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**Research Article / *Araştırma Makalesi***

# TIME-VARYING CAUSALITY IMPACT OF WORLD UNCERTAINTY ON G7 AND F5 COUNTRIES' INFLATION RATES

**Oğuz TÜMTÜRK[1], Mustafa KIRCA[2]**

## ABSTRACT

*Our study explores the causality relationship running from uncertainties to inflation in both G7 and F5 countries by using the largest data set available. We employ World Uncertainty Index (WUI) developed by Ahir et al. (2018) to represent uncertainties. This index differs from other economy-related uncertainties as it is constructed from both major political and economic developments. Since our model parameters are shown to be not stable, we perform time-varying causality analysis. Our results suggest that uncertainties have predictive power on inflation. Second, we also conclude that uncertainties associated with political developments produce price changes at least as much as uncertainties driven by economic developments. This evidence reveals that a stable political environment is also required to reduce inflation rates. Third, even though policy makers successfully recognize the source of uncertainty and conduct national policies against them, reducing inflation rates still can be challenging task for policy makers due to spillover impacts of uncertainties. Finally, causal relationship is more robust in G7 countries as the number of detected causal episodes in G7 countries is substantially higher than F5 countries. This result also implies that changes in uncertainties at different development stages can produce different price responses.*

***Keywords:*** *World Uncertainty, Inflation, Time-varying Causality*

***JEL Classification:*** *E30, E31*

# DÜNYA BELİRSİZLİĞİNİN G7 VE F5 ÜLKELERİNİN ENFLASYON ORANLARI ÜZERİNDEKİ ZAMANLA DEĞİŞEN NEDENSELLİK ETKİSİ

## ÖZET

*Bu çalışma, G7 ve F5 ülkelerinde belirsizliklikten enflasyona doğru olan nedensellik ilişkisini oldukça geniş bir veri seti kullanarak analiz etmektedir. Belirsizlikleri temsilen Ahir vd. (2018) tarafından geliştirilen Dünya Belirsizlik İndeksi verisi kullanılmıştır. Bu indeks, diğer ekonomi-bazlı belirsizlik indekslerinden hem ekonomik hem de politik belirsizliği içermesi bakımından ayrılmaktadır. Kullanılan modelde yer alan parametrelerin istikrarlı olmamasından dolayı, çalışmada zamanla değişen nedensellik analizi uygulanmıştır. Elde edilen sonuçlara göre, belirsizlikler enflasyon üzerinde tahmin gücüne sahiptir. İkinci olarak, politik belirsizlikler tarafından etkilenen fiyatlar en az ekonomik belirsizlikler tarafından etkilenen fiyat değişimleri kadar etkili olabilmektedir. Bu sonuca göre, istikrarlı bir politik çevre de enflasyon ile mücadelede gerekli olmaktadır. Üçüncü olarak, politika yapıcılar belirsizlik kaynağını başarılı şekilde tanımlayıp bunlara ilişkin politikalar geliştirseler dahi, belirsizliklerin yayılma özellikleri nedeniyle enflasyon ile mücadele yine de zor bir görev olabilmektedir. Son olarak, G7 ülkelerinde gözlemlenen nedensellik ilişkisi, nedensellik dönemlerinin F5 ülkelerine göre daha fazla sayıda olması nedeniyle daha güçlüdür. Bu sonuç, belirsizliklerin farklı gelişme evrelerinde farklı fiyat cevapları ürettiğini ortaya koymaktadır.*

***Anahtar Kelimeler:*** *Dünya Belirsizliği, Enflasyon, Zamanla Değişen Nedensellik*

***JEL Sınıflandırması:*** *E30, E31*

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## 1. Introduction

Policy makers and researchers are well aware that rapid changes to the level of aggregate uncertainty generate impact in macroeconomic activity since Keynes (1937). Under the presence of uncertainty shocks, agents in an economy prefer to postpone their economic decisions and wait until they access perfect information. Hence, uncertainty shocks can be considered as one of the key factors that explain economic fluctuations (Caldara et al., 2016). More specifically, Bloom (2009), who conducted a simple reduced form vector-autoregression (VAR) model, documented that uncertainty shocks produce recession periods. Following his seminal paper, the impact of uncertainties on major macroeconomic magnitudes attracts much more attention in the empirical literature. The main aim of this paper is to explore the role of uncertainties in explaining inflation dynamics over the Group of Seven (G7) and Fragile Five (F5) countries. Since G7 and F5 countries have distinctive economic and political structures (such as financial and political institutions, democratic infrastructure, income distribution and inequalities, budget deficits and public debts, foreign trade deficits, growth rates, inflation rates, and etc.), we naturally expect that uncertainties lead to different impacts on their economic fundamentals.

There is a large number of empirical studies in international literature examining the relationships between uncertainty and general level of prices (Alexopoulos & Cohen, 2009; Bloom, 2009; Baker et al., 2013; Caggiano et al., 2013; Nodari, 2014, Colombo, 2013; Alam, 2015; Caldara et al., 2016; Terzioğlu, 2018; Alam & Istiak, 2020; Ashena et al., 2023). Empirical evidence in the related literature strongly concluded that economies suffer contraction in investment and private consumption following an uncertainty shock. As mentioned by Bloom et al. (2006) and Gilchrist et al. (2014), firms prefer traditional "wait-and-see" policy and respond more cautiously at higher level of uncertainty until uncertainty is resolved. By using Bayesian VAR, Leduc & Liu (2013) concluded that an increase in uncertainty resembles an aggregate demand shock and reduces consumption. Carrière-Swallow & Céspedes (2013) ran a reduced-form VAR model and found evidence of severe fall in investment and consumption when uncertainty shock occurs. However, while investment and consumption exhibit sudden drops, the impact of uncertainties on prices is somewhat controversial.

The relationship running from uncertainties to prices can be explained by "consumer and investment channels". According to consumer channel, consumers cannot predict their future income flows due to an uncertainty shock. Hence, they tend to consume less and increase precautionary saving in the current period for consumption smoothing. The decline in consumption expenditures later leads to a decrease in prices (Carroll, 1996). On the other hand, increasing uncertainties in an economy can also induce general price increases via "investment channel". Investment expenditures mostly depend on the future outlook of an economy as stated by Keynes (1937), and hence it is considered the most volatile magnitude of aggregate demand. When investors cannot predict their future returns due to elevated uncertainties, they consider revising their investment decisions and postpone their production plans. A decrease in total investment and output is followed by general price rises. It is important to note that these channels appear when economic agents properly evaluate the current and future state of an economy and hence have correct expectations on the presence of uncertainty shocks. However, since the direction of the price responses with respect to uncertainty changes are theoretically contentious, the calculation of net impact requires country-specific empirical efforts.

This study employs World Uncertainty Index (WUI) developed by Ahir et al. (2018) to represent uncertainty[1]. The authors constructed the WUI for 143 individual countries on a quarterly basis based on Economist Intelligence Unit (EIU) country reports. Basically, they calculate the index using the frequency of the word "uncertainty" in the quarterly EIU reports which document major national political and economic developments and forecast future outlook of political and economic conditions. The WUI differs from another heavily used uncertainty index-the Economic Policy Uncertainty Index (EPU) constructed by Baker et al. (2013) since EPU mainly measures policy-related economic uncertainty and is constructed based on own-country newspaper articles.

We follow the causality framework suggested by Arslanturk et al. (2011) and Balcilar et al. (2010). Considering our relatively extensive data set, the relationships between the variables are expected to exhibit structural breaks and parameter instabilities due to political and economic developments. Hence, we conduct the time varying Granger causality analysis, which allows the coefficients to change over time.

