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## Inflation Surges under Incomplete Markets*

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**Abstract**

*Why did inflation in Pakistan increase from 13.8 percent in May 2022 to the peak of 38 percent in May 2023? Similar surges in inflation are also observed across other developing economies at times of financial stress. This short paper presents a small open economy model where current and expected future risk affects both domestic and CPI inflation. This is due to the assumption of incomplete markets which gives rise to deviations in the uncovered interest rate parity (UIP) condition, also known as excess returns or risk premium. This paper uses the model to demonstrate that the surge in inflation in Pakistan was primarily attributed to the sharp increase in risk premium rather than other factors frequently discussed in popular discourse such as cost shocks, differential in policy rates, inflation expectations, and money supply.*

**Keywords:** Inflation New Keynesian, UIP deviations, Risk, Monetary Policy.

**JEL Classification:** E31, E32, E52, F4, G15.

### Introduction

Inflation in Pakistan increased from 13.8 percent in May 2022 to a peak of 38 percent in May 2023. Similarly, core inflation jumped from 9.7 percent to 20 percent over the same period. To understand this sharp increase in inflation,

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within a short timeframe, this paper develops a small open economy new Keynesian model, following the approach in Justiniano & Preston (2010a). While the initial surge in inflation can be attributed to rising commodity prices, I show that the significant increase in current and expected future risk was the primary driver behind the sharp increase in inflation to the peak of 38 percent. Although risk levels continue to remain elevated, these have decreased significantly , contributing to a decline in inflation since then.

Specifically, the model in this paper assumes incomplete markets and allows for deviations in the uncovered interest rate parity (UIP) condition, as observed in data. This, in turn, results in the risk premium (or excess returns) affecting the value of a country's currency. Additionally, unlike Justiniano & Preston, this paper also incorporates imported inputs into production. This plays a crucial role in amplifying the effect of fluctuations in the risk premium on inflation, by influencing the cost of imported inputs. I then use the model to show that the observed increase in inflation in Pakistan was primarily due to a sharp increase in both current and expected risk premium. The model presented in this paper can also help explain sudden increases in inflation in developing economies during times of financial stress.

A substantial body of literature examines deviations from the uncovered interest rate parity (UIP) condition, which equates returns on assets denominated in different currencies. These deviations imply excess returns that can both be positive or negative for currencies of advanced economies. However, Kalemli-Ozcan & Varela (2021) document that, unlike advanced economies, excess returns for emerging economies are not only positive but also exhibit relatively higher volatility. Furthermore, excess returns for emerging economies are negatively correlated with capital flows. While Kalemli-Ozcan & Varela emphasize the role of policy uncertainty in driving excess returns for countries that borrow from international creditors in their own currencies, default risk is the likely the primary driver of excess returns for countries that borrow in foreign currency, such as Pakistan.

Despite extensive research on the factors driving excess returns, there is a limited body of literature examining how these factors may influence inflation dynamics in developing economies and their implications for monetary policy.[1] Brandao-Marques et al. (2020) find that the effect of monetary policy on the economy in emerging economies is similar to that observed in advanced economies, but only after controlling for changes in exchange rates. As changes in the exchange rate reflect unexpected shifts in interest rate differentials and excess returns (or risk premium), the results in Brandao-Marques et al. highlight the

1 Justiniano & Preston (2010b) study the extent to which external (US) shocks can explain fluctuations in the Canadian economy.

significance of risk as a key factor determining how monetary policy affects the economy in developing countries.

The remainder of this paper is organized as follows: Section 2 outlines the model and discusses how risk may affect both domestic and CPI inflation within the economy. Section 3 calibrates the model and examines how an exogenous increase in risk premium would influence inflation in the model economy. Importantly, I consider both scenarios where the increase in risk premium is relatively persistent and where the central bank places less emphasis on stabilizing inflation. Section 4 uses the model to analyze which of the factors can potentially explain the sharp increase in inflation observed in Pakistan. Section 5 is speculative, briefly discussing how increasing interest rates beyond a certain threshold may prove ineffective. Finally, Section 6 concludes the paper.

However, before proceeding, I briefly discuss why increase in money supply cannot explain the recent increase in inflation in Pakistan.

***Why Money Supply is not the answer***

Considerable discussion on inflation in Pakistan revolves around the role of money supply, and for good reason. Figure 1 presents a scatter plot comparing the five-year moving averages of annual inflation on the vertical axis and broad money growth (M2) on the horizontal axis. The strong positive correlation between the two variables is evident. Moreover, this correlation remains close to 1 when the same figure is plotted using 10-year moving averages for both variables. Therefore, it is reasonable to conclude that, in the case of Pakistan, money growth plays an important role in determining inflation over a medium to long run.

Theoretically, using the equation for the quantity theory of money and further assuming the change in the volatility of money to equal zero, we can write inflation as given by,

$$\pi_t = gr_t^m - gr_t^d \tag{1}$$

where $\pi_t$ is inflation, $gr_t^m$ is the growth in money supply, and $gr_t^d$ is the growth in money demand. Equation 1 implies that inflation in any given period $t$ equals the difference between the growth in money supply and the growth in money demand. With the average GDP growth of 3.5 percent over the last decade, average $gr_t^m$ must be around 13 percent to explain an average inflation rate of close to 9 percent as seen in data. Figure 2 plots data for $gr_t^m$ over the last decade.

While money supply is a significant factor in inflation discussions in Pakistan, it alone cannot fully explain the increase in inflation from 13.8 percent in May 2022 to 38 percent in May 2023. Money growth did rise to 17 percent during Covid-19.

However, holding $g_t^d$ fixed, this increase can only account for a maximum inflation rate of 14 percent.

The inability to explain inflation dynamics solely using money supply growth necessitates an alternative framework that can provide a better understanding of the underlying factors driving inflation. I will now turn to this framework.

**Model**

The model presented here is similar to Justiniano & Preston (2010), with the key distinction being the incorporation of imported inputs in firms' production. This is an important departure, as it allows uninsured risk to directly affect firms' input costs and, consequently, domestic inflation. Without this, risk would primarily affect domestic inflation indirectly through changes in relative prices due to variations in the price of imported consumption goods and their impact on real economic activity. This modification is likely to be quantitatively significant in understanding both the determinants of inflation and how monetary policy operates in emerging economies. In the remaining sections, I provide a concise overview of the model, focusing on the features that differentiate the model in this paper from Justiniano & Preston.

