Unblocking the green transformation in developing countries with a partial foreign exchange guarantee.[1]

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1. Summary

Though rich countries contributed 70% of the stock of greenhouse gases causing global warming, developing economies now contribute over 63% of greenhouse gas emissions. And rising. There is no pathway for the world to remain below critical climate tipping points that does not include an accelerated investment in the green transformation of emerging economies. The 2022 report of the High-Level Expert Group on Climate Finance estimated that by 2030 annual investments exceeding US$2.4 trillion are needed, of which, given the scale and limits of domestic resources, up to US$1 trillion will need to be foreign private investment. But outside of China, the high cost of capital in developing countries – almost always two or three times the cost in developed economies – means we are only seeing a trickle of the necessary foreign private investment. Unless we lower the cost of capital, the needed transformation will not materialise. An analysis of what makes up the high cost of capital suggests we can.

The cost of capital reflects the rate of return projects have to offer investors to compensate them for their fear of loss from the risks they perceive. Development banks are project financiers, so they have focused on reducing project risks, such as construction and regulatory risks, and the risks that buyers or suppliers will default. The standard policy recommendation is to redouble these efforts. However, market data suggest the biggest opportunity for reducing the cost of capital for industrialising emerging economies lies elsewhere.

We can break down the cost of capital into the risk-free rate of return an investor requires of all their investments, plus the macro- and micro-risk premia applying to particular investments in a specific country The macro-risk premium reflects political, sovereign credit and currency risks. We can see it in the higher yields developing-country governments pay investors to buy their bonds. Recently, the South African Government offered investors 12% annually when it borrowed ten-year money, while the German Government paid 1%. The micro-risk premium is the extra return a project has to offer investors above the Government's borrowing cost. The evidence we show in this paper is that in industrialising emerging economies, excluding China, the micro-risk premia are similar or smaller than in developed countries. The macro-risk premia therefore account entirely for the higher cost of capital in emerging economies. This striking result may reflect existing micro-risk

[1] Version 7.0, June 7, 2023. Special thanks to Amar Bhattacharya, Karima Degia, Emma Hamilton, Michael Hugman, Michael Jacobs, Sony Kapoor and Rockefeller Foundation, for direct assistance in the development and preparation of this paper which has also benefited from the wisdom and encouragement of too many others along the way to mention individually here.

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reduction efforts, but the message is clear: to make a difference we must reduce the macro-risk premia.

In industrializing emerging economies like Brazil, India, Indonesia, Mexico and South Africa, but unlike most other developing countries, investors can hedge a large proportion of the additional macro-risk premia in the forward currency markets. But the costs of doing so are so high that what is left of the return is not enough to generate interest in an investment or even in developing a supply of investment-ready projects. Studying where exchange rates end up and where they were predicted to end up by the forward foreign exchange (FX) market reveals that these hedging costs include a substantial excess risk premium or 'overpayment' for actual currency risks. And because capital flows to emerging markets are highly cyclical, if we narrow our focus to when hedging costs rise above the recent norm, this *overpayment* both doubles, *and* becomes more certain. At these times, if an FX Guarantee Agency provided investors with hedging at costs that were reduced by historic excess amounts which could mean a halving of current market costs, there would be adequate protection for future FX risks and sufficient currency-hedged returns to send investors gleefully to emerging economies. By reducing the overpayment only, we are correcting this market failure without subsidy, allowing us to scale up this partial guarantee to cover the entire green transformation investment that needs to be financed externally.

To do this we would need a counter-cyclical mechanism with a public-good mandate, pooling FX risks, and the necessary liquidity and capital to hold fundamentally profitable trades over time. It could be implemented by a joint agency of multilateral development banks, where there is diversity and project expertise, and the International Monetary Fund (IMF), where there is liquidity and macro knowledge.

2. Introduction, or why this is a planet-sized problem to be solved

We care about greenhouse gas (GHG) emissions because they stick around in the atmosphere, in some cases, for hundreds of years. Over the past 270 years, North America and Europe have contributed over 70% of the stock of GHGs in the atmosphere.[3] GHG emissions were an integral part of their story of increased food production, industrialisation, and economic growth. In recent years, as rich countries have reached a point of wealthy post-industrialisation, the carbon intensity of their GDP growth has fallen.[4] Now, as developing countries pursue more intensive agriculture, industrialisation, and economic growth without the spoils of imperialism, their emissions represent 63% of global emissions.[5] This will only grow.

Equity may demand that developing countries wait till they are wealthy to reduce their carbon intensity. The challenge is that earlier rich-country-led industrialisation used up 86%

[3] https://ourworldindata.org/grapher/cumulative-co2-emissions-region. North America and Europe have contributed 70.8% of cumulative CO_2 emissions emitted between 1750 and 2021. Note, this measures CO_2 emissions from fossil fuels and industry only.
[4] https://ourworldindata.org/co2-gdp-decoupling
[5] https://www.cgdev.org/media/developing-countries-are-responsible-63-percent-current-carbon-emissions

of the planet's carbon budget.[6] As we use more of this budget, the planet's physical, chemical and biological systems will destabilise, with cascading effects.[7] These processes are not linear or geographically uniform. The 40% of the global population living between the tropics of Cancer and Capricorn, where temperatures and sea levels will rise to the highest levels, are already experiencing unprecedented loss and damage from climate change impacts amplified by poverty, vulnerability, and indebtedness.[8] Alongside historic responsibilities and differentiated impacts there are now no current pathways in which the planet's temperature remains below critical climate tipping points that do not involve a rapid green transformation in developing countries.

According to the 2022 Songwe, Stern and Bhattacharya (2022) report of the High-Level Expert Group on Climate Finance established by the COP26 and COP27 Presidencies, we need over US$2.4 trillion per year of investment in the green transformation in developing countries if we are to reduce GHG emissions at the correct scale and pace *for the planet*.[9] [10] The good news is that this transformation represents a strong national development and growth strategy for many countries. Moreover, in the developed world, 81% of green transformation investments are financed by the private sector, underscoring that many of these projects are commercially viable.[11]

In the developing world, only 14% of these investments are funded by private savings.[12] Developing-country governments have tried to fill the gap themselves. Some, suspicious of the motives of private investors, believe they should continue to do so. But developing-country governments cannot invest to the scale and pace the world needs. It would be nice if the world financed it for them but we will be waiting for Godot for that. Total global expenditure on aid is less than one tenth of the cost of the green transformation in developing countries and, if anything, aid budgets are getting stretched on non-traditional things – not quadrupling. And developing countries do not have the space on their balance sheets for the debt required even if they wished to finance it themselves. Recall that developing countries start from high debt levels, worsened by the pandemic, the food and fuel crisis following the Russian–Ukraine conflict, and rising loss and damage

