Bulletin of Monetary Economics and Banking, Vol. 21, No. 2 (2018), pp. 217 - 250
p-ISSN: 1410 8046, e-ISSN: 2460 9196

UNDERSTANDING INDONESIA'S MACROECONOMIC DATA: WHAT DO WE KNOW AND WHAT ARE THE IMPLICATIONS?

Susan Sunila Sharma[1], Lutzardo Tobing[2], Prayudhi Azwar[3]

[1] Department of Finance & Centre for Financial Econometrics, Deakin Business School, Australia.
Email: s.sharma@deakin.edu.au
[2] Bank Indonesia Institute, Bank Indonesia, Jakarta, Indonesia. Email: lutzardo@bi.go.id
[3] Bank Indonesia Institute, Bank Indonesia, Jakarta, Indonesia. Email: yudhi@bi.go.id

ABSTRACT

Unit root properties of macroeconomic data are important for both econometric modeling and policymaking. The form of variables (whether they are a unit root process) helps determine the correct econometric model. Equally, the form of variables helps explain how they react to shocks (both internal and external). Macroeconomic time-series data are often at the forefront of shock analysis and econometric modeling. There is a growing research emphasis on Indonesia using time-series data; yet, there is limited understanding of the data characteristics and shock response of these data. Using an extensive dataset comprising 33 macroeconomic time-series variables, we provide an informative empirical analysis of unit root properties of this data. We find that, regardless of data frequency, empirical evidence of unit roots is mixed. Some data series respond quickly to shocks while others take more time. Almost all macroeconomic data suffer from structural breaks. We draw implications from these findings.

Keywords: Unit root; Macroeconomic data; Structural breaks; Shocks; Econometric modeling.
JEL Classification: C5; E1.

Article history:
Received : July 1, 2018
Revised : October 20, 2018
Accepted : October 20, 2018
Available online : October 31, 2018

https://doi.org/10.21098/bemp.v21i2.967

I. INTRODUCTION

Unit Root Properties (URP) have implications for how applied researchers and policymakers interpret and use data. URP assists in understanding the form of data. There are two forms data can take, either stationary or non-stationary. In simple terms, stationary time-series data have mean, variance, and co-variance that do not change over time. By comparison, a non-stationary series is best characterized as one whose mean, variance, and co-variance change over time. Precise knowledge of the form of the time-series data is important, because when its form is stationary, this implies that shocks will have short-term (or temporary) effects. On the other hand, a non-stationary series implies that shocks have long-term or permanent effects on the variable. This knowledge has policy implications because policymakers need to understand the form of variables to deduce how they will react to policy changes and/or shocks.

The second advantage from understanding the form of variables has roots in econometric modeling. Applied researchers are constrained by theory in modeling data. Theory also tends to dictate the form in which variables need to be modeled. There are many examples of this. Two are offered here for demonstration. First, consider the Purchasing Power Parity (PPP) hypothesis, which holds that prices equalize across countries, meaning that any price differences on a good/service in any two like countries should be stationary for PPP to hold; see Narayan (2006a). Second, the popular efficient market hypothesis argues that asset prices (such as stock prices) should be stationary (see Narayan and Smyth, 2007).

So great has been the influence of unit roots pioneered by Nelson and Plosser (1982)—considering the need to understand the shock reaction of variables and the form in which they enter econometric modeling, as discussed above—that there is a separate literature on new tests for unit roots; see also Perron (1989), which marks the starting point for research based on structural break(s). In other words, researchers have focused attention on developing more robust unit root tests that can offer greater precision when testing for the precise form of the data. Two avenues for improvement noted recently are important to highlight. Endogenous structural break treatment has a notable history in unit root testing. However, while the tests became available following Lee and Strazicich (2003), subsequent work (see, for instance, Narayan and Popp, 2010) took issue with the precision in estimating the break dates themselves, because accurate identification of breaks has implications for precise understanding of the form of the data (Narayan and Popp, 2010). More recent work (Narayan and Liu, 2015; Narayan, Liu and Westerlund, 2016) takes issue with the fact that when modeling for unit roots, it is not only structural breaks that are important, but also the role of a time trend and data heteroskedasticity can be equally important in delivering an unbiased understanding of the data.

Macroeconomic data are also important for Indonesia. Several studies analyze Indonesian macroeconomic data via testing different relations. For instance, Amir, Asafu-Adjaye, and Ducpham (2013) examine the impact of Indonesia's income tax reforms on various macroeconomic variables, namely real Gross Domestic Product (GDP), real private consumption, real investment, real government consumption, real exports, real imports, consumer price index,

GDP price index, and average real wage. Dutu (2016) examines economic growth slowdowns in Indonesia. Hsing (2012) examines the impact of macroeconomic forces and external shocks on Indonesia's real output. Chowdhury, Uddin, and Anderson (2018) examine the influence of monetary and fiscal policy variables on the market and firm-level liquidity of eight emerging stock markets in Asia. Tanuwidjaja and Choy (2006) examine the role of Indonesian central bank credibility in achieving an inflation target. Hadiwibowo and Komatsu (2011) examine the macroeconomic trilemma and international capital flows under several financial structures in Indonesia. Djuranovik (2014) develops a model of the term structure of interest rates in Indonesia to create a link between the yield curve and macroeconomic fundamentals, namely real activity, inflation, and interest rate. Sowmya and Prasanna (2018) examine interaction between the yield curve and macroeconomic factors of Asian economies. Such studies and future research would benefit from greater understanding of the importance of unit root tests.

Returning to the idea of understanding the form of the variable, what started off as instrumental knowledge in using macroeconomic data spread quickly to other fields of research where shocks were relevant in understanding how variables respond to them. The unit root idea, for instance, was popularized in Narayan and Smyth (2007) in a time-series setting and extended to a panel data setting in Narayan, Narayan, and Smyth (2008). In tourism economics, the idea was introduced by Narayan (2005a,b) and in health economics by Narayan (2006b). The main message of these studies is that unit root evidence is important to understanding the nature and impact of shocks not only with macroeconomic data (see Section II), but also with other time-series data where shocks are relevant, such as in energy, tourism, and health.

This paper proceeds as follows. Section II reviews the literature on the presence of unit root in macroeconomic data. Section III discusses our data and results. Finally, Section IV sets forth concluding remarks.

II. THE LITERATURE

This section provides a feel for the importance of understanding the unit root behavior of macroeconomic data. We choose selected studies from this literature that we believe best offers a snapshot of the work done on unit roots devoted to macroeconomic data.

Table 1 summarizes selected literature on unit roots. We believe that these studies provide a reasonable representation of the literature and the features that characterize this literature. Let us identify these features more precisely. First, note from Column 2 that unit root tests of macroeconomic data are conducted at different data frequencies (annually, weekly, quarterly, and monthly), although most work seems to use annual data followed by monthly data. The dominance of annual data is expected given that, for most countries, macroeconomic data (over time) is available only annually. One issue arising from this concerns robustness. The question arises of whether the evidence on unit root data is frequency-dependent. We address this by undertaking a unit root test on both annual and monthly data. A caveat here is that one ends up with different start dates when using

higher frequency data. The implication is that a strict comparison of the unit root hypothesis across data frequencies is impossible. However, the advantage is that we have some results that we can consider, depending on policy objectives.

The second feature of the literature, which can be read from Column 3, is that a wide range of macroeconomic data are utilized in unit root tests. The most popular data series seem to be GDP, inflation, and exchange rate; the highest number of variables used is around 14. Our study presents an extensive unit root analysis focusing on Indonesia—our sample includes 33 annual time-series data and 31 monthly time-series data. This represents a first comprehensive analysis of unit root testing of macroeconomic data.

The third feature concerns the econometric approach taken to test the unit root hypothesis. There are several points to note here. First, early studies seem to use tests without structural breaks. These studies are complemented by papers that address the unit root issue with structural breaks. Second, recent studies employ panel data models. Thus, the literature has progressed from time-series–based methods to panel data–based methods for testing the unit root hypothesis. We position our study within the popular structural break unit root testing methodology.

The final feature concerns the evidence on unit root. At best, the evidence appears mixed. Two trends are notable, however. First, panel data models offer greater evidence of stationarity. One reason for this is the gain in power to reject the unit root null that results from an increase in sample size when data is pooled across cross-sections and over time. Second, time-series models that accommodate structural break(s) offer greater evidence of stationarity (evidence against the unit root null hypothesis). These factors have implications for how one should approach unit root testing in macroeconomic data. We employ structural break unit roots tests within a time-series setting.

III. DATA AND RESULTS

Time-series data are used for unit root testing. A total of 31 monthly and 33 annual time-series macroeconomic variables for Indonesia are employed in this study. A complete list of variables is provided in Tables 2 (monthly series) and 3 (annual series). In summary, our dataset has three bond yield variables (separated by maturity), four interbank interest rate variables (separated by maturity), nine financial variables (business confidence index, capital value added, cash return index, dividend yield, Dow Jones stock index, market capitalization to GDP, Jakarta stock exchange Islamic index, price-to-earnings ratio, stock return index), and 17 monetary/trade-related variables (CPI, deposit rate, industrial production, composite index, exchange rate, export goods, export index, import goods, import index, industrial production, lending rate, M1, M2, producer price index, foreign exchange reserves, unemployment, and wholesale price index). All data are obtained from the *Global Financial Database*.

Table 1.
A Summary of Literature

This table provides summary of literature on studies that examine the presence of unit root in macroeconomic variables.

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Drakos et al., (2018)	Annual panel data for 14 EU countries over the period 1970 - 2015.	(1) Investment as % of GDP; and (2) Savings as % of GDP.	Phillips and Sul (2003) factor structure approach, panel stationarity test of Harris, Leybourne, and McCabe (2005).	[1, 2]	
Li and Park (2018)	Annual and monthly time-series data for the USA macroeconomic variables and real effective exchange rate for 61 countries over the period 1860/1869/1890/1900/1909–1988.	(1) Consumer prices; (2) Employment; (3) GNP deflator; (4) Nominal GNP; (5) Bond yield; (6) Industrial production; (7) Real GNP; (8) GNP per capita; (9) Wages; (10) Real wages; (11) Stock prices; (12) Unemployment; (13) Velocity; and (14) Money stock.	(1) ADF; (2) KSS; (3) quantile ratio test; (4) quantile Kolmogorov–Smirnov test; and (5) quantile Cramer-vonMises test	[10, 11, 13] and [1, 3, 4, 8, 9 for some countries].	[2, 5, 6, 7] and [1, 3, 4, 8, 9 for some countries].
Cavaliere and Xu (2014)	Monthly data from Jan 1957 – Sept 2008.	(1) Nominal interest rate	(1) ADF and (2) M-test		[1]
Charles and Darné (2012)	Annual data for the periods 1900/1909/1860/1889 – 1988.	(1) Real GNP; (2) Nominal GNP; (3) Real per capita GNP; (4) Industrial production; (5) Employment; (6) Unemployment; (7) GNP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity; (13) Interest rate; and (14) Stock price.	(1) ADF; (2) ADF – QML; and (3) Robust QML	[2, 7, 8, 9, 10, 11, 12, 13, 14]	[1, 3, 4, 5, 6]

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Narayan and Smyth (2005)	Monthly time-series data over the period 1960 – 2004.	(1) Real GDP; (2) Nominal GDP; (3) Real consumption; (4) Real investment; (5) CPI; (6) Share price; (7) Exchange rate; (8) M1; (9) M3; (10) Manufacturing stock; (11) Industrial production; (12) Manufacturing employment; (13) Manufacturing hourly earnings; (14) Unemployment rate; (15) Short term interest rate; and (16) Long term interest rate.	(1) ADF; (2) One- and two-break endogenous structural break ADF-type unit root tests; and (3) One- and two-break Lagrange multiplier (LM) unit root tests.	Using ADF (trend): [1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 14, 15, 16]	[10, 11, 13].
Lee and Strazicich (2003)	Annual time-series data over the period 1860/1909 – 1970.	(1) Real GNP; (2) Nominal GNP; (3) Real per capita GNP; (4) Industrial production; (5) Employment; (6) Unemployment; (7) GNP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity; (13) Interest rate; and (14) Stock price	(1) Endogenous break minimum LM unit root test; and (2) Endogenous two break unit root LP test	[1, 2, 3, 5, 7, 8, 9, 12, 13, 14]	[4, 6, 10, 11]
Lumsdaine and Papell (1997)	Annual time-series data over the period 1860/1909 – 1970.	(1) Real GNP; (2) Nominal GNP; (3) Real per capita GNP; (4) Industrial production; (5) Employment; (6) Unemployment; (7) GNP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity (13) Interest rate; and (14) Stock price.	(1) ADF; and (2) Two endogenous break are allowed	[7, 8, 9, 10, 11, 12, 13, 14]	[1, 2, 3, 4, 5, 6]

