The NBU's Credibility in the Formation of Firms' Inflation Expectations

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Kateryna Savolchuk[1], Tetiana Yukhymenko[2]

Abstract

This study investigates the influence of central bank credibility in forming inflation expectations, using data obtained from business surveys conducted by the National Bank of Ukraine. We employ a two-stage treatment model to mitigate the potential bias of the endogeneity of firms' answers. The results confirm the vital role of credibility in shaping inflation expectations. Notably, credibility reduces sensitivity to past inflation deviations. Robustness checks, which are based on bootstrapping, reinforce the reliability of the findings. Our study underscores the importance of central bank credibility in anchoring inflation expectations.

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1. Introduction

Firms' inflation expectations play an important role in their current decisions about investment and employment, as well as in setting prices and wages, influencing financial markets, affecting consumer confidence, and guiding monetary policy. Thus, inflation expectations are among the essential elements of the monetary policy transmission mechanism, and are essential for inflation stabilization. Better-anchored inflation expectations decrease the persistence of inflation, and the effects of temporary shocks on inflation are reduced since the public does not overreact (Mishkin, 2007; Bems et al., 2018). As a result, central banks aim to manage inflation expectations.

Central bank credibility helps anchor inflation expectations and ensure the effectiveness of the transmission mechanism. Credibility refers to the trust and confidence that the public and financial markets place in a central bank's ability to achieve its declared inflation targets. Another important role of credibility is to help garner public support for central bank independence. Central bank credibility can be fragile and may take years to build, but it can be quickly eroded if the central bank fails to deliver on its promises or faces political interference. Maintaining credibility is an ongoing challenge for central banks, and they need to demonstrate their commitment to their declared objectives over time to continue to effectively anchor inflation expectations.

Credibility depends on the type of monetary policy regime, and is significantly affected by whether or not a shock can be linked to policy errors (Bordo, 2013). Trust in other institutions is the major driver of a central bank's trust, but subjective and objective knowledge and the socio-demographic characteristics of individuals also matter (Bernd and Neuenkirch, 2014). In addition, an adverse experience with the banking system negatively affects trust. Agents who deal with troubled banks have less trust in banks than those who do not (van der Cruijsen et. al., 2016).

Theoretical modeling (Park, 2023) validates the hypothesis that maintaining credibility helps to anchor expectations and achieve macroeconomic stability. Carrière-Swallow et al. (2021) prove that the relatively high credibility of monetary policy reduces the pass-through effect of the exchange rate on consumer prices. A less credible central bank has less room to stabilize the economy (Faust and Svensson, 2001). Credibility makes the disinflationary process less costly and helps maintain low inflation once it has been achieved (Blinder, 2000). A central bank with a low level of credibility should conduct a less expansionary policy compared to a central bank that enjoys a high level of credibility.

In the same vein, empirical results confirm that a high level of trust in a central bank leads to lower inflation expectations (Christelis et al., 2016; Mellina et al., 2018; Niizeki, 2023). Moreover, it helps reduce uncertainty about future inflation and encourages higher expectations about GDP growth. Higher trust is more important for reducing high inflation expectations than for raising low ones. The effect of trust on expectations is higher than that of knowledge about the central bank's mandate, financial literacy, and optimism. Higher trust reduces the responsiveness of inflation expectations to transitory fluctuations (Stanislawska and Paloviita, 2021). On the other hand,

Kumar et al. (2015) show that even with well-established credibility, it is difficult to fully anchor expectations due to the relatively low level of attention paid by agents to monetary policy objectives and inflation.

One of the important issues surrounding central bank credibility is the elusiveness and fluidity of this concept. Blinder (2000) emphasizes that it is extremely difficult to measure or even assess credibility. Svensson (1993) even suggests distinguishing between absolute credibility and credibility in expectation. As the theoretical framework closely links trust and inflation expectations, some researchers use inflation expectations to measure the degree of credibility (Issler, 2023). They calculate the credibility level indicator as the distance between inflation expectations and the inflation target from survey microdata.

This paper proposes to investigate the role that the credibility of the National Bank of Ukraine (NBU) plays in the formation of inflation expectations. Our analysis builds on the rich, pooled dataset of the Business Outlook Survey, which contains responses from Ukrainian non-financial firms. Among other things, firms self-report their trust in the NBU's actions. The sample spans the period from 2015, which includes the de-facto adoption of inflation targeting, until the large-scale Russian invasion in 2022. To assess the role of credibility in anchoring inflation expectations, we develop a pooled endogenous-treatment regression model, with a view to obtaining unbiased estimates. Furthermore, we also assess whether credibility affects the strength of the relationship between firms' inflation and exchange rate expectations.

The results show that the credibility of the NBU has improved since the transition to inflation targeting in 2015. However, there is room for improvement. In line with other empirical studies, we document that the credibility of the NBU helps to reduce firms' inflation expectations. Moreover, sensitivity to past deviations of inflation also decreases with credibility. Interestingly, credibility does not affect the strength of the relationship between inflation and exchange rate expectations.

This paper is organized as follows. Section 2 describes the survey data and the main stylized facts. Section 3 discusses the methodology applied to assess the role of credibility. Empirical results on inflation expectations anchoring are provided in Section 4. Section 5 tests the robustness of our results, using bootstrapping. And finally, Section 6 provides a summary.

2. Data

Data for the analysis come from the Business Outlook Survey (BOS) conducted by the NBU since 2006. Every quarter top managers of Ukrainian non-financial firms are interviewed in a remote and face-to-face manner to obtain information of particular importance to the central bank.

The survey sample initially covered 1,300 firms but was first shortened in 2014 and then in 2022 due to the large-scale russian invasion of Ukraine.[3] The latest rounds of the survey contain about 700 respondents. Firms are classified by type of economic activity, international trade, size, and region (Table 1A in the Appendix). The sample structure corresponds to the contribution of each region and type of economic activity to the gross value added of the country (Figure 1, 2), which ensures the representativeness of the sample.

