Economics Bulletin

Volume 38, Issue 2

Credibility is not enough: the importance of common knowledge to anchor expectations

Marcelo de C. Griebeler
Federal University of Rio Grande do Sul

Guilherme Stein
Foundation of Economic and Statistics

Abstract

In a linear model, we show that when individuals form their inflation expectations taking into account the others' expectations, credibility - defined as the individual belief that the central bank is speaking the truth and has enough technical capacity to achieve the announced targets - is not sufficient to anchor the aggregate expectations. Instead, we show that it is necessary to add common knowledge of the individual credibility in order to guarantee anchoring.

Citation: Marcelo de C. Griebeler and Guilherme Stein, (2018) "Credibility is not enough: the importance of common knowledge to anchor expectations", *Economics Bulletin*, Volume 38, Issue 2, pages 916-920
Contact: Marcelo de C. Griebeler - marcelo.griebeler@ufrgs.br, Guilherme Stein - guilherme.stein@fee.tche.br.
Submitted: January 03, 2018. **Published:** April 30, 2018.

1 Introduction

Based on a linear model of inflation expectations formation, we provide a proper definition of what it means for the Central Bank to have credibility. Almost all range of models that have been studied in the literature (Blackburn and Christensen, 1989; Blinder, 2000; Drazen and Masson, 1994; Woodford, 2003) describe Central Bank's credibility as the the individual belief that the central bank is speaking the truth and has enough technical capacity to achieve the announced targets. The limitation of this definition is that it fails to take in account the natural conjecture that when agents are forming their expectations, they care about the opinion of the other agents regarding their belief of how credible they think the central banker is. Our definition incorporates this idea and thus we make a distinction between *individual credibility* and *common knowledge credibility*.

This distinction is not innocuous, because we show that individual credibility is not sufficient to anchor inflation. Instead, it is also required that the level of confidence of each individual be common knowledge in order to achieve anchoring. Thus, our model is related to the literature on the importance of common knowledge (e.g. Geanakoplos, 1992) and coordination of expectations in monetary models (e.g. Araujo et al., 2016).

The paper is organized as follows. Section 2 builds our linear model and section 3 present our results. Appendix A brings the omitted proofs in the text.

2 The linear model of expectations formation

Consider an economy populated by n individuals, indexed by i. Each agent forms his own inflation expectations, π_i^e, based on two factors. The first one is an individual perception of the monetary authority's capacity of pursuing its announced target, measured by $\lambda_i \in \mathbb{R}_+$. Let us call λ_i individual credibility. This measure takes into account how credible is the announced policy, namely whether the central banker is believed to be speaking the truth and whether he has enough technical capacity to achieve the announced targets[1]. We assume that λ_i is a decreasing function of the individual confidence in the policymaker. In the case of full individual credibility, for example, $\lambda_i = 0$.

Assumption 2.1 *The individual credibility λ_i is private information of agent i, for $i = 1, ..., n$.*

A direct consequence of the above assumption is that, rather than knowing the true π_j^e for all $j \neq i$, the agent only has a belief about them – and thus a belief about the aggregate inflation expectations. There exist many reasons which may justify assumption 2.1. These include, among others: people have different sources of information – economic information, in particular – and may receive different signals from the policymaker; cognitive processing varies largely among individuals, which makes them interpret the same signal in different ways; and cultural aspects may shape the way of economic agents perceive credibility issues.

The second aspect of the formation of agent's inflation expectations depends on the expectations of the other agents.

Assumption 2.2 *The aggregate inflation expectations are the arithmetic mean of the n individual expectations, that is, $\pi^e = \sum_{i=1}^n \frac{\pi_i^e}{n}$. Moreover, this fact is common knowledge.*

[1]In terms of the model's underlying game of incomplete information, the individual credibility λ_i may be seen as the agent's belief about the central bank's type. Thus, we have a continuum of types.

