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EMPIRICAL ANALYSIS OF TRADE INTEGRATION, MACROECONOMIC SHOCKS AND INDUSTRIAL GROWTH IN WEST AFRICAN MONETARY ZONE: EVIDENCE FROM PANEL VECTOR AUTO-REGRESSION

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ABSTRACT

In a global economy with growing interdependencies among economic sectors, firms and countries, trade and industrial development could be achieved through greater integration and liberalization. This paper sets out to analyze empirically the contemporaneous industrial interdependence and, transmission of trade and macroeconomic shocks in countries of the West African Monetary Zone (WAMZ), namely Gambia, Ghana, Guinea, Liberia, West African Monetary Zone and Sierra Leone. The aim of the paper is to examine industrial

Introduction

Over the decades industrialization and international trade have been construed as the most important engines of growth for many countries. Industrialization connotes the process of transforming raw materials, with the aid of human resources and capital goods into consumer goods new capital goods and, social overhead capital, which in conglomeration with human resources provides new services to both individuals and businesses. It keeps pace whenever production is carried out based on the use of machines and fabricated tools. It involves the application of scientific methods to solving problems, mechanization and a factory system, the division of labor, the growth of the money economy, and the increased mobility of the labour force both geographically and socially. Hence, industrialization is guaranteed when there is a systematic policy measure to steer resources into the productive process, so that eventually growth of output is generated through the growth of productivity (Effiom and Udah, 2014). This therefore, explains logically the nexus between industrialization and growth of an economy.

Countries nowadays are increasingly internationally interwoven through trade and capital flows. The rapidly increasing trade

interdependence and, transmission of trade and macroeconomic shocks among the member countries. The paper utilizes quarterly data on trade openness, index of industrial production, foreign direct investment and international crude oil price. The paper adopts panel vector autoregressive model. The results of the Orthogonalized Impulse Response Functions (OIRFs) and Forecast Error PVARiance Decomposition (FEVD) are expected to reveal evidence of industrial interdependence and, transmission of macroeconomic and trade shocks among countries in the panel. It is hoped that the results would be suggestive of the extent and degree of industrial interdependence, macroeconomic and trade integration of the WAMZ countries over the sample period. The policy implication of the results is that common and countryspecific shocks would serve as a didactic policy guide for the countries towards implementing suitable industrial, trade and macroeconomic policies for attaining greater industrial growth.

KEYWORDS: *Trade integration, Industrial Interdependence, Panel Vector Auto-regression*

interdependencies among countries all over the world can be considered as an outcome of globalization. However, given the growing interdependencies among economic sectors, firms and countries, trade and industrial development could be achieved through greater trade integration and liberalization. Macro-economic policy analysis and formulation does require taking into cognizance the interdependencies that exist across markets and countries, hence, national economic issues need to be viewed from a global perspective (Dees et al., 2007). However, trade provides an anchor for building a common currency zone as trade integration creates the trans-national political and economic infrastructure required for an effective monetary union. Intra-regional trade agreements can be adopted without restricting monetary policy flexibility (Nnanna, 2006).This paper is a didactical empirical analysis of the contemporaneous industrial interdependence and, transmission of trade and macroeconomic shocks in countries of the West African Monetary Zone (WAMZ), namely Gambia, Ghana, Guinea, Liberia, West African Monetary Zone and Sierra Leone. The aim of the paper is to pedagogically pore-over the industrial interdependence and, transmission of trade and macroeconomic shocks among the member countries. The paper is organized into five sections. The first section is introduction, the second section conducts literature review, the third section presents the econometric methodology employed to achieve the objectives of the paper, the fourth section presents and discusses the empirical results and lastly, the fifth section concludes the paper.

