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Monetary policy and the effect of the oil prices pass-through to inflation

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Abstract

The paper examines the impact of oil price shocks on inflation, as well as the impact of the choice of the monetary policy regime on the strength of this influence. We used dynamic models on panel data for the countries of the world for 2000–2017. It is shown that the impact of changes in oil prices on inflation is carried out predominantly through the channel of exchange rate. The paper demonstrates the influence of the transition to inflation targeting on the nature of the relationship between oil price shocks and inflation. This effect is asymmetrical: during periods of rising oil prices, inflation targeting reduces the effect of the oil prices pass-through, limiting the negative effects of shock. During periods of decline in oil prices, this monetary policy regime, in contrast, contributes to a stronger pass-through, helping to reduce inflation.

Keywords: oil prices, inflation targeting, exchange rate, pass-through effect, monetary policy.
JEL classification: C23, C33, E31, E52.

1. Introduction

Oil price fluctuations may have a substantial impact on inflation. There are two channels for this impact identified in the literature: a direct channel, associated with changes in firms' costs caused by the appreciation (or cheapening) of energy resources, and an indirect channel, the effect of which is determined by the foreign exchange rate pass-through in response to increasing or decreasing oil prices (see, e.g., López-Villavicencio and Pourroy, 2019). The latter channel may operate asymmetrically for countries that export and import energy resources. In turn, monetary policy may cushion the consequences of this shock or, conversely, make them more painful. For example, Bernanke et al. (1997) stress that a more stringent monetary

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policy in response to an oil price shock may cause an excessive economic recession due to the high loss-to-results ratio under inflation-fighting conditions.

The indirect impact channel of oil price changes on inflation has been analyzed in a number of papers on the pass-through effect of the foreign exchange rate (see, e.g., Ponomarev et al., 2014).

The effect of the direct channel, in turn, was tested in Hooker (2002), Chen (2009), and Blanchard and Galí (2007). By analyzing U.S. data, Hooker (2002) concluded that until 1981, oil price fluctuations had had a strong effect on inflation. However, beginning in the 1980s, this effect diminished significantly due to changes in the Federal Reserve's policy. Blanchard and Galí (2007), in addition to the U.S., also analyzed France, the UK, Germany, Italy, and Japan. They studied how the various effects of energy price shocks on inflation and economic activity manifest themselves over time. They developed a model over two periods: before and after 1983. Using the structural vector autoregressions, the authors showed that the dynamic effects of oil shocks on inflation diminished significantly over time. Blanchard and Galí attributed this effect to three reasons: a reduced proportion of oil in production; increased flexibility of the labor market; and changes in monetary policy, i.e. transition from controlling output or exchange rate to controlling inflation. At the same time, although the correlation between oil prices and inflation diminishes, it still remains significant and should be taken into consideration when pursuing a stabilization policy. Chen (2009) also reviewed developed economies. Using a sample of nineteen countries, evaluating the extended Philips curve, the author analyzed the pass-through effects of oil prices into inflation across countries and time. Chen discovered the effect of monetary policy on the strength of the correlation between energy price fluctuations and inflation, and pointed out the potential asymmetry of this effect: positive and negative shocks affect inflation to various extents. López-Villavicencio and Pourroy (2019) came to a similar conclusion. Also, for the first time, the authors voiced the hypothesis that this asymmetry may affect the transition to inflation targeting.

Although we now know, on the whole, quite a lot about the consequences of inflation targeting (see, e.g., Svensson, 2010; Moiseev, 2017), the question of how this monetary policy regime affects the impact of oil price pass-through to inflation in developing countries remains open, as existing studies (as shown above) are more closely focused on developed economies.

The goal of our paper is to fill this gap, that is, to find out how the transition to inflation targeting affects the nature of the connection between oil price fluctuations and inflation. This question seems especially important in the context of discussions around the policy pursued by the Bank of Russia, since, given Russia's strong dependence on energy exports, the economy's response to oil price shocks may remain quite strong.

This paper is structured as follows: part two contains a description of the data and the empirical strategy deployed; part three presents the results of our modelling and its interpretation; and the final part contains the results of the study.

2. The data and the econometric approach

We use a sample of 38 countries (11 developed and 27 developing ones) for the period from 1970 to 2017, corresponding to the inflation targeting regime

today. Based on the type of inflation targeting, the countries analyzed can be divided into two groups: those using pure inflation targeting and those using mixed (hybrid) inflation targeting.

