Lahore Journal of Economics
Volume 28, Issue 2,
Autumn 2023

Are Consumer Expectations Forward-Looking: A Case for Pakistan

Ali Inayat
Assistant Director,
Research Department, State Bank of Pakistan
Email: ali.inayat@sbp.org.pk
(Corresponding Author)

Citation: "Inayat, A. (2024). Are Consumer Expectations Forward-Looking: A Case for Pakistan." *Lahore Journal of Economics*, 28(2), 1-13.
https://doi.org/10.35536/lje.2023.v28.i2.a1

Abstract: We have used the Dynamic Time Warping (DTW) algorithm to calculate the forward-looking consumer inflation expectation forward-lookingness. We have used DTW instead of widely used parametric techniques as this algorithm does not require specific assumptions relating to time series data. The results suggest that expectations are more backward-looking from 2012 to 2022. Furthermore, we examined consumers' response to the exchange rate regime shift and found evidence of consumers becoming more forward-looking due to the deliberate change in policy stance from fixed to managed float. This suggests that changes in economic policy can directly impact the consumer's expectations formation process.

Keywords: Consumers, inflation, inflation expectations.

JEL Classification: C63, F31.

Received: 2nd November 2023 Revised: 17th July 2024 Accepted: 25th September 2024

Are Consumer Expectations Forward-Looking: A Case for Pakistan

1. Introduction

Inflation expectations play a crucial role in the monetary transmission mechanism. When consumers expect inflation to rise, they increase their consumption and reduce their savings. Also, when workers expect inflation to rise, they demand higher wages. Hence, understanding how inflation expectations are formed is of primary interest to monetary policymakers across economies.

Much of economic theory assumes that economic agents are 'rational' in their decision-making. One fundamental outcome of this assumption is the full information rational expectation hypothesis, which implies that economic agents, including consumers, use the full set of information available to them while forming expectations about the future and, hence, are forward-looking. More importantly, their decision is free from past movements in economic variables, e.g., inflation, unemployment, etc., but instead focused on how these variables will change in the future in response to the current economic situation and deliberate government policies(Muth (1961); Lucas jr (1976); Evans and Honkapohja (2001)).On the other end of the spectrum, we have an **adaptive expectation model** and a **static expectations model**, both stating, with some variation, that consumers follow past trends to make future predictions, i.e., consumers are backward-looking (Evans and Honkapohja (2001)).

A growing strand of the literature suggests that the actual inflation expectation formation process is more complex than suggested by simple backward-looking (BL) or forward-looking (FL) models. This new specification with FL and BL components is often referred to as a hybrid specification of expectations. The specifications of the model can be seen in equation (1) and (2) below:

$$\pi^{e}_{t+6|t} = \alpha_1 + \alpha_2\pi_{t+6} + (1-\alpha_2)\left[\pi^{e}_{t-1|t-7} + \alpha_3\left(\pi^{e}_{t-1|t-7} - \pi_{t-1}\right)\right] + \epsilon_t \qquad (1)$$

$$\pi^{e}_{t+6|t} = \alpha_1 + \alpha_2\pi_{t+6} + (1-\alpha_2)\pi_{t-1} + \epsilon_t \qquad (2)$$

where $\pi^{e}_{t+k|t}$ represents the inflation expectation at time t for time $t+k$ and π_t represents the inflation at time t.

Note that if $\alpha_1 = 0$ and $\alpha_2 = 1$, both the equations become the same and represent the fully forward-looking model. However, if $\alpha_2 \neq 1$, equation (1) and equation (2) refer to the adaptive expectations model and static specification model, respectively, for the backward-looking component. The adaptive specification hypothesis relates expectations to their past values. It is corrected by past expectation errors, while the static specification model simply links inflation expectation with the latest available inflation data.

