Replication and Archaeology in Macroeconomics

Alex Isakov*
VTB Capital

Alexander Borodin

Alexey Khazanov
Boston College

Andrey Orlov
The Central Bank of Russia

July 13, 2020

1 Introduction

Progress and advances in the economic policy conduct largely depend on how well the production and accumulation of knowledge are organized. This knowledge is typically synthesised from history and experience.

For example, in the field of monetary policy often the policy rule itself becomes the subject of debate (e.g., Belongia & Ireland (2016)), at the modern stage the textual material generated by the policy makers is relatively abundant (*e.g.*, speeches, policy documents). At the same time, the knowledge regarding the tools policy makers rely on is more scarce and sketchy.

Proceeding with the monetary policy as an example, the opacity of the analytical toolkit means that communication between the central bank and the public may be limited. Even more importantly, in the absence of wider discussion, the development of the toolkit can be severely lagging behind the cutting edge practices at the leading central banks, in academia or in private sector. This could undermine the trust

*Corresponding author: Alex Isakov, PhD: alex.isakov@vtbcapital.com

in the ability of the central banks to provide forecasts and economic analysis at the high-quality level, and, consequently, in the success of implementation of inflation targeting or another policy regime.

This issue is by no means unique to the monetary policy or even economic policy in general for that matter, but, we believe, is one facet of the "replication crisis" in social sciences (see Ozier (2019), among many others).

The goal of this paper is to identify the scale of the issues relating to replication of monetary policy-relevant research and to provide and blueprint for publication of replication-ready research.

First, we attempt to run an express-test to diagnose the reproducibility of the published research in the monetary policy field in Russia. We focus on the Russian Journal of Money & Finance (RJMF), which is a journal hosted by the Bank of Russia that invites the submissions related to the following topics: "monetary economics including monetary policy; financial markets; banking; FinTech and Big Data in economics and finance.". In section 2 we find that only for 1 out of 5 published empirical studies the replication code or data can be obtained. This compares with roughly 1 out of 3 for the global benchmark studies, i.e. Gertler et al. (2018).

Secondly, in Section 3 we provide an outline of a boilerplate semi-structural model of class of so-called Quarterly Projection Model (QPM), variation of which are often employed by central banks, i.e. see Bank of Russia (2015), Carabenciov et al. (2008) or Чернявский (2017).

We stress that our goal in this part of the paper is not the *advancement* of the modeling techniques, but rather the *archaeology*, i.e. an attempt to *understand* how well does the published economic research in traditional form, i.e. journal articles, is actually able to preserves and transfer between researchers novel techniques and new knowledge. We also hope that it might serve an *educational purpose*—as a working example of building a QPM-type semi-structural model using the IRIS Toolbox.

We also stress that the discussion of our modelling attempt is just that - an illustration of the wedge between the model's representation in the printed form and its

software implementation. We discuss challenges of this mapping We do not attempt to offer a discussion of short-comings of a a particular model or any class of models, which are available elsewhere.

2 Replication risk: the case of RJMF

2.1 Replication and research

While the process of research, i.e. the production of new knowledge, is hard, the replication of its published results, is often as challenging. For instance, in Gertler et al. (2018) the authors report that out of more than 200 the empirical economic studies they found only 16% that had both raw data and usable code that they were able to run. Ioannidis et al. (2017) conclude that "nearly 80% of the reported effects in these empirical economics literature are exaggerated; typically, by a factor of two and with one-third inflated by a factor of four or more".

Weak reproducibility and challenges of replication are socially costly:

- they limit the use of research results in policy conduct because of the concerns related to their robustness;
- they limit the spillovers of knowledge (and what other goal in principle does the publication in a journal have?) and ability to learn applied research skills from published articles by fellow researchers and students;
- they slow down the development of the research agenda, because of the, requiring researchers to replicate the results from scratch despite the technical complexity of their empirical approach;
- they impede other researchers' ability to check and confirm results independently.

The last effect is potentially built in by institutional design of the academy, as noted in Gertler et al. (2018), as incentives of those who produce novel results and those who

replicate them are in conflict: journals tend to accept papers which refute previously published results more readily then those confirming them.

The response of the the academic community to the replication crisis has been along two lines.

First, projects such as Macro Model Database (https://www.macromodelbase.com/) and Replication Wiki (httpshttp://replication.uni-goettingen.de/) sprung up to coordinate efforts in verification of the existing results.

Second, a new class of studies— studies of the other studies or *meta-studies*, emerged. These studies which survey the academic journals' websites to understand how pervasive are requirements to publish original data and code, how frequently these are available. They can also focus on the replication of published results and on studying possible biases in the body of published work.

Third, the research community started to discuss more actively the institutional changes that can be introduced to create incentives for researchers to produce results which are more robust and more easily verifiable, the best ways to harmonize incentives of researchers and reproducers, and ultimately align incentives of the academia and the public.

The practice of verification has a long history in economic research, as shown by Christensen & Miguel (2018): "Feldstein (1974) estimates a life cycle model showing that social security reduces private savings by as much as 50%. [...] but Leimer and Lesnoy (1982) discovered that a flaw in Feldstein's computer program that overestimated the growth rate of Social Security wealth for widows led to larger effects of Social Security wealth than when the mistake was corrected."

However, we claim that the practice of posting data and code remains fully foreign to the universe of Russian economic academic journals. But could it be that the cooperation between researchers is not inhibited by this lack of infrastructure, and the tools are freely shared through other channels?

Below we suggest an approach to illustrating the gravity of the replication crisis under the present conditions.

2.2 Replication in harsher climates

First, we are not aware of the existence of a top-tier Russian economic journal that systematically publishes underlying data or code to accompany an article, as it is done by American Economic Association journals that are considered as one of the most reputable in the profession[1].

We thus cannot follow in the footsteps of Gertler et al. (2018), who collect code and data directly from the journals' websites.

Instead in order to assess the reproducibility of research we conducted the following experiment:

1. We compiled a list of all empirical articles published on the CBR's Money and finance journal since its relaunch, which in our case meant from issue 1 of 2018 to issue 2 of 2019. This resulted in the total of 27 articles, for full list see appendix 5.1.

2. We then emailed each of the authors requesting a replication package: data and code behind the published results. We have introduced ourselves as a fictional graduate student *Anastasia Ivanova*, who was kindly asking for code in order to learn the techniques used in the paper. Our templates for requests in Russian and English are available in the Appendix 5.2.

More precisely, the algorithm was as follows:

- request started from the most recent issues of the RJMF;
- we mailed an author only once: if he or she succeeded in authoring a number of papers in the RJMF then we requested the replication package only for the most recent one;
- we emailed all the co-authors for whom the emails were made available;

[1] See Data and Code Availability Policy at American Economic Review's website: https://www.aeaweb.org/journals/policies/data-code

- we chose to address authors in English if at least one of the co-authors was affiliated with a foreign institution;
- we distributed our emails on Monday July 22, 2019.
- we established a cut off for the collection of responses on Friday August 23, 2019.

2.3 Resumé of replies

We identified 26 articles published in the RJMF as empirical studies. In order to query an author only once we had to censor out 4 articles, we also had to exclude another article for the lack of publicly available email address. This makes a total of **21 emails** sent out.

In response we have received **11 replies, a 52% gross response rate**.

Out of the 11 replies **7 refused** to provide either data, or code which would allow replication, **4 provided both data and code** suitable for running a replication, which is a **19% total positive response** rate.

The causes for refusal or failure to provide the data or code were as follows:

- in 2 cases the code and data have been either lost or kept by a co-author, who could not have been accessed at the time;
- in 2 cases part of the data was not public (neither code, nor data were provided);
- in 2 cases the fact that the code behind the published work is considered property of the researchers' employer was stated as the reason for inability to share it (both of our correspondents claimed that it can be potentially recovered from one or several publicly available sources);
- in 1 case the researcher only inquired regarding institutional affiliation and did not return the reply.