***Households***

The households' problem is similar to that presented by Justiniano & Preston (2010). Households choose $\{C_{t+s}\}_{s=0}^{\infty}$ and $\{L_{t+s}\}_{s=0}^{\infty}$ to maximize expected lifetime utility,

$$E_t \sum_{s=0}^{\infty} \beta^s \left[ lnC_{t+s} - \frac{L_{t+s}^{1+\varphi}}{1+\varphi} \right] \tag{2}$$

where $L_t$ is labour supply and $C_t$ is the consumption basket which includes both the domestic and imported consumption goods such that,

$$C_t = \left[ (1-\alpha)^{\frac{1}{n}} C_{h,t}^{\frac{n-1}{n}} + \alpha^{\frac{1}{n}} C_{m,t}^{\frac{n-1}{n}} \right]^{\frac{n}{n-1}}$$

where $C_{h,t}$ is domestic consumption and $C_{m,t}$ is imported consumption. Both $C_{h,t}$ and $C_{m,t}$ are the Dixit-Stiglitz aggregates of differentiated goods produced at home and abroad, respectively. $\alpha$ is the weight on the consumption of domestic goods in households' consumption basket and $\eta$ is the elasticity of substitution between domestic and imported consumption goods.

Households maximise their expected lifetime utility subject to the flow budget constraint of the form,

$$P_tC_t + D_t + S_tB_t = D_{t-1}(1 + i_{t-1}) + S_tB_{t-1}(1 + i^*_{t-1})\rho_t(.) + W_tL_t + \prod H, t + T_t \quad (3)$$

where $W_t$ is the nominal wage and $P_t$ is the price of the consumption basket. $P_t$ is a composite of both the price of the domestic consumption good, $P_{h,t}$, and the imported consumption good, $P_{m,t}$,

$$P_t = [(1-\alpha)P_{h,t}^{1-n} + \alpha P_{m,t}^{1-n}]^{\frac{1}{1-n}} \quad (4)$$

$\Pi_{H,t}$ in the flow budget constraint represent profits from firms which are transferred to the households. $T_t$ is lump-sum taxes and transfers. Finally, $D_t$ is a one-period domestic bond with a corresponding (nominal) interest rate of $i_t$, and $B_t$ is a one-period foreign currency bond with a corresponding interest rate of $i^*_t$.

Importantly, and as in Justiniano & Preston, $B_t$ and $D_t$ are the only assets available to the households. Since households cannot fully insure themselves against future states, the return on foreign currency bonds also carries a risk premium,. $\rho_t$. $\rho_t$ can be endogenised (reduced-form) such that,

$$\rho_t = exp[-x(Z_t + \widetilde{\Phi_t})] \quad (5)$$

where $\rho_t$ is a function of some endogenous variable, $Z_t$, and an exogenous shock, $\tilde{\phi}_t$.

***UIP condition under incomplete markets***

The no arbitrage condition in the international finance literature requires that returns on different currency assets are always equal. However, the presence of a risk premium, arising from the assumption of incomplete markets, results in the no-arbitrage condition holding only after adjusting for risk. The log-linearized version of the UIP condition under incomplete markets, derived from households solving their maximization problem as outlined above, is given by,

$$\underbrace{i^*_t}_{\text{return on foreign assets}} = \underbrace{i_t - E_t\Delta s_{t+1} - \rho_t}_{\text{risk-adjusted return on domestic assets}} \quad (6)$$

where $E_t\Delta s_{t+1}$ is expected percentage change in the exchange rate. $s_t$ is defined as the log of the value of one unit of foreign currency in terms of domestic currency. Importantly, for this paper, we can rewrite equation 6 as,

$$s_t = E_t\Sigma_{s=0}^{\infty}(i^*_{t+s} - i_{t+s}) + \underbrace{E_t\sum_{s=0}^{\infty}\rho_{t+s}}_{\text{due to incomplete markets}} \tag{7}$$

While Equation 7 is not be new, it is essential to understanding the discussion in this paper. It states that the value of a country's currency depends not just on the expected path of interest rate differential between domestic and foreign markets but also on the expected path of risk premium. For a given expected path of interest rate differential, a sharp increase in risk premium will result in the exchange rate depreciating significantly. The magnitude of exchange rate depreciation will be even greater if the increase in risk premium is expected to be more persistent.

### *CPI Inflation*

Before proceeding, it is also useful to consider an expression for CPI inflation. Log-linearising equation 4 and further assuming law of one price allows me to write CPI inflation as a function of domestic inflation, $\pi_{h,t,}$ and percentage change in terms of trade, $\Delta tot_t$,

$$\pi_t = \pi_{h,t} + \alpha\Delta tot_t \tag{8}$$

where terms of trade is the ratio of the price of imported and domestic consumption goods. CPI inflation in equation 8 can be rewritten as a function of domestic inflation, foreign inflation ($\pi^*$), and change in the exchange rate.

$$\pi_t = (1-\alpha)\pi_{h,t} + \alpha(\pi^*_t + \Delta s_t) \tag{9}$$

Equation 9 makes explicit the direct effect of exchange rate depreciation, $\Delta s_t$, on CPI inflation. But what does $\Delta s_t$ depend on? Iterating equation 6 one period backward gives an expression for the value of $\Delta s_t$, as expected in the previous period,

$$E_{t-1}\Delta s_t = E_{t-1}s_t - s_{t-1} = i_{t-1} - i^*_{t-1} - \rho_{t-1} \tag{10}$$

In the framework in this paper, any new information that results in $s_t \neq E_{t-1}s_t$, arrives in the form of an exogenous shock that the framework allows for. For now, and mostly to ease exposition, I denote $s_t - E_{t-1}s_t$ with $\epsilon_t$ which is a function of any other shocks in the paper, and has a mean value of zero. This gives us an expression for the change in exchange rate,

$$\Delta s_t = i_{t-1} - i^*_{t-1} - p_{t-1} + \epsilon_t \tag{11}$$

A notable example of $\epsilon_t$ taking a positive value in the context of Pakistan occurred in September 2022 when the then Prime Minister declared to a Bloomberg interviewer that "all hell will break loose" if the world did not step forward with (external) financial assistance. This new information led to a significant upward revision in the expected path of risk premium, explaining the subsequent exchange rate depreciation. The depreciation was initially observed in in the black market before mirroring in the official rate once exchange rate restrictions were lifted.

The discussion in this section makes explicit the link between the exchange rate and the risk premium, and how it directly affects CPI inflation. I return to this in section 5 where I discuss the role of monetary policy in stabilizing inflation.

***Firms***

Unlike in Justiniano & Preston, I assume that each firm $f$ uses both labour and imported inputs to produce differentiated output using production technology of the form,

$$Y_{f,t} = (A_t L_{f,t})^{1-\gamma} {M_{f,t}}^{\gamma} \tag{12}$$

where $A_t$ is productivity, and $L_{f,t}$ and $M_{f,t}$ represent labour and imported inputs used by firm $f$ in production. $M_{f,t}$ is the Dixit-Stiglitz aggregate of the differentiated imported inputs. Firms choose $L_{f,t}$ and $M_{f,t}$ to minimise their costs subject to the production function. The cost minimisation problem gives us an (log-linearised) expression for firms' real marginal costs, $mc_t$,

$$mc_t = (1-\gamma)(w_t - a_t) + \gamma q_t \tag{13}$$

where $w_t$ is the real wage and $q_t$ is the real exchange rate.

