁹ See appendix for cross-section dependence test of individual variables.

4.3.4. Unit Root Test

The results of the cross-sectional augmented IPS (CIPS) second generation unit root test of Pesaran (2007) are as follows:

Table 4.5. Unit Root Test Results

Cross-Sectional IPS (CIPS) test results					
Panel Series	CIPS at level		CIPS at first difference		Decision
	Constant	Linear time trend	Constant	Linear time trend	
LNINDP	-1.835	-2.620	-6.190***	-6.420***	I(1)
LNTSY_10YR	-2.132	-2.140	-6.190***	-6.420***	I(1)
SPREAD	-2.052	-2.394	-6.190***	-6.420***	I(1)
POL	-0.690	-0.739	-5.769***	-5.871***	I(1)
CPI	-1.561	-2.438	-5.999 ***	-6.208***	I(1)
LNEXCH	-2.432**	-2.517	-6.190***	-6.420***	I(1)
LNS	-2.432	-1.898	-6.190***	-6.420***	I(1)
LNMSCI	-0.871	-3.014**	-6.190 ***	-6.420***	I(1)
LNOIL	-0.675	-0.386	-5.853***	-6.384***	I(1)

Note: “*,” “,” and “***” indicate the rejection of the null hypothesis at 10%, 5%, and 1% respectively**

From Table 4.5 above, the CIPS unit root test has a null hypothesis of unit root. In this study, it is computed with a constant as well as constant and trend terms at level and first difference respectively. The test reveals that all the variables are stationary at first difference, i.e., they are I(1) stationary. This, therefore, provides reasonable grounds to employ the dynamic econometric models.

4.3.5. Cointegration Results

After the stationarity test, the panel cointegration test follows. Table 4.6 below provides the results of the cointegration test.

Table 4.6. Cointegration Test Results

Westerlund	Statistic	Pedroni	Statistic	Kao	Statistic
All Panels		Eqn. 1		Eqn. 1	
Eqn. 1	-0.5750	M-PP t	-11.6771***	M-DF t	-9.7331***
Eqn. 2	-0.6995	PP t	-11.6800***	DF t	-5.8359***
Eqn. 3	0.1087	ADF t	-11.9209***	ADF t	-4.3196***
				UM-DF t	-17.8947***
				U-DF t	-7.3044***
Some Panels		Eqn. 2		Eqn. 2	
Eqn. 1	-1.1603	M-PP t	-11.0552***	M-DF t	-10.7214***
Eqn. 2	-0.7764	PP t	-10.7939***	DF t	-6.3092***
Eqn. 3	-0.0149	ADF t	-10.9407***	ADF t	-4.5205***
				UM-DF t	-19.3192***
				U-DF t	-7.7526***
		Eqn. 3		Eqn. 3	
		M-PP t	-9.6547***	M-DF t	-8.2921***
		PP t	-9.6712***	DF t	-5.1515***
		ADF t	-9.9095***	ADF t	-3.7650***
				UM-DF t	-14.7999***
				U-DF t	-6.4466***

As depicted in Table 4.6 above, the results of both Westerlund tests are not statistically significant. Hence, we fail to reject the null hypothesis and conclude that there is no cointegration in the series. On the other hand, however, the results of the Pedroni and Kao tests indicate high statistical significance at the 1% level of significance. As a result, we reject the null hypotheses and conclude that there is cointegration in the series. Based on the rule of thumb, the results of the Pedroni and Kao tests provide adequate evidence of the existence of a long-run relationship.

4.3.6. Slope Homogeneity

After testing for cointegration, the slope homogeneity test is conducted to determine which estimators best fit the econometric models. In this case, we employ the Pesaran and Yamagata (2008) and Blomquist and Westerlund (2013) slope homogeneity tests. The results are reported in Table 4.7.

Table 4.7. Slope Homogeneity Test Results

Models	Pesaran and Yamagata		Blomquist and Westerlund		HAC	
	Delta	p-value	Delta	p-value	Delta	p-value
Eqn. 1	16.158	0.000	5.049	0.000	4.474	0.000
	adj. 16.591	0.000	adj. 5.184	0.000	adj. 4.593	0.000
Eqn. 2	10.550	0.000	3.299	0.001	2.918	0.004
	adj. 10.832	0.000	adj. 3.387	0.001	adj. 2.996	0.003
Eqn. 3	19.370	0.000	2.287	0.022	3.509	0.000
	adj. 19.888	0.000	adj. 2.348	0.019	adj. 3.603	0.000

Source: Author's analysis using STATA 17, 2023

The results of the slope homogeneity tests in Table 4.7 are statistically significant at the 1% level of significance. We, therefore, reject the null hypothesis and conclude that the slope coefficients are not homogenous, making it impossible to employ a dynamic panel estimator like the cross-sectionally augmented distributed lag (CS-DL) (Chudik et al., 2015), which primarily requires slope homogeneity to be valid.

We, however, proceed with other dynamic panel models such as the FMOLS, DOLS, and CCR models to test for the long-run relationship.

4.4. Regression Results

Tables 4.8, 4.9, and 4.10 report the regression outputs of the FMOLS, DOLS, and CCR, respectively. Three models have been accordingly estimated. The first model, i.e., the main model, contains the long-run regression results when controlled for the local equity index (the All Share/Composite Index). The second model contains the long-run regression results when controlled for the international equity index; that is, for this study, the iShares MSCI (EM) index, which is broadly consistent with the general objective of the study. The third model contains the long-run regression results when the iShares MSCI EM index is replaced with the WTI oil prices as an alternative international benchmark. This way, robustness is achieved not just theoretically, but, somewhat, empirically. For simplicity and convenience, the variables shall be interpreted, as per the order of arrangement, on a row-by-row basis.

