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Time Inconsistency, Inflation Expectation and Economic Growth: Application of Game Theory

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Abstract

Economic agents need to solve decision problems occurred in the result of the impact of the decision of certain rational agent on the other agent's reward. This is what classical game theory does. The inflation in terms of classical game theory has been suggested and analyzed. The main idea of the paper is to examine the classical Barro-Gordon game model for inflation. It gives us the clear picture of inflation expectations and time inconsistency problems in the field of macroeconomics. Time inconsistency occurs when the weak policymakers are intended to realize the high inflation rate, when the society expects for the low one. As a result, public or society decides to punish those weak policymakers. Accordingly, we are going to consider how the public expectations for a low inflation rate can lead to the Nash equilibrium for the time inflation in the Barro-Gordon model, which will resolve the problem of this game.

Keywords: Time Inconsistency, Expected Inflation, Barro - Gordon Game.

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Introduction

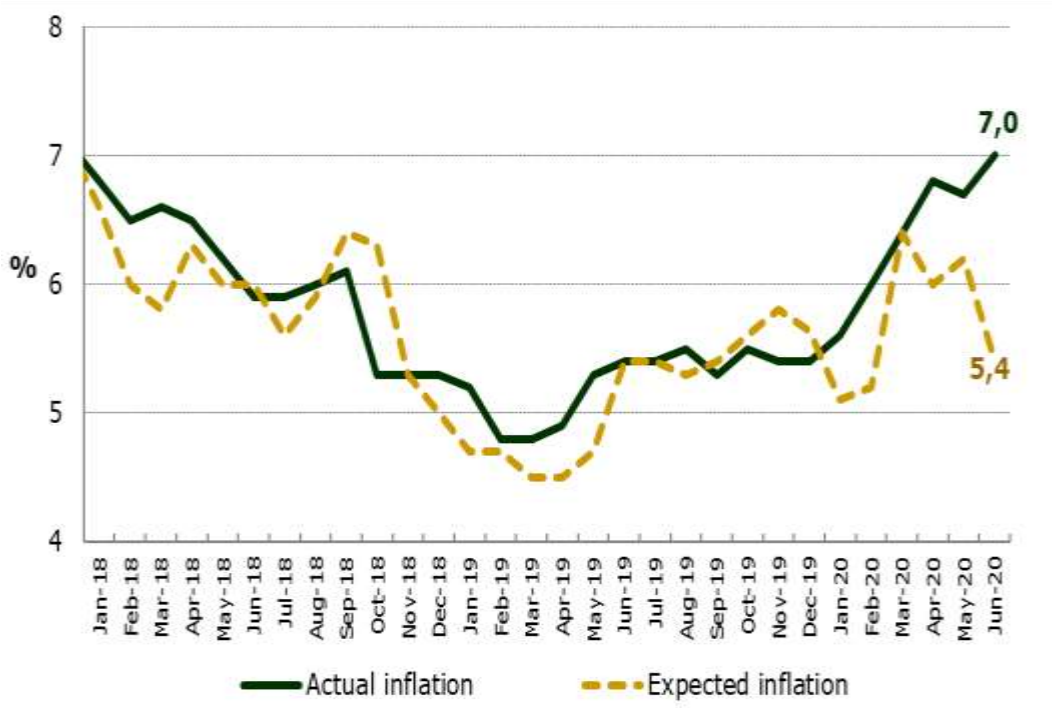
Inflation targeting defined as a monetary policy regime arranged on surroundings as well as accomplishing inflation target within the medium run. A recognizing characteristic of this regime is to identify the monetary policy goals and needs as a result of encouragement of preferential expectations of the public and the market along with rising assurance inside policymakers' validity. During an inflation targeting regime, significant function is dedicated towards the channel of interest rate, via which the politician's interest rate approach impacts market rates through the pass-through in the direction of the user, investment and saving behavior of the people, moreover, headed for inflationary processes. The National Bank's key tool in the field of monetary policy is the base rate. An inflation prediction that pays attention to inflationary anticipation of the public is used like an intermediary objective intended for the decision-making regarding the level of interest rate. Within the case, if the expected inflation surpasses its target in the medium run, the policymakers make the verdict to increase the actual level of the base rate, and alternative option. A short-run interest rate taking part in the money market is utilized the same as an operating target; for the most part, this is an instantaneously charge. Inflationary predictions exhibit presumptions of the public, also of the market members with respect to an upcoming inflation configuration. Presumptions concerning a potential inflation configuration appearing in future come up with effect at the economic activity of the public and the market. In case if inflationary predictions are low, the market members will be attempting to contribute their money into the businesses, investment projects, and fiscal operations. If inflationary expectations are high, in that case the market members will be contributing their money into products, real assets, steady foreign exchange as well as other resources, whose fee is not dependent on the inflation rate. This investigation of firms is special