In this study, we have applied a non-parametric Dynamic Time Warping (DTW) technique to establish a relationship between inflation expectations and inflation. This novel solution is motivated by the shortcomings of existing procedures due to characteristics of time series data (expectations are mostly non-stationary). (Rutkowska and Szyszko (2022)). DTW is not new in itself, but its application to economic time series is a recent phenomenon. Initially, the technique originated from speech recognition (Itakura (1975); Rutkowska and Szyszko (2022)), and in economic time series, it has found its use case in measuring similarity or distance between two temporal time series. Few research papers have been published in the last decade using DTW in economics. Some have used it to predict the US recessions of 1997 and 2007, while others have used it (along with cluster analysis) to study the business cycles of different US states during the Great Depression and have found evidence of temporal alignment between state dynamics. More recently, authors have used the DTW to estimate the forward-lookingness of inflation expectations for the EU region and found results similar to those of the parametric approach. To our knowledge, no study for Pakistan has used DTW for economic time series analysis.

Using DTW, we calculated the similarity between consumer inflation expectations and inflation. Our study finds that the consumers follow a hybrid model for expectation formation with more weight given to historical inflation. This study also finds that consumers become more forward-looking following a structural economic change.[1]

2. Data and Methodology

Data

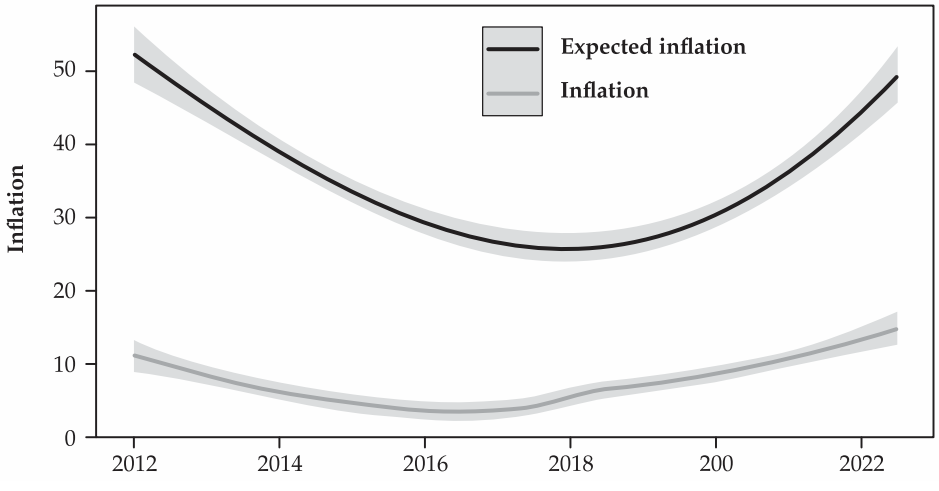
We have a Michigan-style survey conducted jointly by the State Bank of Pakistan and the Institute of Business Administration (IBA). We

[1] In our case, the major structural change was the change in the de facto exchange rate regime in 2019.

have used the mean expectations data from Q6[2] of the survey. This data gives responses about expectations of how the prices of goods will change after six months, i.e., their inflation expectations after six months. After taking out the outliers,[3] we are left with around 89000 responses between January 2012 and July 2022.

Figure 1 compares the expected inflation with the realized inflation for 2012-2022. The graph clearly shows that although consumer inflation expectations are consistently higher than actual inflation, both move in the same direction for most of the period. Expectations higher than the actual are not surprising, and the same phenomenon can be observed in many countries. The graphical relation can be formalized using the Pearson correlation coefficient, which is 0.62 in our case. Detailed interactions between inflation and consumer expectations for Pakistan have been explored, establishing a relationship between inflation and different sub-components of consumer inflation expectations. This relationship between expectations and inflation gives us a good starting point to explore whether expectations are adaptive or rational and their composition is exogenous.

Figure 1: Expected inflation vs Inflation from Jan 2012 till July 2022[4]



Source: Inayat, A. (2024). Household Inflations Expectations Uncertainty: A Case for Pakistan. *Lahore Journal of Economics,* 28(l):l-36.

