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INTERNATIONAL MONETARY FUND

INDONESIA

SELECTED ISSUES

May 5, 2023

Approved By
Asia and Pacific Department

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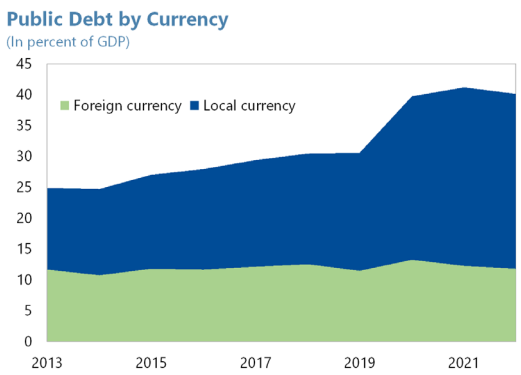
NOT ALL INVESTORS ARE THE SAME: LESSONS FOR A CHANGING INVESTOR BASE IN INDONESIA[1]

Against the backdrop of a significant shift in the investor base of local currency (LC) sovereign debt in Indonesia, this paper finds that: (i) NR holdings of LC debt in Indonesia are mostly driven by global factors, while Bank of Indonesia (BI) acts as a residual financier; (ii) higher NR holdings support the bond market and domestic credit, but increase exchange rate volatility; and episodes of rapid and large declines in the NR share of LC debt in EMs are associated with higher future market volatility and lower credit to the private sector; and (iii) domestic nonbanks play a key role in absorbing new LC debt, especially during episodes of large and rapid nonresident outflows. These results call for a further deepening of the investor base, especially domestic nonbanks, to support market depth and reduce volatility.

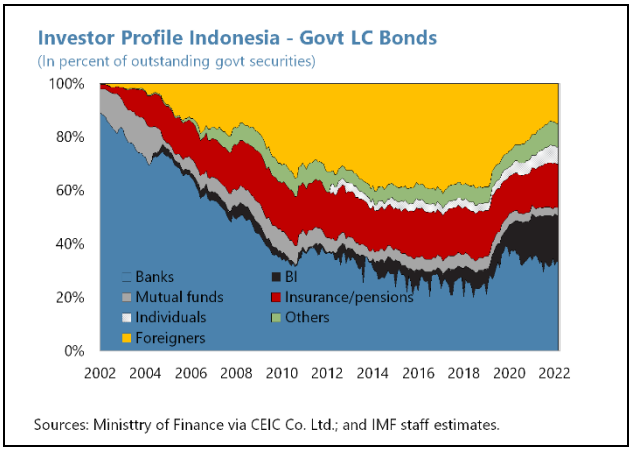
A. Introduction

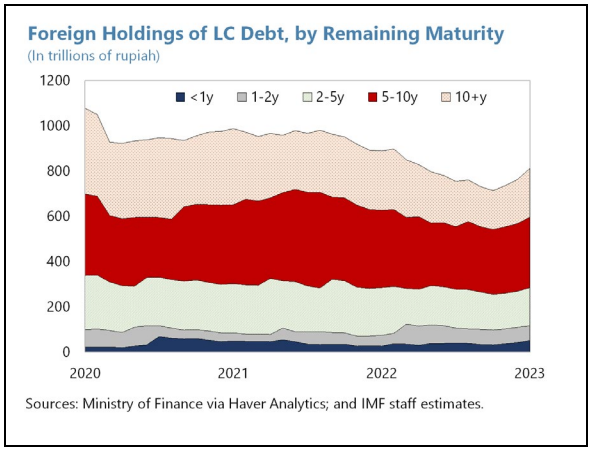
1. Indonesia has experienced a significant decline in the nonresident (NR) share of local-currency (LC) debt coinciding with the pandemic. Public debt is estimated to have reached 40.1 percent of GDP in 2022 from 30.6 percent in 2019, mostly driven by higher LC debt issuances, owing to the exceptional fiscal measures deployed in 2020-22 to fight the COVID-19 pandemic, during which the fiscal rule was temporarily suspended and the BI-MoF introduced a burden-sharing financing agreement. At the same, time, the NR share of LC debt declined from 39 percent in 2019Q4 (one of the highest ratios across a large sample of EMs from Arslanalp and Tsuda 2014) to about 14 percent at end-2022. While the institutional investors' (mutual funds, insurance companies, and pension funds) share of LC debt holdings have remained broadly stable, the shares of Bank of Indonesia (BI) and domestic banks have increased during COVID years, in line with BI's primary market purchases under the BI-MoF burden-sharing financing agreement. NR holdings have shown some signs of recovery in recent months and remain mostly concentrated in long-dated securities.



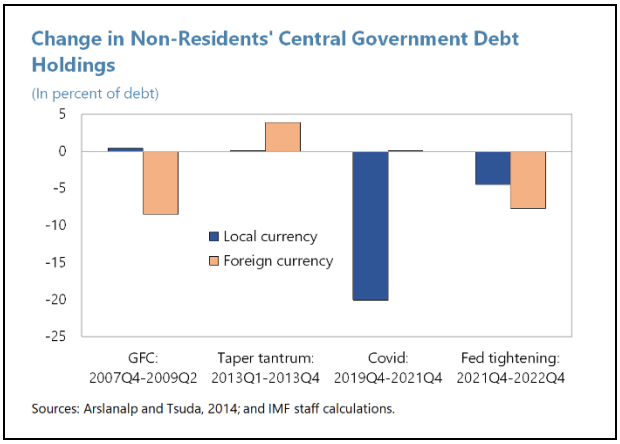
Source: Authorities.

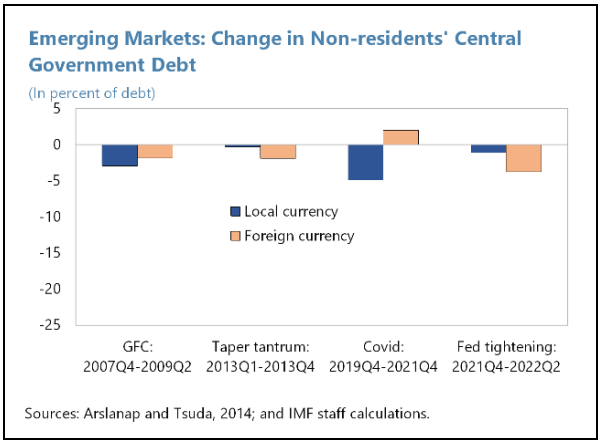
[1] Prepared by Bruno Albuquerque (SPR) and Amr Hosny (FAD). Agnes Isnawangsih provided excellent research assistance. The authors benefitted from useful inputs during the mission from participants at a seminar at the Ministry of Finance of Indonesia.





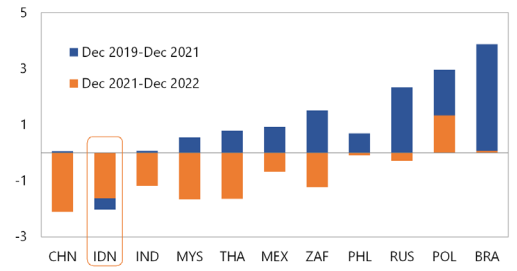
2. The recent fall in the NR Share of LC debt is unprecedented historically, and relative to other EMs. Since COVID-19, Indonesia has recorded the largest decline in the NR share of LC debt, of roughly 25 percentage points until 2022Q4, compared to other periods of financial stress (left panel of figure). The decline in NR holdings of LC debt has been economically important: almost 3 percent of GDP. The decline in the NR share of LC debt since the COVID shock can be broken down into two periods. In the first period, covering 2020 and 2021, large NR outflows mainly reflected the COVID shock, and BI started primary market purchases under the BI-MoF agreement amid rising fiscal deficits. The decline in NR holdings continued in 2022, amid the tightening in global financial conditions driven by the Fed tightening. In turn, the share of NRs in foreign-denominated debt has fallen by significantly less during 2020-22, likely due to limited exchange rate risk in this segment, although it has declined by more since the Fed tightening. By contrast, the average EM country did not experience such a significant fall in LC debt since 2020 (right panel of figure).[2]





[2] We find a similar pattern for ASEAN countries.

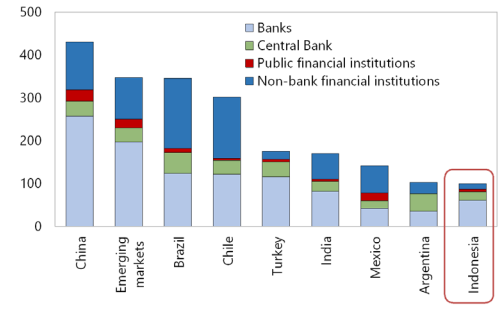
3. The decline in the NR share may reflect a combination of different factors, including a larger decline in the yield differential relative to US bond yields. First, the decline in returns since the COVID-19 pandemic–as measured by the difference between the yield on LC debt and the equivalent US bond yield–has been larger for Indonesia relative to other EMs, driven fully by higher US bond yields, while yields on Indonesia's LC debt declined. In fact, most of decline in returns took place in 2022, a period characterized by a rapid Fed tightening cycle. Second, it may also reflect the large purchases by BI: the share of BI holdings increased almost 10 percentage points since COVID, mostly in the primary market in line with the BI-MOF financing agreement.



Change in the 10y LC Government Bond Yield Differential 1/
(In percentage points, December 2022 relative to December 2019)

Sources: Haver Analytics; and IMF staff estimates.
1/ Defined as the difference from the 10y US Treasury bond yield.

4. The NR share of LC debt in Indonesia is now close to the average EM. Indonesia had the second highest NR share of LC debt in 2019Q4, just before the pandemic, but now stands at about the EM average. At the same time, the limited size and role of domestic nonbanks (institutional investors) may partially explain the historically high share of NR holdings in Indonesia.



Financial Institution Assets, 2021
(In percent of GDP)

Source: Global Monitoring Report on Non-financial Intermediation 2022.

