

A Dual-Measurement Approach to Corporate Foreign Exchange Exposure in Indonesian Non-Financial Firms, 2020–2024

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Keywords:

Foreign Exchange Exposure;
FX Beta; Foreign Currency
Debt; Export Intensity;
Derivative Use

Abstract

How corporate foreign exchange exposure is measured can change what a study concludes. This paper compares two measures of exposure for Indonesian non-financial firms over the high-volatility period 2020 to 2024: the absolute FX beta, which captures the magnitude of exposure, and the signed FX beta, which captures its direction. FX beta is estimated firm-by-year from weekly returns in a two-factor market model for a panel of 30 firms and 150 firm-year observations. Each measure is then regressed on foreign currency debt, derivative use, export intensity, the debt-by-export interaction, and firm controls, with panel diagnostics selecting pooled OLS and White diagonal standard errors. The two measures give different results from the same data. Under the magnitude measure, only derivative use significantly lowers exposure (-0.3776 ; $p = 0.009$). Under the signed measure, export intensity is positive and significant (1.2916 ; $p = 0.091$), which identifies a transactional-gain channel for commodity exporters that the magnitude measure hides. The study concludes that exposure research in commodity economies should report both measures, because the absolute value alone discards information on which firms gain and which lose from currency movements.

INTRODUCTION

The rupiah moved through repeated, differently sourced shocks between 2020 and 2024. It reached Rp16,608 per US dollar during the COVID-19 flight to quality in March 2020, Rp15,737 amid aggressive Federal Reserve tightening and the Russia-Ukraine war in November 2022, Rp15,192 under further hawkish Fed signals in July 2023, and Rp16,280 during Middle East escalation and delayed rate cuts in April 2024 (Bank Indonesia, 2025). For Indonesian firms that borrow in dollars but earn in rupiah, each episode raised the domestic-currency value of foreign liabilities without a matching rise in assets. The vulnerability is structural on the cost side as well, because raw materials and capital goods together stayed near 90 percent of national imports throughout the period (Badan Pusat Statistik, 2025), so a weaker rupiah feeds directly into production costs for import-dependent firms.

Yet hedging in Indonesia remains thin. Derivatives make up only about 44 percent of total foreign exchange turnover, well below Malaysia at 80 percent, Singapore at 75 percent, and Thailand at 65 percent (Bank for International Settlements, 2022, as reported in Bank Indonesia, 2025). The gap is costly. Across EMEAP economies, firms that do not hedge lose on average 5.63 percent of EBIT to currency losses during depreciations, against 1.47 percent for derivative users (Hong Kong Monetary Authority, 2024, as cited in ISDA, 2025). This

combination of large, recurring currency shocks and shallow hedging is the empirical setting the present study examines.

Against this backdrop, foreign exchange exposure remains one of the most studied yet least settled quantities in international finance. Following Jorion (1990), exposure is estimated as the sensitivity of a firm's stock return to exchange-rate changes after controlling for the market. Despite decades of work, observed exposure tends to be small and often insignificant, a pattern Bartram, Brown, and Minton (2010) call the exposure puzzle. Most of the debate concerns which variables drive exposure; less attention has gone to a prior question, namely what the exposure coefficient actually measures.

The coefficient carries two pieces of information at once: how strongly a firm's value reacts to the exchange rate, which is the magnitude, and in which direction it reacts, which is the sign. Many studies take the absolute value so that exposure becomes a measure of risk in which a larger value means more exposure regardless of direction. That is reasonable for questions about hedging effectiveness, but it discards the sign, and the sign carries economic meaning of its own.

This distinction matters in a commodity-based, import-dependent economy. Pure commodity exporters such as mining and plantation firms sell in dollars while paying most costs in rupiah, so a depreciation raises their profits and share prices, whereas import-dependent manufacturers face the opposite effect. Two firms with the same export share can therefore carry opposite signs of exposure, and this currency mismatch is a recognised source of vulnerability for emerging-market non-financial firms (Chui, Kuruc, & Turner, 2016). When exposure is measured only in absolute value, these opposing effects are pooled and tend to cancel, which can make a genuinely important variable look irrelevant.

