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INSTITUTIONAL DESIGN AND CREDIBILITY

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Institutional Design and Credibility

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Abstract

The optimal design of a monetary institution to achieve policy effectiveness has been of utmost importance to policy-makers. This paper presents an empirical analysis of the link between the structure of a monetary institution and inflation persistence in an economy. It is well established in literature that governance structure of a monetary institution affects the stability of an economy. But the mechanism by which it operates remains unclear. In this paper, we claim this mechanism to be the credibility of the monetary institution. A Central Bank with an autonomous and transparent governance structure is deemed to be more credible by agents, which in turn leads to higher inflation stability in the economy. We investigate this hypothesis using data for the UK. Our results suggest that credibility is the missing link. The institutional design of the Central Bank contributes to its credibility, which subsequently affects the degree of inflation persistence in the economy.

Key words: *central bank; central bank independence; inflation persistence; monetary policy credibility; policy making; time-inconsistency*

JEL Codes: *E52; E58; E31; E61; C32*

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INTRODUCTION

Long since, monetary institutions have struggled with building and maintaining credibility to determine the effectiveness of policies. A monetary policy announcement might not have its desired impact if people do not believe it to be true. This belief of the private sector is what lies at the heart of the credibility theory. Credibility has been defined in many ways over the years; “the extent to which the public believes that a shift in policy has taken place when, indeed, such a shift has actually occurred” (Cukierman, 1986), “... that your pronouncements are believed – even though you are bound by no rule and may have an incentive to renege”, “...it is...built up by a history of matching deeds to words...” (Blinder, 1999) and so on. The principal idea behind credibility can be associated with a very basic human trait- will power. Credibility of a monetary authority, much like will power, can be thought of as trying hard to do something if you’ve committed to it, even though now your commitment doesn’t make much sense (due to dynamic inconsistency).

Credibility helps in output stabilization in the long run. If there are supply-side distortions in the economy, then there is a case for stabilization on second-best grounds, which entails targeting a level of output above the distorted natural rate of output. The best solution is to remove these micro distortions, caused by taxes, subsidies, unemployment benefits, etc. In a simplistic world, with a signal extraction Phillips Curve, if the Central Bank goes for inflation higher than the inflation expected by the private sector (i.e., the announced inflation target by the Central Bank), it can achieve an output more than the natural rate (Barro and Gordon, 1983). And so, the Central Bank has an incentive to take advantage of its credibility by cheating. However, under rational expectations, the private sector would avoid being fooled in this fashion, leading to a sub-prime equilibrium or a fourth-best solution (Kydland and Prescott, 1977). This sub-optimal solution ultimately leads to an inflationary bias. The end result is that inflation increases without any gain in the average output because the target announcement by the

Bank isn't deemed credible by the private sector. This underlines the importance of the credibility of the monetary authority.

Having established the importance of credibility, it becomes imperative to seek how one can achieve the commitment equilibrium; an equilibrium in which the Bank commits to its pre-announced inflation target. One solution is to have a weight conservative Central Bank (Ken Rogoff, 1985). A Central Bank that tries to minimize its loss function and places more weight on inflation stabilization than the society (and hence, is more independent as it can choose to have a single mandate), can help achieve greater inflation stability with lower mean inflation, but at the cost of greater output instability (See Appendix, Figure A.1). Thus, there is no free lunch in Rogoff's world. In the real world, however, there appears to be no such trade-off (Alesina and Summers, 1993). This is because a weight conservative central bank has a lesser inflation target than the society. This eventually leads to lesser average inflation with the same variability of output. However, the real world is marked by a much more complex and dynamic (rather than a static) loss function of the Central Bank. This increases the Bank's incentive to cheat as the payoff from cheating (in present value terms) is much higher in the dynamic model, due to persistence (Svensson, 1997). By making the model more realistic, the problem of inflation bias is aggravated because an adverse supply shock has a huge cost (as it carries into future time periods). So it becomes imperative to close the output gap, emphasizing the necessity of maintaining credibility in the real world.

The widely recognized 'credibility hypothesis' predicts that in a monetary regime which lacks credibility, learning by private agents can generate high levels of inflation persistence. However, in a credible monetary regime, agents learn quickly, leading to a drop in inflation persistence. We investigate the role of credibility as the link between the institutional design of a monetary institute and inflation persistence in an economy. Thus, the relationship between the degree of inflation persistence and the credibility of monetary authority becomes the

starting point of our study. For this, we estimate an autoregressive process in inflation reduced-form. The inflation persistence parameter is recursively estimated using the Kalman filter and modeled to be dependent on a proxy for credibility. Next, we assess whether credibility is affected by the structure of the monetary institution. We conclude that the inflation persistence crucially depends on the credibility of monetary policy, which in turn, is driven by the institutional design of the monetary authority and thus, credibility qualifies as the "missing link".

Institutional Factors Affecting Credibility

"Willpower is trying hard not to do something that you really want to do" said Frog.

"You mean like trying not to eat all these cookies," asked Toad.

"Right," said Frog. He put the cookies in a box. "There, now we will not eat any more cookies."

"But we can open the box," said Toad.

"That is true," said Frog. He tied some string around the box.

He got a ladder and put the box up on a high shelf. "There, now we will not eat any more cookies."

"But we can climb the ladder " (Lobel 1972, Cukeirman, Webb and Neyapti, 1992)

The idea of functioning within well-defined constraints isn't new to Economics. The question is, whether it is believable that one will respect these constraints or not. Credibility is one of the many channels through which economic institutions collaborate to achieve certain desirable outcomes, like output stabilization, price stability, low unemployment, etc. However, credibility itself is endogenously determined by certain characteristics of these institutions. To study such institutional factors, Cukeirman, Webb and Neyapti (1992) took a sample of 21 developed and 51 developing countries over a period of four decades (1950-89) and constructed an overall measure of Central Bank independence (CBI) which was a combination of three independent indices of CBI:

1. Legal Independence Index: Each piece of legislation was coded on 16 dimensions related to four components of CBI, on a country-year basis. These four components are-
 - i. Characteristics of the Bank's Chief Executive Officer (CEO)- appointment, dismissal, term of office, and other offices held by the CEO (usually the governor)
 - ii. Policy formulation attributions- who formulates and makes the final decision in monetary policy and the role of the Central Bank in the budget process
 - iii. Central bank's objectives- whether there is a sole mandate of price stability or other conflicting goals exist as well
 - iv. Central bank's limitations on lending to the public sector- terms of advances and lending to the banks and the government, analysis of potential borrowers