*New Keynesian Philips Curve*

Following the New Keynesian tradition, I assume that firms have price-setting power but face nominal rigidities a la Calvo (1983), allowing them to adjust their prices in any given period with a probability less than one. Consequently, when setting their prices, firms must adopt a forward-looking approach and set a price that maximizes their expected future profits over the expected duration during which they may not have the opportunity to reset their prices. Firms' profit maximization problem yields the New Keynesian Philips curve of the form,

$$\pi_{h,t} = E_t\pi_{h,t+1} + kmc_t \tag{14}$$

Equation 14 states that domestic inflation depends on expected domestic inflation in the next period and marginal costs. The sensitivity of domestic inflation to firms' marginal costs is captured by the parameter $\kappa$ which itself depends on the Calvo probability and the elasticity of substitution between goods produced by each firm $f$. After some algebraic manipulation and using the expressions for $q_t$ and $tot_t$, equation 14 can be rewritten in the following form which is helpful for subsequent discussion:

$$\begin{aligned} \pi_{h,t} = E_t\pi_{h,t+1} &+ k(1-\gamma)(w_t - a_t) \\ &+ k_\gamma E_t \sum_{s=0}^{\infty}(i^*_{t+s} - i_{t+s}) \\ &+ k_\gamma(p^*_t - p_t) \\ &+ k_\gamma \underbrace{E_t \sum_{s=0}^{\infty} \rho_{t+s}}_{=\rho_t + E_t \sum_{s=1}^{\infty}\rho_{t+s}} \end{aligned} \tag{15}$$

Equation 15 shows that domestic inflation depends on expected domestic inflation in the next period, the labour market, expected path of interest rate differential, terms of trade shock, and the expected path of risk premium. In the special case where firms do not use imported input in production (i.e., $\gamma = 0$), equation 15 is reduced to,

$$\pi_{h,t} = E_t\pi_{h,t+1} + k(w_t - a_t) \tag{16}$$

Equations 15 and 16 make explicit how abstracting from the role of imported inputs in production can lead to an overemphasis on the importance of domestic inflation expectations and labour market conditions in driving domestic inflation dynamics. This is particularly important for understanding inflation dynamics in small open developing economies.

***Monetary Policy***

I assume that the central bank conducts monetary policy according to a Taylor-type rule. Specifically, I assume that the central bank sets the nominal interest rate in response to changes in inflation and output gap. The log-linearised version of the Taylor rule is given by,

$$i_t = \chi_\pi \pi_t + \chi_y y_t \tag{17}$$

where $y_t$ is output gap, and $\chi_\pi$ and $\chi_y$ are coefficients in front of the targeting variables such that $\chi_\pi > 1$ and $\chi_y \geq 0$.

The market clearing and the rest of the foreign block is standard as in the small open economy literature. Therefore, I do not discuss it here for brevity.

**Table 1: Structural Parameters**

| Parameters | Values | Parameters | Values |
|---|---|---|---|
| Β | 0.97 | α | 0.1 |
| χ | 0.05 | η | 0.5 |
| 1/φ | 0.5 | θ | 10 |
| γ | 0.1 | ζ | 0.6 |
| $\chi_\pi$ | 1.5 | $\chi_y$ | 0.2 |
| $\rho_\phi$ | 0.7 | $\sigma^2_\emptyset$ | 0.0025 |

Note: This table provides calibrated values for the structural parameters of the model.

**Simulation results**

Before analyzing the recent surge in inflation in Pakistan, I present simulation results from the model outlined in the previous section. The objective is to show how an exogenous increase in risk premium, $\rho_t$, would affect inflation. Specifically, I calibrate model parameters as in Table 1 and assume the risk premium shock, $\tilde{\phi}t$, to follow an AR(1) process:

$$ln\widetilde{\phi}_t = \rho_\phi ln\widetilde{\phi}_{t-1} + \sigma_\phi \hat{e}_{\phi,t} \tag{18}$$

Figure 3 plots impulse responses to a one-standard-deviation risk premium shock, considering both when the shock process is less persistent ($\rho_\phi$ = 0.7) and more persistent ( $\rho_\phi$ = 0.9). Let us first consider the case where $\rho_\phi$ = 0.7. A one-standard-deviation shock increases risk premium (or excess returns) by nearly 5 percentage points. The risk premium remains high for the following few quarters before gradually returning to its initial level. The increase in demand for excess returns by investors results in capital flight, causing the exchange rate to depreciate by almost 20 percent at the time of the shock. As households directly consume imported consumption goods, CPI inflation jumps by more than 4 percentage points. However, CPI inflation does not simply increase due to the rise in the price of imported consumption goods. Since firms also rely on imported inputs, domestic inflation also increases by almost 2 percentage points in the next period. As CPI inflation also includes domestic inflation, the increase in domestic inflation provides an additional explanation for why CPI inflation rises upon impact of the shock. However, as the shock dissipates, inflation returns to the trend.

What happens when the shock is more persistent? In other words, when everyone expects risk premium to remain high for a longer period? To answer this question, I increase the persistence of the shock process, $\rho_\phi$, from 0.7 to 0.9. The solid-red line in Figure 3 plots impulse responses under this scenario. The IRFs demonstrate that, while the initial increase in risk premium is similar to the case where $\rho_\phi = 0.7$, it is expected to remain high for an extended period. It is estimated to take approximately 15 quarters for the risk premium to decline from 5 percentage points to 1 percentage point.

Figure 3 illustrates that when the risk premium is anticipated to stay high for a longer period, the same shock has a significantly greater impact on the economy. The exchange rate depreciates by almost 50%. Consequently, both domestic and CPI inflation increase by twice as much and take even longer to return to the trend, despite the exchange rate stabilizing after two periods.

It is important to note that, in both cases, the increase in inflation also leads the central bank to raise the nominal interest rate by more than one-to-one in response. While this helps to curb inflation and return it to the trend sooner, it also causes economic activity to contract significantly. When the shock is more persistent, GDP contracts by more than 7% on impact before returning to its trend level. Similarly, consumption falls. The increase in the price of imported goods and the sharp contraction in economic activity result in a considerable improvement in the trade balance, due to both a sharp drop in imports and an increase in exports.

### *Monetary Policy*

An important question is what would happen if the central bank was to respond less aggressively to the increase in inflation, following the shock? To test this, I recalibrate the value for $\chi_\pi$ from 1.5 to 1.1 in equation 19. In other words, in the new world, the central bank places less emphasis on stabilizing inflation compared to the previous scenario. Figure 4 plots the impulse responses from this exercise.