This is the gap the study addresses. Prior work, in both advanced and emerging markets, generally reports a single exposure measure, almost always the absolute value (for example, Allayannis & Ofek, 2001; Chue & Cook, 2008; Bartram, 2019), and in doing so cannot separate firms that gain from a depreciation from those that lose. Firm-level exposure of this kind has been examined from Chinese manufacturers (Tang, 2019) to industry-level United States studies (Dominguez & Tesar, 2006), but the reliance on a single measure leaves the directional channel unobserved.

This study adopts a dual-measurement approach. For a panel of 30 Indonesian non-financial firms over 2020 to 2024, it estimates exposure as both the absolute FX beta and the signed FX beta and regresses each on the same firm-level determinants. The aim is to test whether the two measures lead to the same conclusions and, if not, to identify what the absolute measure hides, asking specifically whether foreign currency debt, derivative use, and export intensity affect exposure and whether their effects depend on the measure used.

The contribution is a dual-measurement design applied to a commodity-based emerging market during an unusually volatile period. It shows that the magnitude and signed measures are not interchangeable and that the signed measure recovers a transactional-gain channel the absolute measure mechanically conceals, and it argues that exposure studies in commodity economies should report both.

Literature Review

Following Jorion (1990), exposure is the coefficient on the exchange-rate change in a return regression that controls for the market; its signed value indicates direction and its absolute value indicates size. The conceptual definition of exposure as the sensitivity of firm value to currency movements (Adler & Dumas, 1984) is neutral about sign, so the choice of measure is analytical rather than definitional. Bartram, Brown, and Minton (2010) document that observed exposure is small and frequently insignificant and trace this to offsetting hedging channels, operational and financial, that shrink net exposure below the level of detection.

Three firm-level determinants recur. Foreign currency debt creates a balance-sheet effect in which a depreciation raises the real value of foreign-currency liabilities and depresses firm value (Krugman, 1999; Bleakley & Cowan, 2008). Derivative use transfers currency risk to a counterparty and is expected to reduce exposure (Allayannis & Ofek, 2001; Bartram, 2019; Sikarwar & Gupta, 2019); firms undertake it because lowering the variability of firm value reduces expected financial-distress costs (Smith & Stulz, 1985). Export intensity provides a natural hedge when foreign-currency revenue offsets foreign-currency costs and liabilities (Kamil & Sutton, 2009), though a recent meta-analysis finds that operational choices do not deliver a natural hedge uniformly across firms (Saharan & Rajendran, 2024). Emerging-market evidence qualifies all three: relationships significant in one period vanish or reverse in another (Chue & Cook, 2008), gross international operations explain little cross-sectional variation (He, Liu, & Zhang, 2021), and central-bank intervention itself reshapes measured exposure (Sikarwar, 2020).

Industry structure shapes the sign of exposure. Marston (2001) argues that a firm's economic exposure depends on the currency composition of its revenues and costs, so firms with similar export shares can carry opposite signs. Consistent with this, Asif and Frömmel (2022) find systematically different exposure for exporting versus domestic firms in emerging Europe. The implication is direct: an absolute-value measure conceals heterogeneity that a signed measure preserves.

Evidence from Indonesia is itself mixed. Frensidy and Mardhaniaty (2019) find that hedging exchange-rate risk raises firm value on the Indonesia Stock Exchange, whereas Devina and Dalimunthe (2023) find no significant risk-reducing effect of derivatives, attributing the divergence partly to exchange-market intervention that dampens volatility. This unresolved picture motivates fresh evidence from the volatile 2020 to 2024 window.

Hypotheses

The study does not privilege one measurement. It estimates both models with the same determinants and asks whether the conclusions diverge.

H1: Foreign currency debt is positively associated with exposure magnitude.

H2: Derivative use is negatively associated with exposure magnitude.

H3: Export intensity is negatively associated with exposure magnitude.

H4: The signed model reveals directional information, such as a transactional-gain channel, that the magnitude model conceals.