Since the official adoption of inflation targeting, the survey has evaluated firms' attitudes to the NBU's policy.[4] Figure 3 shows that shortly after the introduction of the regime, the central bank had quite low credibility.[5] The initially low level may have potentially reflected agents' mistrust in the newly established regime or the uncertainty caused by the already experienced inflation surge. In subsequent years, the NBU managed to increase its credibility to a moderate level. Moreover, its credibility even temporarily rose from 44% to 56% of respondents who had confidence in the NBU after the full-scale russian invasion. The increase may have been attributed to the perceived success of the NBU's unprecedented policy measures to maintain the resilience of the economy during the war.
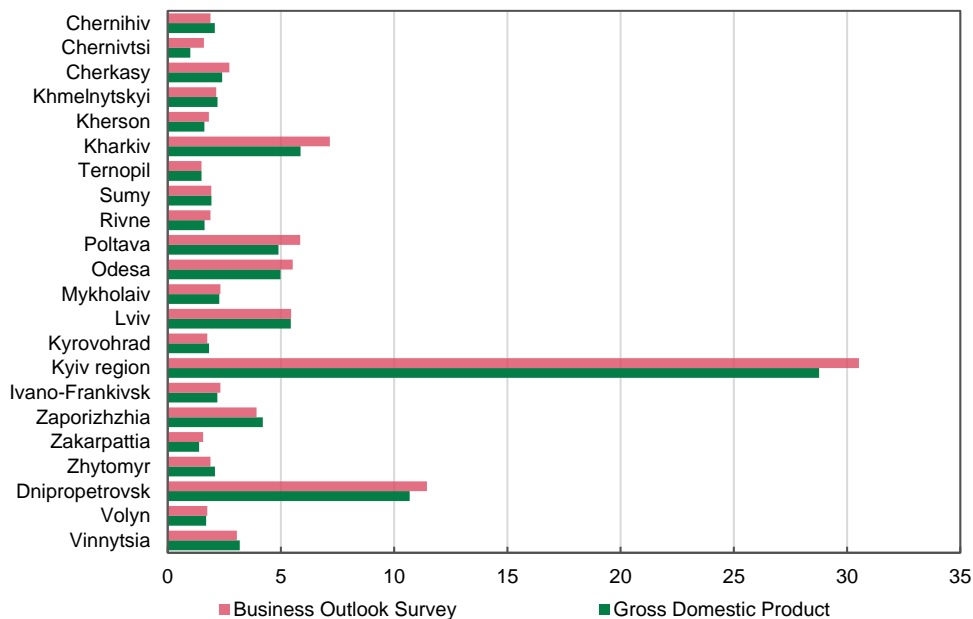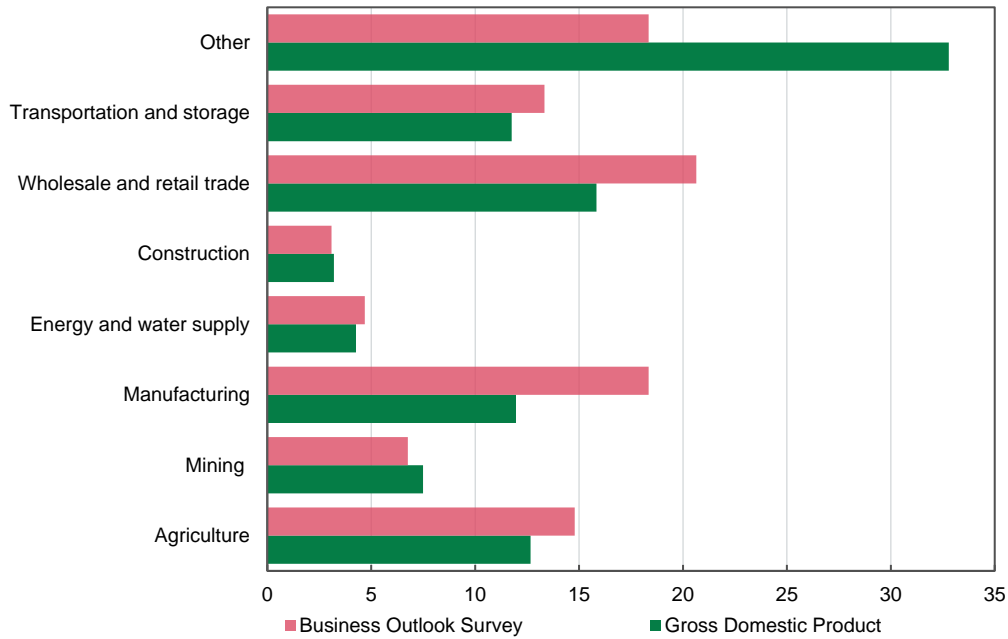

Note: The graph shows the average structure of the BOS surveys conducted in 2021 and the contribution each region made to the gross domestic product in 2021.

Figure 1. Sample Structure by Regions, %

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[3] The sample has excluded the temporarily occupied territories of Crimea, Donetsk and Luhansk regions since Q3 2014. Since Q2 2022, the sample has excluded the temporarily occupied Kherson region.

[4] The survey asks, "What is your attitude to the NBU's policy?" In response to the question, respondents choose one of the following options: (1) trust it, (2) do not trust it, (3) difficult to say.

[5] Levieuge et al. (2018) confirm that monetary policy is not necessarily perceived as very credible at the outset of inflation targeting (Czech Republic, Indonesia, Romania and Turkey).

Note: The graph shows the average structure of the BOS surveys conducted in 2021 and the contribution of economic activities made to the 2021 gross value added. The contribution of other types of economic activities to the gross value added corresponds to the sum of the contributions of the following economic activities: (1) accommodation and food service activities, (2) financial and insurance activities, real estate activities, (3) professional, scientific and technical activities, (4) administrative and support service activities, (5) public administration; compulsory social security, (6) education, (7) human health and social work activities, (8) arts, entertainment and recreation, and (9) other service activities.

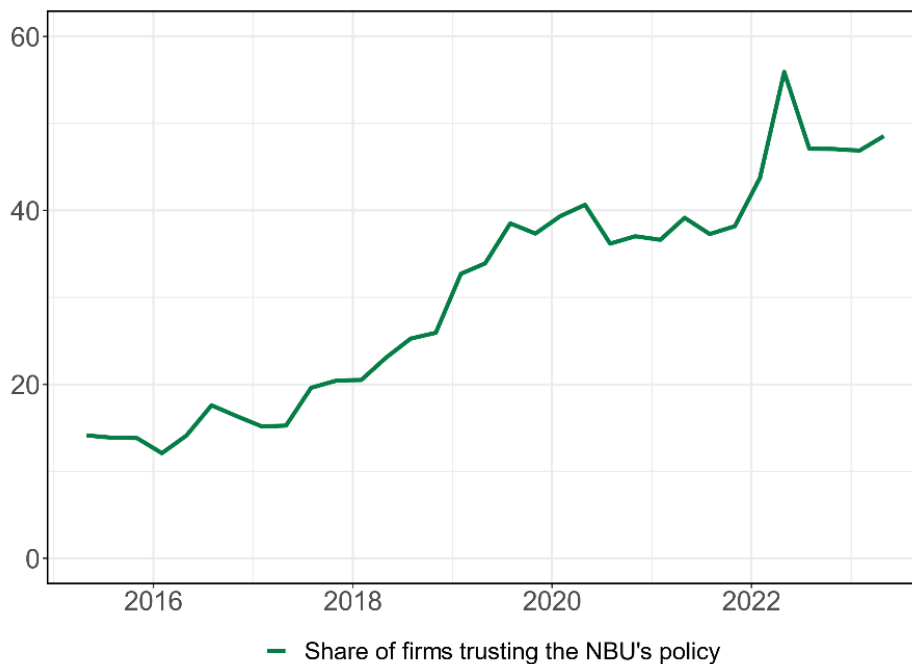**Figure 2.** Sample Structure by Types of Economic Activities, %

Figure 3. Credibility

A Razumkov Centre survey raises a similar question about trust in the NBU and other social institutions.[6] The credibility level assigned by firms to the central bank is quite similar to the credibility assigned to the institution by the general public (Figure 1B in the Appendix). Thus, credibility from BOSs can be used as a proxy for the overall credibility of the NBU. Moreover, the spike in the NBU's credibility at the beginning of the large-scale invasion coincided with an increase in the credibility of other institutions, confirming that trust in the central bank is related to trust in other institutions (Bernd and Neuenkirch, 2014).[7]

Credibility levels vary broadly across firms (Figure 3B in the Appendix). On average, only 19% of firms operating in northern Ukraine rate the NBU's policies as credible. In contrast, companies in western Ukraine and the Kyiv region assign a much higher level of credibility – 34% and 35% respectively. Different economic conditions and political situations could be the reasons for the regional differences. In addition, firms in the construction industry have the lowest level of confidence in the central bank's actions compared to firms in other sectors. Across sizes, on average, 26% and 29% of small- and medium-sized firms trust the NBU, while the share of "trusters" among large firms is more substantial, at 36%. Firms that are engaged in international trade assign a higher level of credibility than those that are not. Finally, on average, 31 percent of those companies that have had no problems with conducting banking operations trust the NBU, compared to only 18 percent of those who have.