[6] https://www.carbonbrief.org/analysis-which-countries-are-historically-responsible-for-climate-change/
"by the end of 2021, the world will collectively have burned through 86% of the carbon budget for a 50-50 probability of staying below 1.5C".
[7] https://www.ipcc.ch/sr15/
[8] https://www.bbc.co.uk/news/world-58080083
[9] Songwe V, Stern N, Bhattacharya A (2022) 'Finance for climate action: Scaling up investment for climate and development'. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science. https://www.cgdev.org/sites/default/files/IHLEG-report-finance-for-climate-action.pdf
"Emerging markets and developing countries other than China will need to spend around $1 trillion per year by 2025 (4.1% of GDP compared with 2.2% in 2019) and around $2.4 trillion per year by 2030 (6.5% of GDP), on the specific investment and spending priorities identified above. These numbers are based on the analytical work set out in Bhattacharya et al. (2022) assessing sector and geographical requirements for investments and actions to keep the target of capping warming at 1.5C in reach and to meet the goals of the Paris Agreement across all its dimensions. The numbers are broadly consistent with the work of the International Energy Agency and the Energy Transition Commission."
[10] Bhattacharya A, Dooley M, Kharas H, Taylor C (2022) 'Financing a big investment push in emerging markets and developing economies for sustainable, resilient and inclusive recovery and growth'. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science, and Washington, DC: Brookings Institution. https://www.lse.ac.uk/granthaminstitute/publication/financing-a-biginvestment-push-in-emerging-markets-and-developing-economies/
[11] Songwe et al. (2022).
[12] Songwe et al. (2022).

from climate change impacts.[13] About 60 percent of low-income developing countries are already at high risk of or in debt distress.[14]

To solve the problem of equity, pace and scale, we must find a way to excite and catalyse investment of domestic and external private savings into developing countries for that part of the green transformation that generates revenues. The challenge is that the green shift is highly capital-intensive, and outside of China, a high cost of capital is blocking domestic and overseas investment. Unless we can reduce that, either the green transformation will not happen, with grave planetary consequences, or it will create an inequitable drag on the economic development of the poor. There is a way, however. A significant proportion of the high capital cost in emerging economies represents an excess risk premium, in short, an overpayment for perceived risks that do not materialise. This paper sets out why, what, how and who can remove this overpayment and, by doing so, unblock the flow of private capital.

There are two important caveats to flag before we go further. First, the problem and solution set out here are most relevant to industrialising emerging countries, *excluding China*. This group is still big. It emits, in aggregate, almost as much GHGs as the United States, and their emissions are multiplying fast. The reason China is excluded from this particular solution is that it already has a surfeit of local savings and technology. Its cost of capital is at developed country levels and markets are not holding back its green transformation. Second, this paper focuses on unblocking the flow of private finance for green transformation projects with a revenue stream. This is the most significant part of the climate finance that developing countries as a group need and according to Songwe, Stern and Battacharya is almost US$1.4 trillion per year, split between the domestic and external private sector. But it is far from the whole story, and it is essential to separate this story's parts. A substantial amount of the investment climate-vulnerable countries require today has no revenues. Much of this is for adaptation projects, like sea and flood defences. Because these countries need to be more resilient today and not in the distant future, we must also urgently find a way to finance these investments. Where the investments yield annual savings, if not revenues, like reduced annual loss and damage from flooding, these are best funded through a tripling of long-term and low-cost development bank financing for resilience building. There are also climate investments where there are no revenues or annual savings, like the reconstruction of low-income housing after a climate disaster. These need to be the focus of new, non-debt, external revenue sources.[15]

[13] https://blogs.worldbank.org/voices/are-we-ready-coming-spate-debt-crises
[14] https://www.imf.org/external/pubs/ft/ar/2022/in-focus/debt-dynamics/
[15] This framework is set out in Persaud, A. (2022) 'Breaking the deadlock on climate: The Bridgetown Initiative', After Cop 27: Geopolitics of the Green Deal, Issue #3. *Geopolitique*. https://geopolitique.eu/en/articles/breaking-the-deadlock-on-climate-the-bridgetown-initiative/

3. Identifying the biggest obstacle to the green transformation in industrialising emerging economies

The average cost of capital of a utility-sized solar farm in our sample of industrialising emerging economies excluding China (Brazil, India, Indonesia, Mexico and South Africa) is 10.6%, compared to 4.0% in the EU (statistics from the IEA for 2021; see Table 1). This difference of 6.6% per year in the cost of capital matters critically because renewable energy projects are capital-intensive. Take solar; after a developer has paid for the land, panels, batteries, and erection and connection cost upfront, the operating costs of generating power are nearly zero. Given these different costs of capital, most of what is profitable in the EU and other G7 countries is not profitable in industrialising emerging economies. If two similar projects can earn a rate of return on capital employed of 10%, and the cost of capital is 4.0% in Germany and 10% in South Africa, it will happen in Germany but not South Africa. And it is unclear how the South African project could push up its local rate of return when it is essentially providing energy to poorer consumers than in Germany. We must lower the cost of capital.

Table 1. Comparative cost of capital (2021) for a utility-sized solar farm between developed countries and industrialising developing countries.

Country category	**Weighted cost of capital**	**Difference from EU**
Developed countries (represented by the European Union as a sample group)	*4.0%*	-
Industrialising developing countries – sample average	10.6%	6.6%
Sample breakdown		
Brazil	13.1%	9.1%
India	9.9%	5.9%
Indonesia	10.1%	6.1%
Mexico	9.7%	5.7%
South Africa	10.0%	6.0%

Notes:
Cost of capital: The nominal cost of capital is the midpoint of the ranges included in the Cost of Capital Observatory.
Weighted cost of capital source: https://www.iea.org/reports/cost-of-capital-observatory/tools-and-analysis#abstract

The cost of capital reflects the rate of return investors require to compensate them for their fear of losses because of the risks they perceive. Development banks are project financiers, so they have focused on reducing project risks, such as construction, and regulatory risks and the risks that buyers or suppliers will default. Like the World Bank's Multilateral Investment Guarantee Agency (MIGA), Multilateral Development Banks (MDBs) and their agencies also offer project guarantees. This is essential work. But it is said that when you have a hammer, all you see are nails, and most development bankers

believe that project risks are the nail to hammer down. Their standard policy recommendation is to redouble these efforts. Their theory of change is that developing countries need better sectoral policies. Market prices tell us something more.

We can break down the cost of capital into three components:

1. The risk-free rate of return is universal to all investments.
2. The rate of return to compensate investors for macro risks at the level of the country.
3. The rate of return to compensate investors for micro risks at the level of the project or sector.