We have also attached two attributes to the review articles: i) whether one of the co-authors has been affiliated with the CBR (at the moment of our replication package

request), ii) whether one of the co-authors was primarily affiliated with international or domestic institution.

Based on this the break-down of the response rates has been as follows:

- 2 of the positive responses came from the CBR-affiliated authors, which means a 40% response rate (2/5), vs 12.5% (2/16) response rate from authors not affiliated with the CBR;
- 3 Russian-only author groups provided data and code which means a 25% (3/12) response rate vs 11% (1/9) response rate from international co-authors.

We are conscious regarding the limited scale of our sample and thus reserved regarding the conclusions that can be drawn based on it.

And yet the small sample size itself is indicative of the gravity of the problem: roughly only 1 in 5 empirical research papers can be backed by the code and data which allow for independent verification. We believe that this response rate actually overstates what can be expected from a broader sample of Russian academic journals based on two pieces of evidence:

- As we show above, response rates from non-CBR affiliated researchers tends to be lower, and we believe that the "home bias" of the RJMF means that they are much less concentrated in other journals;
- RJMF's prestigious status means that the competition for publication is higher and we believe that this competition is associated with higher willingness to provide replication materials.

Hamermesh (2007) reports: "Pure replication depends on the availability of all the information from the project that is to be replicated. Its potential importance was demonstrated to the profession in the mid-1980s by a project undertaken by the editor of the Journal of Money, Credit and Banking (Dewald et al, 1986). He sought data sets and documentation from authors of recently published and accepted manuscripts from his Journal, received them from a disturbingly small fraction (about one-third) [...]".

This one-third was disturbing enough for the American Economic Review to mandate that "authors of accepted articles pledge to make their data sets available upon request unless the data were proprietary".

We hope that, despite the smaller sample size of this study, our results will appear to be disturbing enough to trigger similar changes in the universe of Russian economic journals. We provide the summary of our suggestions in this regard in the next subsection.

2.4 A way forward

The results we obtained in the exercise about rise a question—what can be done to improve the situation from the *institutional* point of view? We would like to share our opinion regarding the way forward. In large part it is informed by the work we have done for this paper and is line with Hamermesh (2007) noting: "Any demand for replication must arise from the profession as a whole, as intermediated by the actions and decisions of the editors of the most visible professional journals."

We believe that a change in the quality of the monetary policy related research requires rethinking of the role of the editor of the RJMF: instead of passive role of filtering the incoming submissions, we believe, the editor may take on an active role of *demanding* the replicability from the submitted articles, as well as *verifying* it.

The procedure might be quiet simple: subjects for replication may be chosen at random among previously published results with probability distributed uniformly or, perhaps, proportional to the level of the public interest to the results (e.g., proxied by the number of downloads).

Another change we hope to see is the change in the submission requirements making publication of data (when there are no legal restrictions) and code (always) on the designated resource. Additionally, the editors can state their preferences for research based on the publicly available data, all else being equal.

Lastly, the journal should become an institution responsible for storing the data and code accompanying published research. One way to do that could be creation of

special a repository administered by the RJMF (for instance, a popular platform used for such purposes currently is GitHub, but RJMF can as well post the data on the website). In this way RJMF's editorial board would be able to guarantee that there would be no "sweeping under the rug" post publication in case if typos are discovered, and all the changes in the contents would be publicly announced. It would also guarantee the 24/7 availability of the code, which would protect interested researchers from delays in replies to the code requests addressed personally to the authors.

In the next section we provide a case study that illustrates the the challenges of replication in case when code and data are unavailable. We also show potential setbacks in development of a highly relevant monetary policy tool this unavailability may cause.

3 The blueprint: boilerplate QPM

While generally researchers, in our experience, support higher standards of transparency, on the individual basis one rarely enjoys those strict standards being applied to their own results. As Hamermesh (2007) notes: "Our expressions of preference are cheap talk. The profession provides few incentives for most active economists to produce replications of others' research [...]".

Due to the same shortcomings of the current knowledge accumulation infrastructure in Russia and elsewhere, which required our mail-based exercises in the previous section—no journal in Russia currently systematically publishes neither code nor data—we have to opt for a bit of macroeconomic archaeology, i.e. reconstructing research solely from published articles' text, instead of rerunning publicly available original code (defined as "pure verification" in Hamermesh (2007)).

In this section we attempt to provide what we believe to be a useful *template* for sharing empirical results of monetary policy-related studies. This means providing ready access to underlying data, data transformation and estimation code, which itself is readable and closely corresponds to the notation of the paper.

To draw further analogy with archaeology and history, we can roughly say that the two key, or at least important, sources of our knowledge about the past, are *texts* and *tools*. Unless texts provide a detailed description of, for instance, a production method, we wouldn't be able to infer it without discovering tools employed for this process. Further, the production process can shed light on regional trade patterns, or reveal the logic behind the structure of an industry and the society. For an example, see a fascinating study by Nunn & Qian (2011).

By analogy, we have plenty of textual evidence regarding the conduct of monetary policy that allows to draw some mnemonic rules regarding the way the central bank employs the available data to produce forecasts and monetary policy decisions. However, the tools monetary policy makers rely on that are available for our "discovery" are rather more obscure.

We believe that publication of research tools, used by central banks' staff, may rectify this issue as well as provide deeper insight into the challenges of monetary policy conduct for wider audience[2].

In this section we provide a template for publication of the monetary policy oriented research and as a subject we choose a boilerplate versions of the Quarterly Projection Model (QPM).

There are two primary reasons for choosing this type of models for this exercises:

- it is a popular tool in the applied monetary policy research and forecasting, i.e. see Amarasekara et al. (2018), Carabenciov et al. (2008), Чернявский (2017), Бородин (2014) among many others;
- we believe that mapping of such type of models into publications is less linear and more prone to more omission than for many other common types of models, such as VARs, and thus reinforces our thesis.

Before proceeding with the exercise, we believe it is necessary to state our goals, and also to clarify the goals that we definitely do not attempt to achieve. We attempt

[2]It will likely also increase cooperation between researchers, as unavailability of the source code is an impediment for that, see Бородин et al. (2008) registers just 7 references

to reconstruct a boilerplate QPM model based on **publicly available sources** within a template, which we consider appropriate for publishing empirical work of this kind.

We, however, do not attempt to improve upon this work, and neither do we attempt any exercises testing predictive power of the QPM, but we provide the relevant code. These types of efforts, we believe, should become ever so slightly easier due to this work. Current section proceeds as follows. First, in subsection 3.1 we review publicly available source on the structure of the QPM-type models. Second, in subsection 3.2 we layout the equations of the QPM in the notation of the preceding literature. Third, we comment on the data used and transformation applied in subsection 3.3. Fourth, we describe our estimation approach in subsection 3.4.

3.1 QPM: Literature review

Central banks use a wide variation of the QMP-type models which vary in scale and complexity. In what follows we are mostly guided by two examples: Чернявский (2017), who provides a relatively recent example of QMP designed for Kazakhstan, and Бородин et al. (2008) and Bank of Russia (2015), who develop and apply the QPM framework to the Russian data, and Бородин (2014), who show the scope of phenomena which can be included in the QPM-type models, such as:

- multiple Phillips curves components of the headline inflation;
- accounting for foreign variables such as output gaps and inflation;
- systematic accounting of the role of inflation expectations.

Below we will focus on a standard version of QPM-type model and estimate it using data for Kazakhstan.

3.2 QPM: Model outline

For ease of exposition, in the model outline below we follow broadly the notation of Бородин et al. (2008). The subsections also contain links to corresponding appen-

dices, where the code is outlined. We build the mode using the IRIS Toolbox[3]. Supplementary materials including the code and data are available at the GitHub repository.

3.2.1 The key transition equations

The BGPP's first four core equations are the Phillips curve, the investment-saving (IS) curve, the uncovered interest rate parity (UIP) and the Taylor rule.