Theoretical Literature

It is noteworthy that models or theories of industrialization are essentially intertwined and related to economic growth and development. An industrializing economy is basically one which experiences continuous economic growth, which is why industrialization is regarded as an imperative for growth. Hence, in discussing models of industrialization, it is instructive to formalize the theories of economic growth. From the classical and neo classical models to the Rostovian,

Gerschenkron's backwardness, as well as the technology gap models, through to the Washington Consensus and Beijing models, economies have passed through different growth trends and trajectories contingent upon the models adopted. Currently, emphasis has shifted away from the more fundamental neoclassical paradigm of capital labor combinations to endogenous models which underscore the primacy of institutions and a knowledge-driven economy as the basis of industrial and economic development(Effiom and Udah, 2014)

In theory, trade is the lynchpin to creating a common currency area, because trade integration creates the trans-national political and economic infrastructure required for an effective monetary union. Intra-regional trade agreements can be adopted without restricting monetary policy flexibility. As against monetary unions, trade unions preferably permit members to enjoy communal benefits of preferential treatment without sacrificing the benefits of monetary policy autonomy (Nnanna, 2006). However, an overview on economic and monetary integration is essentially predicated on the Optimum Currency Area (OCA). The OCA is a useful starting point for any discussion on regional integration (Nnanna, 2006). It addresses the central question of whether a monetary union should be pursued. Mundell (1961) defines the optimum currency area as a region in which factors of production are internally mobile but internationally immobile, so as to facilitate the intraregional redistribution of resources in reaction to demand shifts. Kaboub(2001) sees it as the optimum geographical domain having as a general means of payment either, a single common currency, or several currencies whose exchange values are immutably pegged to one another with unlimited convertibility for both current and capital transactions, but whose exchange rates fluctuate in unison against the rest of the world.

The first feature of an OCA is price and wage flexibility, which was the basis for Friedman's argument in favor of flexible exchange rates. A second characteristic of an OCA is that of financial market integration, suggesting that a successful currency area must be sufficiently integrated in financial trading. The third characteristic is that of factor market integration. This includes internal factor mobility, both inter-regional and inter-industry mobility. The fourth is the integration of the goods market, suggesting that a successful currency area must have a high degree of internal openness that could be measured by the marginal propensity to import, or the ratio of tradable to non-tradable goods in production or consumption. An OCA requires a close coordination of national monetary authorities or even the creation of a supranational central bank,which implies the surrendering of the national sovereignty over the conduct of monetary policy.

McKinnon (1963) expands the theory of OCA and incorporated the trade factors. By demonstrating the influence of openness in a currency area, he opined that considerations of a country's trade behavior are essential in determining optimality. Specifically, he noted that "if we move across the spectrum from closed to open economies, flexible exchange rates become both less effective as a control device for external balance and more damaging to internal price-level stability". On the issue of financial credibility, he underscored the importance of liquidity where capital accumulation depends on confidence in the domestic currency. Alluding to the common currency of America's fifty states as an example, he noted that small areas are more in need of a fixed exchange rate to assure that individual currencies remain liquid, particularly in cases where intra-regional trade is extensive.

Frankel and Rose (1998) introduced the notion of endogeneity. They submitted that a group of countries that does not qualify as an OCA *ex ante*, may evolve into one *ex post*, by virtue of adopting a common currency. They contend that countries with closer trade links tend to have more tightly correlated business cycles and thus, would converge towards the ideal conditions for monetary integration. This observation undermines conventional OCA theory, as it proves difficult to rule out potential common currency regions on the basis of their shortcomings.

Empirical Literature

Athina and Athanasios (2014) investigates the symmetry of shocks and trade integration on aggregate supply and aggregate demand shocks across the enlarged European Union (EU) using quarterly data drawn from Eurostat (KRONOS) covering the period$1995Q_1$-$2005Q_5$m. Demand and supply shocks are identified from real-output-growth and GDP-deflator-growth data using the Blanchard-Quah structural PVARs methodology. The overall trade intensity is found to have a positive impact on the correlation of both demand and supply shocks across the EU economies. Intra-industry trade is found to be positively linked to the correlation of supply-sides hocks but negatively linked to the correlation of aggregate demand shocks. Their findings conclude that tradestrongly affects the international transmission of business cycles but the way inwhich this occursdepends onthesource ofthe disturbance and suggesting that increased overall trade, andthushigher bilateral trade intensities, has on balance correlation-increasingeffects throughinternational spillovers, via productivity andspending channels. Therefore, the result provides evidence insupportofa Frankel-Rose type ofeffect, rather than a Krugman-type effect, regarding the association between increased tradeand cross-country business-cycle symmetry.