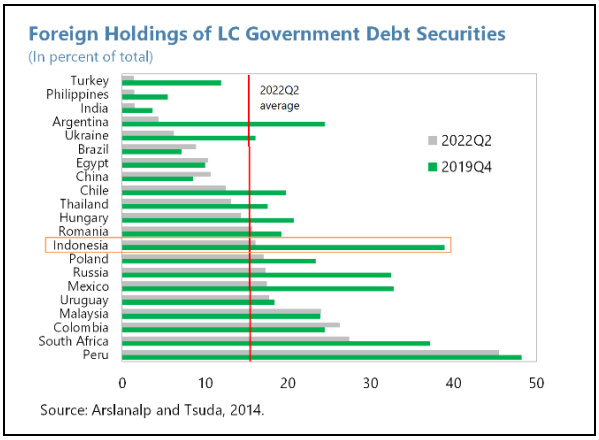
5. Different investor profiles come with different risks. Sovereign borrowing can help buffer the economy from the impact of adverse macroeconomic shocks. But it can also make a country vulnerable to financial distress. On top of that, not all investors are the same. The literature points to several pros and cons of having a higher NR share of LC debt:

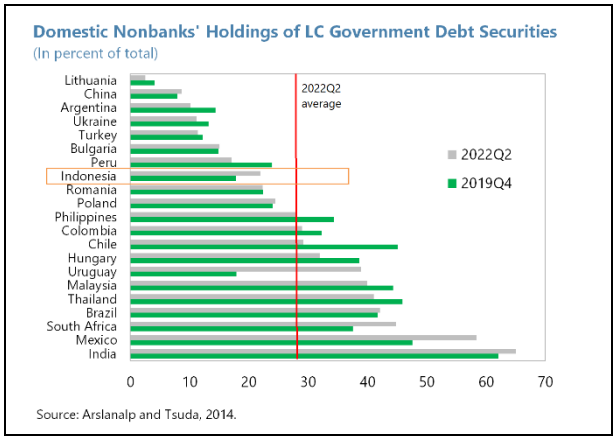
- **Pros**: Foreign investors can improve price discovery, increase demand for longer-maturity instruments and provide liquidity (Bae 2012, Arslanalp and Tsuda 2014). Greater foreign participation can reduce long-term government bond yields due to a more diversified investor base (Arslanalp and Tsuda 2014, Ebeke and Lu 2014, Peiris 2010, Lu and Yakovlev 2017).[3] A higher NR share can also minimize the crowding-out of private credit and the sovereign-bank nexus (Broner et al 2014, Asonuma et 2015).

- **Cons**: Higher NR shares can increase rollover and exchange rate risks (Calvo et al. 2006). Higher NR shares can also increase risks to sudden stops or capital reversals, as these flows are more volatile and short term in nature (Calvo et al. 2006, BIS 2007). In addition, there is some evidence of increased yield volatility with higher shares of NR holdings (Ebeke and Lu 2015, Ebeke and Kyobe

[3] Asonuma et (2015) find that high domestic banks' holdings of domestic debt (home bias) can generally reduce borrowing costs, but this effect diminishes during crisis and maybe associated with less responsive fiscal policy.

2015). Burger and Warnock (2007) argue that U.S. investors avoid LC bonds that have returns with historically high variance and negative skewness–features that are predominant in EMs.





6. This paper is structured as follows. First, we examine the global and domestic factors driving different investor holdings in Indonesia. Second, we study the macroeconomic and financial implications of the change in the investor base towards domestic investors using cross-country data from a panel of EMs. Third, we draw lessons from episodes of rapid and large declines in the NR share of LC debt in EMs. We conclude the paper by studying the marginal investor of sovereign debt under normal and stress episodes.

B. Do Different Investors Respond Differently to Global and Domestic Factors in Indonesia?

7. The decision of different investors to hold LC government debt can reflect both global and domestic conditions. Domestic (or pull) factors usually include domestic bond yields, the amount of debt issuance, and different country-specific risks. Global (or push) factors typically include global commodity prices, global interest rates and financial market volatility. For a survey of the empirical literature on the drivers of capital inflows into EMs, see for instance Koepke (2018).

8. Global factors tend to carry a large weight in index-funds and decisions to invest in LC debt in EMs. Several studies argue that portfolio flows to EMs tend to be correlated, driven by the so-called "benchmark effect" (see Arslanalp et al 2020, Arslanalp and Tsuda 2015, BIS 2007). This refers to the observation that benchmark-driven investors are typically more sensitive to global than country-specific factors, as their investments consider EMs as an asset class, thus focusing mainly on factors that affect EMs as a group, rather than on country-specific developments.[4] Raddatz et al (2017) find that benchmarks explain, on average, between 40-70 percent of equity and bond mutual fund portfolio allocations after controlling for country-specific effects. Rey (2015) argues that capital flows are mainly driven by monetary conditions in main financial centers. Sienaert (2012) highlights

[4] Benchmark-driven investors are those who invest in countries through a fund that either tracks or closely follows a flagship benchmark index. One of such indices is the J.P. Morgan Government Bond Index-Emerging Markets (GBI-EM), which tracks local currency bonds issued by EMs. Indonesia has a weight of 10 percent in the GBI-EM index as of end-December 2021, ahead of countries like Malaysia and South Africa.

the role of benchmark index inclusion, or the risk of exclusion if already included, in affecting investment decisions of institutional investors.

9. We model investor holdings of LC debt in Indonesia as a function of domestic and global factors. Using time-series data for Indonesia, we examine the role of both domestic and global factors in the investment decisions of different types of resident and non-resident investors (see Koepke 2018 and Hosny 2020 for a survey of the empirical literature). Specifically, using monthly data for Indonesia over 2002M12-2022M12, we estimate the following equation:

$$\text{Investor holdings}_t = \beta_0 + \beta_1 \text{domestic}_t + \beta_2 \text{global}_t + \epsilon_t$$

where the dependent variable represents different investor holdings of Indonesia's LC tradable debt securities. The investors include foreign investors (*LCdebt_F*), domestic banks (*LCdebt_bank*), BI (*LCdebt_BI*), and nonbank residents or institutional investors (*LCdebt_nbres*). We regress the holdings of these investor types on a set of domestic and global variables following the literature (Grigorian 2019, Koepke 2018, Konopczak 2015, Rey 2015; Bae 2012). All variables, except bond yields, are expressed in logs.

- **Domestic factors** include the rate of return on domestic securities, specifically the ten-year sovereign bond yield (*yield_10y*), and LC debt issuances (*issuances*).
- **Global factors** include an index of global commodity prices (*comm prices*) as Indonesia is a diversified commodity exporter, a measure of global financial volatility in bonds (*MOVE)*,[5] as well as the ten-year US bond yield (*yieldUS_10y*) to account for the opportunity cost of investing in Indonesia.

10. Methodology. To distinguish long-run from short-run effects, we use the autoregressive distributed lag (ARDL) co-integration approach of Pesaran et al (2001). The long-run equation is represented in levels and the short-run equation is represented as an error correction equation in first differences. Both equations are simultaneously estimated by OLS. An advantage of the ARDL procedure is that it is applied irrespective of the time-series properties of the regressors.[6] In estimating the models, we use information criteria to select the optimum lag.[7]

[5] The Merrill Lynch Option Volatility Expectations (MOVE) index tracks the movement in U.S. Treasury yield volatility implied by current prices of one-month options on 2-year, 5-year, 10-year and 30-year Treasuries. It is published by ICE BofAML and can be accessed at https://macrovar.com/united-states/move-index/. It has been cited that one can think of MOVE as the "VIX for Bonds".

[6] Specifically, the Pesaran et al (2001) bounds testing approach reports two sets of critical values; an upper bound critical value assuming all variables are *I(1)*, and a lower bound assuming all are *I(0)*. If the calculated F-statistic is above the upper bound, then the variables are jointly statistically significant, indicating long-run cointegration.

[7] See Bahmani-Oskooee and Tanku (2008) for details. Panopoulou and Pittis (2004) provide evidence that ARDL generally performs better than alternative methods, such as dynamic OLS, both in terms of estimation precision and reliability of statistical inferences.

11. Results point to the importance of global factors especially for nonresidents, while domestic investor holdings are mostly associated with higher debt security issuances, and BI acts as a residual financier under adverse conditions. We find that foreign holdings are associated with global factors, such as global commodity prices and volatility in global bond markets. This result is in line with the "benchmark effect" of Rey (2015) and Arslanalp et al (2020) in EMs.[8] We also find some evidence that higher domestic yields may attract foreigners. All investors seem to increase their holdings with higher debt security issuances. Holdings of resident banks and BI seem to decrease with higher global commodity prices, potentially because in such cases NR shares increase and/or banks may prefer lending to the private sector linked to commodities. The BI increases its holdings with higher debt issuances as expected, but importantly its holdings are also positively correlated with a worsening in the global factors considered in the regression, indicating that BI acts as a residual financier under adverse conditions.

Table 1. Indonesia: ADRL Long-Run Model, 2002M12 – 2022M12

	Local currency debt holders			
	Foreigners	Banks	Bank Indonesia	Non-banks
Domestic factors:				
yield_10y	0.249*	0.044	0.056	-0.023
	(0.149)	(0.033)	(0.063)	(0.026)
Issuances	1.102***	0.521***	1.926***	1.196***
	(0.391)	(0.093)	(0.166)	(0.073)
Global factors:				
yieldUS_10y	-0.103	-0.043	0.202*	0.015
	(0.234)	(0.083)	(0.106)	(0.049)
Comm prices	1.783**	-0.310*	-0.976**	0.187
	(0.710)	(0.185)	(0.406)	(0.134)
MOVE	-1.949**	-0.203	0.789***	0.427***
	(0.814)	(0.158)	(0.269)	(0.131)
Observations	227	227	206	231
R-squared	0.406	0.403	0.351	0.355
ARDL	(5,4,2,0,1,1)	(6,0,6,4,0,1)	(4,0,0,0,0,0)	(6,2,1,0,0,0)
Sample	Full	Full	Full	Full

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

12. Results are mostly robust to different specifications. We experiment with different robustness checks. This includes adding new independent variables such as the exchange rate (IDR/USD) and a measure of country risk (proxied by the ICRG index),[9] as well as different definitions of independent variables, including yield spreads (instead of domestic and U.S. yields separately), commodities (oil vs all commodities), yield maturities (5y vs 10y), a measure of global expected volatility of equities (VIX),[10] and real instead of nominal yields. We also examine different sample periods (before COVID-19), and different definitions of the dependent variable (holdings to GDP ratio, and holdings to total debt ratio instead of the nominal value of holdings).[11]

[8] Hosny (2020) finds similar evidence of the importance of global factors in NR portfolio inflows into Nigeria.