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Lucas (1995)	Annual time-series data over the period 1860/1909 – 1988.	(1) Real GNP; (2) Nominal GNP; (3) Real per capita GNP; (4) Industrial production; (5) Employment; (6) Unemployment; (7) GNP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity; (13) Interest rate; and (14) Stock price.	1. Dickey-Fuller test for M-estimators.	[2, 5, 7, 8, 9, 10, 11, 12, 13, 14]	[1, 3, 4, 6]
Nelson and Plosser (1982)	Annual time-series data over the period 1860/1909 – 1970.	(1) Real GNP; (2) Nominal GNP; (3) Real per capita GNP; (4) Industrial production; (5)Employment; (6) Unemployment; (7) GNP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity; (13) Interest rate; and (14) Stock price.	1. ADF	[1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14]	[6]
Niang et al. (2011)	Annual time-series data over the period 1964 – 2008.	A number of variables related to: (1)Real output; (2) Employment; (3) Housing; (4) Public receipts, expenditure, investment; (5). Market (NYSE, AMEX, NASDAQ)	1. DF–GLS	[5]	[1, 2, 3, 4]

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Romero-Ávila (2008)	Annual panel data for 23 OCCD countries over the period 1960 - 2005.	(1) Consumption - income ratios	(1) MZ-GLS; (2) ADF – GLS; (3) MSB – GLS; (4) P-GLS; (5) Panel unit root test of Pesaran (2003); (6) Panel unit root of Smith et al. (2004); and (7) Panel staionarity test of Hadri (2000).	[1]	
Hurlin (2010)	Annual panel data for OECD countries over the period 1950 - 2003.	(1) Real GDP; (2) Nominal GDP; (3) Real per capita GDP; (4) Industrial production; (5) Employment; (6) Unemployment; (7) GDP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity; (13) Bond yield; and (14) Stock price.	(1) Levin and Lin unit root tests; (2) Im, Peseran and Shin (2003) unit root tests; (3) Maddala and Wu (1999) test; (4) Choi (2001) test; (5) Bai and Ng (2004) for common factors; (6) Bai and Ng(2004) for idiosyncratic shocks; (7) Moon and Perron (2004); (8) Choi (2002) test; (9) Pesaran (2003) test; and (10) Chang (2002) test.	[13, 14] Chang (2002) show all variables are I(1).	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Maslyuk and Smyth (2008)	Weekly time-series data over the period 1991 – 2004.	(1) US WTI price at (spot, 1, 3, 6 months); and (2) UK Brent price (spot, 1, 3, 6 months).	(1) ADF; (2) PP; and (3) Lagrange multiplier (LM) unit root tests with one and two endogenous structural breaks proposed by Lee and Strazicich	[1, 2]	
Narayan (2008)	Quarterly time-series data over the period 1959:01 to 2004:02.	(1) M1; (2) M2; (3) Real income; and (4) Nominal interest rate	(1) Lagrange multiplier structural break unit root		Without allowing for any breaks: [1, 2, 3, 4]
Gil-Alana and Robinson (1997)	Annual time-series data over the period 1860/1909 – 1988.	(1) Real GNP; (2) Nominal GNP; (3) Real per capita GNP; (4) Industrial production; (5)Employment; (6) Unemployment; (7) GNP deflator; (8) Consumer Price; (9) Nominal wages; (10) Real wages; (11) Money stock; (12) Velocity; (13) Interest rate; and (14) Stock price.	(1) LM unit root tests	[7, 8, 9, 10, 11]	[4, 6]
Chambers (2015)	Monthly time-series data from Feb 1996 to Mar 2014.	(1) Producer price data	(1) Testing for the presence of a unit root in a discrete and continuous time setting	(1) Producer price data has unit root in discrete time.	(1) Producer price data is stationary in continuous time.

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Aslanidis and Fountas (2014)	Annual panel data from 1870 – 2008.	(1) Real GDP	(1) Pesaran's (2007) panel unit root test with cross-sectional dependence; and (2) IPS test.	[1]	[1] is stationary when no allowance for cross-sectional dependence is made.
Narayan and Narayan (2010)	Monthly panel data over the period Jan 1960 – Dec 2004 for 17 OECD countries.	(1) Inflation rate	(1) ADF; (2) ADF – GLS; (3) KPSS; (4) LM test with two structural breaks proposed by Lee and Strazicich (2003); and (5) KPSS structural break test.	(1) ADF: unit root in 15 out of 17 countries; (2) ADF-GLS: unit root in all cases; (3) KPSS: unit root in all cases; (4) LM: unit root in 15 out of 17 countries; and (5) KPSS structural break test: unit root in 7 out of 17 countries after allowing for multiple structural breaks.	(1) KPSS structural break test: Stationary in 10 out of 17 countries after allowing for multiple structural breaks; (2) Inflation for G7 are stationary; and (3) KPSS panel unit root test: stationary in panel (when countries found nonstationary are excluded in presence of structural breaks).

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Kappler (2009)	Annual panel data for 30 OECD countries over the period 1950 – 2005.	(1) Hours worked per employee	(1) Demetrescu, Hassler and Tarcolea (2005, DHT); (2) Phillips and Sul (2003, PS); (3) Moon and Perron (2004, MP); (4) Bai and Ng (2004, BN); (5) ADF; and (6) DF-GLS	(1) Hours worked per employee has unit root in most cases using ADF and DF-GLS; and (2) Second generation panel unit root methods mostly found unit root as well	(1) MP method rejected unit root hypothesis
Chang et al. (2007)	Monthly time-series data over the period Jun 1993 – Sept 2001.	(1) Unemployment rates for 21 regions	(1) Levin–Lin–Chu panel-based unit root test; (2) Im–Pesaran–Shin test; (3) ADF; (4) DF-GLS; and (5) PP tests.	(1) Univariate unit root test shows unemployment has unit root except in 4 regions.	(1) Unemployment rates are stationary using panel-based unit root tests.
Chang et al. (2006)	Monthly panel data for 22 countries over the period Jan 1980 – Dec 2003.	(1) Bilateral real exchange rate	(1) ADF; (2) PP-test; (3) KPSS; (4). NP; (5) DF-GLS; and (6) Leybourne et al. (1998) test.	(1) Mostly has unit root.	(1) Stationary in 6/22 countries using Leybourne et al. (1998) test; and (2) Using 1-5 methods, stationary in 1/25 case.

Table 1.
A Summary of Literature (Continued)

Authors	Data	Variables Studied	Unit root Method used	Variables that are unit root	Variables that are stationary
Hüseyin (2005)	Monthly time-series data for the USA, UK, Germany, and Italy over the period Jan 1982 – Dec 2003.	(1) Bilateral real exchange rate	(1) ADF; (2) PP-test; (3) KPSS; (4) Modified Ng and Perron test.	(1) Maximum presence of unit root in the case of Germany and Italy.	(1) Maximum cases of stationarity for the USA and UK.
Smyth (2003)	Quarterly panel data for 6 Australian state and 2 territories over the period Feb 1982 – Jan 2002.	(1) Unemployment rates	(1) ADF; (2) Levin-Lin and FGLS Tests; and (3) IPS Test.		Both ADF and IPS finds [1] to be a stationary variable.
				Levin and Lin (1992) and FGLS test show presence of unit root in [1].	
Choi (2001)	Monthly panel data over the period Mar 1973 – Mar 1996.	(1) Real exchange rates (US real exchange rates vs. the Canadian dollar; German Mark; Japanese Yen; French Franc; British Pound; and the Swiss Franc).	(1) DF-GLS; and (2) combination unit root tests and IPS' t-bar test.	(1) DF-GLS shows unit root in Exchange rates	(1) Combination unit root tests and IPS' t-bar test shows some evidence of stationarity.

Table 2.
Descriptive Statistics of Monthly Data

This table presents descriptive statistics for monthly data. Thirty-one data series are considered, and Column 3 contains the sample period for each series followed by the number of observations (Obs.) in the sample. The mean, Standard Deviation (SD), skewness, Jarque–Bera (JB) test coefficient and its respective p-values are presented in Columns 5 to 9, respectively. The JB test examines the null hypothesis of a normal distribution.

No.	Series	Sample Period	Obs.	Mean	Std. Dev.	Skewness	Jarque-Bera	*p*-value
1	Bond Yield, 3 Year	2009:05-2018:06	110	1.814	0.178	-0.672	9.194	0.010
2	Bond Yield, 5 Year	2009:05-2018:06	110	1.952	0.182	-0.453	5.342	0.069
3	Bond Yield, 10 Year	2009:05-2018:06	110	2.019	0.170	-0.125	0.794	0.672
4	Business Confidence Index	2002:01-2017:12	190	4.602	0.010	-1.526	97.560	0.000
5	Capital Value Traded	1990:01-2018:05	341	11.288	1.334	-0.235	16.770	0.000
6	Cash Return Index	1989:12-2018:06	343	4.480	1.122	-0.513	34.768	0.000
7	Composite Index	1983:03-2018:06	424	6.582	1.365	-0.073	16.025	0.000
8	Consumer Confidence Index	2001:04-2017:12	201	4.601	0.013	-1.062	56.344	0.000
9	CPI Inflation	1967:01-2018:06	618	2.630	1.615	-0.333	32.348	0.000
10	Deposit Rate	1974:04-2016:07.	508	2.421	0.495	0.364	16.186	0.000
11	Dividend Yield	1990:11-2018:06	332	0.598	0.651	-2.934	1850.536	0.000
12	Exchange Rate	1876:01-2018:06	1710	-0.629	6.495	0.519	259.035	0.000
13	Dow Jones Stock Index	1992:01-2018:06	318	5.982	0.836	0.152	33.685	0.000
14	Export Goods	1961:01-2018:05	689	9.772	1.846	-0.617	65.459	0.000
15	Export Index	1991:01-2018:05	329	-0.304	0.289	0.040	20.510	0.000
16	GFD Market Capitalisation of GDP	1995:01-2018:05	281	-7.049	1.534	0.672	58.232	0.000
17	Import Goods	1960:01-2018:06	701	9.426	1.856	-0.370	46.696	0.000
18	Import Index	1991:01-2018:05	329	-0.295	0.324	-0.641	25.998	0.000
19	Indonesia 1 Month Interbank Interest Rate (JIBOR)	1990:01-2018:06	342	2.357	0.546	0.914	73.150	0.000
20	Indonesia 3 Month Interbank Interest Rate (JIBOR)	1993:12-2018:06	295	2.340	0.526	0.996	64.297	0.000
21	Indonesia 6 Month Intebank Interest Rate (JIBOR)	1991:01-2018:06	330	2.382	0.478	0.779	39.274	0.000
22	Indonesia 12 Month Intebank Interest Rate (JIBOR)	1997:03-2018:06	256	2.334	0.484	1.127	66.305	0.000
23	Industrial Production Volume	1991:12-2018:04	317	12.579	0.224	0.208	8.340	0.015
24	Jakarta Stock Exchange Islamic Index	2000:07-2018:06	216	5.700	0.861	-0.715	26.511	0.000
25	Lending Rate for Working Capital	1986:03-2016:08	366	2.860	0.275	0.316	10.954	0.004
26	M1-Money Supply	2008:01-2018:04	124	13.550	0.366	-0.150	8.081	0.018
27	M2-Money supply	200:801-2018:04	124	14.965	0.374	-0.234	9.233	0.010

Table 2.
Descriptive Statistics of Monthly Data (Continued)

No.	Series	Sample Period	Obs.	Mean	Std. Dev.	Skewness	Jarque-Bera	*p*-value
28	Price to Earnings Ratio	1990:01-2018:06	342	2.813	0.342	0.049	32.162	0.000
29	Producer Price Index Excluding Oil	1971:01-2016:04	544	2.604	1.575	-0.200	26.700	0.000
30	Stock Return Index	1988:01-2018:06	366	7.637	1.286	0.153	22.583	0.000
31	Total Foreign Exchange Reserves (exclude Gold)	1971:01-2018:06	570	9.383	1.659	-0.478	24.609	0.000

Table 3.
Descriptive Statistics of Yearly Data

This table presents descriptive statistics for yearly data. Thirty-three data series are considered, and Column 3 contains the sample period for each series followed by the number of observations (Obs.) in the sample. The mean, Standard Deviation (SD), skewness, Jarque–Bera (JB) test coefficient and its respective p-values are presented in Columns 5 to 9, respectively. The JB test examines the null hypothesis of a normal distribution.