The one-year ahead inflation expectations of Ukrainian firms are unanchored.[8] Despite gradually improving in 2016-2020 after the adoption of IT, they consistently remained well above the target (Figure 4). This comes as no surprise given the low initial credibility, the short history of inflation targeting, and the significant inflation shocks in recent years (Zholud et al., 2019). Coibion and Gorodnichenko (2015) suggested that the NBU would likely not be able to anchor the inflation expectations of firms. Even in countries that are pioneers in inflation targeting and have well-established credibility, the expectations of firms appear to be unanchored. Moreover, inflation expectations depend heavily on current inflation – an ordinary feature even in developed countries. For example, the correlation between businesses' inflation expectations and the actual inflation seen in previous months in the United States exceeds 0.9, while the correlation between inflation expectations and last month's inflation in the UK exceeds 0.8 (Figure 2B in the Appendix). The reason for this is the firms' relatively low level of knowledge about monetary policy and

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[6] The survey asks, "To what extent do you trust the following social institutions?" The respondents chose one of the following options: (1) totally distrust, (2) rather distrust, (3) rather trust, (4) fully trust, (5) hard to say. The Razumkov Centre survey is conducted using stratified multistage sampling with random selection at the first stages of sampling and quota selection of respondents at the final stage (when respondents were selected on the basis of sex and age quotas). The sample structure reproduces the demographic structure of the adult population of the territories where the poll was conducted (by age, sex, settlement type).

[7] The results of the Razumkov Centre survey: https://razumkov.org.ua/napriamky/sotsiologichni-doslidzhennia/otsinka-gromadianamy-sytuatsii-v-kraini-ta-dii-vlady-dovira-do-sotsialnykh-instytutiv-liutyi-berezen-2023r

[8] The BOS asks, "In your opinion, how will the price level of consumer goods and services in Ukraine change over the next 12 months?" In response to the question, respondents choose one of the proposed intervals that covers expected inflation. The intervals are not the same for each round of surveys and change depending on the current level of inflation. Expectations are calculated as the sum of the shares of respondents who chose a given interval multiplied by the interval average.

inflation dynamics (Kumar et al, 2015). That said, the upward bias is lower for those who trust the NBU's policy. On average, the expectations of "trusters" are 1.6 percentage points lower compared to those of other agents. In 2022, expectations surged amid the full-scale Russian invasion, although the spike in the inflation expectations of trusting firms was less pronounced.

Ukrainian firms tightly link their exchange rate and inflation forecasts (Figure 5).[9] To some extent, agents use the exchange rate as a proxy for inflation dynamics. In particular, this can be explained by the strong pass-through effect of the hryvnia exchange rate on inflation, which is even higher in the case of depreciation (Faryna, 2016). Thus, exchange rate volatility could lead to changes in inflation expectations, creating additional obstacles to inflation stabilization. The regression slopes indicate that the strength of the connection is quite similar for "trusters" and "non-trusters."

Since inflation expectations dynamics and their relationship with exchange rate expectations, which are shown in Figures 4 and 5, are also affected by factors other than credibility, we should proceed with a formal analysis.
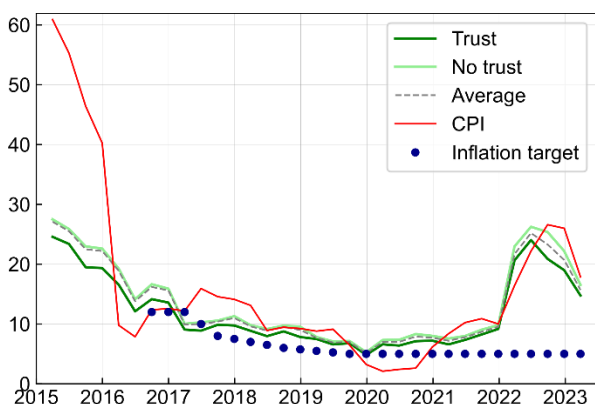
Note: The graph plots the inflation expectations of those agents who answered that they trust the NBU's policy ("Trust"), of those who do not trust the NBU's policy, as well as of those who replied "Hard to say" ("No trust").

Figure 4. One-Year Ahead Inflation Expectations across Credibility Levels, Inflation, and Inflation Target
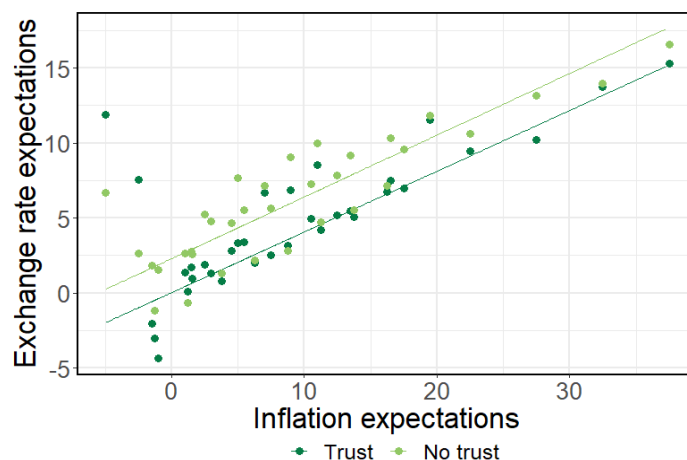
Note: The figure shows the binscatter for the joint distribution of inflation and exchange rate expectations. The exchange rate expectations are expressed as a percentage change.

Figure 5. Interactions between Inflation and Exchange Rate Expectations

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[9] The survey asks, "What exchange rate of UAH to USD (UAH per 1 USD) do you expect in 12 months?" The respondents pick one of the proposed intervals that covers the expected level of the exchange rate.

3. Methodology

3.1. Correction for Endogeneity

The decision of a particular firm whether or not to trust the central bank's policy is unlikely an exogenous process. Thus, to obtain unbiased estimates of the credibility effect, we should account for the potential bias that arises from endogenous decisions and related self-selection.

The instrumental variable (IV) technique is one of the commonly used approaches to address the endogeneity problem. However, if the endogenous variable is discrete rather than continuous, this is ignored by the first-stage regression. Thus, researchers resort to different approaches to account for the discrete nature. Some use the nonlinear estimator for the first-stage regression, such as a probit or logit model, and then directly plug the obtained estimations into the second one. Such an approach, which is sometimes called forbidden regression, does not provide consistent estimates, except that the nonlinear model turns out to be correct (Wooldridge, 2010; Angrist et al., 2001). Other researchers use a linear approximation to describe the endogenous discrete variable. However, applying the two-stage least square regression to the linear probability model also poses certain difficulties. One can get a predicted probability below zero or above one, which is meaningless. Moreover, estimations are very sensitive to observed samples (Clougherty et al., 2016). In turn, Angrist et al. (2001) suggest that the second-stage estimates of IVs will still be consistent, even when the linear first-stage regression for endogenous dummy variables is used.

Finally, the most important problem that could arise with IVs is bad instruments. The IV estimator is consistent, but not unbiased. The misspecification of the first-stage regression could affect this bias. Instruments that are correlated with omitted variables could lead to a significantly greater bias in estimates than the one produced by OLS (Angrist et al., 2001).

Another approach for addressing endogeneity is the endogenous treatment-regression model, which is also known as the endogenous dummy-variable model. The model was proposed by Heckman (1977). The original motivation was to address a sample selection bias. Later, the model was widely used to deal with self-selection issues, related endogenous treatment, and switching problems (Maddala et al., 1983).

Heckman's two-stage estimation procedure explicitly takes into account the discrete nature of endogenous variables and corrects for the selection bias by including a hazard-rate variable. The latter controls for variance that arises as a result of selection and, without correction, would be present in the error term (Clougherty et al., 2016). This approach assumes the joint normality of the error terms in the system, which makes it possible not to rely on instruments. However, Clougherty et al. (2016) and Toomet (2020) suggest that additional exclusion restrictions (instruments) should be included in such models for better identification and that otherwise, estimates would be less precise.

Heckman's approach is widely used to assess the impact of different types of "treatment" of firm performance. Thus, Morrow et al. (2007) use this procedure to estimate how the strategic actions, such as new products, processes, or technologies, taken by firms affect investors' expectations. Gore et al. (2011) assess the impact of financial expertise on a firm's governance structure, namely its finance committee or CEO with a financial background, on the Chief Financial Officer's (CFOs) contractual incentives. Chung and Luo (2013) assess how leadership transition, in particular successor origin, affects the performance of firms in emerging economies. Singh and Mitchell (2005) estimate the relationship between interfirm collaboration and firm performance. Finally, Adams et al. (2009) examine the effect of a founder-CEO on firm performance.