When we turn to the difference in the cost of capital for the same project in different countries, the risk-free rate common to both projects falls away, leaving differences in macro and micro risks. Macro risks – like government, political, credit and currency risks – are partly reflected in the higher yields developing countries have to offer investors above those offered in countries investors consider safer. In the bond markets our industrialising emerging economies paid on average 8.0%[16] more per annum than G7 countries in 2021 – and even more this year.[17]

The additional return a project has to offer investors over and above the return available on government bonds is compensation for project risks or other micro risks (Table 2, column 3). In 2021, solar projects in industrialising emerging economies paid on average 2.9% over government bond yields to attract investors. That is lower than the micro-risk premium for solar projects in the EU or other G7 countries. This striking result is consistent with the earlier observations that the average difference in the cost of capital between developed and developing projects is 6.6%, and the additional macro-risk premia of investing in developing countries is 8%. *The difference in project risks is not adding to the higher cost of capital in industrialising emerging economies compared to developed ones – it is subtracting from it.*

This result will surprise some but resonates with my experience as a government negotiator in a developing country in two ways. First, it is not that there aren't great policy uncertainties in developing countries, but that they exist elsewhere too. Twenty-five-year power purchase agreements that span several elections will carry risks and uncertainties wherever they are. Germany and Spain, for instance, started off with feed-in tariffs for renewable projects but then changed tack and introduced auctions. Pipeline projects in the US have a long history of stop–go with commercial consequences for all energy projects. There is an evolving and sometimes bewildering set of community, national and EU-wide carbon credits, renewable subsidies, and tax regimes. Europe will introduce a new Carbon Border Adjustment Mechanism next year which I quite like but its effects and implementation are uncertain. And yes, even in the US and Europe, regulatory changes or

[16] See Table 2, column 2. Difference between the Group average (7.7%) and EU government cost of borrowing (-0.3%).
[17] We use bond spreads here because there is greatest consistency in these long-dated instruments across countries, but where they exist, the forward foreign exchange markets, which reflect the largest component of the macro-risk premia, the FX risk, suggests this is likely an underestimate of the macro-risk premia and therefore an overestimate of the micro-risk premia.

the lack of changes are the result of local lobbying that may be prejudicial to foreign firms and investors.[18] Second, across these tax and incentive changes, developed economies (correctly) hold tightly to their sovereign right to make changes without compensating anybody who loses directly or indirectly. But in developing countries, foreign investors threaten to walk if they are not given guaranteed fiscal privileges and immunities and agreements that subject developing countries for decades to come to international arbitration around compensation for policy changes.

Table 2. Comparative Project risks or Micro Risks (using 2021 annual data) between developed countries and industrialising developing countries.

Country category	**(1) Weighted cost of capital (as in Table 1)**	**(2) Gov cost of borrowing**	**(3) Project risk (1) - (2)**
Developed countries (represented by the European Union as a sample group)	*4.0%*	*-0.3%*	*4.3%*
Industrialising developing countries – sample average	10.6%	7.7%	2.9%
Sample breakdown			
Brazil	13.1%	9.7%	3.4%
India	9.9%	6.3%	3.8%
Indonesia	10.1%	6.2%	3.7%
Mexico	9.7%	6.8%	2.9%
South Africa	10.0%	9.3%	0.7%

Notes:

1. Weighted cost of capital source: https://www.iea.org/reports/cost-of-capital-observatory/tools-and-analysis#abstract
2. 10yr government bond rates for 2021 (source: Bloomberg).

These project incentives in developing countries are partly there as an offset for perceived high macro risks. But whatever the underlying reasons, this uncompromising attribution of risks sends a clear message. If we need to reduce the cost of capital of renewable energy projects in industrialising emerging economies, the scope for lowering project and micro risks any further is limited – more limited than commonly thought. We must place far more attention than at present on reducing macro risks. The good news is that further analysis of the macro-risk premia reveals this is possible.

[18] For measures of the success of industry lobby groups in the US and Europe, see Mahoney, C. (2008) 'Brussels versus the Beltway: Advocacy in the United States and the European Union'. Georgetown University Press.

4. Overpaying for macro and FX risks

Green transformation projects earn in local currency but need foreign currency to pay for imported capital and equipment. Someone along the line must exchange local currency revenues for foreign currency interest and dividends: either the project, or the investor. In industrialising emerging economies, investors can use forward FX markets to lock in future exchange rates and hedge against exchange rates moving against them and reducing their returns. Amongst developing countries, having forward markets is almost unique to a handful of industrialising emerging economies. TCX, for instance, is a company that creates FX hedges for projects in approximately 100 developing-country markets that do not have forward FX markets.[19] But even where the forward FX markets exist or have been created, the costs of hedging FX risks are high. This is because the foreign exchange markets act as a proxy for the large macro risks we have just discussed. Most macro risks have a currency impact: political uncertainty leads a currency to fall, as does fear of a government getting into financial problems that raise the risk they would monetise their debt and devalue the currency. Moreover, in developing countries, there are few other ways of hedging future macro risks.[20]

In the forward foreign exchange market, the cost of an FX hedge is expressed in terms of the difference between the price of buying foreign currency with local currency in the future – the forward rate – and the current price – the spot rate.[21] To facilitate comparison across projects, we can express this as an annual percentage cost. For example, in March 2016, the average spot rate for the Brazilian Real was 3.91 to the US dollar, and the five-year forward rate was 6.44, meaning that if you wanted to buy US dollars five years ahead and lock-in a rate, it would cost 71% more Real or 11.3% more *per year*. There are a few ways to look at that, but the bottom line is that the cost of guaranteeing yourself against the Real falling against the dollar (reducing the dollar value of your interest and dividends) was 11.3% per year. If a dollar-based investor invested in a Brazilian solar project that boasted a local currency rate of return of 15% per annum, after hedging out the currency risk, they would have been left with a US dollar return of just 3.7% per year (15% minus 11.3%). This would not be enough to get them out of bed in the morning – recall that the US S&P 500 equity index has a long-term return of 6.5% per annum plus inflation.[22] Across our sample group of major industrialising emerging markets, the costs of hedging currency risks averaged 5.7% per annum in 2021 and 2022. Like in the 2016 Brazilian example above, foreign currency hedged returns for long-term green projects which generate revenues from consumers in developing countries are too low to generate external investment demand across multiple currencies and decades. But this is because the cost of FX hedging overstates and therefore overpays for the actual risk.

[19] https://www.tcxfund.com/
[20] See, Liao, G and T Zhang (2020), "The Hedging Channel of Exchange Rate Determination", *International Finance Discussion Paper*.
[21] It is called "spot" versus forward, because in the case of "spot" the exchange takes place at the exact spot or point that the trade is settled not some forward date.
[22] See, Siegel, J. J. *(2014) Stocks for the Long Run: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies*, fifth edition, New York, NY: McGraw-Hill Education.

If the forward FX market were efficient and transaction costs low, the cost of the FX hedge would over time and currencies, average close to the actual FX depreciation. Individual observations would rarely be the same, but in an efficient market there would be no significant systemic bias. Students of economics would expect that roughly half the time, the current exchange rate would end up stronger than the five-year forward rate, five years ago, and half the time weaker, and these over- and under-"predictions" from five years ago would approximately cancel each other out, especially over 20 years and several currencies. After allowing for transaction costs the average net 'overpayment' should be close to zero.[23] Instead, we find a significant, +2.2% per annum, average *ex post* "overpayment" for FX risks, with an overpayment occurring in 62% out of 372 five-year hedges starting as early as 1999 and finishing in 2022. (The overpayment is the annualised percentage difference between today's spot exchange rate and the rate implied five years ago by the five-year forward market; see Table 3 column 2).

Table 3. Annual overpayment (excess foreign exchange risk premium) for hedging when hedging costs are below or above the trailing three-year average, using spot versus 5-yr forwards, 5 years ago.