An online article titled *Does Growing Regional Integration Make Asian Economies Move More in Sync?(2013) investigates whether the growing regional integration make Asian economies move more in Sync. The finding of the study revealed that*trade openness among the regional integration has increased more rapidly in Asia than elsewhere since 1990, andso has intraregional trade, although these trends have come to a halt since the mid–2000s and this is the case even after netting out trade in intermediate inputs by using value-added trade data—which take into account the increasingly important supply chain networks across the globe and the regionrather than gross trade data while the degree of intra-industry trade has barely increased across Asia but, on average, it is slightly higher than in the rest of the world. However, for ASEAN-5 the effect of having a similar industrial structure could be a more important factor in driving synchronization. Indeed, ASEAN-5 faces higher intra-industry trade and higher correlation between trade specializations—although the latter has declined since the 1990s, possibly reflecting increased specialization along the regional supply chain. This would mean that if most shocks are industry-specific, cycles should co-move more in ASEAN-5 than elsewhere.

Christian and Yanqun (2013) studied the economic integration of China as regards its effects on growth and inflation in industrial countries. Using quarterly data from International Financial Statistics for the period $1979Q_1$ to $2009Q_4$ and a Global Vector Autoregression (GPVAR) econometric techniques they modeled and estimated the interdependencies between the business cycles in China and industrial countries, including the US, the euro area and Japan. The results revealed that the impact of economic integration on GDP growth in the advanced economies was substantial for the Asian

region. Nonetheless, the expansionary effects on the US and the euro area from the impulse response functions have been found to be much lower and decreased due to rising inflation pressure.

Ayhan, et al. (2004) carried out a study on the effects of trade and financial integration on Growth and macroeconomic volatility of the U.S. They examined the relationship in the context of globalization. The results delineated that international trade and financial integration that has intensified since the mid-1980s in the United States. They found that while the basic negative association between growth and volatility had been preserved during the 1990s, both trade and financial integration significantly weakened this negative relationship. Specifically, they found that the estimated coefficient on the interaction between volatility and trade integration is significantly positive.

Sebnemet al. (2001) conducted a study on the economic integration, industrial specialization, and the asymmetry of macroeconomic fluctuations among the OECD countries for the period 1977–1994 using simple stylized model. The results revealed that the OECD countries and the US have higher industrial specialization which exhibits output shocks that are less correlated on average with the aggregate OECD as well as the US output. Fielding and Shields (2001) applied the OCA theory to the two francophone monetary unions. The study adopted PVAR model and focused on shocks to aggregate output growth and to aggregate price inflation. The results indicated that if a lot of weight was put on the importance of initial output shocks in assessing the cost and benefit of the monetary union and less on price shocks, then the CFA area should be reorganized and that Cote d'Ivoire and Mali should form one monetary union, with other CFA member states coming together to form another union. The cost of CFA membership in terms of lost monetary autonomy would be larger than in a world where a monetary response to a shock is immediate. The study concluded that the cost of monetary union membership would depend on the extent to which price and output shocks are correlated across countries and the degree of similarity in the long run effect of the shocks on the macro-economy.

Anyanwu (2003) used panel data from the Economic and Monetary Union of West Africa(UEMOA) and non-UEMOA ECOWAS countries to determine whether the monetary union has brought about price and output, fiscal and trade stabilization during the period 1990-2001. The results indicated that economic growth and stability was greater in the West African Economic and Monetary Union (WAEMU) countries than in the nonWAEMU countries during the study period, but the reverse was the case for inflation. Inflation in the WAEMU region was higher than in the non-WAEMU region.

Studies that apply the gravity model of trade appear to have found a robust support for monetary integration these include inter alia Rose (2000), Engel and Rose (2002) as well as Frankel and Rose (2002) have generated a substantial literature on the relationship between currency integration and intraregional trade. The conclusion of these studies is that the use of a common currency increases trade by threefold.

Empirical Methodology

We consider a K PVARiate panel PVAR of order p with panel-specific fixed effects represented by the following system of linear equations:

$$\boldsymbol{Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + \cdots + Y_{it-p+1}A_{p-1} + Y_{it-p}A_p + X_{it}B + u_{it} + e_{it}}$$

$$i \in \{1,2,\dots,N\}, t \in \{1,2,\dots,T_i\}$$

The parameters above may be estimated jointly with the fixed effects or, alternatively, independently of the fixed effects after some transformation, using equation-by-equation ordinary least squares (OLS). With the presence of lagged dependent PVARiables in the right-hand side of the system of equations, however, estimates would be biased even with large (Nickell, 1981). PVARious estimators based on GMM have been proposed to calculate consistent estimates of the above equation, especially in fixed and large settings.4 With our assumption that errors are serially uncorrelated, the first-difference transformation may be consistently estimated equation-by-equation.

