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Expectation Shocks and Business Cycles

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Expectation Shocks and Business Cycles

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ABSTRACT

I study a smorgasbord of different expectation shocks in two kinds of macroeconomic models. As a baseline, I use a simple aggregate demand and supply framework with adaptive expectations. I present impulse response results for exogenous, temporary expectation shocks lasting for one period only or four periods, expectation shock with output gap-centered Taylor rule as opposed to inflation targeting and permanent exogenous shocks (long-run shock) to expectations. Later, I extend my results using a New Keynesian model, allowing for a richer analysis. In this New Keynesian setting, I study the impact of anticipated and unanticipated preference shocks with backward- and forward-looking expectations.

My results indicate the centrality of the expectation formation process in driving the shock reactions and propagation 1. Policymakers in Pakistan should design policies which manoeuvre market sentiments more effectively through press releases and frequent information sharing with the market to make business cycle fluctuations more docile.

JEL Classification: E00, E12, E30, E32, E40, E50, E52, E70, E71, D84

Keywords: Smorgasbord of Inflation Expectation Shocks, Temporary, Permanent and Sequence of Temporary Expectation Shocks, Monetary Policy and Inflation Expectations, AD and AS Model, Expectation Shocks in New Keynesian Models.

MOTIVATION

There is a large and growing literature in macroeconomics which attributes business cycle fluctuations to expectations, especially considering the Great Recession, which did not seem to have been driven by highly unfavourable fundamentals. Many economists now recognise an enlarged role for beliefs in the narrative of business cycles (see, for example, Kozlowski, et al. 2019; Gennaioli and Shleifer, 2020). Classic studies such as those of Minsky (1977); Kindleberger (1978) and more recently, Reinhart and Rogoff (2009) argue that the failure of investors to assess risks accurately is a common thread of many of these episodes. Meanwhile, Rajan (2006) and Taleb (2007) stressed the dangers of low probability risks to financial stability due to subprime mortgages.

For instance, in October 2017, the University of Chicago surveyed a panel of leading economists in the United States and Europe on the importance of various factors contributing to the 2008 Global Financial Crisis. According to the panellists, the number one contributing factor was the "flawed financial sector" in terms of regulation and supervision. Meanwhile, the number two factor among the twelve considered ranking just below the first in estimated importance was an underestimation of risks from financial engineering. The experts seem to agree that the fragility of a highly leveraged financial system exposed to significant housing risk was not fully appreciated in the period leading to the crisis. Many economists increasingly recognise that the Lehman bankruptcy and the fire sales during 2008 revealed that investors and policymakers learned that the financial system was more fragile and interdependent than they previously thought Gennaioli and Shleifer (2020).

If the output over-expansion is fueled by excessive credit growth, as suggested by recent historical evidence Schularick and Taylor (2012); Mian, et al. (2017) (footnote 2), then the eventual recognition of tail risks and overheating in financial markets paves the way for a Minsky Moment Minsky (1977). For instance, Bordalo, et al. (2018) build a micro-founded and behavioural model of expectations called diagnostic expectations and credit cycles in which beliefs overreact to incoming news because of the representative heuristic. This phenomenon creates excessive optimism when credit spreads are low during booms. In contrast, it exaggerates subsequent reversal when good news inflow slows down, leading to endogenous cycles in the absence of change in fundamentals, endogenously engendering a recession.

Much of this work indicates that there are errors in expectations throughout the the business cycle, leading to the trend of data collection by various global central banks, such as the Federal Reserve in the USA, and even the State Bank of Pakistan (SBP), on expectations through survey data. Increasingly, such data is considered a valid and beneficial source of information for economic research. We have learned that expectations in financial markets tend to be extrapolative rather than rational, and this essential feature needs to be integrated into economic analysis.

In this work, I focus on modelling expectation shocks in a simple aggregate demand and supply model with adaptive expectations as a baseline, followed by an extension into a New Keynesian model with a combination of forward-looking and adaptive expectations. I study a variety of expectation shocks, such as temporary shocks lasting for one period versus those lost for four periods, permanent shocks, and a series of repeated temporary shocks. In doing so, I analyse the responses of inflation, output and nominal and real interest rates in reaction to various expectation shocks. Lastly, I use some stylised data from Pakistan and analyse the impulse responses of key macroeconomic variables to such expectation shocks in a developing economy with lower levels of financial access and high poverty.

STYLISED FACTS

There is a structure, pattern, regularity, and relative coherence in the way that consumer expectations evolve over the business cycle, especially when one examines cross-sectional heterogeneity. Certain demographic groups have consistently more pessimistic and inaccurate expectations, such as women, ethnic minorities, lower socio-economic groups and young people (see, for instance, Madeira and Zafar (2015) and Curtin (2019)). There is also an average pessimism bias across all demographic groups because of asymmetric recall of negative news in the elicited expectations relative to estimates of rational expectations Curtin (2019), Bhandari, et al. (2019). The volatility of consumer sentiment over the business cycle also varies across groups, with higher socio-economic groups showing more volatility Curtin (2019). Meanwhile, the time series co-movements across demographic groups are very high.

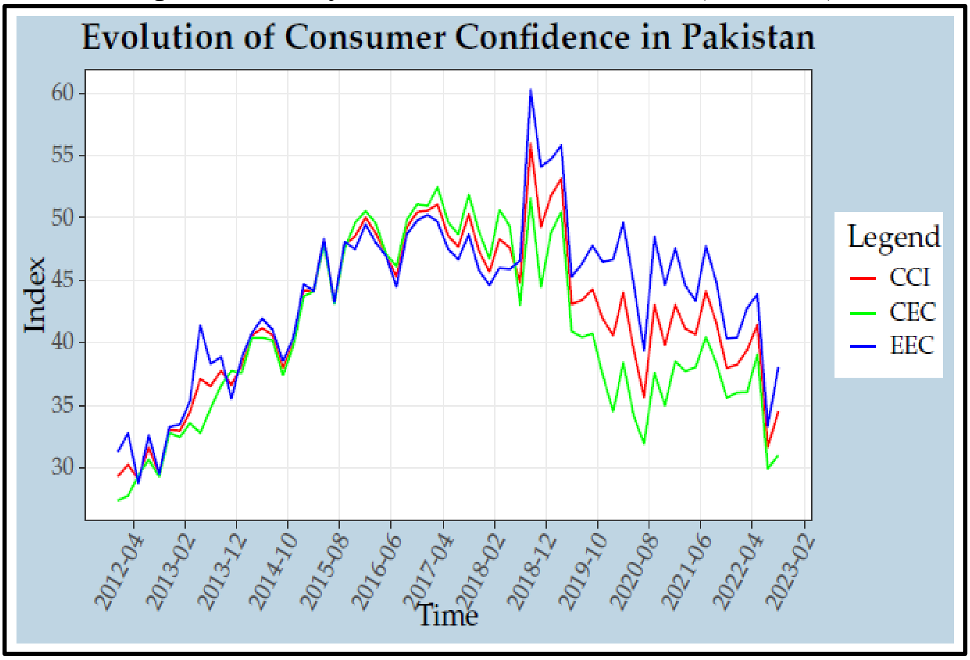
Moreover, the literature has established that consumer sentiment indices regularly predict recessions, though not by a long horizon. The forward-looking, informative and leading indicator nature of consumer sentiment data is precisely the reason why the University of Michigan survey and similar surveys have become globally popular among central banks and policymakers. This evidence suggests that while “autonomous” components of consumer sentiment, such as those driven by instruments, are needed for econometric identification of plausibly exogenous variation, there is also an important systematic and endogenous component to these sentiments—which is responding to, predicting and causing significant developments in the real economy. For instance, sentiments can influence search intensity in labour markets, consumer durable goods purchases, etc. There is evidence that household expectations are predictive of economic and financial behaviour Armantier, et al. (2015); Armona, et al. (2018), and high volatility in consumer durable goods purchases over the business cycle has often been attributed in the literature to consumer sentiment fluctuations (see for instance Katona. et al. (1960); Mishkin, et al. (1978)).