Country	Average "overpayment" for all periods (annual %)	Average "overpayment" when hedges costs begin >3y MA (annual %)
Brazil	4.71	5.31
India	1.95	3.68
Indonesia	3.18	5.07
Mexico	1.54	4.33
South Africa	2.2	3.89
Group Average	2.72	4.65

Notes:

1. Figures for India are calculated using the 10-year bond spread as there is a longer data series (see Appendix 1 for more detail).
2. For all other countries, calculations use spot FX versus 5-year forward rates 5 years ago.

In our 2016 Brazilian example, between March 2016 and 2021, the Real depreciated against the dollar by 6.9% per annum, not the 11.3% discounted in the five-year forward market. In this case the overpayment for hedging turned out to be 4.3% per annum. To appreciate the significance of this overpayment, if an investor was charged what turned out to be the fair price for the hedge in March 2016, their expected dollar return would not have been a debilitating 3.7% per annum, but a compelling 8% plus diversification benefits. That is the prize. Is it achievable ex-ante or just observable ex-post?

While the average level and probability of overpaying for FX hedges across our sample are significant (see the first column in Table 3), the average masks an even more powerful and useful result. The background to what follows is that in the international financial system, markets not defined or treated as safe, experience either feast or famine of

[23] Transaction costs in currency markets are supposedly some of the lowest in financial markets. This is more so in the "spot" foreign exchange markets for developed country currencies than the forward markets and for emerging market currencies, but no one suggests they are close to 1.0% per transaction, or even 0.5% *per annum*, far less 2.2% per annum.

international capital flows.[24] Extremes are their normal. And critically, for our purposes, knowing whether we are in a feast or famine does not require omniscience. It can be reasonably identified by looking at current and recent averages of hedging costs. In feast time, capital is flowing and hedging costs are below their recent average. Whenever current hedging costs fall below a trailing three-year average, say, the 'overpayment' using the five-year forward market occurs on only 53% of occasions, almost 50-50.[25] But when hedging costs are *above* the trailing three-year average, the overpayment occurs 74% of the time (Table 4), and the magnitude of overpayment jumps to an average of 4.7% per annum (the second column of Table 3). This result is significant because it means it is possible to intervene safely in FX hedging markets by enough to make a difference.

Table 4. Comparative frequencies of positive versus negative "overpayments" of 5-year hedging costs between periods in which hedging costs begin below the 3-year average and periods above.

	% of hedges that ended up as an over / underpayment when 5-year hedging costs began *below* 3-year average	% of hedges that ended up as an over / underpayment when 5-year hedging costs began *above* 3-year average	Total number of observations
Positive excess risk premium (overpayment for hedges)	53%	74%	230
Negative excess risk premium (underpayment for hedges)	47%	26%	142
Total number of observations	213	159	372

Notes:

Quarterly observations based on 5-year FX forward rates vs USD for Brazil (BRL), Colombia (COP), Mexico (MXN), and South Africa (ZAR) for the period Q1-1999 to Q1-2018 and Indonesia (IDR) for the period Q1-2002 to Q1-2018.

If we examine periods in recent history when local hedging costs exceed the 3-year average, we see that the largest market failures often coincide with significant external shocks to the international financial system; see Chart 1 which compares the difference between current and average hedging costs for the Indonesian rupiah with global events.

Chart 1. This chart highlights periods in which the current quarter average, 5-year hedging costs for the Indonesian Rupiah versus the US dollar (the blue line) are above the three-year moving average of 5-year hedging costs (the red line).

[24] See, Griffith-Jones S., R. Gottschalk and J. Cailloux (eds) (2003) *International Capital Flows in Calm and Turbulent Times: The Need for New International Architecture* (Development And Inequality In The Market Economy).

[25] By using a trailing average we are comparing current with the past and not using any future information, and so the fact that this metric allows us to separate two very different environments in the future is highly significant. There are other similar averages that could be used, perhaps supplemented with other instruments like international interest rates, equity prices and capital flow data to assess feast versus famine.

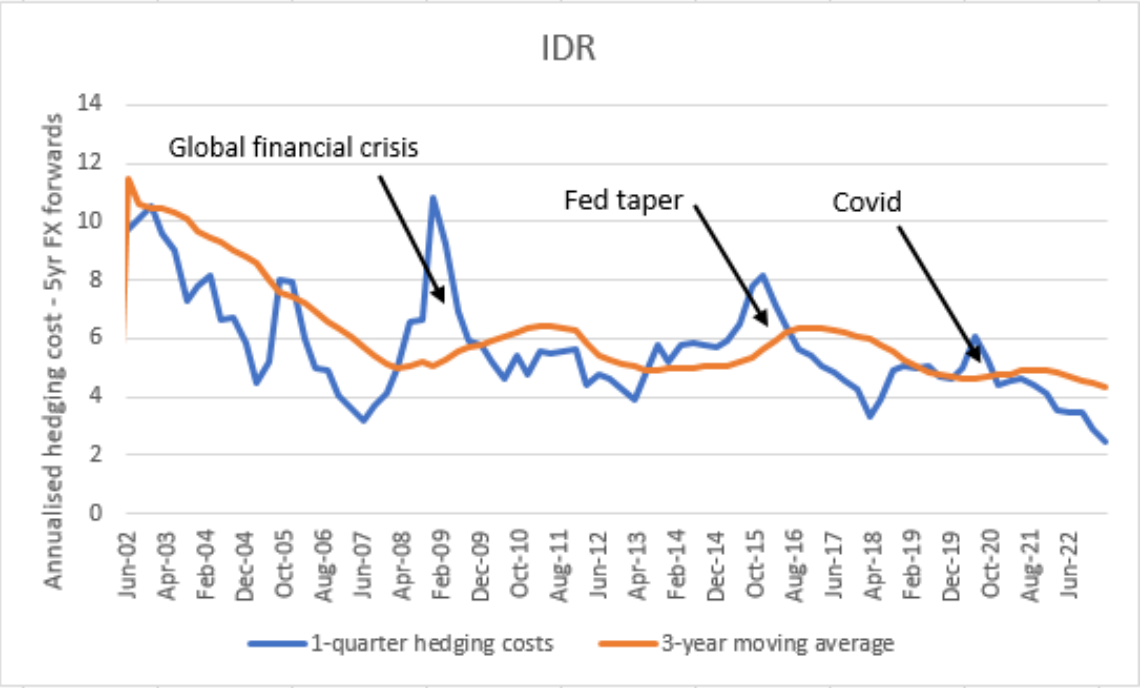
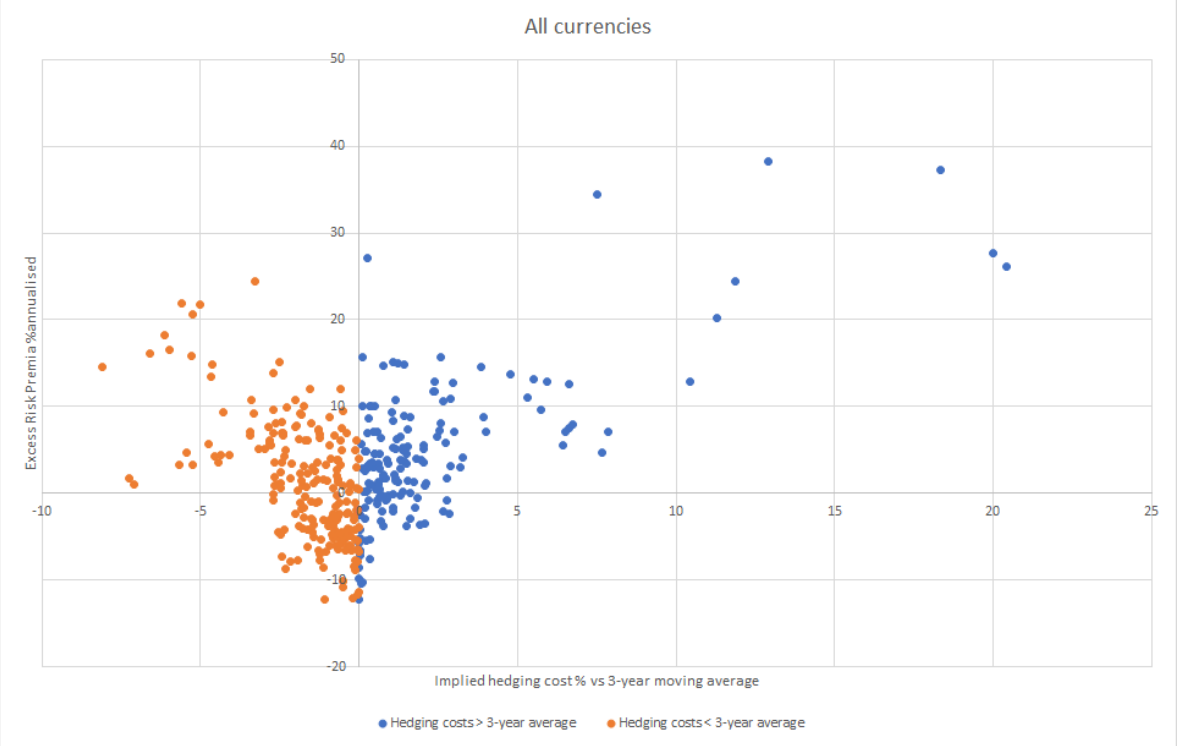