$$Y_{it}^{*} = \overline{Y_{it}^{*}}A + e_{it}^{*}$$

$$Y_{it}^{*} = [y_{it}^{1*} \quad y_{it}^{2*} \quad \dots \quad y_{it}^{k-1*} \quad y_{it}^{k*}]$$

$$\overline{Y_{it}^{*}} = [Y_{it-1}^{*} \quad Y_{it-2}^{*} \quad \dots \quad Y_{it-p+1}^{*} \quad Y_{it-p}^{*} \quad X_{it}^{*}]$$

$$e_{it}^{*} = [e_{it}^{1*} \quad e_{it}^{2*} \quad \dots \quad e_{it}^{k-1*} \quad e_{it}^{k*}]$$

$$A' = [A_1' \quad A_2' \quad \dots \quad A_{p-1}' \quad A_p' \quad B']$$

The GMM estimator is given by

$$A = (\overline{Y^{*\prime}Z}\,\widehat{W}\,\overline{Z'Y^{*}})^{-1}(\overline{Y^{*\prime}Z}\,\widehat{W}\,\overline{Z'Y^{*}})$$

Applying Andrews and Lu's MMSC to the GMM estimator in (3), their proposed criteria select the pair of vectors (p, q) that minimizes

$$MMSC_{BIC,n}(k,p,q) = J_n(k^2p,k^2q) - (|q| - |p|)k^2 \ln n$$

$$MMSC_{AIC,n}(k,p,q) = J_n(k^2p,k^2q) - 2k^2(|q| - |p|)$$

$$MMSC_{HQIC,n}(p,q) = J_n(k^2p,k^2q) - Rk^2(|q| - |p|)\ln\ln n, \qquad R > 2$$

Lutkepohl (2005) and Hamilton (1994) both show that a PVAR model is stable if all moduli of the companion matrix are strictly less than one, where the companion matrix is formed by

$$\overline{A} = \begin{bmatrix} A_1 & A_2 & \cdots & A_p & A_{p-1} \\ I_k & 0_k & \cdots & 0_k & 0_k \\ 0_k & I_k & \cdots & 0_k & 0_k \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0_k & 0_k & \cdots & I_k & 0_k \end{bmatrix}$$

Stability implies that the panel PVAR is invertible and has an infinite-order vector moving-average (VMA) representation, providing known interpretation to estimated impulse-response functions

and forecast terror PVARiance decompositions. The simple impulse-response function may be computed by rewriting the model as an infinite vector moving-average, where are the VMA parameters.

$$\Phi_i = \begin{cases} I_k , & i = 0 \\ \sum_{j=1}^{i} \Phi_{t-j} A_j , & i = 1, 2, .. \end{cases}$$

The *h*-step ahead forecast-error can be expressed as

$$Y_{it+h} - E[Y_{it+h}] = \sum_{i=0}^{h-1} e_{i(t+h-i)} \Phi_i$$

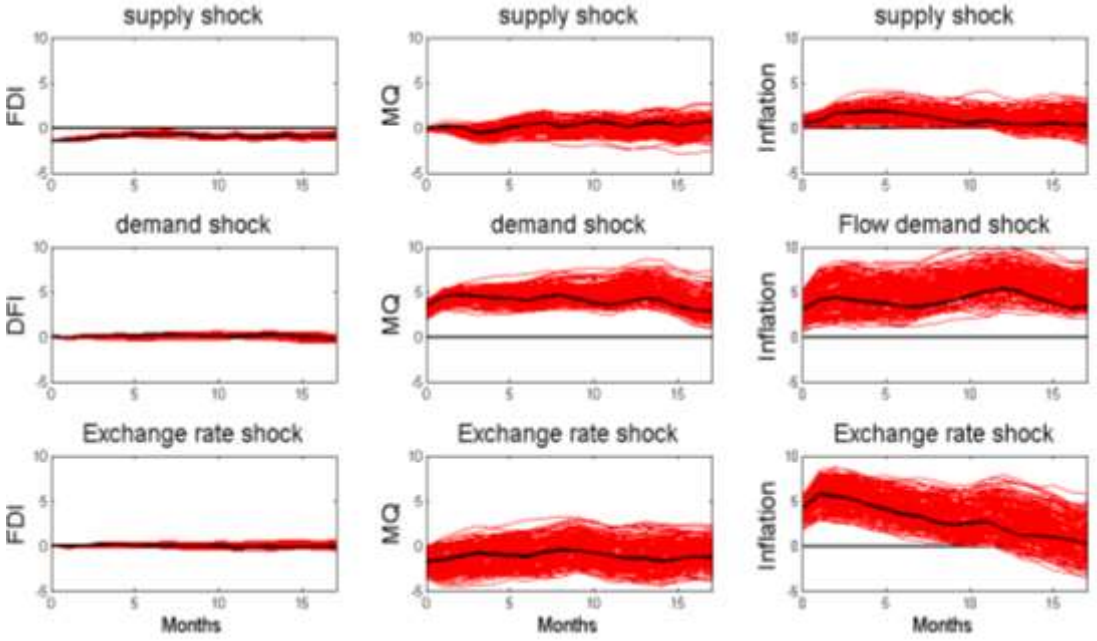
Similar to impulse-response functions, confidence intervals may be derived analytically or estimated using PVARious resampling techniques.