Assumption 2.3 *The higher the aggregate inflation expectations* π^e*, the harder the conduct of monetary policy is, that is, increases in* π^e *make the policymaker's task of achieving the promised inflation more difficult. Moreover, this fact is common knowledge.*

In general, central banks build their own aggregate inflation expectations after observing π_i^e, such that every individual expectations affects the aggregate measure. Assumption 2.2 states that the impacts of every π_i^e on π^e are positive. It also states that all agents in the economy know such characteristics of the aggregate inflation expectations. Central banks often make public disclosure of the aggregation rule adopted, which makes it common knowledge.

One can justify assumption 2.3 by recalling that a high π^e implies that individual expectations are also high. Thus, firms may be raising their prices above the inflation target in order to protect their real profits, for example. This makes the current inflation raise, which creates difficulties for the central bank achieving the target. In fact, the well known central banks' concern about anchoring inflation expectations is grounded in the idea expressed in assumption 2.3. We also assume that all agents in the economy are aware that increases in the aggregate inflation expectations make the conduct of monetary policy harder. This can be justified by the public announcements made by monetary authorities, in which one states the aim of making inflation expectations converge to its target.

Based on the above assumptions, we model the inflation expectations of the agent i as

$$\pi_i^e = \lambda_i + \pi^* + \phi \mathbb{E}_i \left[\pi^e - \pi^* \right], \tag{2.1}$$

where $\phi \in (0, n)$ is a parameter that measures the weight given by the agent i to the "expected inflation bias", and π^* is the exogenous inflation target. For the sake of simplicity, we assume that ϕ is equal for all agents. By considering assumption 2.2 we can rewrite (2.1) as

$$\pi_i^e = \frac{n}{n-\phi} \left[\lambda_i + \pi^* (1 - \phi) \right] + \frac{\phi}{n-\phi} \mathbb{E}_i \left[\sum_{j \neq i}^{n} \pi_j^e \right], \tag{2.2}$$

which highlights the importance of the beliefs about the others' expectations.

Given that rational expectations require that individuals use all information available in the economy, which includes the credibility that others individuals attach to the policy or policymaker, their inflation expectations must also be considered. This is the another reason to allow an individual takes into account the expectations of the others when he is forming his own expectations. An important point in our construction is that all available information includes not only the expectations of the other agents, but also the fact of every other agent takes into account all available information as well. Therefore, it includes that every other agent knows that every other agents knows that every other agent uses all available information. This chain takes us to the concept of common knowledge.

3 The role of common knowledge credibility

Our main result is built on two different concepts of credibility. The first one considers only the individual aspect of (2.2) and it is stated below. Notice that it covers all the definitions cited in the introduction and therefore can be applied to those models[2].

Definition 3.1 *We say a monetary policy has full credibility whenever every agent in the economy has full individual credibility, that is,* $\lambda_i = 0$ *for all* i.

The second concept of credibility we introduce takes into account the role of the inflation expectations of the others agents in the individual expectations formation process. The idea is that the individual credibility must be common knowledge in order to build a stronger notion of credibility. By common knowledge we mean the well known definition, first mathematically formalized by Aumann (1976), and largely used in game theory. This notion of credibility rules out the case in which every agent in the economy has full individual credibility, but at least one of them believes that other agent does not have the same perception of credibility. In fact, as one can see in the next definition, common knowledge credibility is rather restrictive.

Definition 3.2 *We say a monetary policy has common knowledge credibility whenever (i) every agent in the economy has full individual credibility, that is,* $\lambda_i = 0$ *for all* i*; and (ii) this latter fact is common knowledge*[3].

Observe that common knowledge credibility implies full credibility, given the requirement of item (i) in its definition. In addition, if definition 3.2 is satisfied, then $\mathbb{E}_i[\lambda_j] = 0$ for all i and j, $\mathbb{E}_k[\mathbb{E}_i[\lambda_j]] = 0$ for all i, j and k, and so on ad infinitum. We can therefore state common knowledge credibility only in terms of expectations about individual credibility. This equivalence is used to prove our main result, which is stated in the following theorem.