Chart 2 is a scatter diagram showing all 371 "overpayments" across our industrialising emerging economies over 20 to 30 years. On the horizontal axis is how much hedging costs at the beginning of the hedge were above or below the three-year moving average. The right-hand side of the diagram shows over- or underpayments when hedging costs were above average – all painted blue – and the left-hand side shows over- or underpayments when hedging costs are below average – all painted red. There is a heavy skew to overpayments when current hedging costs are above average. Seventy-four per cent of observations are above the zero line on the vertical axis and so in the top right-hand quadrant.

Chart 2. The relationship between over- or underpayments (the vertical axis) and whether hedging costs at the beginning of the hedge were above (coloured blue) or below (coloured red) the three-year moving average (the horizontal axis)[26]

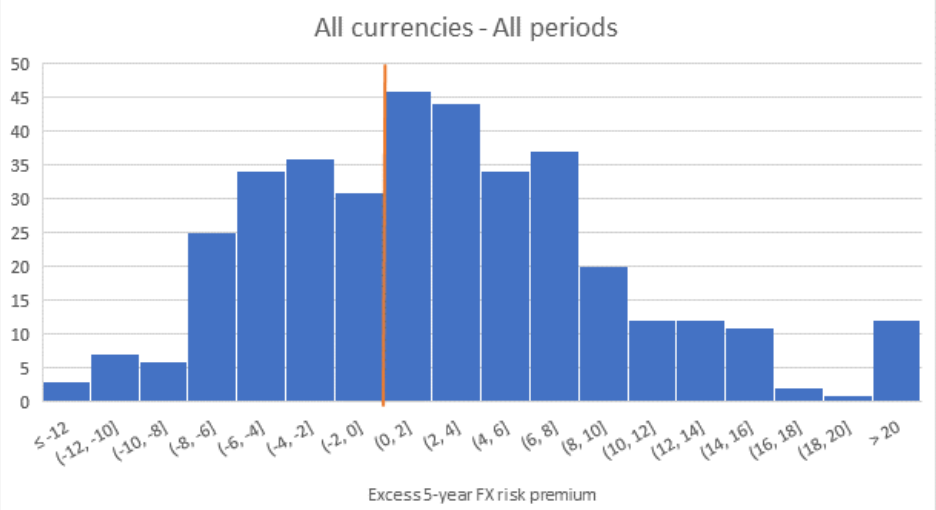


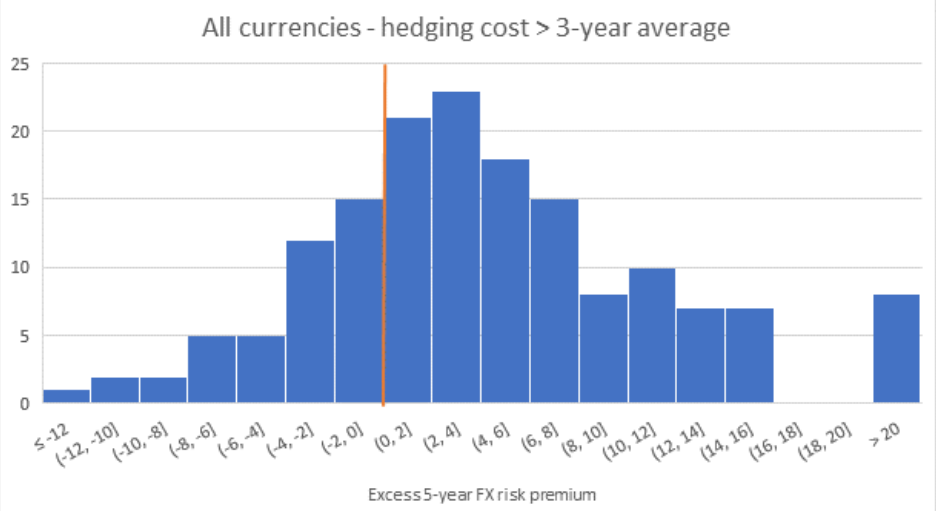
Charts 3, 4, and 5 are histograms showing the distribution of over- and underpayments across our sample of industrialising emerging market currencies over the past 20 to 30 years. For instance, the first blue bar to the right of the zero line indicates that there were 45 occasions (reading off the vertical axis) in which the exchange rate turned out between 0 and 2.0% per annum (reading off the horizontal axis) stronger than the five-year forward rate, five years ago. The first histogram, Chart 2, shows the overpayments for the whole sample of currencies and time. The 371 observations are reasonably evenly distributed around the 0 to +2% and +2 to +4% boxes, showing a bias to overpayments. This bias is also seen by thirty-eight per cent of all the observations being negative and in boxes to the left of the zero line, and sixty-two per cent being positive, and in boxes to the right.

