Monetary policy regime and survival of price shocks in inflation targeting regime: does the level of countries‘ development matter?

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Monetary policy regime and survival of price shocks in inflation targeting regime: does the level of countries‘ development matter?

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Abstract

This study expands on the existing literature by investigating the impact of Inflation Targeting (IT) policies on the duration of High Inflation Episodes (HIEs) in both developed and emerging economies. Utilizing Survival Analysis, the study evaluated HIEs' lengths before and after IT policy implementation across 26 countries from 2003 to 2023. The findings reveal that IT policies significantly reduce the duration of HIEs. Kaplan-Meier estimates indicate a clear decline in ongoing HIE probability over time, with a more pronounced reduction in emerging economies. Statistical tests like the Log-Rank and Wilcoxon tests provide robust evidence supporting the effectiveness of IT policies, showing significant differences in HIE durations pre- and post-IT implementation. This study also addresses the literature gap by distinguishing the differential effects of IT policies based on the developmental status of countries, demonstrating their efficacy in enhancing price stability across diverse economic contexts.

1. Introduction

In contemporary discourse, there has been a notable trend towards recognizing price stability as the foremost, enduring goal of monetary policy. This acknowledgment underscores the central role of establishing a nominal anchor, as emphasized by Mishkin and Eakins (2016). Mishkin's research in 2001 identified four primary monetary policy strategies, each employing distinct key variables to guide policy decisions. These strategies encompass exchange-rate targeting, monetary targeting, inflation targeting, and monetary policy with an explicit objective, albeit without a specific key variable. This classification underscores the diverse approaches adopted by Reserve Bank worldwide in their pursuit of monetary stability and economic prosperity.

Price stability is defined as the circumstance in which a country's currency's purchasing power remains largely consistent throughout time. It is distinguished by low and steady inflation rates, which enable consumers and businesses to make economic decisions with confidence and clarity about future pricing (Friedman, 1969, Hayek, 1978, Mishkin, 2016, Blanchard, 2017). Inflation targeting is one of the monetary policy approaches that aims to maintain monetary stability. It entails Reserve Banks setting explicit inflation rate targets over a given time span, with the goal of achieving and maintaining low and stable inflation levels. Reserve Banks that commit to precise inflation targets provide clarity and transparency about their monetary policy objectives, which helps anchor inflation expectations and foster economic stability (Bernanke, 2019).

In 1990, the Reserve Bank of New Zealand implemented a new monetary policy known as inflation targeting, since then, several nations have adopted the inflation target as an approach for attaining price stability (Guo, 2024). The inflation target policy involves a Reserve Bank setting an inflation rate objective, often around 2%, with either a tolerance band or a target range. Should actual inflation rates depart from the objective, the Reserve Bank takes remedy action, mainly by adjusting interest rates, to bring them back in line.

Several literatures have studied the effect of inflation targeting policy on price stability by inspecting inflation performance. Previous study by Mishkin, et al (2007) on the observed countries, found that Inflation has decreased by over 3 percentage points on average since inflation targeting was implemented.

According to Mishkin et al (2002), the implementation of inflation targeting is anticipated to yield a monetary policy that effectively manages both internal and external shocks while maintaining low inflation. Furthermore, inflation targeting has resulted in less enduring inflation, with inflationary shocks diminishing more swiftly compared to the majority of the past century, King (2002), this is slightly the enhancement to what Ball and Sheridan (2004) found, the idea that adopting inflation targeting advances economic performance as measured by the dynamics of inflation, output, or interest rates is generally not supported by actual data. Nevertheless, a more detailed analysis of nations that have just adopted inflation targeting policies reveals a discernible increase in their performance from the pre-targeting era to the post-targeting one. For example, output growth also showed signs of stabilization, and inflation rates decreased and became more stable. However, it is important noting that nations who did not adopt inflation targeting also experienced advancements in comparable time periods as those that followed targeting plans. This

finding implies that variables other than the adoption of inflation targeting policies most likely had an impact on the noted improvements in economic performance, Ball and Sheridan (2004).

The study conducted by Ball and Sheridan builds upon the foundation laid by Nicoletti-Altimari (2002), delving deeper into the impact of inflation targeting on macro-economic efficiency. Their research not only examined the effect of inflation targeting on various aspects of economic performance but also provided additional insights into its implications. Specifically, their findings reinforced the notion that inflation targeting exerts positive influences on macroeconomic performance, notably by bolstering price stability. Through meticulous analysis, Ball and Sheridan further elucidated the mechanisms through which inflation targeting contributes to enhancing overall economic stability, shedding light on its multifaceted benefits for policymakers and practitioners alike.

Previous research has delved into the effects of adopting Inflation Targeting (IT) policy on various aspects of inflation performance, such as its levels, volatility, and persistence. Studies by Canarella and Miller (2017), Siklos (1999), Vega and Winkelried (2005), Bratsiotis et al. (2015), Johnson (2002), Petursson (2004), and Baxa et al. (2014) have all uncovered evidence supporting the idea that countries implementing IT tend to experience lower inflation levels, reduced volatility, and improved persistence compared to those not following IT. However, there's a lack of research focusing on analyzing inflation performance during extended periods of high inflation within an Inflation Targeting framework.

The present paper aims to build upon the research conducted by Guo and Lim (2024). While Guo and Lim examined the impact of factors such as GDP growth, exchange rates, and oil prices on inflation rates, this study will uniquely expand by incorporating advancements in technology to analyze the factors influencing inflation rates. Guo and Lim's study focused on countries that had implemented the Inflation Target framework but did not distinguish between the developmental levels of these countries. Consequently, this paper seeks to investigate whether the average duration of High Inflation Episodes differs between developed and emerging economies.

The integration of findings from Guo (2024) and Herzog (2023) underscores the paramount significance attributed to the credibility and efficacy of inflation targeting frameworks in fostering macroeconomic stability, particularly amidst heightened inflationary circumstances. As previously noted, their respective inquiries elucidated the role of inflation targeting frameworks in bolstering price stability, particularly during periods characterized by elevated inflation rates. Notably, their investigations did not account for the developmental status of countries and its potential influence on the efficacy of inflation targeting in positively impacting price stability. Consequently, the present study seeks to address this gap by exploring the potential differential effects of inflation targeting on price stability across countries of varying developmental levels.

Guo (2024) and Herzog (2023) did not explore the impact of Inflation Targeting policy on financial stability, despite its significance highlighted by Reichlin and Baldwin (2013) post the 2007-08 global financial crisis. They argue that achieving price stability requires consideration within a

broader context of financial stability, which acts as a prerequisite. Consequently, this study aims to examine the intricate relationship between IT policy, financial stability, and price stability, investigating whether the monetary policy regime influences both price and financial stability or if a country's developmental status is a determining factor.