This paper has several distinctive features. First, this paper is one of the earliest to use WUI when investigating the causality relationship between uncertainties and inflation.[2] The related literature frequently used economy-related uncertainty indexes such as Chicago Board Options Exchange Volatility Index-VIX (Bloom, 2009; Carrière-Swallow & Céspedes, 2013; Caggiano et al., 2013), consumer surveys (Leduc & Liu, 2016; Tumturk & Kırca, 2024), policy-related economic uncertainty index-EPU (Baker et al., 2013; Colombo, 2013; Alam & Istiak, 2020; Alam, 2015) to represent uncertainties. However, the uncertainties are not only driven by economic factors. Inflation rates heavily rely on future price evaluations. If the political environment is not stable and political uncertainty increases due to frequently occurring elections, referendums, strikes, civil protests, unrests and riots, etc., agents can adjust their future price evaluations. Based on a dataset covering around 100 countries, Aisen & Veiga (2006) documented that a higher degree of political instability is associated with higher inflation. As stated by the authors, "*The higher the probability of being replaced, the greater will be the importance attributed to short-term objectives. Then, it is difficult to maintain low inflation (p.1381)*". Paldam (1987) and Telatar et al. (2010) also showed the positive impact of political instability on inflation. As a result, we employ the WUI to measure the impact of uncertainties driven by both economic and political developments on the general price level. Second, this paper is also the first to use exogenous factors in time varying causality framework when exploring the relationship between uncertainties and inflation. Previous studies use both variables in standard VAR equations and assume that both variables dynamically influence each other (Balcilar & Ozdemir, 2013; Athari et al., 2022; Karagöl, 2023). However, there may be several exogenous factors that affect general price levels but are restricted from responding to domestic price changes. Finally, our data contains both G7 and F5 countries and these countries have substantially different economic and political conditions. Therefore, we also aim to explore whether uncertainty changes in different development stages generate distinctive price responses.

1 Please see https://www.policyuncertainty.com/wui_quarterly.html to have more detailed information for World Uncertainty Index.

2 For another study which investigates the uncertainty-inflation nexus by WUI, see Marasanti & Verico (2024).

The paper is organized as follows. In Section 2, we present the data and methodological approach followed in the paper. In Section 3, we report estimation results and discuss them. Finally, Section 4 concludes.

## 2. Data and Methodology

This study contains two groups of countries: G7 (US, Canada, Germany, UK, France, Italy and Japan) and Fragile 5 (India, Brazil, Indonesia, Türkiye and South Africa). The "World Uncertainty Index" data were obtained from https://worlduncertaintyindex.com/data/ database while inflation data are sourced from the OECD (2023). Selected sample period for each country differs due to data availability . We also include two exogenous variables: US inflation rates and oil prices. Al-Nassar & Albahouth (2023), Hall et al. (2023), Istiak et al. (2021) revealed that inflationary shocks in the US generate spillover impacts on home country economics. Additionally, Yang et al. (2023), Zakaria et al. (2021), Sek et al. (2015), Killian (2009), Atems et al. (2015) and many others documented the impact of oil price changes on home country inflation rates. Oil price data is obtained from the FRED (2023).

This study follows the time-varying causality framework suggested by Arslanturk et al. (2011) and Balcilar et al. (2010). As stated by Abakah et al. (2023), Apergis et al. (2023), Arslanturk et al.(2011), Balcilar et al. (2010), Coronado et al. (2023) and Tang (2008), relationships between variables can change over time due to policy changes, economic-political developments, domestic and foreign crises. By using the time-varying causality test, we aim to focus on the existence of causal relationships in sub-periods rather than the entire sample.

Time-varying causality test employed in this study is based on the Toda & Yamamoto (1995). Toda & Yamamoto (1995) causality test has two main advantages over the traditional causality test developed by Granger (1969). First, variables can be stationary at different levels. Second, there is no need to investigate the cointegration relationship before performing causality test. Toda & Yamamoto (1995) explore causality relationship by using Vector Autoregressive (VAR) models and include the maximum degree of integration of variables ($d_{max}$) as additional lag(s). The maximum degree of integration is determined by unit root (stationarity) tests.[3] Accordingly, we estimate the following VAR(p+$d_{max}$) model as shown in Equation 1.

$$\begin{bmatrix} inflation_t \\ WUI_t \end{bmatrix} = \begin{bmatrix} \beta_0^{inflation} \\ \beta_0^{WUI} \end{bmatrix} + \begin{bmatrix} \beta_{11,1}\beta_{12,1} \\ \beta_{21,1}\beta_{22,1} \end{bmatrix} \begin{bmatrix} inflation_{t-1} \\ WUI_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} \beta_{11,p+d_{max}}\beta_{12,p+d_{max}} \\ \beta_{21,p+d_{max}}\beta_{22,p+d_{max}} \end{bmatrix} \begin{bmatrix} inflation_{t-p+d_{max}} \\ WUI_{t-p+d_{max}} \end{bmatrix} + \begin{bmatrix} \delta_{11,1}\delta_{12,1} \\ \delta_{21,1}\delta_{22,1} \end{bmatrix} \begin{bmatrix} USinflation_t \\ oilprice_t \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \quad (1)$$

where "p" indicates the optimum number of lags of the model. While δ's denotes the coefficients of exogenous variables, β's form the coefficient matrices.

3 In this study, unit root tests are not included in order not to increase the word count. According to the findings of the unit root tests applied to the variables, the variables were found to be stationary at maximum first difference. This means that dmax=1 is accepted in the analysis. Unit root test results of the variables can be obtained from the authors upon request.

After estimating the VAR(p+$d_{max}$) model, causality relationships over the whole sample are obtained by following restrictions: $H_{0A}$: $\beta_{12,1}=\beta_{12,2}=\ldots=\beta_{12,p}=0$ ("WUI is not a Granger Cause of Inflation") and $H_{0B}$: $\beta_{22,1}=\beta_{22,2}=\ldots=\beta_{22,p}=0$ ("Inflation is not a Granger Cause of WUI"). Since this study investigates the causality link running from uncertainty (WUI) to inflation, our main aim is to test $H_{0A}$ hypothesis. Balcilar et al. (2010) analyzed the causality relationships between variables using the Likelihood Ratio (LR) test. To avoid non-normality, The LR test statistics are generated by the bootstrap method suggested by Hacker & Hatemi-J (2006). Considering our large data set, the relationships between the variables are more likely to encounter structural breaks due to economic and political developments, policy changes or financial and political turmoils. Therefore, we also performed a statistical test and examined the stability of parameters in Equation 1. Andrews (1993), Andrews & Ploberger (1994) proposed a parameter stability test of whether the coefficients in a time-series regression vary over the periods. The test is Likelihood Ratio (LR) test and uses the Supremum LR (Sup-LR), Exponential LR (Exp-LR) and Mean LR (Mean-LR) test statistics. The null hypothesis of these tests is "$H_0$: *There are parameters (coefficients) stability*". Rejection of the null hypothesis implies that estimated parameters in equation (1) do not remain constant over time; that is, the relationships between variables are unstable (parameter instability). If the estimated coefficients of equation (1) are not stable and the model exhibits parameter instability, time-varying coefficients and causality tests are required.

We detect changes in causal relationships over time based on the "Rolling Window (ROW)" recursive estimation method similar to Arslanturk et al. (2011) and Balcilar et al. (2010). We also follow Caspi's (2017:11) advice and the window size is determined by the formula $\tau = T(0{,}01 + \frac{1{,}8}{\sqrt{T}})$. As stated by Brooks & Hinich (1998), the specified window size should also be long enough to ensure the validity of the causality tests in the sub-periods. Accordingly, our rolling procedure contains "τ=33 quarters (approximately 8 years)" for each estimation and the first LR test statistic is calculated based on the selected window size, τ=33. Then, the test is repeated for the data set between the second quarter and "τ+1". Similarly, the third window contains the data set between third quarter and "τ+2. Thus, the ROW algorithm renews the information in the sample of the same size by including the newest observation and removing the oldest one. The rolling process proceeds until the last observation point is contained by the very last rolling window. The LR test statistics and bootstrap probability values are sequentially calculated. If the bootstrap probability value of the LR test statistic is less than 20%, the null hypothesis $H_{0A}$ is rejected. The time-varying coefficients can also be calculated as in Arslanturk et al. (2011) and Balcilar et al. (2010). Thus, the sign of the impact of uncertainty on inflation can also be estimated.