Each of these variables was coded on a scale of 0 to 1, with 1 being the highest level of independence. Relevant weights were then attached to each of these 16 variables and a score (between 0 and 1) of legal independence was obtained for each country.¹ The legal CBI index is the most widely used index of CBI in literature. It encompasses both the internal functioning of the bank (first and the third component), as well as the relationship of the bank with the executive branch (second and fourth component). There has been a marked increase in this index since its formation among both developed and developing countries. However, the distribution of change in exact components of the index differs across the two. "Areas of independence pertaining to relations between the executive and the monetary authority – notably in terms of dispute resolution and central bank financing of government – demonstrate an increase in both advanced and emerging market and developing economies. However, areas of the index relating to appointment procedures for the governor and the existence of a well-documented policy target have increased significantly only for the latter

¹ See Appendix (Table A.2) for a detailed description of the coding of this index.

group of countries, reflecting the fact that they were already relatively high in advanced economies.” (Crowe and Meade, 2008).

2. Turnover rate of Central Bank governor Index: It is defined as the number of times the governor changes over a year. Frequent firing of the governor may indicate the dismissal of a voice of dissent against the government. Thus a higher turnover rate would imply a significant decline in independence.
3. Questionnaire Index: A questionnaire was sent to monetary policy specialists of some Central Banks with focus on intermediate policy targets, actual priority given to price stability, degree of actual tenure overlap between the governor and high officials in the executive branch, determination of salaries of high bank officials, etc. This index captures the divergence between actual and legal independence, particularly when the divergence is large, such as in developing countries.

These indices were individually used in a regression model to explain the variation in inflation. The coefficients from the regression were then used as weights for these indices to create an overall index of CBI, based on inflation.

Several attempts have been made thereafter to improve the index given by Cukeirman, Webb and Neyapti (1992). Florin Cornel Dumiter (2014) does a meta-analysis of all the indices of Central Bank independence, accountability and transparency given by authors till then. The most comprehensive measure of CBI, however, is given by Ana Carolina Garriga (2016). The index makes a clear cut distinction between *de jure* and *de facto* independence. *De jure* independence is defined as “constitutions, laws, amendments, and decrees that directly refer to central banks, and central bank charters”, while *de facto* independence covers the practical aspect of transparency, accountability, questionnaires, turnover rates, etc. The study covers 182 countries for

every year between 1970 and 2012. This index (further used in our study) is the overall index of CBI given by Cukeirman, Webb and Neyapti (1992) with the following additional terms:

- i. A dummy variable for the year of creation of Central Bank
- ii. A Central Bank reform that affects CBI in a given year
- iii. The direction of such reform (whether it increases or decreases CBI)
- iv. A dummy variable for whether the Central Bank is a regional entity (i.e., if the country's monetary policy is in the hands of a regional monetary union, for e.g., the European Central Bank)²

Bade and Parkin (1988) constructed a (1-4) scale of CBI, based on political independence. "Political independence is taken to depend on the institutional relationship between the central bank and the executive, the procedure to nominate and dismiss the head of the central bank, the role of government officials on the central bank board, and the frequency of contacts between the executive and the bank" (Alesina and Summers, 1993). Another index of CBI, which considered both political and economic independence were given by Grilli, Masciandaro, and Tabellini (1991). Economic independence was dependent on the extent of the liability of the central bank to help the government finance its deficit. It has been widely recognized in the literature that these legal measures of CBI, along with other factors (degree of openness of the economy, financial sector's ability to oppose inflation, etc.) help explain the inflation differential across countries (Campillo and Miron, 1996). However, these do not account for the inflation variations within developing economies. A major reason is that the legal CBI index does not explicitly take into account the political vulnerability of the Central Bank, i.e., the fraction of political transitions that are followed by a replacement of the governor of the Bank. Cukeirman and Webb, 1995 gave their measure of CBI which

² For our case (UK), the first and the fourth components are absent and there are two reforms (1972 and 1998), one of which reduces CBI while the other increases it (see Results and Analysis).

talks about the political influence on Central Banks, especially in developing economies, in great detail. They concluded by relating political stability to the stability of government institutions along with macroeconomic stability. While it is well established that a higher degree of CBI leads to inflation stability, the exact mechanism by which it does so, remains unexplored so far. This study is one step in this direction.

Transparency is another institutional aspect of the Central Bank. The attempts to quantify transparency were made much later than those to measure independence. Eijffinger and Geraats (2002) focused heavily on the role of various components of transparency of Central Bank in maintaining credibility. A multi-dimensional approach to Central Bank transparency distinguishes between political transparency (clarity with which policy objectives are stated and the relationship between the executive and the Central Bank), economic transparency (private sector having access to macroeconomic models, data and forecasts generated by the Bank), procedural transparency (openness regarding the way monetary policy decisions are taken), policy transparency (prompt policy announcements) and operational transparency (openness about policy implementations subject to macroeconomic disturbances). Dincer and Eichengreen (2014) gave an index of Central Bank Transparency for 120 Central Banks, for every year from 1998 to 2010. They distinguished three sub-categories within each of the above five dimensions of transparency. Every subcategory is rated on a scale of 0-1. The scores are then summed across all the categories for a maximum of 15 (highly transparent Bank), to get an overall measure of transparency.³

All the above mentioned authors have devised these indices with the ultimate motive of finding their effect on inflation, unemployment and growth rate of an economy. The debate around the optimal way of implementing an economic policy to achieve its desired outcome, has been going on in academic circles long since 1977, when Kydland and

³ See Appendix (A.3) for a detailed description of the coding of this index.

Prescott spoke about whether a monetary policy should be carried out according to well-defined rules or should it be left at the discretion of the government. According to them, for monetary policy to be credible, and hence successful, policymakers' hands are better tied than left free. They argue their case in favor of the Central Bank following pre-announced rules but recognize that just rules are not enough; it is paramount to establish a credible commitment to the rules.