The Phillips curve describes the evolution of inflation:

$$\pi_t = \alpha_1 \pi 4_{t+4} + \alpha_2 \pi 4_{t-1} + (1 - \alpha_1 - \alpha_2) * (\Delta ls_t + \pi_t{}^{for} - \Delta lz_t^{eq}) + \alpha_3 y_t^{gap} + \varepsilon_t^{(1)} \quad (1)$$

The IS curve describes the evolution of the output gap:

$$y_t^{gap} = \beta_1 y_{t+1}^{gap} + \beta_2 y_{t-1}^{gap} - \beta_3 (rr_{t-1}^{market} - rr_{t-1}^{marketeq}) + \beta_4 * lz_{t-1}^{gap} + \beta_5 y_t^{gapfor} + \varepsilon_t^{(2)} \quad (2)$$

The uncovered interest rate parity links interest rates with expected exchange rate dynamics:

$$ls_t = \delta_1 ls_{t+1} + (1 - \delta_1) * (ls_{t-1} + \Delta_2 ls_t^{eq}/4) - (rs_t - rs_t^{for} - \rho_t)/4 + \varepsilon_t^{(3)} \quad (3)$$

The Taylor-type monetary policy rule:

$$rs_t = \gamma_1 rs_{t-1} + (1 - \gamma_1) * (rs_t^{neutral} + \gamma_2 (\pi 4_{t+4} - \pi_{t+4}^{tar}) + \gamma_3 y_t^{gap}) + \varepsilon_t^{(4)} \quad (4)$$

[3]IRIS Toolbox can be found here: https://github.com/IRIS-Solutions-Team/IRIS-Toolbox/wiki/IRIS-Macroeconomic-Modeling-Toolbox

3.2.2 Exogenous variables transition equations

Next block defines the exogenous equations, which are typically defined as random walks or auto-regressions.

Inflation target:

$$\pi_t^{tar} = \pi_{t-1}^{tar} + \eta_t^{(1)} \tag{5}$$

Equilibrium output growth:

$$\Delta y_t^{eq} = \chi y_{t-1}^{eq} + (1-\chi) * \Delta y_{ss}^{eq} + \eta_t^{(2)} \tag{6}$$

Nominal interest rate on bank lending:

$$rs_t^{market} = \xi rs_{t-1}^{market} + (1-\xi) * ((rs_t + rs_{t+1} + rs_{t+2} + rs_{t+3})/4 + \rho_t^{market}) + \eta_t^{(3)} \tag{7}$$

Equilibrium nominal interest rate on bank lending:

$$rr_t^{market\ eq} = \zeta_2 rr_{t-1}^{market\ eq} + (1-\zeta_2) * rr_{ss}^{marketeq} + \eta_t^{(4)} \tag{8}$$

Term premium:

$$\rho_t^{market} = \kappa \rho_{t-1}^{market} + (1-\kappa) * \rho_{ss}^{market} + \eta_t^{(5)} \tag{9}$$

Equilibrium change of the real exchange rate:

$$\Delta lz_t^{eq} = \zeta_1 \Delta lz_{t-1}^{eq} + (1-\zeta_1)\Delta lz_{ss}^{eq} + \eta_t^{(6)} \tag{10}$$

Risk premium:

$$\rho_t = \zeta_3 \rho_{t-1} + (1-\zeta_3) * \rho_{ss} + \eta_t^{(7)} \tag{11}$$

Foreign output gap:

$$y_t^{gap\ for} = 0.85 y_{t-1}^{gap\ for} + \eta_t^{(8)} \tag{12}$$

Foreign nominal interest rate:

$$rs_t^{for} = 0.85 rs_{t-1}^{for} + \eta_t^{(9)} \tag{13}$$

Foreign inflation:

$$\pi_t^{for} = 0.85 \pi_{t-1}^{for} + \eta_t^{(10)} \tag{14}$$

3.2.3 Identities

This block contains definitions of variables, which are some algebraic transformations of other variables and do not have their own shocks.

Annual inflation:

$$\pi 4_t = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4 \tag{15}$$

Output:

$$y_t = y_t^{eq} + y_t^{gap} \tag{16}$$

Equilibrium output:

$$y_t^e q = y_{t-1}^e q + \Delta y_t^e q/4 \tag{17}$$

Nominal neutral policy rate:

$$rs_t^{neutral} = rr_t^{market\ eq} - \rho_t^{market} + \pi 4_{t+4} \tag{18}$$

Real policy rate

$$rr_t = rs_t - \pi_{t+1} \tag{19}$$

Real bank interest rate:

$$rr_t^{market} = rs_t^{market} - \pi 4_{t+4} \tag{20}$$

Nominal Exchange rate dynamics:

$$\Delta ls_t = 4(ls_t - ls_{t-1}) \tag{21}$$

Equilibrium exchange rate change over two quarters:

$$\Delta_2 ls_t^{eq} = \pi_t - \pi_{t+1} - \pi_t^{for} - \pi_{t+1}^{for} + 2\Delta lz_t^{eq} \tag{22}$$

Real exchange rate level:

$$lz_t = lz_{t-1} + (\Delta ls_t - \pi_t + \pi_t^{for})/4 \tag{23}$$

Equilibrium real exchange rate level:

$$lz_t^{eq} = lz_{t-1}^{eq} + \Delta lz_t^{eq}/4 \tag{24}$$

Real exchange rate gap:

$$lz_t^{gap} = lz_t - lz_t^{eq} \tag{25}$$

Foreign real interest rate:

$$rr_t^{for} = rs_t^{for} - \pi_{t+1}^{for} \tag{26}$$

3.3 The data and transformations

The observed part of the model includes the following macroeconomic variables: 1. Interest rates: (a) domestic policy rate or money market rate; (b) domestic bank lending interest rate; (c) country risk premium; (d) foreign policy or money market rate. 2. Inflation rates: (a) domestic CPI level; (b) foreign CPI level 3. Economic activity levels: (a) domestic output gap; (b) foreign output gap. 4. Exchange rate.

Below we describe the data used and transformations applied.

	Variable	Observed	Transformations
Interest rates			
domestic money market rate	rs	TONIA	fq,log
domestic bank lending rate	rs^{market}	corporate, up to 1yr	fq,log
country risk premium	ρ	CDS,5yr	fq,log
foreign money market rate	rs^{for}	EFFR, o/n	fq,log
Inflation rates			
domestic CPI level	π	CPI	fq, sa, log, diff
foreign CPI level	π_f	CPI	fq, sa, log, diff
Economic activity			
domestic output	y	GDP SA	log
foreign output gap	$y^{for\ gap}$	GDP	HP,log
Exchange rate	ls	USDKKZT	fq,log

Legend: fq - frequency transformation, which here means down-sampling daily and monthly data to model's quarterly frequency, log - natural log transformation, HP - Hodrick-Prescott filtered gap, sa - seasonal adjustment with ARIMA-X12-SEATS.

3.4 Parameterisation

The model contains a total of 23 parameters, which need to be estimated. There are broadly two estimation strategies available to us:

1. **estimation**—attempt to fit the parameters to the data as closely as possible starting from some prior distributions;

2. **calibration**—manually set the parameters at the values which produce impulse responses consistent with our expectations and broad theory.

We attempt to use both approaches.

3.5 Estimation

We estimate the model by assigning prior distribution to parameters.

3.6 Calibration

More typically QPM-type models are calibrated rather than estimated, see Бородин (2014). The reason for this choice is that more often than not monetary policy involves frequent shifts in the setup, transitions between exchange rate regimes etc. Accounting for such change through informed calibration of the model's coefficient is often considered advisable.