## 3. Empirical Results

This section presents the test results. Table 1 reports the whole sample analysis results. According to Table 1, uncertainty has no predictive power on inflation for the entire period except France and Japan. Although the statistical evidence does not suggest strong causal relationships for the entire period, the existence of causality for distinct sub-periods can easily change due to parameter instabilities as mentioned above.

**Table 1: Causality Test Results from WUI Inflation, Whole Sample**

| G7 Countries | | | |
|---|---|---|---|
| **Country** | **$p+d_{max}$** | **LR statistic** | **Bootstrap p-value** |
| USA | 3+1 | 1.282 | 0.5045 |
| UK | 3+1 | 3.720 | 0.3020 |
| Germany | 6+1 | 0.078 | 0.9695 |
| France | 2+1 | 5.758** | 0.0525 |
| Italy | 2+1 | 2.174 | 0.3385 |
| Japan | 2+1 | 8.954** | 0.0135 |
| Canada | 3+1 | 2.661 | 0.4300 |
| **F5 Countries** | | | |
| **Country** | **$p+d_{max}$** | **LR statistic** | **Bootstrap p-value** |
| Brazil | 3+1 | 2.172 | 0.4735 |
| Indonesia | 3+1 | 3.108 | 0.3765 |
| South Africa | 5+1 | 3.544 | 0.5835 |
| India | 2+1 | 0.035 | 0.9770 |
| Türkiye | 2+1 | 0.633 | 0.7080 |

Note: ** indicates causality at 5% significance level.

Table 2 indicates parameter stability test results. The Supremum, Exponential and Mean LR test results usually reject the null hypothesis of parameter stability. The test results confirm unstable relationships from uncertainty to inflation and require to employ time-varying coefficients. This evidence is also consistent with previous empirical studies concluding that the relationships between economic and political variables are time-varying. (Kocoglu et al., 2023; Raggad & Bouri, 2023; Ren et al., 2023).

**Table 2: Parameter Stability Test Results, Dependent Variable: Inflation**

| G7 Countries | | | |
|---|---|---|---|
| **Country** | **Sup LR** | **Exp LR** | **Mean LR** |
| USA | 10.547* (0.0005) | 2.307* (0.0000) | 3.646* (0.0000) |
| UK | 7.534 *(0.0005) | 1.236** (0.0105) | 1.931** (0.0310) |
| Germany | 4.663* (0.0080) | 1.683* (0.0010) | 3.272* (0.0010) |
| France | 8.649* (0.0010) | 2.376* (0.0000) | 3.763* (0.0005) |
| Italy | 8.250* (0.0000) | 1.361* (0.0070) | 2.266** (0.0130) |
| Japan | 12.594* (0.0000) | 2.368* (0.0005) | 2.462** (0.0140) |
| Canada | 6.220* (0.0000) | 1.662* (0.0000) | 3.010* (0.0000) |

**Table 2 continue**

| F5 Countries | | | |
|---|---|---|---|
| **Country** | **Sup LR** | **Exp LR** | **Mean LR** |
| Brazil | 10.634* (0.0085) | 1.984** (0.0160) | 1.865*** (0.0855) |
| Indonesia | 5.350** (0.0120) | 1.676 (0.0005) | 2.708* (0.0015) |
| South Africa | 3.177*** (0.0570) | 0.842****(0.1545) | 1.519 (0.2370) |
| India | 6.863 (0.0000) | 1.496* (0.0030) | 2.743* (0.0035) |
| Türkiye | 4.524**** (0.1180) | 1.113*** (0.0835) | 2.031*** (0.0800) |

**Notes: *, **, ***, ****** indicate that the coefficients are unstable at 1%, 5%, 10% and 20% significance level respectively. As suggested by Arslanturk et al. (2011), we also use 20% significance level. Values in brackets indicate bootstrap probability values. Bootstrap probability values were generated with 2000 iterations. We follow Andrews' (1993) advice and use symmetric trimming of 15%.

Finally, the time-varying causality test results and sign of the coefficients are shown in Figures 1-12. Figures 1-7 show the estimation results for G7 countries while Figures 8-12 report the estimation results for F5 countries. To be more precise, we also summarize the statistically significant causality periods and associated signs in Table 3.