DATA FROM PAKISTAN

Every two months, the SBP conducts various surveys, including a Consumer Confidence Survey (CCS) and a Business Confidence Survey (BCS). CCS is a telephonic survey of households selected randomly across the country and provides information on “what people are thinking” about the economy. BCS is the telephonic survey of firms and provides information on what firms are thinking about the business conditions in the country.

I use data from the State Bank of Pakistan (SBP) in the following graphs on consumer confidence in Pakistan from 2012 to 2022. Firstly, in Figure 1, I plot the evolution of three consumer confidence indices for Pakistan at a bi-monthly (i.e. six times in one year or once every two months) frequency from January 2012 to September 2022. It is evident that all three indices: the overall Consumer Confidence Index (CCI), current Economic Conditions Index (CEC) and Expected Economic Conditions Index (EEC), co-move with each other. However, since 2018 some variation has been noticeable, with expected economic conditions being the most optimistic, perception of current economic conditions being at the lowest level of optimism and the CCI lying somewhere in the middle. The data also reveals that the recent inflation crisis in Pakistan led to a sharp reduction in consumer confidence in early 2022, which has only mildly recovered by September 2022.

Fig. 1. Bi-monthly Consumer Confidence Indices (2012–2022)

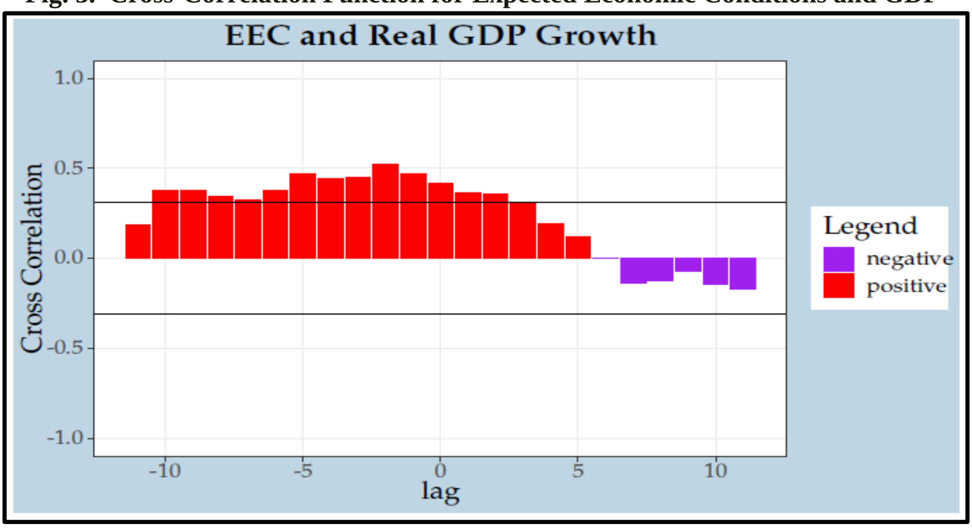


Meanwhile, in Figure 2, I plotted the bi-monthly inflation expectations index, which includes categories such as energy products, food and non-food inflation and daily use items. It is evident that when consumer confidence and expectations regarding economic conditions became more optimistic from 2012 to 2018, inflation expectations also fell six months ahead. From 2018 to 2021, when consumer confidence fell, it was coterminous with a rise in the short run, inflation expectations. Across various items, the inflation expectations were close to each other, but they rose dramatically for daily use items from 2016 to 2018 relative to the other categories. Energy items tend to be associated with lower average inflation expectations relative to all other items, especially daily-use products. These expectations are highly volatile, predominantly driven by frequent bouts of dramatically lower inflation expectations relative to other groups.

Fig. 2. Bi-monthly Inflation Expectations (2012–2021)

In Figure 3, I provide evidence on cross-correlations between quarterly expected economic conditions index and quarterly GDP data for Pakistan from 2012 to 2021, based on SBP's (State Bank of Pakistan) data, i.e. $Corr(EEC_{x-t}, GDP_x)$, where $t \in (-10,10)$. The results below, along with 95 per cent confidence intervals, reveal that increases in past levels of expected economic conditions are positively and significantly correlated with future real GDP growth rates at various horizons, especially five or fewer quarters. Meanwhile, current real GDP growth changes are not significantly correlated with future expected economic conditions.[1]

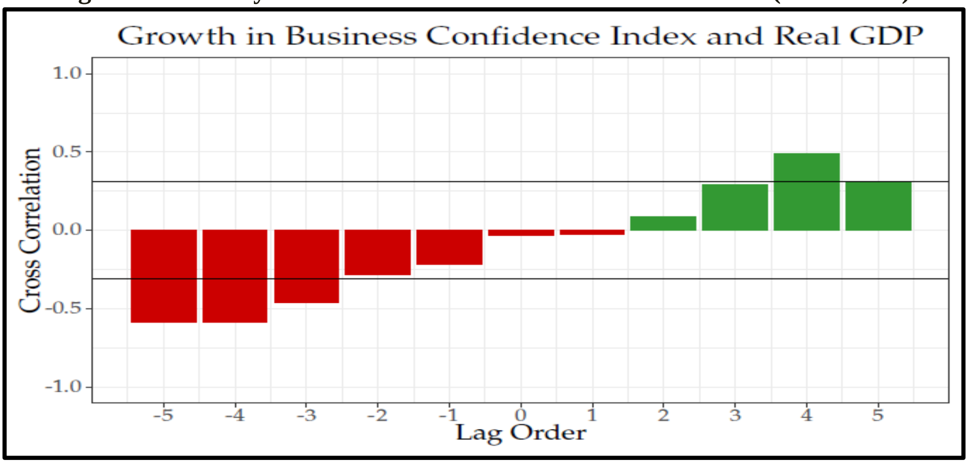
Fig. 3. Cross-Correlation Function for Expected Economic Conditions and GDP



[1]In the appendix, I also present graphs which help visualize the leading role of expected economic conditions, relative to real GDP growth.