The solid-red line represents the case where $\rho_\phi = 0.9$ and $\chi_\pi = 1.5$, similar to Figure 3. The dashed-blue line also has $\rho_\phi = 0.9$ but $\chi_\pi = 1.1$. The impulse responses to the shock offer valuable insights.

First, note that, in both cases, the risk premium increases by the same amount and takes the same time to return to its trend. However, the responses for the remaining variables differ significantly. Since the central bank is less concerned about stabilizing inflation, real economic activity, as measured by GDP and consumption, falls by slightly less and recovers more quickly. This also means that trade balance improves to a lesser extent and returns to its trend within a shorter timeframe.

What about inflation? Since the central bank is expected to respond less aggressively to an increase in inflation, the exchange rate depreciates by more. Moreover, unlike under the previous scenario, it continues to depreciate in subsequent periods, albeit at a slower rate than initially. Knowing that the exchange rate will continue to depreciate in the future, firms that use imported inputs in production would significantly increase their prices, causing domestic inflation to increase by more than 10 percentage points instead of the 4 percentage points when $\chi_\pi = 1.5$. Because prices are sticky, domestic inflation continues to remain high and returns to the trend over a very long time. The response of domestic inflation, combined with the much larger increase in the price of imported consumption goods, implies that CPI inflation also increases by as much as 15 percentage points on impact, returning to its trend at a much slower pace. Most interestingly, because of the much larger increase in CPI inflation, the central bank is forced to increase the nominal interest rate by much more than it would have had to if everyone expected it to respond more aggressively to an increase in inflation.

**Understanding the sharp increase in inflation in Pakistan**

To analyze the potential factors which contributed to the sharp increase in inflation in Pakistan, I should ideally estimate the model using relevant data and decompose inflation into contributions from different underlying shocks. However, the lack of high-quality quarterly time series data on domestic inflation expectations, real wages, consumption, and GDP in most developing countries, including Pakistan, makes this exercise challenging. I hope that this limitation will be less severe in the future as better macroeconomic data becomes available. Given these constraints, I use the model presented in section 2 to gain insights into which factors may have been more important than others in explaining the inflation surge seen in Pakistan.2 Equations 15 and 9 explicitly identify several potential factors

[2] The role of money supply as is current in popular discourse has already been discussed in section 1.1 and is, therefore, not considered in the rest of this paper.

affecting domestic and CPI inflation, respectively. The figures for this section are provided at the end of the paper.

*Domestic inflation*

To understand domestic inflation, $\pi_{h,t}$, I begin by considering the factors which are identified in Equation 15: expected inflation, real wages, terms of trade, the expected path of the interest rate gap and the risk premium.

Figure 7, from PIDE (2021), presents data on business inflation expectations over different horizons. The survey was conducted just before the crisis began. Although inflation expectations were clearly higher than the SBP's medium term inflation target of 5-7 percent, these were still far from what is required to explain the increase in inflation from 13.8 percent in May 2022 to the peak of 38 percent in May 2023.3

Next, I consider real wages. Examining $w_t - a_t$ is crucial because it captures the extent of overheating in the economy. This is particularly relevant if we consider the labour market as an appropriate indicator of overheating. Figure 8 presents the average annual growth in real wages for different time periods, based on the labour force survey data. The figure also includes data on average annual productivity growth for Pakistan, as calculated in Pirzada et al. (2024). Finally, it reports the value for $w_t - a_t$, indicating the degree of overheating in the economy. While the period between 2014 to 2018 clearly shows evidence of overheating, the opposite is true for the period between 2018 to 2021.

Figure 9 depicts the terms of trade measure, calculated as the difference between the log of World CPI and the CPI in Pakistan. To account for differences in trend inflation between the World and Pakistan, I de-trended the CPI data for both. The figure indicates significant inflationary pressures arising from a sharp increase in world prices relative to prices in Pakistan, particularly during 2021 and 2022. However, these inflationary pressures began to diminish during the second half of 2022 and almost disappeared entirely by early 2023. Despite this, inflation continued to rise, reaching its peak in May 2023.

Next, I consider the current and expected path of interest rate differential. Figure 10 illustrates the current interest rate gap between the policy rate set by the US Federal Reserve and the policy rate set by the SBP. To adjust for differences in natural real rate and trend inflation, the figure plots the interest rate gap after demeaning the rates. The figure suggests that the policy rate in Pakistan was sufficiently high to have a favourable impact on domestic inflation through the interest rate gap. While the figure only shows the current interest rate gap, the

[3] While domestic inflation is different from core inflation, core inflation also increased substantially from 9.7 percent in May 2022 to the peak of 20 percent in May 2023.

negative gap implies that the expected path was also negative, further benefitting domestic inflation.

While the previous discussion has not identified any factors that can fully explain the sharp increase in inflation in Pakistan, I now turn to the most important factor: risk premium. Figure 11 plots the credit default swaps (CDS) for Pakistan over a one-year horizon. CDS rates increase from approximately 5 percentage points before the crisis to an average of 40 percentage points during the second half of 2022. This helps explain the increase in inflation during this period.

Although the magnitude of the increase in CDS was similar to that seen in 2008, inflation rose significantly more. If the increase in risk premium is the key factor explaining the surge in inflation, why does the inflation response differ so much across these two episodes? The answer lies in the differences in the expected path of risk premium.

Figure 12 presents the CDS yield curve for Pakistan in 2008 and early 2023. While the short-term CDS spreads were comparable, the CDS yield curve was upward sloping in 2023 and downward sloping in 2008. Given the importance of the expected path of risk premium in understanding inflation dynamics, the divergence in this expected path between 2008 and 2022 may explain the remaining difference in the inflation response across the two episodes.

***CPI inflation***

Equation 9 indicates that the sharp increase in domestic inflation is a significant contributor to the rise in CPI inflation. However, it is not the sole factor. Foreign inflation and exchange rate depreciation also directly affect the price of imported consumption goods. The increase in risk premium, as discussed in the previous section, increases $\epsilon_t$ which in turn affects CPI inflation through its impact on the exchange rate. The surge in foreign inflation, $\pi^*$, during much of 2021 and 2022, also contributed to the increase in CPI inflation. Nevertheless, as noted above, $\pi^*$ decreased during the second half of 2022 and therefore cannot explain the continued sharp rise in CPI inflation in Pakistan during much of 2023.

**Monetary policy in times of financial distress**

In section 3.1, I showed how the economy responds to a risk premium shock when the central bank is expected to respond more aggressively to an increase in inflation. The key finding was that this leads to a much larger increase in inflation and, consequently, the central bank ends up increasing the nominal interest rate by more than it would have otherwise. This phenomenon is evident in several economies such as Turkey, where a less aggressive monetary policy stance has resulted in both higher inflation and higher nominal interest rates.