Discussion of Findings

Sign Identified Structural Impulse Response Analysis

Following the table presented above, the estimates of structural impulse response function is defined in terms of the responses.

Figure 0-1 Structural Impulse Response in WAMZ



Following Inoue and Kilian (2013) and related studies in the literature, we specify a PVAR (2) model with intercept. The model is estimated on annual data for 1986-2016. Figure 1 plots the structural

responses. The responses have been normalized such that each structural shock implies an increase in the demand. The response of index of trade integration WAMZ is obtained by cumulating the responses of its growth rate.

All structural response function estimates are consistent with standard economic intuition. For example, a negative flow supply shock is associated with a persistent decline in index of trade integration, a modest increase in the index of industrial production, and a short-lived decline in inflation from the panel of WAMZ.

A positive flow demand shock is associated with a persistent and hump-shaped response in both index of industrial production and inflation and with little response in index of trade integration. Exchange rate shocks (such as shocks to depreciation) cause a temporary increase in the index of industrial production, a persistent decline in inflation and little response in index of trade integration from the panel of WAMZ. The corresponding credible sets indicate considerable uncertainty about the price responses and to a lesser extent for the responses in index of industrial production, whereas the credible sets for index of trade integration responses are quite narrow. Nevertheless, several response functions are precisely enough estimated to conclude that the response differs from zero. Figure 1 also illustrates that the responses of the most likely model need not be near the centre of the credible set.

Forecast Error Variance Decomposition

A second practically important question that a structural PVAR model can answer is how much of the forecast error variance or prediction mean squared error (MSPE) of y_{t+h} at horizon $h = 0, 1, \ldots, H$ is accounted for by each structural shock wkt, $k = 1, \ldots, K$. In a stationary model, the limit of the forecast error variance decomposition, as $h \to \infty$, is the variance decomposition of yt because the forecast error covariance matrix converges to the unconditional covariance matrix of yt.

Table 4.4.3.1: Forecast Error Variance Decomposition

Horizon Shock	Supply Shock	Demand Shock	Exchange Rate	Shock Residual
1	0.2	02	1.7	98.0
2	0.6	0.5	2.1	97.0
3	0.8	0.5	2.1	96.6
12	2.8	6.8	4.5	85.8
∞	6.6	8.4	7.9	77.1

Source:

Ignoring rounding error, the entries in each row of the table sum to 100% by construction. The entries for horizon ∞ represent the variance decomposition of ITI growth in West African Monetary Zone. In practice, we can approximate ∞ by a very large number. This number is determined by showing that further increments to the horizon do not change the results up to the desired degree of accuracy.

In studying forecast error variance decompositions, one often is interested in the patterns across horizons. In this analysis, we learn that the supply shock and the two other shocks, demand shocks

and exchange rate shock combined account for only 2% of the MSPE of ITI influx growth at the one-month horizon, but that their explanatory power increases to 23% in the long-run. One may also be interested in the relative contribution of different shocks at a given horizon. For example, whereas at the one-month horizon oil specific demand shocks are much more important than supply shocks or aggregate demand shocks in explaining the forecast error variance of ITI growth, each demand and supply shock accounts for about the same share of the unconditional variance.