**Figure 1: Rolling Window Estimation Results for The US**

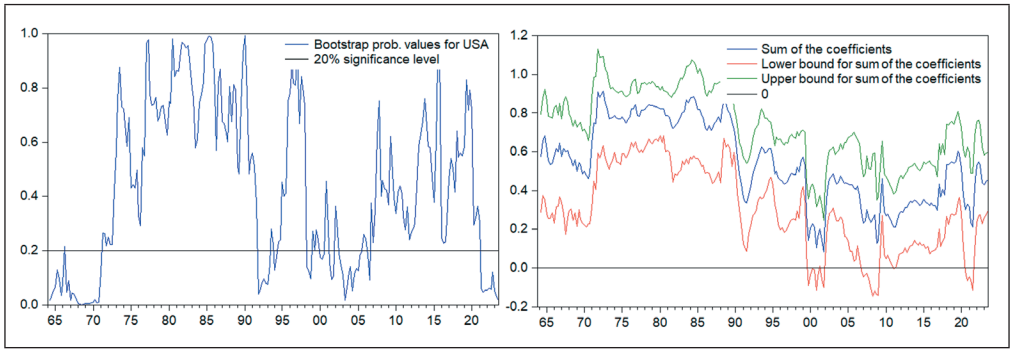



**Figure 2: Rolling Window Estimation Results for the UK**

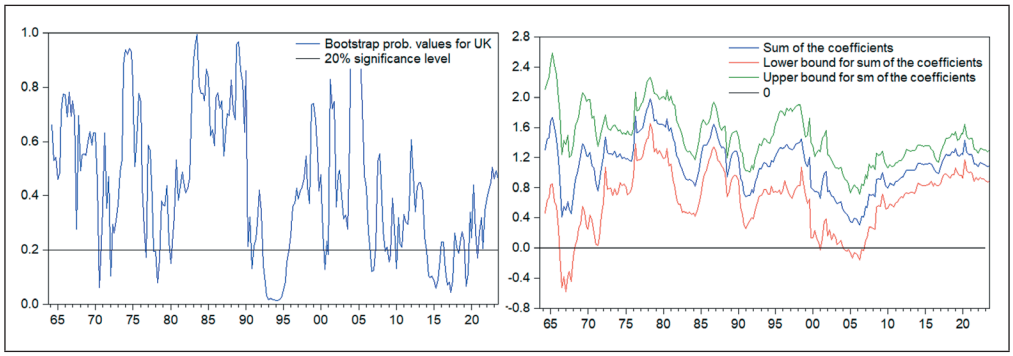


**Figure 3: Rolling Window Estimation Results for Germany**

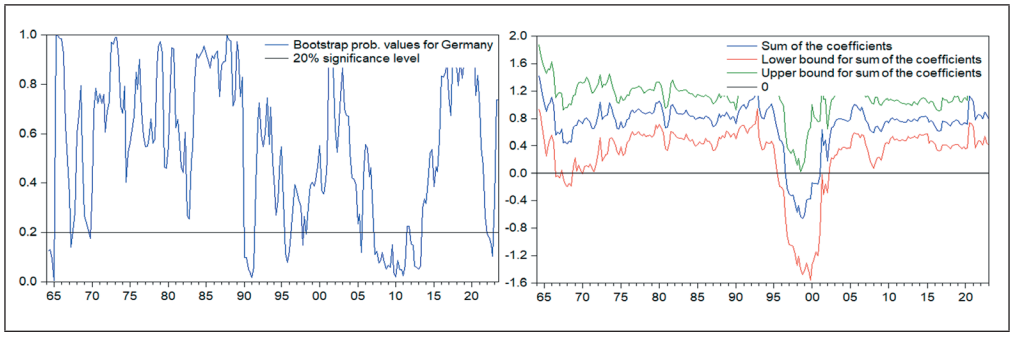



**Figure 4: Rolling Window Estimation Results for France**

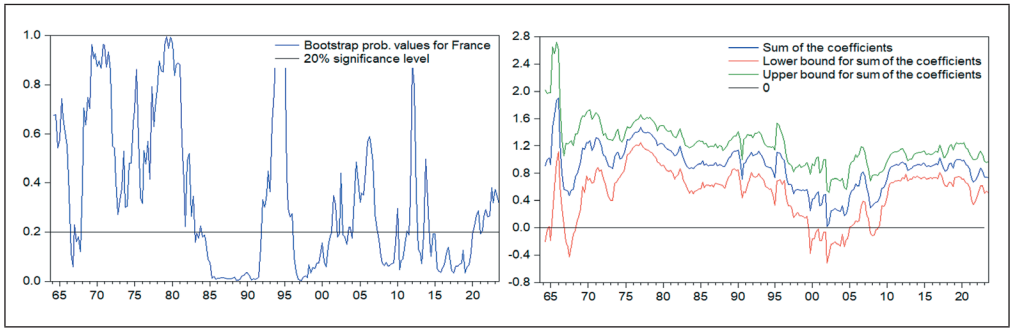



**Figure 5: Rolling Window Estimation Results for Italy**

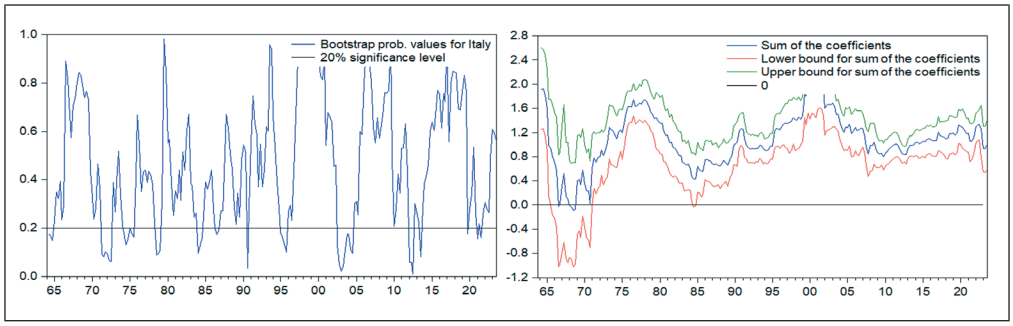


**Figure 6: Rolling Window Estimation Results for Japan**

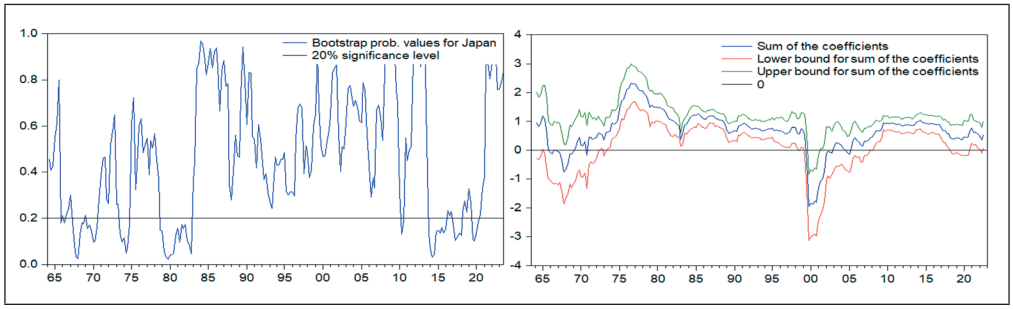



**Figure 7: Rolling Window Estimation Results for Canada**

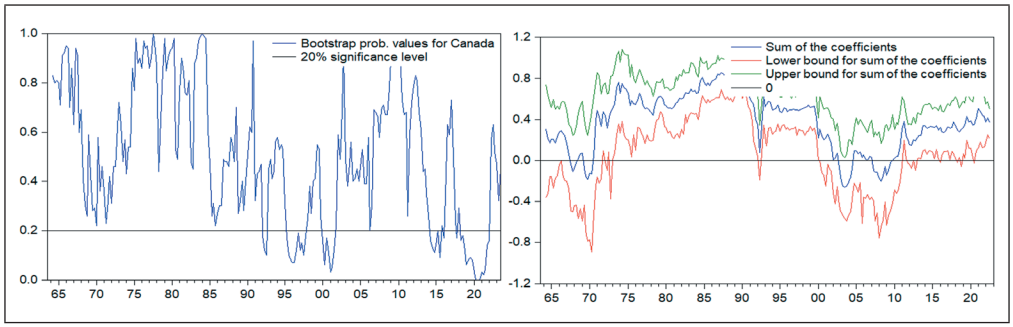



**Figure 8: Rolling Window Estimation Results for Brazil**

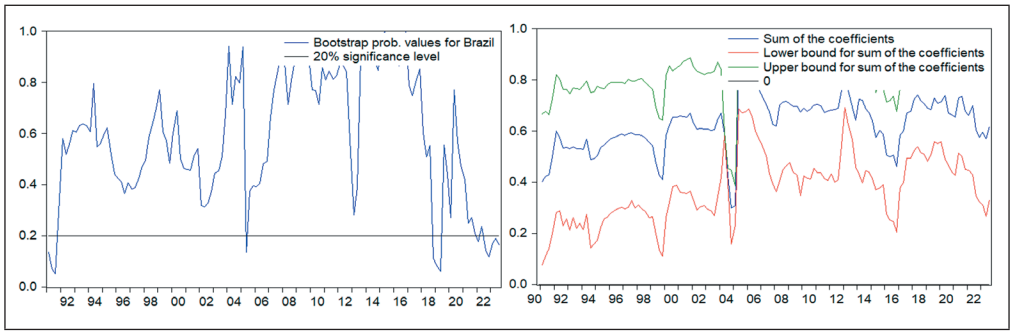


**Figure 9: Rolling Window Estimation Results for Indonesia**

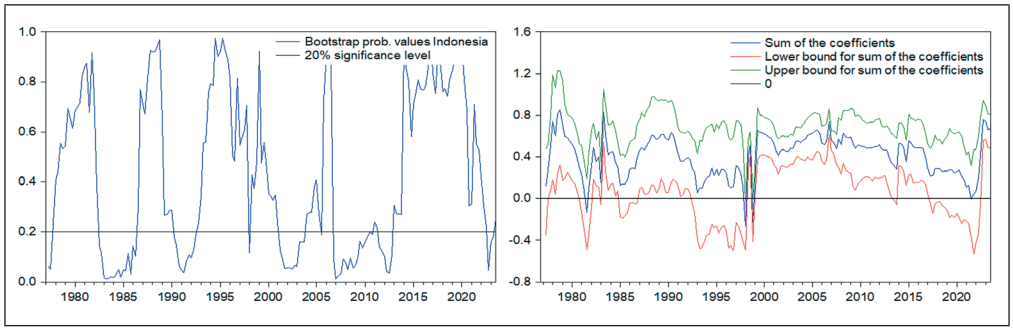



**Figure 10: Rolling Window Estimation Results for South Africa**

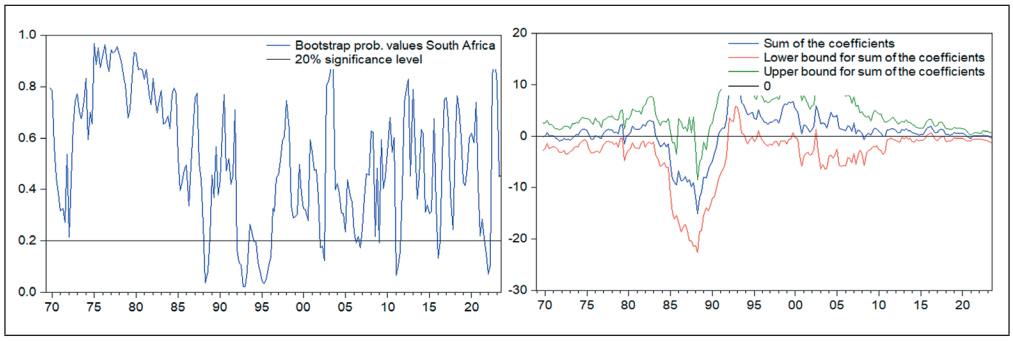



**Figure 11: Rolling Window Estimation Results for India**

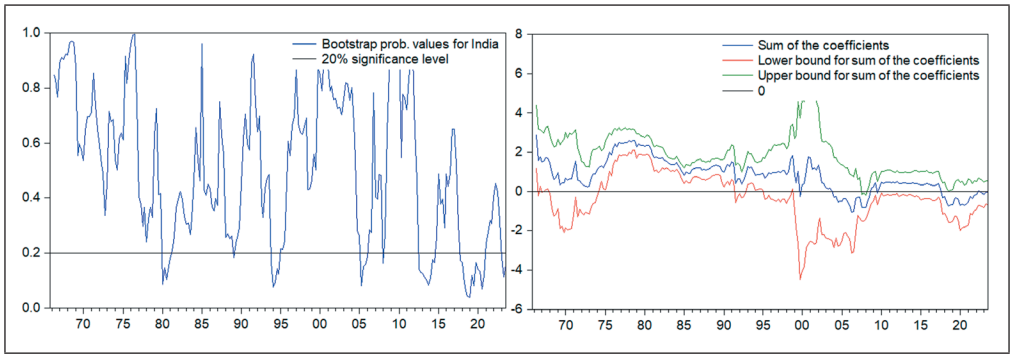
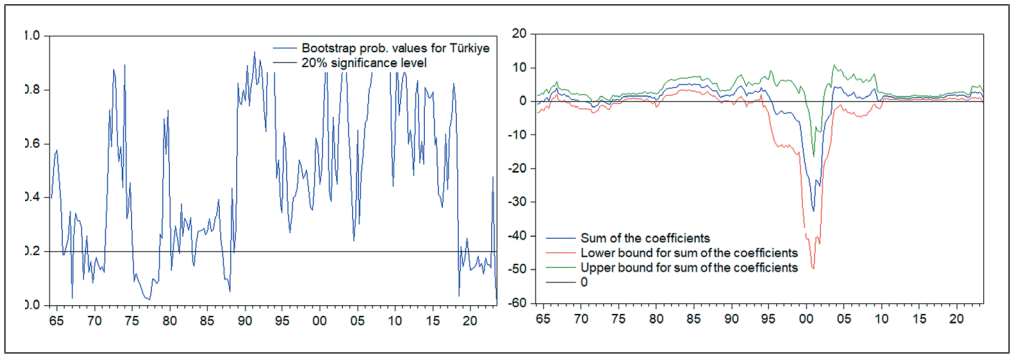


**Figure 12: Rolling Window Estimation Results for Türkiye**




The estimation results depicted between Figures 1 and 12 suggest that uncertainties have predictive power on inflation. When causality appears, it usually lasts longer than a few quarters for both groups of countries. However, the causal relationship is more robust in G7 countries as the number of detected causal episodes in G7 countries is substantially higher than F5 countries. Since Brazil has the narrowest data set, the number of causality quarters was counted over the period of 1990 and beyond for both groups of countries. The investigated causal link emerged in an average of 40 quarters for G7 countries while 28 quarters on average for F5 countries. This difference can be explained by group characteristics. G7 countries naturally have more stable economic and political conditions. Also, agents in developed countries can easily access the current information related to economic and political changes and evaluate them more properly compared to agents in F5 countries due to their educational supremacy and advanced information technologies.[4,5] Agents in developed countries are expected to react to relatively low frequency uncertainty shocks more rapidly and effectively thanks to the properly set expectations. On the contrary, the political and economic conditions in F5 countries are rather unstable. Agents in F5 countries are not expected to react to relatively high frequency uncertainty shocks as sharply as the agents in G7 countries. This is because a lack of complete information and their educational deficiencies relative to G7 countries prevent agents in F5 countries from forming correct expectations on current and future uncertainties. This can explain the relatively weak causality in F5 countries.

Second, considering the events charts in Appendix and Figure 1-12, we can conclude that uncertainties associated with political developments produce price changes at least as much as those driven by economic developments. This evidence reveals that inflation itself is not solely an economic phenomenon and economic policies alone are insufficient to reduce inflation rates. No matter how sound and consistent the monetary and fiscal policies implemented by the policy makers, political developments such as elections, referendums, political conflicts and domestic political instabilities triggered by civil protests, unrests and riots also