Table 4.8. Long-Run Results Using Local Equity Index (ASI)

	(1)	(2)	(3)
VARIABLES	FMOLS	DOLS	CCR
LNTSY_10YR	2.603***	2.975***	2.610***
	(0.217)	(0.448)	(0.271)
SPREAD	-0.252***	-0.304***	-0.253***
	(0.0320)	(0.0634)	(0.0393)
POL	-0.216***	-0.276***	-0.218***
	(0.0354)	(0.0690)	(0.0428)
CPI	0.0398***	0.0449***	0.0399***
	(0.00981)	(0.0142)	(0.00992)
LNEXCH	-0.461***	-0.347**	-0.454***
	(0.0758)	(0.139)	(0.0861)
LNS	0.399***	0.261	0.395***
	(0.0783)	(0.165)	(0.0982)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

From Table 4.8, the LNTSY_10YR (long-term treasury bond) is highly significant at the 1% level in FMOLS, DOLS, and CCR. The coefficient indicates that a 1% increase in the long-term treasury bond increases the industrial production index by approximately 260%, 298%, and 261% in FMOLS, DOLS, and CCR, respectively. The effect of an increase in the long-term bond yield depends on the channel of transmission. According to Ullah et al. (2014), it is the entire curve that channels the policy shocks to the real economy. Hence, instead of using only the yield spread in our estimations, we also included the level, which is an additional layer of the three yield curve factors, to ascertain its effect on the economic activity of the MSCI EMs. Hännikäinen (2017) ascertains that the power of the latent elements varies overtime. However, Yan and Guo (2016) observe that higher government expenditure may raise the level factor of the yield curve. In our study, we have consistently found a positive coefficient for the level factor, which is broadly in line with, at least, the possible scenario of Yan and Guo (2016). Generally, for emerging markets, an increase in the long-term bond yield reflects a positive long-term economic outlook, leading to increased capital flows, especially from foreign direct investment. This means that investors are attracted to long-term bonds due to higher yields. Other factors such as liquidity preference and risk aversion may account for investors' drive for higher yields in long-term bonds. As such, investors tend to demand higher yields for illiquid assets like the long-term bond because of the risk associated with it. However, all other things equal, a positive long-term bond yield, which is influenced by higher government expenditure, leading to an increase in the long-term economic outlook is accompanied by a corresponding increase in economic activity in the long run.

SLOPE (yield curve spread) is highly significant at the 1% level in FMOLS, DOLS, and CCR. The coefficient indicates that a 1% increase in the slope of the yield curve decreases the industrial production index by approximately 25%, 30%, and 25% in FMOLS, DOLS, and CCR, respectively. Generally, a positive spread signals a normal yield curve whereas a negative spread signals an inverted yield curve. However, the results revealed by Tables 4.8, 4.9, and 4.10 mirror a continuous curve inversion, occurring when short-end bond rates are higher than those on the long-

end. It is important to highlight, for instance, that this result is consistent with the latest empirical developments from the twin-deficit hypothesis literature, which suggests that much of the foreign capital trooping into these EMs is short-term in nature than long-term. In the case of an inverted yield curve, there are several potentially cumulative economic outcomes; a) inflation risk and b) budget deficit, as both tend to deeply flatten the yield curve. The former is premised on a supposedly long-term inflation expectation and the latter is fueled by a relatively prolonged period of economic decline (i.e., technical economic recession).¹⁰ Among others, our result for the yield spread confirms Hännikäinen (2017) and, more especially, Botha and Keeton (2014), Altay and Onyibor (2018), Suimon et al. (2020) who relate it to, for instance, severe weaknesses in economic activity and rising short-term rates.

The effect of monetary policy on the industrial production index is also depicted by the results in Table 4.8. POLICY (monetary policy rate) is also statistically significant at the 1% level in FMOLS, DOLS, and CCR, respectively. The coefficient indicates that a 1% increase in the policy rate decreases industrial production by 22%, 28%, and 22% in FMOLS, DOLS, and CCR, respectively. The monetary policy rate is the key short-term rate effectively employed by central banks to target inflation. Conventional monetary policy, on the one hand, dictates raising this benchmark interest rate to arrest inflation, especially during a boom. Unconventional monetary policy, on quite the other hand, dictates a zero interest rate policy (ZIRP), which involves lowering this benchmark interest rate to stimulate the economy, especially in a liquidity trap, otherwise called the zero lower bound (ZLB). In some cases, however, it is widely believed that the slope of the yield curve moves in the direction of monetary policy. This is because as the short-term rates increase, the short end of the yield curve gradually rises over and above the long end, i.e., slopes downward. Such a reaction is likely to produce an inverted yield curve, as found in Table 4.8 above. In this study, however, we have discovered a negative coefficient, which is reflective of higher central bank monetary policy rates. According to Botha and Keeton (2014), this undermines economic activity, which is primarily the reason many policymakers do not see the monetary policy rate as the most effective to curb inflation, especially in the EMs (Yan and Guo, 2015).

¹⁰ Usually, at least, two quarters of decline in economic activity, i.e., Gross Domestic Product (GDP).

CPI (consumer price index) is statistically significant at the 1% level in FMOLS, DOLS, and CCR, respectively. The coefficient is a rather striking one; it indicates that a 1% increase in the consumer price index increases the industrial production index by approximately 3.98%, 4.99%, and 3.99% in FMOLS, DOLS, and CCR, respectively. This result is a contrarian result, which is broadly in line with the general, particularly neoclassical, view that inflation negatively affects economic activity. However, there are certain exceptions where inflation tends to positively affect economic activity. For instance, in a period of boom, inflation is often associated with investment and spending, which then spark economic growth in the long run. Recent disaggregated, microeconomic inflation views and developments point to various instances where inflation can positively affect economic growth.¹¹ One such instance has been observed post-2007/2008 GFC when a relatively longer period of Quantitative Easing (QE), especially in the developed markets, saw huge capital flows to the EMs mainly for investment purposes. At the same time, there have been relatively prolonged levels of increased and sustained productivity due to massive industrial and structural transformations in the EMs. Such inherently inflationary developments might come with a resulting positive effect on economic growth. The result obtained in our study for the CPI is indicative of an effect coming from the investment channel to stimulate the economy, which is corroborated by (Yan and Guo, 2015).

LNEXCH (nominal exchange rate) is highly statistically significant at the 1% level in FMOLS and CCR, respectively. However, it is statistically significant at the 5% level only in DOLS. The coefficient indicates that a 1% increase in the nominal exchange rate decreases the industrial production index by about 46.1%, 34.7%, and 45.4% in FMOLS, DOLS, and CCR, respectively. The effect of the nominal exchange rate on economic activity, especially in emerging markets, depends on two sides of the coin—depreciation or appreciation. The former appears to be the case in Tables 4.8 and 4.9. Depreciation of the nominal exchange rate can be a blessing or a curse at the same time. For instance, a depreciation may lead to cheaper exports, but costlier imports. While an emerging market's currency may gain on the latter (Yung,

¹¹ See the recent works of Isabella Weber, Oliver Blanchard, Claudia Sahm, among others, on “sellers’ inflation,” “profit inflation,” and “distributional conflict.”