This paper aims to extend the work of Guo and Lim (2024) by incorporating technological advancements in analyzing the factors influencing inflation rates. While Guo and Lim focused on the impact of GDP growth, exchange rates, and oil prices on inflation rates, this study seeks to investigate whether the duration of High Inflation Episodes varies between developed and emerging economies. Employing Survival Analysis, similar to Guo and Lim (2024), this study aims to provide insights into the dynamics of inflation in different economic contexts.

To investigate alterations in the length of High Inflation Episodes and disparities amongst Upper Violation Episodes and Lower Violation Episodes within the framework of Inflation Targeting policy, the study employs a novel methodological approach known as Survival Analysis, this method was also employed by the recent literature of Guo (2024). Survival analysis is a statistical technique that is widely used to determine the expected length of an event's impact. I believe that Survival Analysis is an appropriate tool for examining the influence of Inflation Target policy on the length of High Inflation Episodes and identifying differences between Upper Violation Episodes and Lower Violation Episodes.

The methodological framework employed in the present study exhibits certain limitations, encompassing issues such as censoring and truncation, the assumption of independent events, and the incorporation of time-varying covariates. Nevertheless, it is pertinent to acknowledge that Survival Analysis stands out as the most efficient approach for analyzing episodic data in comparison to Ordinary Least Squares (OLS) regression techniques, as per my current understanding. Furthermore, it is worth noting that the limitations associated with this methodology can potentially be mitigated through the attainment of accurate and precise data.

The paper is organized as follows. In Section 2, the provides an overview of the related literature. Section 3 introduces the underlying theory and outlines the empirical methodology. In section 4 the study explore data, do the estimation, and discuss the simulation results. Section 5 draws some conclusions from our analysis.

2. Literature Review

Extensive research has been conducted in the realm of inflation targeting and price stability ever since New Zealand embraced this monetary policy framework. Studies approached the issue of inflation targeting and price stability either by assessing the effects of inflation target on the persistence of inflation, on the reduction of the volatility of inflation and the reduction of the survival rate of high inflation regimes.

Various studies have documented the persistence of inflation and proposed that inflation tends to exhibit a decrease persistence among economies adopting an Inflation Targeting policy framework, for instance a study by Canarella and Miller (2017) examined inflation persistence in six inflation

targeting countries from the global economy perspective. The authors utilized fractional integration and cointegration techniques to examine the long-term properties of inflation series and assess the relationships between the IT countries and the global economy proxies. This approach allowed them to investigate both the weak-form and strong-form global hypotheses by analyzing the persistence and convergence of inflation processes over time. Their findings suggested that the relevance of IT in industrial countries was questionable, but not in developing countries within the sample. They implied that the global economy likely played a significant role in the decline of inflation persistence in industrial countries, but not in developing ones. Additionally, Gerlach and Tillmann (2011) also investigated the impact of inflation targeting on inflation persistence in the Asia-Pacific region, particularly following the Asian financial crisis in 1997-98. Their study focused on central banks that adopted inflation targeting as a monetary policy framework. The scholars employed an autoregressive model to measure inflation persistence, using a median unbiased estimator and bootstrapped confidence bands to ensure robustness in their analysis. Their primary objective was to assess the success of inflation targeting by examining whether it leads to a reduction in the persistence of inflation deviations from target levels. The findings indicate a significant decrease in inflation persistence following the adoption of inflation targeting across the region.

Moreover, Bratsiotis, Madsen, and Martin (2015) explore the impact of inflation targeting on the persistence of inflation. The authors contribute to the theoretical understanding of inflation persistence by incorporating a Taylor Rule for monetary policy into a model of persistence. They argue that the adoption of inflation targets leads to a reduction in the persistence of inflation. To investigate this hypothesis empirically, the authors analyze changes in the time series properties of inflation in seven countries that implemented inflation targets in the late 1980s or early 1990s. The methodology involves examining the dynamics of inflation both before and after the introduction of inflation targets. The findings of the study indicate that the persistence of inflation is significantly reduced or even eliminated following the implementation of inflation targets. These studies suggests that inflation targeting policies have a notable effect on moderating the persistence of inflation over time.

There are several factors that can influence the inflation rate, these includes oil price changes for instance. Several literatures explored oil price changes; Ahmad et al. (2024) conducted a study aimed at understanding the impact of various factors on inflation in South Asian economies. Ahmad et al (2024) utilized the Hausman test to recommend the use of Pool Mean Group (PMG) estimates, ensuring robustness in their analysis. Their study focused on exploring the influences of oil prices, technological advancements, and labor market dynamics on inflation within the region and they identified a positive relationship between oil prices and inflation in South Asian economies, indicating that fluctuations in oil prices significantly influence inflationary pressures within the region. Similarly, Nasir et al. (2019) conducted research centered on the Gulf Cooperation Council member countries and employed Nonlinear Autoregressive Distributed Lag framework and they found a substantial positive impacts of oil price shocks on inflation.

The correlation between GDP growth and inflation rates is not simple or direct in the literature. There are several studies that indicates a positive relationship between GDP growth and inflation

rates, study by conducted by Ghossoub (2024), found a positive correlation between inflation and economic growth when inflation rates are initially low, the author further indicates that the correlation shifts to negative once inflation surpasses a specific threshold level. Mubarik (2005) conducted an analysis focusing on Pakistan, utilizing annual data spanning from 1973 to 2000 and employing a Threshold Model to estimate a threshold level of inflation. His findings suggested that inflation rates exceeding 9% had adverse effects on Pakistan's economic growth, indicating that inflation rates below this threshold were conducive to economic expansion. Similarly, Khan and Ssnhadji (2001) examined unbalanced panel data from 140 countries covering the period 1960–1998, employing the nonlinear least squares (NLS) estimation method to estimate threshold levels for both industrial and developing countries. They discovered a negative and significant relationship between inflation and growth for inflation rates surpassing threshold levels (1–3% for industrial countries and 11–12% for developing countries), a relationship that remained robust across various estimation methods. Additionally, Munir and Mansur (2009) investigated the inflation-growth nexus in Malaysia from 1970 to 2005, utilizing a Threshold Autoregressive (TAR) model. Their analysis unveiled a non-linear relationship between inflation and economic growth; inflation rates above 3.89% were associated with decelerated GDP growth rates, whereas inflation rates below 3.89% exhibited a positive correlation between inflation and GDP growth. These studies collectively underscore the importance of considering threshold effects when examining the relationship between inflation and economic growth, revealing nuanced dynamics that transcend linear associations.