[9] The International Country Risk Guide (ICRG) index comprises 22 variables in 3 subcategories of risk: political, financial, and economic. It is available at https://epub.prsgroup.com/products/icrg, and updated monthly for 140 countries. In the regressions, we use the inverse of the ICRG index, so that higher values represent more risk, so coefficients attached to this risk index would have the same interpretation as the VIX global index.

[10] The VIX volatility index, created by the Chicago Board Options Exchange (CBOE), is a real-time market index derived from the price inputs of the S&P 500 index options. It provides a measure of market risk and investors' sentiments and is widely used in the empirical literature. It is available at http://www.cboe.com/vix. It is a wider measure of volatility compared to MOVE, as it measures volatility of the S&P 500 stock market options as opposed to that of U.S. bonds only. Simple correlation between the VIX and MOVE indices over the sample period is 0.64.

[11] Results are not shown for space considerations, but available upon request.

C. Macroeconomic and Financial Implications of the Change in the Investor Base

13. In this section, we use panel data to draw lessons from EMs on how differences in NR shares of LC debt across countries may impact the macro-financial landscape. To that end, we estimate the dynamic relationship between a higher share of NR holdings of LC debt and different dimensions of the domestic economy. We contribute to the literature by focusing not only on the contemporaneous relationship between the share of NR holdings and the real economy, as in Ebeke and Lu (2014), Ebeke and Kyobe (2015) and IMF (2021), but also the dynamics over time to shed more light on short to medium-term effects. Moreover, we also investigate the association between NR holdings and domestic credit, which has not been a focus of the related literature. Specifically, using data on investor shares from Arslanalp and Tsuda (2014) for 24 EMs over 2004Q1-2022Q2, we employ local projection methods from Jordà (2005) to estimate a separate regression for each h=0, 1,…,12 quarters ahead:

$$Y_{i,t+h} = \beta^h \mathrm{NRshr}_{i,t-1} + \lambda^h X_{i,t-1} + \eta_i^h + \zeta_t^h + \epsilon_{i,t+h}$$

where the dependent variables refer to: (i) the level of the ten-year LC bond yields, (ii) the volatility of the ten-year LC bond yields, measured by the standard deviation of the daily bond yields within the respective quarter, (iii) the FX volatility, measured by the standard deviation of the daily change in the local currency exchange rate relative to the USD, and (iv) cumulative credit growth, measured by the log change in total credit to the private nonfinancial sector. The coefficient of interest is given by the β for each horizon, which shows the association between a one-unit increase in the NR share of LC debt and the dependent variable. We calibrate the coefficient to show a one-standard deviation increase in the sample NR share (13.8 percent). We add country fixed effects to control for permanent differences across countries, and time fixed effects to absorb time-varying unobserved global shocks. We also add the lagged dependent variable, and a set of lagged country-specific controls to minimize possible confounding factors.[12] This exercise looks at correlations, which does not necessarily imply causality from a higher NR share and the real economy. It should instead be interpreted as a prediction exercise that tracks how the economy typically behaves in the presence of a higher NR share of LC debt.

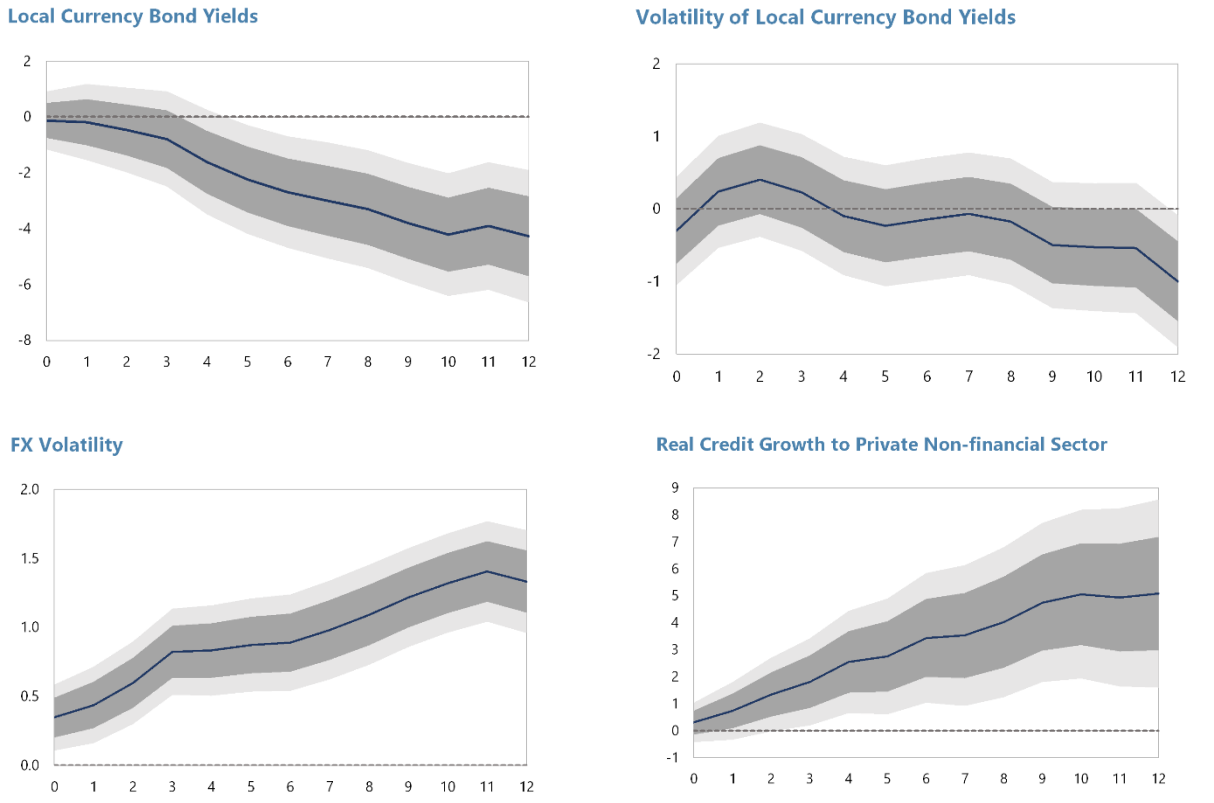
14. Our results suggest that NR holdings of LC debt support the bond market and domestic credit, but financial market volatility may be higher. We find that a one-standard deviation increase in the NR share is associated with a decline in sovereign borrowing costs of 0.2 percentage points after one year, and over 0.4 percentage points after three years.[13] We also find that credit growth to the private nonfinancial sector increases by 2.5 percentage points after one year, and by

[12] We use as controls: GDP growth, the annual CPI inflation rate, the current account as a percentage of GDP, the central bank's policy rate, FX volatility, government debt as a percentage of GDP, and foreign holdings of foreign-denominated sovereign debt. The data come from BIS, Bloomberg, CEIC, and Haver.

[13] The finding that higher NR shares are associated with lower bond yields is in line with several studies in the literature (IMF 2021; Arslanalp and Tsuda 2014; Ebeke and Lu 2014).

roughly 5 percentage points after three years, reflecting a strengthening in financial deepening.[14] But NR flows may come at the expense of higher volatility in the exchange rate. Our results also suggest that these associations tend to be persisent, and possibly even monotonically increasing over time, particularly in the case of FX volatility and credit growth. These results highlight the trade-offs countries face in their risk-management approach of public debt.

Figure 1. Cumulative Responses to a One-Standard Deviation Increase in the NR Share



Source: IMF staff estimates.
Note: The blue line is the average response, and the dark/light grey areas are the associated 68 and 90 percent confidence bands.

D. Lessons from Episodes of Rapid and Large Declines in the NR Share of LC Debt in EMs

15. This section examines the implications for countries that experience fast and large outflows from NRs. We go beyond the assessment of the level of NR holdings in the previous section, as typically done in the literature, by also focusing on the changes in the NR share, after controlling for the NR's stock of LC debt holdings (which we add as an additional control variable). In this context, we contribute to the literature by focusing on the macroeconomic and financial implications of episodes of rapid and large declines in the NR share of LC debt in EMs. Specifically, we identify periods when the NR share of LC debt declines by one standard deviation over two years–

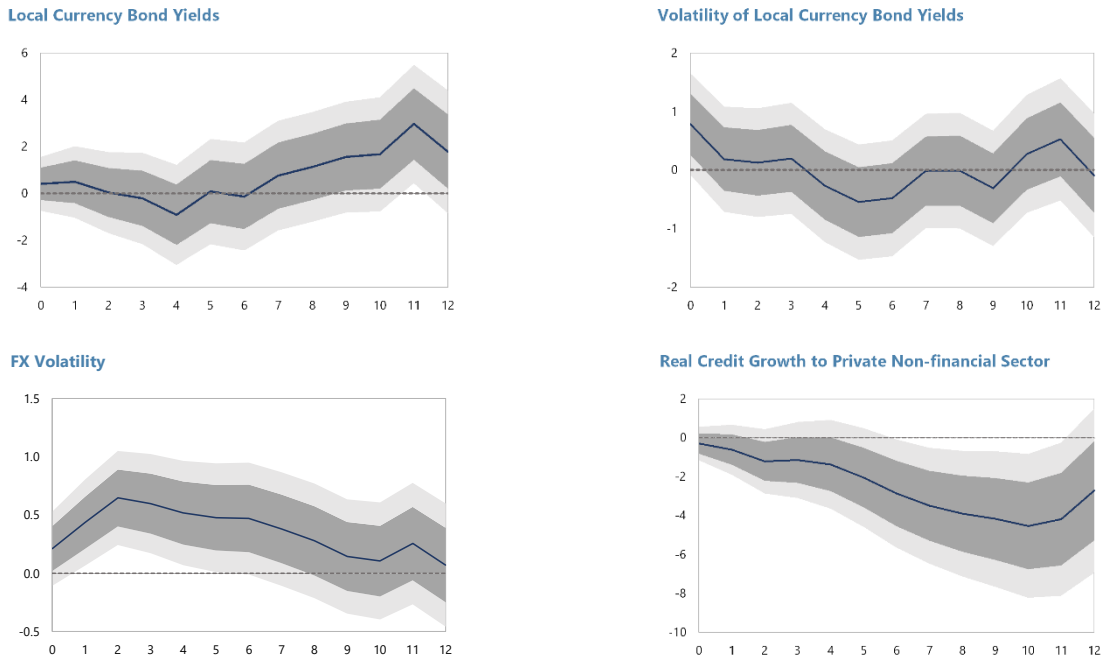
[14] The increase of 2.5 percentage points in credit growth after one year represents less than one half of its sample standard deviation (6 percent).