2021), it may lose on the former. However, usually, the nominal exchange rate is negatively related to real economic activity, especially in emerging markets, when the former dominates. This implies a deceleration of purchasing power due to largely imported inflation, which eventually slows down the economy.

LNSHARE (local stock market index) is positive and statistically significant at the 1% level in FMOLS and CCR, but it is not significant in DOLS. The coefficient implies that a 1% increase in the local stock markets increases industrial production by about 39.9%, 26.1%, and 39.5% in FMOLS, DOLS, and CCR, respectively. Traditionally, a positive effect is expected, as confirmed by Matsumura et al. (2011) and Kuosmanen et al. (2015).

Table 4.9. Long-Run Results Using International Equity Index (MSCI)

	(1)	(2)	(3)
VARIABLES	FMOLS	DOLS	CCR
LNTSY_10YR	2.070***	2.513***	2.061***
	(0.319)	(0.467)	(0.361)
SPREAD	-0.242***	-0.295***	-0.242***
	(0.0359)	(0.0511)	(0.0400)
POL	-0.217***	-0.270***	-0.216***
	(0.0386)	(0.0542)	(0.0421)
CPI	0.0518***	0.0496***	0.0516***
	(0.0112)	(0.0136)	(0.0113)
LNEXCH	-0.0199	-0.0530	-0.0154
	(0.0632)	(0.0780)	(0.0641)
LNMSCI	0.482***	0.371***	0.483***
	(0.0945)	(0.140)	(0.107)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Using the LNMSCI (the international equity index) the results in Table 4.9 do not change significantly from those in Table 4.8, except that the nominal exchange rate is

not statistically significant. However, the MSCI is statistically significant at the 1% level in FMOLS, DOLS, and CCR, respectively. The coefficient indicates that a 1% increase in the MSCI implies a corresponding increase in the industrial production index by 48.2%, 37.1%, and 48.3% in FMOLS, DOLS, and CCR, respectively. The result is technically supported by Matsumura et al. (2011), Kuosmanen et al. (2015), and, especially Junttila and Vataja (2018), when controlled for a financial market benchmark index.

Table 4.10. Long-Run Results Using Oil (WTI)

	(1)	(2)	(3)
VARIABLES	FMOLS	DOLS	CCR
LNTSY_10YR	2.113***	2.607***	2.134***
	(0.311)	(0.449)	(0.372)
SPREAD	-0.240***	-0.288***	-0.243***
	(0.0389)	(0.0547)	(0.0456)
POL	-0.192***	-0.253***	-0.195***
	(0.0439)	(0.0611)	(0.0509)
CPI	0.00270	0.0173	0.00341
	(0.0153)	(0.0190)	(0.0165)
LNEXCH	0.176**	0.0797	0.174*
	(0.0884)	(0.116)	(0.0986)
LNOIL	0.316***	0.215**	0.311***
	(0.0587)	(0.0836)	(0.0692)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Similarly, using the LNOIL (global oil price) the results in Table 4.10 do not change significantly from those in Tables 4.8 and 4.9, except for the consumer price index and the nominal exchange rate. However, in this case, both the nominal exchange rate and the global oil price show positive relations with the industrial production index.

The positive coefficient of the nominal exchange rate indicates that a 1% increase leads to about 17.6%, 7.97%, and 17.4% increase in the industrial production index in FMOLS, DOLS, and CCR, respectively. It must be pointed out that the nominal exchange rate is only statistically significant at the 5% and 10% levels in FMOLS and CCR, respectively; it is not statistically significant in DOLS.

The positive coefficient in the oil suggests that a 1% increase leads to approximately 31.6%, 21.5%, and 31.1% increase in the industrial production index in FMOLS, DOLS, and CCR, respectively. The results are also statistically significant at the 1%, 5%, and 1% levels in FMOLS, DOLS, and CCR, respectively.

Some important observations are made in Table 4.10: When controlled for global oil prices, or when the local and international stock market indexes are replaced with the global oil prices, even though it is of little significance, the nominal exchange rate becomes positive; again, the oil price is positive; however, the yield spread, which is the target variable, is still negative. In the long run, it is expected that oil will positively impact industrial production, especially in emerging markets, with massive industrialization or huge manufacturing base, as they are better able to accommodate both exchange rate risk and energy price fluctuations through a mix of export-driven and capital control policies, which stimulate domestic production and increase foreign reserve. This dynamic has been comprehensively highlighted by Abdul-Rahman et al. (2023), Idilbi-Bayaa and Qadan (2021), and Idilbi-Bayaa and Qadan (2022).

CHAPTER V

CONCLUSIONS

5.1. Summary of Findings

The thesis explored the impact of the yield curve on the economic activity of the MSCI EM group of economies. It specifically examined the effect of movements in the spread on the industrial production indexes of MSCI EMs when controlled for changes in the local share prices, assessed the effect of movements in the yield spread on the industrial production indexes of MSCI EMs when controlled for changes in an international stock market index, and assessed the effect of movements in the yield spread on the industrial production indexes of MSCI EMs when controlled for changes in global oil prices. The study, therefore, employs three panel regression models; namely, Fully-Modified OLS (FMOLS), Dynamic OLS (DOLS), and Canonical Cointegrating Regression (CCR) estimators.

Firstly, the primary model's results show that the TSY_10YR, CPI, and S positively impact the INDP. Here, it implies an increase in these indicators will cause a corresponding increase in the industrial production index. However, the SPREAD, POL, and EXCH appear to be negatively related to the INDP, suggesting that when this set of indicators increase, there is a corresponding decrease in the industrial production index. The negative yield spread in this model reflects an inverted yield curve.

Secondly, the results show that, when controlled for an international equity index, i.e., the iShares MSCI EM index, we find that TSY_10YR, CPI, and the MSCI are positively related to the INDP, which implies that when these indicators increase, a corresponding rate of increase in the industrial production index occurs. However, the SPREAD, POL, and EXCH are negatively related to the INDP, suggesting that an increase in the SPREAD and POL is associated with a corresponding decrease in

the INDP. However, the EXCH is statistically insignificant in the FMOLS, DOLS, and CCR results. Most notably, the yield curve also inverts in this model.