A potential solution to ensure this commitment is to follow an activist rule, which mentions exactly how the rule can be changed in the light of new information. "Such rules remove the policymaker's blindfold but keep his hands tied" (Kydland and Prescott, 1977). The question, however, remains that how should one keep the policymaker's hands tied; how to ensure that rules are followed? They claim that the best way to achieve this is to give full legal independence to the Central Bank and making it free from the political pressures of the government. This paper was among the first few papers to highlight institutional structure as a tool to drive the credibility of monetary policies to ultimately achieve policy effectiveness.

Some authors have also pointed towards the mixed evidence behind the claim that CBI leads to reduced inflation by raising credibility. "There is remarkably little evidence that credibility in monetary policy making buys one much when it comes to lowering the costs of disinflation." (Bordo and Siklos, 2016). Bodea and Hicks (2015) explicitly differentiated between the credibility effect and the disciplinary effect of CBI. They insisted that CBI alone cannot be successful in achieving price stability. Focus must be on the mechanisms (a country's political rights, freedom of press, presidential and legislation election dummy, etc.) through which CBI affects money demand and money supply. To summarize, credibility is determined by a number of economic and institutional factors. Bordo and Siklos (2014) attempted to quantify and measure credibility as the squared deviation of inflation from its implied target value. They modeled credibility as a first-order

autoregressive process simultaneously depending on a number of exogenous factors like oil shocks, CBI, monetary regime in place, bank credit to GDP ratio, exchange rate regime in place, etc. They also backed their analysis with historical narratives from eleven countries.

The credibility analysis remains a vivid area of research with the potential of several multi-dimensional breakthroughs. For e.g., there is another theory that in some parts of the world, especially in Anglo-Saxton countries, certain cultural factors affect business cycles (Altug and Canova, 2013). This means that there is yet another avenue through which the Central Bank's credibility and reputation can be affected. Increasingly, Central Bank accountability is also beginning to take a front seat in the institutional design debate. It is also claimed that the private sector is better equipped to make complete use of public information when forming inflation expectations if the transparency of the central bank is enhanced (Crowe and Meade (2008)). Despite concrete evidence in the literature on how instrumental and evolving the institutional approach to macroeconomic stability has been, several such avenues remain to be explored.

Data and Methodology

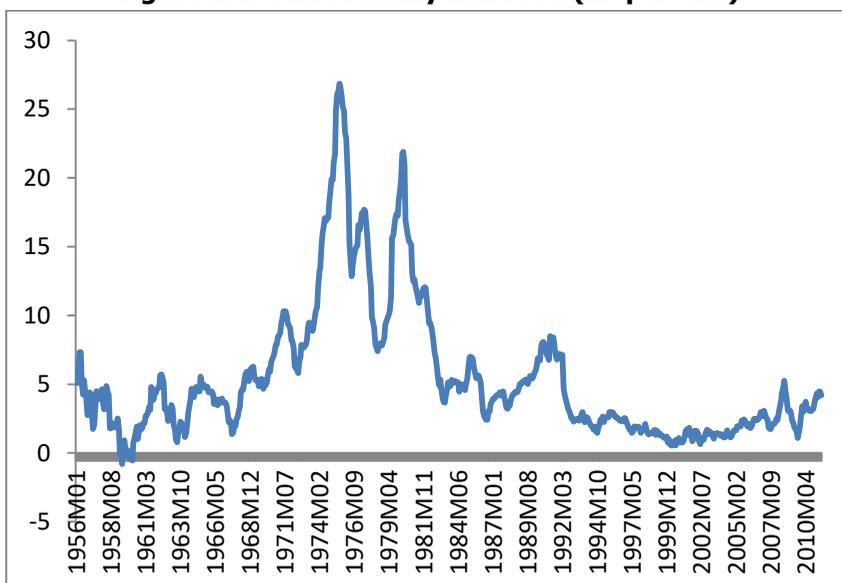
To establish credibility as the missing link between the structure of the monetary authority and inflation stability in the economy, we test a two-fold hypothesis:

1. The inflation persistence depends upon the credibility of the monetary authority; and
2. The credibility of a monetary authority is driven by its institutional design

For the first part of our hypothesis, we use U.K. monthly data on inflation (1956 Jan to 2012 June; a total of 678 observations, see Figure 1.a) and British Government Securities 2.5 percent consol gross flat yield (Figure 1.b). The data has originally been collated from OECD and Office of National Statistics, respectively (Srinivasan and Kumar, 2012).

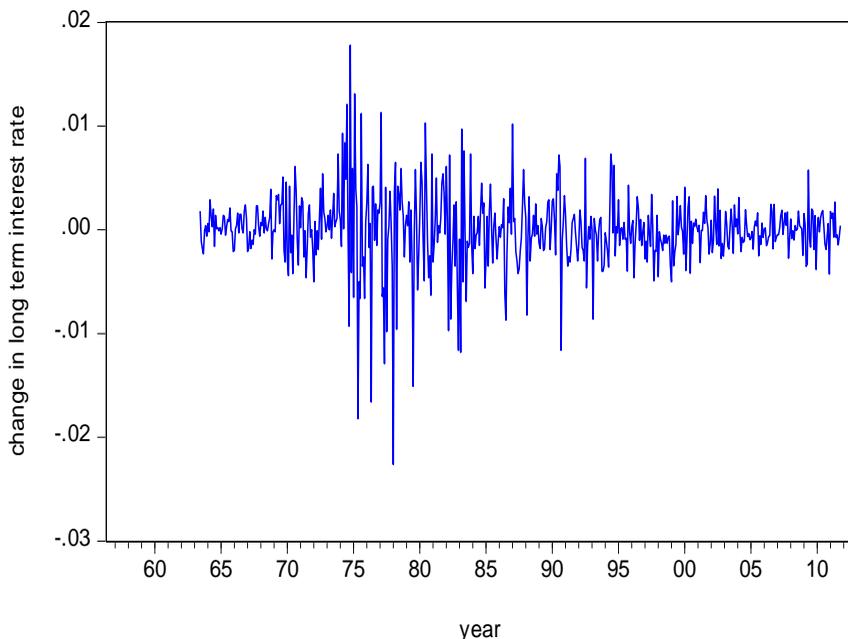
Inflation is measured as the percentage change in the consumer price index (CPI) and we use monthly observations of year ended inflation data.⁴ The monthly changes in the consol yields are used as a proxy for credibility. When the credibility is high, inflation expectations are properly anchored and they do not bounce much around the Central Bank’s target inflation, as the public believes the Central Bank to keep its inflation promise. The Central Bank responds to these stable inflation expectations by keeping long term rates stable. Thus a lower variation in the long term rates implies higher credibility.