In this calibration we following these general principles regarding the intended effects of the following shocks:

- demand shock
  - output gap increases by 1pp or even slightly more and undershoots on the way down;
  - inflation accelerates, but less than the size of the shock, then converges back to the target rate in 2-3 years, it may also slightly undershoot the target;
  - interest rate increases more than inflation (i.e. the real interest rate also goes up), but then descends to the neutral rate, yet initially the real rate may decrease due to monetary policy inertia typical for 00's;
  - FX initially may appreciate, but later settles lower than the original level;
  - real FX rate gap remains negative from the start, but may overshoot later;
- cost-push/supply shock
  - inflation initially gains more than the shock, due to persistent inflation expectations;

  - interest rates react less than to the demand shock (real interest rate gains less or even remain flat)
  - output gap becomes negative, but less in scale than the shock size;
  - real exchange rate is negative, appreciating fast;

- interest rate/monetary policy shock
  - exchange rate appreciates, negative exchange rate gap, negative output gap;
  - interest rate gradually returns back to equilibrium and key variables follow.

- inflation target shock: as the target is defined as random walk (more on that in the section below) then its shocks are basically permanent shifts in the price level. Say, with the decrease in the inflation target the model is expected to display lower interest rates, decline in inflation expectations (however this may be less strictly so if the credibility of the monetary policy remains contested).

- FX shock: is similar to the demand side shock.

3.7 Discussion

We believe that even the fullest disclosure of the structure of the model and the set of parameters would not allow an outside observer to replicate its forecasts. One obvious reason is that a QPM-based forecast is usually conditional and the model does not provide any clues as to the choice of conditioning assumptions (be it oil price path, risk premium assumptions, etc.). Another, more subtle point which is highlighted by the inflation target above is that forecasts are typical arrived at by iterating some initial state of the economy which is subject to judgment and is essential itself is a parameter, unknown to the outside observer.

While in this note we addressed only the issues of one particular model, the point that we would like to make is more general: models used in policy and academic papers are complex. This complexity means that their behavior can hide a lot of surprises, that

	Equation	Parameter	Prior	estimated	Value: BGPP	Value: Estimated	Value: Calibrated
1	(1)	α_1	BGPP	n	0.45	-	-
2	(1)	α_2	BGPP	n	0.45	-	-
3	(1)	α_3	BGPP	n	0.23	-	-
4	(2)	β_1	B(2,2)	y	-	0.00	0.10
5	(2)	β_2	BGPP	n	0.3	-	-
6	(2)	β_3	BGPP	n	0.1	-	-
7	(2)	β_4	BGPP	n	0.2	-	-
8	(2)	β_5	B(2,2)	y	-	0.00	0.50
9	(3)	δ_1	B(2,2)	y	-	0.94	0.20
10	(4)	γ_1	BGPP	n	0.4	-	-
11	(4)	γ_2	G(1,2)	y	-	0.00	1.50
12	(4)	γ_3	G(1,2)	y	-	0.00	0.8
13	(6)	χ	B(2,2)	y	-	0.96	0.5
14	(6)	y_{ss}^{eq}	G(1,2)	y	-	0.00	1.0
15	(7)	ξ	BGPP	n	0.7	-	-
16	(8)	ζ_2	B(2,2)	y	-	0.90	0.5
17	(8)	$rr_{ss}^{market\ eq}$	G(1,2)	y	-	0.00	1.00
18	(9)	κ	B(2,2)	y	-	0.98	0.5
19	(9)	ρ_{ss}^{market}	G(1,2)	y	-	0.02	1.0
20	(10)	ζ_1	B(2,2)	y	-	0.93	0.5
21	(10)	$lz_{qq\ ss}^{eq}$	G(1,2)	y	-	0.04	1.0
22	(11)	ζ_3	B(2,2)	y	-	0.00	0.50
23	(11)	ρ_{ss}	G(1,2)	y	-	2.35	1.0

Table 1: Parameters of the replicated QPM model. Source: BGPP, authors' estimates. Legend: BGPP - estimate from the BGPP, G(a,b) - gamma distribution, B(a,b) - beta distribution.

cannot be inferred from the scarce description presented in the corresponding texts. The most effective treatment to this complexity is matching degree of transparency: publication of codes can allow both to learn useful shortcuts and methodological approaches, usually omitted in the technical descriptions in the papers, and to reveal possible bugs and typos.

4 Conclusion

In this paper we attempt to highlight a major issue of replicability in Russian (in a general sense) macroeconomic research. We approached the issue from two sides: we asked the authors of the papers published in RJMF past relaunch to provide replication materials, and we illustrated challenges of reconstructing popular QMP-type models. The conclusions we made are the following.

First, we believe Russian economics research suffers from the replication issues

experienced globally across social disciplines. We hope we've managed to provide sufficient evidence to trigger a sense of urgency for substantial reforms on this front.

Second, current approach to publication of research results is a peculiar mixture of modern techniques and ancient medium. While it might be suitable for theoretical papers, empirical results can be communicated only incompletely in the standard article format. As Christensen & Miguel (2018) notes quoting another study: "An article about computational science in a scientific publication is not the scholarship itself, it is merely advertising of the scholarship. The actual scholarship is the complete software development environment and the complete set of instructions which generated the figures".

We hope the challenges in estimation of the QPM model show how limited is the traditional exposition of the results.

Finally, we provided some suggestions for the improvement of the publication standards for empirical research in economics. A Russian macroeconomic journal that requests and posts upon publication the replication materials from the authors, as well as verifies the replicability of the paper, has a chance to produce a huge benefit for our research community and for the published authors themselves. That kind of journal can gain good reputation among the macroeconomic academic and policy community attracting attention of interested researchers that would like to dig deep into the empirical techniques in macroeconomics.

5 Appendix

5.1 RJMF: empirical articles issued, 1'18-2'19

Year	Issue	Article	code
2018	1	Grafe, C., Grut, S., Rigon, L. (2018). Neutral Interest Rates in CEEMEA — Moving in Tandem with Global Factors. Russian Journal of Money and Finance, 77(1), pp. 6-25.	GGR2018
2018	1	Ponomarenko, A., Sinyakov, A. (2018). Impact of Banking Supervision on Banking System Structure: Conclusion from Agent-Based Modelling. Russian Journal of Money and Finance, 77(1), pp. 26-50.	PS2018
2018	1	Mamonov, M. (2018). Banks' Hidden Negative Capital Before and After the Senior Management Change at the Bank of Russia. Russian Journal of Money and Finance, 77(1), pp. 51-70.	M2018
2018	1	Panizza, U., Wyplosz, C. (2018). The Folk Theorem of Decreasing Effectiveness of Monetary Policy: What Do the Data Say? Russian Journal of Money and Finance, 77(1), pp. 71-107.	PW2018
2018	2	Makinen, M., Solanko, L. (2018). Determinants of Bank Closures: Do Levels or Changes of CAMEL Variables Matter? Russian Journal of Money and Finance, v. 77(2), pp. 3-21.	MK2018
2018	2	Ushakova, Y., Kruglova, A. (2018). Competition in Russia's Banking Sector Prior and After Supervision Police Enhancement: Conclusions Based on Interest Rate Dispersion and Spread. Russian Journal of Money and Finance, 77(2), pp. 22-50.	UK2018
2018	2	Kreptsev, D., Seleznev, S. (2018). Forecasting for the Russian Economy Using Small-Scale DSGE Models. Russian Journal of Money and Finance, 77(2), pp. 51–67.	KS2018
2018	2	Shulgin, A. (2018). Sterilized Interventions in the Form of Foreign Currency Repos: VECM Analysis Using Russian Data. Russian Journal of Money and Finance, 77(2), pp. 68-80.	Shu2018
2018	2	Styrin, K. (2018). A Multi-Country Study of Cross-Border Transmission of Monetary Policy by IBRN. Russian Journal of Money and Finance, 77(2), pp. 81-94.	Sty2018