Ahmani-Oskooee (1991) undertook a comprehensive analysis spanning 20 developed and 76 less developed countries, reaching the conclusion that fluctuations in exchange rates contribute to variations in inflation levels within the existing floating exchange rate system. This discovery is in line with the Exchange Rate Pass-Through (ERPT) theory, which suggests that alterations in exchange rates exert a positive impact on import prices, potentially leading to an increase in inflation rates. Previous research conducted by Dornbusch (1987), Feenstra et al. (1993), and Campa and Goldberg (2005) has also lent support to the idea that upticks in exchange rates correlate with higher inflation rates, albeit with variances in the degree of ERPT observed across different nations. An examination by Pham et al. (2020) focused on ASEAN-5 countries, revealing that shocks in exchange rates indeed provoke substantial fluctuations in inflation. Moreover, they highlighted the presence of asymmetric effects of exchange rate shocks in Singapore, the Philippines, and Indonesia, with notable differences observed between nations that pursue inflation-targeting policies and those that do not. Nasir and Vo (2020) discovered an intensified ERPT under inflation targeting; however, significant diversity persisted in ERPT among the countries scrutinized, encompassing New Zealand, the UK, and Canada.

Guo and Lim (2024) conducted a comprehensive study to explore the impact of Inflation Targeting policy on price stability. Their research focused on the accountability and transparency inherent in central banks operating under Inflation Targeting policy, postulating that these attributes would facilitate the attainment of price stability. Specifically, they aimed to evaluate whether the implementation of Inflation Targeting policy results in shorter durations of High Inflation Episodes, which they defined as sustained periods characterized by consecutive high inflation rates. To achieve this objective, the authors employed Survival Analysis and analyzed data

spanning from 1980 to 2022. Drawing from existing literature on the influence of GDP growth, exchange rates, and oil prices on inflation rates, Guo, and Lim (2024) posited that these factors play a pivotal role in shaping the duration of periods marked by high inflation rates. Their study uncovered a noteworthy decrease in the average duration of High Inflation Episodes subsequent to the adoption of Inflation Targeting policy. Furthermore, they observed that within countries implementing inflation targeting, the duration of inflation rates remaining below the lower bound of the Inflation Targeting target range was shorter compared to periods above the upper bound. These findings underscore the significant role of Inflation Targeting policies in fostering price stability, even amidst the elevated inflation rates witnessed across various nations since the onset of the COVID-19 pandemic in 2020. Thus, the authors assert that Inflation Targeting policy effectively contributes to the achievement of price stability, a primary objective of this monetary approach.

The present paper aims to build upon the research conducted by Guo and Lim (2024). While Guo and Lim examined the survival probability of high inflation episodes and factors affecting the survival probability such as GDP growth, exchange rates, and oil prices. This study will uniquely expand by incorporating the country's level of development to analyze the factors influencing inflation rates. Guo and Lim's study focused on countries that had implemented the Inflation Target framework but did not distinguish between the developmental levels of these countries. Consequently, this paper seeks to investigate whether the average duration of High Inflation Episodes differs between developed and emerging economies. The study will employ Survival Analysis, similar to the methodology utilized by Guo and Lim (2024).

3. Methodology

The study looks at 26 nations that implemented the Inflation Targeting (IT) policy after 1990 and chose those with available data. Information about inflation target ranges or interval bands around a target level was obtained from the respective central banks' websites, as well as the International Monetary Fund and the World Bank. Table 1a and table 1b lists the nations included in the study, as well as the dates on which the IT policy was enacted and their most recent inflation targets. Inflation rates are computed using annual data from the World Economic Outlook database. There was no need to alter the data further because the inflation target rates are already esxpressed as annualized. The annualized inflation is outlined as follows:

$$\Pi_t = 4 \times \{ln(CPI_t) - ln(CPI_{t-1})\}$$

The investigation spans 2003 to 2023 to determine whether Inflation Target policy has a favorable impact on price stability. Table 2a and table 2b shows the average inflation rates prior to and following the introduction of the Inflation Target policy. The data show that average inflation rates in nations with Inflation Target policies have fallen statistically and significantly following adoption.

The study uses Survival Analysis to investigate the duration or longevity of High Inflation Episodes (HIEs). Survival analysis is commonly used to determine how long it will be until an event happens. In this context, the event of interest is the end of a High Inflation Episode, which is defined as a sustained period of high inflation lasting months, quarters, or years. Because the

inflation data in this study is annualized, the time periods considered are years. The purpose is to apply Survival Analysis to determine the influence of Inflation Target on reducing the duration of High Inflation Episodes by measuring the time to exit the event.

A tolerance band or range is used by several nations when setting inflation targets under the Inflation Target policy. The term "survival" in this study refers to a situation in which inflation rates are above a predetermined upper limit, signifying an unfavorable one. Models used in survival analysis include non-parametric, parametric, and semi-parametric, and models. In particular, the Cox Proportional Hazards model, which is semi-parametric as well as non-parametric, referred to as Kaplan Meier, is used in this work. The study also presents the idea of "Exit," which is characterized as the situation in which inflation rates drop or return to the upper target after deviating from it, thus accomplishing a desired result.

Ordinary Least Squares linear regression has been used in earlier research to examine how Inflation Target affects price stability. Ordinary Least Squares regression, however, is inappropriate for duration analysis for two key reasons. First, time-to-event data, where the risk of leaving HIEs may grow over time and the distribution may be asymmetrical, producing biased conclusions, makes it implausible that Ordinary Least Squares will assume normally distributed errors. Second, right-censoring is a common problem with duration data; some countries stay in High Inflation Episodes until the final data point is available, thus the true duration might be longer if additional data were available. Right-censoring is complex for Ordinary Least Squares regression to estimate, while Survival Analysis is better at assessing episodic data.

This study, as previously indicated, uses semi-parametric and non-parametric models, namely the Cox Proportional Hazards model, which is predicated on several assumptions on the distribution of baseline survival times. A non-parametric technique that works well for comparing the survival histories of a small number of groups or traits that don't change over time, the Kaplan-Meier model. However, when covariates might have a range of values and fluctuate over time, the Cox Proportional Hazards model is better.

Table 1a
Inflation Target for 9 Developed countries and the effective dates.

Country	Inflation Target (%)	IT Effective Dates
Australia	2% - 3%	1993 April
Canada	1% - 3%	1991 February
Czech Republic	1% -3%	1998 January
Iceland	1.5% - 3.5%	2001 March
Israel	2% - 4%	1997 June
Korea (South Korea)	1% -3%	1998 April
New Zealand	1% - 3%	1990 March
Norway	1.5% - 2.5%	2001 March
Sweden	1% - 3%	1993 January

Table 1b
Inflation Target for 17 developing countries and the effective dates.

Country	Inflation Target (%)	IT Effective Dates
Armenia	3% - 5%	2006 January
Brazil	2.5% - 4.5%	1993 June
Chile	2% - 4%	1999 September
Colombia	2% - 4%	1999 September
Ghana	2% - 8%	2007 May
Guatemala	3% -5%	2005 January
Hungary	1% - 4%	2001 June
India	2% - 4%	2016 June
Indonesia	2% - 4%	2005 July
Mexico	1% - 3%	1999 January
Peru	1% - 3%	2002 January
Philippines	2% - 4%	2002 January
Poland	2% -5%	1999 Poland
Serbia	1.5% - 4.5%	2009 January
South Africa	3% - 6%	2000 February
Thailand	1% -3%	2000 May
Türkiye (Turkey)	4% - 6%	2006 January

Table 2a
Change in the average of inflation rates between Pre-IT and Post-IT policy for Developed Countries.