No	Series	Sample Period	Obs.	Mean	Std. Dev.	Skewness	Jarque-Bera	*p*-value
1	Capital Value Traded	1977-2017	41	9.119	3.556	-0.665	4.758	0.093
2	Cash Return Index	1989-2017	29	4.443	1.164	-0.494	2.929	0.231
3	Composite Index	1977-2017	41	6.305	1.448	0.174	2.463	0.292
4	CPI	1960-2016	57	1.626	3.295	-1.647	36.827	0.000
5	CPI Inflation	1948-2017	70	-0.351	5.297	-0.955	12.002	0.002
6	Deposit Rate	1974-2017	44	2.406	0.502	0.514	1.974	0.373
7	Dividend Yield	1990-2017	28	0.585	0.696	-2.858	132.257	0.000
8	Dow Jones Stock Index	1992-2017	26	5.991	0.849	0.113	2.676	0.262
9	Exchange Rate	1818-2017	200	-2.170	6.002	1.058	41.992	0.000
10	Export Goods	1946-2017	72	9.102	2.191	-0.251	5.507	0.064
11	Export Goods and Services	1990-2017	28	13.221	1.256	-0.393	2.339	0.311
12	Export Index	1991-2017	27	-0.299	0.284	0.071	1.951	0.377
13	GDP-Deflator Inflation	1961-2015	55	2.758	1.100	0.970	8.970	0.011
14	GDP-Deflator	1960-2015	56	1.671	2.166	-0.278	2.359	0.307
15	GFD Market Capitalisation of GDP	1993-2017	25	-6.875	1.591	0.612	4.731	0.094
16	Nominal GDP	1951-2017	67	9.383	6.128	-0.850	9.208	0.010
17	Real GDP	1870-2017	148	13.421	1.263	0.634	14.674	0.001
18	Import Goods	1946-2017	72	8.847	2.111	-0.048	5.574	0.062
19	Import Goods and Services	1990-2017	28	13.221	1.256	-0.393	2.339	0.311
20	Import Index	1991-2017	27	-0.280	0.307	-0.458	2.140	0.343
21	Indonesia 1 Month Interbank Interest Rate (JIBOR)	1990-2017	28	2.366	0.503	0.523	1.281	0.527
22	Indonesia 3 Month Interbank Interest Rate (JIBOR)	1993-2017	25	2.361	0.506	0.708	2.202	0.332
23	Indonesia 6 Month Interbank Interest Rate (JIBOR)	1991-2017	27	2.383	0.471	0.728	2.732	0.255

Table 3.
Descriptive Statistics of Yearly Data (Continued)

No	Series	Sample Period	Obs.	Mean	Std. Dev.	Skewness	Jarque-Bera	*p*-value
24	Indonesia 12 Month Interbank Interest Rate (JIBOR)	1997-2017	21	2.341	0.474	0.889	2.814	0.245
25	Industrial Production Volume	1991-2017	27	12.575	0.232	0.203	0.753	0.686
26	Lending Rate for Working Capital	1986-2017	32	2.832	0.286	0.296	0.881	0.644
27	Price to Earnings Ratio	1990-2017	28	2.805	0.307	-0.429	1.332	0.514
28	Producer Price Index Excluding Oil	1971-2017	47	2.740	1.607	-0.209	2.468	0.291
29	Stock Return Index	1987-2017	31	7.573	1.356	0.072	1.378	0.502
30	Total Foreign Exchange Reserves (exclude Gold)	1971-2017	47	9.410	1.651	-0.473	1.947	0.378
31	Total Reserve	1960-2015	56	8.334	2.585	-0.768	5.835	0.054
32	Unemployment	1973-2017	35	1.711	0.858	2.621	201.509	0.000
33	Wholesale Price Index	1971-2016	46	2.662	1.604	-0.207	2.265	0.322

A plot of the annual time-series data is available in Figure 1. Tables 2 and 3 show descriptive statistics based on monthly and annual time-series data, respectively. Given the time-series nature of the data, we note from both these tables the start data. Not all series have lengthy data. For example, some series, like exchange rate, have data going as far back as 1876. Inflation and deposit rate data are available from the 1960s and 1970s, respectively, while for other series much smaller data samples are available. Details are found in Columns 2 and 3 of these tables. Thus, data series have different start dates. This is dictated entirely by data availability.

Figure 1. A Plot of Annual Time-Series Data

This figure plots annual time-series data for 33 variables. Full variable description is given in Appendix Table A1. The time-span of each variable is dependent on data availability and is explicitly noted in Tables 2-3.

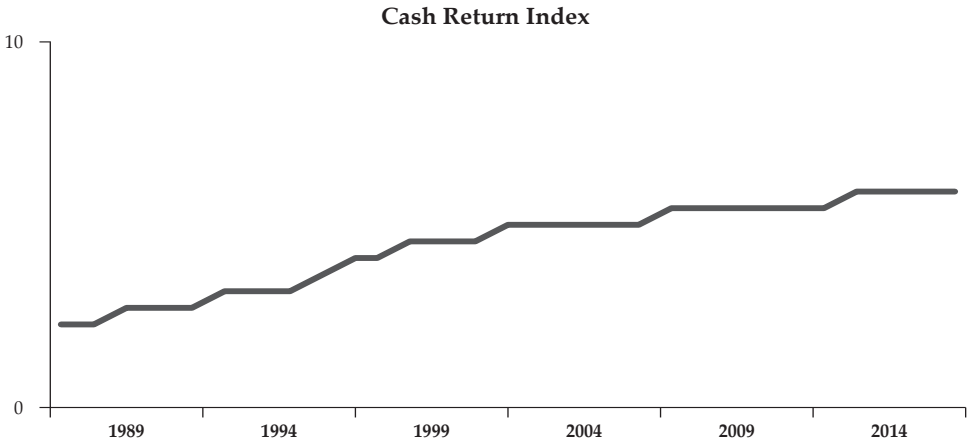
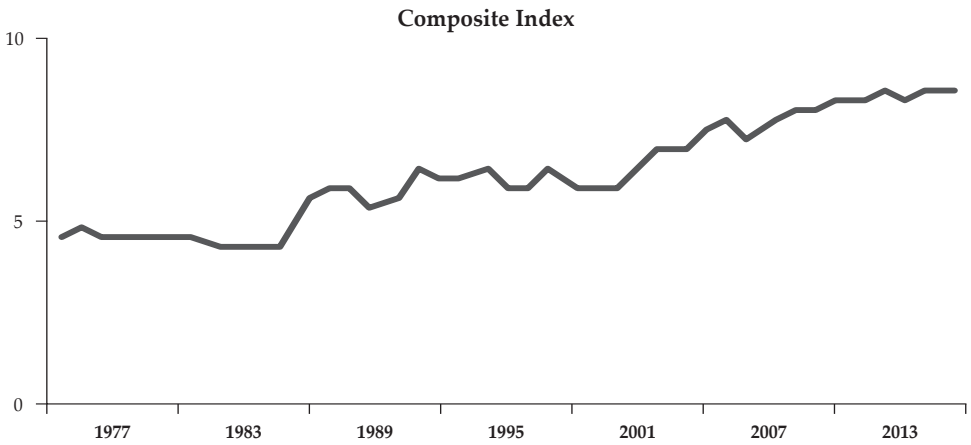
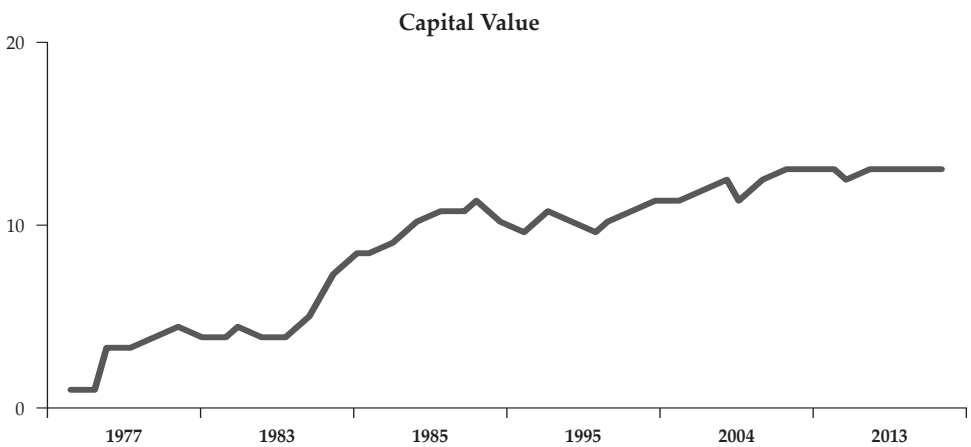


Figure 1. A Plot of Annual Time-Series Data (Continued)





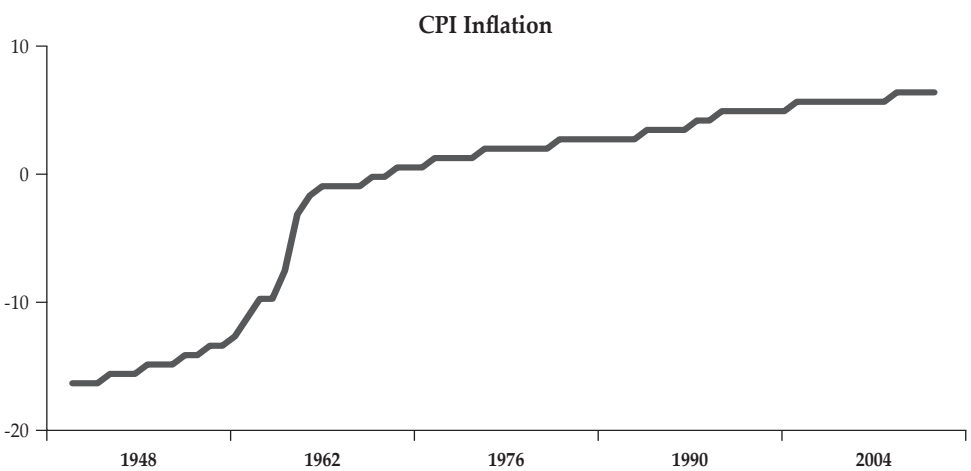


Figure 1. A Plot of Annual Time-Series Data (Continued)