Figure 1.a: U.K. Monthly Inflation (in percent)



⁴ CPI of the same month over consecutive years are used to find the percentage change. For e.g., $\Pi_{2011,06} = [(CPI_{2011,06} / CPI_{2010,06}) - 1] * 100$ percent.

Figure 1.b: Variation in Long Term Rates (Proxy for Credibility)



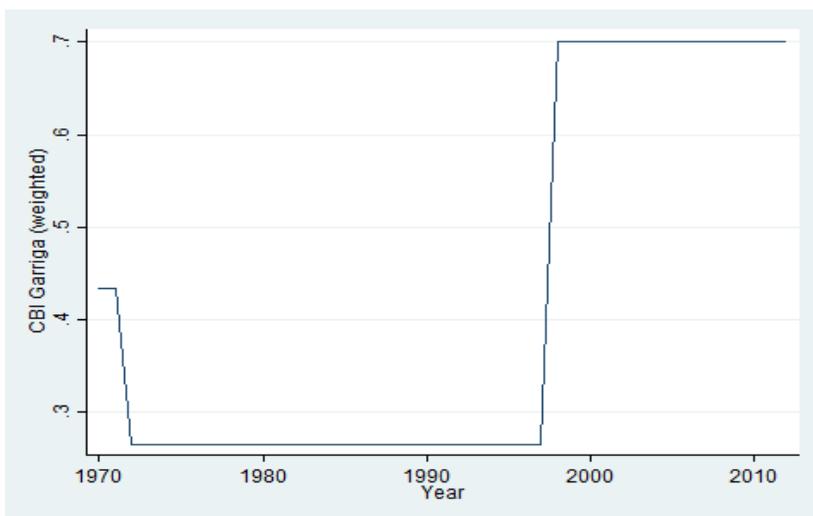
The process of forming inflation expectations lies at the core of the credibility hypothesis. Inflation expectation formation, in turn, depends on the monetary regime in place. Increasingly, economies have started following an inflation forecasting targeting (IFT) regime, which states that given a two year control lag between policy instrument and its effect on the goal variable, it is optimal for a Central Bank to set interest rates at a time such that its current forecast of two year ahead inflation is in line with its target. The Central Bank releases its inflation forecast to the public. If it overshoots its target, we expect the Bank to increase the interest rate. When the interest rate increases, the aggregate demand falls; inflation falls and vice versa. If the inflation forecast is well in line with the target, the Bank adopts a neutral monetary policy stance.

This is further highlighted by the Taylor Stability Principle, which states that when inflation increases by one percent, the interest rate increases by more than one percent. Thus, monetary policy depends on

the inflation forecast. And these forecasts derive greatly from the inflation expectation of the public. Therefore, credibility can be quantified based on how monetary policy actions over time reflect some proxy for inflation expectations. This is the rationale behind using the changes in long term interest rate as a proxy for credibility. Long-term interest rate was also used in the early 1980s by the Thatcher Administration in the U.K. as an important indicator of the credibility of their disinflation program (Minford, 1991). It is also contended that Volcker and other Federal Open Market Committee members regarded long-term interest rate as a key indicator of inflation expectations.

For the second part of our hypothesis, we define Central Bank Independence as a fundamental institutional factor. We use the Central Bank Independence Index for U.K. (Figure 2) given by Garriga (2016). It is a yearly index from 1970 to 2010. We also take a cursory look at the Central Bank Transparency Index for U.K., given by Dincer and Eichengreen (2014). It is also a yearly index from 1998 to 2010.

Figure 2: Central Bank Independence Index



Econometric Modeling

To test if credibility affects inflation persistence, we estimate an autoregressive process in our inflation reduced-form, wherein inflation is an observed variable and inflation persistence parameter is an unobserved time-varying state variable. Further, we estimate the persistence parameter to be dependent on the proxy for credibility. The estimated model is as follows:

$$\Pi_t = \phi + \beta_t \Pi_{t-1} + \varepsilon_t + \sum_{i=1}^q \Theta_i \varepsilon_{t-i} \quad (1.1)$$

$$\beta_t = \beta_{t-1} + \Upsilon C_t + V_t \quad (1.2)$$

where,

Π_t = inflation in time period t

ϕ = intercept

β_t = time-varying persistence coefficient (of inflation); $-1 < \beta_t < 1$

Θ_i = moving average coefficient of the i^{th} lag of error term

C_t = changes in long term interest rates; proxy for credibility

Υ = credibility parameter; $\Upsilon > 0$

q = order of the moving average error term, motivated by the use of year ended data

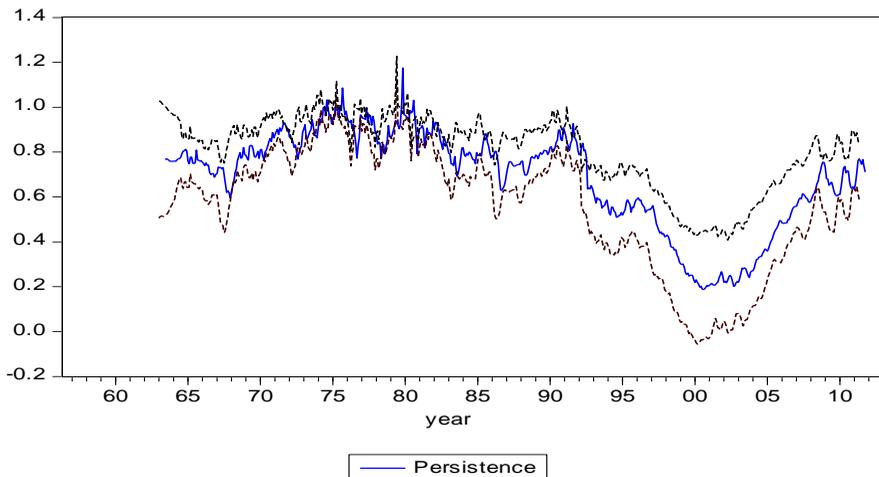
Equation (1.1) is the measurement (observation) equation and equation (1.2) is the transition (state) equation. The disturbance terms in the two equations, ε_t and V_t are serially uncorrelated disturbances with zero mean and constant variances, and are assumed to be uncorrelated with each other in all time periods. The above equations form a state space model, in which the unknown parameters, ϕ , Θ_i , $\sigma^2\varepsilon$, σ^2V and Υ can be estimated using Maximum Likelihood method. We then use the Kalman filter to recursively obtain the optimal estimates of the time-varying state variable, β_t . We expect a positive sign of Υ because as per the credibility hypothesis, low credibility of monetary authority (and hence a higher C_t value) would lead to substantial inflation inertia.