in quite a few ways. Initially, is its quantitative character. At the same time as various surveys of firms' predictions like Ifo, Conference Board are already provided, they prone to be mainly qualitative. For example: "Do you anticipate costs to increase drop or else keep on the same during the next year?". Accordingly, it makes this not easy to pull out quantitative measures of predictions (Bachmann and Elstner 2015). Whereas, we take out quantitative answers of households and on the subject of their viewpoint in the matching approach as other expectations of households' otherwise specialized forecasters' expectations. By the way, we ask firms to present probability distributions intended for their estimates. As a result we can study not only dispersions of direct estimates over respondents but in addition build firm-level measures of uncertainty in relation to the upcoming measures of macroeconomic factors. In this paper, we make the first step toward filling this break by announcing results from a fresh great quantitative survey of firms within Kazakhstan. This survey gives full information in relation to common managers' economic convictions, as well as not only their expectations of upcoming macroeconomic conditions, but, in addition, their beliefs over current economic elements. This permits us to define how seriously firms contributes to current macroeconomic improvements, as well as, whether inattentiveness to current economic policies and situations affects firms' predictions of the future, since set by models of information stability (e.g., Mankiw and Reis 2002, Woodford 2003, Sims 2003). In addition, we learn the indicators of firms' macroeconomic estimates and backside casts, by means of an abounding group of quantitative firm-level controls from the survey.

Background of the Study

While January 2016, the community view surveys have been undertaken to determine inflationary anticipates within Kazakhstan. A periodical survey is performed among the grown-

up residents by the use of a call interview, by way of 1500 participants taking part. The representativeness of the illustration is given by the split of participants interested in such categories such as the district (every district centers, as well Nur-Sultan, Semey, Almaty cities), age and business. The amount of participants within all category is nearby the statistics regarding to authorized measurements of the Republic of Kazakhstan. The quantitative evaluation of the shaping firms' and households' anticipations are implemented via the treatment of the evaluation, so that, changing the analysis results towards the statistical assessment by developing the analogous records by means of the utilize of the possibility method.



Actual inflation rate and public's expectations

Methodology

There are some inconsistencies in the implementation of a particular policy regarding decisions on the inflation. Such inconsistencies have been considered by a lot of investigators. At this point, we are going to consider solutions to this problem provided by Barro & Gordon and Kydland & Prescott. Speaking of the Barro-Gordon game theory (1983), they suggest that the basis lays in preferences changes, while Kydland and Prescott (1977) put forward their theory of rational expectations. The main thing to note is that the state always be tempted to set high inflation, while society's expectations in this regard are lower. Then, there is a situation where the public becomes aware about the purpose and intentions of the state or the Central Bank, and takes appropriate actions, anticipating a high level of inflation for the next period. However, the Central Bank assumes that the public will do so, and again implements high inflation. In the end, even though it is more preferable to hold a low inflation rate, a high level is established in the economy. Given that this situation is more suitable for the Barro-Gordon model, we will use it in further research in this article. Let's look at this theory in more detail: suppose a Central Bank can start printing more and more money, thereby manipulating the inflation rate assumed to increase. In this case, if the public continues to respond to this with the same expectation, the economy will receive a good profit and will be able to pay off public debts while gaining activity. However, if it happens that the public guesses, then politicians will not get what they want, failing to achieve a certain goal. Here it becomes clear, that the greatest benefit of playing with inflation is when it is unexpected by the public. Plus, there will also be a reverse side of the coin for the policymakers associated with the increase in the price level created by exaggerated amount of printed money.

We have two cases considered by this game theory: first, when politicians implement a low level of inflation in order to meet the expectations of the people and in which there are problems of inconsistency; second, when the Central Bank cheats and creates a higher level of inflation, which is the alternative of Nash equilibrium.

$Y_t = m_t - P_t$ (Aggregate Demand)

$Y_t = \varphi(P_t - E_{t-1}P_t)$ (Aggregate Supply)

Table 1

Time=0	Public		
	(CB, Public)	Low (π^e)	High(π^e)
Central Bank	Low π_t	(0; 0)	(-2; -1)
	High π_t	(1; -1)	(-1; 0)

Within BG contest, alike in the direction of prisoner's dilemma, two players contribute to the game; community and policymakers. Here, CB expects that public is guide by the rational expectations. Whereas, the public anticipates inflation due to the Central Bank's decision. From the one side, the CB chooses strategy, by taking into account anticipations of the public. There, we can differentiate between two: first, who's cheating on the publics' believes about the inflation policy or in other words "weak policy maker"; and second ones who is not intended to get profit from the rising the level of inflation or in other words " strong policy maker".