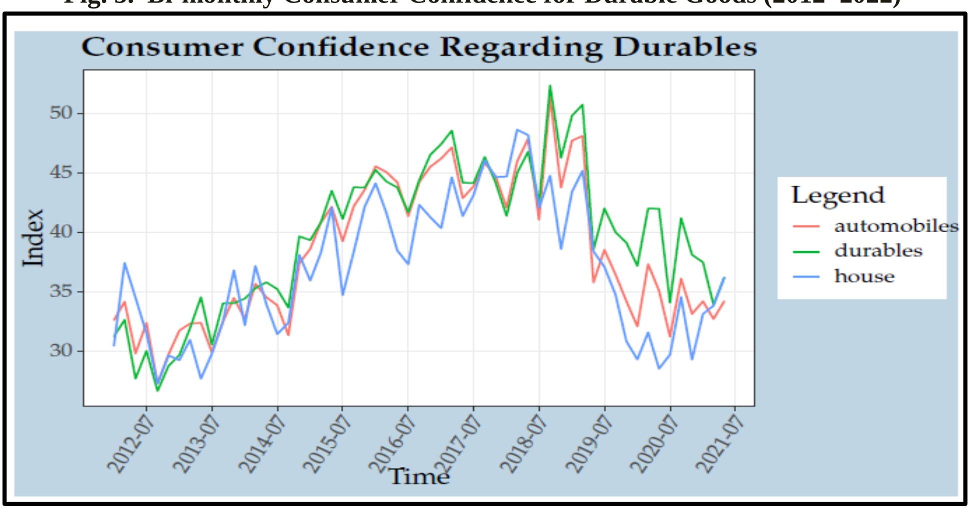
The SBP has also measured the business confidence index since the end of 2017. In Figure 4 below, I present the cross-correlations between the EEC index, which measures business confidence and quarterly real GDP growth for Pakistan. The data reveals that a higher real GDP growth rate follows the stimulation of business confidence in three, four and five quarters ahead in future quarters. Meanwhile, higher real GDP growth is also followed by a recovery in business confidence, which is statistically significant only four quarters after real GDP growth increases. Overall, business confidence is a leading indicator and drives future real GDP growth rates much more than the converse channel.

Fig. 4. Bi-monthly Business Confidence Indices and Real GDP (2017–2022)



Consumer confidence levels regarding durable goods such as automobiles and housing are shown in Figure 5. It is evident that consumer confidence for multiple durable goods categories co-moves closely with each other and the overall consumer sentiment indices analysed above.

Fig. 5. Bi-monthly Consumer Confidence for Durable Goods (2012–2022)



Thus, the stylised facts from empirical evidence in Pakistan reveal a considerable degree of co-movement among economic expectations for various product types and across individual characteristics. Moreover, data on business confidence levels and consumer expectations is an essential barometer to assess the current economic climate and forecast future economic crises, such as business cycle fluctuations. It is consistent with the evidence from advanced economies and other developing economies.

AGGREGATE DEMAND AND AGGREGATE SUPPLY MODEL

I begin with a simple, backwards-looking, textbook-based aggregate demand and supply model as in Abel, et al. (2017) with a standard demand equation, a Fisher equation representing the relationship between real and nominal interest rates, a Philip's curve, adaptive expectations and a monetary policy rule or Taylor rule.

The expectation formation process is adaptive, which implies an expectation of inflation is merely extrapolated from past inflation in addition to an error term, which will be the source of shocks. This is a questionable assumption, but it allows for a simplified and stylised model to understand the fundamental consequences of a shock to expectations.

Building Blocks

Output Equation/Demand for Goods and Services:

$$Y_t = \bar{Y} - \alpha(r_t - \varrho) + \epsilon_t,\ \alpha > 0$$

Fisher Equation:

$$r_t = i_t - \mathbb{E}_t\{\pi_{t+1}\}$$

Philip's Curve:

$$\pi_t = i_t - \mathbb{E}_{t-1}\{\pi_t\} + \phi(Y_t - \bar{Y}) + v_t,\ \phi > 0$$

Adaptive Expectations:

$$\mathbb{E}_t\{\pi_{t+1}\} = \pi_t + \eta_t,\ \forall t$$

Monetary Policy Rule:

$$i_t = \pi_t + \varrho + \theta_\pi(\pi_t - \pi^*) + \theta_Y(Y_t - \bar{Y}),\ \theta_\pi, \theta_Y > 0$$

Long Run Equilibrium

The long-run equilibrium, equivalent to the steady state in this simple model, satisfies the following conditions. After responding to a temporary shock, all variables eventually converge to this original steady state. In other words, deviations from the original steady state would be temporary. However, in the case of a permanent change in steady state, there is a long-run shift in economic equilibrium in response to a shock to expectations.

For instance, the steady state level of output is Y bar, and the steady state level of nominal interest rate, i.e. it is tied to the natural, real interest rate and inflation.

$$
\begin{aligned}
Y_t &= \bar{Y} \\
r_t &= \varrho \\
\pi_t &= \pi^* \\
\mathbb{E}_t\{\pi_{t+1}\} &= \pi^* \\
i_t &= \varrho + \pi^*
\end{aligned}
$$

Parameters

The steady-state output i.e. $\bar{Y} = 50$, steady-state inflation i.e. $\pi^* = 2$ or 2 per cent, the baseline responsiveness to inflation $\phi_\pi = 1$ in the Taylor rule, and responsiveness to output is $\phi_Y = 0.3$. The natural rate of interest, i.e. $\varrho = 2\%$, and the responsiveness of demand to r_t (real interest rates) is measured by $\alpha = 1$. This standard run-of-the-mill parametrisation allows one to compare the results with other standard shocks and emphasise expectation shock alone.

$$
\begin{aligned}
&\bar{Y} = 50 \qquad \pi^* = 2 \\
&\varrho = 2 \qquad \alpha = 1 \\
&\theta_\pi = 1 \qquad \theta_Y = 0.3 \\
&\phi = 0.6
\end{aligned}
$$

Dynamic AS and Dynamic AD Equations

In this section, I derive the two central equations of this aggregate demand and supply model, i.e. the dynamic AD and dynamic AS equations.