amounting to an 8.3 percentage-point drop in the NR share. We refer to this binary variable as the *NR shock*, accounting for almost 7 percent of all observations in our estimation sample.[15] Specifically, we estimate a similar specification as in the previous section:

$$Y_{i,t+h} = \gamma^h \text{NRshock}_{i,t-1} + \delta^h \text{NRshock}_{i,t-1} \times Stress_{t-1} + \lambda^h X_{i,t-1} + \eta_i^h + \zeta_t^h + \epsilon_{i,t+h}$$

where the dependent variables are defined as previously. The coefficients of interests are γ, which captures the dynamics of the real economy during periods of large and rapid declines in the NR share of LC debt outside of financial stress periods, and δ, which captures the additional effect when the *NR shock* coincides with periods of financial stress.[16]

Figure 2. Cumulative Responses to NR Shocks Outside of Financial Stress



Source: IMF staff estimates.
Note: The blue line is the average response, and the dark/light grey areas are the associated 68 and 90 percent confidence bands.

16. Empirical evidence suggests that episodes of rapid and large declines in the NR share of LC debt holdings that take place outside of financial stress periods correlate with future market volatility and weaker credit. We find that rapid capital outflows from nonresidents are associated with higher FX volatility, as well as weaker credit growth over the medium term (the figure shows the γ for each horizon). In unreported results, we also find evidence that rapid and large NR outflows are

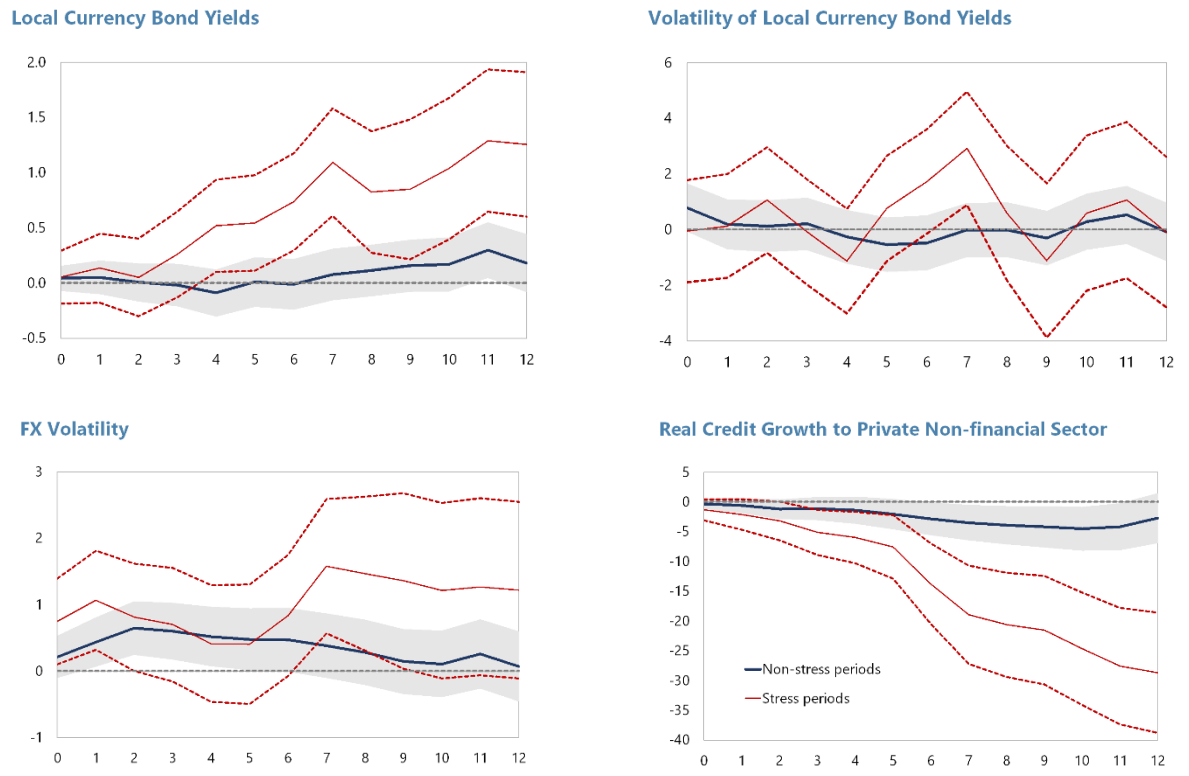
[15] For Indonesia, the NR shock includes the recent episode from 2020Q1 onwards.

[16] The *Stress* dummy in the regression includes the 2007-09 GFC, the 2013 Taper Tantrum, and the initial quarters of the COVID-19 pandemic. These episodes of financial stress account for 25.6 percent of all NR shock periods (and 16.7 percent of all observations in our sample).

associated with currency depreciation in our sample of EMs. In contrast, we do not find robust evidence on the effect on borrowing costs and on bond yields volatility.

17. The negative economic effects are amplified during periods of financial turbulence. We now study the effects on the domestic economy when the *NR shock* coincides with financial stress periods. We find that rapid and large capital outflows from NRs that take place during periods of financial stress tend to have more detrimental effects on the domestic economy (the red lines in the figure refer to the sum of the coefficients γ and δ). This could be driven by a combination of the larger size of capital outflows and the presence of other adverse shocks during such episodes. Overall, these results highlight the risks that a transition to a lower NR share may be associated with if it takes place abruptly, especially during periods of financial stress.

Figure 3. Cumulative Responses to NR Shocks During Financial Stress



Source: IMF staff estimates.
Note: The blue line is the average response, and the dark/light grey areas are the associated 68 and 90 percent confidence bands.

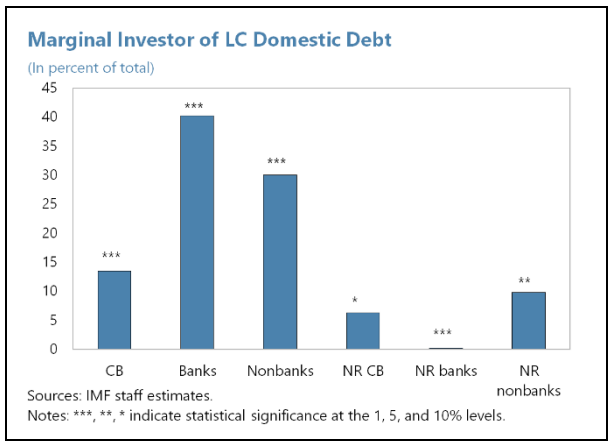
E. Who is the Marginal Investor of LC Sovereign Debt?

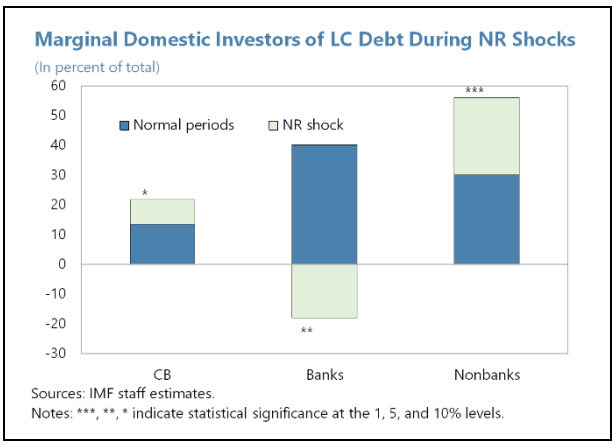
18. To further assess the implications of the NR shocks, we investigate who the marginal investor is when there is an expansion in sovereign debt. This exercise goes beyond just looking at the average share of domestic debt holdings, by also examining the importance of each investor that is not due to trends (in the average shares) but rather due to variations in debt holdings. Specifically, we follow Fang et al. (2022) and regress the change in the stock of LC debt holdings for each investor group *j* on the change in the stock of debt, both scaled by the initial stock of debt. We

control for country and time fixed effects. The coefficient of interest β_1 tells us the percentage of debt that each investor absorbs for a given one-percentage point increase in the stock of debt. We augment the Fang et al. (2022) specification with the interaction of the NR shock with the change in the stock of debt. The coefficient β_2 then captures the additional portion of debt that each investor absorbs during periods of rapid and large declines in the NR share of LC debt:

$$\frac{H_{i,t}^j - H_{i,t-1}^j}{D_{i,t-1}} = \beta_1^j \frac{D_{i,t} - D_{i,t-1}}{D_{i,t-1}} + \beta_2^j \frac{D_{i,t} - D_{i,t-1}}{D_{i,t-1}} \times \text{NRshock}_{i,t} + \eta_i + \zeta_t + \epsilon_{i,t}^j, \quad \text{for each sector } j$$

19. By construction, the estimated coefficients sum up to one. Using the same Arslanalp and Tsuda (2014) database covering the period 2004Q1-2022Q2 for 24 EMs, we present results for six different types of investors: domestic central banks, domestic banks, domestic nonbanks, foreign official sector, foreign banks, and foreign nonbanks. Nonbanks refer to all sectors excluding banks and the official sector, namely NBFIs (pension funds, insurance companies, and other financial institutions), nonfinancial corporations, and households.[17]





20. Our results suggest that domestic banks and nonbanks absorb most of the new issuances of LC debt issued by EMs in the absence of NR shocks. Together, banks and nonbanks are about 70 percent of the marginal investors in our sample of EMs. Foreign investors also play a role, especially nonbanks.