[2] Consumer Confidence Survey Questionnaire (https://www.sbp.org.pk/ccs/Survey%20Information/Questionnaire%20Urdu.pdf)
[3] We have followed for outlier detection.
[4] Loess is used for smoothing

3. Expected inflation vs Inflation from Jan 2012 to July 2022

Dynamic Time Warping - DTW

Dynamic time warping (DTW) is the name of a class of algorithms that compares time series of values with each other. Given two time series, the rationale behind DTW is to stretch or compress them locally to make one resemble the other as much as possible. The distance between the two is computed after stretching by summing the distances of individually aligned elements. (Giorgino (2009)) Let's say we have two time series: a test $X = (x_1, x_2, \ldots, x_N)$ and a reference $Y = (y_1, y_2, \ldots, y_M)$ of lengths N and M respectively. We now choose a distance function f between any pair of elements x_i and y_j:

$$d(i,j) = f(x_i, y_j) \geq 0 \tag{3}$$

$d(i,j)$ is small if the series are similar; otherwise, it is large. The Euclidean distance function is the most widely used function for $d(i,j)$. Once we get the local distance between each pair of x_i and y_j, it is then stored in the cost matrix $C \in \mathbb{R}^{N \times M}$. A warping path ϕ is a contiguous set of matrix elements that defines a mapping between the time indices of X and Y that satisfies the following conditions:

- The boundary condition: $\phi_1 = (1,1)$ and $\phi_T = (N, M)$, which ensures that the first elements of X and Y as well as the last elements of X and Y are aligned with each other.
- The monotonicity condition: $\forall_i\ \phi_i = (r, c),\ \phi_{i+1} = (r', c') \implies r' \geq r$ and $c' \geq c$, reflects the requirement of faithful timing: If an element in X precedes a second element from X, this should also hold for the corresponding elements in Y, and vice versa.
- The continuity condition: $\forall_i\ \phi_i = (r, c)\ , \phi_{i+1} = (r', c') \implies r' - r \leq 1$ and $c' - c \leq 1$, which means that no element in X and Y can be omitted, there are no replications in the alignment.

Given ϕ, total cost d_ϕ and the average normalized cost $\overline{d_\phi}$ between the warped time series X and Y are given as:

$$d_\phi(X,Y) = \sum_{k=1}^{T} d\,(\phi_k), \tag{4}$$

$$\overline{d_\phi}(X,Y) = \sum_{k=1}^{T} \frac{d(\phi_k) \cdot m_{\phi_k}}{M_\phi} \tag{5}$$

where m_{ϕ_k} is per step weightage and M_ϕ is the corresponding normalization constant. We use dynamic programming to determine an optimal path DTW and avoid exponential computational complexity. The cumulative cost matrix D satisfies the following identities:

$$D(n,1) = \sum_{k=1}^{n} d\,(x_k, y_1),\ for\ \ n \in [1{:}\,N], \tag{6}$$

$$D(1,m) = \sum_{k=1}^{m} d\,(x_1, y_m),\ for\ \ m \in [1{:}\,M], \tag{7}$$

$$D(n,m) = min[D(n-1,m-1), D(n-1,m), D(n,m-1)] + d(n,m),\ for\ 1 < n \leq N\ and\ 1 < m \leq M \tag{8}$$

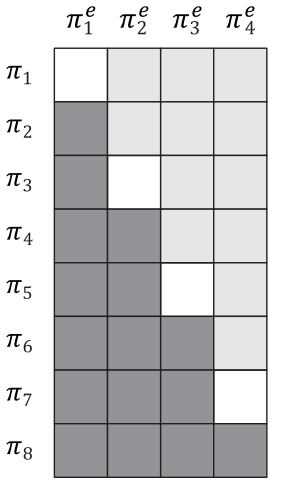
The goal is to find an alignment between X and Y that minimizes the accumulated cost