Year	Issue	Article	code
2018	3	Gerlach-Kristen, P., Moessner, R. and Rosenblatt-Wisch, R. (2018). Computing Long-Term Market Inflation Expectations for Countries without Inflation Expectation Markets. Russian Journal of Money and Finance, 77(3), pp. 23–48.	GKMRW2018
2018	3	Nagy, E.E. and Tengely, V. (2018). External and Domestic Drivers of Inflation: The Case Study of Hungary. Russian Journal of Money and Finance, 77(3), pp. 49-64.	NT2018
2018	3	Kartaev, P. and Luneva, I. (2018). Shaken, not Stirred: Comparing the Effectiveness of Pure and Hybrid Inflation Targeting. Russian Journal of Money and Finance, 77(3), pp. 65–75.	KL2018
2018	3	Mamonov, M., Akhmetov, R., Pankova, V., Solntsev, O., Pestova, A. and Deshko, A. (2018). Identification of Financial Sector Optimal Depth and Structure from the Perspective of Economic Growth, Macroeconomic and Financial Stability. Russian Journal of Money and Finance, 77(3), pp. 89-123	MAPSPD2018
2018	4	Antonova, D. and Vymyatnina, Y. (2018). Inflation and Population Age Structure: The Case of Emerging Economies. Russian Journal of Money and Finance, 77(4), pp. 3–25.	AV2018
2018	4	Yakovleva, K. (2018). Text Mining-based Economic Activity Estimation. Russian Journal of Money and Finance, 77(4), pp. 26–41.	Y2018
2019	1	Baybuza, I. (2018). Inflation Forecasting Using Machine Learning Methods. Russian Journal of Money and Finance, 77(4), pp. 42–59.	Bay2018
2019	1	Styrin, K. (2019). Forecasting Inflation in Russia by Dynamic Model Averaging. Russian Journal of Money and Finance, 78(1), pp. 3–18.	Sty2019
2019	1	Mikosch, H. and Solanko, L. (2019). Forecasting Quarterly Russian GDP Growth with Mixed-Frequency Data. Russian Journal of Money and Finance, 78(1), pp. 19–35.	MS2019
2019	1	Marodin, F. A. and Portugal, M. S. (2019). Exchange Rate Pass-Through in Brazil: A Markov Switching DSGE Estimation for the Inflation Targeting Period. Russian Journal of Money and Finance, 78(1), pp. 36–66.	MP2019

Year	Issue	Article	code
2019	1	Ambriško, R. (2019). Fiscal Devaluation in a Small Open Economy. Russian Journal of Money and Finance, 78(1), pp. 67–88.	A2019
2019	1	Borsuk, M. (2019). Forecasting the Net Interest Margin and Loan Loss Provision Ratio of Banks in Various Economic Scenarios: Evidence from Poland. Russian Journal of Money and Finance, 78(1), pp. 89–106.	Bor2019
2019	2	Charnavoki, V. (2019). International Risk-Sharing and Optimal Monetary Policy in a Small Commodity-Exporting Economy. Russian Journal of Money and Finance, 78(2), pp. 3–27.	Cha2019
2019	2	Deryugina, E. and Ponomarenko, A. (2019). Determination of the Current Phase of the Credit Cycle in Emerging Markets. Russian Journal of Money and Finance, 78(2), pp. 28–42.	DP2019
2019	2	Kilp, J., Anvari, V., Springfield, S. and Roberts, C. (2019). The Impact of the Global Financial Safety Net on Emerging Market Bond Spreads. Russian Journal of Money and Finance, 78(2), pp. 43–66.	KASR2019
2019	2	Fokin, N. and Polbin, A. (2019). Forecasting Russia's Key Macroeconomic Indicators with the VAR-LASSO Model. Russian Journal of Money and Finance, 78(2), pp. 67–93.	FB2019
2019	2	Fomin, L. (2018). Do Higher Interest Rates on Loans and Deposits and Advertising Spending Cuts Forecast Bank Failures? Evidence from Russia. Russian Journal of Money and Finance, 78(2), pp. 94–112.	Fom2019

5.2 Replication package request templates

The request in Russian:

"From: nastyaivanovaphd@gmail.com

To: [Authors]

Subjuct: О статье в ДиК

Добрый день!

Меня зовут Анастасия Иванова, я аспирант.

Мне бы хотелось поблагодарить Вас за замечательную статью: [LINK]

Кроме того, я хочу попытаться воспроизвести Ваши результаты и понять, как на практике проводятся расчеты в подобных исследованиях. Вы не могли бы, пожалуйста, поделиться исходным кодом и данными для этой статьи? Размер данных не представляет проблем - у меня большой dropbox :)

Заранее признательна!”

The request in English:

“From: nastyaivanovaphd@gmail.com

To: [Authors]

Title: re article in CBR’s Money and Finance

Good day!

I’m Anastasia Ivanova, a graduate student.

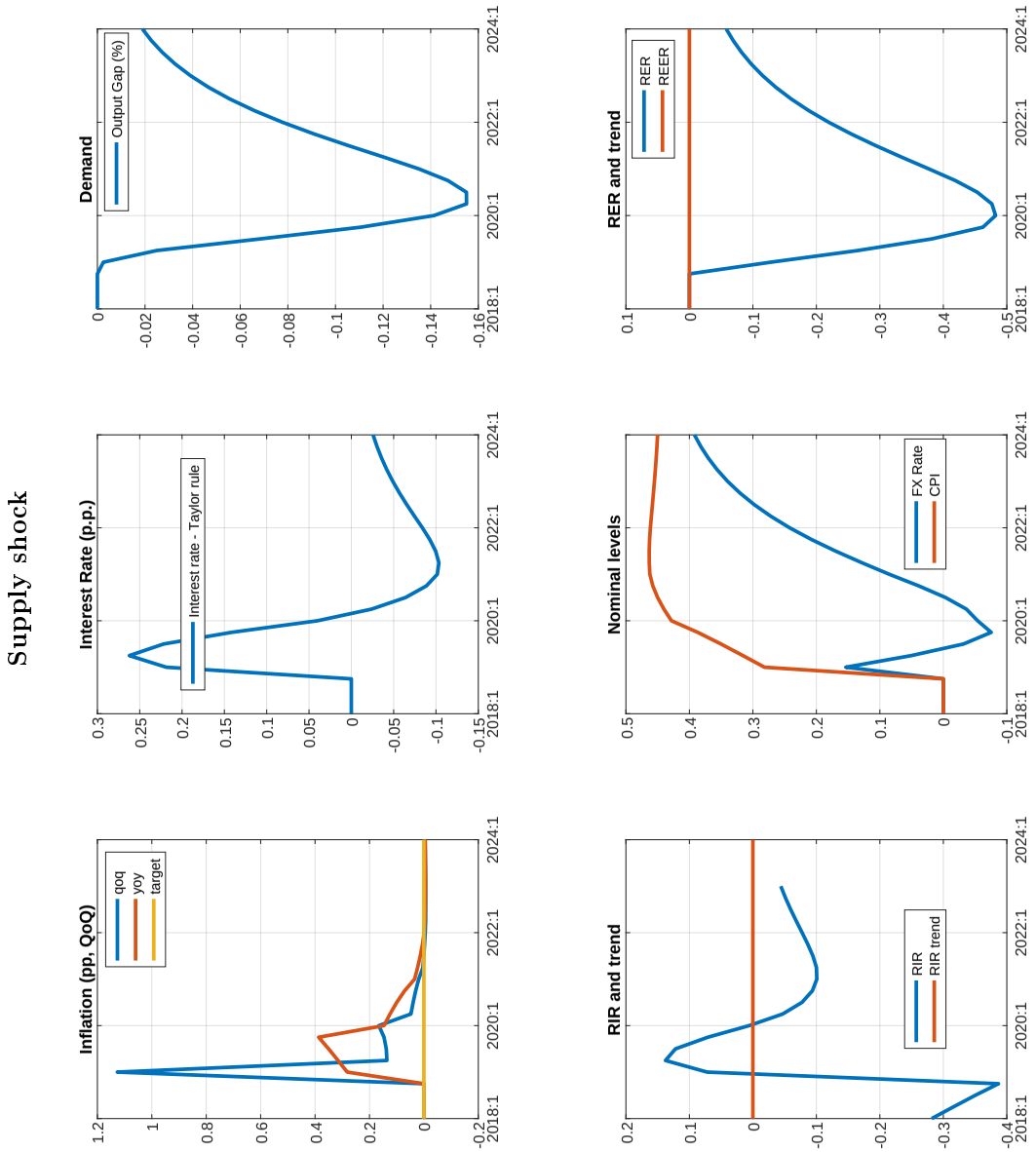
I wanted to thank you for your very informative article: [LINK]

Also, I wanted to attempt to replicate your results and understand, how in practice such empirical work is done.