For our analysis, we will proceed with the endogenous treatment-regression model.

3.2. Model Specification

To assess the role of credibility in anchoring inflation expectations, we have developed the following pooled endogenous-treatment regression model:

$$E_t^i \pi_{t+4} - \pi_{t+4}^{tar} = b_0 + b_1 Credibility_t^i + \gamma_1 sectors + \gamma_2 size + \gamma_3 trade + \gamma_4 region \quad (1)$$
$$+ \gamma_5 time + \varepsilon_{it}$$

$$Credibility_t^i = \begin{cases} 1, Credibility_t^{i^*} > 0 \\ 0, \ otherwise \end{cases} \quad (2)$$

$$Credibility_t^{i^*} = a_0 + a_1 sectors + a_2 size + a_3 trade + a_4 region \quad (3)$$
$$+ a_5 transaction + a_6 time + u_{it}$$

where $\varepsilon_t \sim N(0, \sigma^2), u_t \sim N(0,1), \ corr(\varepsilon_t, u_t) = \rho$. This model consists of equations that describe the firms' treatment decision (2)-(3), credibility, and an equation for the outcome variable (1), expectation anchoring, which is affected by the treatment. The model assumes that the error terms of both treatment and outcome equations are correlated, meaning that some unobservables affect both processes.

The outcome variable is defined as the deviation of one-year ahead inflation expectations from the inflation target: $E_t \pi_{t+4} - \pi_{t+4}^{tar}$.[10] The anchoring of inflation expectations is affected by the treatment variable *Credibility*, which assumes a value of 1 if a firm trusts the NBU's policy and a value of 0 if a firm does not trust the NBU's policy. The variable also takes on sets of firm-level characteristics, such as sector, size, trade, and region dummies. The parameter b_1 indicates the effect of credibility on expectations anchoring. The outcome regression (1) also accounts for the time effect.

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[10] According to Cecchetti and Krause (2002), the more expected inflation deviates from the announced target, the less credible the policy becomes.

Credibility is modeled using the latent variable approach proposed by Heckman (1974). It equals 1 if an unobserved latent variable exceeds the threshold value and 0 if it does not (2). Equation (3) describes the unobserved latent variable, *Credibility**. The latter is determined by the same sets of firm-level characteristics as the outcome variable, plus the *transaction* dummy, which indicates whether or not firms have had any problems with conducting operations using funds in their bank accounts. In our setting, *transaction* is an additional exclusion restriction, which assumes that a firm's own experience with the banking system is exogenous for agents and affects firms' attitude to the NBU, but has no direct impact on inflation expectations.

We estimate the system of the above equations by the maximum likelihood (ML) on the sample from Q1 2017 to Q2 2023. Estimates from the Heckman two-step procedure are taken as the starting values of ML estimations. During the first step, the treatment equation (2)-(3) is estimated via the probit model. This step allows us to calculate the control variable, which is also commonly referred to as the inverse Mill's ratio. Then, the inverse Mill's ratio is inserted into regression (1) as additional covariates to correct estimates for endogeneity and self-selection biases. During the second step, corrected equation (1) is estimated using the OLS method.

We are also interested in assessing whether or not credibility helps make expectations less sensitive to the observed deviations of inflation from its pre-announced target. Potentially, firms that trust the central bank's policy may expect the monetary authority to implement successful contractionary actions following an inflationary shock and, as a result, be less responsive to short-term inflation fluctuations (Stanislawska and Paloviita, 2021).

Thus, we extend the specification of our base model (1)-(3) by additionally taking into account the gap between past inflation and the inflation target. The outcome equation of the second model specifications is the following:

$$E_t^i \pi_{t+4} - \pi_{t+4}^{tar} = b_0 + b_1 Credibility_t^i + b_2(\pi_{t-1} - \pi_{t-1}^{tar}) \hspace{2cm} (4)$$
$$+ b_3(\pi_{t-1} - \pi_{t-1}^{tar})Credibility_t^i + \gamma_1 sectors + \gamma_2 size + \gamma_3 trade$$
$$+ \gamma_4 region + \gamma_5 time + \varepsilon_{it}$$

where π_{t-1} is the inflation rate, known at the period of expectation formation. The interaction term between the inflation gap and credibility is included to assess the effect of credibility on firms' sensitivity to past deviations.

Finally, as the strength of the relationship between firms' inflation and exchange rate expectations is important for the strength of monetary policy transmission, we consider one more specification. In addition to the determinants of expectation anchoring considered in equation (4), the outcome of equation (5) includes firms' depreciation expectations, $E_t e_{t+4}$, and the corresponding interaction with credibility:

$$E_t^i \pi_{t+4} - \pi_{t+4}^{tar} = b_0 + b_1 Credibility_t^i + b_2(\pi_{t-1} - \pi_{t-1}^{tar}) \qquad (5)$$
$$+ b_3(\pi_{t-1} - \pi_{t-1}^{tar})Credibility_t^i + b_4 E_t^i e_{t+4} + b_5 E_t^i e_{t+4} Credibility_t^i$$
$$+ \gamma_1 sectors + \gamma_2 size + \gamma_3 trade + \gamma_4 region + \gamma_5 time + \varepsilon_{it}$$

The treatment equation for the second and third model specifications is the same as for the base one.

4. Results

The results of the first-stage probit estimation of the endogenous-treatment models (Table 2A in the Appendix) show that the region in which a firm operates has a bearing on firms' confidence in the NBU's policy in our sample. For example, for regions in western Ukraine, Kyiv, and Khmelnytskyi regions, there is a higher likelihood that firms will trust the NBU's policy, while for Zhytomyr and Mykolaiv regions the probability is lower. In addition, firms in the manufacturing and construction industries tend to have lower trust levels. Larger-sized firms are also associated with a significantly higher likelihood of credibility. Finally, the absence of problems with performing banking operations has a positive and significant impact on credibility.

We have also checked whether or not there is any interdependence between some regions and economic sectors. The multicollinearity test did not reveal any significant relationship between these indicators. We have also analyzed how a region influences credibility in each industry (Table 4A in the Appendix). The least varied regional impact on confidence is for agriculture, wholesale trade, transportation, and other sectors. Instead, the impact on retail, construction, and energy varies the most. There are also some differences between the regions. Companies in Kyiv, Kharkiv, Odesa, Kherson, Khmelnytskyi, and Lviv regions that operate in manufacturing, construction, wholesale and retail trade, transportation, and other sectors tend to have higher levels of credibility. On the other hand, companies in the construction, energy, and retail sectors in Zhytomyr, Mykolaiv, Chernivtsi, and Poltava regions tend to have less credibility. Numerous factors, such as the level of financial inclusion, and proximity to the war zone, can explain the differences between the regions. However, this requires separate research due to the heterogeneous nature of these factors.

The results of the second-stage regression are reported in Table 1, along with the naïve OLS method, which ignores endogeneity. The first specification of the second-stage regression shows that the coefficient that is of interest to us – the credibility dummy – is negative and statistically significant. The inflation expectations of those firms that consider the NBU's policy to be credible are on average 2.7 percentage points closer to the pre-announced target level, confirming that credibility helps manage expectations.

The likelihood ratio test indicates that the second model augmented by the inflation gap and the interaction term has a significantly higher goodness-of-fit compared to the nested one. In the extended model, the interpretation of the credibility effect is the same as in the constrained one,

but the effect is somewhat lower in magnitude. Thus, the gap between inflation expectations and the inflation target shrinks by 2 percentage points for "trusters" compared to "non-trusters". The estimated coefficient of past inflation deviations is positive and statistically significant. The size of the latter indicates that one-fourth of the observed inflation gap is directly transmitted to firms' inflation expectations. However, sensitivity reduces once credibility is gained. The weight that trusting firms assign to past inflation deviations is 0.1 lower compared to that assigned by non-trusting ones. Agents believe in the ability of the central bank to bring inflation to its target level and, as a result, do not react much to the volatility of inflation.