In this section, I briefly consider how monetary policy affects the economy as outlined in this model. To do so, I modify the Taylor rule in equation 19 by allowing for an exogenous monetary policy shock to affect the nominal interest rate.

$$i_t = \chi_\pi \pi^t + \chi_y y^t + m_t \tag{19}$$

where $m_t$ is the exogenous monetary policy shock which follows an AR(1) process of the form,

$$m_t = \rho_m m_{t-1} + \sigma_m \hat{\epsilon}_{m,t} \tag{20}$$

where $\epsilon\hat{}_{m,t}$ is the i.i.d. shock with mean zero. I calibrate $\rho_m$ to equal 0.4 and $\sigma_m$ to equal 0.04.

How does an increase in nominal interest rate affect the economy? Figure 5 illustrates the impulse responses to a-one-standard deviation contractionary monetary policy shock. The economy behaves as expected. The increase in current and expected interest rate differential causes the exchange rate to appreciate. Simultaneously, real economic activity contracts, leading to an improvement in the trade balance. The appreciation of the exchange rate and the decline in real economic activity results in both CPI and domestic inflation decreasing by more than 2 percentage points.

While the results so far align with what is traditionallly believed, it is important to note that the risk premium (i.e., spread) also increases. As shown in equation 5, the risk premium depends on both an exogenous component, $\tilde{\phi}t$, and an endogenous component, $Z_t$. In this paper, and in much of the literature, $Z_t$ is modeled as the external debt to GDP ratio.4 Therefore, in Figure 5, the decline in GDP is sufficient to increase both $Z_t$ and, consequently, risk premium. However, the increase in the risk premium is small and has no significant impact on the rest of the economy. Monetary policy operates as expected.

[4] In Justiniano & Preston (2010) and other papers in this literature risk premium is modelled as "debt elastic interest rate premium" which depends positively on the ratio of external debt to potential output, and an exogenous shock. Specifically, $Z_t$ in equation 5 is assumed to be,

$$Z_t = \frac{S_t B_t}{P_t Y} \tag{21}$$

where a negative value for $B_t$ would imply external debt.

### *Times of financial distress*

But what about times when the economy is in financial stress? This should be modeled in a more elaborate manner than what I do here. However, to still say something useful about this, I model *financial stress* as an increase in the sensitivity of risk premium to the changes in the external debt to GDP ratio. Specifically, I compare thee impulse responses to a contractionary monetary policy shock as presented in Figure 5 (baseline) with impulse responses when $\chi$ equal 0.5. Note that $\chi = 0.05$ in the baseline.

Figure 6 compares the impulse responses under the baseline scenario ($\chi = 0.05$) and during times of financial distress ($\chi = 0.5$). The results warrant caution. Unlike under the baseline scenario, the contraction in economic activity leads to a significantly larger and more persistent increase in risk premium. This is attributed to the heightened sensitivity of financial markets to a country's external position. Specifically, the risk premium increases by 40 basis points at its peak.

The significant increase in the current and expected risk premium now prevents the exchange rate from appreciating, even when the current and expected interest rate differential should have led to currency appreciation, as in the baseline scenario. In fact, the exchange rate depreciates in the periods following the shock. This finding that an increase in the interest rate can increase the risk premium and lead to exchange rate depreciation is consistent with the empirical evidence presented in Kalemli-Ozcan & Varela (2021). Kalemli-Ozcan & Varela note, "investors expect further depreciation after an exogenous shock to interest rate differentials, leading to depreciation of the EM (emerging markets) currency."

This has implications for both CPI and domestic inflation, which not only fall by less, but also exhibit a quicker recovery. The absence of appreciation and relatively higher prices results in a declining GDP and consumption by almost twice as much as in the baseline, and taking longer to recover to the trend.

These results imply that the central bank's aggressive stance may have unintended consequences. Section 3.1 that, when the central bank is expected to be *dovish*, a financial shock can prove to be more destabilizing. However, the results in this section also call for caution. While maintaining an aggressive stance which is aligned with what is suggested by the policy rule (equation 19) is crucial, the central bank may also be cautious by not surprising the market with contractionary shocks.

The key theme underlying why central banks may want to exercise caution - as described in the previous paragraph - in times of financial distress is the possibility that an increase in the interest rate would increase risk premium by enough such that it would prevent the central bank from achieving its objective of stabilising inflation and economic activity. However, this is not always the case and depends crucially on the underlying factors driving the increase in the risk premium. A body of literature explores these factors. Hilscher & Nosbusch (2010) explore the role of volatility in terms of trade. Longstaff et al. (2011) and Pan and Singleton (2008) study the influence of global factors such as the US interest rate and stock market volatility. Bellas et al. (2010) and Dell'Erba et al. (2013) highlight the role of public debt, particularly external debt. Petrova et al. (2010) also find that foreign reserves, debt servicing burden, political risk, and domestic financial stress play a significant role in explaining the fluctuations in risk premium. It is conceivable that increasing interest rates might help decrease the risk premium by improving the trade balance, particularly if the factors driving the increase in risk premium include the depletion of the reserve cover and large current account deficits. However, the discussion in this section on how changes in interest rates may affect the risk premium remains largely speculative. Equation 5 is reduced-form equation and not derived from micro foundations.

Nonetheless, while the utility of increasing interest rates must be emphasized to prevent the crisis, it is essential to remember that excessive interest rate hikes can also be harmful. In the context of Pakistan, while such hikes have arguably helped reduce the risk premium by improving the trade imbalance and increasing the reserve cover, excessive exposure of banks to the government, coupled with interest payments constituting a large fraction of government tax and non-tax revenue, could lead to a scenario where the crisis spills over and exacerbates domestic financial stress. This could undermine the effectiveness of further interest rates increases beyond a certain point.

## Conclusion

This paper presents a model that can help understand inflation surges in developing economies during times of financial stress. I then apply the model to analyze the surge in inflation in Pakistan between May 2022 and May 2023. While the increase in global commodity prices played a significant role during the first half of 2022, the analysis presented here shows that the increase in current and expected risk premium was the key driving factor behind the surge during the period under consideration. The paper also examines the role of money growth, labour market conditions, differences in policy rates, and inflation expectations. None of these factors appear to be important for explaining the surge in inflation observed in the data.

I also discuss the implications for monetary policy during times of crisis. A contractionary policy can help address economic imbalances in the economy, such as large current account deficits, by reducing aggregate demand and potentially decreasing the risk premium. A casual examination of the data reveals this to be true for Pakistan in the past two years. The economic slowdown, caused by various factors including tighter monetary policy, reduced imbalances, leading to a decline in default risk and subsequent inflation. However, caution is warranted. Excessive interest rate hikes can exacerbate financial stress in certain cases. For example, in Pakistan, excessive exposure of banks to the government can make the banking system vulnerable if rising interest payments threaten sovereign default. In such cases, a country might consider non-traditional approaches to restore economic stability, such as debt restructuring, as suggested by Rogoff (2022).