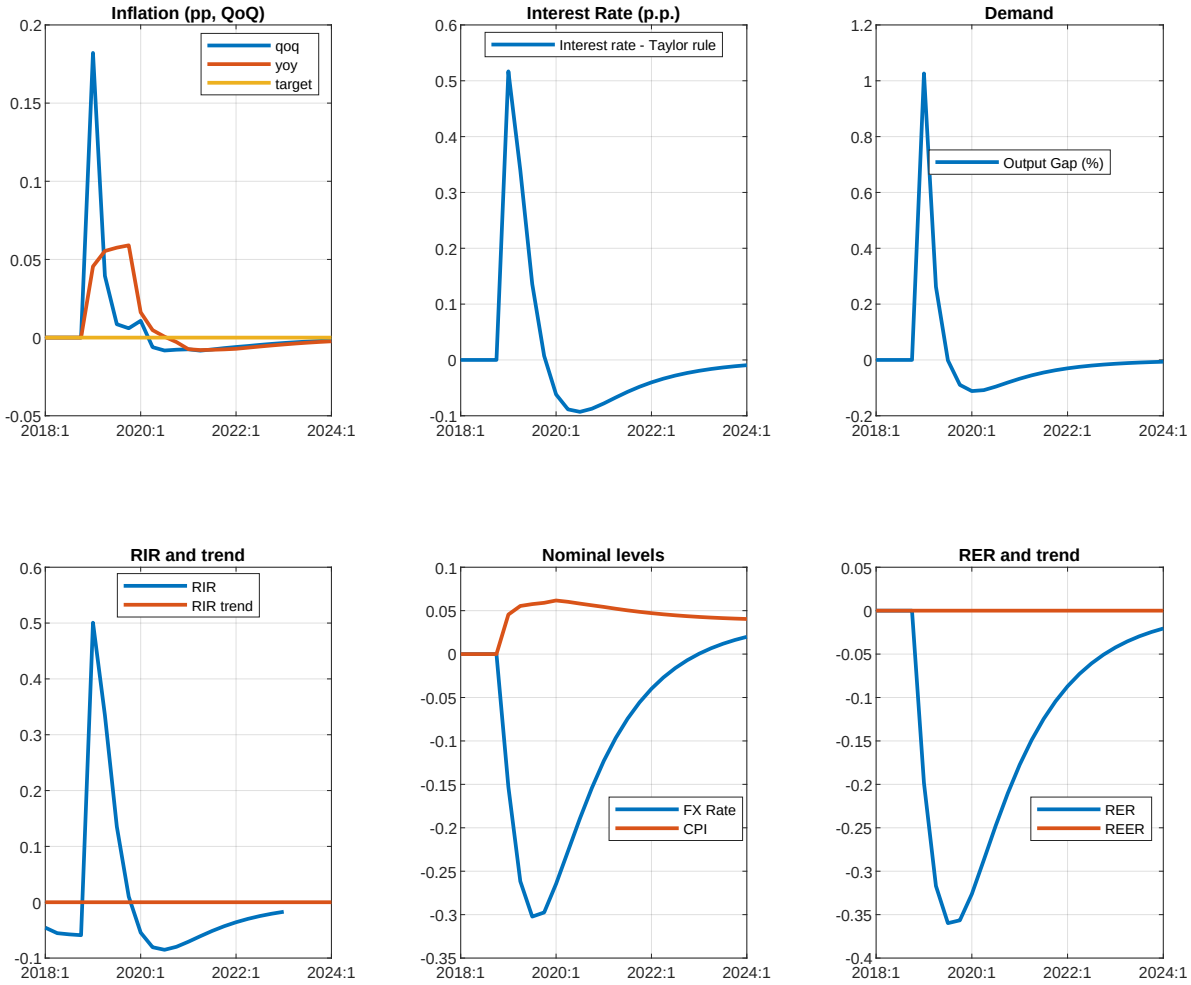
Could I, please, ask for your codes and data, used in the article? The size of the data should not be a concern - I have a rather large dropbox limit :)

Thanks in advance!”