4 The internet usage rate on average as percentage of population is 51 for G7 countries while 22 for F5 countries according to the World Bank Statistics. Please see https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations for the detailed individual country statistics.

5 Mean years of schooling for G7 countries is around 12.8 years while 8.6 years for F5 countries according to the United Nations Development Programme (UNDP) statistics. Please see https://hdr.undp.org/data-center/human-development-index#/indicies/HDI for the detailed individual country statistics.

lead to substantial impact on inflation. This result naturally implies that a more stable political environment is required to combat inflation in addition to well-planned economic policies. Our result is also consistent with previous literature exploring the link between political instability and inflation. (Paldam, 1987; Aisen & Veiga, 2006; Telatar et al., 2010)

Third, the causality link between uncertainty and inflation appeared to be stronger in the 1980s and beyond than in the pre-1980s era. This result can be explained by the fact that global-specific uncertainties have become more effective on domestic macroeconomic variables due to the influence of globalization. The financial liberalization movements that come along with technological developments in the finance sector induce countries more closely related to each other. Thanks to the deregulation policies around the world, the uncertainties produced by financial and economic developments do not only affect the home countries but also easily spread beyond the country borders. As a result, economic uncertainties, whose effects mainly were limited within the country before 1980s, have crossed the borders with their spillover effects and appeared to be more effective on inflation over the period of 1980s and beyond. In addition, relatively limited developments of communication and internet technologies in the pre-1980s can reveal why predictive power of uncertainties on inflation deteriorates in this period. Accordingly, insufficient communication and internet technology is expected to prevent economic agents from accessing perfect information and hence accurately evaluating political or economic developments. Since uncertainty shocks cannot properly be recognized, the causality chain from uncertainty to inflation weakens.

Fourth, all countries with no exception exhibit causality link over the period of 2019 and beyond. This common causality period contains several important global developments that severely damage global supply chain such as US-China trade tension, Brexit period, COVID-19 disease, Ukraine-Russia war and the bankruptcy of US banks. As a result, highly increased global uncertainties since 2019 have generated world-wide price changes via spillover impacts.

Finally, as shown in Figures 1-12 and Table 3 in detail, the direction of price responses under the presence of uncertainty changes are usually positive; that is, an increase in uncertainty promotes inflation. On the other hand, uncertainty rises rarely lower inflation. This evidence reveals that price changes generated by the investment channel and political instabilities outperform price changes generated by consumption channel. This result also implies that consumers are less sensitive to changes in uncertainty.