21. Additional evidence points to domestic nonbanks playing a key role in absorbing new debt supply during episodes of large and rapid declines in the NR share of LC debt. These results underscore the importance of expanding the investor retail base by deepening financial markets. This result is in line with Lu and Yakovlev (2018) who present evidence from Malaysia that despite the importance of foreign investors, domestic participants, as the core investor base, could help to ensure the stability and proper functioning of the bond market. Reforms that develop the

[17] Arslanalp and Tsuda (2014) do not have a detailed sectoral breakdown for LC debt, only for total domestic debt. For the breakdown of LC debt, we assume that the share of holdings of each sector is proportionally similar to the one we observe for total debt in the database.

nonbanking sector, particularly by improving the regulatory framework that encourages investment in long-term securities, are thus crucial for the diversification of the domestic retail investor base.

F. Concluding Remarks

22. In this paper we find that NR investors in Indonesia mostly respond to global factors. Using time-series econometrics on Indonesian data over 2002M2-2022M12, we find that foreign participation in the LC debt market in the long-run is positively correlated with global factors such as global commodity prices, volatility in global bond markets, and global interest rates. We also find some evidence that higher domestic yields may attract foreigners. Domestic banks and non-banks tend to increase their holdings with higher debt issuances, and BI acts as a residual financier under adverse global conditions. Even if global factors are a major driver of NR inflows, Gosh et al (2016) argue that domestic policies in EMs also matter. Strong policies and fundamentals during periods of capital inflows – such as macroeconomic stability, fiscal and external buffers, and institutional quality – would make a country more resilient when capital flows reverse.

23. We find that NR holdings may support the domestic economy, but volatility in the exchange rate may be higher. The historical experience in a large panel of EMs suggests that nonresidents play an important role in deepening and supporting the domestic bond market and domestic credit growth. This needs to be balanced against higher exchange rate volatility, especially during periods of financial turbulence.

24. We present new findings that indicate greater market volatility during episodes of rapid and large declines in the NR share of LC debt holdings. This should be taken into account when a country is experiencing a trend towards a lower share of NR holdings, as has been in the case of Indonesia since the beginning of the COVID shock. We find that this is particularly important when the decline in the NR share takes place during episodes of financial stress. Nevertheless, we caveat that our analysis remains silent about causality effects. Our analysis should instead be interpreted as a prediction exercise that tracks how the economy typically behaves in the aftermath of large and rapid declines in the NR share of LC debt.

25. Finally, we find that domestic banks and nonbanks are typically the marginal investors of new LC debt issued in EMs. In normal times, domestic banks and nonbanks absorb most of the new issuances of LC debt in our sample of EMs. However, domestic nonbanks assume the key role in absorbing new debt supply during episodes of large declines in the NR share of LC debt. This finding is important for Indonesia, given the limited role of domestic nonbanks in the economy. In this context, further deepening of the domestic retail investor base, in line with the Indonesian authorities' medium-term debt strategy, could support market depth and reduce volatility.

References

Arslanalp, S. and T. Tsuda (2014) "Tracking Global Demand for Emerging Market Sovereign Debt", *IMF Working Paper* no. 14/39. Washington, D.C.: International Monetary Fund.

Arslanalp, S. and T. Tsuda (2015) "Emerging Market Portfolio Flows: The Role of Benchmark-Driven Investors", *IMF Working Paper* no. 15/263. Washington, D.C.: International Monetary Fund.

Arslanalp, S., D. Drakopoulos ; R. Goel and R. Koepke (2020) "Benchmark-Driven Investments in Emerging Market Bond Markets: Taking Stock", *IMF Working Paper* no. 20/192. Washington, D.C.: International Monetary Fund.

Asonuma, Tamon, Said Bakhache, and Heiko Hesse (2015) "Is Banks' Home Bias Good or Bad for Public Debt Sustainability?", *IMF Working Paper* no. 15/44. Washington, D.C.: International Monetary Fund.

Bae, Kee-Hong (2012) "Determinants of Local Currency Bonds and Foreign Holdings: Implications for Bond Market Development in the People's Republic of China", *ADB Working Paper Series on Regional Economic Integration* no. 97. Asian Development Bank.

Bahmani-Oskooee M and A. Tanku (2008) "The Black Market Exchange Rate vs. the Official Rate in Testing PPP: Which Rate Fosters the Adjustment Process?", *Economics Letters*, 99 (1): pp. 40–43.

BIS (2007) "Financial Stability and Local Currency Bond Markets", *CGFS Papers* no. 28, Committee on the Global Financial System. Basel: Bank for International Settlements.

Broner, Fernando, Aitor Erce, Alberto Martin, Jaume Ventura (2014) "Sovereign debt markets in turbulent times: Creditor discrimination and crowding-out effects", *Journal of Monetary Economics* 61: pp. 114-142.

Burger, John D. and Francis E. Warnock (2007) "Foreign Participation in Local Currency Bond Markets", *Review of Financial Economics* 16 (2007): pp. 291–304.

Calvo, Guillermo A., Alejandro Izquierdo, Ernesto Talvi (2006) "Sudden Stops and Phoenix Miracles in Emerging Markets", *American Economic Review* 96 (2): pp. 405-410.

Ebeke, C., and A. Kyobe (2015) "Global Financial Spillovers to Emerging Market Sovereign Bond Markets", *IMF Working Paper* no. 15/141. Washington, D.C.: International Monetary Fund.

Ebeke, Christian and Yinqiu Lu (2015) "Emerging Market Local Currency Bond Yields and Foreign Holdings—a Fortune or Misfortune?" *Journal of International Money and Finance*, 59: pp. 203-219.

Fang, Xiang, Bryan Hardy, and Karen K. Lewis (2022) "Who Holds Sovereign Debt and Why It Matters", CEPR DP17338.

Gosh, Atish, Jonathan D. Ostry, and Mahvash S. Qureshi (2016) "When Do Capital Inflow Surges End in Tears?", *American Economic Review* 106 (5): pp. 581–585.

Grigorian, D. A. (2019) "Nonresident Capital Flows and Volatility: Evidence from Malaysia's Local Currency Bond Market", *IMF Working Paper* no. 19/23. Washington, D.C.: International Monetary Fund.

Hosny, Amr (2020) "Non-Resident Holdings of Domestic Debt in Nigeria: Internal or External Driven?", *IMF Working Paper* no. 19/23. Washington, D.C.: International Monetary Fund.

IMF (2021) "Indonesia's Government Bond Yields and Nonresident Participation in Government Bond Markets", Indonesia: Selected Issues. Washington, D.C.: International Monetary Fund.

Jordà, Òscar (2005) "Estimation and Inference of Impulse Responses by Local Projections", *American Economic Review* 95 (1): pp. 161-182.

Koepke, Robin (2018) "What Drives Capital Flows to Emerging Markets? A Survey of the Empirical Literature", *Journal of Economic Surveys* 33 (2): pp. 516-540.

Konopczak, Michal (2015) "Government Debt Holdings of Non-Residents: An Analysis of the Impact on Selected Emerging Economies' Sovereign Risk", *MPRA Paper* no. 68597.

Lu, Yinqiu, and Dmitry Yakovlev (2017) "Exploring the Role of Foreign Investors in Russia's Local Currency Government Bond (OFZ) Market," *IMF Working Paper* no. 17/28. Washington, D.C.: International Monetary Fund.

Lu, Yinqiu, and Dmitry Yakovlev (2018) "Instruments, Investor Base, and Recent Developments in the Malaysian Government Bond Market," *IMF Working Paper* no. 18/95. International Monetary Fund.

Panopoulou, E. and N. Pittis (2004) "A Comparison of Autoregressive Distributed Lag and Dynamic OLS Cointegration Estimators in the Case of a Serially Correlated Cointegration Error", *Econometrics Journal* 7: pp. 585–617.

Peiris, Shanaka J. (2010) "Foreign Participation in Emerging Markets' Local Currency Bond Markets", *IMF Working Paper* no. 10/88. Washington, D.C.: International Monetary Fund.

Pesaran, M. Hashem, Yongcheol Shin, Richard J. Smith (2001) "Bounds Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics*16 (3): pp. 289-326.

Raddatz, C., S. L. Schmukler, and T. Williams (2017) "International asset allocations and capital flows: The benchmark effect", *Journal of International Economics* 108 (September): pp. 413-430.

Rey, Hélène (2015) "Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence", *NBER Working Paper* No. 21162.

Sienaert, Alex (2012) "Foreign Investment in Local Currency Bonds: Considerations for Emerging Market Public Debt Managers", *WB Policy Research Working Paper* no. 6284. The World Bank Group.

ESTIMATING THE NEUTRAL REAL INTEREST RATE FOR INDONESIA[1]

This chapter estimates Indonesia's neutral real interest rate (NRIR) using various methods commonly employed in the literature. The findings indicate that the NRIR for the Indonesian economy falls between 1 and 2 percent and has remained broadly stable since the Global Financial Crisis (GFC). It also appears to have been unaffected by the COVID-19 pandemic thus far. The NRIR also suggests that monetary policy has historically been responsive to inflation pressures, with the real policy rate rising above the NRIR during periods of high inflation. With headline inflation anticipated to return to Bank Indonesia's (BI's) target range in the second half of 2023 and the output gap to close by end-2023, the current monetary policy stance is assessed as neutral. The long-term path of the NRIR is uncertain, however, and will importantly depend on Indonesia's progress in advancing its structural reform agenda and minimizing the scarring effects of COVID-19.

A. Introduction

1. BI has significantly tightened its monetary policy stance since 2022H2 to address inflation risks. In a context of a strong post-pandemic economic recovery and rising inflation in 2022, BI increased its policy rate by a cumulative 225 basis points during August 2022-January 2023 to 5.75 percent—above the pre-pandemic level of 5 percent at end-2019. Simultaneously, BI withdrew excess banking system liquidity to bring the overnight interbank money market rate closer to the policy rate level (5.6 percent). The monetary policy tightening has contributed to a consistent decline in inflation and inflation expectations, resulting in an ex-ante real policy rate of 1.8 percent as of March 2023,[2] up from -0.5 percent in September 2022. Given BI's decisions to maintain the current policy rate in February and March, a crucial policy question now is whether the current monetary policy stance is appropriately aligned with achieving BI's monetary policy objective. An overly accommodative stance could allow inflation pressures to re-intensify, while an excessively restrictive stance could disrupt Indonesia's nascent economic recovery despite the remaining economic slack.