Country	Pre-IT	Post-IT
Australia	4.14	2.71
Canada	5.87	2.11
Czech Republic	9.41	3.34
Iceland	19.94	4.95
Israel	82.62	2.12
Korea (South Korea)	7.14	2.52
New Zealand	9.95	2.32
Norway	5.22	2.42
Sweden	7.37	2.14

Table 2b
Change in the average of inflation rates between Pre-IT and Post-IT policy for Developing Countries.

Country	Pre-IT	Post-IT
Armenia	6.90	4.54
Brazil	134.54	6.83
Chile	16.59	3.76
Colombia	23.10	5.42
Ghana	31.44	15.57
Guatemala	12.12	5.04
Hungary	20.47	5.07
India	7.92	4.95
Indonesia	11.32	5.33
Mexico	47.55	4.98
Peru	81.63	3.21
Philippines	11.19	3.88
Poland	51.92	3.74
Serbia	26.37	5.49
South Africa	11.70	5.61
Thailand	4.11	2.00
Türkiye (Turkey)	58.35	17.42

4. Data, estimation, results, and discussion

To evaluate the impact of Inflation Targeting (IT) on price stability across different countries, the study gathered detailed information about the inflation target ranges or interval bands surrounding a target level. This data was sourced from the official websites of the respective central banks, along with additional data from the International Monetary Fund (IMF) and the World Bank. These sources provided comprehensive and authoritative information necessary for accurate cross-country comparisons.

For the computation of inflation rates, the study relied on annual data extracted from the World Economic Outlook (WEO) database. This database, maintained by the IMF, offers a robust set of economic indicators, including inflation rates, which are crucial for analyzing trends and drawing meaningful conclusions about the effectiveness of IT policies. By using annual data, the study ensures that the inflation rates are standardized and comparable across the different countries and time periods under investigation.

The study first examines the duration of High Inflation Episodes (HIEs) using the nonparametric Kaplan-Meier Model. This model estimates the survival function, $S(t)$, without making any assumptions about its underlying functional form. The survival function indicates the probability that HIEs will persist until time t t, as well as the probability that they will end immediately after time t.

Before delving into the survival function, the study addresses two key aspects of High Inflation Episodes: a) the threshold value that defines a High Inflation Episodes, and b) the minimum duration required for an episode to be considered a High Inflation Episodes. The threshold value is defined as 4.5 percent for all countries, regardless of their level of development. Specifically, the threshold for developed countries is set at 3.11 percent, while for emerging countries it is 4.53 percent. These thresholds were determined by averaging the upper bounds of the inflation target ranges or tolerance bands from the 27 inflation-targeting countries listed in Table 1.

This implies that for the combined list of countries, an inflation rate must be at least 4.5 percent to qualify as an HIE. For developed countries, the minimum inflation rate is 3.11 percent, and for emerging countries, it is 4.53 percent. Typically, when a stationary time-series variable deviates from its mean due to a temporary economic shock, it tends to revert to its mean. The half-life estimate of a time-series variable is used to gauge the time required for the impact of a temporary economic shock to diminish by half. After calculating the half-life estimates for inflation rates across the 27 inflation-targeting countries, the study finds that the average half-life is three periods. Consequently, the study defines an HIE as a situation where a country's inflation rate remains above 4.5 percent for at least three periods for the combined list of countries, above 3.11 percent for developed countries, and above 4.53 percent for emerging countries. The Kaplan Meier estimate equation of the survival function time, t, is as follows:

$$\hat{s}(t) = \prod_{j|t_j \leq t} \left(\frac{h_j - e_j}{h_j} \right)$$

In the context of the study, the variable h_j presents the number of High Inflation Episodes (HIEs) that are ongoing at the specific time point t_j. This count includes all episodes that have not yet concluded by t_j. Conversely, the variable ej denotes the number of HIEs that naturally terminate during the time interval tj. It is important to note that e_j excludes episodes that are right censored at t_j, meaning those episodes that end due to the study period ending or data limitations rather than a natural conclusion.

The survival estimate, denoted as $\hat{s}(t)$ is calculated by multiplying the conditional probabilities of surviving at each observed time point t_j for all $j|t_j \leq t$. This means that $\hat{s}(t)$ is the product of the survival probabilities up to time t. At any given time tj, it is possible for one or more countries to exit the HIEs. This framework allows for a detailed analysis of the probability of HIEs persisting or concluding over time.

Figure 1a: Kaplan Meier Estimates for High Inflation Episodes for Combine list of countries.

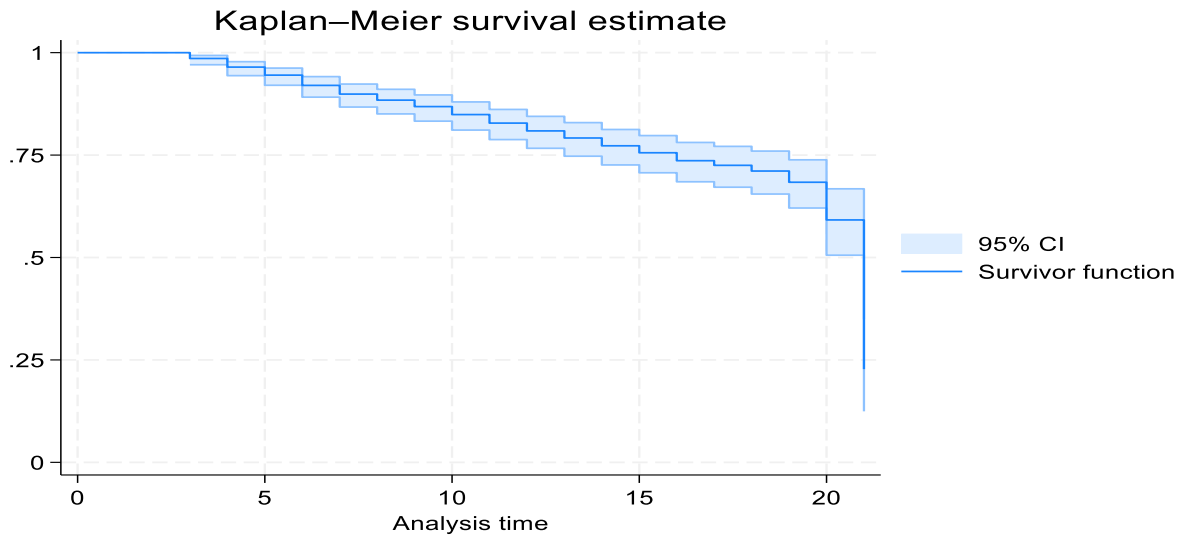

Figure 1b: Kaplan Meier Estimates for High Inflation Episodes for Developed countries.