Adding depreciation expectations and the corresponding interaction term as additional covariates leads to a statistically significant improvement in the model fit. Figure 4B in the Appendix shows that the residuals of the third model specification cluster around zero, better confirming the model's higher predictive power.

The estimates of the full model confirm that bias in the expectations and sensitivity to observed inflation is lower for trusting firms. The positive and statistically significant coefficient of depreciation expectations suggests that those who expect a weaker currency also expect higher inflation. Thus, the expectations of 10 percentage point depreciation on average leads to a more than 3 percentage point increase in expectations regarding future inflation. The corresponding interaction term with credibility is negligible in size and is not statistically significant. The latter implies that the sensitivity to movements in the exchange rate is the same for both groups of agents – trusting and non-trusting ones. This finding may indicate that agents consider the exchange rate to be completely beyond the control of monetary policy. As a result, firms translate exchange rate volatility into their inflation beliefs, ignoring the possibility that the exchange rate could be managed by monetary policy tools.

The correlation coefficients between the errors of the treatment and outcome equations are positive and statistically significant for all specifications, implying that there are omitted variables that cause credibility and anchoring to move in the same direction.

The null hypothesis of no correlation between the errors in the system is a direct test of credibility exogeneity. We reject the null for all of our specifications (albeit at different significance levels), meaning that credibility is an endogenous process. Thus, to obtain unbiased estimates, it is important to account for endogeneity.

The right-hand side of Table 1 reports the results of the models estimated via OLS, where credibility is mistakenly assumed to be exogenous. The results of the first model specification show that the OLS estimate of the credibility dummy is also negative and statistically significant, despite the magnitude being more than two times lower than the corresponding one of the endogenous-treatment model. Thus, the positive correlation between unobservables in our system generates the upward biased estimates of the credibility effect. Furthermore, the results of the third model show an even greater difference in the credibility coefficient estimates. The OLS

estimate is -0.34 compared to -1.54 of the endogenous-treatment model, while other coefficients are similar. To sum up, ignoring endogeneity leads to misleading conclusions about the credibility effect, downplaying its role in anchoring expectations.

Finally, the central bank's transparency and communications are other potential channels through which inflation expectations could be affected. The literature suggests that central banks' forecasts help manage expectations. Central bank inflation projections tend to reduce the forecast error of the private sector's inflation forecasts (Jain and Sutherland, 2018).

We consider alternative specifications to examine whether or not credibility still matters when an alternative factor is taken into account. Thus, alternative treatment regressions account for the effect of the NBU's past forecast errors and for the deviations of observed inflation from the central bank's inflation projections that were published a year ago. We assume that the NBU's forecast errors determine how the inflation forecasts of firms deviate from those of the central bank.

Table 1. Credibility and Inflation Expectations Anchoring

Independent variables	Dependent variable: Inflation expectations deviation from the inflation target					
	End. treat. (I)	End. treat. (II)	End. treat. (III)	OLS (I)	OLS (II)	OLS (III)
Credibility	-2.68***	-2.02***	-1.54**	-1.23***	-0.69***	-0.34**
Inflation deviation from the target	-	0.25***	0.25***	-	0.23***	0.22***
Inflation deviation from the target: Credibility	-	-0.10***	-0.09***	-	-0.10***	-0.09***
Devaluation expectations	-	-	0.35***	-	-	0.35***
Devaluation expectations: Credibility	-	-	0.01	-	-	0.01
Industry dummies	+	+	+	+	+	+
Size dummies	+	+	+	+	+	+
International trade dummies	+	+	+	+	+	+
Time dummies	+	+	+	+	+	+
Observation	16779	16779	16779	16779	16779	16779
Log-Likelihood	-62604.8	-62578.1	-61265.46	-	-	-
Adj. R^2	-	-	-	0.49	0.50	0.57
Correlation estimate	0.16**	0.14*	0.14*	-	-	-
P-value ind. eqs.	0.02	0.08	0.07	-	-	-
Likelihood-ratio test	-	0.00	0.00	-	-	-

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10%.

The results of the alternative specification are provided in Table 3A in the Appendix. The estimates confirm the role of credibility. First, the credibility of the central bank helps bring firms' inflation expectations closer to published inflation forecasts. Moreover, the coefficients of credibility are hardly different from those in the base models, confirming the robustness of the results. Second, the role of the central bank's past forecast errors in shaping expectations is smaller for those firms that consider the institution's policy to be credible.

Overall, these results suggest that the institutional credibility of the central bank is crucial for managing inflation expectations.

5. Robustness Check

Survey data often involve complex sampling designs, such as stratification or clustering, and may suffer from nonresponse and missing data, which could introduce bias. As these problems introduce sampling variability, it is important to test the sensitivity of research findings to different survey designs or sample inclusion criteria. Thus, assessing estimator variability, impacting uncertainty measurement, estimator efficiency comparisons, and inference procedure construction, like confidence intervals, are vital aspects of statistical inference.

Bootstrapping, introduced by Efron (1979), is a resampling technique commonly used in econometric research to estimate the sampling distribution of a statistic or parameter of interest. Bootstrapping provides a robust, nonparametric, and model-independent approach to assessing the variability and stability of their results, accounting for sampling and nonresponse issues, and testing the sensitivity of findings under different conditions. Bootstrapping involves the repeated and random resampling of the original data set, with replacement, to create a large number of simulated data sets. This approach assumes that the empirical cumulative distribution function is a reasonable estimate of the unknown population cumulative distribution function. In other words, the empirical density function approximates the population density function.

Our dataset consists of 17K data points, which correspond to approximately 650 observations per quarter. Thus, we consider the data to be limited and that it may deviate from perfect normality. Bootstrapping helps to mitigate this problem by providing more robust estimates and confidence intervals. Bootstrapping is also less sensitive to the nonlinear relationships that may be observed in nonuniform data sets. Thus, we do the resampling process 1,000 times for each model specification to construct an empirical distribution of the parameters that approximates their sampling distribution under the observed data. Each sample contains the same number of points as the original dataset. This allows us to confirm the estimates made for the basic specification of the models, as well as to test the significance of the coefficients and to compare different models. This process also enhances the robustness and reliability of the empirical results of this research.

Table 2. Confidence Intervals of Coefficients for Model Specifications, Derived using Bootstrapping

	End. treat. (I)		End. treat. (II)		End. treat. (III)		OLS (I)		OLS (II)		OLS (III)	
	[5%	95%]	[5%	95%]	[5%	95%]	[5%	95%]	[5%	95%]	[5%	95%]
Credibility	-3.45	-2.01	-3.04	-1.26	-2.12	-0.52	-1.38	-1.07	-0.85	-0.52	-0.59	-0.14
Inflation deviation from the target			0.21	0.30	0.20	0.29			0.18	0.27	0.18	0.27
Inflation deviation from the target: Credibility			-0.13	-0.07	-0.12	-0.06			-0.13	-0.07	-0.12	-0.06
Devaluation expectations					0.34	0.37					0.34	0.37
Devaluation expectations: Credibility					-0.02	0.03					-0.01	0.03

Bootstrapping results show that the proposed models are robust to changes in the data sample and that the potential impact of outliers has no significant effect. This makes it possible to confirm the reliability of the research results for the entire dataset. Another interesting finding is that treatment regressions have much wider confidence intervals compared to the standard OLS method (for example, see Figure 5B in the Appendix). This is a rather logical consequence of the extension of the probit function deviations to the second stage of the regression. However, even taking into account such variances, the credibility coefficients remain statistically significant in the formation of inflation expectations.