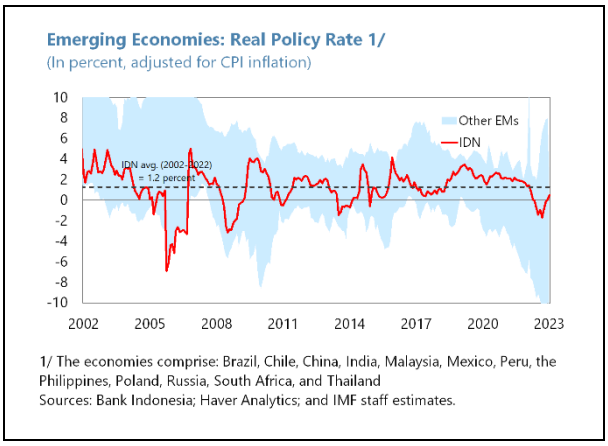
2. This chapter estimates the NRIR for the Indonesian economy using several methods widely employed in the literature. The NRIR is the short-term interest rate that aligns with the central bank's inflation target and output at its potential level, a concept initially introduced by Wicksell (1898). A real policy rate above the NRIR indicates a contractionary monetary policy stance that restricts economic activity and reduces inflation, and vice versa. In this respect, the NRIR can serve as a useful metric to evaluate whether the current policy rate is consistent with BI's price stability objective. However, the NRIR is a non-observable variable and must be derived from observable data, inevitably leading to considerable uncertainties around its estimated values. To

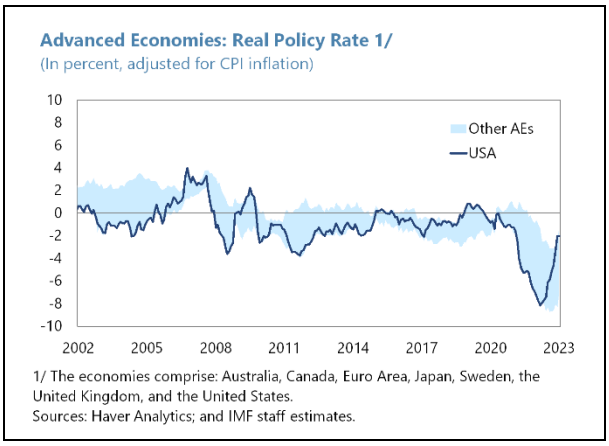
[1] Prepared by Minsuk Kim (APD), with helpful inputs from Agnes Isnawangsih (APD) and Rani Setyodewanti (RRO in Jakarta).

[2] Based on the average consensus forecast inflation for 2023.

address this issue, this chapter employs a range of empirical methods to estimate the NRIR, including: (1) a semi-structural model by Holston, Laubach, and Williams (2017), adjusted for the COVID-19 shock following the approach in Holston, Laubach, and Williams (2020); (2) a yield-curve model by Basdevant, Björksten, and Karagedikli (2004); and (3) a consumption-based capital asset pricing model with habit persistence, as proposed by Campbell and Cochrane (1999).

3. It is worth noting upfront that Indonesia's real policy rate has been broadly stable since the Asian Financial Crisis (AFC). Between 2002 and 2022, Indonesia's ex-post real policy rate averaged 1.2 percent, in line with the average for major emerging markets; and has been generally stable since the AFC. Notably, the post-GFC average rate of 1.4 percent during 2010-2022, slightly higher than the average of 1.2 percent during 2000-2009, with a relatively moderate standard deviation of 1.2 percent. As documented in Forbes (2019) and IMF (2023), the overall stable real rate trend in emerging markets stands in stark contrast with that of major advanced economies, where the real rates saw a sharp drop during the GFC and have not returned to their pre-GFC levels.[3] In the United States, for example, the post-GFC real policy rate averaged -1.8 percent with a standard deviation of 1.9 percent, compared with an average of about 0 percent during 2002-2009. These observations suggest that Indonesia's NRIR has likely been relatively stable since the AFC, consistent with the findings in this chapter and other studies (e.g., IMF, 2017).





B. Empirical Methods

Hodrick-Prescott (HP) Filter

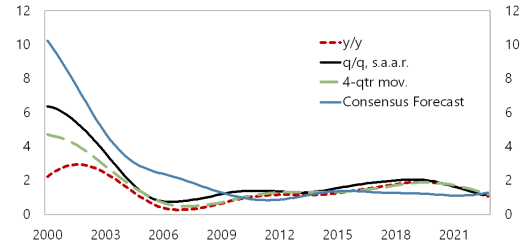
4. Before estimating the models, we first examine the range of plausible values of the NRIR by applying the HP filter to various real policy rate measures. Specifically, we deflate the nominal policy rate series using four different measures of inflation to check the sensitivity of the estimated NRIR: (i) the year/year inflation in period t; (ii) the quarter/quarter, s.a.a.r. inflation in period t; (iii) the four-quarter moving average inflation for period t-1 to t-4; and (iv) the

[3] As noted in Obstfeld (2021), both advanced and emerging market economies have broadly balanced current account balance, indicating the presence of capital flow frictions that prevent a convergence of real interest rates between the two groups.

one-year-ahead consensus forecast in period t. We also use IMF staff forecasts for the policy rate and headline inflation up to 2024Q4 to mitigate the end-point problems associated with the HP filter.

HP-Filtered Real Policy Rate 1/

(In percent, policy rate adjusted for different measures of inflation)



1/ We extended all series to end-2024 using the IMF April 2023 World Economic Outlook forecasts before applying the Hodrick-Prescott filter to minimize end-point problems.
Sources: Haver Analytics; Consensus Forecasts; and IMF staff estimates.

5. The NRIR estimate obtained from the HP filter (with a smoothing parameter value of 1,600) is about 1.1-1.3 percent as of end-2022, depending on the inflation measure considered (Table 1). For the entire sample period (2000Q1-2022Q4), the NRIR ranges from 1.4 to 2.4 percent, with an average of 1.9 percent, predictably close to the average ex-post real policy rate of 1.7 percent.

Table 1. Indonesia: NRIR Based on HP Filter

Inflation Measure	End-2022	Sample Avg.	Std. Dev.
one-year-ahead consensus forecast	1.3	2.4	2.3
4-quarter moving average (t-1 to t-4)	1.2	1.7	1.0
year/year	1.1	1.4	0.7
quarter/quarter, s.a.a.r.	1.1	2.0	1.4

Note: The estimates are obtained by applying the Hodrick-Prescott filter (with a smoothing parameter of 1600) to the quarterly data from 2000Q1 to 2022Q4, together with IMF forecasts until 2024Q4.

Holston, Laubach, and Williams (2020)

6. This approach involves estimating a semi-structural macroeconomic model that features an IS equation linking the output gap to the NRIR and a Phillips curve linking inflation to the output gap. The model consists of the following set of equations:

$$y_t = y_t^* + y_t^{gap} \quad (1)$$

$$\pi_t = \beta_0 \pi_{t-1} + (1-\beta_0)\pi^* + \beta_1 y_{t-1}^{gap} + \varepsilon_{1,t} \quad (2)$$

$$y_t^{gap} = \beta_2 y_{t-1}^{gap} + \beta_3 (r_{t-1} - r_{t-1}^*) + \varepsilon_{2,t} \quad (3)$$

$$y_t^* = y_{t-1}^* + \beta_4 g_{t-1} + \varepsilon_{3,t} \quad (4)$$

$$g_t = g_{t-1} + \varepsilon_{4,t} \quad (5)$$

$$r_t^* = g_{t-1} + z_{t-1} \quad (6)$$

$$z_t = z_{t-1} + \varepsilon_{5,t} \quad (7)$$

Both y and y^* are the logarithms of real GDP and the unobserved potential output, respectively. r and r^* denote the real policy rate and the NRIR. Equation (2) depicts the Phillips curve, where inflation (π, q/q, s.a.a.r.) is explained by its own one-period lag and the average of its second to fourth lags (π^*), as well as the one-period lagged output gap (y^{gap}). Equation (3) describes the IS

curve, with the output gap expressed as a function of its own one-period lag and the deviation of the real policy rate from the NRIR.[4] The stochastic error terms (ε_1 and ε_2) capture transitory shocks to inflation and output, respectively, and are assumed to follow a white noise process with variance σ_π^2 and σ_y^2. In Equation (6), the NRIR (r^*) is defined as the sum of the growth rate of potential output (g) and an unobserved variable (z) that captures all other determinants of r^*.

7. This model also considers the impact of the COVID-19 pandemic on the NRIR by augmenting the original model of Holston, Laubach, and Williams (HLW, 2017) with a variable that serves as a proxy for the direct effects of pandemic-related mobility restrictions. Specifically, the Oxford COVID-19 Government Response Tracker by Hale and others (2020) is used to capture these effects (d), which ranges from 0 to 100 with larger values indicating stricter restrictions and containment policies.[5] From the specification above, the potential output (y^*) is replaced by $y^* + \varphi \cdot d/100$ and the output gap by $(y - y^*) - \varphi \cdot d/100$, while the rest of the model specification above remains unchanged. The parameter φ is a parameter that translates the COVID indicator (d) into effects on output and potential output and is estimated along with other parameters in Equations (1)-(7).

8. This modification allows the model to address two challenging aspects of the COVID-19 shock in estimating the NRIR: While the stochastic error terms in HLW (2017) are assumed to follow a normal distribution, the COVID-19 was an exceptionally large shock by historical standards, which potentially violates this normality assumption, and was persistent, lasting over several quarters since 2020, which violates the assumption of no serial correlation. The inclusion of the COVID-19 restriction indicator in the model makes it possible to capture the direct effects of COVID-19 restrictions and decompose other economic shocks into transitory and permanent components.

9. The model is estimated using the Kalman filter and Indonesia's quarterly data during 2001Q1–2022Q2. The inflation variable π is constructed using the seasonally adjusted[6] core inflation series from Haver (annualized) since December 2007 and splicing the headline inflation series since 2001Q1, following the approach in HLW (2017). The real policy rate is obtained by subtracting the Consensus Forecast's one-year-ahead expected inflation rate from BI's 7-day reverse repo rate. As noted in Laubach and Williams (2003), a well-known issue when estimating the standard deviations of the disturbance terms for potential growth (σ_g) and the variable (σ_z) using the maximum likelihood method is the "pile-up" problem, which is a tendency for these estimates to be biased toward zero (Stock, 1994). To address this problem, we use Stock and Watson's (1998) median unbiased estimator to first obtain the estimates of the ratio $\lambda_g \equiv \sigma_g/\sigma_{y^*}$ and $\lambda_z \equiv \sigma_z/\sigma_y$ and then impose these ratios in the next stage estimation, following the approach in HLW (2017).