According to the approach used in Kartaev and Luneva (2018), we view pure inflation targeting as a regime where the target function for the monetary authorities only includes the deviation of inflation from the target. In this case, the central bank does not intervene in the foreign exchange market (except for emergencies) and achieves the monetary policy goal by relying on the interest channel of monetary transmission. In turn, hybrid inflation targeting requires that the foreign exchange rate be actively used as a monetary policy tool in addition to the interest rate (or is even included in the target function for the monetary authorities in addition to inflation).

The main difficulty in obtaining a correct estimate of the impact of changing monetary policy is the shift caused by self-selection. As countries make independent decisions on transitioning to inflation targeting, these decisions may be associated with specific national characteristics. For example, it would be natural to expect that economies more strongly affected by inflation are more inclined to choose a monetary policy that would mitigate the inflation. In other words, the decision to switch to inflation targeting is endogenous, which may lead to an inadequate estimate of the respective model coefficient. To overcome this problem, we use a dynamic model based on panel data, and evaluated using the generalized method of moments. This enables us to, first, take into account inflation trends in the economy during previous periods; second, take into account country-specific effects; and third, make sure that endogeneity is removed through instrumental variables and subsequently testing their validity.

We use the following dynamic panel model:

$$\Delta \ln P_{it} = \varphi \Delta \ln P_{it-1} + \lambda \Delta \ln e_{it} + \beta \Delta \ln e_{it} IT_{it} + \theta \Delta \ln OP_{it} + \\ + \tau \Delta \ln OP_{it} IT_{it} + \delta X_{it} + \mu_i + \varepsilon_{it}, \quad (1)$$

where the index i is the country, and t is the year; P is the consumer price index. Accordingly, $\Delta \ln P$ is the logarithmic price growth rate, i.e. inflation. Adding to the right-hand part of the equation, the lagging value of the dependent variable reflects the inertial nature of inflation, attributable to the adaptive nature of inflation expectations for a portion of economic agents, which has been confirmed by a number of modern papers (see, e.g., Doepke et al., 2006, Galati et al., 2011); e is the nominal exchange rate for the national currency of the given country (increasing this variable means cheapening the national currency); OP represents the level of oil prices; IT is a dummy variable equal to one during periods when the given country targets inflation, and equal to zero during other periods; X is the vector of control variables; μ is the fixed country effects removing the shift of results due to a country's heterogeneity within the sample.

In this kind of specification, the λ shows the instantaneous foreign exchange rate elasticity of prices (i.e. the pass-through effect of foreign exchange rate) in countries not targeting inflation. The sum of $(\lambda + \beta)$ means similar elasticity for countries targeting inflation. In the same way, θ and $(\theta + \delta)$ describe the pass-through effects of oil prices into domestic prices in countries which do not target and target inflation, respectively. In other words, they show the percentage

increase in prices within the country as a result of a one-percent oil appreciation. For example, θ equal to 0.5 means that a 1% oil appreciation, all other conditions being equal, leads to an 0.5% increase in the general level of prices in countries that do not target inflation.

The specification we use relies on a wide range of publications regarding the impact of the foreign exchange rate pass-through into prices (see, e.g., Gagnon and Ihrig, 2004; Prasertnukul et al., 2010; Kartaev and Yakimova, 2018, etc.). Our advance from the above papers is that we do not restrict ourselves to an analysis of the pass-through effect of the foreign exchange rate, we also focus on the pass-through effect of oil prices. In addition, we expand the list of control variables used, which in our case includes the following factors:

- the US manufacturing price index as a proxy variable for global inflation;
- output gap — deviation of actual real GDP from potential. We use GDP data in constant prices. Based on them, across each country's time series using the Hodrick-Prescott filter, we build smoothed series that serve as an estimate for potential GDP. The output gap variable was obtained as the difference between the logarithms of GDP in constant prices and potential GDP. Including this variable is important for estimating the pass-through effect, as it may differ depending on business cycles, as shown in An and Wang (2012);
- net national debt as a percentage of GDP — a variable reflecting the state of fiscal policy. This factor should be taken into account as deteriorating fiscal conditions may affect the ability of central banks to control inflation (Mishkin and Savastano, 2001);
- sum of exports and imports relative to GDP is a variable characterizing the country's trade openness. As shown in Romer (1993) and Rogoff (2003), more open economies have lower inflation shifts by central banks;
- the VIX volatility index (deemed the volatility of S&P 500 options), published by the Chicago Board Options Exchange. This is a proxy variable for macroeconomic volatility. The reason for including it is that monetary policy is less effective under high uncertainty (Baley and Blanco, 2016);
- the number of replacements of central bank heads within the country during the year — a proxy variable for the central bank's level of independence. This variable is important, as the degree of independence of monetary authorities may impact the effectiveness of monetary policy (Cukierman et al., 1992). We were forced to give up using more advanced indices of the central bank's independence, as it would have required a substantial reduction of the sample;
- dummy variables characterizing the "great recession" years;
- a dummy variable equal to one for inflation targeters adhering to the hybrid inflation targeting regime, and equal to zero for countries whose central banks use pure targeting.