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# Appendix

**Figure 1: Inflation and Broad Money Growth: 5 Year Moving Average**

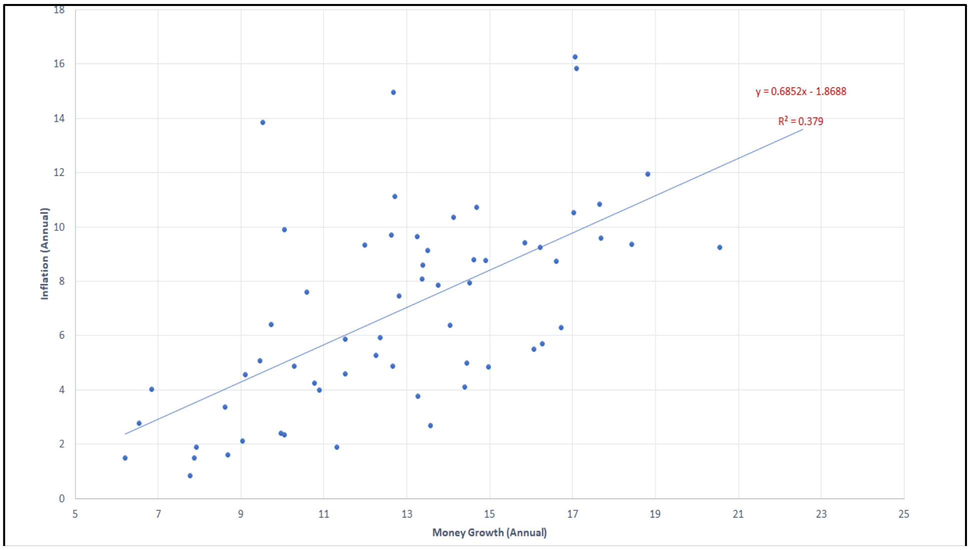


**Figure 2: Broad Money Growth**

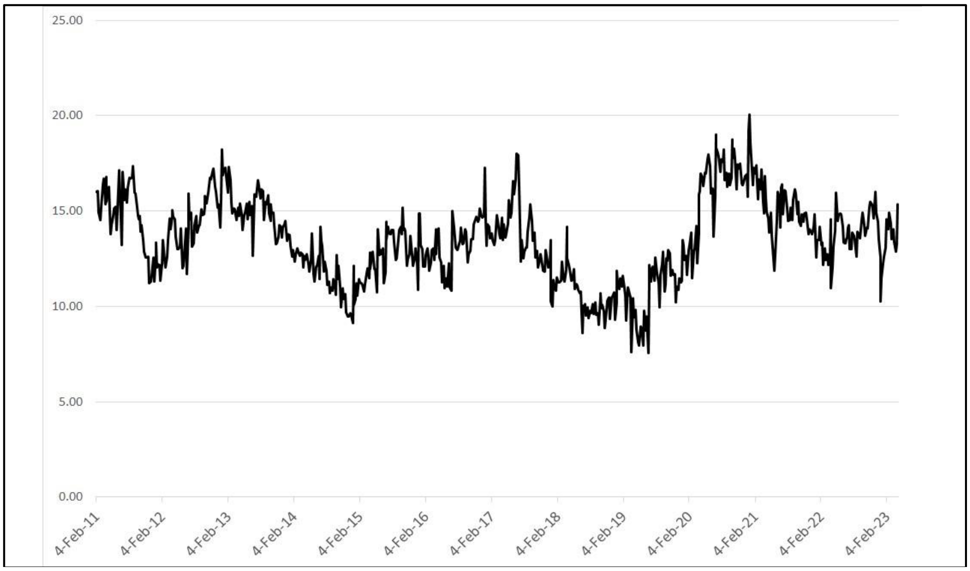

**Figure 3: Impulse response to a risk premium shock. I define less persistent as when $\rho_{\emptyset}$ = 0.7, and high persistent as when $\rho_{\emptyset}$ = 0.9**

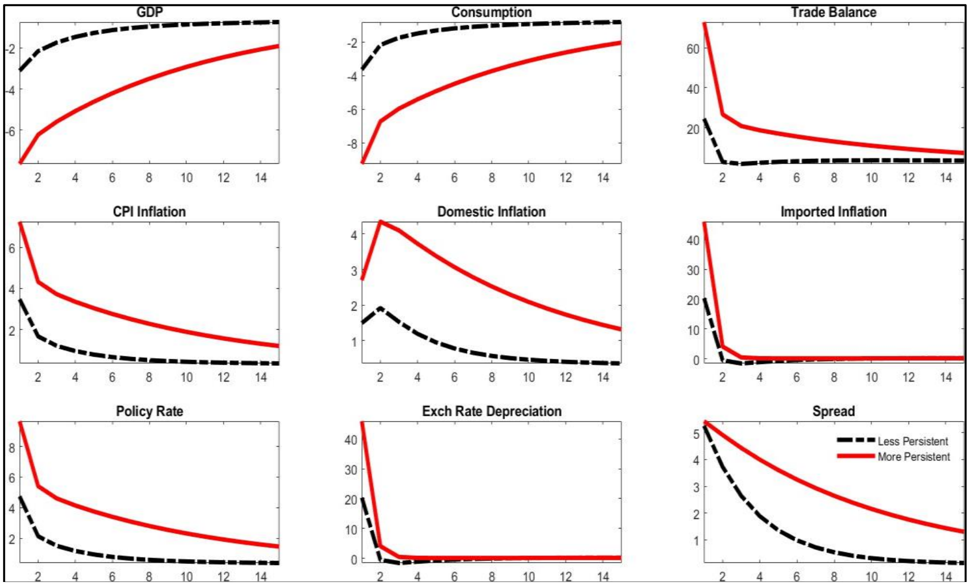


**Figure 4: Impulse response to a risk premium shock when the central bank cares less about stabilising inflation.** ***High Persistent + Slack SBP is when $\rho_{\emptyset}$ = 0.9 and $\chi_{\pi}$ = 1.1.***