The dynamic AS curve is displayed in equation 6 below:

$$\pi_t = \pi_{t-1} + \eta_{t-1} + \phi(Y_t - \bar{Y}) + v_t$$

The dynamic AD curve is displayed in equation 7 below:

$$Y_t = \bar{Y} - \frac{\alpha\theta_\pi}{1+\alpha\theta_Y}(\pi_t - \pi^*) + \frac{1}{1+\alpha\theta_Y}\epsilon_t + \frac{\alpha}{1+\alpha\theta_Y}\eta_t$$

In equilibrium, aggregate demand equals aggregate supply, which implies that:

$$\pi_t = \pi_{t-1} + \eta_{t-1} + \phi(\bar{Y} - \frac{\alpha\theta_\pi}{1+\alpha\theta_Y}(\pi_t - \pi^*) + \frac{1}{1+\alpha\theta_Y}\epsilon_t + \frac{\alpha}{1+\alpha\theta_Y}\eta_t - \bar{Y}) + v_t$$

Some further simplification yields:

$$
\begin{aligned}
\pi_t(1 + \frac{\phi\times\alpha\times\theta_\pi}{1+\alpha\theta_Y}) = \pi_{t-1} + \eta_{t-1} + \phi(\frac{\alpha\theta_\pi}{1+\alpha\theta_Y} \times \pi^* \\
+ \frac{1}{1+\alpha\theta_Y}\epsilon_t + \frac{\alpha}{1+\alpha\theta_Y}\eta_t) + v_t
\end{aligned}
$$

Using some further notation for simplification and assuming that $v_t = 0$ (assuming no supply shocks), I derive the following equations (8 and 9) for inflation and output in equilibrium. These equations can be solved for equilibrium levels of π_t and Y_t in any period, given the shocks, exogenous parameters (defined in the last section) and past values[2] of π_{t-1} and η_{t-1}. Thus, one can compute the impulse responses for any forward horizon, given any initial shock to either η_t (expectation shock) or ϵ_t (demand shock).

[2] This is a backward-looking model.

For instance, let's assume that we were in the long-run equilibrium (i.e. $\pi_{t-1} = \pi^* = 2\%$, $\bar{Y} = 50$, $i^* = 4\%$ and $r^* = 2\%$) before a positive, exogenous and one-period (temporary) expectation shock i.e $\eta_t = 1$ hits the economy during period 1. In this case, we can compute the impulse responses for inflation and output (using 8 and 9), before computing them for nominal and real interest rates (using equations 10 and 11 after we have solved for π_t and Y_t). Figure 1 of section 3 below depicts the impulse responses (50 periods) for exactly such a one-period expectation shock.

$$\pi_t = \frac{\pi_{t-1} + \eta_{t-1} + \gamma \times \pi^* + \theta \times \epsilon_t + \beta \eta_t}{\zeta}$$

$$Y_t = \bar{Y} - \frac{\gamma}{\phi}(\pi_t - \pi^*) + \frac{\theta}{\phi}\epsilon_t + \frac{\beta}{\phi}\eta_t$$

$$i_t = \pi_t + \varrho + \theta_\pi(\pi_t - \pi^*) + \theta_Y(Y_t - \bar{Y}),\ \theta_\pi, \theta_Y > 0$$

$$r_t = i_t - (\pi_t + \eta_t)$$

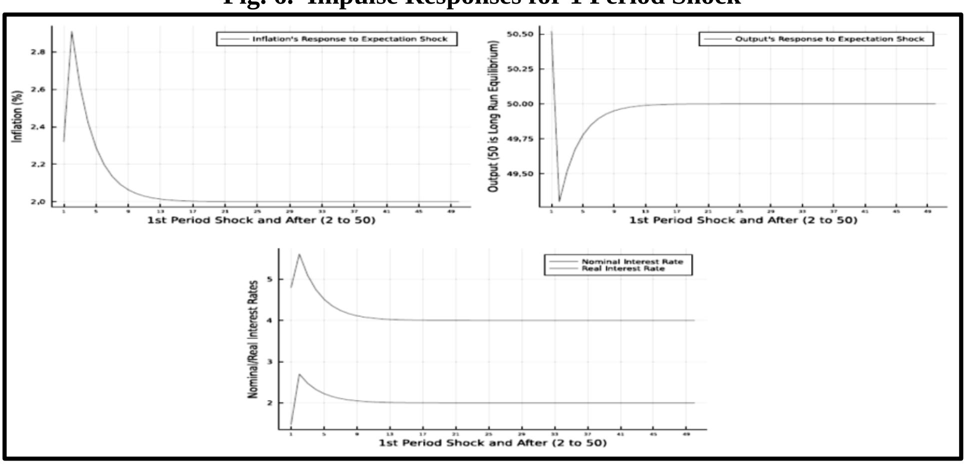
Note that $\zeta = (1 + \frac{\phi \times \alpha \times \theta_\pi}{1 + \alpha\theta_Y})$, $\gamma = (\frac{\alpha \times \phi \times \theta_\pi}{1 + \alpha\theta_Y})$, $\theta = (\frac{\phi}{1 + \alpha\theta_Y})$, $\beta = (\frac{\phi \times \alpha}{1 + \alpha\theta_Y})$.

Impulse Responses

All of the graphs in this section show responses to expectation shocks, i.e. various types of shocks to η_t.

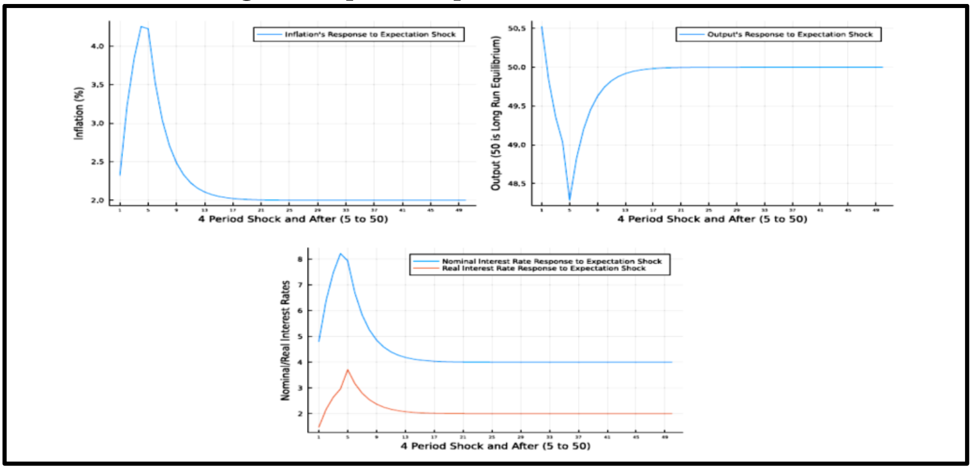
In Figure 6, I present the responses of a system perturbed by a one-period, temporary shock to expectations and observe the response of inflation, output and real and nominal interest rates. It is evident that this optimistic sentimental shock boosts the level of inflation in the economy and output levels relative to the initial steady state in the first period. During the second period, output actually falls below the steady state before converging to the initial steady state before the shock after 13 periods. Meanwhile, inflation continues to be higher than the steady state in the 2nd period, i.e. above the 2.8 percent level and ultimately converges back to the initial steady state of 2 per cent after around 14 periods.

Fig. 6. Impulse Responses for 1 Period Shock



In response to a 4-period shock to expectations, we observe the following impulse responses. Inflation continues to rise for a more extended period after the initial shock in this case, which is intuitive given the persistence of both the shock and adaptive expectations for inflation. Hence, we must tolerate inflation above 4 percent before it starts to revert toward the previous steady state five periods after the shock. Output fluctuations are similar to the last case. Still, the downward trend of output is more persistent and has a more pernicious effect by decreasing output levels by a more substantial magnitude relative to the last scenario. To respond to the persistent shock, monetary policymakers must pursue a contractionary monetary policy for a more extended period before allowing nominal interest rates to converge to the initial steady state of 4 percent.