The classification of countries based on their type of inflation targeting regime is taken from Kartaev and Luneva (2018). The data source for foreign exchange rates and consumer price indices is International Financial Statistics. The CBI trends were obtained from the database of the Swiss Economic Institute (KOF ETH).[1] VIX data was obtained from the Chicago Board Options

[1] https://www.kof.ethz.ch/daten/data-on-central-bank-governors.html

Exchange database.[2] All other variables are available in the IMF WEO 2018 database.[3]

The right-hand part of the equation contains previous values for the dependent variable, therefore we used the generalized method of moments in the evaluation. This is advisable, as ordinary models with fixed effects in this case result in inadequate coefficient estimates. We used inflation lags as tools according to the approach utilized by Arellano and Bond (1991).

3. Modeling results

The estimates obtained from equation modelling are given in Table 1. In all models, the Sargan test suggests a conclusion that the instruments used are exogenous, which proves that the estimates are adequate. The results of the autocorrelation in the residuals test, which demonstrates the potential presence of first-order autocorrelation and the absence of second-order autocorrelation, also speaks in favor of the correct specification of the models used (see Arellano and Bond (1991) for technical details).

In all specifications, the estimated λ coefficient is significant, positive, and below one, confirming the partial impact of foreign exchange rate pass-through into consumer prices. In turn, the estimated β coefficient is always significant and negative, suggesting a reduced impact by foreign exchange rate pass-through as a result of switching to inflation targeting.

This result is extremely resistant to changes in the set of control variables for the subsample analyzed and the evaluation period, and correlates well with previ-

Table 1
Estimates of the model's basic specifications.

Parameter	Model 1, 2000–2017	Model 2, 2000–2008
φ	0.453^{***}	0.367^{***}
	(0.082)	(0.089)
λ	0.270^{***}	0.397^{***}
	(0.049)	(0.048)
β	-0.148^{***}	-0.148^{***}
	(0.053)	(0.053)
θ	0.004	0.043^{*}
	(0.011)	(0.026)
τ	0.015	–0.035
	(0.015)	(0.021)
Control variables	Yes	Yes
Number of observations	831	303
AR(1)	–2.70 [0.0069]	–2.16 [0.0306]
AR(2)	–0.09 [0.9315]	–0.14 [0.8909]

Note: In parentheses we specified the standard errors adequate under conditions of heteroscedasticity and autocorrelation; in brackets, we specified the *p*-values for the respective tests; $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
Source: Authors' calculations.

[2] http://www.cboe.com/products/vix-index-volatility/vix-options-and-futures/vix-index/vix-historical-data
[3] https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx

ous studies on the impact of the foreign exchange rate pass-through (Kartaev and Yakimova, 2018). It may be attributable to the anchoring of inflation expectations at a level close to the inflation target. Due to this anchoring, economic agents respond to a lesser degree to foreign exchange rate shocks, perceiving them as temporary.

For the full sample, the estimated θ coefficient statistically insignificantly differs from zero for the period of 2000–2017, but is significant and positive for the period of 2000–2008 (when oil prices grew steadily). This is evidence of the presence of the oil prices pass-through effect to inflation when they are increasing. In addition, oil price fluctuations affect inflation not only directly but also indirectly, through changes in the foreign exchange rate caused by such fluctuations. This is evidenced by the significant impact of the foreign exchange rate pass-through.

The insignificance of the estimated τ parameter, i.e. the coefficient in the product $\Delta\ln OP_{it} IT_{it}$, can potentially be explained with one of two methods: (1) a change in monetary policy does not affect the correlation between oil prices and inflation, or (2) monetary policy is still important, but we cannot identify its effect due to the heterogeneity of the full sample. To find out which of the two explanations is closer to the truth, we focus on the effect of inflation price pass-through in developing countries. This makes the sample more homogeneous in terms of inter-country comparisons. We also break down the sample into two periods: 2000–2008 and 2011–2016. The first corresponds to a period of steady growth in oil prices; the second, to a period of decline.