Historical Decomposition

Structural forecast error variance decompositions and structural impulse response functions describe the average movements in the data. They represent unconditional expectations. Sometimes we are interested instead in quantifying how much a given structural shock explains of the historically observed fluctuations in the PVAR variables. In other words, we would like to know the cumulative effect of a given structural shock on each variable at every given point in time. For example, we may not be interested in the average contribution of monetary policy shocks to the variability of ITI growth over the last decades.

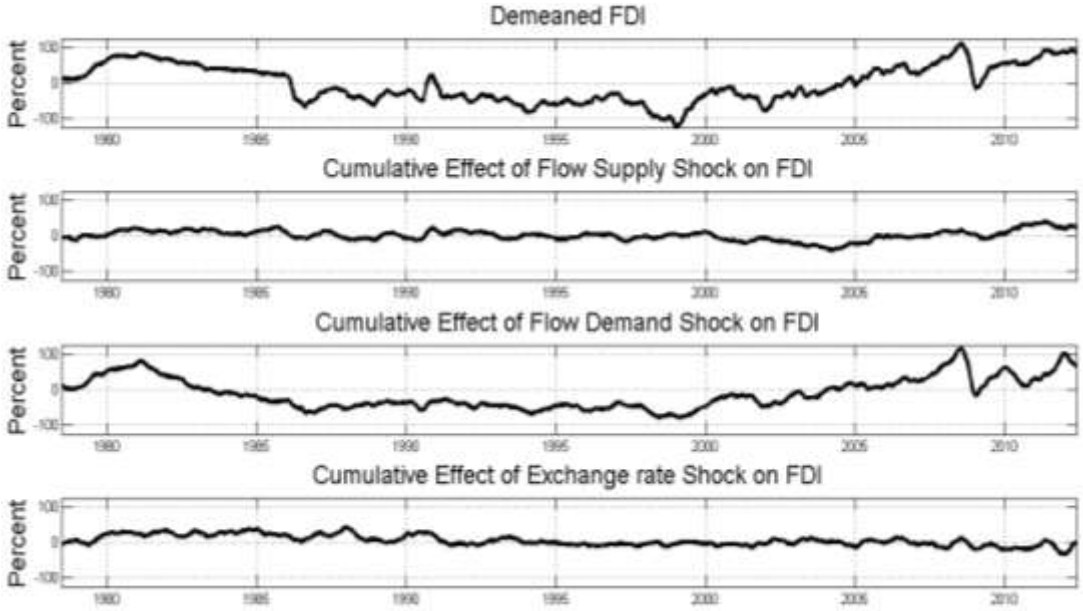
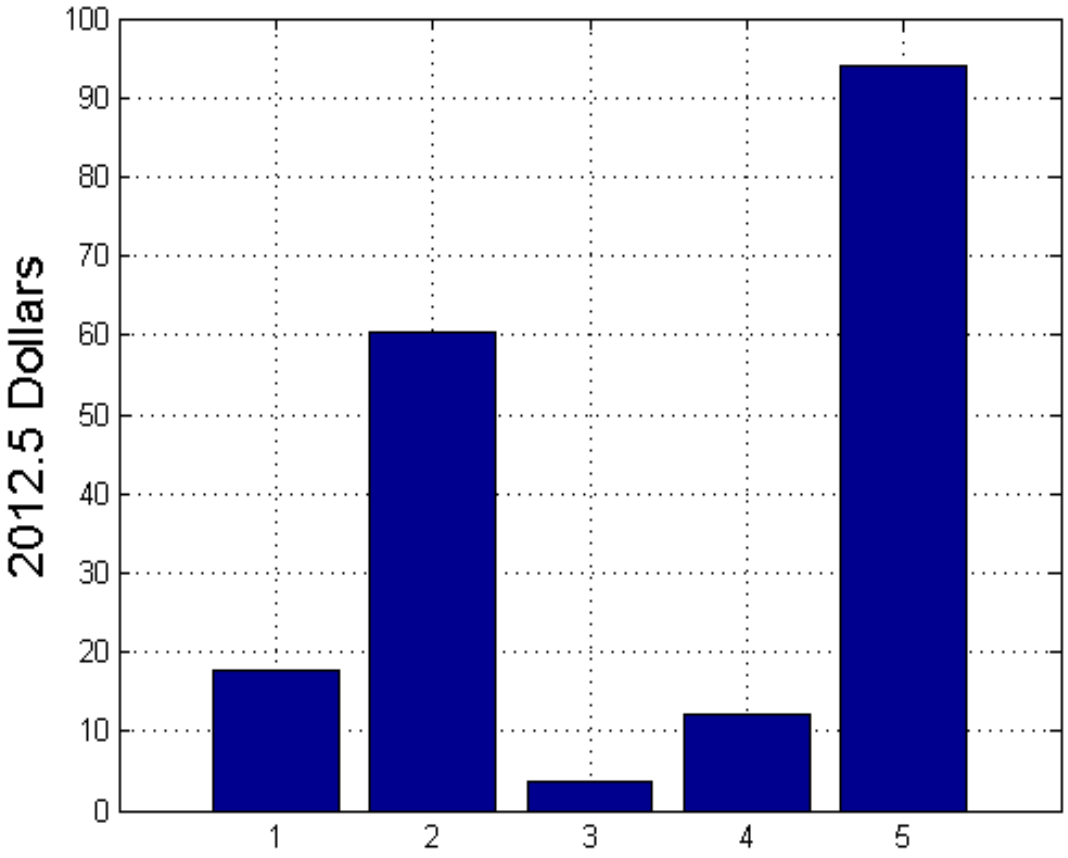