METHOD

Sample

The population is all non-financial firms listed on the Indonesia Stock Exchange (IDX) over 2020 to 2024. The 2020 to 2024 window is chosen deliberately because it spans four depreciation shocks of different origin (the COVID-19 flight to quality, Federal Reserve tightening alongside the Russia-Ukraine war, further hawkish Fed signals, and Middle East escalation with delayed rate cuts), which provides the cross-time variation needed to identify exposure. Purposive sampling requires continuous listing, disclosure of foreign currency derivatives together with FX debt and/or export revenue in audited statements, and no delisting, prolonged suspension, or disruptive corporate action. Restricting the sample to identified derivative users is a data-availability requirement, since derivative notionals must be disclosed to be measured; it also means the sample tilts toward larger, actively hedging firms, a selection effect we return to when interpreting the results.

Weekly closing stock prices for each firm and the Jakarta Composite Index (IHSG) are drawn from established market databases, and the IDR/USD exchange rate is the Bank Indonesia reference rate (JISDOR). The screening yields 30 firms and 150 firm-year observations, as shown in Table 1.

Table 1. Sample Selection

No.	Description	Number
1	Firms listed on the Indonesia Stock Exchange (IDX)	957
2	Less: financial-sector firms and firms first listed after 1 January 2020	(407)
3	Non-financial firms continuously listed throughout 2020–2024	550
4	Less: firms not identified as users of foreign currency derivatives	(442)
5	Non-financial firms identified as foreign currency derivative users	108
6	Less: firms with incomplete derivative, financial-statement, or stock-market data	(78)
	Final sample of firms	30
	Total observations (30 firms × 5 years)	150

Source: IDX and Bank Indonesia data, processed (2026).

Measuring Exposure: The Two-Stage Procedure

Exposure is estimated in two stages. In the first stage, the FX beta is estimated firm-by-year from 51 to 53 weekly return observations in a two-factor market model (Jorion, 1990; Allayannis & Ofek, 2001):

$$R_{i,t} = \alpha + \beta_m R_{m,t} + \beta_{FX} \Delta Kurs_t + \varepsilon_{i,t} \quad (1)$$

The exchange-rate change $\Delta Kurs$ is rupiah per US dollar, so an increase denotes a rupiah depreciation. The estimated β_{FX} gives one value per firm-year, used in two forms: its absolute value $|\beta_{FX}|$ measures the magnitude of exposure and its signed value β_{FX} measures the direction. The second stage regresses each on the firm-level determinants.

Second-Stage Model

Both measures are regressed on the same specification:

$$EXP_{i,t} = \alpha + \beta_1 FXDEBT + \beta_2 DERIV + \beta_3 EXPORT + \beta_4 (FXDEBT \times EXPORT) + \beta_5 SIZE + \beta_6 ROA + \mu_{i,t} \quad (2)$$

where EXP is $|\beta FX|$ in the magnitude model or βFX in the direction model. FXDEBT is FX debt over total assets, DERIV is derivative notional over total assets, EXPORT is export revenue over total sales, and SIZE and ROA are controls. Model selection follows the standard panel sequence (Gujarati & Porter, 2009). The Chow test (cross-section F $p = 0.2577$), the Hausman test ($p = 0.5957$), and the Breusch-Pagan LM test (cross-section $p = 0.9196$) jointly select pooled OLS. No multicollinearity is present (all centered VIF below 10) and no serial correlation is found (Breusch-Godfrey $p = 0.2976$; Durbin-Watson = 1.996). Heteroskedasticity is detected (Breusch-Pagan-Godfrey $p = 0.0303$), so inference uses White diagonal standard errors.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 2 reports the descriptive statistics. Exposure magnitude $|\beta FX|$ has a mean of 0.8081 and a standard deviation of 0.9007. FX debt averages 0.1352 of total assets. Derivative use averages 0.1453 with a much lower median of 0.0529, which indicates concentration in a few firms. Export intensity averages 0.3056 of sales.