Thirdly, the results show that, when the international equity index, i.e., the iShares MSCI EM index, is substituted with the global oil price, i.e., the West Texas Intermediate (WTI), we find that the TSY_10YR, CPI, EXCH and, now, the WTI positively impact the INDP, meaning that an increase in these indicators produces a corresponding increase in the INDP. Nevertheless, the SPREAD and POL negatively affect the INDP, which means an upswing in the SPREAD and POL is associated with a corresponding decrease in the INDP. In this model, the EXCH's statistical significance is established in the FMOLS and CCR results. However, the CPI is statistically insignificant in the FMOLS, DOLS, and CCR. Again, the results indicate an inverted yield curve in this model.

5.2. Conclusion

In all three long-run panel models, the yield spread is negatively related to the industrial production index, i.e., the proxy for economic activity. Hence, the negative yield spread reflects an inverted yield curve, which means that the yield curve's forecasting performance in the MSCI EMs group has decayed during the period understudied. This could occur as a result of factors such as higher interest rates on the short-end, including the benchmark policy rate, exchange rate and oil price fluctuations, and credit market frictions. Specifically, the result is robust to both the international equity market index and the global oil price. Among these empirical heterogeneous models, the primary model containing the local stock market index appears to give the best-expected outcome. The findings will interest policymakers, quantitative (portfolio) analysts, and other practitioners engaged in the technical analysis of the financial market.

5.3. Limitations of the Study

Access to relevant data for certain variables of other MSCI EMs has particularly limited the study to only nine (9) MSCI EMs, largely due to time and financial constraints. Again, critical time dummies have not been added to observe the effects

of the 2007/2008 GFC, 2012-2013 Greece debt crunch, and 2020-2021 COVID-19 pandemic.

5.4. Recommendation

The following policy and market recommendations are provided:

- i. Market participants should strive to avoid confusing market sentiment (i.e., “market animal spirits”) with the status of the economy.
- ii. Policymakers should stick to a broad-based, data-driven macro process, and keep in mind that getting the time lags right matters.
- iii. As controversial as it may sound, central banks in the MSCI EMs should target specific interest rates (i.e., short to long-term) to minimize, if not eliminate, the downside risks of credit market frictions, using the Yield Curve Control (YCC) tool.
- iv. The governments, through fiscal policy, should deploy automatic fiscal stabilizers such as the recently widely acclaimed “Job Guarantee” (JB) policy to stimulate their economies.

The following academic recommendations are proposed:

- i. Further studies could include time dummies to diagnose the effects of the 2007/2008 GFC, the 2012-2013 Greece debt crunch, and the 2020-2021 COVID-19 pandemic.
- ii. The 10-year long-term bond rate could be replaced with the 5-year long-term bond rate to check the accuracy of the yield spread in measuring the economic activity of the MSCI EM.

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APPENDIXES

APPENDIX A

TRENDS

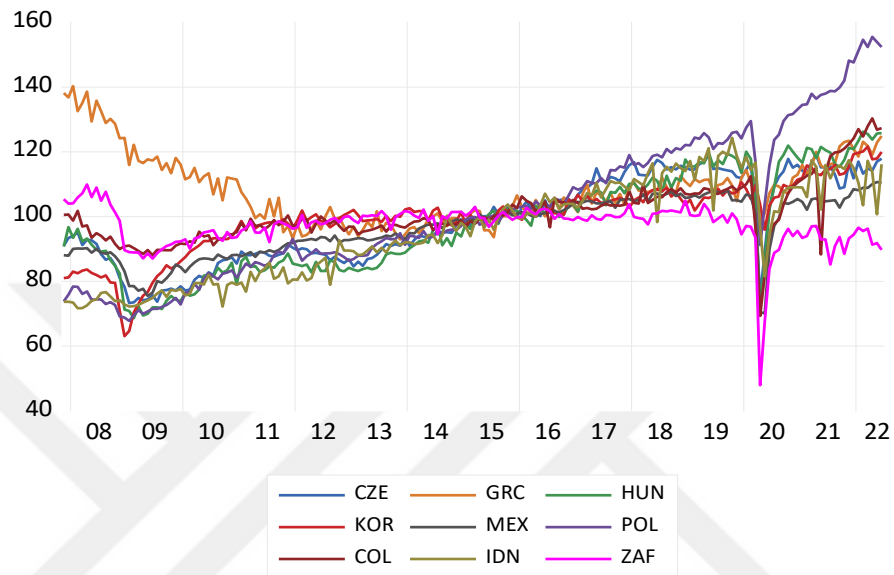


Figure A.1. Industrial Production Index (INDP)

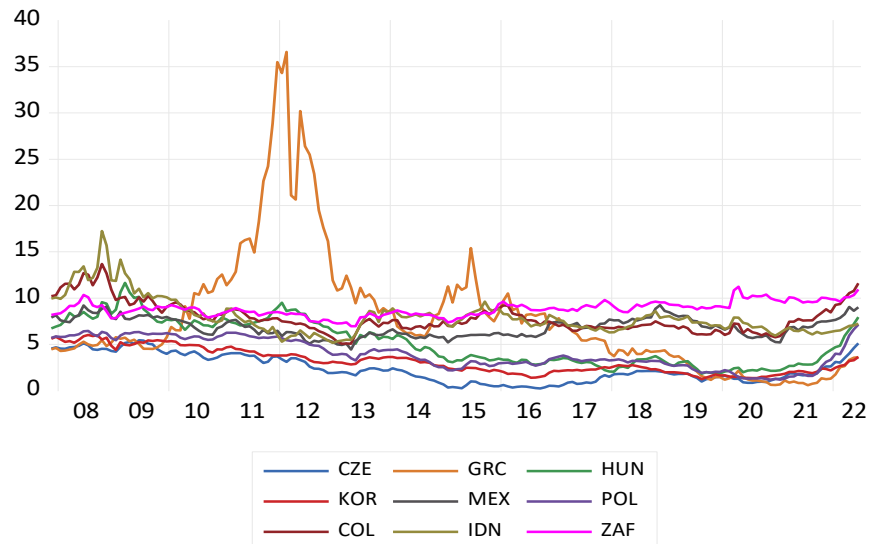


Figure A.2. 10-Year Long-Term Bond Rate (TSY_10YR)