Theorem 3.3 *Suppose that assumptions 2.1, 2.2 and 2.3 are satisfied. Then, a monetary policy has common knowledge credibility if and only if* $\lambda_i = 0$ *for all* i *and* $\mathbb{E}_i\left[\pi_j^e\right] = \pi^*$ *for all* $i \neq j$.

The first aspect to note in theorem 3.3 is that it introduces the Harsanyi transformation in our framework: each agent i does not need to consider all the belief hierarchy, it suffices to take into account the inflation expectations of each other agent in order to establish common knowledge credibility[4].

A direct consequence of the above theorem is the following corollary.

Corollary 3.4 *Suppose that assumptions 2.1, 2.2 and 2.3 are satisfied, then* $\pi^e = \pi^*$ *if and only if the monetary policy has common knowledge credibility. In particular, only full credibility does not suffice to guarantee* $\pi^e = \pi^*$.

[2] For example, if we see λ_i as the agent's belief about the central bank's type, then our framework covers the definition often adopted by reputational models, in which the public subjective probability that the bank is "tough" is a measure of credibility.

[3] That is, all the agents know $\lambda_i = 0$, they all know that they know $\lambda_i = 0$, they all know that they all know that they know $\lambda_i = 0$, and so on ad infinitum, for all i. In other words, $\lambda_i = 0$ for all i is common knowledge.

[4] Observe that we introduce the Harsanyi transformation because there is an underlying game of incomplete information in our model, despite our framework itself is not a game. Although agents do make choices, our model starts from their best response functions, given by (2.2), such that they just form their expectations following such rules. Therefore, despite the presence of incomplete information in our model, there are no explicit strategies and payoffs. Recall that it is possible to characterize the underlying game as one of incomplete information if we consider λ_i as the agent's belief about the type of the central bank.

An interesting consequence of the above theorems is that the aggregate expectations will be higher than the target whenever at least one agent believes that at least one other expects inflation higher than the target.

References

Araujo, A., Berriel, T., and Santos, R. (2016). Inflation targeting with imperfect information. *International Economic Review*, 57(1):255–270.

Aumann, R. J. (1976). Agreeing to disagree. *The annals of statistics*, 4(6):1236–1239.

Blackburn, K. and Christensen, M. (1989). Monetary policy and policy credibility: theories and evidence. *Journal of Economic Literature*, 27(1):1–45.

Blinder, A. S. (2000). Central-bank credibility: Why do we care? How do we build it? *The American Economic Review*, 90(5):1421–1431.

Drazen, A. and Masson, P. R. (1994). Credibility of policies versus credibility of policymakers. *The Quarterly Journal of Economics*, 109(3):735–754.

Geanakoplos, J. (1992). Common knowledge. *Journal of Economic Perspectives*, 6(4):53–82.

Woodford, M. (2003). *Interest and prices: Foundations of a theory of monetary policy.* Cambridge University Press.

A Proof of theorem 3.3

First, suppose that the monetary policy has common knowledge credibility. By definition, $\lambda_i = 0$ for all i. Thus, by (2.2) we can conclude that $\pi_i^e = \pi_j^e$, which implies $\mathbb{E}_i\left[\pi_j^e\right] = \pi_i^e$ for all $i \neq j$. By using this fact we have

$$\pi_i^e = \frac{n}{n-\phi}\left[\lambda_i + \pi^*(1-\phi)\right] + \frac{\phi}{n-\phi}(n-1)\pi_i^e.$$

Finally, by solving for the individual inflation expectations we obtain $\pi_i^e = \pi^*$, and then $\mathbb{E}_i\left[\pi_j^e\right] = \pi_i^e = \pi^*$ for all $i \neq j$.