$$DTW(X,Y) = \min_{\emptyset} d_{\emptyset} \tag{9}$$

DTW for Testing Expectations Forward-Lookingness

Global constraints or windowing can be implemented on the warping path to modify the DTW algorithm to extract the forward-lookingness or backward-lookingness of consumers. In the algorithm, when the warping path is restricted to interactions between inflation expectations and past inflation, we can get the DTW distance for the backward-looking expectations model. Compared to the static model specified in equation (2), this strategy has an added advantage: the consumer can interact with any past inflation to form their inflation expectations and is not limited to the latest inflation values only. Similar is the case for forward-looking expectations through DTW; the consumer may refer to any future inflation while forming their inflation expectations, and they are not limited to any time frame. Thus, our central assumption, which differentiates this study from classical work, is that we define following expectations as forward-looking when consumers refer to any future inflation while forming expectations and backward- when they formulate expectations based on the value of inflation from the past. Figure 2 gives a pictorial representation of how the region is selected for FL DTW and BL DTW. The first thing to note is that the expectations are available bi-monthly, i.e., if π_1^e is an expectation for January, then π_2^e is an expectation for March. However, inflation data is available monthly, i.e., if π_1 represents inflation for January, then π_3 represents inflation for March. The grey region in Figure 2 represents the possible region for warping for FL DTW, and the blue region represents the BL DTW.

Figure 2: Grey and blue shaded regions for forward- and backward-looking expectations, respectively.



Source: Author's estimates.

4. Results

Expectations formation with DTW

Using the above algorithms, we have calculated the distance between expectations coming from the survey and the inflation. Table 1 below highlights how consumers are more BL than FL from 2012 to 2022. Further, DTW Forward is the DTW distance measured by restricting interactions between inflation expectations and future inflation only. In contrast, DTW backward is calculated by restricting interactions between inflation expectations and past inflation only. Normalization is done by dividing the DTW results by the total data points available for inflation and inflation expectations, i.e., $M + N$. It should be noted that Normalized DTW represents the "distance," i.e., a smaller value translates into greater similarity between the two time series with a given constraint. Finally, we calculated the coefficient by taking the ratio of the inverse Normalized DTW forward with the sum of inverse Normalized DTW forward and backward, i.e.,

$$Coefficient\ of\ FL = \frac{\frac{1}{FL}}{\frac{1}{FL} + \frac{1}{BL}}$$

where *FL* is Normalized DTW forward, and *BL* is Normalized DTW backward. The coefficient value ranges from 0 to 1, with 1 being fully forward-looking and 0 being fully backward-looking. The coefficient value of 0.36 can roughly be used as the weightage consumers give to the FL component while forming expectations. The results align with contemporary research[5], which states consumers are more backward-looking than forward-looking. Furthermore, monetary policy becomes less effective when expectations are backward-looking. In addition to the stated result, we also checked the relationship at a disaggregated level for different demographics[6] and found no difference in results (Table 4).

Table 1: DTW results comparing if consumers are more BL or FL

	Distance/Cost
DTW	1931.78
Normalized DTW	10.11
DTW forward	4393.44
Normalized DTW forward	23.00
DTW backward	2544.89
Normalized DTW backward	13.32
Coefficient of FL	0.37

Source: Author's calculations.
Note: The distance/cost value for BL is lower than the same for FL, suggesting that consumers are generally more BL than FL. The general result has a distance lower than the separate constrained costs for BL and FL, indicating that consumer expectations comprise both BL and FL components.