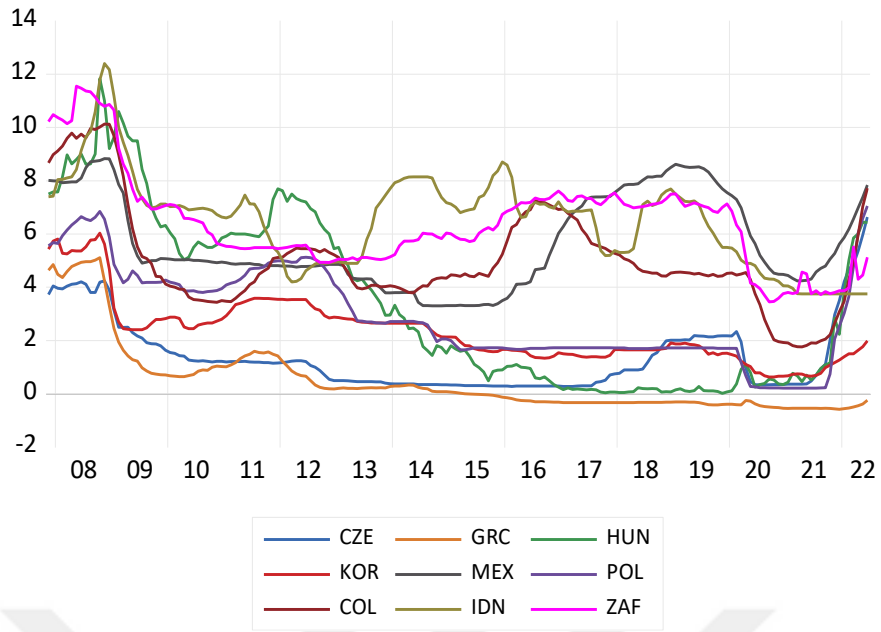


Figure A.3. 3-Month Short-Term Bond Rate (TSY_3M)

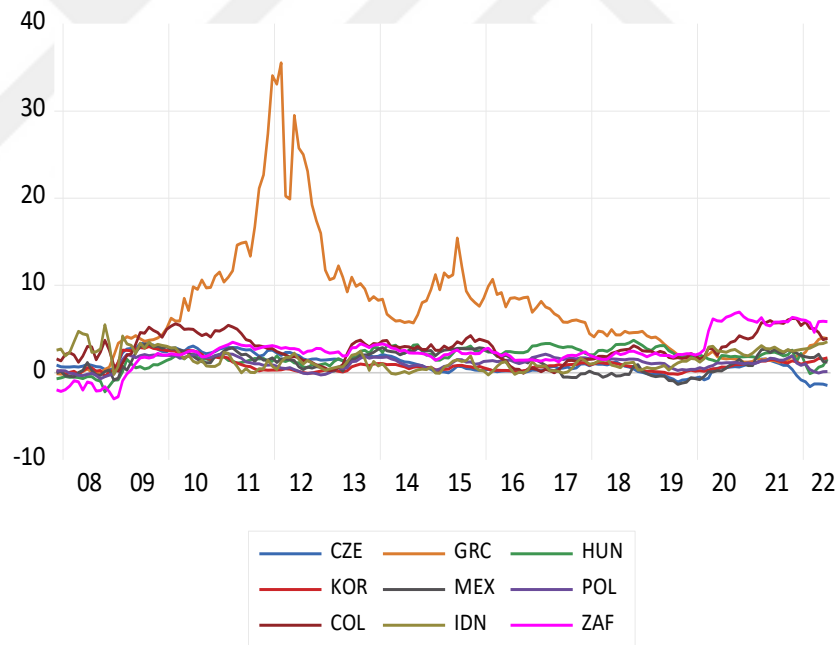


Figure A.4. Yield Spread (SPREAD)

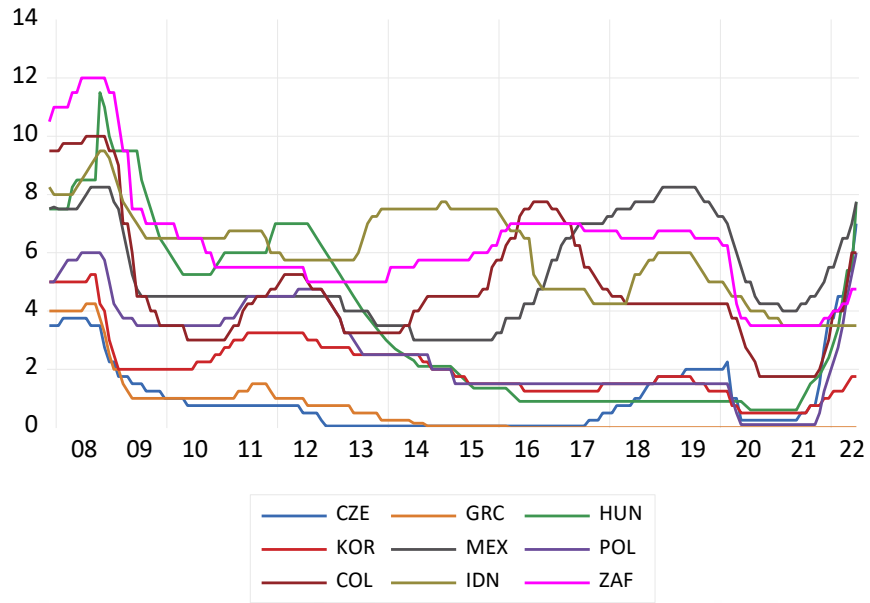


Figure A.5. Central Bank Monetary Policy Rate (POL)