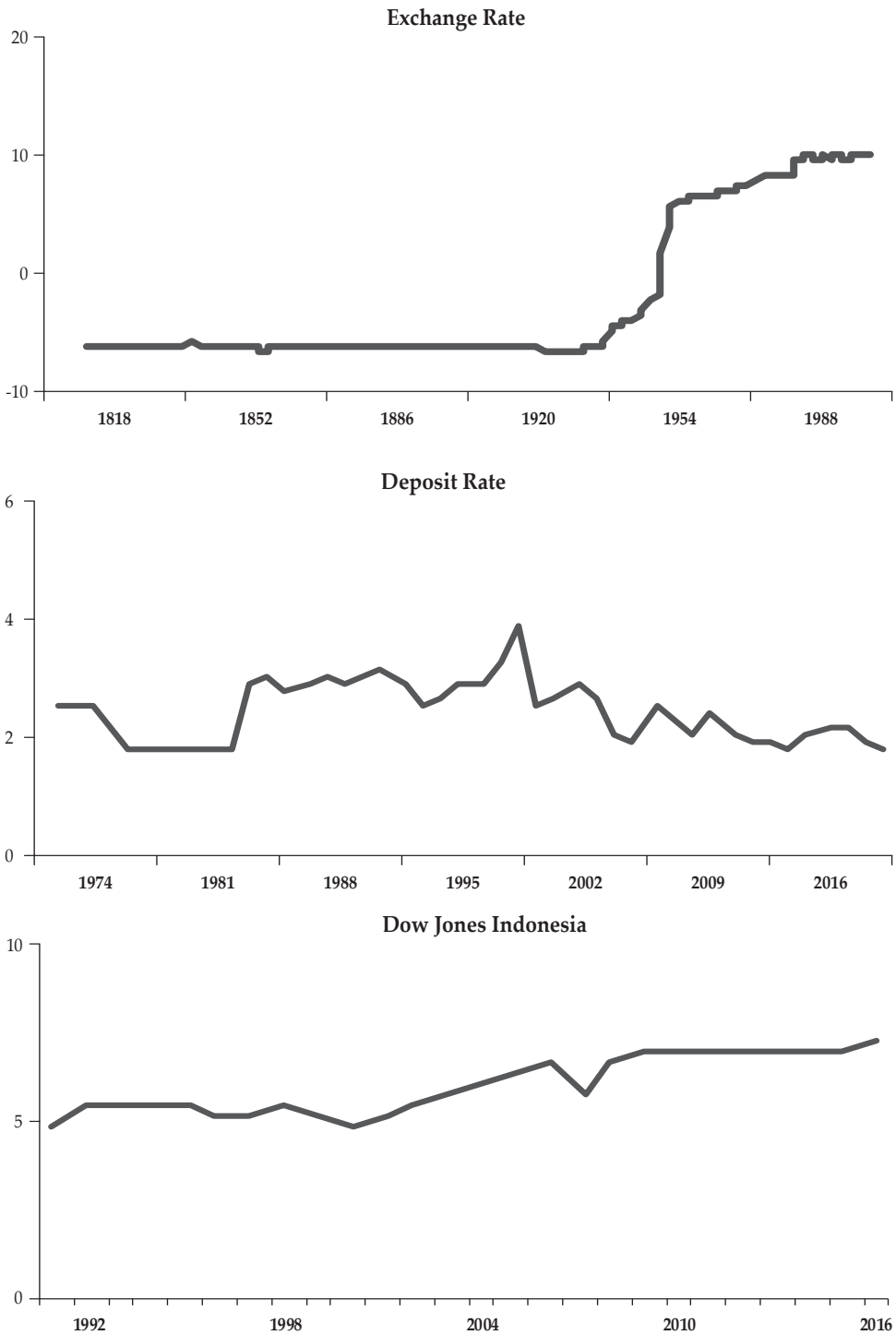


Figure 1. A Plot of Annual Time-Series Data (Continued)

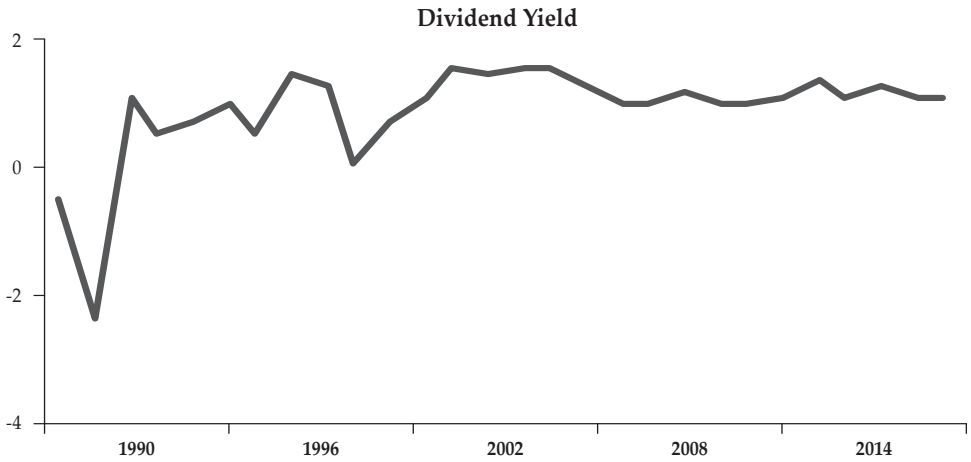


Figure 1. A Plot of Annual Time-Series Data (Continued)

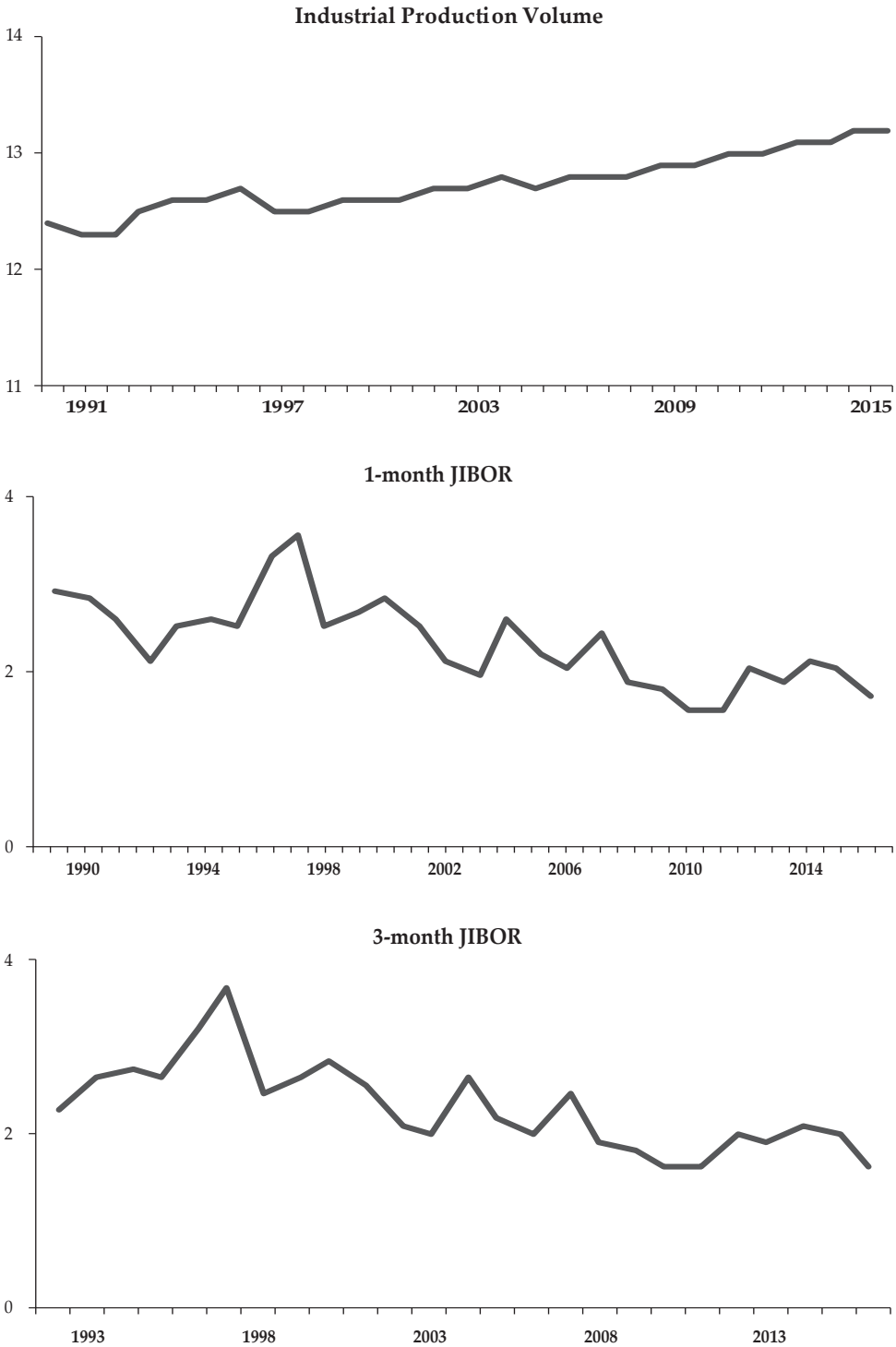
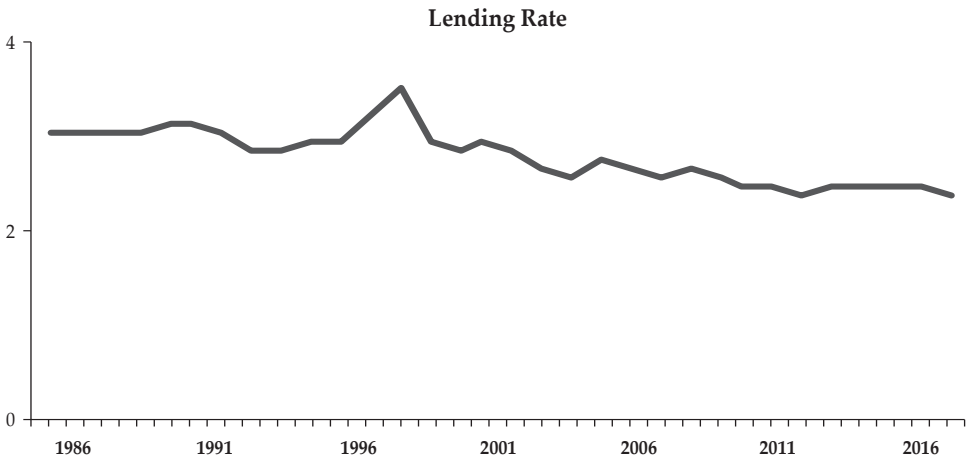


Figure 1. A Plot of Annual Time-Series Data (Continued)



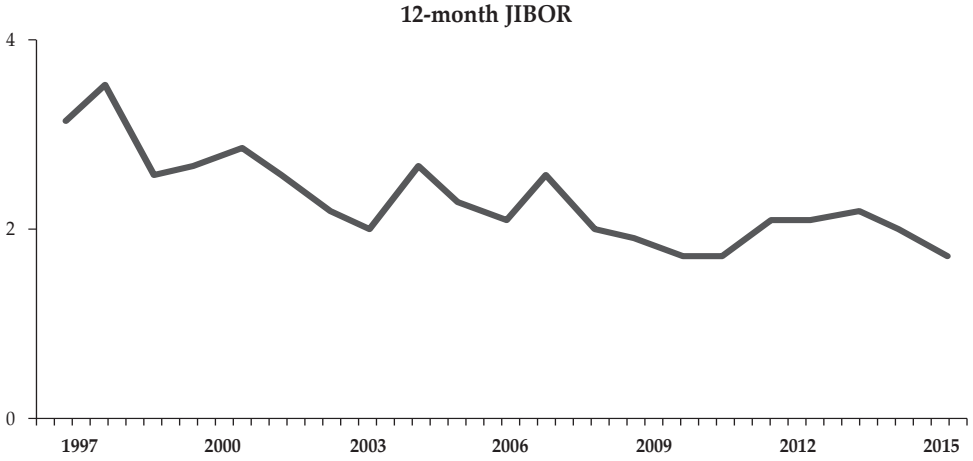


Figure 1. A Plot of Annual Time-Series Data (Continued)