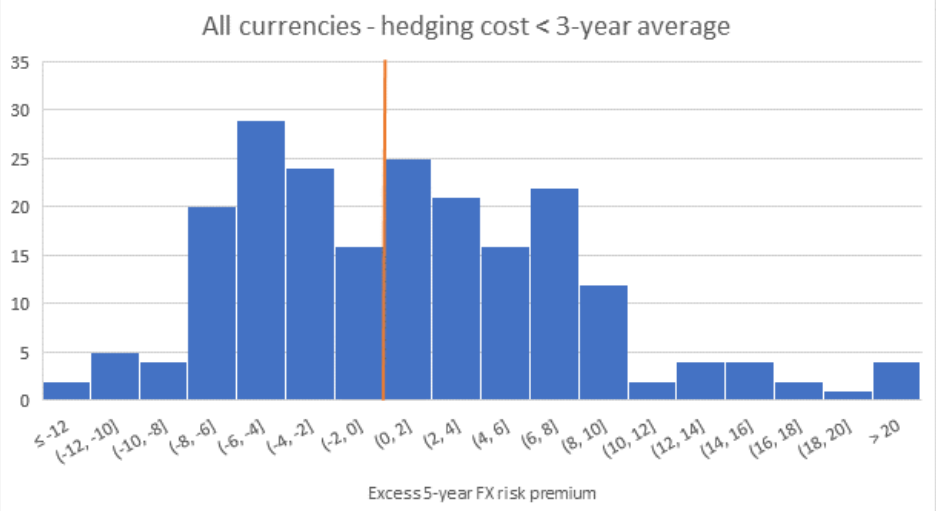
In the second histogram (Chart 4), we only look at overpayments when current hedging costs exceed the past three years' moving average. This shows the histogram shifting right (Chart 3), and now centred around the +2 to +4% and +4 to +6% boxes and the number of *under*payments falling sharply to just 26% of observations, and *over*payments rising to 74%. These are good odds.

[26] The currencies included are: Brazilian Real, Colombia Peso, Mexican Peso and South African Rand, Q1-1999 to Q1-2018 and Indonesian Rupiah for the period Q1-2002 to Q1-2018.

Charts 3, 4, 5. Histograms showing number of quarterly observations (vertical axis) and size of ex-post annual "overpayments" when comparing FX spot with the 5-year forward 5 years previously for the Brazilian Real, Colombia Peso, Mexican Peso and South African Rand, Q1-1999 to Q1-2018 and Indonesian Rupiah for the period Q1-2002 to Q1-2018. [27]







[27] See Appendix 3 for separate country charts.

In the third histogram (Chart 5), we only look at overpayments when current hedging costs are below the average of the past three years. Now, the histogram shifts left and the distribution is centred around the 0 to +2% box. During these periods 47% of all observations are negative and 53% positive (I recommend avoiding intervention in these periods, but the odds are still better, though not by much, than a coin toss).

In these histograms there are separate observations for each currency. If instead we pool the FX risks and treat them like one currency or portfolio, capturing the benefits of diversification, the number of negative observations when hedging costs are above the three-year trailing average falls from 26% to 21% and the number of positive overpayments rise from 74% to 79%. Those are uncommonly good odds.

In the same way that the average project financier would be unsettled to learn that macro risks are greater than micro risks, the average economist will need support to deal with the idea that there is a persistent overpayment for FX risks and such favourable odds, albeit, at specific, predictable, times. The question we are trained to ask is: why has competition not caused financial institutions to reduce the overpayment (or: why is the author wasting time writing this down and not busy trading FX forwards)? My fellow economists will leave the £5 note lying on the pavement because it cannot be there, leaving us poorer (but still smug).

5. Thoughts on the reasons for persistent 'overpayments' and market failures

Economists are taught at university that systematic biases cannot persist. It would be irrational, and after Bob Lucas' rational expectations revolution in the 1970s, economic ideas and models always assume rationality. It is hard to square that with multiple studies that reveal a long-term "forward rate bias" or the financial sector's healthy profitability.[28] The consultant psychiatrist Dr Rajendra Persaud explained to me that economists have it a little off: humans are not rational; but they are rational*ising*.

There are three ways to rationalise the excess risk premium in the FX markets or overpayment. First, it is an "uncertainty premium". Foreign investors don't know and feel they don't understand these markets, so they stay away. The old trader's adage is that if you don't understand it, don't trade it. Second, it could be "investor risk aversion". The structure of safe and risky currencies, the feast and famine of international capital flows that follows from that, amplifies the boom–bust cycle in emerging markets. As a result, emerging market currencies are more volatile. If investors are more averse to short-term losses than gains, especially in less-familiar markets, they will avoid volatile markets or require an 'overpayment' to offset their risk aversion.[29] Third, to capture the more reliable

[28] For example, Levine, R. (1991) 'An empirical inquiry into the nature of the forward exchange rate bias'. *Journal of International Economics*.

[29] As Michael Hugman has reminded me, it could be a particular type of risk aversion: an aversion to the "peso problem" the small probability of a large depreciation. The good news then is that by focusing only on occasions when hedging costs are above average and pooling FX risks we appear to have sharply reduced, or even eliminated in our sample, the peso

parts of the overpayment is to behave counter-cyclically: to stand down when hedging costs are low and offer below-market hedging costs when they are high. There are plenty of micro-economic reasons why counter-cyclical behaviour is hard for private firms to do and so why this market failure persists. If you were acting counter-cyclically, when investors around you are making out like bandits in a feast of capital flows, you would be tying up capital and not using it. Persuading investors to do this in a short-term, trend-following world is hard. And when investors are risk-averse, and there is a famine of capital flows, you would likely be using scarce liquidity and capital to absorb short-run losses in risky instruments to make modest long-run returns. This is not a winning business model.[30] As a result, private investors are leaving money on the table. But even more significant are the far greater social gains from saving the planet and boosting green growth in developing countries that are being left alongside.

It is worth asking why international investors hedge at all if hedging is expensive and often an overpayment. The answer lies in a combination of market behavioural factors. First, the investments must compete with others in the investor's local currency and second, the investors are being paid to find value in equity and credit, not currencies. Investors would rather not take on an additional unfamiliar risk, not just the price risk of currencies, but also currency management and trading risks like counterparty and liquidity risks.[31]

6. A proposed planet sized solution: a partial FX guarantee

To address the planet-sized problem outlined at the beginning, and based on the preceding analysis, I propose a Partial FX Guarantee Mechanism limited to green transformation projects. Market failures and overpayments observed in the historic data offer a basis for intervening to reduce the overpayment when it is most extreme. The micro-economic arguments for the market failure described above, the distribution of the overpayments across time and the portfolio effects discussed earlier, guide us on how we could best operationalise such an FX guarantee. It is best implemented in a public-sector environment with a counter-cyclical and public-good mandate and where liquidity and capital can be employed in market stress. A conservative approach is also critical, as sticking to an objective of reducing the overpayment but not providing a subsidy will allow the mechanism to scale up safely enough to materially close the US$1 trillion per year gap on private finance. And spreading or pooling currency risks is also a valuable risk-reducer. Based on this, my proposal is for a joint agency of the Multilateral Development Banks and the IMF to offer a partial FX guarantee at specific times and to pool the risks. The MDBs would provide diversity and project expertise, and the IMF could provide liquidity and macro knowledge.

problem. For the classic description of the peso problem that is very apt to what we are describing, see Obstfeld, M. (1987) "Peso Problems, Bubbles, and Risk in the Empirical Assessment of Exchange-Rate Behavior," *NBER Working Paper 2203*, National Bureau of Economic Research, Inc.