Fig. 6a. Impulse Responses for 4 Period Shock



If monetary policymakers are not conservative and respond more aggressively to any deviation of output from its steady state, we will observe more aggressive appreciation in nominal interest rates, which lasts for longer periods in response to the same 4 period expectation shock. Figure 7 below also reveals that when there is an output preference, inflation can rise above 6 percent and slowly converges to 2 percent in approximately 40 periods after the initial shock. Meanwhile, output recovers to a level above 49.75 after 15 periods and slowly converges back to 50, approximately 45 periods after the shock.

Fig. 7. Impulse Response for 4 Period Shock and Output Preference

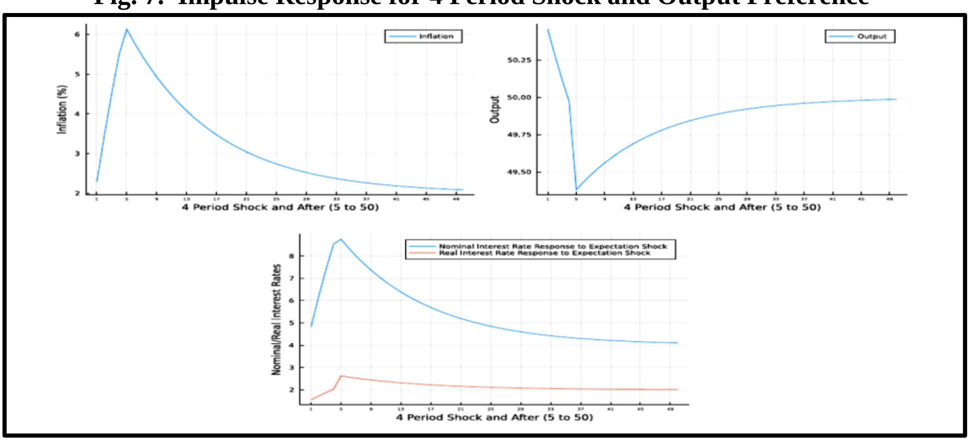
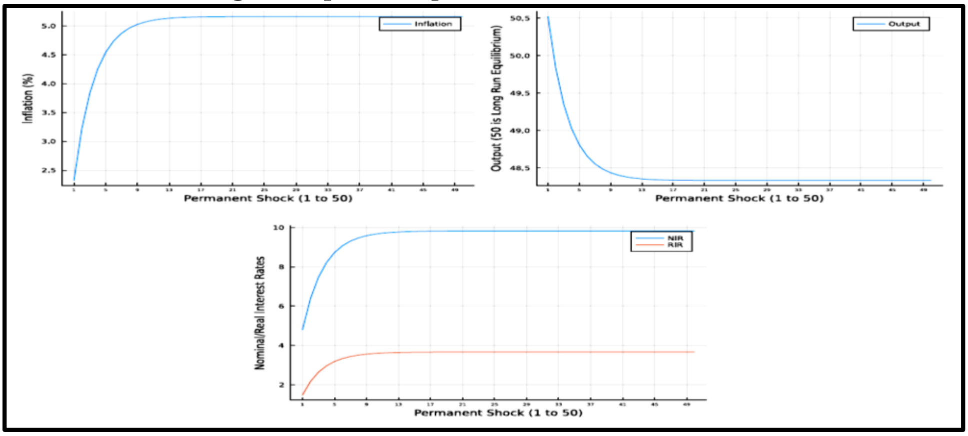


Figure 8 displays responses to a permanent shock to expectations. In this case, inflation, output, nominal and real interest rates converge to a new long-run steady-state since the expectation shock is permanent.

Inflation is permanently higher, the output is permanently lower and both nominal and real interest rates converge to permanently higher rates.

Fig. 8. Impulse Responses for Permanent Shock



New Keynesian Model

After building some intuition about the impact of an expectation shock on key macroeconomic variables, I extend the model in a more realistic, New Keynesian setting as in Galí (2015).

Framework

I begin by using a simple, stylised, 'three equation" New Keynesian model as developed in Gali (2015). The following three (12 to 14) equations represent the NKPC (New Keynesian Philip's Curve), Output Gap Equation and Taylor rule.

New Keynesian Philip's curve:

$$\pi_t = \beta \mathbb{E}_t\{\pi_{t+1}\} + \kappa\, \tilde{y}_t$$

Output Gap Equation:

$$\tilde{y}_t = -\frac{1}{\sigma}(i_t - \mathbb{E}_t\{\pi_{t+1}\} - r_t^n) + \mathbb{E}_t\{\widetilde{y_{t+1}}\}$$

Interest Rate Rule (Taylor Rule):

$$i_t = \varrho + \phi_\pi \pi_t + \phi_y \tilde{y}_t + v_t$$

The three equations stated above can be combined and represented as a system of difference equations which has the following representation:

$$\begin{bmatrix} \tilde{y}_t \\ \pi_t \end{bmatrix} = \mathbf{A}_T \begin{bmatrix} \mathbb{E}_t\{\widetilde{y_{t+1}}\} \\ \mathbb{E}_t\{\pi_{t+1}\} \end{bmatrix} + \mathbf{B}_T u_t$$

In the above system, the matrices and vectors are defined as follows:

$$\mathbf{A}_T \equiv \Omega \begin{bmatrix} \sigma & 1-\beta\phi_\pi \\ \sigma \times \kappa & \kappa + \beta(\sigma + \phi_y) \end{bmatrix}, \mathbf{B}_T \equiv \Omega \begin{bmatrix} 1 \\ \kappa \end{bmatrix}, \Omega \equiv \frac{1}{\sigma + \phi_y + \kappa\phi_\pi}$$

$$and\ u_t \equiv \psi_{ya}(\phi_y + \sigma(1-\varrho_a))a_t + (1-\varrho_z)z_t - v_t$$

Note that the natural rate of interest r_t^n can be defined as: $r_t^n = \varrho - \sigma(1 - \varrho_\alpha)\psi_{ya}a_t + (1-\varrho_z)z_t$, where z_t is the discount rate shock (shock to consumer utility or demand), α_t is the technology shock (supply shock or production shock) and v_t is the monetary policy shock (i.e a deviation from the monetary policy rule). Moreover, $\psi_{ya} = \frac{1+\varphi}{\sigma(1-\alpha)+\varphi+\alpha}$ and $\widetilde{y_t} = y_t - y_t^n$, so that the output gap i.e. $\widetilde{y_t}$ is the deviation of output from its natural rate y_t^n. All three exogenous shocks are represented as AR(1)[3] processes i.e. $z_t = \varrho_z z_{t-1} + \epsilon_t^z$, $v_t = \varrho_v v_{t-1} + \epsilon_t^v$ and $a_t = \varrho_a a_{t-1} + \epsilon_t^a$. For a display of all key model equations, refer to the appendix, section 7.2 and for an even more detailed exposition on the baseline, the New Keynesian model refers to [4], which also includes the conditions on parameters needed for a unique, local solution to this model[5].