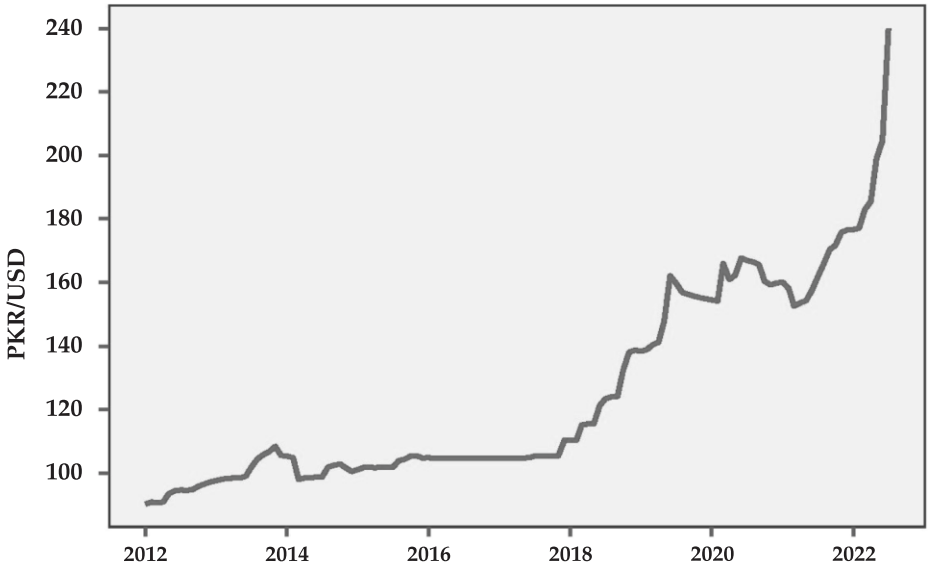
Expectation formation and policy shifts

Based on the available literature on expectation formation, news about the economy can have significant implications for how expectations are formed. For instance, some authors examined the impact of the Russian invasion of Ukraine on inflation expectations among professional forecasters and found that news of the invasion increased these expectations. Similarly, other authors used survey data from German consumers right before and after monetary policy announcements to evaluate the implications of ECB meetings on inflation expectations. They discovered that policy rate announcements lead to prompt and significant adjustments in household inflation expectations, with the effects peaking after six months. Similar results were observed in the US, utilizing data from the Federal Reserve Bank of New York's Survey of Consumer

[5] See Chapter of World Economic Outlook, October 2023, for references.
[6] We checked results for gender, location, and education level attained.

Expectations (SCE). The authors analyzed consumer sentiment responses to gas price changes through daily Gallup survey data and found that consumer sentiment tends to become more pessimistic as gas prices rise in the US. Comparable findings were reported in Pakistan using the CCS data from 2011 to 2013. These studies highlight the influence of economic news on expectations. This provides motivation to investigate whether consumers alter their expectation formation behavior in response to news about shifts in economic policy. We believe that the significant shift in Pakistan's exchange rate regime in 2019 can be used to test this hypothesis.

Figure 3: Month End PKR per USD



Source: State Bank of Pakistan.

On its website, the State Bank of Pakistan states that the SBP has followed a market-determined exchange rate regime with occasional interventions to 'quell excessive volatility.' However, the nominal exchange rate did not move much despite external pressures between 2012 and 2018. In 2019, Pakistan entered into an IMF program, and one of the main demands from Pakistan was *a flexible, market-determined exchange rate to restore competitiveness*. As a result, we see a sharp depreciation of the Pakistani rupee in 2019 and the determination of the exchange rate by market forces since then. Figure 3 depicts the month-end USD value against PKR. From Jan 2012 until Jan 2018, we see the USD rising slightly from PKR 90 to PKR 110; by the end of 2018, the exchange rate reached PKR 140 per USD. This slide in the exchange rate can be attributed to the looming

speculation about Pakistan entering into an IMF program. After that, the PKR kept on its downward slide, with USD reaching as high as PKR 240/USD in July 2022.[7,8] The news about this shift was widely cited in the national media, reaching a wider societal audience. As a result, according to our hypothesis, consumers should become more aware of the current economic situation and follow economic news more closely; hence, they should become more forward-looking. This hypothesis can be checked by dissecting our data into two periods: 2012-2018 and 2019-2022. The separate results can be seen in Table 2, which exhibits that the coefficient of FL increased from 0.33 to 0.55 from the first period to the second. From this, we can infer, with a certain degree of confidence, that a structural change in any major economic variable makes consumers more FL than before.