[30] Of course, highly leveraged funds do try to capture these excess premia, but they have to leverage up the returns to make it sufficiently worth their time which increases risks and limits market-wide scalability. Maybe eight out of ten years they end up in the Hamptons and two out of ten they lose other peoples' money and are trying to avoid Rikers.

[31] For some sense of these risks see, "Traders Said to Rig Currency Rates to Profit Off Clients", *Bloomberg News*, 12 June 2013.

Projects could come to the FX Guarantee Agency via the MDBs where they may have benefited from project-risk reduction, or some other safe-guarding exercise. The FX Guarantee Agency could prioritise projects that have the most significant projected positive impact on the climate, with the quantity of GHGs reduced per dollar employed as one possible performance measure. As I suggest above, the Agency could wait until hedging costs were above the three-year average and then offer FX hedges that cost on average 3.5% per annum less than that being offered by the forward FX market – less than the historic overpayment in these periods. At this level future FX risks would very likely be still covered while investors hedged returns would rise by 3.5% per annum into the 8% per annum zone that would attract institutional investors. The Agency, however, should determine its own operational rules and be able to adapt them as it treads a fine balance between financial sustainability and making a difference. We don't need yet another small program. Making a dent in the external investment required to finance the green transformation must be embedded in its key performance indicators.

Would the Agency distort the market? We can limit adverse consequences by restricting the availability of these low-cost hedges to only green transformation projects. If the Agency misjudges and ends up paying a subsidy by mistake, the subsidy will support a global public good that can justify being subsidised. And if the Agency impacts pricing outside of these projects, it will reduce excess market-risk premia, not create new ones.

7. Conclusion

The proposed FX guarantee aims to provide a planet-sized solution to a planet-sized problem. It reduces the cost of capital that is blocking the flow of investment into developing countries for the green transformation. It focuses on reducing the largest risk premia, the macro-risk premia, where and when the market failure is greatest. For industrialising emerging markets, there is strong evidence that the amount of the risk premia that can be reduced safely, with the help of pooling and acting counter-cyclically, is enough to make green investments in developing countries attractive for investors everywhere. This means we can scale it up to make a planet-sized difference.

Appendix 1. Average annual excess FX risk premia for India

(Excess Risk Premia equates to overpayment for FX hedge)

	India		
	10-year bond spread (Local-SDR)	Avg. Annual Excess FX Risk Premium (%)	Avg. Annual Excess FX Risk Premium % in 'above average spread' years
1994	5.45	1.30	1.30
1995	7.04	4.08	4.08
1996	7.92	5.14	5.14
1997	6.67	4.19	4.19
1998	7.25	5.10	5.10
1999	7.35	4.85	4.85
2000	6.04	4.32	4.32
2001	5.03	2.93	2.93
2002	2.96	0.30	-
2003	1.96	-1.16	-
2004	1.93	-1.30	-
2005	3.31	0.05	-
2006	3.54	0.11	-
2007	3.69	0.06	-
2008	4.22	0.70	-
2009	3.52	0.80	-
2010	4.71	0.68	-
2011	5.15	1.44	1.44
2012	6.11	3.49	3.49
Average	**4.94**	**1.95**	**3.68**

Sources: 10y bond yields: https://tradingeconomics.com; SDR valuation history xls from https://www.imf.org/external/np/fin/data/rms_sdrv.aspx; SDR exchange rates: https://www.imf.org/external/np/fin/ert/GUI/Pages/CountryDataBase.aspx; Euro bond yields: https://sdw.ecb.europa.eu

Appendix 2. Return expectation from solar projects in Emerging Market Developing Countries[32]

Country	S&P Rating	Required return from solar project (%)
Germany	AAA	7%
USA	AA+	9%
UAE	AA	10%
Saudi Arabia	A-	12%
Chile	A	12%
Morocco	BBB-	15%
India	BBB-	17%
Algeria	B	18%
Oman	BB-	18%
Peru	BBB	20%
Costa Rica	B	21%
Namibia	BB-	21%
Ghana	B-	22%
Brazil	BB-	22%
Nigeria	B+	22%
Bolivia	B+	24%
Tanzania	B	24%
Egypt	B	28%
Zambia	CCC-	38 %
Argentina	CCC+	52%

Source: Climate Policy Initiative (forthcoming)

[32] https://www.cgdev.org/sites/default/files/IHLEG-report-finance-for-climate-action.pdf pp. 50.

Appendix 3. Histograms: All period v >3-year Moving Average Excess Risk Premia (where positive Excess Risk Premia equates to overpayment for FX hedge, negative ERP equates to underpayment)