[4] Substituting the one-period lagged deviation of the real rate from the NRIR with the average of one to two-period lagged deviations as in the original Holston, Laubach, and Williams' (2017) setup does not lead to meaningful changes in the final estimates.

[5] The pre-pandemic values are set equal to zero, following HLW (2020).

[6] Adjusted using a regular ARIMA model in X-13ARIMA-SEATS and accounting for Ramadan.

10. Table 2 presents the estimated coefficients for two different values of λ_z. Model 1 presents the estimates for the median values of λ_g and λ_z ("High lambda_z"), and Model 2 presents the estimates for the median value of λ_g and the lower bound of the 90 percent interval for λ_z ("Low lambda_z").[7] In both models, the coefficients have the expected signs, including for the output gap variable in the IS curve ($\beta_1 > 0$) and the real interest rate gap variable in the Philipps curve ($\beta_3 < 0$) but come with large standard errors, as is typical in other empirical studies using similar models. The standard error for r^* at the end of the sample period (2022Q2) is much larger in Model 1 (6.760) than in Model 2 (0.393), with Model 2 implying a 95-percent confidence interval for r^* of 0.9-1.6 percent.[8] Finally, while not presented here, we note that applying the upper bound of the 90 percent interval for λ_z (0.166) results in an implausibly volatile NRIR series ranging from -1.7 to 3.5 percent over the sample period.

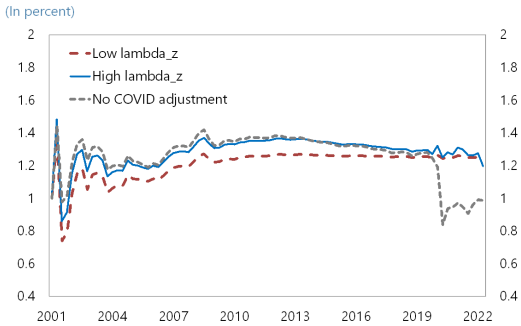
Table 2. Indonesia: Estimation Results from Holston, Laubach, and Williams (2020)

	Model 1 ($\lambda_g = 0.073, \lambda_z = 0.0216$)		Model 2 ($\lambda_g = 0.073, \lambda_z = 0.001$)	
	Coefficient	Std. Error	Coefficient	Std. Error
β_0	0.336 ***	0.052	0.335 ***	0.053
β_1	0.102	0.626	0.136	0.650
β_2	0.921 ***	0.158	0.921 ***	0.161
β_3	-0.047	0.053	-0.047	0.053
φ	0.127 ***	0.003	0.127 ***	0.004
σ_1	4.257		4.255	
σ_2	0.629		0.621	
σ_3	0.236		0.256	
	Final State	Sample Avg.	Final State	Sample Avg.
g	1.210	1.286	1.200	1.285
r^*	1.116	1.281	1.116	1.281
(std.error)	6.760		0.393	
y^{gap}	1.252	-0.483	1.262	-0.521

Note: The sample period is 2001Q1-2022Q2. The final value for y_gap (COVID-19-adjusted) is the avearge of 2021Q3-2022Q2.

11. The model NRIR estimates have been broadly stable, fluctuating within a narrow band of 1.2-1.3 percent since the GFC. It is also worth noting that the original HLW (2017) model that does not feature any COVID-19 adjustment generates a level downshift in the NRIR estimates at the onset of the pandemic, from 1.2 percent in 2019Q4 to 0.8-0.9 percent starting from 2020Q2. The estimates from the COVID-adjusted model suggest that this could largely reflect the exceptional characteristics of the COVID-19 shock discussed above, rather than fundamental changes in the economic structure during the pandemic.

NRIR Estimates from HLW, 2020
(In percent)



Sources: Haver Analytics; and IMF staff estimates.

[7] For reference, the median unbiased estimates of λ_g and λ_z for the four advanced economies in HLW (2020)–Canada, the Euro Area, the United Kingdom, and the United States–range between 0.023 and 0.053 for λ_g and between 0.024 and 0.040 for λ_z.

[8] For reference, the standard errors of r^* in HLW (2020) for the four advanced economies range from 1.53 (United States) to 6.04 (Euro Area) as of end-2016.

Yield Curve Model of Basdevant, Björksten, and Karagedikli (2004)

12. This approach uses the information available from the government bond yield curve, interpreting the NRIR as a common stochastic trend between short and long-term yields. Compared to the HLW model above, this model has the advantages that it does not require an estimation of the output gap, which has been challenging due to the pandemic, and that the influence of global interest rates may be better captured given the significant presence of non-resident investors in Indonesia's local-currency government bond market. Specifically, the following system of equations are estimated using the Kalman filter:

$$r_t = r_t^* + \pi_{t+1}^e + \varepsilon_{s,t} \quad (8)$$

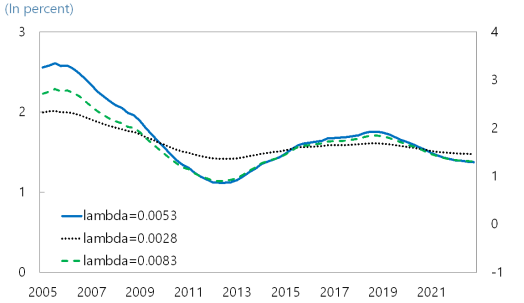
$$R_t = r_t^* + \alpha_t + \pi_{t+1}^e + \varepsilon_{L,t} \quad (9)$$

$$r_t^* = r_{t-1}^* + \epsilon_{1,t} \quad (10)$$

$$\alpha_t = \delta_0 + \delta_1 \alpha_{t-1} + \epsilon_{2,t} \quad (11)$$

where r and R denote nominal 3-month and 10-year government bond yields, respectively, α the yield curve spread or term premium, π^e the one-year-ahead inflation forecast, and r^* the NRIR. The model is estimated using monthly data since January 2005, with the 3-month JIBOR rate used as the proxy for the 3-month T-bill rate for the months prior to August 2016. Notably, we impose a restriction on the standard deviation of the disturbance term ϵ_1 to ensure that the NRIR is "sufficiently" smooth with respect to the short-term rate. Estimations are conducted using different values of the smoothing parameter $\lambda \equiv \sigma_{r^*}/\sigma_s$ to examine the sensitivity of the NRIR estimates, where σ_{r^*} and σ_s are standard deviations of ϵ_1 and ε_s, respectively.[9] The values considered are 0.0028, 0.0053, and 0.0083, which correspond to 129600 (following Ravn and Uhlig, 2002), 36000, and 14400 (following Hodrick and Prescott, 1997) for the ratio of $\sigma_s^2/\sigma_{r^*}^2$.

13. The estimated NRIR has been stable at 1.3-2.1 percent since 2015, after a moderate decline following the Global Financial Crisis. Reassuringly, the estimates are not sensitive to the choice of the smoothing parameter, with the NRIR ranging 1.3-1.5 percent as of end-2022. However, some caution is warranted when using these estimates to assess BI's monetary policy stance. Firstly, like many emerging markets, Indonesia's secondary bond market remains relatively shallow, limiting the degree of monetary policy transmission along the yield curve. Secondly, since the start of the pandemic, BI has started intervening in the secondary market as part of its "triple intervention" strategy to stabilize market conditions during stress times and its "operation twist" to strengthen the transmission of monetary policy tightening along



1/ Based on smooth Kalman filter estimates.
Sources: Bloomberg L.P.; Haver Analytics; and IMF staff estimates.

[9] Given the small sample, estimating the model without imposing this restriction yields implausibly volatile NRIR estimates, as also noted in Basdevant and others (2004).

the yield curve. To the extent that these transactions moderate increases in long-term rates, containing upward shifts in the yield curve, the NRIR will tend to be underestimated.

Consumption-Based Capital Asset Pricing Model

14. This approach uses the Euler equation derived from a representative agent's utility maximization problem. Assume that the representative agent has a constant relative risk aversion utility function (CRRA) given by:

$$u(c_t) = {c_t}^{1-\gamma}/(1-\gamma), \quad \text{with } \gamma > 0,$$

where c stands for consumption, and γ is the degree of risk aversion. The agent maximizes its lifetime expected utility (with future consumption by discounted by β), subject to a budget constraint where he could save and hold financial asset B that grows at interest rate r. The equilibrium interest rate r depends on the discount factor β, the degree of risk aversion γ, and the expected growth of consumption. Assuming the steady state consumption growth g follows a normal distribution, the first order condition can then be approximated as the following (Fuentes and Gredig, 2007):

$$\ln(1+r^*) \cong -ln\beta + \gamma E_t(g) - (1/2)\gamma^2 var(g)$$

where r^* stands for NRIR. This equations states that neutral rate will be higher if expected growth is high. As households smooth out their consumption over time, the expected higher future income will lead to more consumption today, and a higher interest rate is therefore needed to obtain the same amount of saving. However, the level of r^* calculated from the Euler equation above tends to be much higher than the actual real rate in emerging market economies. For this reason, several studies use the model with habit persistence, which yields the following first order condition:

$$\ln(1+r^*) \cong -ln\beta + \gamma E_t(g) - 1/2\,\gamma(1-\varphi),$$

where φ refers to the degree of habit persistence.

15. Assuming a set of plausible parameter values for β and γ, the model implied NRIR for Indonesia ranges between 0.9 and 1.8 percent (Table 3). For the steady state consumption growth rate g, we use Indonesia's average annual real GDP per capita growth rate of 3.6 percent for the period of 2000-2022, and 0.95 for the habit persistence parameter.[10] The NRIR is calculated using the typical values of β and γ in the literature, with an average value of 1.3 percent.

[10] The habit persistence parameter value of 0.95 is closely in line with similar studies on emerging markets: e.g., 0.93 for ASEAN countries in the April 2015 IMF Asia and Pacific Regional Outlook report (Box 1.12), 0.95 in Fuentes and Gredig (2007) for Chile, and 0.97 in Perrelli and Roache (2014) for Brazil. The NRIR estimate, however, is not sensitive to the chosen parameter value, ranging between 1.32 and 1.35 percent for the value of φ between 0.93 and 0.97.