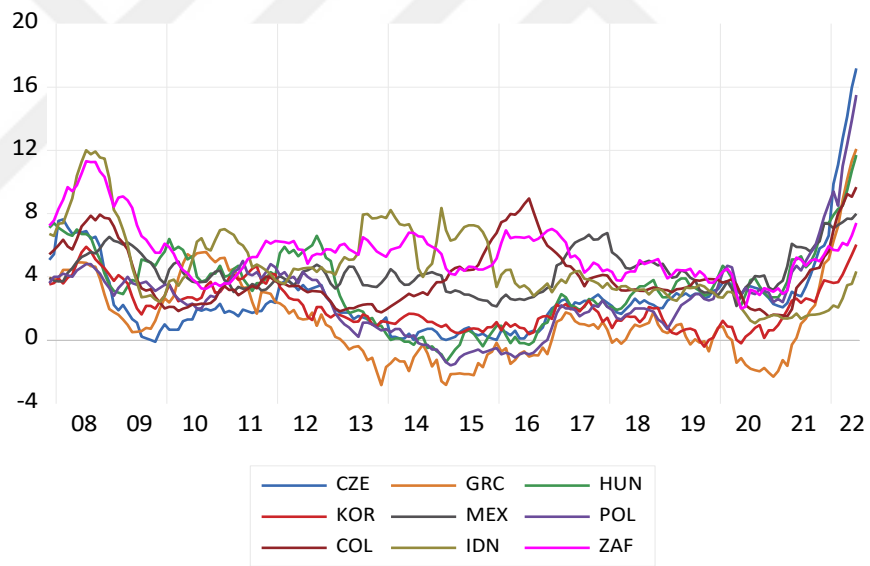


Figure A.6. Inflation-Consumer Price Index (CPI)

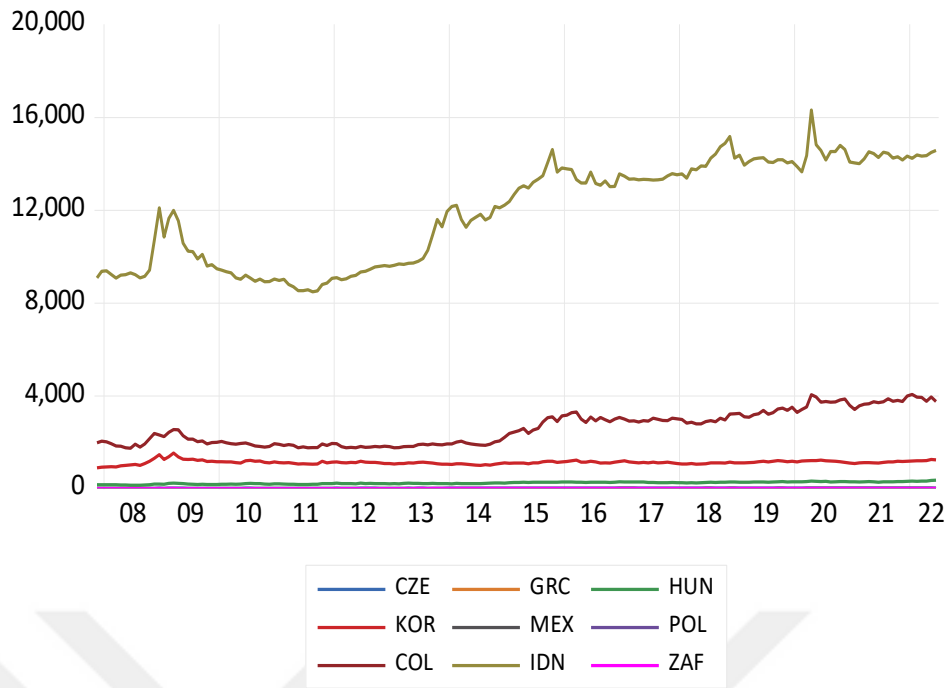


Figure A.7. Nominal Exchange Rate (EXCH)

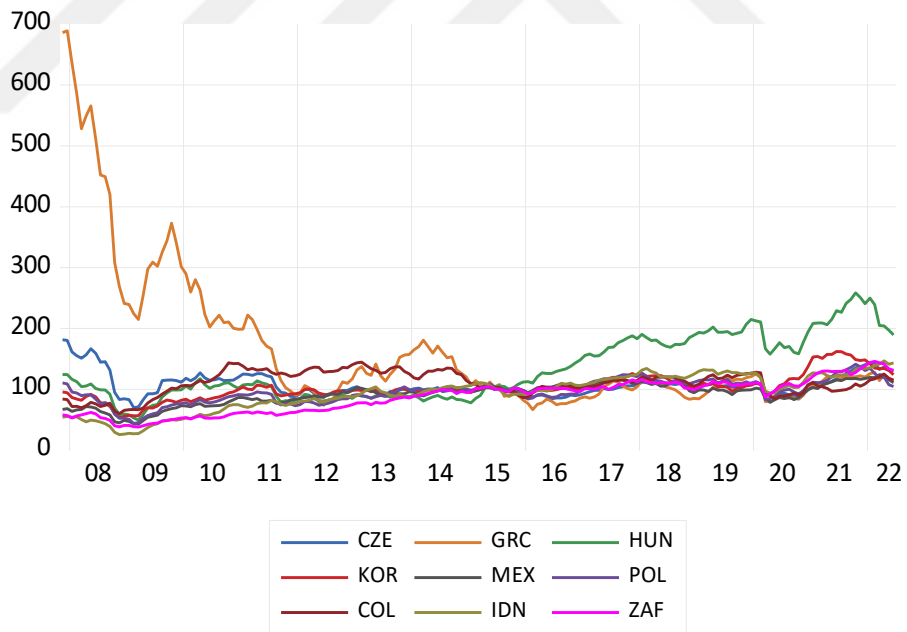


Figure A.8. Local Stock Market Index (S)