**Table 3: Significant Time-Varying Causality Periods and Their Signs**

| G7 (Figure 1-7) | | F5 Figure (8-12) | |
|---|---|---|---|
| **Countries** | **Causality Sub-Periods (Sign)** | **Countries** | **Causality Sub-Periods (Sign)** |
| US | 1964Q2-1971Q1(+), 1991Q4-1993Q2(+), 1994Q1-1994Q2(+), 1998Q2-1998Q4(+), 1999Q2(+), 2000Q1-2000Q3(+), 2001Q3-2001Q4(+), 2002Q3-2005Q3(+), 2006Q2-2006Q3(+), 2021Q2-2023Q3(+) | BRAZIL | 1991Q1-1991Q3(+), 2005Q2(+), 2018Q4-2019Q2(+), 2022Q1(+), 2022Q3-2023Q3(+) |
| UK | 1970Q3(+), 1972Q1(+), 1976Q4(+), 1977Q4-1978Q3(+), 1980Q1(+), 1990Q4(+), 1992Q2-1995Q4(+), 2000Q3(+), 2001Q1(+), 2006Q4-2007Q1(+), 2008Q3(+), 2009Q2(+), 2010Q1(+), 2014Q1-2015Q4(+) , 2016Q3-2017Q3(+) , 2018Q2(+) , 2019Q2-2019Q3(+) , 2020Q4(+) | INDONESIA | 1977Q2-1977Q3(+), 1982Q3-1986Q2(+), 1990Q2-1992Q3(+), 1998Q1(-), 2001Q2-2003Q4(+), 2005Q3(+), 2006Q4-2010Q4(+), 2011Q3-2012Q4(+), 2022Q4-2023Q2(+) |
| GERMANY | 1964Q2-1965Q1(+),1967Q2(+), 1969Q4(+), 1990Q1-1991Q2(+), 1995Q3-1996Q1(+),1997Q4(-),1998Q2(-), 2005Q3(+), 2007Q2-2011Q2(+), 2012Q1-2013Q2(+), 2022Q1-2022Q4(+) | SOUTH AFRICA | 1988Q2-1988Q3(-), 1992Q1-1993Q2(+), 1994Q1-1996Q1(+), 2002Q1-2002Q3(+), 2006Q2(+), 2006Q4(+), 2009Q1(+), 2011Q1-2011Q3(+), 2016Q1-2016Q2(+), 2021Q4-2022Q2(+) |
| FRANCE | 1966Q3-1966Q4(+), 1967Q2-1967Q4(+), 1983Q1-1983Q3(+), 1984Q1-1991Q4(+), 1996Q2-2001Q2(+), 2002Q1-2002Q2(+), 2002Q4-2003Q2(+), 2004Q1(+), 2007Q3-2009Q4(+), 2010Q2-2011Q1(+), 2011Q3(+), 2012Q4-2013Q3(+), 2014Q2-2020Q1(+), 2021Q1(+) | INDIA | 1980Q1-1981Q1(+), 1989Q1(+), 1993Q4-1994Q4(+), 2005Q2-2006Q1(-), 2008Q1(-), 2012Q3-2014Q3(+), 2017Q4-2020Q4(-), 2023Q1-2023Q3(-) |
| ITALY | 1964Q2-1964Q4(+), 1971Q2-1972Q3(+), 1974Q2-1975Q3(+), 1978Q3-1979Q1(+), 1984Q1-1984Q3(+), 1986Q3-1986Q4(+), 1990Q3(+), 1995Q1-1995Q4(+), 2002Q3-2004Q3(+), 2012Q1-2012Q3(+), 2013Q3(+), 2019Q4(+), 2021Q1(+), 2021Q3(+) | TÜRKIYE | 1965Q4-1966Q1(+), 1967Q1(+), 1968Q3-1968Q4(+), 1969Q2-1971Q2(-), 1975Q2- 1978Q3(+), 1980Q2(+), 1981Q2(+), 1983Q1-1983Q2(+), 1987Q1-1988Q1(+), 1988Q3(+), 2018Q3(+), 2019Q2(+), 2019Q4- 2022Q4(+), 2023Q2-2023Q3(+) |
| JAPAN | 1965Q4(+), 1966Q2(-), 1967Q3-1968Q4(-), 1969Q2-1970Q3(+), 1973Q3-1974Q4(+), 1978Q4-1982Q4(+), 2010Q2-2010Q3(+), 2013Q4-2016Q1(+),2017Q1-2018Q1(+), 2019Q3-2020Q2(+) | | |
| CANADA | 1992Q1-1992Q3(+), 1995Q2-1997Q4(+), 2000Q1-2001Q3(+),2014Q2-2015Q1(+), 2015Q3(+), 2016Q1(+), 2017Q4(+), 2018Q2-2022Q1(+) | | |

## 4. Conclusion and Policy Recommendations

Our study explores the causality from uncertainties to inflation in both G7 and F5 countries. Uncertainties are represented by the WUI developed by Ahir et al. (2018). This index is constructed from both major political and economic developments in the quarterly EIU reports. The causality link running from uncertainties to inflation can be explained by "consumer and investment channels". Under the presence of uncertainty shocks, investment and consumption drops lead to different price responses. Empirical literature also documents that a higher degree of political instability is associated with higher inflation. Since our model suffers from parameter instabilities as expected when considering the extensive size of our data set, we conduct time-varying causality analysis. Our results can be summarized as follows:

- Uncertainties precede inflation. More importantly, the impact of uncertainties on inflation is mostly positive. This evidence confirms that investment channel have strong explanatory power on price increases.
- In addition to economy-related uncertainties, uncertainties associated with political developments and political instabilities also generate price changes. This evidence reveals that a stable political environment is also required to reduce inflation rates.
- Uncertainties are more predictive of inflation in both groups of countries over the period of 1980s and beyond, since global-specific uncertainties are appeared to become more effective on domestic macroeconomic variables due to the influence of globalization. This result also confirms the validity of spillover impacts of uncertainties.
- Finally, the causal relationships last longer in G7 countries than F5 countries. This result also reveals that changes in uncertainties at different development stages can produce different price responses. This result can be explained by correctly formed expectations due to relative educational supremacy and advanced information technologies in G7 countries.

Fighting against inflation has not recently been an easily achievable policy target for policy makers and especially central banks. Well-organized economy policies, increased transparency to reduce uncertainty, inflation targeting policies, interest rate rises etc. are not considered to be sufficient to reduce inflation rates. Governments should also avoid political decisions that endanger political stability and lead to the escalation of domestic tension and conflicts. Even though policy makers successfully identify the source of uncertainty and develop national policies to minimize them, reducing inflation rates still can be challenging task for policy makers due to spillover impacts of uncertainties documented in this study. The validity of this assertion can be confirmed by empirically documented causality link over the period of 2019 and beyond for all countries with no exception. It is important to note that this causal episode is associated with important global developments that increase the worldwide level of uncertainties such as US-China trade tension, Brexit period, COVID-19 disease, Ukraine-Russia war and the bankruptcy of US banks. As a result, our study concludes that inflation cannot only be considered as a domestic economic issue. Fighting against inflation requires a broader perspective, which includes globally designed and conducted uncertainty-reducing policies.

**Conflict of Interest**

The authors declare that there is no conflict of interest.

**Contribution Statement of Researchers**

The authors contributed equally.