The baseline parameterisation is displayed in the following table and is consistent with the literature. The elasticity of intertemporal substitution is set to $\sigma = 1$ and discount factor, i.e. $\beta = 0.99$.

width=0.4

$\sigma = 1$	$\varphi = 5$
$\phi_\pi = 0.5$	$\phi_y = 0.125$
$\theta = 0.75$	$\varrho_v = 0.5$
$\varrho_z = 0.6$	$\eta = 3.77$
$\varrho_a = 0.9$	$\beta = 0.99$
$\alpha = 0.25$	$\epsilon = 9$

Impulse Responses

The following figures plot the dynamic responses of various variables to a temporary, negative shock to discount rates or discount factor shock, i.e. negative shock to ϵ_t^z or a decrease in z_t[6]. This shock can be interpreted as causing a *reduction* in households' weight to current utility, relative to future utility. In the following diagrams, "ann" refers to annualised, pi refers to inflation (π in the above equations), y_{gap} refers to the output gap i.e. $\widetilde{y_t}$ in the model above, p refers to price levels, i refers to nominal interest rates, r refers to real interest rates, m refers to the money supply, n refers to hours worked, and w refers to real wages.

---

[3] autoregressive processes of order 1.

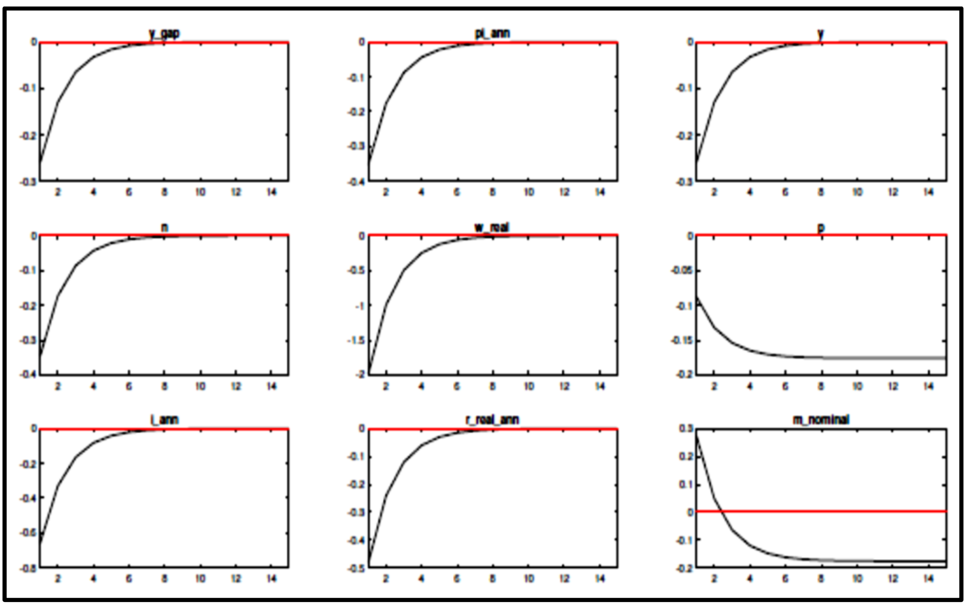
[4] Chapter 3, Basic New Keynesian (henceforth NK) Model in .

[5] Assuming that ϕ_π and ϕ_y are non-negative coefficients, it has been shown by that the necessary and sufficient condition for a unique, local equilibrium is $\kappa(\phi_\pi - 1) + (1-\beta)\phi_y > 0$

[6] The plots were generated using Dynare and code was motivated by the code, produced by Dr. Johannes Pfeifer (see https://github.com/JohannesPfeifer).

Figure 10 below plots the impulse responses to a temporary, negative discount rate shock with forward-looking expectations. The impulses reveal that if we work with the baseline 3 equation New Keynesian model, a negative shock to discount rates make the output gap negative, as the output deviates downwards from a steady state and so do hours worked, real wages and output levels. Moreover, the real and nominal interest rates at annualised levels fall due to the shock. Meanwhile, the price level, i.e. p depreciates and displays a persistent effect of the shock, which lasts for several years, stabilising at close to negative 20 percent after 6 periods. Lastly, after an initial appreciation in the nominal money supply, we observe negative growth rates in the long term for the money supply, which is close to 20 percent.

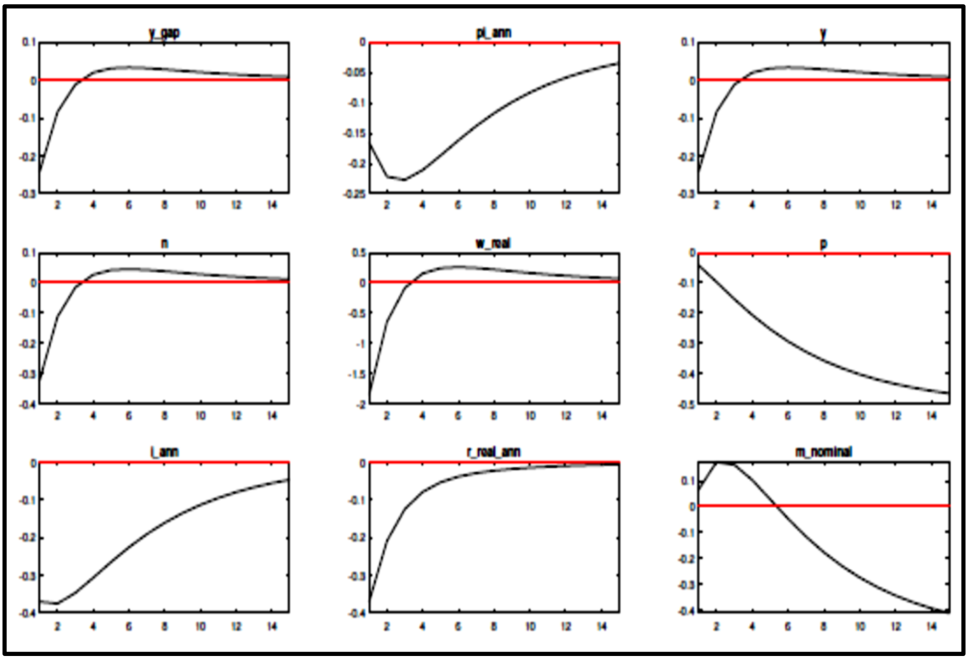
In sum, with forward-looking expectations, a negative discount rate shock leads to a recession in which both annualised inflation and output are decreasing. The monetary policy is expansionary in response to the shock. Still, it cannot avoid a temporary decline in all key, real economic variables such as real wages, hours worked, output, inflation and price levels.