Results and Analysis

We have estimated an ARMA (1, 12) model for observed inflation with a differential persistence coefficient, which simultaneously depends on the

credibility proxy. Most error lag terms have significant coefficients.⁵ Surprisingly, the coefficients of first and second lags of error were insignificant, while the later lag coefficients were mostly significant (at 5 percent level of significance). This might be due to the use of year ended inflation data. A shock to inflation last June might be a seasonal shock and thus can have some spillover effect on inflation this June, while a shock last month (say this May) might not affect inflation in June at all. The estimated time-varying path of inflation persistence parameter (β_t) is plotted in Figure 3, along with two root mean square error bands (95 percent confidence interval). We also get a statistically significant coefficient (standard error in parenthesis) for the credibility parameter, Υ (Table 1.1). It is of the expected sign, confirming that a loss in credibility leads to a rise in persistence. Figure 4 plots our estimate of inflation persistence alongside our credibility proxy, showing that periods of high variation in long term rates (low credibility) are marked by high values of persistence coefficient (0.6 or above); and vice versa.

Figure 3: Inflation Persistence with Standard Error bands

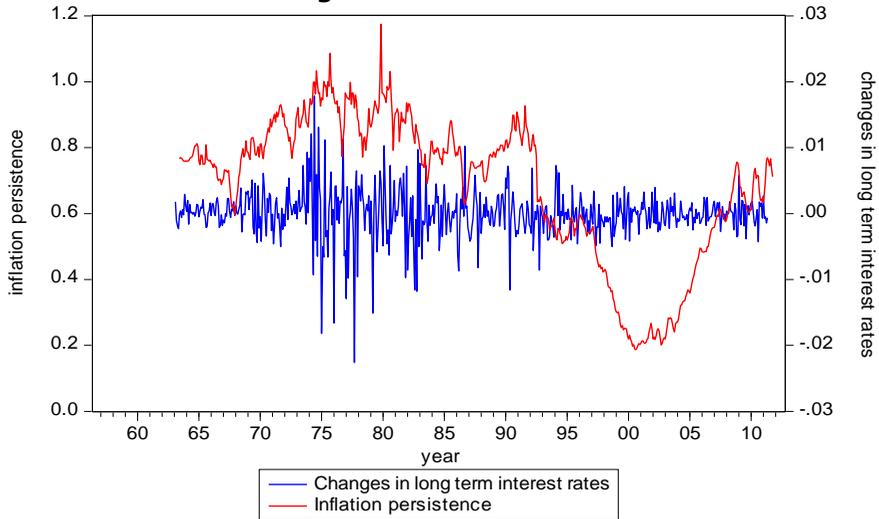


⁵ See Appendix for estimation results (Table A.1)

Table 1.1: Maximum Likelihood Estimates for UK

Parameters	Υ	$\sigma^2\varepsilon$	σ^2v
Estimates	2.15 (0.63)	$1.8 \cdot 10^{-3}$ (0.08)	$5.8 \cdot 10^{-2}$ (0.16)

Figure 4: Inflation Persistence and Month On Month Variation In Long Term Interest Rates



We have used data pertaining to U.K.'s Central Bank, Bank of England (BOE). BOE was established in 1694 as an independent entity, not in the hands of any regional monetary union (like the European Monetary Union and European Central Bank). Initially, the Bank had policy independence with bank/discount rate being its main policy instrument. U.K. was on gold standard back then. So BOE, very soon into its existence, gained credibility by maintaining gold convertibility of bank notes at a fixed official price. In 1810, the inflation in U.K. reached around 10 percent and soon declined, ensuring further credibility to BOE. It was a pretty smooth journey for BOE in terms of maintaining its credibility till the First World War, when interest rates plunged and inflation spiked to an all-time high of 200 percent. BOE was unable to curb inflation immediately. After struggling for a bit, the U.K. managed to

come back to the gold standard in 1925, albeit at an overvalued sterling. Gold Standard returned, but credibility did not. "Credibility evolves possibly in a non-linear manner, is earned slowly and painstakingly yet susceptible to evaporate on a moment's notice" (Bordo and Siklos, 2014). Finally, in 1931, the gold standard broke down.

The Second World War was no different in terms of its impact on inflation. The Bank couldn't manage for long in the face of lost confidence in its ability to handle inflation. The war ended with the BOE getting nationalized in 1945 and the Bank officially losing all its independence. In 1946, U.K. became part of the Bretton Woods system. The 1950s and 60s were a period of "stop-go" monetary policy, marked by a vicious cycle of U.K. facing a balance of payments deficit, being rescued by IMF and ending up with an overvalued sterling. The cycle finally ended after the devaluation of 1967. According to the Radcliffe Committee Report of 1960, monetary policy was rendered "impotent" during this period. Credibility of the monetary regime suffered a huge setback. The period post 1970s is marked by two major structural breaks. The first one was in 1972, with the breakdown of the Bretton Woods system. The sterling floated, followed by a heavy devaluation, eventually leading to a currency crisis. This was the period of "Great Inflation". The Treasury controlled the monetary policy at this time. The inflation spiral finally ended in the 1980s as Margaret Thatcher and Alan Walters came to power and consequently, reduced money growth and capital controls, leading up to a period, later known as the "Great Moderation". The shift of the administration from having a Keynesian stance to a monetarist one (in which fiscal targets became subservient to monetary targets), helped regain credibility. In 1992, BOE began formal inflation targeting (IT). Consequently, the second structural break came in 1998 when BOE gained operational independence from the Treasury. The goal of price stability, however, was still determined by the government.

Figure 1.a clearly confirms with our narrative. Inflation peaks to around 20 percent in the post-World War II period, stabilizes during the

Thatcher years, and finally falls to about 2 percent in the late 1990s with an IT regime in place. Figure 4 also lends credence to U.K.'s experience. The period of 1970s is marked by a large variation in the long term rates. During this time, inflation expectations weren't anchored and consequently, the inflation persistence was very high. The persistence drops significantly (to about 0.2) after 1998, as the long term rates also tend to be more stable in this period.