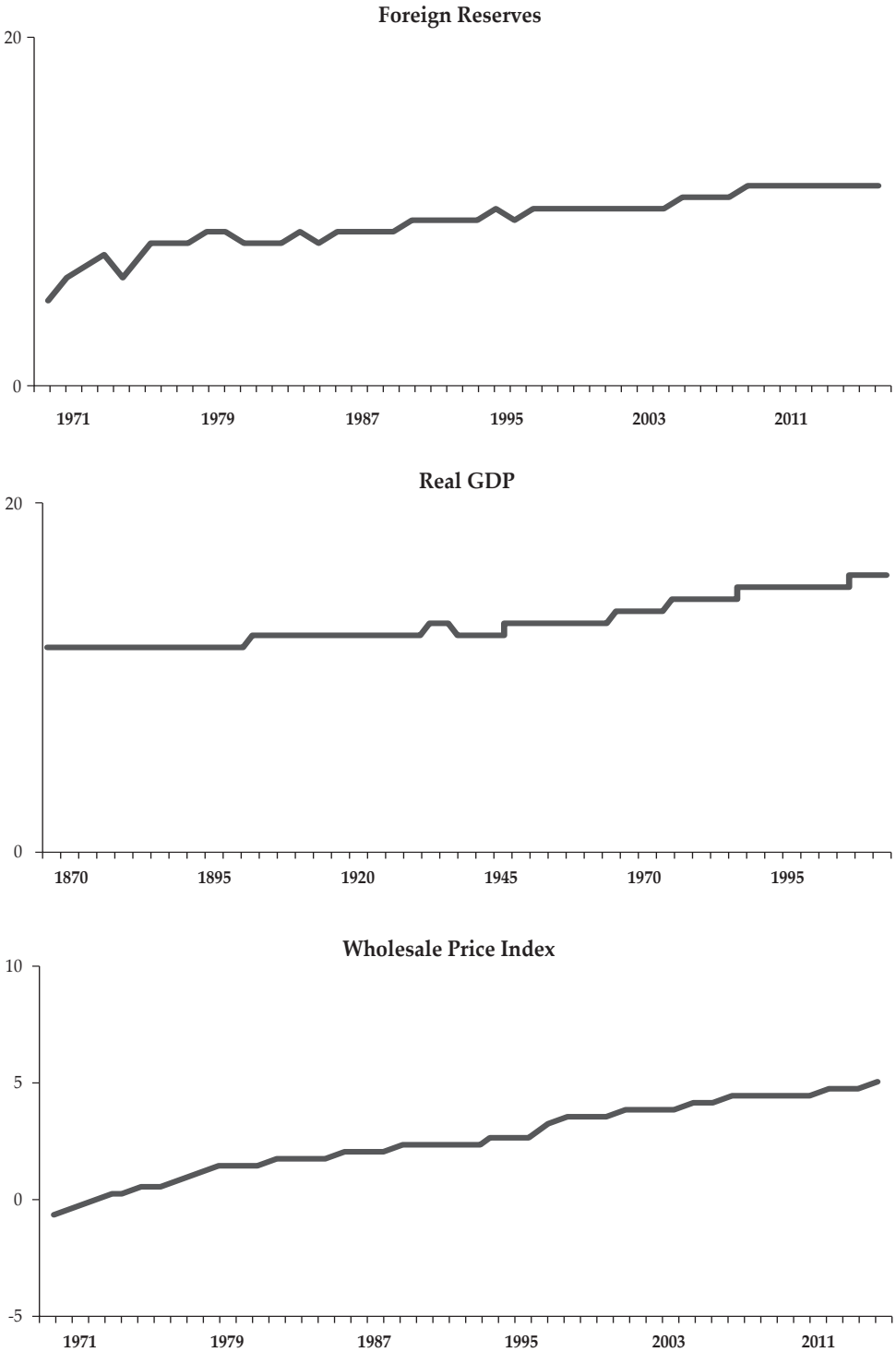
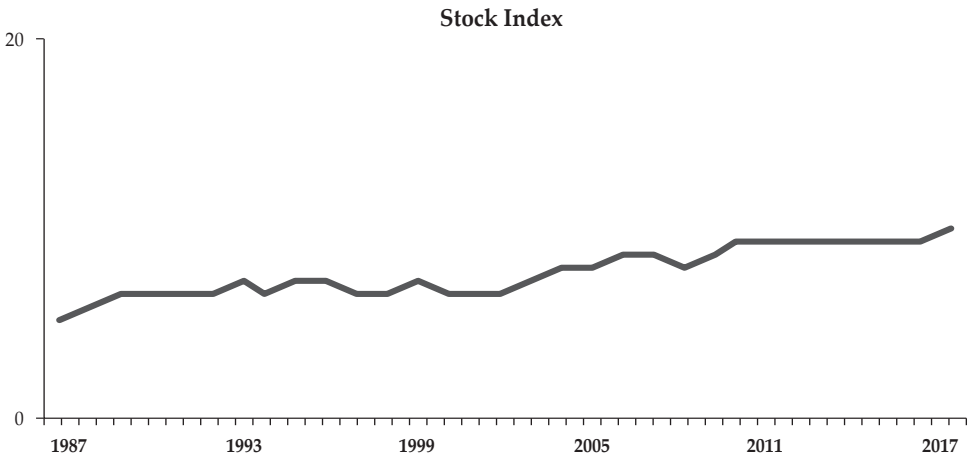


Figure 1. A Plot of Annual Time-Series Data (Continued)



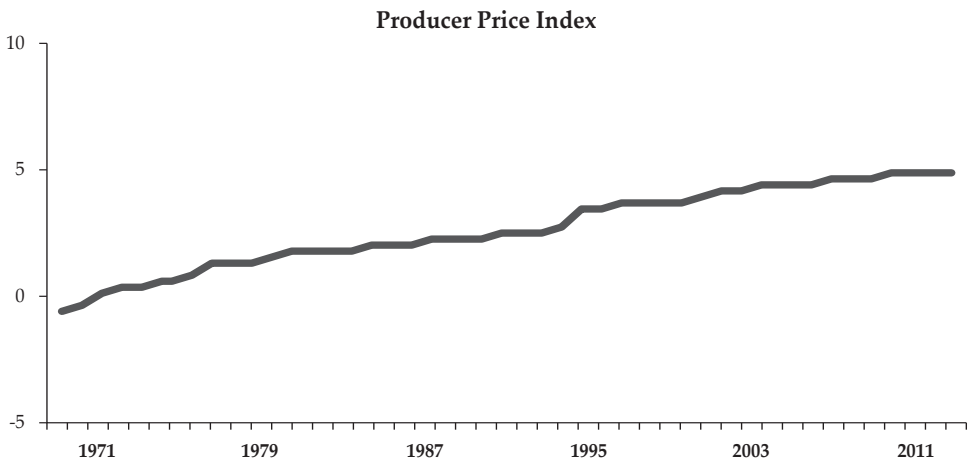


Figure 1. A Plot of Annual Time-Series Data (Continued)

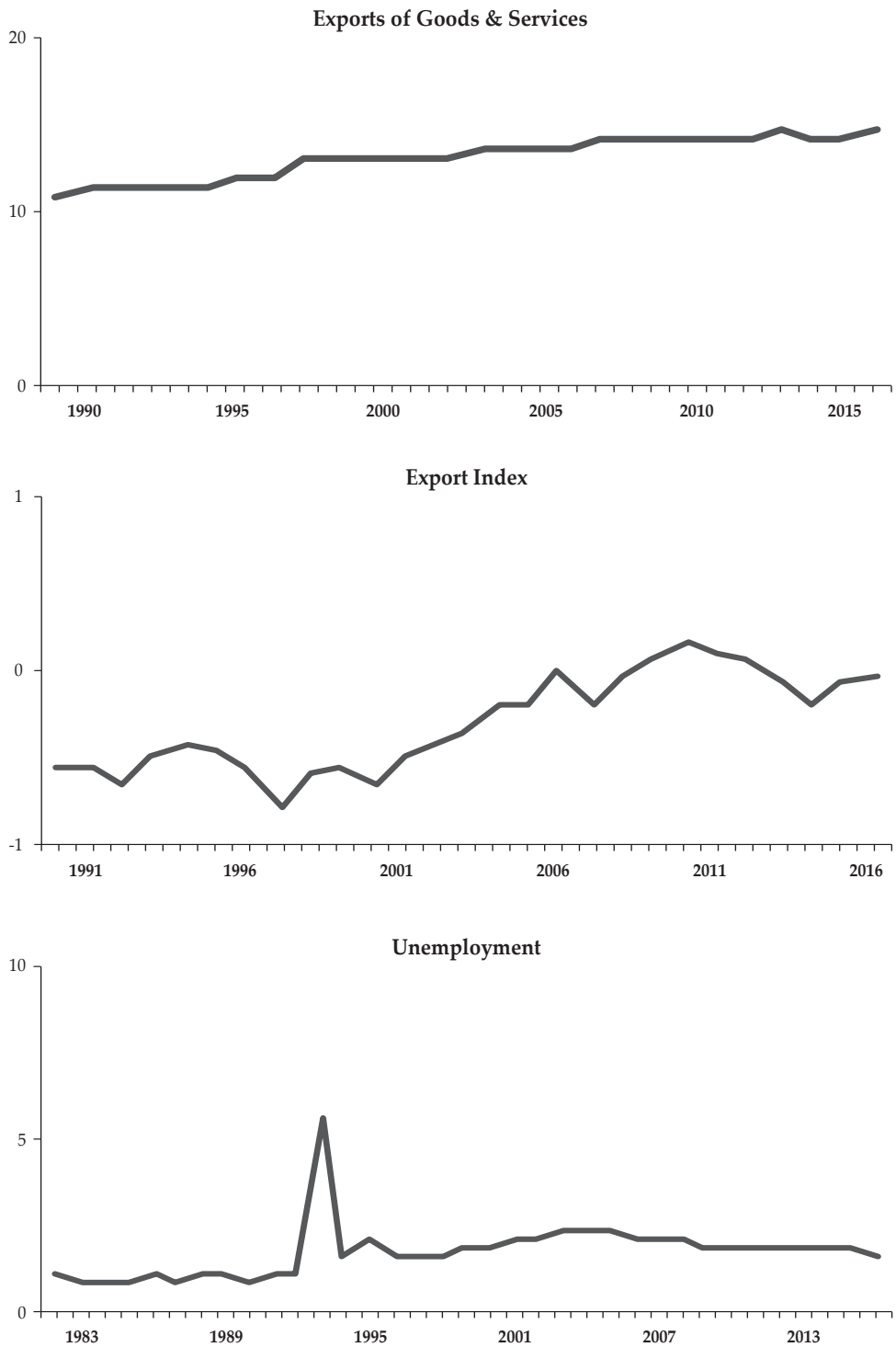
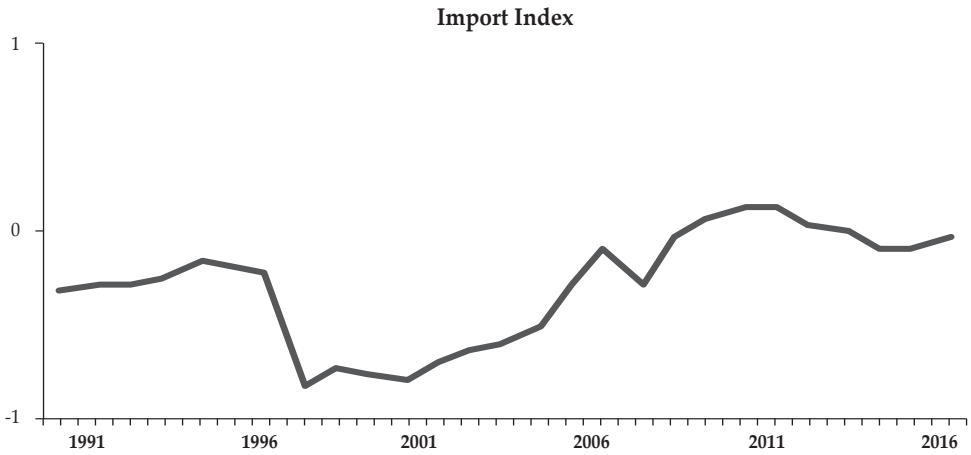


Figure 1. A Plot of Annual Time-Series Data (Continued)