One might argue that the increase in FL cannot be linked to the change in the ER regime alone, as the COVID-19 pandemic followed the shift in the ER regime in 2020. The increase in FL may be attributed to the pandemic and the subsequent lockdown. To counter this argument, we can further divide the managed ER regime period into pre-COVID and post-COVID to assess the impact on the FL coefficient purely from the ER regime shift. Table 3 shows that the change in the coefficient of FL is mainly driven by the shift in the ER regime and increased slightly further after COVID-19. This result signifies that the pandemic has affected consumer expectations' forward-lookingness. However, the impact is limited when compared to the significant change in the coefficient of FL caused by the change in the ER regime.

Now we have established, to a certain degree, that changes in the exchange rate regime have caused a shift in the expectation formation process of consumers. Further breakdown of expectations based on demographic characteristics during a "managed regime" shows that although the forward-lookingness of all sections of society has increased, the gap between male and female populations has widened. These results contrast with those found after the ER regime change, where we saw little deviation in forward-lookingness among different sections of society. This indicates that the shift in the ER regime and the news surrounding the IMF program has a bigger impact on the male population than the female population. One possible reason for this could be that in Pakistan, the male population has more access to information than the female population and,

[7] https://www.imf.org/en/News/Articles/2019/05/12/pr19157-IMF-Reaches-Staff-Level-Agreement-on-Economic-Policies-with-Pakistan-for a-Three-Year-EFF

[8] https://www.imf.org/en/News/Articles/2019/07/03/pr19264-pakistan-imf-executive-board-approves-39-month-eff-arrangement

on average, has higher financial literacy (Fletschner and Mesbah (2011)). In fact, data shows that financial access for females is more than 50 percent less than for males in Pakistan in 2021.

Table 2: DTW results for fixed ER regime versus Managed ER regime

	Fixed ER regime	Managed ER regime
DTW	1436.47	809.86
Normalized DTW	11.49	12.46
DTW forward	2949.58	833.29
Normalized DTW forward	23.60	12.82
DTW backward	1413.53	1022.69
Normalized DTW backward	11.31	15.73
Coefficient of FL	0.32	0.55

Source: Author's calculations.
Note: Fixed ER regime is from 2012-2018 and managed ER regime is from 2019-2022.

Table 3: DTW results with bifurcation for Covid-19.

	Fixed	Managed (pre-Covid)	Managed (post-Covid)
DTW	1436.47	233.21	569.92
Normalized DTW	11.49	11.66	12.95
DTW forward	2949.58	229.66	538.78
Normalized DTW forward	23.60	11.48	12.24
DTW backward	1413.53	259.13	784.36
Normalized DTW backward	11.31	12.96	17.83
Coefficient of FL	0.32	0.53	0.59

Source: Author's calculations.
Note: Divided time into three periods: fixed ER regime (2012-18), managed ER regime pre-covid (2019), and managed ER regime post-covid (2019-2022).

Table 4: Disaggregated DTW results under managed ER regime

	Male	Female	Urban	Rural	Non-Graduate	Graduate
DTW	682.48	1014.80	803.99	826.68	824.76	726.27
Normalized DTW	10.50	15.61	12.37	12.72	12.69	11.17
DTW forward	672.04	1075.87	837.32	814.59	842.54	804.54
Normalized DTW forward	10.34	16.55	12.88	12.53	12.96	12.38
DTW backward	957.79	1221.30	1008.43	1053.33	1024.48	945.90
Normalized DTW backward	14.74	18.79	15.51	16.21	15.76	14.55
Coefficient of FL	0.59	0.53	0.55	0.56	0.55	0.54

Source: Author's calculations.