Now suppose that $\lambda_i = 0$ for all i and $\mathbb{E}_j\left[\pi_i^e\right] = \pi^*$ for all $i \neq j$. Note that the expression of $\mathbb{E}_j\left[\pi_i^e\right]$ is given by:

$$\begin{aligned}\mathbb{E}_j\left[\pi_i^e\right] &= \mathbb{E}_j\left[\frac{n}{n-\phi}\left[\lambda_i + \pi^*(1-\phi)\right] + \frac{\phi}{n-\phi}\mathbb{E}_i\left[\sum_{k\neq i}\pi_k^e\right]\right] \\ &= \frac{1}{n-\phi}\left\{\mathbb{E}_j\left[\lambda_i\right]n + \pi^*(1-\phi)n + \phi\mathbb{E}_j\left[\sum_{k\neq i}\mathbb{E}_i\left[\pi_k^e\right]\right]\right\}.\end{aligned}$$

As $\mathbb{E}_i\left[\pi_k^e\right] = \pi^*$ for all $i \neq k$ by assumption, we have

$$\begin{aligned}\pi^* &= \frac{1}{n-\phi}\left\{\mathbb{E}_j\left[\lambda_i\right] n + \pi^*(1-\phi)n + \phi\mathbb{E}_j\left[(n-1)\pi^*\right]\right\} \\ &= \frac{1}{n-\phi}\left\{\mathbb{E}_j\left[\lambda_i\right] n + \pi^*(1-\phi)n + \phi(n-1)\pi^*\right\}. \qquad \text{(A.1)}\end{aligned}$$

After some calculation one can see that the only value that satisfies (A.1) is $\mathbb{E}_j\left[\lambda_i\right] = 0$.

The same reasoning may be applied to $\mathbb{E}_k\left[\mathbb{E}_j\left[\pi_i^e\right]\right]$:

$$\begin{aligned}\mathbb{E}_k\left[\mathbb{E}_j\left[\pi_i^e\right]\right] &= \mathbb{E}_k\left[\mathbb{E}_j\left[\frac{n}{n-\phi}\left[\lambda_i + \pi^*(1-\phi)\right] + \frac{\phi}{n-\phi}\mathbb{E}_i\left[\sum_{m\neq i}\pi_m^e\right]\right]\right] \\ &= \frac{1}{n-\phi}\left\{\mathbb{E}_k\left[\mathbb{E}_j\left[\lambda_i\right]\right] n + \pi^*(1-\phi)n + \phi\mathbb{E}_k\left[\mathbb{E}_j\left[\sum_{m\neq i}\mathbb{E}_i\left[\pi_m^e\right]\right]\right]\right\}.\end{aligned}$$

As $\mathbb{E}_k\left[\mathbb{E}_j\left[\mathbb{E}_i\left[\pi_m^e\right]\right]\right] = \mathbb{E}_k\left[\mathbb{E}_j\left[\pi^*\right]\right] = \mathbb{E}_k\left[\pi^*\right] = \pi^*$ by assumption, we have

$$\begin{aligned}\pi^* &= \frac{1}{n-\phi}\left\{\mathbb{E}_k\left[\mathbb{E}_j\left[\lambda_i\right]\right] n + \pi^*(1-\phi)n + \phi\mathbb{E}_k\left[\mathbb{E}_j\left[(n-1)\pi^*\right]\right]\right\} \\ &= \frac{1}{n-\phi}\left\{\mathbb{E}_k\left[\mathbb{E}_j\left[\lambda_i\right]\right] n + \pi^*(1-\phi)n + \phi(n-1)\pi^*\right\},\end{aligned}$$

which has as solution $\mathbb{E}_k\left[\mathbb{E}_j\left[\lambda_i\right]\right] = 0$.

One can easily see that the same procedure may be used to prove that every expectations about the individual credibility is equal to zero. This means that all the agents know $\lambda_i = 0$, they all know that they know $\lambda_i = 0$, they all know that they all know that they know $\lambda_i = 0$, and so on ad infinitum, for all i. In other words, we have common knowledge credibility. ■