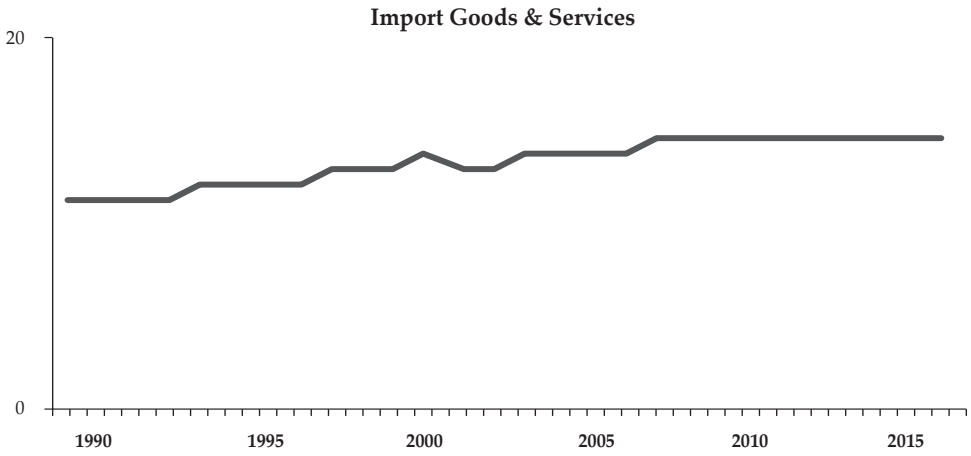
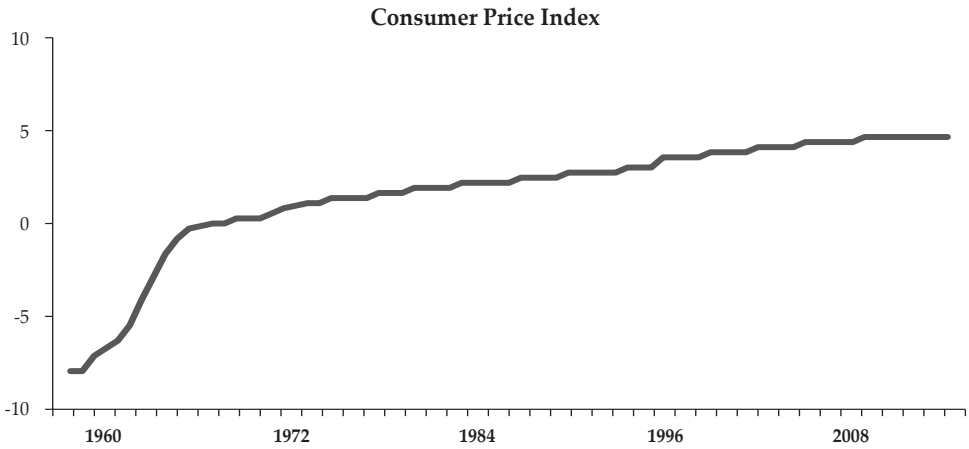
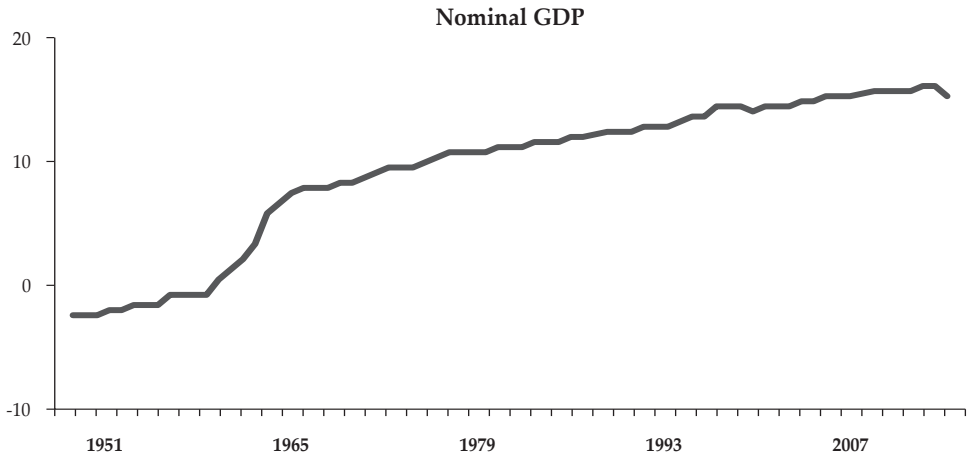


Figure 1. A Plot of Annual Time-Series Data (Continued)





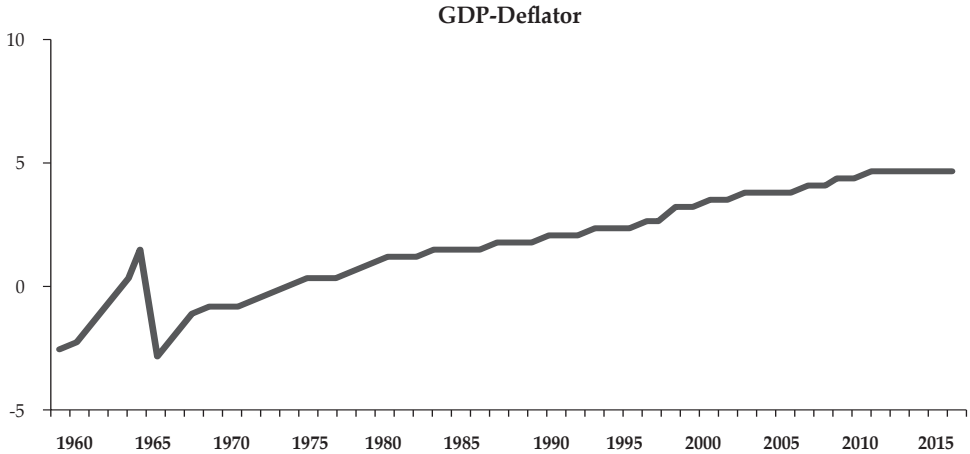
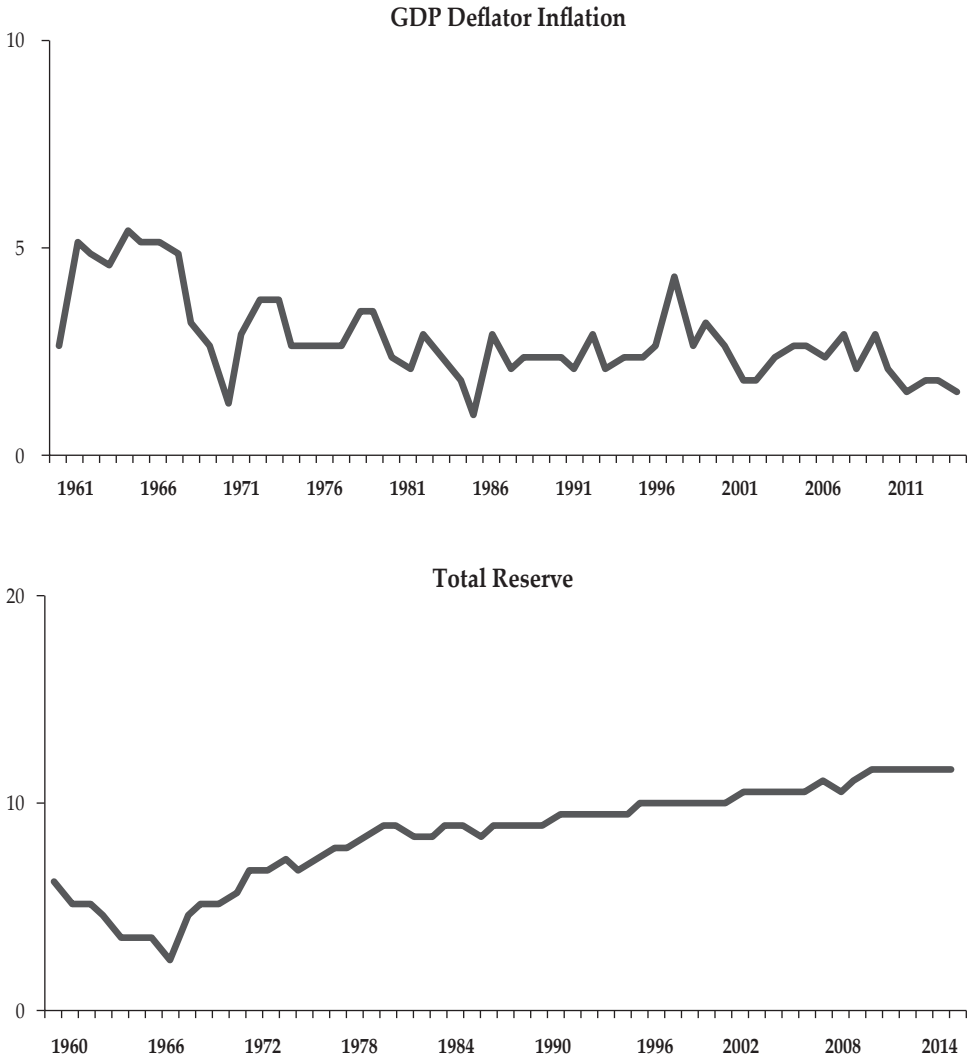


Figure 1. A Plot of Annual Time-Series Data (Continued)



The Narayan and Popp (2010) test results for monthly data are reported in Table 4. We document that regardless of the type of model specification (i.e., Model 1 or Model 2), the unit root null hypothesis with monthly data is rejected for business confidence index, capital value traded, cash return index, consumer confidence index, exchange rate, 1- and 3-month interbank interest rate, industrial production (volume), lending rate, M1, price-earnings ratio, and foreign reserves. In total, therefore, we discover that the unit root hypothesis can be rejected in 13/31 monthly series, equivalent to 42% of the time-series data on hand.

Table 4.
Unit Root Results for Monthly Data

This table shows Narayan and Popp (2010) unit root results for monthly data. Columns 3 and 4 show the sample period and the corresponding number of observations (T). We refer to Table 3 of Narayan and Popp (2010) for critical values for unknown break dates. Models 1 and 2 are two models for testing unit root. Model 1 (see Column 5) allows for two breaks in level and the Model 2 allows for two breaks in level as well as slope (see Column 6). The true break dates are denoted by TB1 and TB2; k represents the optimal lag length; and ***, **, and * indicate that the unit root null hypothesis is rejected at the 1%, 5%, and 10% levels of significance, respectively.