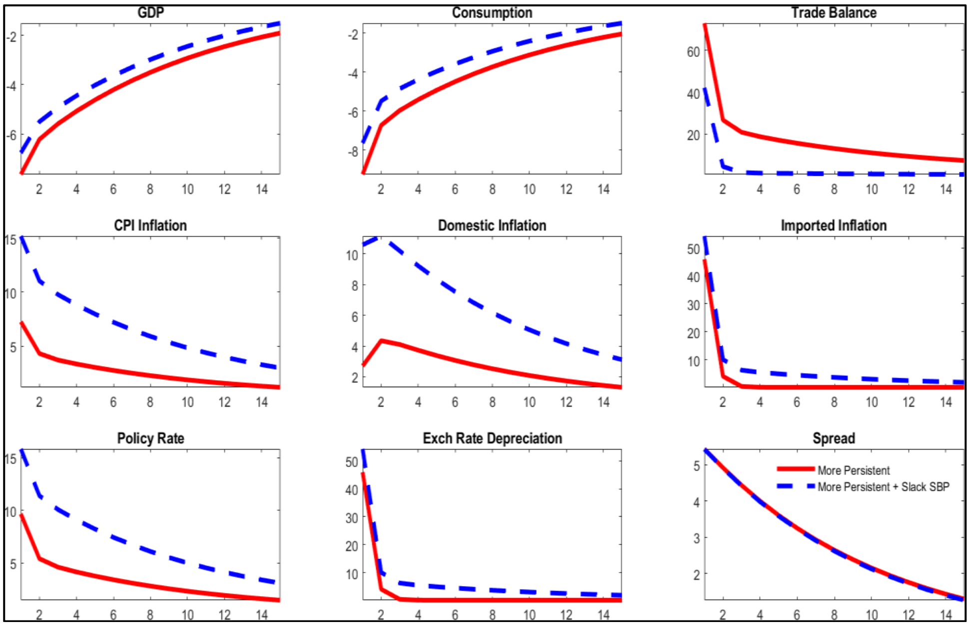

**Figure 5: Impulse response to a contractionary monetary policy shock**

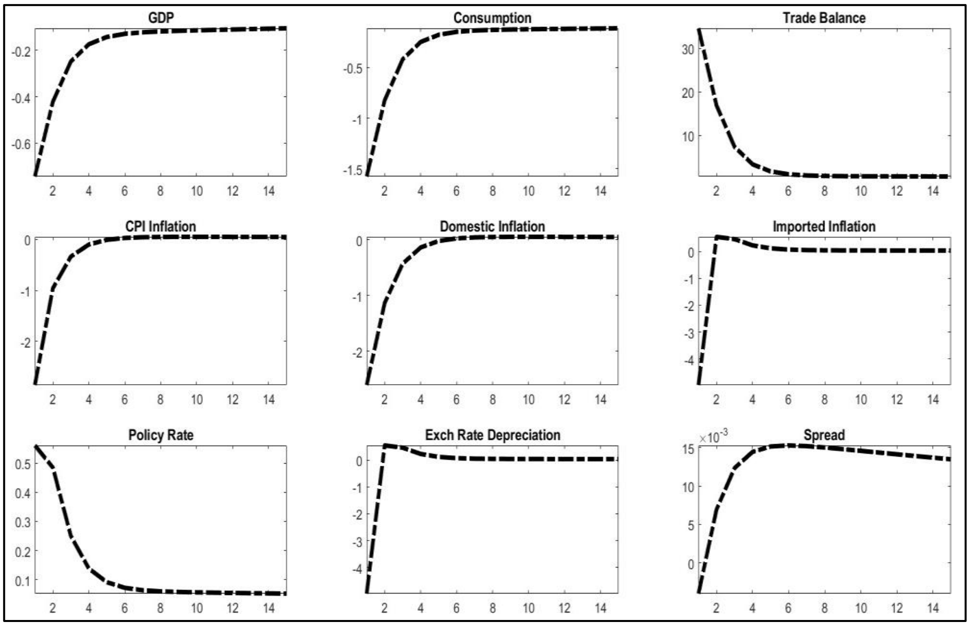


**Figure 6: Impulse response to a contractionary monetary policy shock in normal times (baseline) and in times of financial stress.**

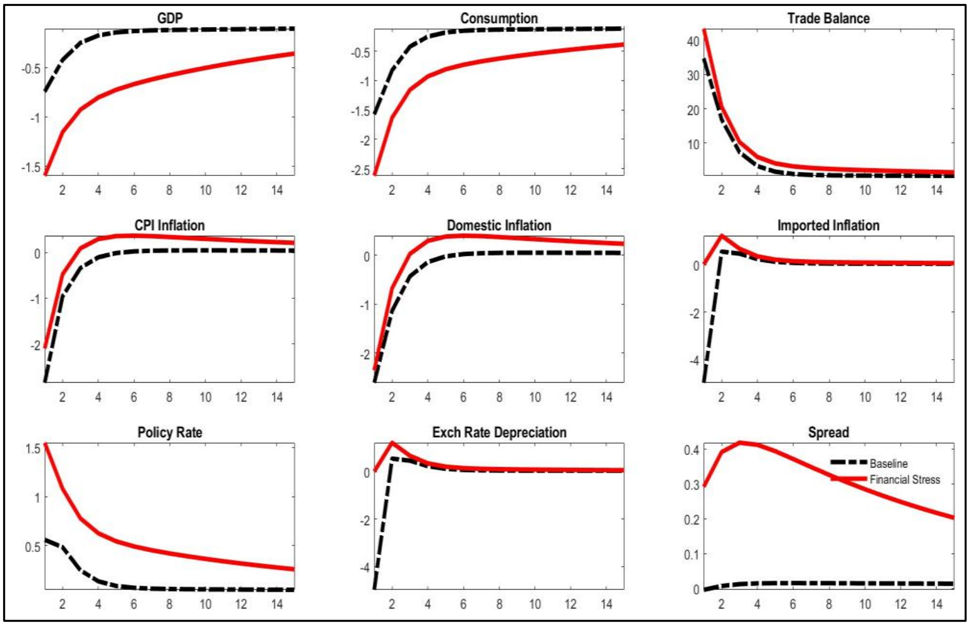

Figure 7: Inflation Expectations (PIDE, 2021)

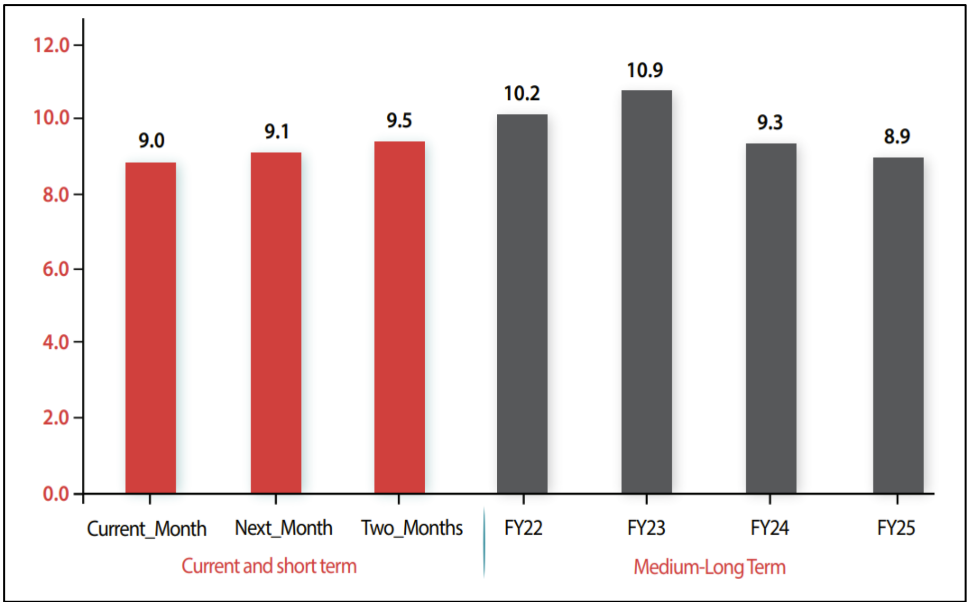


Figure 8: Real Wages (source: PBS Labour Force Surveys)

| | Annual Wage Growth | Annual Productivity Growth | Overheating |
|---|---|---|---|
| *FY08 – FY13* | 0.6 | 1.5 | -0.9 |
| *FY14 – FY18* | 4.3 | | 2.8 |
| *FY18 – FY21* | -3.4 | | -4.9 |