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## Appendix

**Table AI: Event Charts, G7 Countries**

| US | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | 1964-1968 PRESEDENTIAL ELECTIONS<br>1963 KENNEDY ASSASINATION<br>1963-1973 VIETNAM WAR<br>1963MARTIN LUTHER KING CIVIL RIGHT MOVEMENTS<br>1968 MARTIN LUTHER KING ASSASINATION | 1969-1970 ECONOMIC RECESSION | THE COLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973) |
| 1970-1979 | | | |
| 1980-1989 | | | |
| 1990-1999 | 1991-SOVIET COLLAPSED AND COLD WAR ENDS<br>1991 GULF WAR I<br>1992 PRESIDENTIAL ELECTION<br>1998 CLINTON-LEWINSKY SCANDAL<br>2000 PRESIDENTIAL ELECTION | 1992 HURRICANE ANDREW<br>1992 HURRICANE INIKI<br>1994 NORTHRIDGE EARTHQUAKE | |
| 2000-2009 | 2001 SEPTEMBER 11 ATTACKS<br>2001 WAR IN AFGHANISTAN<br>2003 IRAQ WAR<br>2004 PRESIDENTIAL ELECTION | 2001 ECONOMIC RECESSION<br>2005 HURRICANE KATRINA | 2003 OUTBREAK OF SARS |
| 2010-2023 | 2021 CAPITOL ATTACK | 2023 COLLAPSE OF SILICON VALLEY BANK, SIGNATURE BANK, AND CREDIT SUISSE | 2022-WAR IN UKRAINE |

Note: See https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions for recession periods of the US.

| UK | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | | |
| 1970-1979 | 1970 GENERAL ELECTIONS<br>1979 GENERAL ELECTIONS | 1979-1981 ECONOMIC RECESSION | THE COLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973)<br>1970s ENERGY CRISIS |
| 1980-1989 | | | |
| 1990-1999 | 1990 POLL TAX RIOTS<br>1990 THATCHER RESIGNS<br>1992 GENERAL ELECTION | 1989-1992 ECONOMIC RECESSION<br>1994-1996 ECONOMIC RECESSION<br>1993-1996 BSE OUTBREAK (MAD COW DESEASE-ONE OF THE WORST VIRUS OUTBREAKS IN BRITAIN UNTIL COVID-19 | 1990 GOLF WAR I |
| 2000-2009 | 2010 GENERAL ELECTION | 2000-2002 ECONOMIC RECESSION<br>2008-2009QECONOMIC RECESSION | |
| 2010-2023 | 2015-2017-<br>2019 GENERAL ELECTIONS<br>2016 BREXIT | 2019-2020 ECONOMIC RECESSION | 2019 US-CHINA TRADE TENSIONS AND BREXIT<br>2020 OUTBREAK OF COVID |

Note: See https://fred.stlouisfed.org/series/gbrrecm recession periods of the UK.

| GERMANY | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | 1966-1967 ECONOMIC RECESSION | |
| 1970-1979 | | | |
| 1980-1989 | 1990-1991 GERMAN REUNIFICATION<br>1990 GERMAN FEDERAL ELECTION (FIRST OF THE RE-UNITED GERMANY)<br>1990 BATTLE OF MAINZER STRAßE | | 1990 GULF WAR I |
| 1990-1999 | 1998 GERMAN FEDERAL ELECTION | | |
| 2000-2009 | 2005 GERMAN FEDERAL ELECTION<br>2009 GERMAN FEDERAL ELECTION | 2008-2009 ECONOMIC RECESSION | |
| 2010-2023 | 2012 BLOCKUPY MOVEMENT | | 2012 US FISCAL CLIFF AND SOVEREIGN DEBT CRISIS IN EUROPE<br>2022 UKRAINE WAR |

Note: See https://www.sachverstaendigenrat-wirtschaft.de/en/topics/business-cycles-and-growth/konjunkturzyklus-datierung.html for recession periods of Germany.

| FRANCE | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | 1967 PARLIAMENTARY ELECTION | | 1963-1973 VIETNAM WAR |
| 1970-1979 | | | |
| 1980-1989 | 1986-1988 PARLIAMENTARY ELECTION<br>1988 PRESIDENTIAL ELECTION<br>1988 REFERANDUM | | 1990 GULF WAR 1 |
| 1990-1999 | 1997 PARLIAMENTARY ELECTION | 1992 ECONOMIC RECESSION | |
| 2000-2009 | 2002-2007 PRESIDENTIAL AND PARLIAMENTERY ELECTIONS<br>2000-2005 REFERANDUMS | 2008-2009 ECONOMIC RECESSION | 2003 IRAQ WAR<br>2003 OUTBREAK OF SARS |
| 2010-2023 | 2012-2017 PRESIDENTIAL AND PARLIAMENTARY ELECTIONS<br>2015 PARIS TERRORIST ATTACKS<br>2016 FRENCH TAXI DRIVER STRIKE<br>2017 SUBURBAN RIOTS<br>2018 YELLOW VESTS MOVEMENT | 2019-2020 ECONOMIC RECESSION | 2012 US FISCAL CLIFF AND SOVEREIGN DEBT CRISIS IN EUROPE<br>2016 BREXIT<br>2019 US-CHINA TRADE TENSIONS, AND BREXIT<br>2020 OUTBREAK OF COVID |

Note: See https://www.afse.fr/fr/cycles-eco/english-version-500228 recession periods of France.

| ITALY | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | | |
| 1970-1979 | 1972-1976-1979 ITALIAN GENERAL ELECTIONS<br>1970S THE YEARS OF LEAD (STREET VIOLENCE, ARMED STRUGGLE AND TERRORISM). | 1975 ECONOMIC RECESSION<br>1977 ECONOMIC RECESSION | 1970S ENERGY CRISIS (1973-1980)<br>THE COLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973) |
| 1980-1989 | 1980s THE YEARS OF LEAD (STREET VIOLENCE, ARMED STRUGGLE AND TERRORISM ) | 1980-1983 ECONOMIC RECESSION | |
| 1990-1999 | 1990 ITALIAN REFERANDUM | 1995-1996 ECONOMIC RECESSION | 1990 GULF WAR I |
| 2000-2009 | 2003 MULTI-BILLION EURO FRAUD IN PARMALAT FOOD-MANUFACTURING GIANT<br>2004 BERLUSCONY BRIBERY TRIAL | 2002-2003 ECONOMIC RECESSION | 2003 IRAQ WAR<br>2003 OUTBREAK OF SARS |
| 2010-2023 | 2013 ITALIAN GENERAL ELECTIONS | 2012-2013 ECONOMIC RECESSION | 2012 SOVEREIGN DEBT CRISIS IN EUROPE<br>2020 OUTBREAK OF COVID |

Note: See Altissimo et al. (2000) and Clementi et al. (2015) for recession periods of Italy.

| JAPAN | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | 1967-1969 JAPAN ELECTIONS | | 1963-1973 VIETNAM WAR |
| 1970-1979 | 1970: THE KOZA RIOT<br>1979 JAPAN ELECTIONS | 1970-1971 ECONOMIC RECESSION<br>1973-1975 ECONOMIC RECESSION | 1970s ENERGY CRISIS<br>THE COLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973) |
| 1980-1989 | 1979-1980-1983 JAPAN ELECTIONS | | |
| 1990-1999 | | | |
| 2000-2009 | | | |
| 2010-2023 | 2014-2017 ELECTIONS | 2018-2020 ECONOMIC RECESSION | 2019 US-CHINA TRADE TENSIONS AND BREXIT<br>2020 OUTBREAK OF COVID<br>2022 UKRAINE WAR |

Note: See https://www.esri.cao.go.jp/en/stat/di/rdates.html for recession periods of Japan.

| CANADA | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | | |
| 1970-1979 | | | |
| 1980-1989 | | | |
| 1990-1999 | 1997-2000 GENERAL ELECTIONS<br>1995 QUEBEC REFERANDUM | 1990-1992 ECONOMIC RECESSION | |
| 2000-2009 | | | 2001 SEPTEMBER 11 ATTACKS |
| 2010-2023 | 2015-2019-2021 GENERAL ELECTIONS | 2020 ECONOMIC RECESSION | 2019 US-CHINA TRADE TENSIONS AND BREXIT<br>2020 OUTBREAK OF COVID<br>2022 UKRAINE WAR |

Note: See https://www.cdhowe.org/council/business-cycle-council recession periods of Canada.