5. Conclusion

In this paper, we used a novel dynamic time-warping technique to study the relationship between consumer inflation expectations and realized inflation. The advantage of the non-parametric technique of DTW is that it is not restrained by the time series modeling assumptions required while using any parametric time series model. This study establishes that inflation expectations are neither entirely forward-looking nor backward-looking but rather follow a hybrid model with more weightage given to the backward-looking component. Furthermore, the study also looks into the impact of policy shifts on expectations and uses the 2019 exchange rate regime shift as a proxy. The results show that after the ER regime was loosened, the expectations became more forward-looking, indicating that households updated their information following any major policy shifts by the government.

6. References

Abbas, H., Beg, S., and Choudhary, M. (2015). Inflation expectations and economic perceptions in a developing country setting. *Available: dsqx. sbp. org. pk/ccs/swrvey% 20information/paper. pdf. Ahmad, E. and H. Ram (1991)."Foreign Price Shocks and Inflation in Pakistan: A Monetarist Approach." Pakistan Economic and Social Review,* 29(1):1 20.

Binder, C. and Makridis, C. (2022). Stuck in the Seventies: Gas Prices and Consumer Sentiment. *Review of Economics and Statistics,* 104(2): 293-305.

Binder, C. C., Campbell, J. R., and Ryngaert, J. M. (2024). Consumer Inflation Expectations: Daily Dynamics. *Journal of Monetary Economics,* page 103613.

Demirgiiq-Kunt, A., Klapper, L., Singer, D., and Ansar, S. (2022). *The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19.* World Bank Publications.

Drager, L., Griindler, K., and Potrafke, N. (2022). Political Shocks and Inflation Expectations: Evidence from the 2022 Russian Invasion of Ukraine.

Evans, G. and Honkapohja, S. (2001). Economics of expectations. In Smelser, N. J. and Baltes, P. B., editors, *International Encyclopedia of the Social and Behavioral Sciences,* pages 5060-5067. Pergamon, Oxford.

Fletschner, D. and Mesbah, D. (2011). Gender Disparity in Access to Information: do Spouses Share what they Know? *World Development,* 39(8):1422-1433.

Franses, P. H. and Wiemann, T. (2020). Intertemporal Similarity of Economic Time Series: An Application of Dynamic Time Warping. *Computational Economics,* 56:59-75.

Giorgino, T. (2009). Computing and Visualizing Dynamic Time Warping Alignments in r: The DTW Package. *Journal of Statistical Software,* 31(7):1-24.

Inayat, A. (2024). Household Inflations Expectations Uncertainty: A Case for Pakistan. *Lahore Journal of Economics,* 28(l):l-36.

Itakura, F. (1975). Minimum Prediction Residual Principle Applied to Speech Recognition. *IEEE Transactions on Acoustics, Speech, and Signal Processing,* 23(l):67-72.

Lucas Jr, R. E. (1972). Expectations and the Neutrality of Money. *Journal of Economic Theory,* 4(2): 103-124.

Lucas Jr, R. E. (1976). Econometric Policy Evaluation: A critique. In *Carnegie-Rochester Conference Series on Public Policy,* Volume 1, pages 19-46. North-Holland.

Muth, J. F. (1961). Rational Expectations and the Theory of Price Movements. *Econometrica: Journal of the Econometric Society,* pages 315-335.

Raihan, T. (2017). Predicting us Recessions: A Dynamic Time Warping Exercise in Economics. *Available at SSRN 3047649*.

Rast, S. (2021). Central Bank Communication with the General Public: Survey Evidence from Germany. *Unpublished, European University Institute.*

Rutkowska, A. and Szyszko, M. (2022). New DTW Windows Type for Forward- and Backward-Lookingness Examination, Application for Inflation Expectation. *Computational Economics*, 59(2):701-718.

Weber, M., D'Acunto, F., Gorodnichenko, Y., and Coibion, O. (2022). Reality check: How People form Inflation Expectations and why you should Care. *SSRN Scholarly Paper ID*, 4058361.