Next, Figure 2 shows that there are two jumps in the Central Bank Independence index- 1972 (the breaking down of Bretton Woods and floating of sterling) and 1998 (BOE gaining operational independence from the Treasury). These jumps when plotted against the month on month variation in the long term rates reveal that periods with a low degree of Central Bank independence also depict highly volatile long term rates, and vice versa (Figure 5). Thus there exists a positive correlation between the Central Bank Independence and credibility. However, one should be cautious to find causality between the two. It has already been shown that high credibility leads to low persistence. Thus, we expect a negative correlation between Central Bank Independence and inflation persistence.

Figure 6 shows that persistence drops significantly as the BOE gains operational independence in 1998. The correlation coefficient between the two is found to be (-) 0.68. A similar negative correlation can be observed between Central Bank Transparency and inflation persistence (Figure 7). This correlation seems weaker than the one with Central Bank Independence.⁶ However, the direction of correlation suggests that as the Bank becomes more transparent in its outlook in the early 2000s, persistence falls (to almost 0.2) while persistence rises sharply (to almost 0.8) post 2008, when the Bank loses its transparency

⁶ One should be careful not to read too much into this observation. It could be either because independence is a more important factor than transparency in determining inflation stability, or simply because there is very limited data (1 decade) for the construction of the Transparency Index as compared to the Independence Index (4 decades).

by some points. This loss of transparency can be traced to the Bank's handling of emergency lending to the Royal Bank of Scotland and HBOS in the face of financial crisis of 2008.

Figure 5: Month On Month Variation In Long Term Rates And Central Bank Independence Index

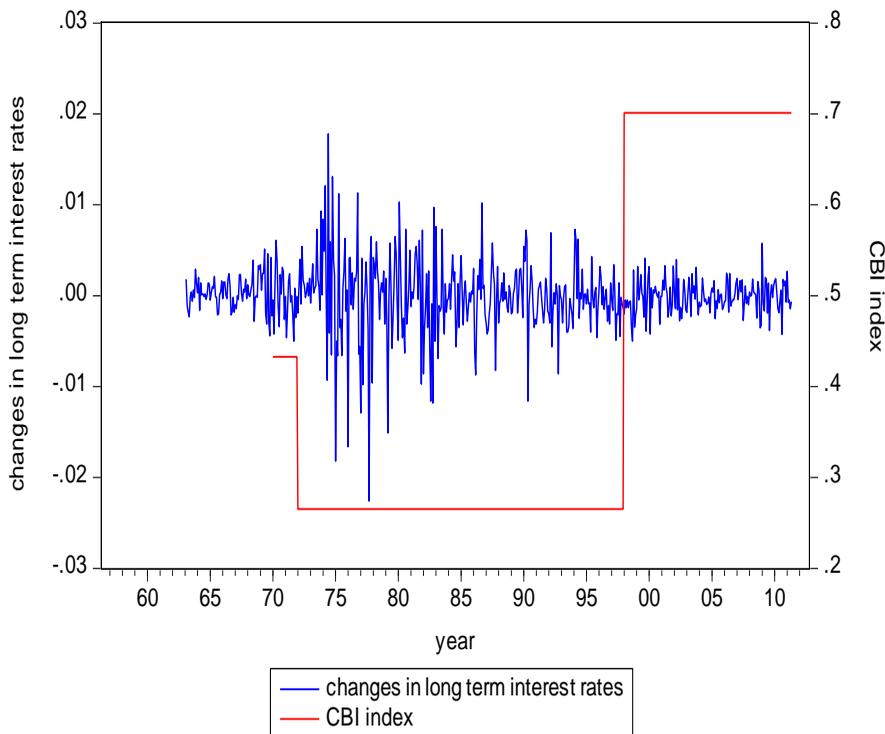


Figure 6: Inflation Persistence and Central Bank Independence Index

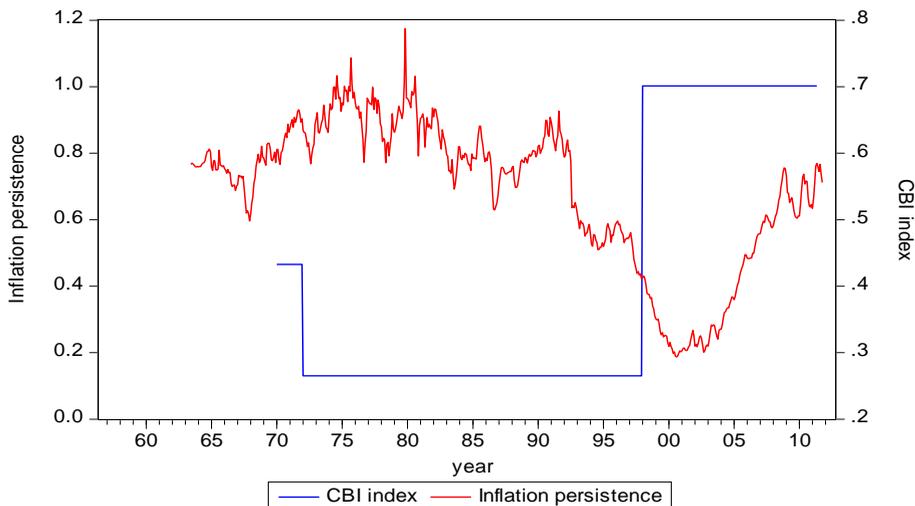
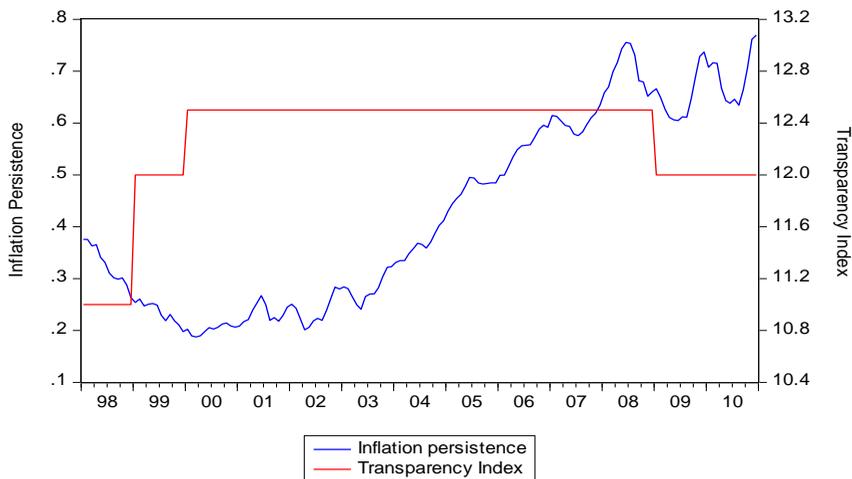