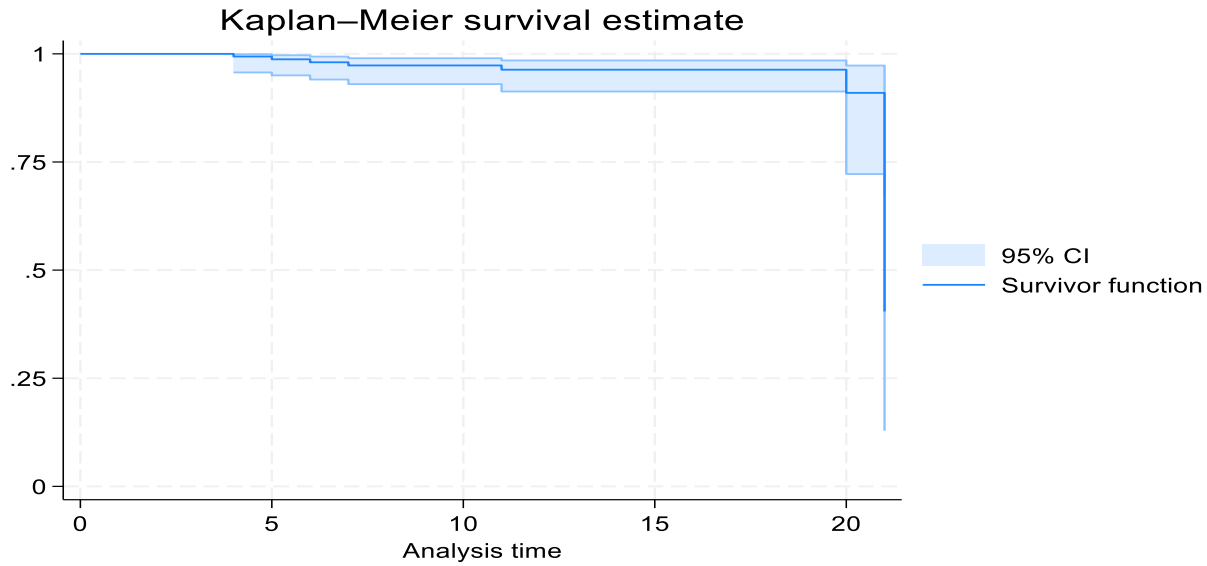

Figure 1c: Kaplan Meier Estimates for High Inflation Episodes for Emerging countries.

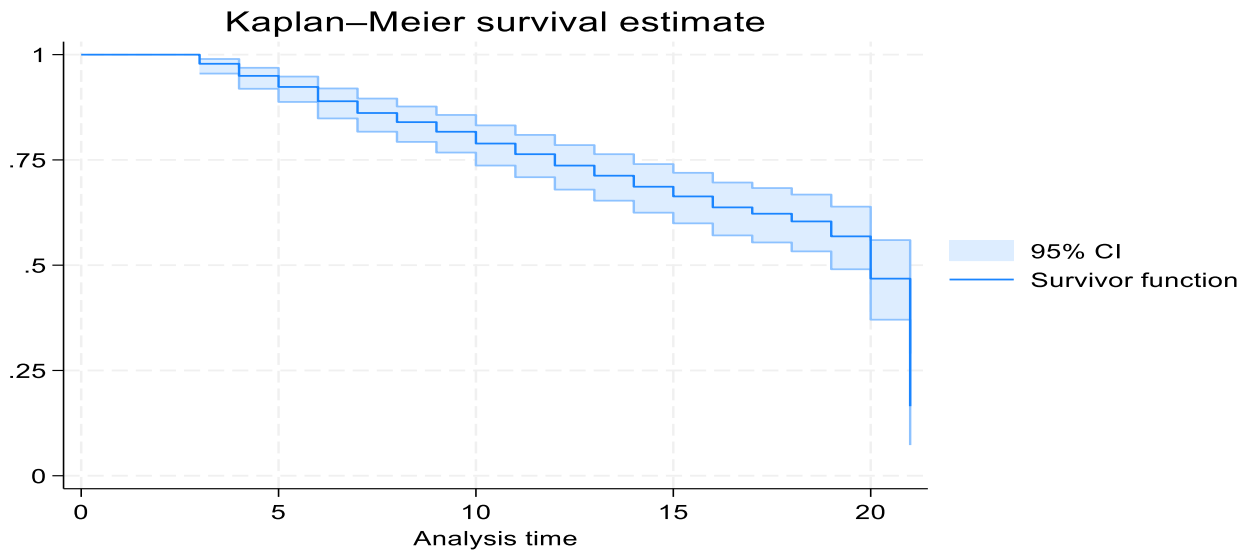

Figure 2a: Kaplan Meier Estimates for High Inflation Episodes for All countries, Pre-IT and Post-IT.

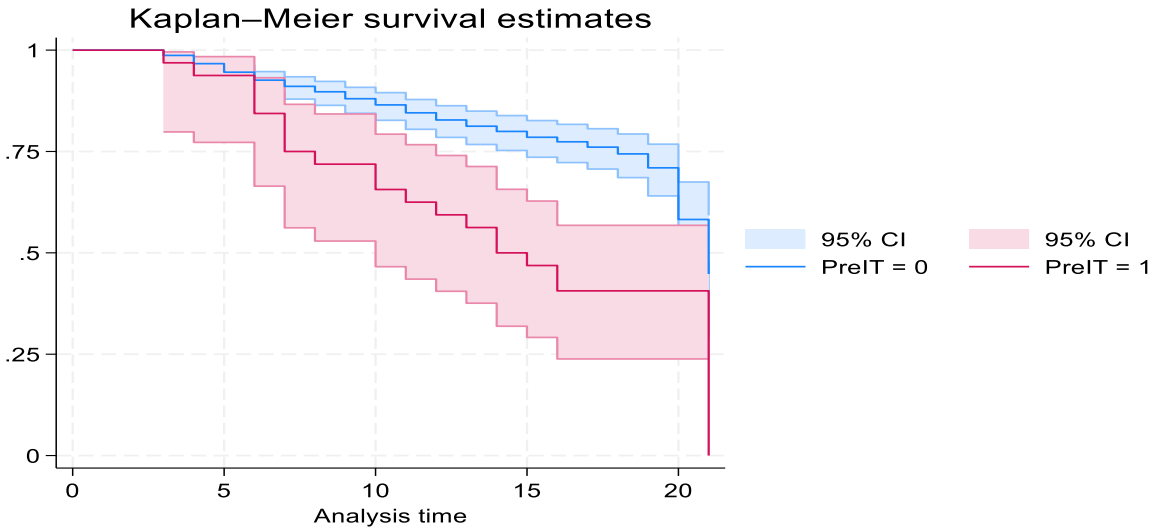

Figure 2b: Kaplan Meier Estimates for High Inflation Episodes for Developed countries, Pre-IT and Post-IT.