Dynamic Responses to Stochastic Discount Rate Shock with Forward Looking $\mathbb{E}$

Meanwhile, Figure 11 plots the responses to a negative discount rate shock with \textit{backward-looking, adaptive} expectations in an otherwise New Keynesian model. In this case, the output and output gap display an initial downward trajectory, followed by a brief and mild expansion after 4 periods, which lasts for roughly 7 periods and slowly tapers off.

Similar dynamics are displayed by hours worked n and real wages, i.e. w. On the other hand, the price levels display a continuous and monotonic fall after the shock period. Meanwhile, the annualised inflation level slowly recovers toward a steady state after the initial downward shock. Both nominal and real interest rates depreciate in response to the shock, followed by a gradual recovery toward a steady state, but the nominal interest rates are more rigid in the recovery process after the initial contraction due to backward-looking expectations. Lastly, the nominal money supply appreciates in reaction to the discount rate shock before displaying hump-shaped persistence for some periods and finally (after 4 periods) begins its depreciation toward the de-growth process, slowing down by 40 percent relative to steady-state by the 14th period.

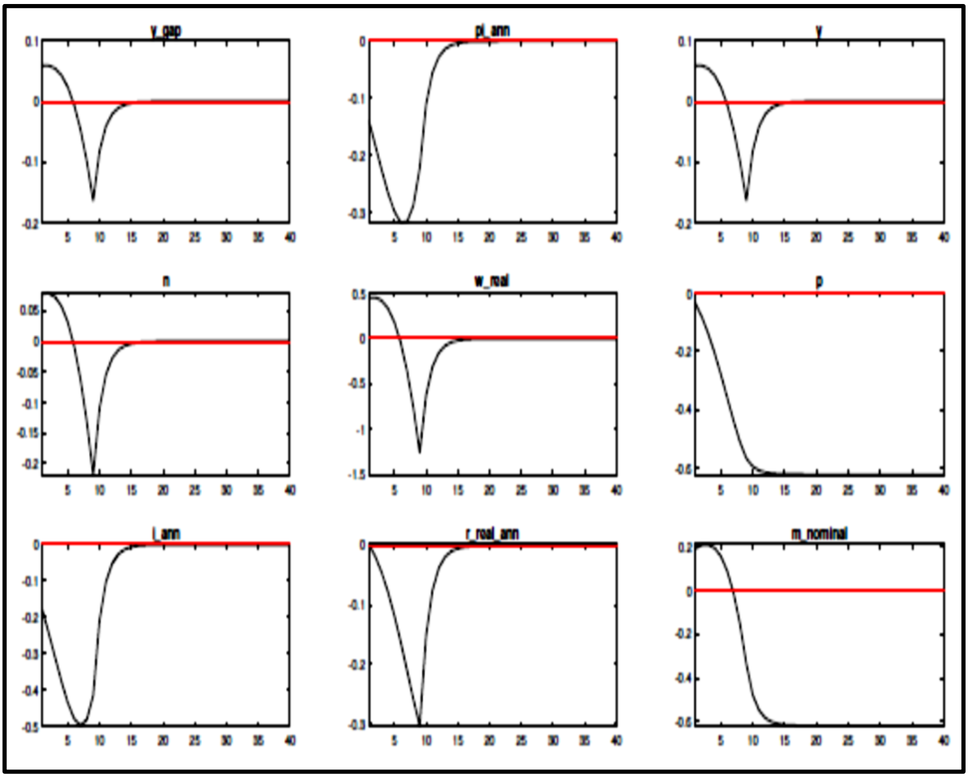


Dynamic Responses to Stochastic Discount Rate Shock with Backward Looking $\mathbb{E}$

Figure 12 reports the impulse responses to an 8 period ahead, \textit{anticipated} and negative discount rate shock with forward-looking expectations.

In this case, we observe an initial \textit{appreciation} in output, output gap, real wages and hours worked in response to the shock in the shock period. Subsequently, output and all other quantities fall below the steady-state and reach the previous steady state of zero after approximately 15 periods. Meanwhile, annualised inflation rate falls, and so do the price levels in the impact period. After a significant deflation relative to the steady-state of around 50 percent, annualised inflation recovers and converges back to the initial steady-state, 15 periods after the shock.

The nominal money supply expands in the first period to accommodate the expansionary impulse of output before entering into a permanent depreciation after period 7. Lastly, the nominal and real interest rates fall substantially and take approximately 20 periods to recover toward their initial steady state.



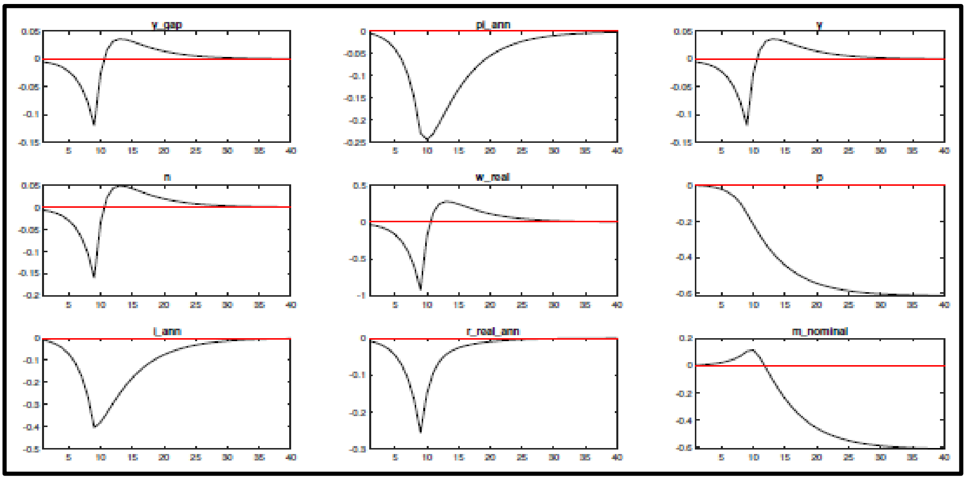
Anticipated (8 Period Ahead) Discount Rate Shock with Forward Looking 𝔼

Lastly, Figure 13 reports the impulse responses to an 8 period ahead, \textit{anticipated} and negative discount rate shock with \textit{backward-looking} expectations.

In this case, the shock is anticipated, but expectations are backwards-looking and hence are lethargic in adjusting toward new levels. The output gap and inflation depreciate relative to their steady-state values in the shock period, which continues to occur for some periods. After approximately 10 periods, the output gap recovers and even appreciates relative to its steady state before converging to its original steady state after 25 periods. The annualised inflation rate also recovers its original steady state, but this process is slower and less dynamic than output adjustment. The aggregate price level p is unresponsive for a short period but enters into a prolonged and persistent slump 5 periods after the initial shock.

Real wages and hours worked essentially mimic the adjustment pattern of the output gap, demonstrating an initial negative response before recovering from the avalanche and overshooting for a short period, ultimately deviating back to the original steady state.

Both nominal and real interest rates fall for some periods due to expansionary monetary policy reactions, before recovering to previous steady-state levels. Meanwhile, the nominal money supply is lacklustre in reacting to the shock for approximately 5 periods, before displaying a brief period of appreciation and ultimately entering into a persistent slump in growth rates.