Table 3. Indonesia: NRIR from Consumption Model

		γ: 1	1.5	2
	0.970	0.91	1.35	1.79
	0.975	0.91	1.35	1.79
β:	0.980	0.90	1.34	1.78
	0.985	0.90	1.34	1.78
	0.990	0.89	1.33	1.77

Average: 1.34 percent
Std. dev: 0.36 percent

C. Main Findings

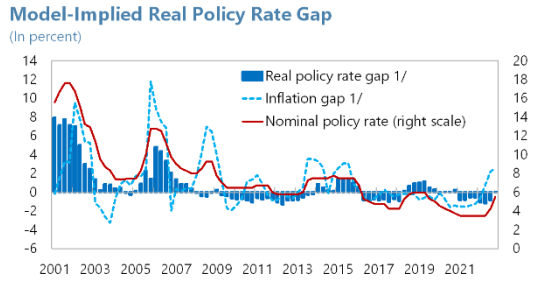
16. The results above indicate that Indonesia's NRIR stands approximately at 1-2 percent (Table 4). The different methods produce very similar estimates of the NRIR, which is not surprising given the limited fluctuation of the real interest rate since the AFC. The results are also well in line with the findings from previous studies using pre-pandemic data (IMF, 2017; Tanaka, Ibrahim, and Brekelmans, 2021), which found a broadly stable NRIR post-AFC around these levels (e.g., 1.5-1.7 percent for the period; IMF, 2017), and appear to support the view that the pandemic has not led to a significant change in the NRIR despite the exceptional size and persistence of COVID-19 shock.

Table 4. Indonesia: Summary of NRIR Estimates

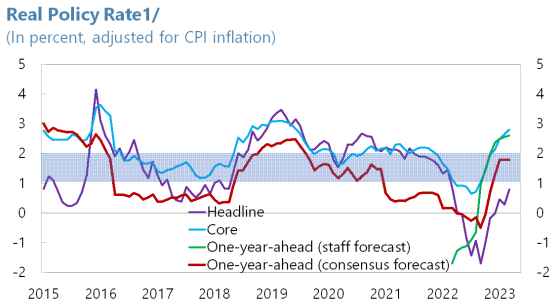
	Latest 1/	Sample Avg.	Std. Dev.
HP Filter	1.1 - 1.3	1.4 - 2.4	0.7 - 2.3
HLW (2021)	1.1 - 1.2	1.3	0.1 - 0.09
BBK (2004)	1.3 - 1.5	1.7	0.3 - 0.5
Consumption		0.9 - 1.8	0.4

1/ The latest data point is 2022Q2 for HLW (2021) and 2022Q4 for the HP filter and BBK (2004) estimates.

17. Based on the NRIR estimates, BI's monetary policy appears to have been responsive to inflation pressures since 2000 and is now in a neutral position. Since 2001, Indonesia has experienced 4 major episodes of markedly high inflation gap, characterized by headline inflation exceeding the mid-point of BI's target band by 3 percentage points or more (2001Q3-2002Q4, 2005Q4-2006Q3, 2008Q2-2009Q1, 2013Q3-2014Q2). In all these episodes, BI increased the policy rate aggressively, resulting in a significant tightening of the monetary policy stance, as indicated by the positive real interest rate gap based on the HLW (2020) estimates. The real policy rate also increased significantly in 2022Q4, reflecting BI's monetary policy tightening amid an average inflation gap of 2.5 percent. As of March 2023, the real policy rate is estimated at about 0.8-2.8 percent, based on different measures of inflation, with the ex-ante one-year-ahead consensus forecast-based real policy rate at 1.8 percent, which falls within the estimated neutral zone of 1-2 percent.

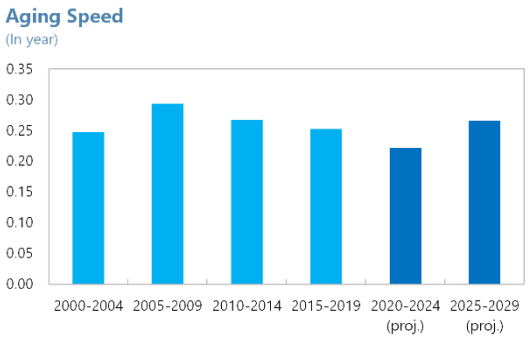


1/ The real policy rate gap estimates are obtained using the COVID-adjusted version of HLW (2017), with the nominal policy rate adjusted using 1y-ahead inflation forecasts. The inflation gap series is calculated by subtracting the mid-point of BI's inflation target range from headline inflation (y/y).
Sources: Bank Indonesia; Haver Analytics; and IMF staff estimates.

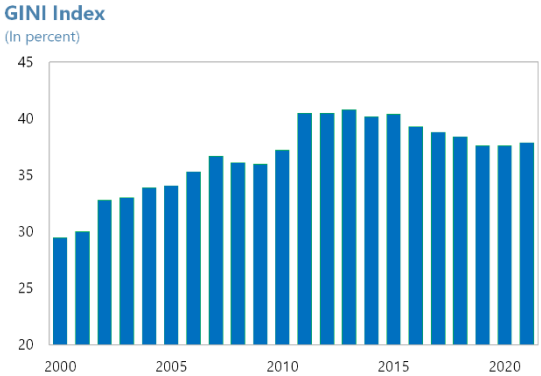


1/ The shaded area indicates the range of the estimated real neutral policy rate estimated in this paper (1-2 percent).
Sources: Bank Indonesia; Haver Analytics; IMF April 2023 World Economic Outlook and IMF staff estimates.

18. The long-term trajectory of Indonesia's NRIR remains uncertain but appears more likely to trend downward. While the pandemic does not seem to have any evident immediate impact on the NRIR, its long-term effects are yet to be seen. These could include negative impacts on education and training that lead to lower productivity growth, resulting in reduced investment demand and thus downward pressure on the NRIR. Conversely, the pandemic-induced increase in public debt in advanced economies and a potential post-pandemic acceleration in productivity-enhancing digitalization would exert upward pressures on the NRIR. Apart from the scarring effects of the pandemic, some of the structural forces that had been putting upward pressures on the NRIR prior to the pandemic may reverse course in the long term. The favorable demographic trend, as captured by the slowing of aging speed (from 0.31 year in 2000 to 0.19 in 2021, defined as the annual change in the median age), may not persist, leading to higher savings and lower investment. The extent of success in continuing the recent progress in reducing inequality would also importantly affect the NRIR.[11] On balance, Indonesia's NRIR appears more likely to experience downward pressures, along with other emerging market economies (IMF, 2023).



Note: aging speed = average annual increase in the median age.
Sources: United Nations 2022 Revision of World Population Prospects; and IMF staff estimates.



Source: World Bank, World Development Indicator Database.

[11] Higher income inequality would increase the savings rate because higher-income groups tend to have a higher propensity to save than lower-income groups.

References

Basdevant, O., N., Bjorksten, and O., Karagedikli, 2004, "Estimating a Time Variant Neutral Real Interest Rate for New Zealand," Discussion Paper No.2004/01, Wellington: Reserve Bank of New Zealand.

Campbell, J., and J., Cochrane, 1999, "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior," Journal of Political Economy, Vol. 107, No. 2, pp. 205–51.

Forbes, Kristin J. ''Discussion of 'Riders on the Storm' by Jordà and Taylor," Federal Reserve Bank of Kansas City 2019 Jackson Hole Symposium.

Fuentes, R., and F. Gredig, 2007, "Estimating the Chilean Natural Rate of Interest," Working Paper No. 448, Santiago: Central Bank of Chile.

Hale T., N. Angrist, R. Goldszmidt, B. Kira, A. Petherick, T. Phillips, S. Webster, E. Cameron-Blake, L. Hallas, S. Majumdar, and H. Tatlow. 2021. "A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker)." Nature Human Behaviour.

Hodrick, R. J. and E. C. Prescott, 1997, "Postwar us business cycles: an empirical investigation," Journal of Money, credit, and Banking, 1–16.

Holston, K., Laubach, T., & Williams, J. C. 2017. "Measuring the Natural Rate of Interest: International Trends and Determinants." Journal of International Economics, 108, S59–S75.

Holston, K., Laubach, T., & Williams, J. C. 2020. "Adapting the Laubach and Williams and Holston, Laubach and Williams Model to the COVID-19 pandemic." FRBNY note.

IMF 2015. "Asia and Pacific's Outlook: Still Leading Global Growth" Regional Economic Outlook: Asia and Pacific, Chapter 1.

IMF 2017. "Asia: At Risk of Growing Old before Becoming Rich?" Regional Economic Outlook: Asia and Pacific, Chapter 2.

IMF 2023. "The Natural Rate of Interest: Drivers and Implications for Policy," World Economic Outlook, Chapter 2.

Laubach, T. and J., Williams, 2003, "Measuring the natural rate of interest," Review of Economics and Statistics 85(4), 1063–1070.

Obstfeld, M. (2021). "Two Challenges from Globalization." Journal of International Money and Finance. Vol 110, 1–9.

Perrelli, R., and S. Roache. 2014. "Time-Varying Neutral Interest Rate—The Case of Brazil." IMF Working Paper 14/84, International Monetary Fund, Washington, DC.

Ravn, M. and Uhlig, H., 2002, "On adjusting the Hodrick-Prescott filter for the frequency of observations," The Review of Economics and Statistics, 84, issue 2, p. 371-375.

Stock, J., and M. Watson. 1998. "Median Unbiased Estimation of Coefficient Variance in a Time-Varying Parameter Model," Journal of the American Statistical Association, 93, March, 349-358.

Tanaka, K., P. Ibrahim and S. Brekelmans (2021), "The Natural Rate of Interest in Emerging Asia: Long-Term Trends and the Impact of Crises", ADBI Working Paper 1263, Asian Development Bank Institute, Tokyo.

Wicksell, K., 1907, "The Influence of the Rate of Interest on Prices," Economic Journal, Vol. 17, June.

_____, 1898, Geldzins und Guterpreise, translated by R.F. Kahn, 1936, as "Interest and Prices."