				M1				M2			
No.	Series	Sample	T	*T*-stat	TB1	TB2	k	*T*-stat	TB1	TB2	k
1	Bond Yield, 3 Year	2009:05-2018:06	110	-3.796	2011:08	2013:05	4	-4.306	2011:08	2013:05	4
2	Bond Yield, 5 Year	2009:05-2018:06	110	-3.480	2013:05	2013:09	0	-3.062	2013:05	2013:10	0
3	Bond Yield, 10 Year	2009:05-2018:06	110	-3.711	2011:12	2013:05	0	-4.123	2013:05	2013:10	3
4	Business Confidence Index	2002:01-2017:12	190	-5.235***	2006:08	2006:11	3	-5.170**	2006:08	2006:12	3
5	Capital Value Traded	1990:01-2018:05	341	-2.639	1997:07	1998:07	2	-5.520***	1997:07	2008:09	5
6	Cash Return Index	1989:12-2018:06	343	-6.238***	1997:07	1997:10	4	-3.535	1997:07	1998:09	4
7	Composite Index	1983:03-2018:06	424	-3.026	1997:07	2008:09	1	-3.613	1997:07	2008:09	1
8	Consumer Confidence Index	2001:04-2017:12	201	-4.099*	2004:09	2006:12	1	-4.585	2004:09	2006:12	1
9	CPI Inflation	1967:01-2018:06	618	-5.400***	1998:01	2005:09	4	-6.085***	1998:01	2005:09	4
10	Deposit Rate	1974:04-2016:07.	508	-2.882	1984:02	1997:07	3	-3.451	1984:02	1997:07	3
11	Dividend Yield	1990:11-2018:06	332	-3.339	1999:06	2000:03	0	-3.648	1999:06	2000:03	0
12	Exchange Rate	1876:01-2018:06	1710	-6.105***	1960:07	1963:12	4	-4.498*	1960:07	1963:12	4
13	Dow Jones Stock Index	1992:01-2018:06	318	-2.690	1998:07	2008:09	0	-3.675	1998:07	2008:09	0
14	Export Goods	1961:01-2018:05	689	-2.014	1974:01	1977:02	4	-1.951	1974:01	1977:02	4
15	Export Index	1991:01-2018:05	329	-2.072	1997:12	2008:10	5	-3.703	1997:12	2008:10	5
16	GFD Market Capitalisation of GDP	1995:01-2018:05	281	-1.241	2004:04	2005:11	0	-1.825	2004:04	2005:11	0
17	Import Goods	1960:01-2018:06	701	-2.363	1978:03	1986:11	3	-3.067	1978:03	1986:11	3
18	Import Index	1991:01-2018:05	329	-2.457	1997:12	1998:04	5	-1.792	1997:12	1998:06	5
19	Indonesia 1 Month Interbank Interest Rate (JIBOR)	1990:01-2018:06	342	-3.791	1997:07	1997:10	5	-4.559*	1997:07	1998:01	4
20	Indonesia 3 Month Interbank Interest Rate (JIBOR)	1993:12-2018:06	295	-2.566	1999:04	1999:06	0	-4.449*	1999:05	2005:07	5
21	Indonesia 6 Month Interbank Interest Rate (JIBOR)	1991:01-2018:06	330	-3.102	1997:08	1999:05	5	-3.032	1997:08	1998:04	5
22	Indonesia 12 Month Interbank Interest Rate (JIBOR)	1997:03-2018:06	256	-3.423	2005:07	2008:09	5	-4.373	2005:07	2008:09	5
23	Industrial Production Volume	1991:12-2018:04	317	-4.408*	1999:01	2003:11	4	-6.984***	1997:12	2003:11	4
24	Jakarta Stock Exchange Islamic Index	2000:07-2018:06	216	-2.981	2004:10	2008:09	3	-4.026	2008:02	2008:09	0
25	Lending Rate for Working Capital	1986:03-2016:08	366	-4.534**	1997:07	1998:02	5	-5.126**	1997:07	1998:05	5
26	M1-Money Supply	2008:01-2018:04	124	-4.691**	2010:11	2011:11	3	-5.840***	2011:11	2013:12	0

Table 4.
Unit Root Results for Monthly Data (Continued)

				M1				M2			
No.	Series	Sample	T	*T*-stat	TB1	TB2	k	*T*-stat	TB1	TB2	k
27	M2-Money Supply	2008:01-2018:04	124	-1.627	2010:11	2011:11	4	-1.848	2010:11	2011:11	4
28	Price to Earnings Ratio	1990:01-2018:06	342	-4.719**	1998:09	2008:12	1	-5.118**	1998:09	2008:12	1
29	Producer Price Index Excluding Oil	1971:01-2016:04	544	-3.374	1986:08	1997:12	5	-2.136	1986:08	1997:12	5
30	Stock Return Index	1988:01-2018:06	366	-3.277	1997:07	1998:07	1	-3.530	1998:07	1998:11	0
31	Total Foreign Exchange Reserves (exclude Gold)	1971:01-2018:06	570	-6.325***	1983:02	1990:11	5	-4.018	1983:02	1987:06	5

As a robustness check, we examine annual time-series data. The results from the unit root test are reported in Table 5. With the Model 1, the unit root null is rejected for 12/33 series while with the Model 2, the null is rejected for 9/33 series. Taking both models together, with annual data, a total of 16 series are unit root stationary, meaning the unit root null hypothesis is comfortably rejected. This represents 48% of the variables.

Table 5.
Unit Root Results for Yearly Data

This table shows Narayan and Popp (2010) unit root results for yearly data. Column 3 and 4 show the sample period and the corresponding number of observations. We refer to the Table 3 of Narayan and Popp (2010) for the critical values for unknown break dates. M1 and M2 are two models for testing unit root. The model M1 (see Column 5) allows for two breaks in level and the model M2 allows for two breaks in level as well as slope (see Column 6). The true break dates are denoted by TB1 and TB2. The k represents the optimal lag length. ***, **, and * indicate the unit root null is rejected, at levels of statistical significance 1%, 5%, and 10%, respectively.

				M1				M2			
No.	Series	Sample	T	*T*-stat	TB1	TB2	k	*T*-stat	TB1	TB2	k
1	Capital Value Traded	1977-2017	41	-4.396	1988	1996	2	-4.504	1996	1999	1
2	Cash Return Index	1989-2017	29	-0.461	1997	2000	1	-2.383	1997	2000	0
3	Composite Index	1977-2017	41	-3.642	1987	1996	0	-3.322	1987	1992	0
4	CPI	1960-2016	57	-15.732	1971	1997	5	-9.516	1972	1997	5
5	CPI Inflation	1948-2017	70	-0.274	1961	1965	2	-5.215	1961	1965	0
6	Deposit Rate	1974-2017	44	-4.881	1983	1997	2	-2.857	1983	1998	4
7	Dividend Yield	1990-2017	28	-4.647	2001	2003	5	-7.136	1998	2009	5
8	Dow Jones Stock Index	1992-2017	26	-4.878	1999	2007	5	-7.423	1999	2007	0
9	Exchange Rate	1818-2017	200	1.465	1963	1966	3	-7.265	1952	1963	1
10	Export Goods	1946-2017	72	-3.540	1973	1985	0	-2.282	1972	1975	0
11	Export Goods and Services	1990-2017	28	-1.780	1997	2004	1	-2.056	1998	2004	0
12	Export Index	1991-2017	27	-2.627	1998	2008	3	-3.295	1998	2007	0
13	GDP-Deflator Inflation	1961-2015	55	-5.610	1985	1997	0	-6.002	1971	1997	0
14	GDP-Deflator	1960-2015	56	-4.262	1971	1997	5	-4.226	1971	1997	4
15	GFD Market Capitalisation of GDP	1993-2017	25	-0.881	2004	2007	0	-0.678	2004	2009	0
16	Nominal GDP	1951-2017	67	2.118	1965	2001	2	-2.208	1965	2001	1
17	Real GDP	1870-2017	148	-2.168	1941	1946	4	-4.345	1941	1948	3

Table 5.
Unit Root Results for Yearly Data (Continued)

				M1				M2			
No.	Series	Sample	T	*T*-stat	TB1	TB2	k	*T*-stat	TB1	TB2	k
18	Import Goods	1946-2017	72	-2.948	1965	1979	1	-3.808	1972	1997	4
19	Import Goods and Services	1990-2017	28	0.244	1997	1999	5	-1.927	1998	2003	0
20	Import Index	1991-2017	27	-3.594	2005	2007	0	-3.558	1998	2007	0
21	Indonesia 1 Month Interbank Interest Rate (JIBOR)	1990-2017	28	-4.009	2002	2008	3	-2.885	1998	2002	5
22	Indonesia 3 Month Interbank Interest Rate (JIBOR)	1993-2017	25	-3.100	2002	2008	5	-5.755	2002	2005	5
23	Indonesia 6 Month Interbank Interest Rate (JIBOR)	1991-2017	27	-3.870	1998	2008	5	-3.144	1998	2004	0
24	Indonesia 12 Month Interbank Interest Rate (JIBOR)	1997-2017	21	-3.213	2004	2006	3	-5.753	2004	2009	3
25	Industrial Production Volume	1991-2017	27	-7.292	2001	2008	3	-2.159	1998	2006	4
26	Lending Rate For Working Capital	1986-2017	32	-4.250	1997	2002	3	-1.107	1998	2004	0
27	Price To Earnings Ratio	1990-2017	28	-4.834	1999	2005	3	-2.445	1999	2002	3
28	Producer Price Index Excluding Oil	1971-2017	47	-2.995	1982	1997	4	-3.346	1997	2004	0
29	Stock Return Index	1987-2017	31	0.167	2002	2007	2	-2.274	2002	2007	2
30	Total Foreign Exchange Reserves (exclude Gold)	1971-2017	47	-3.693	1981	1985	3	-3.924	1981	1989	0
31	Total Reserve	1960-2015	56	-7.073	1971	1976	4	-8.261	1974	1981	0
32	Unemployment	1973-2017	35	-5.774	1993	1998	5	-3.170	1993	1999	5
33	Wholesale Price Index	1971-2016	46	-1.614	1984	1997	4	-2.079	1984	1997	5

With monthly data, the unit root null hypothesis is rejected for business confidence index, capital value traded, cash return, consumer confidence, CPI inflation, exchange rate, 1- and 3-month interbank interest rate, industrial production (volume), lending rate, M1, price-earnings ratio, and foreign reserves. With annual data, the null is rejected for capital value traded, CPI inflation, deposit rate, dividend yield, Dow Jones stock index, GDP deflator, exchange rate, 3- and 12-month interbank interest rate, industrial production (volume), lending rate, price-earnings ratio, reserves, and unemployment rate. The variables for which the null is rejected regardless of data frequency (in other words, those variables that are stationary in a robust manner) include capital value traded, CPI inflation, exchange rate, industrial production (volume), lending rate, price-earnings ratio, 3-month interbank interest rate, and foreign reserves. This represents only 24% of the sample of variables. In other words, data frequency matters to unit root tests and it should be left to policymakers to decide which data frequency is of policy relevance to them in understanding the nature of shocks to time-series data.[4]

[4] Some of the break dates relate to obvious events. The monthly CPI inflation break, for instance, corresponds to the period of 2002-2006 when the world oil price increased. In response, the Indonesian government had increased the price of subsidized gasoline by almost two times in 2005. For yearly CPI inflation data break dates correspond to the period of hyperinflation in Indonesia.

IV. CONCLUDING REMARKS

This paper examines the URP of macroeconomic time-series data for Indonesia. A total of 33 variables for which sufficient time-series data are available form part of our empirical analysis. We test the hypothesis using the popular Narayan and Popp (2010) unit root test, which allows for two endogenous structural breaks in the data series. Our analysis is based on both annual and monthly time-series data. We find that data frequency is important in understanding URP. First, we show that with annual data, the unit root null hypothesis is rejected in only 48% of the variables, while with monthly data the number of rejections is equivalent to 42%. The implication here is that there is more evidence of stationarity of variables with annual data than monthly data. Second, across data frequencies, the variables found to be stationary in both data frequencies are capital value traded, CPI inflation, exchange rate, industrial production (volume), lending rate, price-earnings ratio, 3-month interbank interest rate, and foreign reserves. This represents only 24% of the sample of variables. The implication is that, for these variables, shocks have only a short-term or temporary effect.

Three policy implications emerge from our analysis. First, for policy purposes, it matters whether one uses annual or monthly data. It seems there are more cases of stationary variables with annual data than monthly data, suggesting that more data at annual frequency will be relevant for understanding short-run effects. The second implication relates to forecasting. In most cases, for policy purposes, practitioners need to forecast inflation, exchange rate, and short-term interest rate. These variables for Indonesia are stationary, meaning standard forecasting models that require the dependent variable (variable to be forecast) to be stationary are ideal for forecasting these variables. The third implication concerns the importance of structural breaks. The results described in this paper make clear that structural breaks characterize Indonesia's macroeconomic data. Therefore, it would be costly to ignore breaks in data when econometric modeling, including forecasting, is the subject of research.

REFERENCES

Amir, H., Asafu-Adjaye, J., and Ducpham, T. (2013). The impact of the Indonesian income tax reform: A CGE analysis. *Economic Modelling*, 31, 492-501.

Aslanidis, N., and Fountas, S. (2014). Is real GDP stationary? Evidence from a panel unit root test with cross-sectional dependence and historical data. *Empirical Economics*, 46, 101-108.

Cavaliere, G., and Xu, F. (2014). Testing for unit roots in bounded time series. *Journal of Econometrics*, 178, 259-272.

Chambers, M. (2015). Testing for a unit root in a near integrated model with skip-sampled data. *Journal of Time Series Analysis*, 36, 630-649.