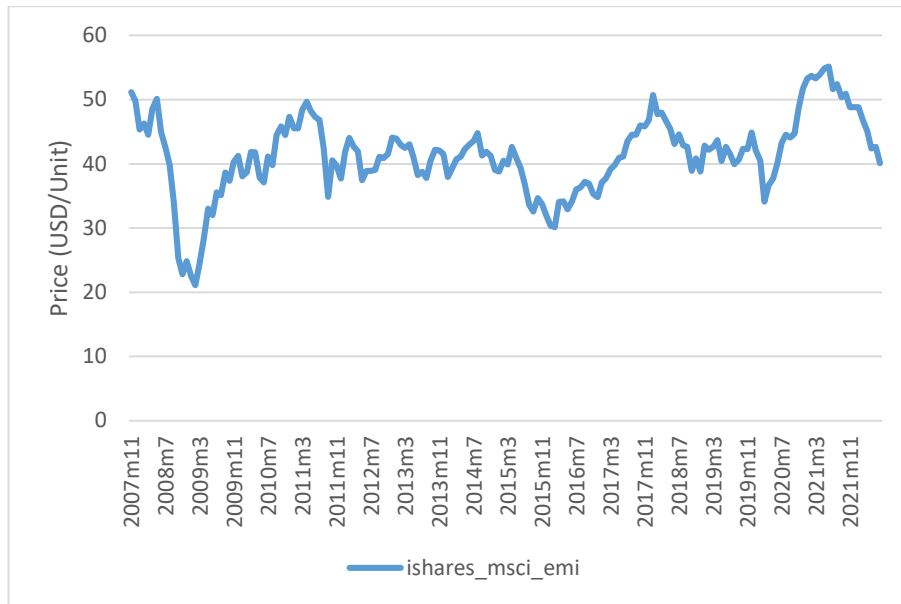


Figure A.9. iShares MSCI EM Index (MSCI)

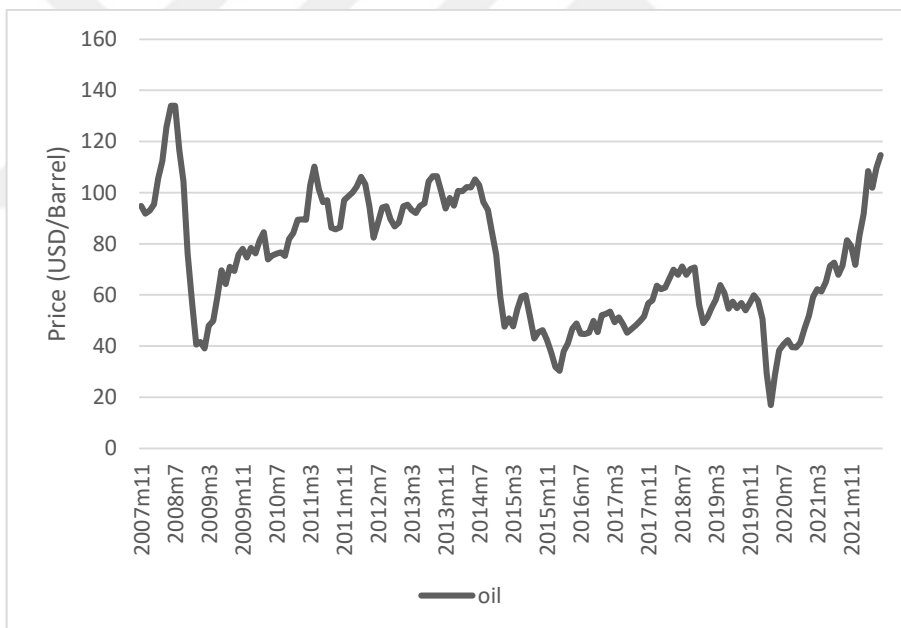


Figure A.10. Oil (WTI)