Figure 7: Inflation persistence and Central Bank Transparency Index



We see that there is a correlation between the Bank's independence (and transparency) and credibility and a causal relationship between credibility and inflation stability, with the former causing the

latter. Our empirical results are backed by literature, which tells us that a strong institutional design which gives enough autonomy to its monetary authority to achieve its goals and enough access to the public about the functioning of their monetary authority, forms the backbone of a stable economy in which inflation expectations are well anchored. "There exists a fairly broad consensus that central bank independence and accountability are essential ingredients in maintaining credibility and reputation" (Bordo and Siklos, 2014).

CONCLUSION

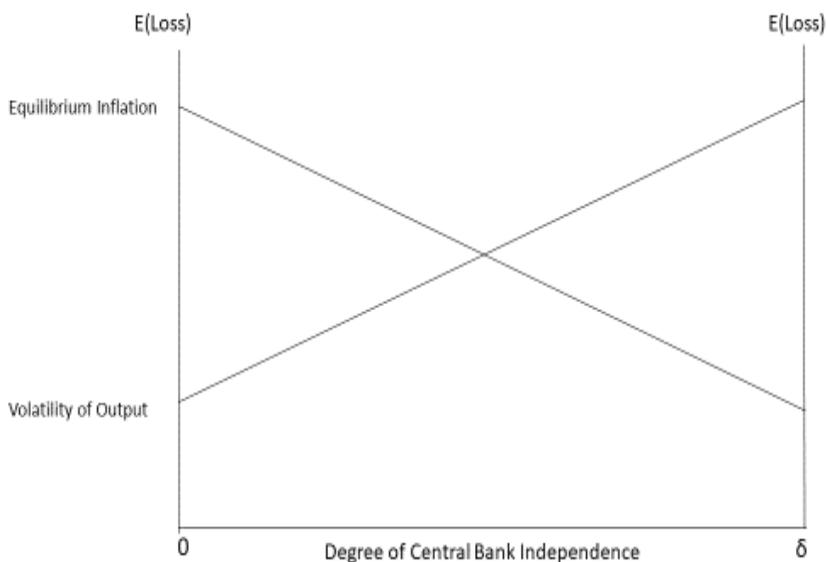
The empirical evidence and its analysis along with the existing literature, confirms the hypothesis that credibility is the mechanism by which fundamental institutional factors affect the inflation lag dynamics. The U.K. narrative lends support to these results. We conclude that factors like inflation expectations of the private sector, their confidence on the monetary authority, their belief that the Bank is not driven by political pressures, and most importantly, their trust that the Bank is an autonomous and transparent body having an incentive to stay true to its announced targets lead to the stability of an economy by making policy announcements credible.

There is potential to extend the scope of this study in certain ways. Firstly, the empirical results must be tested for robustness, using different measures of credibility like the difference between yields of nominal and inflation-indexed bonds, the difference between the yields of long term and short term bonds, survey measure of inflation expectations (through consumer confidence reports published by some Central Banks), etc. Secondly, the Central Bank transparency index can be extended to years before 1998 and an accountability index can be devised for the same years. Finally, the link between credibility and output stability can also be studied to see if the results support the 'free lunch' claim of

Alesina and Summers (1993).⁷ Finding the relevant data for U.K. for the given time frame remains a challenge. Nevertheless, the field is undoubtedly a goldmine for further research.

APPENDIX

Figure A.1: Central Bank's Loss Function and Degree of Central Bank Independence



⁷ See Introduction for a detailed discussion of the claim

Table A.1: UK- Maximum Likelihood (Marquardt) Estimates

Sample: 1956M05 2012M10

Included observations: 581

Convergence achieved after 123 iterations

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.262908	0.144729	1.816555	0.0693
C(2)	0.296691	0.152940	1.939922	0.0524
C(3)	0.370563	0.132124	2.804663	0.0050
C(4)	0.268282	0.128759	2.083591	0.0372
C(5)	0.197559	0.118273	1.670354	0.0948
C(6)	0.377066	0.156702	2.406261	0.0161
C(7)	0.212830	0.139054	1.530555	0.1259
C(8)	0.249396	0.153550	1.624203	0.1043
C(9)	0.292303	0.136412	2.142797	0.0321
C(10)	0.286090	0.116646	2.452631	0.0142
C(11)	0.276360	0.078672	3.512799	0.0004
C(12)	-0.436418	0.075963	-5.745143	0.0000
C(14)	2.147173	0.628941	3.413951	0.0006
C(15)	-6.290948	0.080542	-78.10816	0.0000
C(16)	-2.830287	0.164980	-17.15530	0.0000
C(17)	1.038339	0.172538	6.018036	0.0000
	Final State	Root MSE	z-Statistic	Prob.
SV2	0.712715	0.076178	9.355863	0.0000
SV3	0.000000	0.242891	0.000000	1.0000
SV4	-0.165620	0.174618	-0.948471	0.3429
SV5	-0.068806	0.167572	-0.410604	0.6814
SV6	0.328919	0.155300	2.117964	0.0342
SV7	-0.230055	0.164772	-1.396200	0.1627
SV8	-0.020146	0.159939	-0.125961	0.8998
SV9	0.234107	0.154866	1.511670	0.1306
SV10	0.401268	0.138985	2.887126	0.0039
SV11	0.013210	0.138409	0.095439	0.9240
SV12	0.065164	0.136475	0.477480	0.6330
SV13	-0.223922	0.140233	-1.596790	0.1103
SV14	0.064136	0.136759	0.468970	0.6391
SV15	-0.094098	0.140366	-0.670374	0.5026
Log likelihood	-364.1462	Akaike info criterion		1.308593
Parameters	16	Schwarz criterion		1.428793
Diffuse priors	14	Hannan-Quinn criterion		1.355451

where, $C(1) = \theta_1$, $C(2) = \theta_2, \dots$, $C(12) = \theta_{12}$, $C(14) = \gamma$, $C(15) = \ln(\sigma^2 \varepsilon)$,
 $C(16) = \ln(\sigma^2 v)$, $C(17) = \phi$, $SV2 = \beta_t$, $SV3 = \varepsilon_t$, $SV4 = \varepsilon_{t-1}, \dots$, $SV15 = \varepsilon_{t-12}$
[LHS are estimates and RHS are their respective parameters]