So, the following equation evaluates the utility function for those policymakers:

$$U_t = \lambda b(Y_t - Y_n)^2 - \frac{a}{2}(\pi_t - \pi_n)^2 \quad (1)$$

where,

π_t- cost of inflation

Y_n – Natural rate of output

Y_t – Actual rate of output

a - an arbitrary cost parameter

b – Dummy variable: {1 - weak policy maker}

{0 - strong policy maker}

Λ - a how much the central bank cares about deviation of output from in natural rate with $\lambda > 0$

If $Y_t > Y_n$, on the basis of Philips curve, Central Bank is intended to reduce unemployment and get profit as it is shown in Eq. (1).

The following equation evaluates the utility function for the public:

$$Y_t = Y_n + \varphi\,(\pi_t - E_{t-1}(\pi_t)) + \varepsilon_t \quad (2)$$

Where,

π_t - Actual inflation

$\pi^e = E_{t-1}(\pi_t)$ - expected inflation

φ - Sensitiveness of the public to deviation of inflation from their expectation of inflation

ε_t - Error term (sensitive for all other shocks to the economy)

As we can see from this equation, the inflation bias causes the burden to the society.

Naïve Solution

Whether government should inflate at announced level or deviated from its announcement depends on its incentives. In the case of cheating, the wage setters believe that economy always do the normal steady state $\pi_t = \pi_n$ and $Y_t = Y_n$. The government incentive is now:

$\min_{\{\pi\}} L = \lambda b(Y_t - Y_n)^2 - \frac{a}{2}(\pi - \pi_n)^2$ (3)

$s.t. Y_t = Y_n + \varphi\,(\pi_t - E_{t-1}(\pi_t)) + \varepsilon_t$ (4)

And $\pi_t = \pi_n$ given (5)

So we substitute in the Philips curve:

$$\min_{\{\pi\}} L = \lambda b(Y_n + \varphi\,(\pi_t - E_{t-1}(\pi_t)) + \varepsilon_t - Y_n)^2 - \frac{a}{2}(\pi - \pi_n)\text{^}2 \quad (6)$$

In order to minimize our function, we use the derivative as follows:

$$\frac{dL}{d\pi} = \alpha(\pi - \pi^e) - (y_t - y_n) + \varepsilon_t + 2\pi = 0 \quad (7)$$

$\pi = \frac{y - y_n + \pi^e - \varepsilon_t}{1+\lambda}$ (8)

Substitute (8) into (1)

$$Y_{opt} = Y_n + \frac{Y_t - Y_n - \lambda\pi^e - \lambda\varepsilon_t}{1+\lambda} \quad (9)$$

Equation 9 shows us how when wage setters set $\pi_t^e = \pi_n$, government is intended to implement inflation rate that is exaggerating the expected level of inflation by public. Thus, since the real wage is reduced the actual unemployment falls below the natural rate on the basis of Phillip curve. Policy makers will decide optimal inflation rate by observingλ . λ is small policy makers does not much care increase Y_t, relative to inflation want to stabilize price more than output. If λ is large, policy makers concern more on output rather than inflation.

Rational Expectation solution

The interesting point is that the results obtained from Naïve suggest that society will always remain ridiculous, thinking that the state will meet their expectations about inflation without any deception, not taking into account the fact that their actions will be retaliatory, since they have the opportunity to punish the state with similar methods. So it's no surprise that Naïve

results are considered pretty ignorant. By contrast, Kidland and Prescott have proposed a very rational and reality-related solution (Rational Expectation) in which society behaves more realistically with relevant and consistent expectations, analyzing previous deceptions of politicians or their absence. With the purpose to find the answer to this model, we are going to presume that the agents' expectations are correct:

$\pi_t = \pi^e$.