Chang, T., Chang, H-L., Chu, H-P., and Su, C-W. (2006). Does PPP hold in African countries? Further evidence based on a highly dynamic non-linear (logistic) unit root test. *Applied Economics*, 38, 2453-2459.

Chang, T., Yang, M., Liao, H-C., and Lee, C-H. (2007). Hysteresis in unemployment: empirical evidence from Taiwan's region data based on panel unit root tests. *Applied Economics*, 39, 1335-1340.

Charles, A., and Darné, O. (2012). Trends and random walks in macroeconomic time series: A reappraisal. *Journal of Macroeconomics*, 34, 167-180.

Choi, I. (2001). Unit root tests for panel data. *Journal of International Money and Finance*, 20, 249-272.

Chowdhury, A., Uddin, M., and Anderson, K. (2018). Liquidity and macroeconomic management in emerging markets. *Emerging Markets Review,* 34, 1-24.

Djuranovil, L. (2014). The Indonesian macroeconomy and the yield curve: A dynamic latent factor approach. *Journal of Asian Economics*, 34, 1-15.

Drakos, A., Kouretas, G., and Vlamis, P. (2018). Saving, investment and capital mobility in EU member countries: A panel data analysis of the Feldstein–Horioka puzzle. *Applied Economics*, 50, 3798-3811.

Dutu, R. (2016). Why has economic growth slowed down in Indonesia? An investigation into the Indonesian business cycle using an estimated DSGE model. *Journal of Asian Economics*, 45, 46-55.

Gil-Alana, L., and Robinson, P. (1997). Testing the unit root and other non-stationarity hypothesis in macroeconomic time series. *Journal of Econometrics*, 80, 241-268.

Hadiwibowo, Y., and Komatsu, M. (2011). Trilemma and macroeconomic policies under different financial structures in Indonesia. *Journal of Asian Economics*, 22, 302-310.

Hsing, Y. (2012). Impacts of macroeconomic forces and external shocks on real output for Indonesia. *Economic Analysis and Policy*, 42, 97-104.

Hurlin, C. (2010). What would Nelson and Plosser find had they used panel unit root tests?. *Applied Economics*, 42, 1515-1531.

Kappler, M. (2009). Do hours worked contain a unit root? Evidence from panel data. *Empirical Economics*, 36, 531-555.

Lee, J., and Strazicich, M. (2003). Minimum lagrange multiplier unit root test with two structural breaks. *Review of Economics and Statistics*, 85, 1082-1089.

Li, H., and Park, S. (2018). Testing for a unit root in a nonlinear quantile autoregression framework. *Econometric Reviews*, 37, 867-892.

Lucas, A. (1995). An outlier robust unit root test with an application to the extended Nelson-Plosser data. *Journal of Econometrics*, 66, 153-173.

Lumsdaine, R., and Papell, D. (1997). Multiple trend breaks and the unit root hypothesis. *Review of Economics and Statistics*, 79, 212-218.

Maslyuk, S., and Smyth, R. (2008). Unit root properties of crude oil spot and futures prices. *Energy Policy*, 36, 2591-2600.

Narayan, P. K., and Liu, R. (2015). A unit root model for trending time-series energy variables. *Energy Economics*, 50, 391-402.

Narayan, P. K., Liu, R., and Westerlund, J. (2016). A GARCH model for testing market efficiency. *Journal of International Financial Markets Institutions and Money*, 41, 121-138.

Narayan, P., and Narayan, S. (2010). Is there a unit root in the inflation rate? New evidence from panel data models with multiple structural breaks. *Applied Economics*, 42, 1661-1670.

Narayan, P., and Popp, S. (2010). A new unit root test with two structural breaks in level and slope at unknown time. *Journal of Applied Statistics*, 37, 1425-1438.

Narayan, P., and Smyth, R. (2005). Structural breaks and unit roots in Australian macroeconomic time series. *Pacific Economic Review*, 10, 421-437.

Narayan, P. K., and Smyth, R. (2007). Mean reversion versus random walk in G7 stock prices: evidence from multiple trend break unit root tests. *Journal of International Financial Markets Institutions and Money*, 17, 152-166.

Narayan, P. K., Narayan, S., and Smyth, R. (2008). Are oil shocks permanent or temporary? Panel evidence from crude oil and NGL production in 60 countries. *Energy Economics*, 30, 919-936.

Narayan, P. K. (2005a). Did Rabuka's military coups have a permanent effect or a transitory effect on tourist expenditure in Fiji: Evidence from Vogelsang's structural break test. *Tourism Management*, 26, 509-515.

Narayan, P. K. (2005b). The structure of tourist expenditure in Fiji: evidence from unit root structural break tests. *Applied Economics*, 37, 1157-1161.

Narayan, P. K. (2006a). Are bilateral exchange rates stationary? Evidence from Lagrange multiplier unit root tests for India. *Applied Economics*, 38, 63-70.

Narayan, P. K. (2006b). Examining structural breaks and growth rates in international health expenditures. *Journal of Health Economics*, 25, 877-890.

Narayan, P. (2008). Revisiting the US money demand function: an application of the Lagrange multiplier structural break unit root test and the bounds test for a long run relationship. *Applied Economics*, 40, 897-904.

Nelson, C., and Plosser, C. (1982). Trends and random walks in macroeconomic time series: some evidence and implications. *Journal of Monetary Economics*, 10, 139-169.

Niang, A., Diagne, A., and Pichery, M. (2011). Exploring the finance-real economy link in U.S.: Empirical evidence from panel unit root and cointegration analysis. *Empirical Economics*, 40, 253-268.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, 57, 1361-1401.

Smyth, R. (2003). Unemployment Hysteresis in Australian States and Territories: Evidence from Panel Data Unit Root Tests. *The Australian Economic Review*, 36, 181-192.

Sowmya, S., and Prasanna, K. (2018). Yield curve interactions with the macroeconomic factors during global financial crisis among Asian markets. *International Review of Economic and Finance,* 54, 178-192.

Tanuwidjaja, E., and Choy, K. M. (2006). Central bank credibility and monetary policy in Indonesia. *Journal of Policy Modeling,* 28, 1011-1022.

APPENDIX

Table A1.
Variable Description

This table provides detail description of data used in this study.

Variable Name	Ticker	Series Type	Currency
Indonesia 1-year Government Note Yield	IGIDN1D	Government Bond Yields	Indonesia Rupiah
Indonesia 5-year Government Note Yield	IGIDN5D	Government Bond Yields	Indonesia Rupiah
Indonesia 10-year Government Bond Yield	IGIDN10D	Government Bond Yields	Indonesia Rupiah
Indonesia Business Confidence Index	BCIDNM	Production and Output	Non-currency Series
Jakarta SE Capitalization, Value Traded (USD)	SCIDNM	Stocks - Capitalization, Volume	United States Dollar
GFDatabase Indonesia Cash Return Index	TRIDNBIM	Total Return Indices - Bills	Indonesia Rupiah
Indonesia Consumer Confidence Index	CCIDNM	Production and Output	Non-currency Series
Jakarta SE Composite Index	_JKSED	Stock Indices - Composites	Indonesia Rupiah
Indonesia Final consumption expenditure (constant 2000 US$)	NE.CON.TOTL.KD IDN	National Accounts - Expenditures	United States Dollar
Indonesia Consumer Price Index Inflation Rate	CPIDNM	Consumer Price Indices	Indonesia Rupiah
Indonesia Currency in Circulation	MSIDNM0	Monetary Aggregates	Indonesia Rupiah
Indonesia 3-month Time Deposits	ICIDNTM	Deposit Rates	Indonesia Rupiah
Dow Jones Indonesia Stock Index	_ID1	Stock Indices - Composites	Indonesia Rupiah
Indonesia Rupiah per US Dollar	USDIDR	Exchange Rates - Market	United States Dollar
Indonesia Dividend Yield	SYIDNYM	Stocks - Dividend Yields and P/E Ratios	Non-currency Series
Indonesia Export of Goods	TDGXIDNM	Exports and Imports	United States Dollar
Indonesia Exports of Goods and Services	GDPXIDN	National Accounts - Expenditures	Indonesia Rupiah
Indonesia Export Price Index	EXPIDNM	Trade Indices	Indonesia Rupiah
Indonesia Household final consumption expenditure, etc. (% of GDP)	NE.CON.PETC.ZS IDN	National Accounts - Expenditures	Non-currency Series
Indonesia Inflation, GDP deflator (annual %)	NY.GDP.DEFL.KD.ZG IDN	National Account Aggregates	Non-currency Series
Indonesia Real GDP in 2010 Rupiah	GDPCIDN	National Account Aggregates	Indonesia Rupiah
Indonesia Gross national expenditure (% of GDP)	NE.DAB.TOTL.ZS IDN	National Accounts - Expenditures	Non-currency Series
Indonesia Gross domestic savings (% of GDP)	NY.GDS.TOTL.ZS IDN	National Account Sectors	Non-currency Series
Indonesia Import Price Index	IMPIDNM	Trade Indices	Indonesia Rupiah

Table A1.
Variable Description

Variable Name	Ticker	Series Type	Currency
Indonesia Imports of Goods	TDGMIDNM	Exports and Imports	United States Dollar
Indonesia Imports of Goods and Services	GDPMIDN	National Accounts - Expenditures	Indonesia Rupiah
Indonesia Imports of Goods	TDGMIDNM	Exports and Imports	United States Dollar
Indonesia Industrial Production Volume SA	NDWIDNM	Production and Output	United States Dollar
Indonesia 1-month JIBOR	_JKIID	Stock Indices - Composites	Indonesia Rupiah
Indonesia 3-month JIBOR	JIIDR1MD	Interbank Interest Rates	Indonesia Rupiah
Indonesia 6-month JIBOR	JIIDR3MD	Interbank Interest Rates	Indonesia Rupiah
Indonesia 12-month JIBOR	JIIDR6MD	Interbank Interest Rates	Indonesia Rupiah
Indonesia 12-month JIBOR	JIIDR1YD	Interbank Interest Rates	Indonesia Rupiah
Indonesia Average Lending Rate for Working Capital	ILIDNM	Lending Rates	Indonesia Rupiah
Indonesia M1 Money Supply	MSIDNM1	Monetary Aggregates	Indonesia Rupiah
Indonesia M2 Money Supply	MSIDNM2	Monetary Aggregates	Indonesia Rupiah
GFD INDONESIA Market Cap Pct of GDP	SCIDNMCAPPCTM	GFD Indices - Market Capitalization	United States Dollar
Indonesia Price/Earnings Ratio	SYIDNPM	Stocks - Dividend Yields and P/E Ratios	Non-currency Series
Indonesia Nominal GDP	GDPIDN	National Account Aggregates	Indonesia Rupiah
Indonesia Net foreign assets (current LCU)	FM.AST.NFRG.CN IDN	Financial Sector	Indonesia Rupiah
Indonesia Total Foreign Exchange Reserves Excluding Gold	FXRIDNM	International Liquidity	United States Dollar
Indonesia Real GDP in 2010 Rupiah	GDPCIDN	National Account Aggregates	Indonesia Rupiah
Indonesia Producer Prices excluding Oil	WPIDNM	Producer Price Indices	Indonesia Rupiah
Indonesia Wholesale price index (2005 = 100)	FP.WPI.TOTL IDN	Wholesale Price Indices	Indonesia Rupiah
Indonesia Semi-Annual Unemployment Rate	UNIDNM	Employment	Non-currency Series
Indonesia Total reserves (includes gold, current US$)	FI.RES.TOTL.CD IDN	International Liquidity	United States Dollar
Indonesia Consumer price index (2005 = 100)	FP.CPI.TOTL IDN	Consumer Price Indices	Indonesia Rupiah
Indonesia GDP deflator (base year varies by country)	NY.GDP.DEFL.ZS IDN	National Account Aggregates	Indonesia Rupiah
Jakarta SE Islamic Index	_JKIID	Stock Indices - Composites	Indonesia Rupiah
Indonesia Stock Return Index	TRIDNSTM	Total Return Indices - Stocks	Indonesia Rupiah