**Figure 9: World prices minus Pak prices (detrended)**

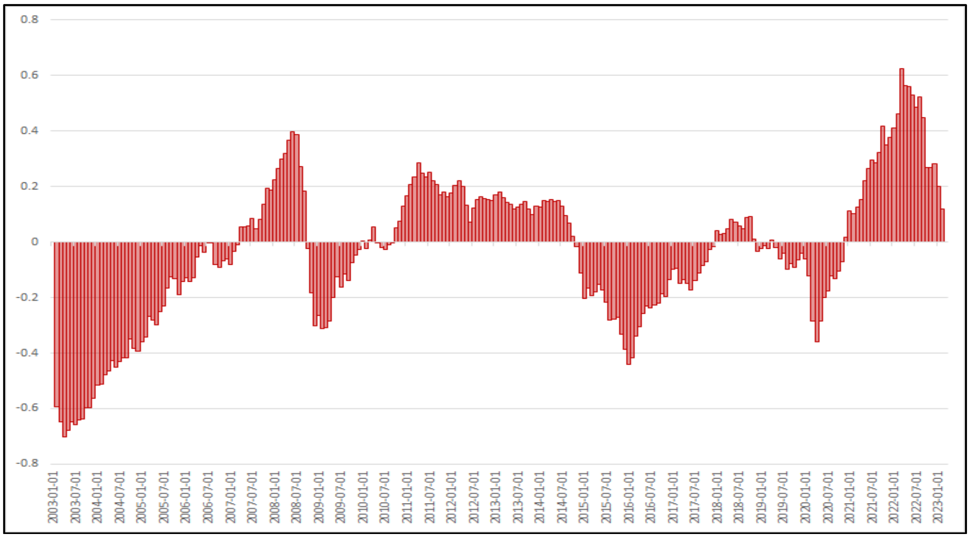


**Figure 10: US policy rate minus Pak policy rate (demeaned)**

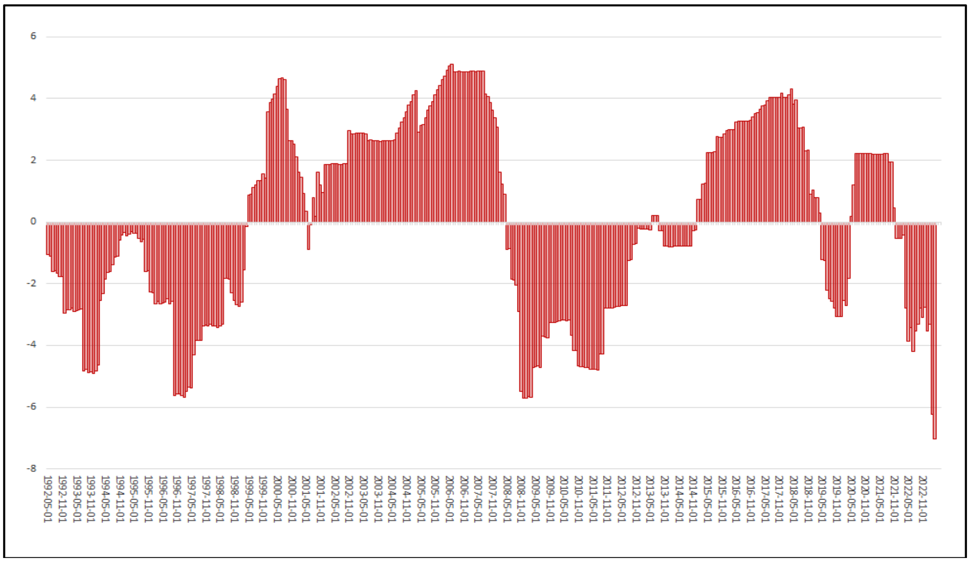

**Figure 11: 1 Year CDS spread**

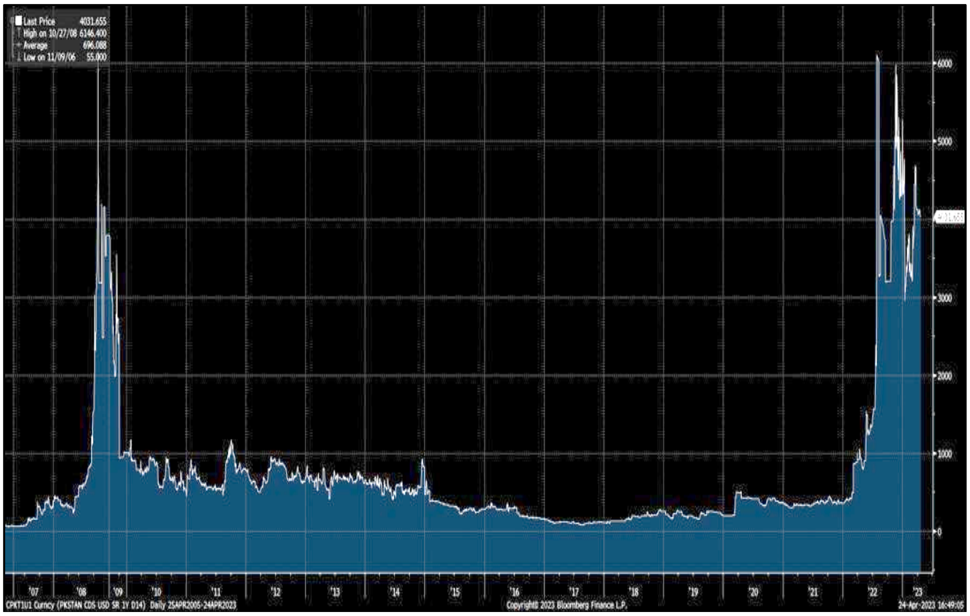


**Figure 12: Term structure of Credit Default Swaps. The yellow line shows the CDS spreads over different horizon as observed in May 2008. The green line shows the same as observed in March 2023**