The important point is that we can apply this assumption only for the 1st order condition. That's why our equation considering rational expectation turn to be as follows:

$$\pi^e = E(\pi^{OPT}) = \frac{y_t - y_n + \pi^e}{1+\lambda}$$

$$\pi^e = \frac{y_t - y_n}{\lambda} \quad (10)$$

Substitute equation (10) into eq. (8) and eq. (9)

$$\pi^{OPT} = \frac{y_t - y_n}{\lambda} + \frac{\varepsilon}{1+\lambda} \quad (11)$$

$$y_{OPT} = y_n - \frac{2\varepsilon}{1+\lambda} \quad (12)$$

Under rational expectation optimal inflation and output depends on policy variables and supply shocks. Despite of the standard that $Y_t = Y_n$, inflation rate is higher than it is actually have to be. The inflation variance from the issue of time inconsistency is positive in this case.

Changes to supply shock

$$\frac{d\pi}{d\varepsilon} = \frac{1}{1+\lambda}$$

$$\frac{dL}{d\pi} = -\frac{\lambda}{1+\lambda}$$

Under rational expectation, there is no scenario when policy makers can use policy to trick public to increase output above natural level of output (Y_n) (see Appendix 1). There is a limit to

expansion monetary policy. Policy will be if policy makers set actual inflation greater than optimal inflation then actual output will increase but policy makers' utility falls too much.

Adoptive expectation

We are not going to reveal the usual expectations model; however, we can notice there is a gradual progression between the rational expectations and the Naïve solutions. Under adoptive expectation public gets fooled one, but not twice. High inflation mean economic inefficiency which reduce policy makers utility and leads in second period inflate low level means not deviating from announced inflation. Policy will be if utility and output are high and inflation low, thus better than one period of high output followed by high inflation.

Conclusion and Policy Recommendation

Summarizing our study, let's consider the table below:

Inflation (π) Unemployment (U) Loss (L) Naïve Solution

$\pi > \pi e = \pi * Y < Y_n$ lower than steady-state RE solution

$\pi^e = \pi > \pi * Y = Y_n$ higher than optimal if could commit

So, we find out the main point that the economy turn out to be in the less preferable position or balance because of the fact that the government cannot maintain the normal political course. That is the reason why the major meaning of the policy is to find the way that will allow the government or Central Bank take an obligation to not cheat with an intend to obtain the likely results of inflation. Multiple assumptions about the solution of this problem were provided and even some of them used in the real world. For instance, the Central Bank is independent and cares about the target value of inflation, so that to delegate the monetary policy to them. Also, it

is obvious, that the key decision for such situation is timing suggestion. If the setting wages would be more regular and workers can do it after the Central Bank implements a certain policy, the appearance of the cheat will be reduced to zero. According to the statement "Y_t $is\ greater\ than$ Y_n", the scale of the inflation displacement is due to the difference between $them$. Consequently, diminishing this difference, we can solve the problem at the root.

The Barro-Gordon game theory represents the game with the public in one side and policymakers in another one. There policymakers try to cheat on inflation expectations of public to gain profit from implementing policy in the short-term period. Although, they will lose their outputs because of the increase in the inflation when public punishes them in the next period. By the way, the low level of inflation implemented by the policymakers is also not good decision which leads to the Nash equilibrium. Concluding, we can say the best scenario to the BG game model is the first one.

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Appendix

The inability of monetary policy affects real variables under rational expectation

$Y_t = m_t - P_t$ (1)

$$Y_t = \varphi(P_t - E_{t-1}P_t) (2)$$

$m_t = \overline{m} + \mu_t$ (3)

Where,

$$Y = \log(Y) - \log(Y^*)$$

Equilibrium at eq. (1) equal to eq. (2):

$\varphi(P_t - E_{t-1}P_t) = m_t - P_t$ (4)

Take both side expectations at $t-1$ and solve for E_{t-1}:

$$\varphi(E_{t-1}P_t - E_{t-1}P_t) = E_{t-1}(\overline{m}) + E_{t-1}(\mu_t) - E_{t-1}(P_t)$$

$0 = \overline{m} + 0 - E_{t-1}(P_t)$

$E_{t-1}(P_t) = \overline{m}$ (5)

Substitute eq. (5) into eq. (4) and solve for P_t:

$$\varphi(P_t - \overline{m}) = \overline{m} + \mu_t - P_t$$

$$P_t = \overline{m} + \left(\frac{1}{1+\varphi}\right)\mu_t \ (6)$$

Obtain the solution for output by substituting eq. (5) and eq. (6) into aggregate supply eq. (2):

$$Y_t = \varphi\left(\overline{m} + \left(\frac{1}{1+\varphi}\right)\mu_t - \overline{m}\right) \quad (7)$$

Simplifying equation,

$$Y_t = \varphi\left(\left(\frac{1}{1+\varphi}\right)\mu_t\right)$$

Only stochastic shocks affect real variables which anticipated policy ($\overline{m}$) is neutral.