**Table AII: Event Charts, F5 Countries**

| TÜRKİYE | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | 1967 1969 STUDENT MOVEMENTS<br>1968 TURKISH SENATE ELECTION<br>1969 BLOODY SUNDAY- SIXTH FLEET | 1961 1ST STANDBY WITH IMF WAS SIGNED-RESIGNED EVERY YEAR UNTIL 1970 | THE COLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973) |
| 1970-1979 | 1970-1971 GOVERNMENT RESIGNATIONS, STUDENT MOVEMENTS, DECLARATION OF MARTIAL LAW<br>1975- 1979 STUDENT MOVEMENTS AND LABOR STRIKES CONTINUE<br>1974 CYPRUS PEACE OPERATION<br>1975 US EMBARGO AGAINST TURKIYE<br>1977 TAKSIM SQUARE MASSACRE | 1970-1979 TURKISH LIRA DEVALUATIONS, EARTHQUAKES<br>1979 TURKISH ECONOMIC RECESSION | 1970S ENERGY CRISIS (1973-1980)<br>THE COLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973) |
| 1980-1989 | 1980 SEPTEMBER 12 TURKISH COUP D'ÉTAT<br>1983 GENERAL ELECTIONS<br>1987 PKK TERRORIST ATTACKS AND STATE OF EMERGENCY IN 10 PROVINCES<br>1987 GENERAL ELECTIONS | 1980 RADICAL POLICY CHANGE IN THE TURKISH ECONOMY<br>1980 TURKISH ECONOMIC RECESSION. | 1990 GULF WAR I |
| 1990-1999 | | | |
| 2000-2009 | | | |
| 2010-2023 | 2018 GENERAL ELECTIONS AND TRANSITION TO THE PRESIDENTIAL SYSTEM<br>2018 ARREST OF PASTOR BRUNSON<br>2019 LOCAL ELECTIONS<br>2023 GENERAL ELECTIONS | 2020 EARTHQUAKES<br>2021-2023 ECONOMIC POLICY CHANGE (CHINESE MODEL)<br>2023 EARTHQUAKES | 2020 COVID 19 PANDEMICS<br>2022 WAR IN UKRAINE |

| SOUTH AFRICA | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | | |
| 1970-1979 | | | |
| 1980-1989 | 1988 TERRORIST ATTACKS AND ASSASSINATIONS | 1981-1989 ECONOMIC RECESSION<br>1980S ECONOMIC BOYCOTTS | |
| 1990-1999 | 1992-1993-1994 ASSASSINATIONS, SHOOTINGS AND POLITICAL CHAOS<br>1994 GENERAL ELECTIONS | 1990-1993 ECONOMIC RECESSION<br>1994 (STOCK MARKET) ECONOMIC RECESSION<br>1998 (STOCK MARKET) ECONOMIC RECESSION | 1990 GULF WAR I |
| 2000-2009 | 2002 ATTACKS AND EXPLOSIONS,<br>2006 STUDENT ARRESTS, STRIKES, SHOOTINGS AND POLITICAL PROTESTS | | 2003 IRAQ WAR<br>2003 OUTBREAK OF SARS |
| 2010-2023 | 2010's POLITICAL INSTABILITIES<br>2011 GENERAL ELECTIONS | | 2019 US-CHINA TRADE TENSIONS, AND BREXIT<br>2020 OUTBREAK OF COVID |

| BRAZIL | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | | |
| 1970-1979 | | | |
| 1980-1989 | | | |
| 1990-1999 | TRANSITION TO A NEW SYSTEM AND GOVERNMENTAL APPROACH | 1988,1990,1992 ECONOMIC RECESSION<br>(FROM THE EARLY 1990S ONWARDS, ECONOMIC LIBERALIZATION MOVES TOOK PLACE, ACCOMPANIED BY A CURRENCY FREEZE AND AN 18-MONTH FREEZE ON BANK DEPOSITS) | 1990 GULF WAR I |
| 2000-2009 | 2005 BRAZILIAN FIREARMS AND AMMUNITION REFERENDUM | | 2003 IRAQ WAR |
| 2010-2023 | 2018 GENERAL ELECTIONS<br>2022 GENERAL ELECTIONS<br>2023 OCCUPATION OF THE BRAZILIAN CONGRESS | | 2008-2010 GLOBAL FINANCIAL CRISIS<br>2020 OUTBREAK OF COVID |

| INDONESIA | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | 1965 30 SEPTEMBER MOVEMENT- COUP IN INDONESIA<br>1965-1966 INDONESIAN MASS KILLINGS | 1962 ECONOMIC RECESSION | THECOLLAPSE OF THE BRETTON WOODS SYSTEM (1968-1973) |
| 1970-1979 | 1975 OCCUPATION OF EAST TIMOR | | 1970S ENERGY CRISIS (1973-1980) |
| 1980-1989 | 1982 TERRORIST ATTACKS<br>1984 DEADLY REBELLIONS | 1983 ECONOMIC POLICY CHANGE LIBERALIZATION AND EXPORT-LED RAPID GROWTH (1983-1996) | 1990 GULF WAR I |
| 1990-1999 | 1991 FREE ACEH MOVEMENT AND THE DEATH OF 2000 PEOPLE, ATTACKS IN EAST TIMOR<br>1995 STUDENT MOVEMENTS AGAINST THE REGIME<br>1998 STUDENT MOVEMENTS AND KILLINGS | 1998 FINANCIAL CRISIS | 1997 ASIAN FINANCIAL CRISIS |
| 2000-2009 | 2001 MASS PROTESTS AND THE FALL OF THE GOVERNMENT<br>2002-2003 TERRORIST ATTACKS AND POLITICAL COURT CASES<br>2009 TERORIST ATTACKS | 2001 CORRUPTION EVENTS AND IMF'S SUSPENSION OF ADDITIONAL LOANS<br>2006 EARTHQUAKE | 2008 GLOBAL FINANCIAL CRISIS |
| 2010-2023 | 2011 INTERRELIGIOUS CONFLICTS | 2010 VOLCANO ERUPTION | 2022 WAR IN UKRAINE |

| INDIA | POLITICAL EVENTS | ECONOMIC EVENTS | GLOBAL EVENTS |
|---|---|---|---|
| 1960-1969 | | | |
| 1970-1979 | | | |
| 1980-1989 | 1988 GENERAL ELECTIONS | 1979 ECONOMIC RECESSION<br>1988 NEPAL EARTHQUAKE | |
| 1990-1999 | 1992-1993-1994-1995 ATTACKS, SHOOTINGS, TERORIST ATTACKS AND POLITICAL PROTESTS, ELECTIONS<br>1996 CORRUPTION SCANDALS<br>1996 ELECTIONS AND CHANGING GOVERNMENT | 1992 1992 LOCAL CURRENCY DEPRECIATED BY 50%<br>1993 EARTHQUAKE | 1997 ASIAN FINANCIAL CRISIS |
| 2000-2009 | 2002 PUBLIC SECTOR STRIKES AND CONFLICTS WITH PAKISTAN<br>2006 AND 2009 TERORIST ATTACKS<br>2009 ELECTIONS | 2006 EARTHQUAKE | 2008 GLOBAL FINANCIAL CRISIS |
| 2010-2023 | 2014 GENERAL ELECTIONS | | 2008-2010 GLOBAL FINANCIAL CRISIS<br>2020 OUTBREAK OF COVID |