Figure 4.2 illustrates the use of historical decompositions in understanding the evolution of the ITI influx from the late 1980s to early 2016. The motivation is based on a global oil market model studied in Kilian and Lee (2014). This structural model attributes variation in the ITI to shocks to the flow supply, shocks to the flow demand, and exchange rate shock, and a residual shock designed to capture various idiosyncratic shocks.

Figure focuses on the role of the structural shocks that have an explicit economic interpretation under the maintained assumption that the log differenced of ITI is an *I*(0) time series during the estimation period. It shows that much of this surge (as well as the collapse of the ITI in late 2008 and its recovery since then) must be attributed to the effects of flow demand shocks. Neither flow

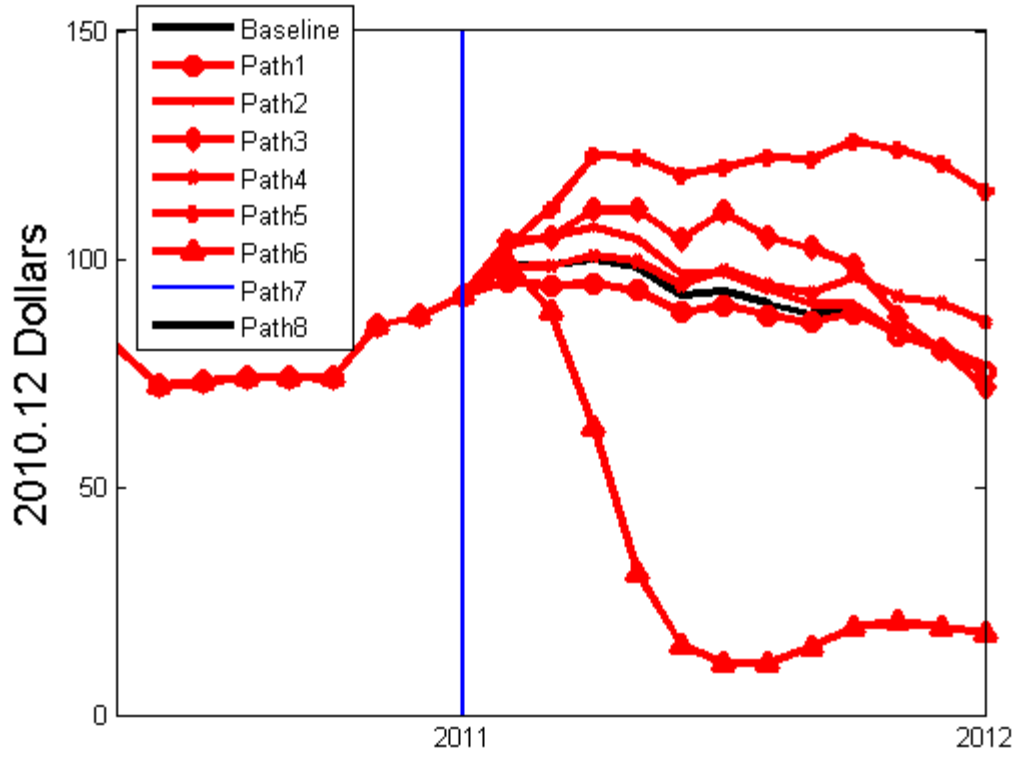
supply shocks nor speculative demand shocks are able to explain the surge in the real price of oil during this period. This result could not have been inferred from the structural impulse responses, that trace out the average effect of a hypothetical one-time structural shock, or from forecast error variance decompositions, that measure the extent to which a structural shock explains the variability of a variable on average.