Table A.2: Coding Legal Central Bank Independence

Variable No.	Description of variable	Weight	Numerical coding
1.	Chief Executive Officer (CEO)	0.20	
a.	Term of office		
	Over 8 years		1.00
	6-8 years		0.75
	5 years		0.50
	4 years		0.25
	Under 4 years or at the discretion of appointer		0.00
b.	Who appoints CEO?		
	Board of central bank		1.00
	A council of the central bank board, executive branch, and legislative branch		0.75
	Legislature		0.50
	Executive collectively (e.g. council of ministers)		0.25
	One or two members of the executive branch		0.00
c.	Dismissal		
	No provision for dismissal		1.00
	Only for reasons not related to policy		0.83
	At the discretion of central bank board		0.67
	At legislature's discretion		0.50

	Unconditional dismissal possible by legislature		0.33
	At executive's discretion		0.17
	Unconditional dismissal possible by executive		0.00
d.	May CEO hold other offices in government?		
	No		1.00
	Only with permission of the executive branch		0.50
	No rule against CEO holding another office		0.00
2.	Policy Formulation	0.15	
a.	Who formulates monetary policy?		
	Bank alone		1.00
	Bank participates, but has little influence		0.67
	Bank only advises government		0.33
	Bank has no say		0.00
b.	Who has final word in resolution of conflict?		
	The bank, on issues clearly defined in the law as its objectives		1.00
	Government, on policy issues not clearly defined as the bank's goals or in case of conflict within the bank		0.80
	A council of the central bank, executive branch, and legislative branch		0.60
	The legislature, on policy issues		0.40

	The executive branch on policy issues, subject to due process and possible protest by the bank		0.20
	The executive branch has unconditional priority		0.00
c.	Role in the government's budgetary process		
	Central bank active		1.00
	Central bank has no influence		0.00
3.	Objectives	0.15	
4.	Limitations on lending to the government	0.50	

Source: Cukierman, Webb and Neyapti (1991)

A.3 Coding Central Bank Transparency

1. Political Transparency:

- i) Is there a formal statement of the objective(s) of monetary policy, with an explicit prioritization in case of multiple objectives?
 No formal objective(s) = 0
 Multiple objectives without prioritization = 0.5
 One primary objective, or multiple objectives with explicit priority = 1
- ii) Is there a quantification of the primary objective(s)?
 No = 0 Yes = 1.
- iii) Are there explicit contacts or other similar institutional arrangements between the monetary authorities and the government?
 No central bank contracts or other institutional arrangements = 0
 Central bank without explicit instrument independence or contract = 0.5

Central bank with explicit instrument independence or central bank contract although possibly subject to an explicit override procedure
= 1

2. **Economic Transparency:**

- i) Is the basic economic data relevant for the conduct of monetary policy publicly available? (The focus is on the following five variables: money supply, inflation, GDP, unemployment rate, and capacity utilization.)

Quarterly time series for at most two out of the five variables = 0

Quarterly time series for three or four out of the five variables = 1/2

Quarterly time series for all five variables = 1

- ii) Does the central bank disclose the macroeconomic model(s) it uses for policy analysis?

No = 0

Yes = 1

- iii) Does the central bank regularly publish its own macroeconomic forecasts?

No numerical central bank forecasts for inflation and output = 0

Numerical central bank forecasts for inflation and/or output published at less than quarterly frequency = 0.5

Quarterly numerical central bank forecasts for inflation and output for the medium term (one to two years ahead), specifying the assumptions about the policy instrument (conditional or unconditional forecasts) = 1

3. **Procedural Transparency:**

- i) Does the central bank provide an explicit policy rule or strategy that describes its monetary policy framework?

No = 0

Yes = 1

- ii) Does the central bank give a comprehensive account of policy deliberations (or explanations in case of a single central banker) within a reasonable amount of time?

No or only after a substantial lag (more than eight weeks) = 0
Yes, comprehensive minutes (although not necessarily verbatim or attributed) or explanations (in case of a single central banker), including a discussion of backward- and forward-looking arguments = 1

- iii) Does the central bank disclose how each decision on the level of its main operating instrument or target was reached?

No voting records, or only after substantial lag (more than eight weeks) = 0

Non-attributed voting records = 0.5

Individual voting records, or decision by single central banker = 1

4. **Policy Transparency:**

- i) Are decisions about adjustments to the main operating instrument or target announced promptly?

No or only after the day of implementation = 0

Yes, on the day of implementation = 1

- ii) Does the central bank provide an explanation when it announces policy decisions? No = 0

Yes, when policy decisions change, or only superficially = 0.5

Yes, always and including forwarding-looking assessments = 1

- iii) Does the central bank disclose an explicit policy inclination after every policy meeting or an explicit indication of likely future policy actions (at least quarterly)?

No = 0

Yes = 1

5. **Operational Transparency:**

- i) Does the central bank regularly evaluate to what extent its main policy operating targets (if any) have been achieved?

No or not very often (at less than annual frequency) = 0

Yes but without providing explanations for significant deviations = 0.5

- Yes, accounting for significant deviations from target (if any); or, (nearly) perfect control over main operating instrument/target = 1
- ii) Does the central bank regularly provide information on (unanticipated) macroeconomic disturbances that affect the policy transmission process?
- No or not very often = 0
- Yes but only through short-term forecasts or analysis of current macroeconomic developments (at least quarterly) = 0.5
- Yes, including a discussion of past forecast errors (at least annually) = 1
- iii) Does the central bank regularly provide an evaluation of the policy outcome in light of its macroeconomic objectives?
- No or not very often (at less than annual frequency) = 0
- Yes but superficially = 0.5
- Yes, with an explicit account of the contribution of monetary policy in meeting the objectives = 1

Source: Dincer and Eichengreen (2014)

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