Anticipated (8 Period Ahead) Discount Rate Shock with Backward Looking 𝔼

In sum, the effect of same negative discount rate shock produces different dynamic responses for output, hours worked, real wages, annualised inflation rates, real/nominal interest rates and nominal money supply, depending on the expectation formation process (Figures 10 versus 11 and 12 versus 13) and whether the shock is anticipated or not (Figures 12 to 13 versus 10 to 11).

For instance, at a prima facie level, it can be inferred that backward-looking expectations lead to dynamics in Figure 11, which are more unstable relative to those of Figure 10 with forward-looking expectations. This is because, under both cases, the ultimate long-run steady state is the same, but with backwards-looking expectations, inflation is persistently low for many periods before it recovers. Similarly, output fluctuations are more rapid and dynamic in Figure 11 relative to the forward-looking expectations scenario in Figure 10.

In the anticipated shock cases with forward-looking expectations (Figure 12), unlike the previous cases, we observe an initial \textit{increas}e in output levels relative to the steady-state and subsequent reversal and ultimate convergence to the initial steady-state. Meanwhile, the response of inflation is similar to the response in Figure 10, but the level of persistence is higher relative to non-anticipated shock.

In the anticipated shock cases with backwards-looking expectations (Figure 13), unlike in Figure 12, we observe an initial \textit{decrease} in output levels relative to steady state, subsequent positive reversal and ultimate convergence to initial steady state, similar to the dynamics in Figure 11 (backwards looking, unanticipated shock). Meanwhile, the response of inflation is similar to the response in Figure 12; the level of persistence is even higher due to the role of backwards-looking expectations.

In Table 1 below, I summarise the key directions of changes in annualised inflation and the output gap in response to the four shock types studied above. For instance, \$FL/UA\$ in the table represents the direction of changes in annualised inflation and output gap variables in response to a negative, temporary and unanticipated discount rate shock with forward-looking expectations.

The initial, dynamic response is captured by the notation $t+j$, displayed as a subscript of any parameter's response to a shock which originates in period 1. For instance, $R(\pi_{t+j}) $ refers to the response of inflation to the said shock, where $j \in [1, P] $. Whereas, $t+k$ represents the later periods, i.e. $k > j$ and $k \in [P+1, Q] $, where P is the maximum time-period for which the direction of initial impulse has not \textit{strictly} changed relative to initial sign; Q is the maximum time-period after which the shock has finally and permanently converged back to original steady state. Both P and Q will clearly vary across variables\footnote{These two subsets are sufficient to represent all the signs of impulse responses since, for the results considered in this paper, the impulses only change their signs from strictly positive/negative to negative/positive only once.}.

Table 1

Responses to Temporary, Negative Discount Rate Shock

Categories	$R(\pi_{t+j})$	$R(\pi_{t+k})$	$\overline{R(\widetilde{y_{t+j}})}$	$R(\tilde{y}_{t+k})$
FL/UA	–	–	–	–
BL/UA	–	–	–	+
FL/A	–	–	+	–
BL/A	–	–	–	+

Hence, the welfare effects of discount rate shocks also depend on the expectation formation process and whether the shock is anticipated or not.

CONCLUSION

I demonstrate that consumer and business sentiment is a central pillar which drives the fluctuations in Pakistan's business cycles. Hence, in line with the recent trend of collecting data and researching sentiments by the SBP, this research agenda must continue to be a priority in the future.

The models in this paper and associated impulse responses reveal that the expectation formation process is a determinant of the response of economic variables to an expectation shock or preference shock. Moreover, the response of central banks to expectation shocks is a crucial determinant of dynamics for aggregate output and inflation, which are affected by the nominal and real interest rates.

Lastly, whether the discount rate shock is anticipated or not is also a key determinant of the dynamic responses of various quantities and prices to the same shocks. Ultimately, the welfare effects of these shocks are interconnected with whether expectations are forward or backwards-looking and whether the shocks are anticipated or not.

Surprisingly little is known about the expectation formation process of consumers and firms in Pakistan. We need to encourage micro-research in this area so that the role of consumer and business confidence can be better understood in the context of Pakistan's business cycles. We need the State Bank of Pakistan and economic ministries to be cognisant of self-fulfilling beliefs as drivers of business cycles. Policymakers should design policies which manoeuvre market sentiments more effectively through press releases and frequent information sharing to make business cycle fluctuations more docile.

Ultimately, more dormant business cycles will translate into higher social welfare in Pakistan through various channels, including encouraging foreign direct investments, local investments in productive and innovative sectors with higher risks, the direct welfare effects on workers and consumers due to a modest business cycle fluctuation and so on.

APPENDIX

NK Model

$$\Omega = \frac{1-\alpha}{1-\alpha+\alpha\,\epsilon}$$

$$\psi\_n\_ya = \frac{1+\varphi}{\alpha+\varphi+(1-\alpha)\,\sigma}$$

$$\lambda = \frac{(1-\theta)\,(1-\theta\,\beta)}{\theta}\,\Omega$$

$$\kappa = \lambda\left(\sigma+\frac{\alpha+\varphi}{1-\alpha}\right)$$

$$\pi = \beta\,\pi + \kappa\,\tilde{y}$$

$$\tilde{y} = \tilde{y} + \frac{(-1)}{\sigma}\,(i-\pi-r^{nat})$$

$$i = \pi\,\phi_{\pi} + \phi_{y}\,\hat{y} + \nu$$

$$r^{nat} = (-\sigma)\,\psi\_n\_ya\,(1-\varrho_{a})\,a + (1-\varrho_{z})\,z$$

$$r^{r} = i - \pi$$

$$y^{nat} = \psi\_n\_ya\,a$$

$$\tilde{y} = y - y^{nat}$$

$$\nu = \nu\,\varrho_{\nu} + \varepsilon_{\nu}$$

$$a = \varrho_{a}\,a + \varepsilon_{a}$$

$$y = a + (1-\alpha)\,n$$

$$z = \varrho_{z}\,z - \varepsilon_{z} - \tau_{z}$$

$$\Delta m = \pi\,4$$

$$m - p = y - i\,\eta$$

$$i^{ann} = i\,4$$

$$r^{r,ann} = r^{r}\,4$$

$$r^{nat,ann} = r^{nat}\,4$$

$$\pi^{ann} = \pi\,4$$

$$\hat{y} = y - (y)$$

$$\pi = 0$$

$$y = c$$

$$w - p = \sigma\,c + \varphi\,n$$

$$\frac{w}{p} = w - p$$

$$m = m - p + p$$

$$\mu = y\left(-\left(\sigma+\frac{\alpha+\varphi}{1-\alpha}\right)\right) + a\,\frac{1+\varphi}{1-\alpha}$$

$$\hat{\mu} = \tilde{y}\left(-\left(\sigma+\frac{\alpha+\varphi}{1-\alpha}\right)\right)$$

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