Table 2. Descriptive Statistics

Variable	N	Mean	Median	Max	Min	Std. Dev.	J-B Prob.
$ \beta FX $	150	0.8081	0.5580	6.4021	0.0072	0.9007	0.0000
FXDEBT	150	0.1352	0.1101	0.4037	0.0026	0.1023	0.0008
DERIV	150	0.1453	0.0529	2.1738	0.0000	0.3026	0.0000
EXPORT	150	0.3056	0.2433	0.9930	0.0004	0.2749	0.0006
FXDEBT $\times$ EXPORT	150	0.0426	0.0276	0.2719	0.00001	0.0485	0.0000
SIZE	150	29.7890	29.4654	32.9379	26.7288	1.4594	0.0599
ROA	150	0.0818	0.0565	0.6080	-0.3652	0.1311	0.0000

Source: Processed data (2026). N = 150. Signed βFX shares the same first-stage estimation as $|\beta FX|$.

Based on Table 2, the sample is dominated by large firms, since SIZE has a high mean of 29.7890 with limited dispersion. The Jarque-Bera test rejects normality for almost all variables except SIZE.

Magnitude versus Direction: Side-by-Side Estimates

Table 3 places the two models side by side. The contrast is the central result of the study.

Table 3. Magnitude ($|\beta_{FX}|$) versus Direction (β_{FX}) Models, Side by Side

Variable	$ \beta_{FX} $ Coef.	Prob.	β_{FX} Coef.	Prob.	Direction
C	1.6402	0.3251	-0.7745	0.7134	
FXDEBT	0.6746	0.4629 ns	-1.9541	0.2053 ns	sign flips
DERIV	-0.3776	0.0093 ***	0.1285	0.6130 ns	magnitude only
EXPORT	0.8431	0.1518 ns	1.2916	0.0909 *	direction only
FXDEBT $\times$ EXPORT	-1.5359	0.5520 ns	-2.7951	0.5557 ns	both ns
SIZE	-0.0350	0.5423 ns	0.0328	0.6533 ns	
ROA	-0.2107	0.7107 ns	-1.7502	0.0365 **	direction only

Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; ns = not significant. White diagonal standard errors. Magnitude model: $R\text{-squared} = 0.0606$, $F = 1.5376$ ($p = 0.1700$). Direction model: $R\text{-squared} = 0.0980$, $F = 2.5883$ ($p = 0.0207$).

Based on Table 3, in the magnitude model derivative use is the only significant determinant, with a coefficient of -0.3776 ($p = 0.0093$). Financial hedging reduces how much a firm is exposed. FX debt, export intensity, and the interaction are insignificant. The direction model tells a different story. Here export intensity becomes positive and significant, with a coefficient of 1.2916 ($p = 0.0909$), while derivative use loses significance. The sign on FX debt also flips from positive in the magnitude model to negative in the direction model, consistent with the balance-sheet logic that firms heavy in FX debt lose value when the rupiah weakens, though it is insignificant in both.

The overall fit also differs. The magnitude model has an insignificant F-statistic ($p = 0.1700$) and an R-squared of 0.0606, whereas the direction model has a significant F-statistic ($p = 0.0207$) and a higher R-squared of 0.0980. The set of determinants explains the direction of exposure better than its magnitude, which is itself evidence that the two measurements are not interchangeable.

The low R-squared in both models, 0.0606 and 0.0980, is itself economically informative rather than a defect. It implies that most of the cross-firm variation in exposure is not captured by observable balance-sheet and hedging variables, which is the signature of the exposure puzzle: when firms actively manage currency risk, gross positions are large but net, observable exposure shrinks toward zero (Bartram, 2008). The practical implication is that exposure cannot be read off reported FX debt or export shares alone; it has to be inferred from realised return sensitivity, which is why the firm-level FX beta, and its sign, carry information that the raw determinants do not.

The two measurements lead to different conclusions from the same data, and the difference is economically interpretable. The magnitude model answers a risk question. Among these firms, only active derivative use measurably reduces how exposed a firm is. This is consistent with derivatives functioning as risk-transfer instruments (Allayannis & Ofek, 2001; Bartram, 2019); cross-country evidence puts a magnitude on the effect, with derivative users showing 11 to 22 percent lower cash-flow and value volatility than non-users (Bartram, Brown, & Conrad, 2011). The effect holds even though Indonesia's derivative market is shallow, with

derivatives at only 44 percent of total foreign exchange transactions, well below Malaysia at 80 percent, Singapore at 75 percent, and Thailand at 65 percent (Bank for International Settlements, 2022, as reported in Bank Indonesia, 2025).