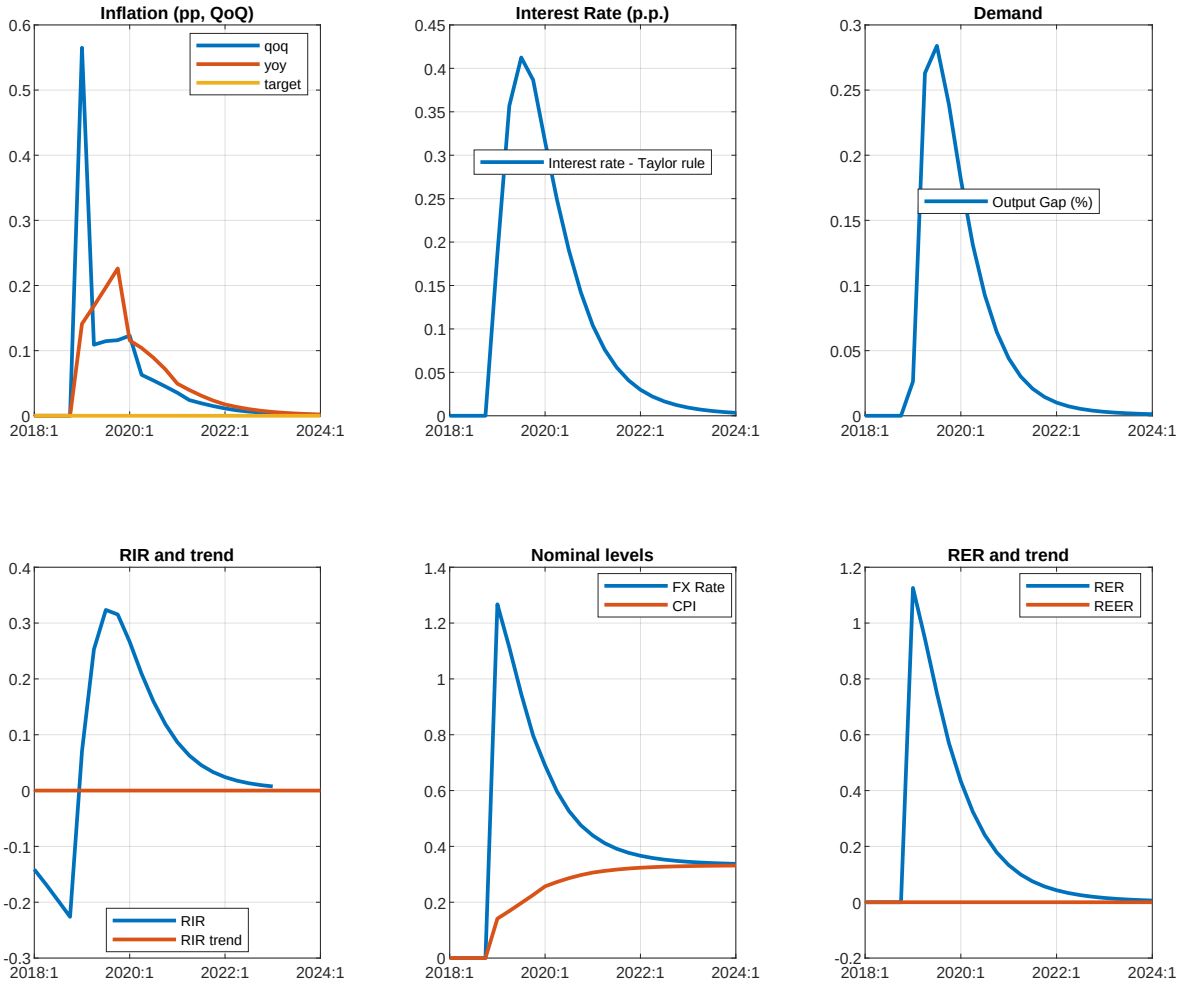
5.3 Calibrated IRFs



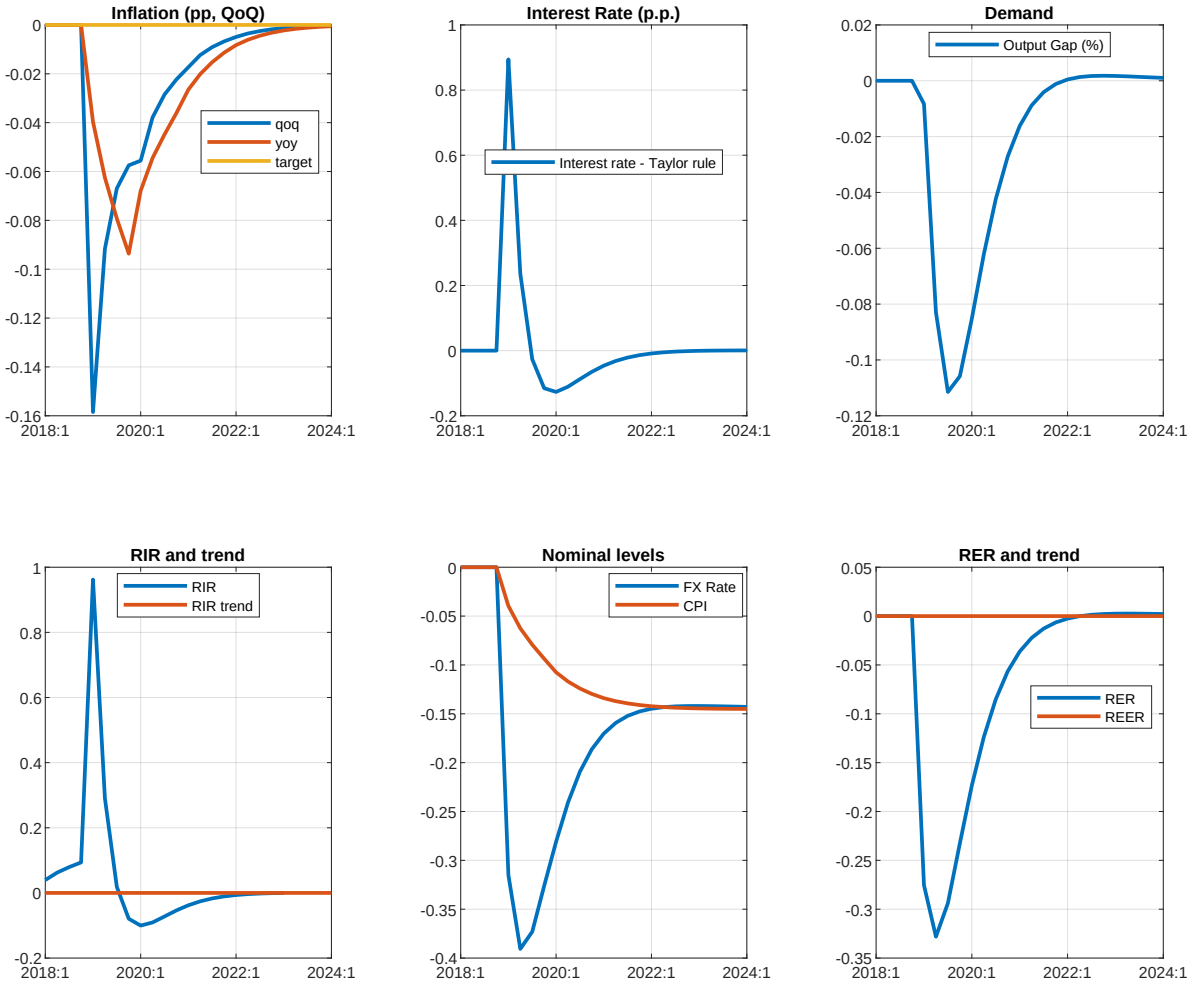
Demand shock



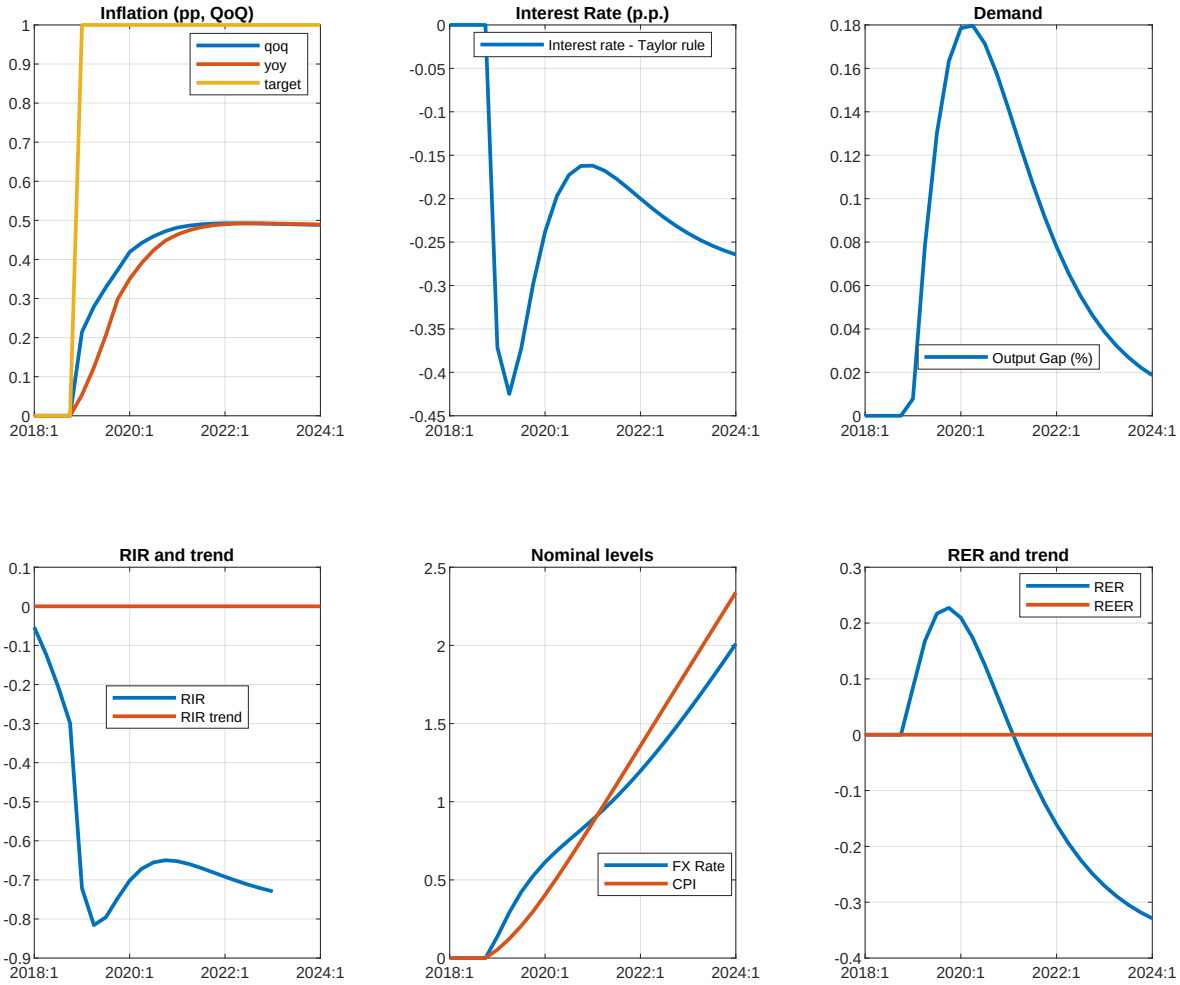
Exchange rate shock



Policy shock

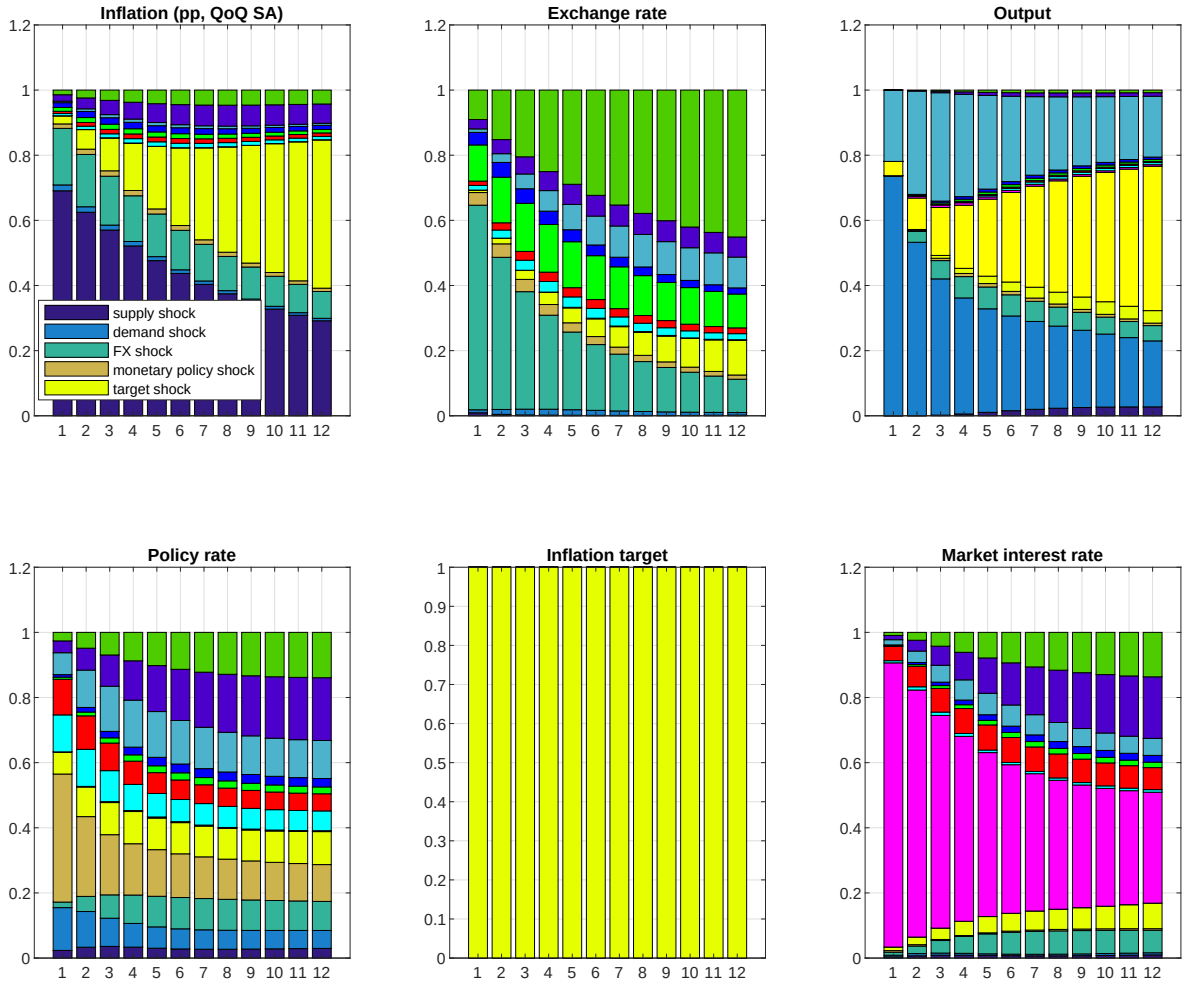


Inflation target shock



5.4 FEVD

Forecast error variance decomposition



References

Amarasekara, C., Anand, R., Ehelepola, K., Ekanayake, H., Jayawickrema, V., Jegajeevan, S., Kober, C., Nugawela, T. & Plotnikov, S. (2018), *An Open Economy Quarterly Projection Model for Sri Lanka*, International Monetary Fund.

Bank of Russia (2015), 'Monetary policy report for 1q15'.
URL: *http://cbr.ru/Collection/Collection/File/8359/2015_01_ddcp_e.pdf*

Belongia, M. T. & Ireland, P. N. (2016), 'The evolution of us monetary policy: 2000–2007', *Journal of Economic Dynamics and Control* **73**, 78–93.

Carabenciov, I., Ermolaev, I., Freedman, C., Juillard, M., Kamenik, O., Korshunov, D. & Laxton, D. (2008), 'A small quarterly projection model of the us economy', *IMF Working Papers* pp. 1–54.

Christensen, G. & Miguel, E. (2018), 'Transparency, reproducibility, and the credibility of economics research', *Journal of Economic Literature* **56**(3), 920–80.
URL: *https://www.nber.org/papers/w22989.pdf*

Gertler, P., Galiani, S. & Romero, M. (2018), 'How to make replication the norm'.
URL: *https://www.nature.com/articles/d41586-018-02108-9*

Hamermesh, D. S. (2007), 'Replication in economics', *Canadian Journal of Economics/Revue canadienne d'économique* **40**(3), 715–733.
URL: *https://www.nber.org/papers/w13026.pdf*