6. Concluding Remarks

This study examines the impact of central bank credibility on inflation expectations. For this purpose, we used data from the business surveys conducted by the NBU. Although surveys contain questions about trust in the central bank, the use of such data can lead to a significant bias in estimates, as firms determine the degree of trust themselves, which may not be entirely reliable. To address this problem, we use a treatment model that involves two-stage modeling. The first stage of the probit model reveals the influence of firm characteristics and other exogenous factors on the level of trust in the central bank's policy. This makes it possible to use these results in the second stage.

Modeling results under different specifications confirm the significant role of credibility in shaping inflation expectations. The more companies trust the NBU, the closer their inflation expectations are to the target. Moreover, credibility makes inflation expectations less sensitive to previously observed inflation deviations. In a different specification, we also show that central bank credibility helps firms' inflation expectations to converge with published inflation forecasts. We also check our estimates, using bootstrapping, which shows that the results of our research are robust and reliable.

Thus, credibility may be a valuable instrument for central banks in anchoring inflation expectations, providing more flexibility in responding to economic shocks. This becomes even more important in times of crisis or unforeseen events, when a credible central bank can implement unconventional policies with greater confidence, with the public interpreting these actions as necessary and appropriate.

According to Blinder (2000), a central bank builds its credibility by having "a history of doing what it says it will do". It is a recursive process – low and stable inflation contributes to higher credibility, which, in turn, anchors inflation expectations and helps stabilize inflation. Other pieces of advice include transparency, clear objectives, and systematic reactions to economic developments, in contrast to discretionary policies. Building a strong reputation could take years or even decades. However, it is essential for a central bank to demonstrate its consistent commitment to long-term economic well-being.

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APPENDICES

Appendix A. Tables

Table 1A. Sample Characteristics

Region
Vinnytsia
Volyn
Dnipropetrovsk
Zhytomyr
Zakarpattia
Zaporizhzhia
Ivano-Frankivsk
Kyiv and Kyiv region
Kyrovohrad
Lviv
Mykholaiv
Odesa
Poltava
Rivne
Sumy
Ternopil
Kharkiv
Kherson
Khmelnytskyi
Cherkasy
Chernivtsi
Chernihiv
Economic activities
Agriculture, forestry and fishing
Mining and quarrying
Manufacturing industry
Electricity, gas, steam, water supply, sewage and waste management
Construction
Wholesale
Retail trade, repair of motor vehicles and motorcycles
Transporting and storage, postal and courier activities and telecommunications
Other
Size by number of employees
Small (<=50)
Medium (51-250)
Large (>=251)
International trade
Only export
Only import
Both export and import
Neither export or import

Table 2A. Probit Estimates of Credibility

Region	
Volyn	0.02
Dnipropetrovsk	-0.06
Zhytomyr	-0.43***
Zakarpattia	0.63***
Zaporizhzhia	0.13
Ivano-Frankivsk	0.22*
Kyiv and Kyiv region	0.31***
Kirovohrad	-0.14
Lviv	0.34***
Mykolaiv	-0.25**
Odesa	0.07
Poltava	-0.12
Rivne	0.27**
Sumy	-0.09
Ternopil	0.61***
Kharkiv	0.16*
Kherson	0.07
Khmelnytskyi	0.43***
Cherkasy	0.34
Chernivtsi	0.16
Chernihiv	-0.11
Industry	
Mining	0.08
Manufacturing	-0.17***
Energy and water supply	0.06
Construction	-0.34***
Wholesale	-0.05
Retail	0.03
Transport	-0.07
Other	0.11**
Size	
Medium	0.11***
Large	0.36***
International trade	
Importers only	0.01
Both exporters and importers	0.03
Neither exporters nor importers	-0.12**
Banking transactions	
Had no difficulties	0.49***
Time dummies	+
N	16779
Log-likelihood	-9994.10
Pseudo R^2	0.08

Notes: The model includes dummies for each region, except for Vinnytska, as well as for each sector of the economy, except for agriculture. The dummies for small firms and those engaged only in export operations are also excluded. Finally, the firm-specific controls include a dummy that takes unity if the firm has no difficulties with providing operations with their funds and zero otherwise.
***, **, * indicate statistical significance levels at 1%, 5%, and 10%.

Table 3A. Results of Alternative Specification (NBU Inflation Projections)

Independent. variables	Dependent variable: Inflation expectations deviation from NBU inflation projections		
	End. treat. (I)	End. treat. (II)	End. treat. (III)
Credibility	-2.32***	-1.85***	-1.37**
Inflation deviation from NBU inflation projections	-	0.19***	0.22***
Inflation deviation from NBU inflation projections: Credibility	-	-0.1***	-0.09***
Devaluation expectations	-	-	0.34***
Devaluation expectations: Credibility	-	-	0.01
Industry dummies	+	+	+
Size dummies	+	+	+
International trade dummies	+	+	+
Time dummies	+	+	+
Observation	15688	15688	15688
Log-Likelihood	-57904.84	-57872.65	-56695.26
Correlation estimate	0.13**	0.13*	0.12*
P-value ind. eqs.	0.03	0.06	0.07

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10%.

Table 4A. Coefficients for the Region Factors of Probit Regressions across Industries

|	Agriculture	Mining and quarrying	Manufacturing	Energy	Construction	Wholesale	Trade	Transporting and storage	Other
Volyn	-0.66**		0.34		0.66	0.55	0.09	-1.15***	0.72**
Dnipropetrovsk	0.06		0.24	-0.12	6.34	0.51	-1.26*	-1.36***	0.02
Zhytomyr	0.02	-0.92**	-0.90**	-0.22	0.72	0.90*	-0.98*	-6.56	-0.21
Zakarpattia	0.26		1.26***		0.96	0.42	0.60	-0.08	0.89***
Zaporizhzhia	0.29	0.94***	0.48**	-0.87**	5.85	1.54***	-4.96	-3.26***	0.40
Ivano-Frankivsk	0.59**	-0.48	0.71**	1.18***	4.56	1.18**	-6.54	-1.12***	-0.29
Kyiv and Kyiv region	0.32*		0.57***	1.10***	5.54	1.25***	0.19	-1.38***	0.33*
Kyrovohrad	-0.18	1.46***	-0.71*	-4.81		0.19	-5.89	-2.16***	0.99***
Lviv	0.69***	-0.11	0.20	0.76*	3.87	1.28***	0.28	-1.11***	0.64***
Mykholaiv	-0.62**		0.14	-0.44	0.65	0.46	-4.93	-1.41***	0.01
Odesa	0.33*		0.04	1.25**	5.86	0.82*	0.62	-1.53***	-0.11
Poltava	0.26	0.06	0.23	-5.10	4.22	-0.68	-4.37	-1.58***	0.29
Rivne	0.30		1.27***	0.31	0.69	1.08*	0.29	-2.56***	0.09
Sumy	0.04	0.07	-0.18	-4.79		-0.43	-0.09	-1.75***	0.83***
Ternopil	0.82***		1.98***			0.99*	-0.19	-2.10***	0.48*
Kharkiv	0.34*	0.29	0.12	0.40	5.74	0.72	0.57	-1.47***	0.49**
Kherson	0.15		0.90***	0.30		-3.49	-0.28	-1.95***	0.38
Khmelnytskyi	1.28***		0.38	-0.02	6.18	1.60***	-0.88	-1.48***	-0.40
Cherkasy	0.39*		0.49*	-0.06	0.65	0.91*	-0.98*	-0.85**	1.49***
Chernivtsi	1.05***		-4.05	-0.70	0.14	1.02*	-5.75	-1.19***	1.19***
Chernihiv	0.12	0.38	0.27	-5.31		0.78	-5.04	-0.66*	-1.17***