This allows us to provide a quick summary of the evidence for any subperiod of interest. Kilian and Lee (2014) use this tool to summarize the determinants of the surge in the real price of oil between January 2003 and June 2008 on the one hand, and since the peak of the real price of oil on the other. Here, it is used to explain the sudden change in ITI in our study.

Conditional Forecast

The objective of forecast scenarios is to assess the sensitivity of reduced-form PVAR forecasts to hypothetical future events. Constructing such forecast scenarios requires a structural PVAR model, the reduced-form representation of which generates accurate out-of-sample forecasts. It is important to keep in mind that the objective of constructing forecast scenarios is not to improve the accuracy of the baseline reduced-form PVAR forecast. Indeed, that forecast by construction already provides the best possible out-of-sample prediction from a given forecasting model.



Based on a model of the global oil market similar to that used in Kilian and Lee (2014), this empirical research also tries to investigate a wide range of real-time forecast scenarios for the Foreign Direct Investment including a return of global economic recovery to full capacity, a supply disruption in oil market, a strong recovery of the global economy, a financial meltdown similar to the collapse of Lehman Brothers, and two contagion scenarios in which expectations of rising oil prices are triggered by political events in the Middle East. Some of these scenarios are based on historical precedent, while others are purely hypothetical. All scenarios involve sequences of structural shocks within the range of historical experience. Figure 4.5 shows how the forecast of the ITI would deviate from the baseline real-time PVAR forecast as of December 2010, if one were willing to condition on each one of these events occurring in isolation. Such evidence allows policymakers to gauge the potential effects of unlikely, but high-impact events on the ITI.

Conclusion and Policy Implication

Understanding and quantifying the international transmission mechanism whereby economic shocks are propagated around economies is important for formulating possible policy responses to developments in the world economy. This is one of the reasons why a substantial empirical literature has focused on this issue. But the existing work on this issue shares two shortcomings. First, analyses do not allow for the possibility of time-variation in the parameters of the model.

This feature is surprising as changing dynamics of variables such as inflation and output have been highlighted by many studies of macroeconomies. Second, most empirical studies on the international transmission of shocks are based on small-scale vector autoregressions (VARs) (models that relate each variable in the system to past values of all included variables). Arguably, central banks across the world monitor (and possibly respond to) a far wider information set than is typically assumed in these small VARs, leaving them open to the possibility of misspecification. Moreover, from a practical perspective small VARs are unable to provide inference on a large number of variables that may be of interest to policy makers.

A foreign monetary policy easing has substantially different effects on the WAMZ in the period after 1990. In particular, the response of the domestic economy in the period before 1990 resembles a classic beggar-thy-neighbor scenario, with decreases in foreign money supply resulting in an increase in WAMZ real activity. In contrast, the post-1990 period is characterized with negative but insignificant response of WAMZ real activity to this shock. A positive foreign aggregate demand shock has a large positive impact on WAMZ GDP during the years 1980-90. Its impact over the more recent period have been substantially smaller. Foreign supply shocks led to a persistent increase in WAMZ inflation and wages during the 1970s, with the current impact estimated to be relatively small.

Forecast error variance decomposition from the model suggests that the contribution of foreign shocks to forecast error variance of domestic variables have been relatively modest, yet non-negligible ranging at most 40% to 50% in total for some variables. The contributions also display time-variation: the role of foreign monetary policy and supply shocks have become smaller over the sample period. In contrast, foreign demand shocks remain important for WAMZ inflation and asset prices.

In this study, we have identified changes to the international transmission of shocks around 1990 which corresponds to significant changes to the WAMZ's monetary policy framework. Future research could therefore be directed towards understanding the interactions between monetary policy response and the international transmission mechanism.

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