Ioannidis, J. P., Stanley, T. D. & Doucouliagos, H. (2017), 'The power of bias in economics research'.
URL: *https://www.hoplofobia.info/wp-content/uploads/2015/10/2017-The-Power-of-Bias-in-Economics-Research.pdf*

Nunn, N. & Qian, N. (2011), 'The potato's contribution to population and urbanization: evidence from a historical experiment', *The quarterly journal of economics* **126**(2), 593–650.

Ozier, O. (2019), 'Replication redux: The reproducibility crisis and the case of deworming', (8835).
URL: *http://documents.worldbank.org/curated/en/118271556632669793/pdf/Replication-Redux-The-Reproducibility-Crisis-and-the-Case-of-Deworming.pdf*

Чернявский, Д. (2017), Квартальная прогностическая модель Республики Казахстан и ее роль в принятии решений по денежно-кредитной политике [Chernyavskiy, Denis, 2017. Quarterly Projection Model for the Republic of Kazakhstan and its role for monetary policy decision-making], Technical Report 2017-4, Национальный Банк Казахстана.

Бородин, А. (2014), ‘Структурное макроэкономическое моделирование для целей центрального банка [Borodin, Alexander, 2014. Structural macroeconomic modelling for the purposes of the Central Bank.]’.

Бородин, А., Горбова, Е., Плотников, С. & Плущевская, Ю. (2008), ‘Оценка потенциального выпуска и других ненаблюдаемых переменных в рамках модели трансмиссионного механизма монетарной политики (на примере России)[Borodin,Alexander; Gorbova, Elena, Plotnikov, Sergei, and Pluschevskaya, Yulia, 2008 [Estimating the potential output and other unobserved variables within a model of monetary policy’s transmission mechanism (the case of Russia)]’.