Note: The matrix shows the region coefficients of individual probit regressions for each industry. ***, **, * indicate the statistical significance levels of 1%, 5%, and 10%. The colors indicate deviations from the median region coefficient for each industry. The red color means that the coefficient is bigger than the median, while the blue color shows that it is lower than the median. The color intensity indicates the size of the deviation.
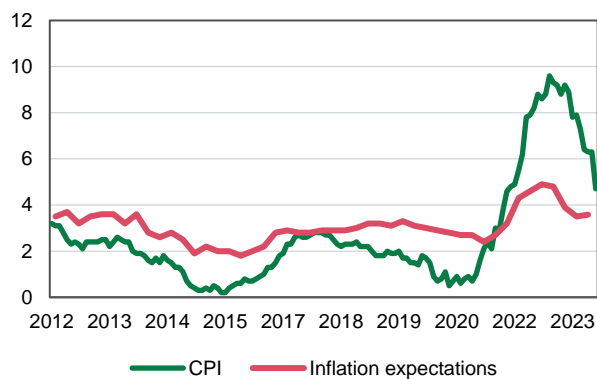
Appendix B. Figures
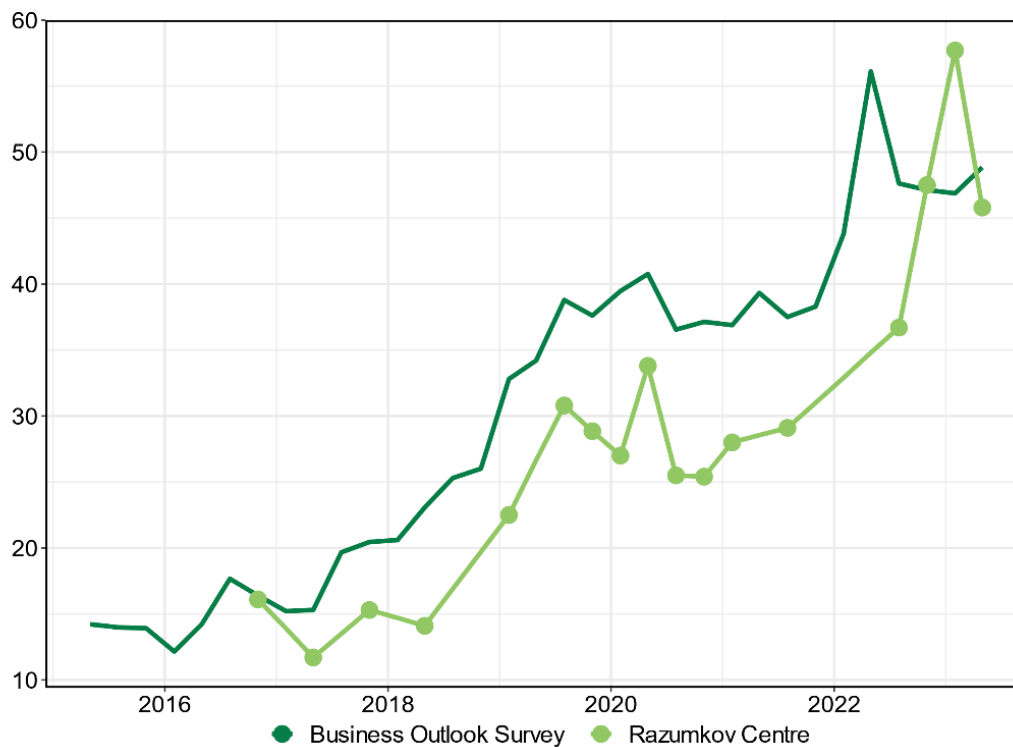
Note: The credibility level from the Razumkov Center survey corresponds to the sum of total answers "fully trust" and "rather trust".
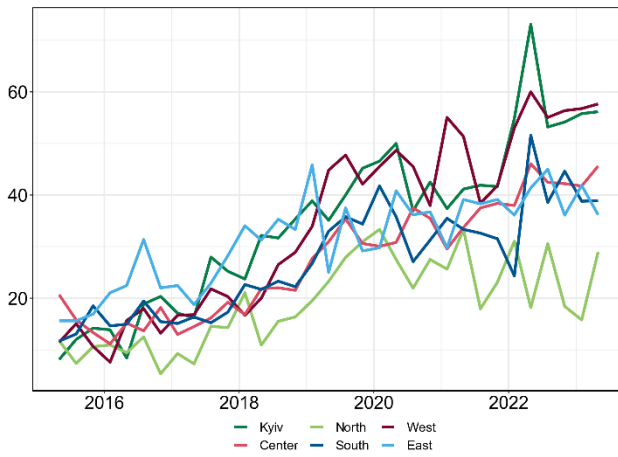
Figure 1B. Credibility of the NBU
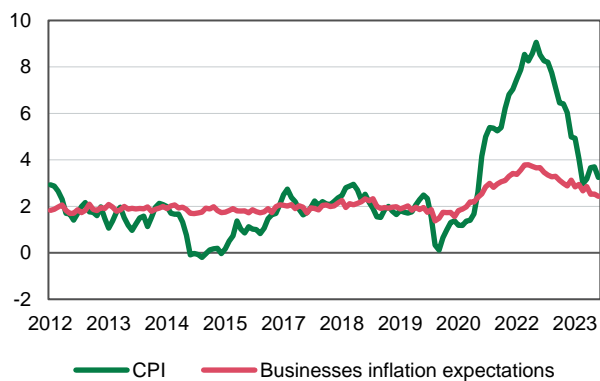
a) USA
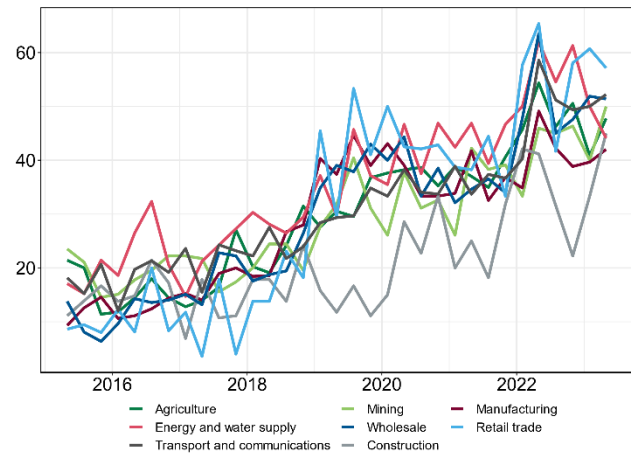Source: BLS, Federal Reserve Bank of Atlanta.

b) UK
Source: BoE, ONS.

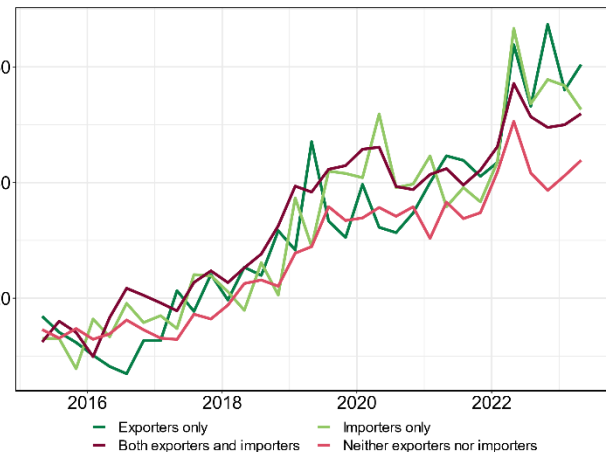**Figure 2B.** Inflation and Inflation Expectations in Selected Countries
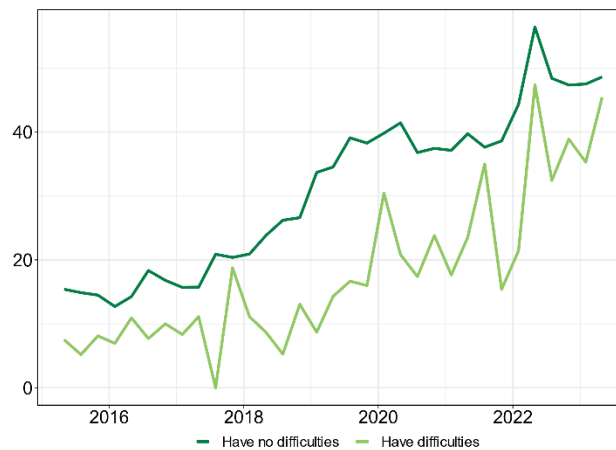
a) across regions