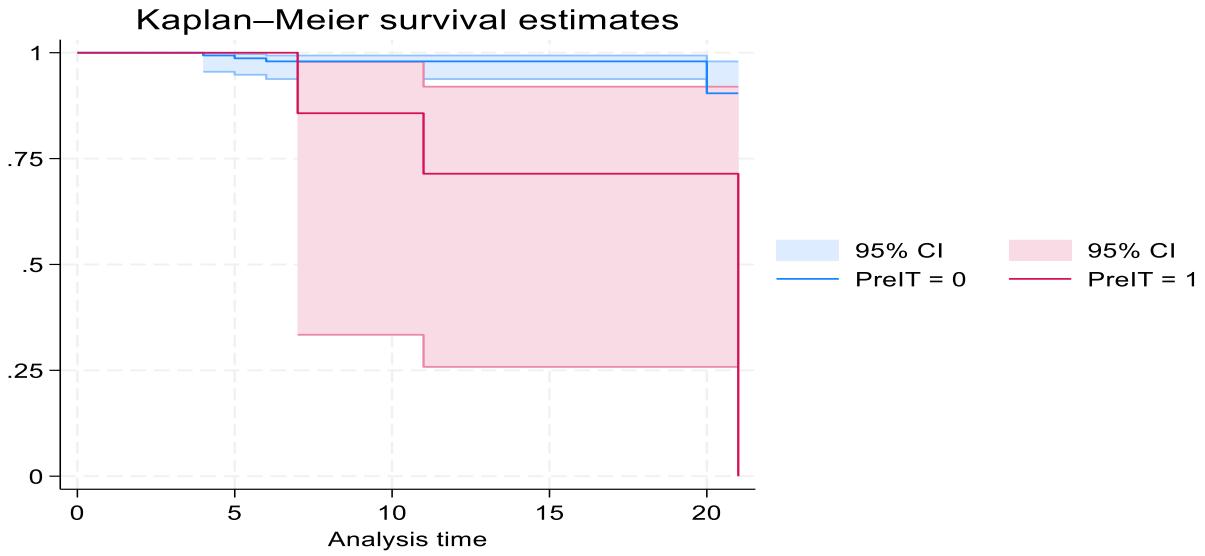

Figure 2c: Kaplan Meier Estimates for High Inflation Episodes for Emerging countries, Pre-IT and Post-IT.

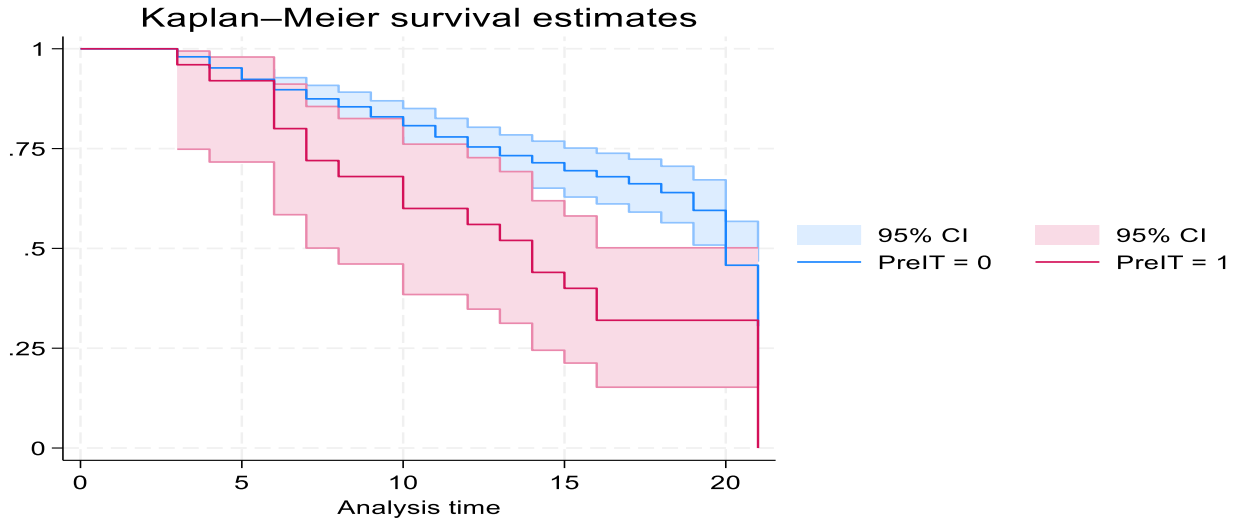

Figure 1 illustrates the declining estimated probability $\hat{s}(t)$ over time, indicating the likelihood of High Inflation Episodes persisting. The bottom section of Figure 1 shows the number of ongoing

High Inflation Episodes at various specific time points. This visualization aids in understanding the duration dynamics of High Inflation Episodes.

The primary focus of the study is to determine whether the implementation of Inflation Targeting (IT) policies effectively reduces the duration of High Inflation Episodes. To investigate this, we divided the sample into two distinct periods: Pre-IT policy and Post-IT policy, and then estimated $\hat{s}(t)$ for each period.

Figure 2 compares the exit speeds of HIEs for these two periods. The blue line represents the probability of remaining in High Inflation Episodes during the pre-IT policy period, while the red line represents the Post-IT policy period. The placement of the blue line above the red line signifies that the probability of remaining in HIEs is higher during the pre-IT policy period compared to the post-IT policy period. This indicates that countries with IT policies exit High Inflation Episodes more quickly in the post-IT period.

These findings suggest that the IT policy has a beneficial impact on reducing the duration of high inflation episodes. The comparative analysis of the Pre-IT and Post-IT periods provides evidence that the implementation of IT policies contributes to a faster resolution of high inflation, thereby enhancing price stability. The emerging countries have a faster reduction in the duration of High Inflation Period relative to developed countries.