Figure A3.1. Colombia

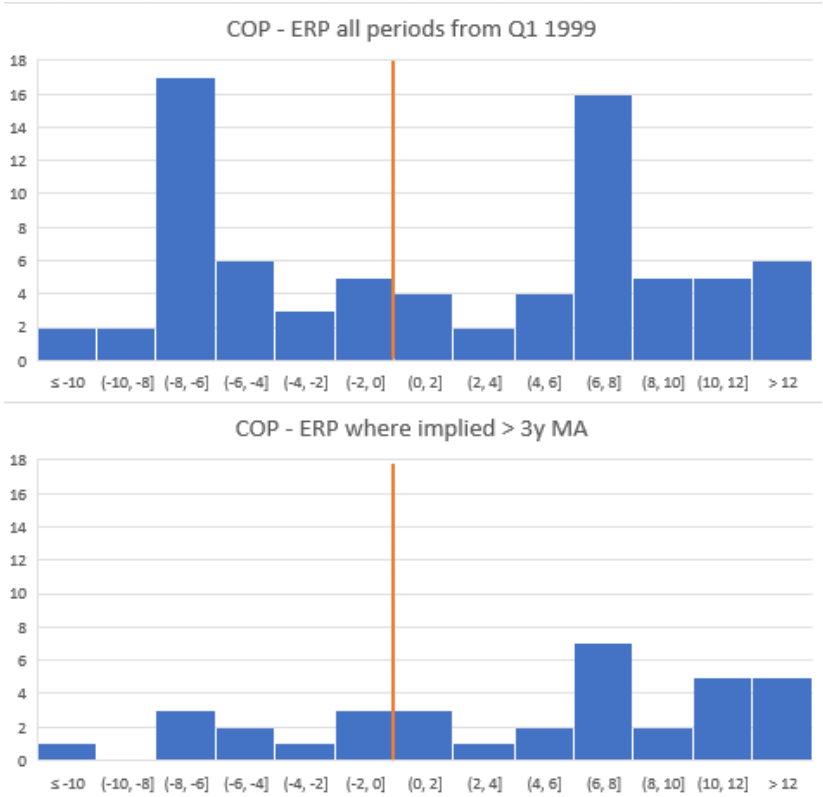


Figure A3.2. Brazil

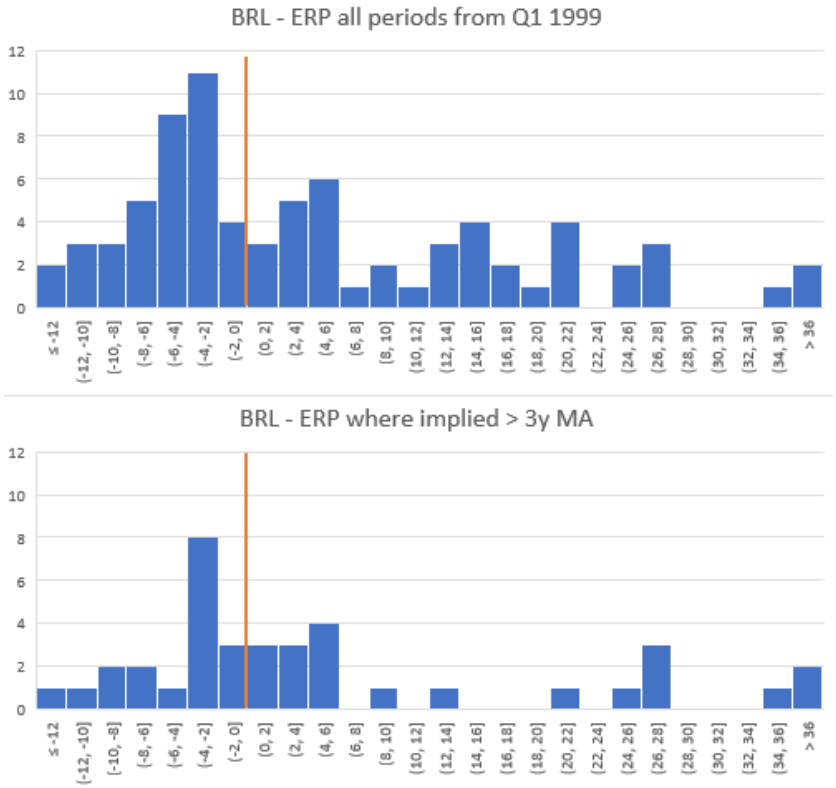


Figure A3.3. Mexico

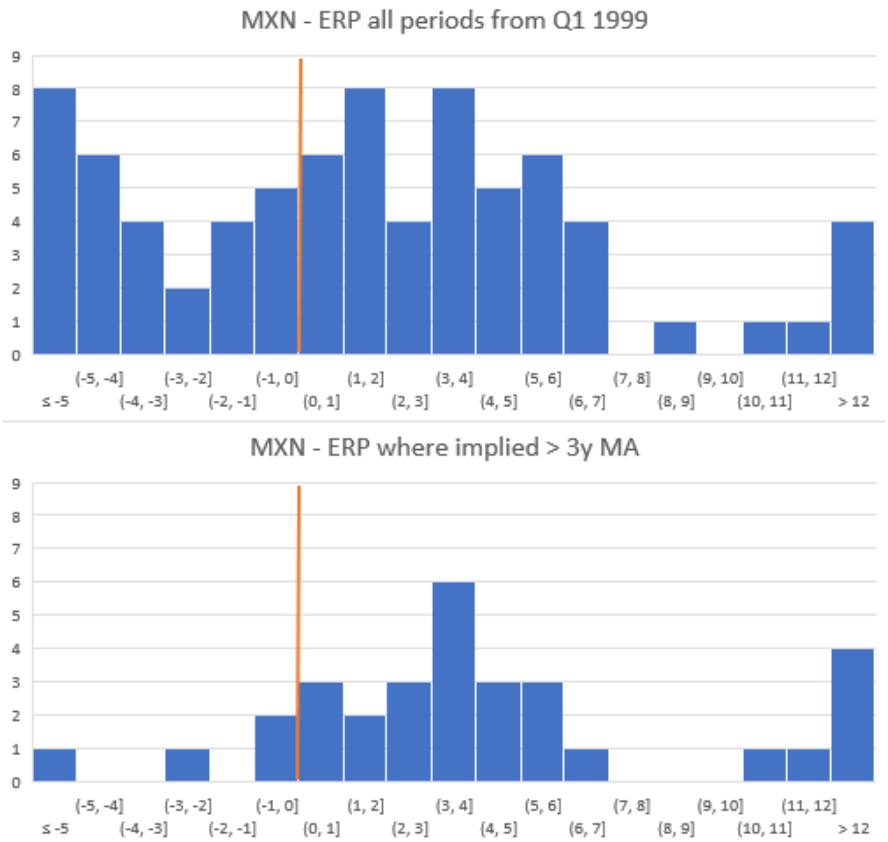


Figure A3.4. South Africa

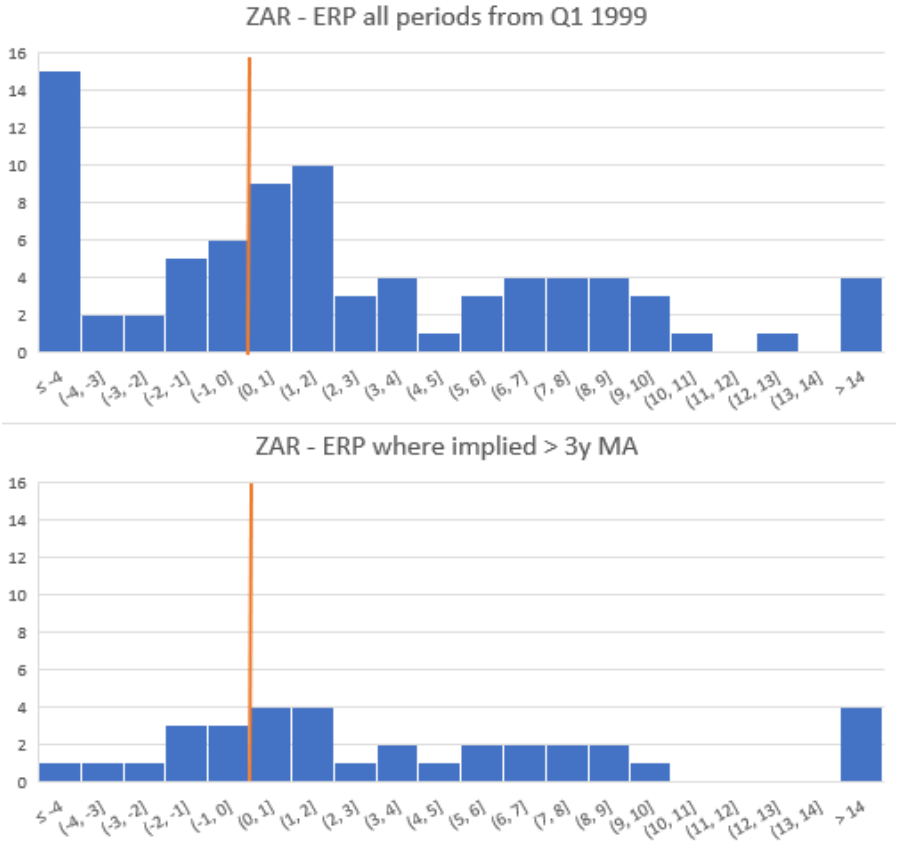


Figure A3.5. Indonesia