b) across types of economic activities

c) across sizes

d) across types of international trade

e) across difficulties with performing banking operations

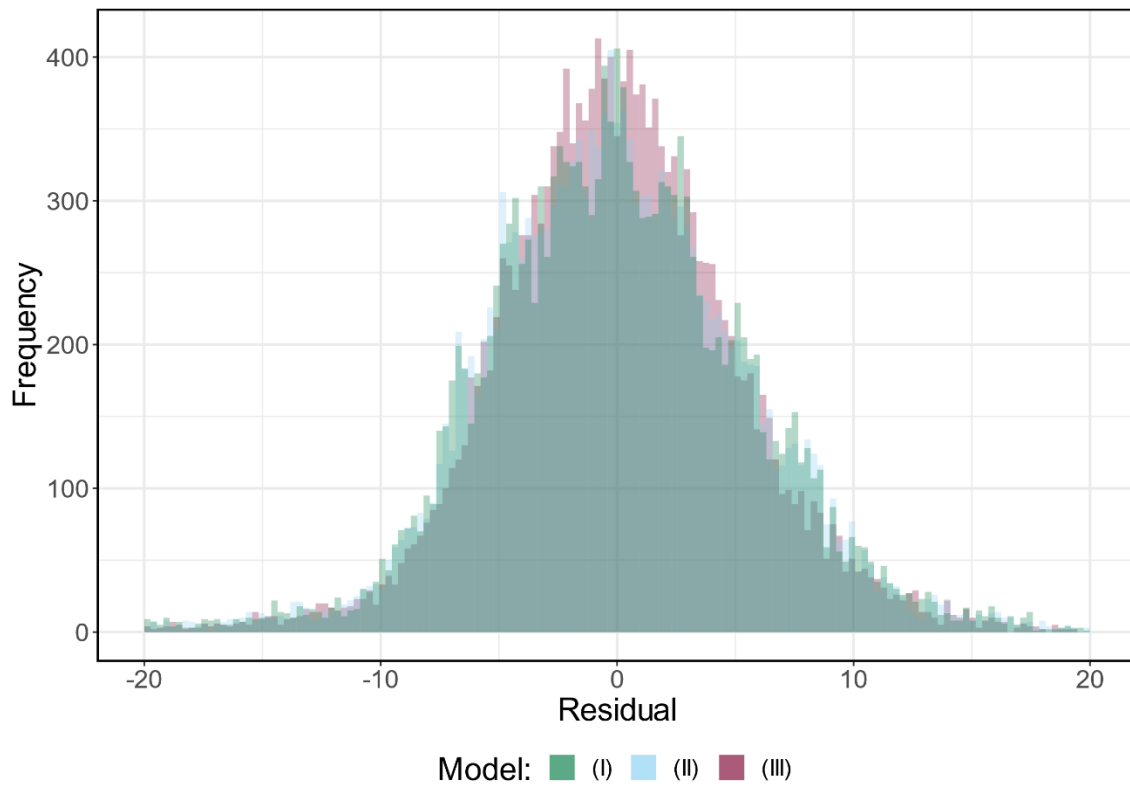**Figure 3B.** Credibility across Firms
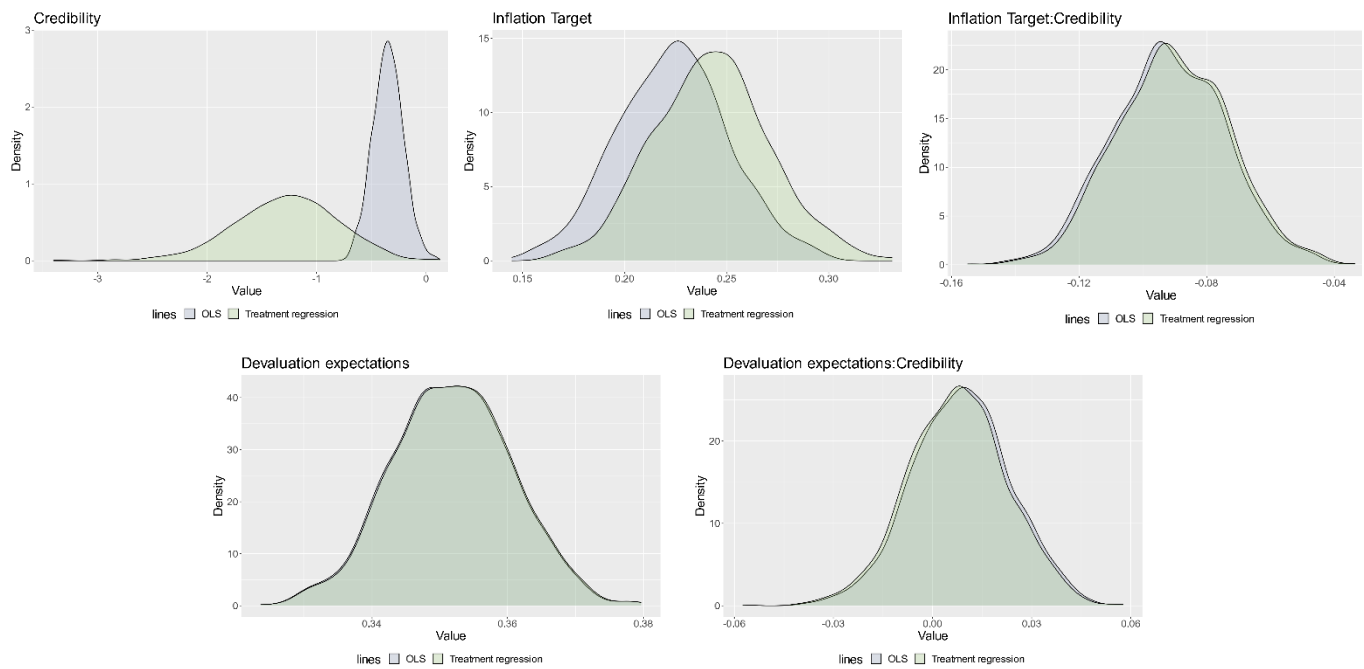
Figure 4B. Residual Plot

Figure 5B. Bootstrapping Results for Model III Specification

Appendix C. Survey Questions Used in the Study

Q1: Please choose from the list below the main type of economic activity of your company.

Q2: Define the size of your company by the number of employees.

Q3: Indicate whether or not your company performs export-import transactions.

Q4: In your opinion, how will the price level of consumer goods and services in Ukraine change over the next 12 months?*

Q5: What exchange rate of UAH to USD (UAH per 1 USD) do you expect in 12 months?*

Q6: Do you have any problems with conducting operations with funds in your bank account?

Q7: What is your attitude to the NBU's policies?

*Businesses are asked to pick from a set of inflation and exchange rate intervals in the following format: less than minimum (zero in case of inflation expectations); between minimum and minimum + X; between minimum +(N-1)*X and minimum + N*X percent; over minimum + N*X percent, where N is in the range from two to the number of intervals minus one, and X is the width of the interval.
Average expectations are computed using the following formula:

$$E = \sum_{t=0}^{N-1} w_t \cdot \left(min + (t - \frac{1}{2}) \cdot X\right)$$

where *w* is the share of respondents who pick the respective interval, and N is the number of intervals.