This breakdown will help test the presence of asymmetry in the effect of price pass-through to inflation in accordance with the ideas laid down in López-Villavicencio and Pourroy (2019). This asymmetry was first discovered in Bacon (1991), which analyzed the U.S. petroleum market. The author found that, when global energy prices are increasing, local petroleum sellers tend to raise prices for their products to increase their revenues. At the same time, when oil prices are declining, they are reluctant to decrease petroleum prices, preferring to earn extra profits arising due to lower production costs. The cost of petroleum, in turn, affects the trend in prices charged by end-product producers (as it represents a significant share of their costs) and, ultimately, consumer inflation.

The modelling results for these subsamples are shown in Table 2. The specification for the estimated equation is similar to the specification for the full sample. It is easily seen, that the estimated τ coefficient is significant and negative for the period of rising oil prices and, vice versa, significant and positive for the period of falling oil prices. Thus, during periods of increasing oil prices, inflation targeting helps limit inflation pressure, while during periods of declining oil prices, this monetary policy results in a greater pass-through, encouraging a decline in the general price level.

To test the hypothesis that the choice between pure and hybrid inflation targeting may affect the oil price pass-through impact, we also estimated parameters for the following modification to the basic model:

$$\Delta\ln P_{it} = \varphi\Delta\ln P_{it-1} + \lambda\Delta\ln e_{it} + \beta\Delta\ln e_{it} IT_{it} + \theta\Delta\ln OP_{it} + \\ + \tau\Delta\ln OP_{it} IT_{it} + \tau_2\Delta\ln OP_{it} HYB_{it} + \delta X_{it} + \mu_i + \varepsilon_{\text{it}}. \quad (2)$$

The coefficient for the $\Delta\ln OP_{it} HYB_{it}$ variable was close to zero and insignificant, therefore we must conclude that this choice does not affect the nature of

Table 2
Estimates of the oil price pass-through impact for developing economies

Parameter	Model 3, 2000–2008	Model 4, 2011–2016
φ	0.405***	0.637***
	(0.082)	(0.006)
λ	0.380***	–0.425
	(0.038)	(0.270)
θ	0.025	–0.012
	(0.018)	(0.027)
τ	–0.034*	0.064***
	(0.020)	(0.017)
Control variables	Yes	Yes
Number of observations	215	134
AR(1)	–2.26204 [0.0237]	–2.60064 [0.0093]
AR(2)	0.0696956 [0.9444]	0.918297 [0.3585]

Note: In parentheses we specified the standard errors adequate under conditions of heteroscedasticity and autocorrelation; in brackets, we specified the *p*-values for the respective tests; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Authors' calculations.

the relationship between oil prices and the general price level in the economy. In other words, regulating the foreign exchange rate as part of inflation targeting does not produce additional advantages compared with a free-floating national currency in terms of changing the pass-through effect. This, however, does not contradict the fact that this regulation may affect other monetary policy performance characteristics, as shown in Pourroy (2012), and Kartaev and Luneva (2018).

6. Conclusions

The transition to inflation targeting affects the nature of the relationship between oil price shocks and inflation. We found evidence in favor of the effectiveness of the two channels of this impact:

- The direct channel consists of directly changing the oil price elasticity of the general price level in the economy as a result of changes in monetary policy. This impact is asymmetrical: during periods of rising oil prices inflation targeting reduces the oil price pass-through impact, limiting the negative consequences of the shock. And vice versa, during periods of declining oil prices, this monetary policy encourages a greater pass-through, helping reduce inflation.
- The operating principle of the indirect channel is a reduction in the foreign exchange rate pass-through to prices impact as a result of inflation targeting. Thus, energy price shocks, which result in foreign exchange rate fluctuations, affect the economy to a lesser extent.

Quantitative estimates show that the direct effect is comparatively small: for example, a 10% increase in oil prices under a stable foreign exchange rate causes the general price level in countries not targeting inflation to grow by approximately 0.3%. Whereas a 10% decline in the foreign exchange rate leads to 6% long-run growth in the general price level.

The empirical results obtained are quite consistent with the theory, according to which a correctly chosen monetary policy rule cannot only eliminate inflation shifts, but also ensure the optimal response of the central bank to exogenous shocks, neutralizing their negative impact on the economy (Walsh, 2017).

Taking into account the considerable dependence of the Russian economy on energy price trends, these results can provide another argument in favor of the advisability of using a floating foreign exchange rate and inflation targeting in Russia (in addition to a mechanism for reducing the effect of external shocks such as a budget rule).

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