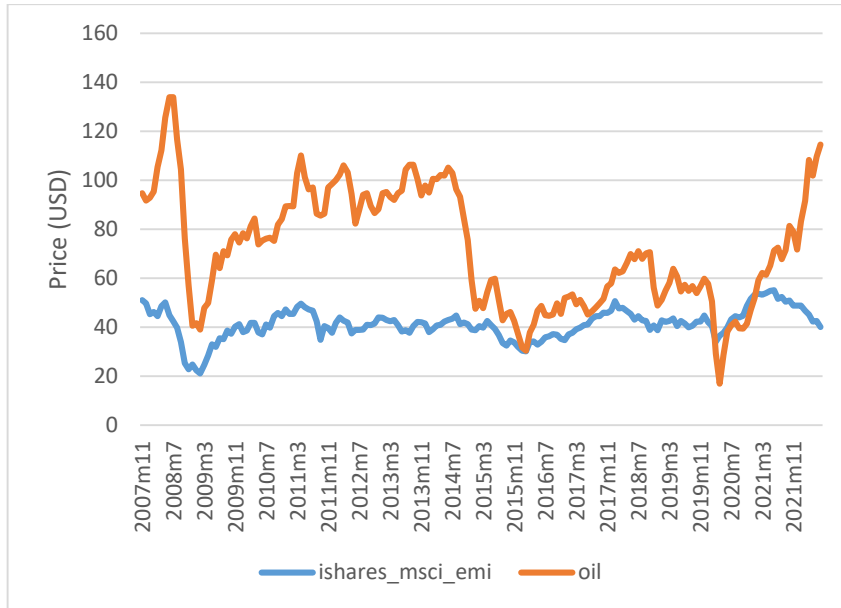


Figure A.11. iShares MSCI EM Index vs. WTI Oil

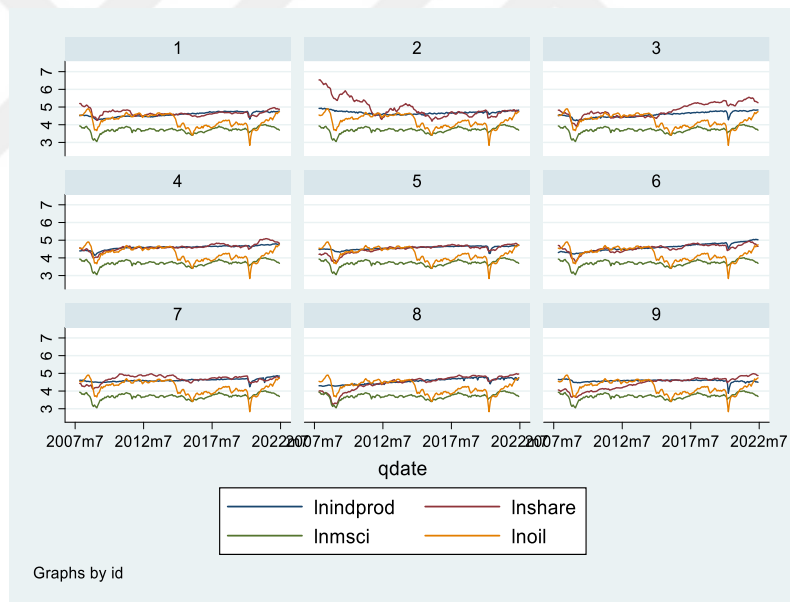


Figure A.12. Real Sector Indicators

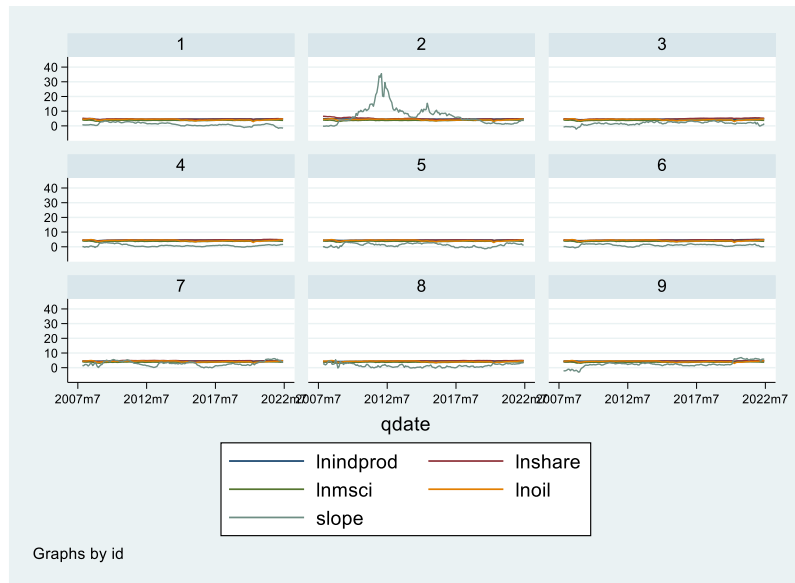


Figure A.13. Real Sector Indicators vs. The Slope of the Yield Curve (Yield Spread)

APPENDIX B

Table B.1. CD Test Results for Individual Variables

Variable	CD-test	p-value	corr	abs(corr)
Lnindprod	42.310	0.000	0.532	0.561
Lntsy_10yr	28.730	0.000	0.361	0.471
Slope	16.090	0.000	0.202	0.294
Policy	42.010	0.000	0.528	0.534
Cpi	34.710	0.000	0.436	0.452
Lnexch	31.850	0.000	0.400	0.766
Lnshare	28.290	0.000	0.355	0.569
Lnmsci	79.600	0.000	1.000	1.000
Lnoil	79.600	0.000	1.000	1.000

**Table B.2. Westerlund Test for Cointegration 1 and 2
(All Panels and Some Panels)**

Westerlund 1	Statistic	p-value
Eqn. 1	-0.5750	0.2827
Eqn. 2	-0.6995	0.2421
Eqn. 3	0.1087	0.4567
Westerlund 2		
Eqn. 1	-1.1603	0.1230
Eqn. 2	-0.7764	0.2188
Eqn. 3	-0.0149	0.4941

Table B.3. Pedroni Test for Cointegration

Eqn. 1	Statistic	p-value
Modified Phillips–Perron t	-11.6771	0.0000
Phillips–Perron t	-11.6800	0.0000
Augmented Dickey–Fuller t	-11.9209	0.0000

Table B.3. (cont.)

Eqn. 2		
Modified Phillips–Perron t	-11.0552	0.0000
Phillips–Perron t	-10.7939	0.0000
Augmented Dickey–Fuller t	-10.9407	0.0000
Eqn. 3		
Modified Phillips–Perron t	-9.6547	0.0000
Phillips–Perron t	-9.6712	0.0000
Augmented Dickey–Fuller t	-9.9095	0.0000

Table B.4. Kao Test for Cointegration

Eqn. 1	Statistic	p-value
Modified Dickey–Fuller t	-9.7331	0.0000
Dickey–Fuller t	-5.8359	0.0000
Augmented Dickey–Fuller t	-4.3196	0.0000
Unadjusted modified Dickey–Fuller t	-17.8947	0.0000
Unadjusted Dickey–Fuller t	-7.3044	0.0000
Eqn. 2		
Modified Dickey–Fuller t	-10.7214	0.0000
Dickey–Fuller t	-6.3092	0.0000
Augmented Dickey–Fuller t	-4.5205	0.0000
Unadjusted modified Dickey–Fuller t	-19.3192	0.0000
Unadjusted Dickey–Fuller t	-7.7526	0.0000
Eqn. 3		
Modified Dickey–Fuller t	-8.2921	0.0000
Dickey–Fuller t	-5.1515	0.0000
Augmented Dickey–Fuller t	-3.7650	0.0001
Unadjusted modified Dickey–Fuller t	-14.7999	0.0000
Unadjusted Dickey–Fuller t	-6.4466	0.0000

APPENDIX C

COUNTRY RATINGS

Table C.1. S and P Credit Rating

Country (Code)	Currency	Short-Term	Long-Term	Outlook
Czech Republic (CZE)	Czech Koruna (CZK)	A-1+	AA-	Stable
Greece (GRC)	Euro (EUR)	B	BB+	Positive
Hungary (HUN)	Hungarian Forint (HUF)	A-	BBB-	Stable
Korea (KOR)	South Korean Won (KRW)	A-1+	AA	Stable
Mexico (MEX)	Mexican Peso (MXN)	A-2	BBB	Stable
Poland (POL)	Polish Zloty (PLN)	A-2	A-	Stable
Colombia (COL)	Colombian Peso (COP)	B	BB+	Stable
Indonesia (IDN)	Indonesian Rupiah (IDR)	A-2	BBB	Stable
South Africa (ZAF)	South African Rand (ZAR)	B	BB-	Stable

Source: Refinitiv, June 2023

Table C.2. StarMine Risk Assessment

Country (Code)	Country (+ Political) Risk	Implied Rating
Czech Republic (CZE)	0.689	AA+
Greece (GRC)	0.388	B
Hungary (HUN)	0.378	A-
Korea (KOR)	0.721	AA

Source: Refinitiv, June 2023

Table C.2. (cont.)

Mexico (MEX)	-0.051	BBB
Poland (POL)	0.476	A
Colombia (COL)	0.086	BB
Indonesia (IDN)	0.201	BBB
South Africa (ZAF)	0.118	BB-



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