Table 3a

Time	At risk	Fail	Lost	Survivor function	Std. error	[95% conf.	int.]
3	494	7	19	0.9858	0.0053	0.9705	0.9932
4	468	10	16	0.9648	0.0084	0.9439	0.9780
5	442	9	17	0.9451	0.0105	0.9204	0.9623
6	416	11	15	0.9201	0.0126	0.8914	0.9415
7	390	9	17	0.8989	0.0142	0.8672	0.9233
8	364	6	20	0.8841	0.0152	0.8505	0.9105
9	338	6	20	0.8684	0.0162	0.8329	0.8968
10	312	7	19	0.8489	0.0174	0.8110	0.8797
11	286	7	19	0.8281	0.0187	0.7878	0.8614
12	260	6	20	0.8090	0.0198	0.7666	0.8445
13	234	5	21	0.7917	0.0209	0.7473	0.8293
14	208	5	21	0.7727	0.0220	0.7260	0.8125
15	182	4	22	0.7557	0.0231	0.7068	0.7976
16	156	4	22	0.7363	0.0245	0.6848	0.7808
17	130	2	24	0.7250	0.0254	0.6717	0.7712
18	104	2	24	0.7111	0.0267	0.6549	0.7598
19	78	3	23	0.6837	0.0300	0.6208	0.7384
20	52	7	19	0.5917	0.0415	0.5057	0.6677
21	26	16	10	0.2276	0.0587	0.1246	0.3492

Table 3b

Time	At risk	Fail	Lost	Survivor function	Std. error	[95% conf.	int.]
3	171	0	9	1.0000	.	.	.
4	162	1	8	0.9938	0.0062	0.9570	0.9991
5	153	1	8	0.9873	0.0089	0.9503	0.9968
6	144	1	8	0.9805	0.0112	0.9406	0.9937
7	135	1	8	0.9732	0.0132	0.9301	0.9899
8	126	0	9	0.9732	0.0132	0.9301	0.9899
9	117	0	9	0.9732	0.0132	0.9301	0.9899
10	108	0	9	0.9732	0.0132	0.9301	0.9899
11	99	1	8	0.9634	0.0164	0.9130	0.9848
12	90	0	9	0.9634	0.0164	0.9130	0.9848
13	81	0	9	0.9634	0.0164	0.9130	0.9848
14	72	0	9	0.9634	0.0164	0.9130	0.9848
15	63	0	9	0.9634	0.0164	0.9130	0.9848
16	54	0	9	0.9634	0.0164	0.9130	0.9848
17	45	0	9	0.9634	0.0164	0.9130	0.9848
18	36	0	9	0.9634	0.0164	0.9130	0.9848
19	27	0	9	0.9634	0.0164	0.9130	0.9848
20	18	1	8	0.9099	0.0543	0.7221	0.9730
21	9	5	4	0.4044	0.1526	0.1288	0.6704

Table 3c

Time	At risk	Fail	Lost	Survivor function	Std. error	[95% conf.	int.]
3	171	0	9	1.0000	.	.	.
4	162	1	8	0.9938	0.0062	0.9570	0.9991
5	153	1	8	0.9873	0.0089	0.9503	0.9968
6	144	1	8	0.9805	0.0112	0.9406	0.9937
7	135	1	8	0.9732	0.0132	0.9301	0.9899
8	126	0	9	0.9732	0.0132	0.9301	0.9899
9	117	0	9	0.9732	0.0132	0.9301	0.9899
10	108	0	9	0.9732	0.0132	0.9301	0.9899
11	99	1	8	0.9634	0.0164	0.9130	0.9848
12	90	0	9	0.9634	0.0164	0.9130	0.9848
13	81	0	9	0.9634	0.0164	0.9130	0.9848
14	72	0	9	0.9634	0.0164	0.9130	0.9848
15	63	0	9	0.9634	0.0164	0.9130	0.9848
16	54	0	9	0.9634	0.0164	0.9130	0.9848
17	45	0	9	0.9634	0.0164	0.9130	0.9848
18	36	0	9	0.9634	0.0164	0.9130	0.9848
19	27	0	9	0.9634	0.0164	0.9130	0.9848
20	18	1	8	0.9099	0.0543	0.7221	0.9730
21	9	5	4	0.4044	0.1526	0.1288	0.6704

Table 3 presents the detailed results of the Kaplan-Meier estimates for High Inflation Episodes (HIEs) among the 27 countries that have adopted inflation targeting. The dataset encompasses a total of 494 HIEs for the period from 2003 to 2023 across all included countries. In this context, an HIE is defined as a period during which the inflation rate is 4.04 percent or higher and lasts for

at least three quarters. Thus, the analysis incorporates all 494 HIEs identified among the 27 inflation-targeting countries.

Given that the minimum duration for an HIE is three quarters, the earliest observed exit time, denoted as t, is 3, as shown in Table 3a. At the beginning of the third quarter, all 494 HIEs are still ongoing (referred to as "at risk" in the table). Over the course of the third quarter, 7 HIEs exit the high inflation phase, recorded as "Fail" in Table 4a. The column "Number of Net Lost" or "Lost" indicates the number of right-censored episodes in the third quarter.

The estimated survival probability at time t=3 is calculated as $\hat{s}(3) = \frac{494-7}{494} \approx 0.9858$. When the period extends to four, the number of ongoing HIEs ("No. High Inflation Episodes") is 468, derived from 494−7−19, and the number of exits ("No. Exited") is 10. The corresponding estimated survival probability is $\hat{s}(4) = 0.9858 * \frac{468-10}{468} \approx 0.9648$. This indicates that the probability of remaining in an High Inflation Episodes at t=4 is approximately 96 percent. The last row of Table 3 indicates that the maximum observed duration of an HIE among the 27 inflation-targeting countries is 21 periods, equivalent to 20 years, as observed in Mexico. The final three columns of Table 4 provide the standard error and confidence interval for the Kaplan-Meier estimates. As time progresses, the estimated survival probability decreases, demonstrating that High Inflation Episodes in all 27 inflation-targeting countries eventually conclude.

Tables 3b and 3c, which focus on developed and developing countries respectively, offer similar interpretations. Despite accounting for the level of development, the results indicate that HIEs decline and ultimately end in inflation-targeting countries.

To assess whether the median and mean durations of High Inflation Episodes significantly decrease following the implementation of Inflation Targeting policies, the study employs both the Log-Rank test and the Wilcoxon test. These tests are used to compare the overall equality of the survival functions for the pre-IT and post-IT periods. The primary distinction between these two tests lies in their weighting of the test statistics. The Log-Rank test gives more emphasis to differences at larger values of time, while the Wilcoxon test places greater weight on differences at smaller values of time.

Table 4 presents the results of these tests. The "Event Observed" column indicates the number of High Inflation Episodes recorded, with 4 observed during the Pre-IT period and 7 observed during the Post-IT period. The "Event Expected" column shows the total number of events that would be anticipated if both groups shared the same survival function.

The significant disparity between the observed and expected events yields a p-value of 0.003 for the Log Rank Test and 0.0016 for the Wilcoxon Test for the chi-squared test with one degree of freedom, as reported in Table 4a for the developed countries. This result leads to the rejection of the null hypothesis, which posits that the survival functions for the Pre-IT and Post-IT periods are equal.

The significant disparity between the observed and expected events when observing emerging countries, they yield the p-values of 0.0012 for the Log-Rank Test and 0.0038 for the Wilcoxon Test, this outcome leads to the rejection of the null hypothesis, which posits that the survival functions for the Pre-IT and Post-IT periods are equal. The event observed is 90 during the Pre-IT period and 25 observed during the Post-IT period.