The direction model answers a different question, namely who gains and who loses when the rupiah weakens. The positive, significant coefficient on export intensity is the finding the absolute measure hides. It indicates that exporting firms, on average, see their share prices rise during a depreciation. This is the transactional-gain channel. For pure commodity exporters whose costs are in rupiah and revenue in dollars, a depreciation lifts profits. In the magnitude model this group is pooled with import-dependent manufacturers, and the signal cancels out, which is precisely why export intensity is insignificant there. The sign is not noise; it is the information.

The insignificance and sign instability of FX debt fit the emerging-market evidence rather than contradicting it. Chue and Cook (2008) document that the relationship between debt and exposure can be significant in one period and vanish or reverse in another, and He, Liu, and Zhang (2021) find that gross international operations explain little of the cross-sectional variation in exposure. Against this backdrop, the wrong-signed and insignificant FX-debt coefficient in the Indonesian magnitude model is a familiar pattern, plausibly reflecting that the sampled firms have partially hedged or otherwise offset their balance-sheet positions, and that exchange-market intervention compresses measured exposure in settings like Indonesia (Sikarwar, 2020; Devina & Dalimunthe, 2023). Bartram (2008) supplies the mechanism. When firms hedge, gross exposure is large but net exposure shrinks below the threshold of empirical detection, which is also consistent with the low R-squared observed here.

This has a direct methodological implication. In a commodity-based economy, compressing exposure into its absolute value discards the heterogeneity that distinguishes a firm that profits from a depreciation from one that suffers from it. The distinction is what industry-structure arguments predict, because exposure direction depends on the currency composition of revenues and costs, so firms with similar export shares can carry opposite signs (Marston, 2001). Studies that report only the magnitude risk concluding that exports do not matter for exposure, when in fact exports matter a great deal for its direction. The recommendation is not to abandon the magnitude measure, which remains the right tool for risk-reduction questions such as hedging effectiveness, but to report both measures so that the directional channel is visible. The exposure puzzle, in this light, is partly a measurement artifact, since averaging opposing signs into a magnitude mechanically shrinks the apparent role of variables, such as exports, whose effect runs through direction rather than size.

For investors and managers, the dual view is practical. The magnitude measure flags which firms have successfully reduced exposure, which makes derivative use an observable signal of risk-management quality. The signed measure flags the direction of a firm's currency position, which allows a portfolio that combines export-driven positive-exposure firms with FX-debt-driven negative-exposure firms to net out some currency risk. Neither insight is available from the other measure alone.

CONCLUSION

This study compared magnitude and direction measures of corporate foreign exchange exposure for Indonesian non-financial firms over 2020 to 2024 and found that the two, estimated from the same two-stage procedure, lead to different conclusions: financial hedging through derivatives lowers the magnitude of exposure, while export intensity shapes its direction through a transactional-gain channel that the magnitude measure conceals. For practice, this means managers should treat financial hedging and export-based natural hedging as answers to different problems, using derivatives to cut the size of exposure and reading the sign of exposure to understand whether a depreciation helps or hurts the firm, while investors can treat active derivative use as an observable signal of risk-management quality and combine positive-exposure exporters with negative-exposure FX-debt firms to net out currency risk at the portfolio level, and regulators gain from deepening the derivative market given its demonstrated effectiveness. These conclusions are bounded by a small single-country sample of 30 firms and 150 observations, by a sample restricted to identified derivative users that tilts toward larger hedging firms, by an export-intensity proxy that does not capture the net matched foreign-currency position by currency, maturity, and amount, and by low explanatory power common to exposure studies; future research can therefore apply the dual-measurement approach to larger multi-country samples, construct a net foreign-currency-position measure, and separate commodity exporters from import-dependent manufacturers in advance to test the transactional-gain channel directly.

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