The outcomes of the Log-Rank and Wilcoxon tests provide robust evidence that the median and mean durations of HIEs are significantly reduced after the adoption of IT policies. This supports the conclusion that IT policies are effective in shortening the duration of high inflation episodes, thereby contributing to greater price stability across the observed countries.s

Table 4a

Significance tests for equality of Kaplan-Meier Survival Function (3.11 %): Pre-IT vs Post-IT (Developed Countries)

IT - Policy	Event Observed	Event Expected		Event Observed	Event Expected	Sum of Ranks
Pre-IT	4	7.69		4	7.69	-215
Post-IT	7	3.31		7	3.31	215
Total	11	11		11	11	0
	Log-Rank Test			Wilcoxon Test		
	chi2(1) = 12.93 Pr>chi2 = 0.003			chi2(1) = 9.97 Pr>chi2 = 0.0016		

Table 4b

Significance tests for equality of Kaplan-Meier Survival Function (4.53%): Pre-IT vs Post-IT (Emerging Countries)

IT - Policy	Event Observed	Event Expected		Event Observed	Event Expected	Sum of Ranks
Pre-IT	90	99.95		90	99.95	-1770
Post-IT	25	15.05		25	15.05	1770
Total	115	115		115	115	0
	Log-Rank Test			Wilcoxon Test		
	chi2(1) = 10.49 Pr>chi2 =0.0012			chi2(1) = 8.38 Pr>chi2 = 0.0038		

The Kaplan-Meier technique is particularly useful for comparing the survival experiences of groups or covariates that remain constant over time. However, when covariates can assume multiple values or change over time, a parametric model is necessary. Semi-parametric models employ the hazard function, $h(t) = -\frac{s(t)}{s(t)}$, which represents the instantaneous rate of "failure" or exiting the High Inflation Episodes at time t, given that the country has experienced the HIEs for

t periods. The hazard function is defined as the negative rate of change in the survivor function over time:

$$h(t|x_i, x_{-i}) = h_0(t)\, exp(XB)$$

The Cox Proportional Hazards (PH) model is the standard technique for such analysis, allowing the study to examine the relative effects of multiple covariates on the probability of exiting HIEs. This model is particularly advantageous when these covariates can change over time. The hazard function in this model is expressed as:

$$h(t|x_i, x_{-i}) = h_0(t)\, exp(XB)$$

where B is a vector of coefficients, and X is a matrix of covariates, including the primary variable x_ii (indicating whether the Pos-IT policy is in place or not) and other control variables x_{-i} (such as exchange rates, the development level of the country, exchange rate volatility, oil prices, high income, global inflation, and real GDP growth rate). The term $h_0(t)$ is known as "baseline hazard function," representing the probability of exiting HIEs at time t when all covariates are zero. This function can take various forms over time but must satisfy h0(t) ≥ 0 since the probability of exiting HIEs should always be non-negative. The form exp(XB) ensures that the hazard function remains non-negative over time, making the hazard rates proportional to $h_0(t)$across different covariate values and eliminating the need to assume a specific functional form for $h_0(t)$. This is a key advantage of the Cox Proportional Hazards Model, as it prevents mis-specification of the baseline hazard, although it only estimates relative hazards.

The analysis of the hazard function indicates several key findings regarding the statistical significance of various coefficients at different confidence levels. A coefficient being statistically significant at the 5% level means that there is strong evidence to suggest that the corresponding variable has a meaningful impact on the dependent variable within the model, with a p-value less than or equal to 0.05. Specifically, the variables related to global inflation, growth rate, and high income exhibit such significance, indicating their robust influence on the hazard function.

Additionally, the S&P 500 index is statistically significant at the 10% level, meaning its coefficient has a p-value less than or equal to 0.10. While this is a weaker level of significance compared to the 5% threshold, it still suggests a moderate level of confidence in the impact of the S&P 500 index on the hazard function.

Conversely, the variable representing crude oil, although it has a positive coefficient, is statistically insignificant. This implies that the p-value associated with the crude oil variable is greater than 0.10, and thus, there is insufficient evidence to conclusively state that crude oil has a significant effect on the dependent variable in the context of this model. The positive sign of the coefficient suggests a potential positive relationship, but the lack of statistical significance means that this relationship cannot be reliably confirmed based on the available data.

Table 5

Cox regression with no ties

No. of subjects = 19 — Number of obs = 19
No. of failures = 19
Time at risk = 228
LR chi2(5) = 13.45
Log likelihood = -32.613149 — Prob > chi2 = 0.0195

_t	Haz. ratio	Std. err.	z	P>|z|	[95% conf.	interval]
GlobalInfla~n	2.478745	.7389742	3.04	0.002	1.381873	4.446269
CrudeOilPri~e	.9971892	.0081305	-0.35	0.730	.9813804	1.013253
AnnualGDPRe~e	.1693389	.1182885	-2.54	0.011	.0430691	.6658056
Adjustednet~n	4.883999	3.055024	2.54	0.011	1.433292	16.64242
VIXSP500	26.69467	47.46895	1.85	0.065	.8180932	871.0567

Both the current study and the research by Minjie Guo and Eun-Son Lim explore the impact of Inflation Targeting (IT) policies on price stability, focusing particularly on the duration of High Inflation Episodes (HIEs). Guo and Lim (2024) employ Survival Analysis to investigate the effectiveness of IT policies in reducing the duration of HIEs. They find that IT policies significantly decrease the average duration of HIEs and enhance price stability, even during periods of elevated inflation rates, such as those experienced during the COVID-19 pandemic.

The present study builds on Guo and Lim's work by distinguishing between developed and emerging economies, analyzing how the effectiveness of IT policies varies across these different economic contexts. The results from the Kaplan-Meier estimates indicate that IT policies are effective in both contexts but have a more pronounced impact on emerging economies. This differentiation adds a layer of specificity to the findings of Guo and Lim, who did not distinguish between the developmental levels of countries in their analysis.

5. Conclusion

The adoption of IT policies is confirmed as a crucial strategy for reducing the duration of high inflation episodes, thereby promoting price stability and overall economic stability. This study contributes to a broader understanding of monetary policy effectiveness and offers a foundation for future exploration of IT policies' nuanced impacts across various economic landscapes. The study recommends that countries, especially those in emerging economies should adopt Inflation Target frameworks to reduce HIEs duration and achieve greater price stability. Similarly to Guo and Lim, (2024), the paper suggest that Inflation Target policies effectively shorten High Inflation periods and stabilize prices. Central banks should emphasize transparency and accountability within IT frameworks to enhance their effectiveness. This involves clear communication of targets and regular reporting on progress. Neither this study nor the study conducted by Guo and Lim, (2024) explores the impact of Inflation Target policies on financial stability. Given the interconnectedness of financial and price stability, future research should investigate how IT policies influence broader economic stability.

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