



Bank of Russia



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# FOREIGN EXCHANGE RESERVES AND MONEY SUPPLY

Analytical note

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## Abstract

Money supply growth is what eventually drives inflation. In this note, we examine how changes in foreign exchange reserves and money supply are interrelated in the economy. We seek to demonstrate that even though foreign exchange reserve purchasing by a central bank has no direct effect on the dynamics of money supply or credit as long as an efficient bank liquidity management mechanism is in place, its indirect effects may be substantial. They are reflected in changes in the balance of payments (an increase in current account surplus and (or) an inflow of capital into the non-banking sector) and an increase in risk taking in the banking sector.

That said, money supply does not expand if foreign exchange reserve accumulation is accompanied by the comparable increase of sovereign wealth funds, e.g. as part of a formal fiscal rule. On the other hand, sovereign wealth fund spending stimulates money supply growth only if it is not accompanied by a commensurate decrease in foreign exchange reserves.

The Bank of Russia has been actively accumulating foreign exchange reserves over the past few decades. Analyses of the implications of those steps are often limited to reviewing the effect of changes in the supply of bank reserves in the interbank market. Indeed, this effect may be important in terms of managing liquidity or short-term interest rates.<sup>1</sup> Yet in this note we examine the implications of foreign exchange reserve accumulation by a central bank in a broader sense, and analyse the changes it causes in the banking system balance sheet and the balance of payments.

## Direct effect

Let us look at the central bank's balance sheet, where  $NFA^{CB}$  represents net foreign assets,  $C^{CB}$  is the central bank's credit to commercial banks, and  $R$  stands for liabilities owed by the central bank to commercial banks, which may include correspondent account and deposit balances as well as the central bank's bonds.<sup>2</sup> For simplicity purposes, we refer to those funds as bank 'reserves'. *Other* represents a balancing indicator encompassing all of

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<sup>1</sup> Apart from an impact of reserves supply on interbank rates, some theories posit the existence of a direct link between the dynamics of monetary base and money supply (the 'money multiplier' theory). Yet we believe that the modern approach to conducting monetary policy has largely stripped this logic of its practicality (see Bindseil (2004), Borio and Disyatat (2010), Carpenter and Demiralp (2012), and Bundesbank (2017) for more details). At the same time, this note reviews the indirect effects of reserve accumulation on the monetary base and money supply.

<sup>2</sup> The interplay between various instruments is determined by current bank liquidity management and interbank interest rates steering objectives, and is outside the scope of this note.

the balance sheet's other items. Purchasing of foreign exchange reserves by the central bank<sup>3</sup> in the interbank market implies an increase in bank 'reserves':

$$\uparrow NFA^{CB} + C^{CB} = \uparrow R + Other$$

The aggregated balance sheet of commercial banks changes accordingly ( $NFA^B$  = net foreign assets,  $C^B$  = commercial banks' credit to the non-banking sector, and  $D$  = deposits of the non-banking sector<sup>4</sup>):

$$\downarrow NFA^B + C^B + \uparrow R = C^{CB} + D + Other$$

This transaction will be recorded in the balance of payments as an increase in the central bank's foreign exchange reserves resulting from an outflow of capital from the banking sector. There are no outflow/inflow of capital from the non-banking sector ( $\Delta NFA^{NBS}$ ) or changes in the current account ( $CA$ ) surplus:

$$\uparrow \Delta NFA^{CB} + \downarrow \Delta NFA^B + \Delta NFA^{NBS} = CA$$

To simplify further discussion, we denote external transactions of the non-banking sector as  $CA - \Delta NFA^{NBS}$ :

$$\uparrow \Delta NFA^{CB} + \downarrow \Delta NFA^B = (CA - \Delta NFA^{NBS})$$

We can therefore conclude that the central bank's foreign exchange reserve accumulation transactions have no direct effect on the non-banking sector's balance sheet items (money supply or credit).

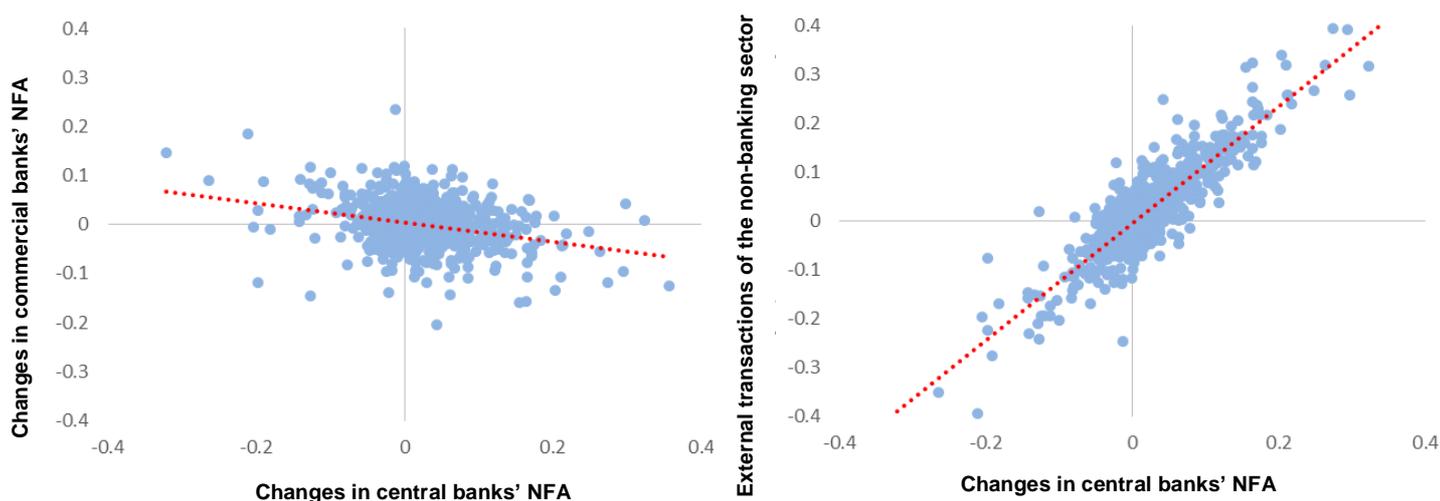
<sup>3</sup> We regard the purchasing of foreign exchange by the central bank as a stand-alone transaction aimed at replenishment of foreign exchange reserves. Please refer to the Appendix for analysis of a situation where the central bank's foreign exchange interventions are in response to changes in external conditions.

<sup>4</sup> For simplicity purposes, in this note we eschewed looking into the dynamics of cash as part of money supply, and assumed that the dynamics of deposits drive the money supply dynamics.

## Indirect effects: balance of payments

We have good reasons to believe that eventual transformation of balances extended over time (e.g. taking place over a quarter) will be different from the direct effect. In particular, our analysis shows that growth in central banks' foreign exchange reserves is accompanied not so much by a decrease in commercial banks' net foreign assets as it is by changes in external transactions of the non-banking sector (an increase in the amount of capital inflows into the non-banking sector and in the balance of payment's current account surplus) (Figure 1).<sup>5</sup>

Figure 1. Changes in central bank's foreign exchange reserves, commercial banks' net foreign assets and the non-banking sector's external transactions in emerging economies<sup>6</sup> (ratio to broad money supply)



Source: Ponomarenko (2017).

Based on that, let us assume that commercial banks' net foreign assets remain unchanged as a result of eventual transformation of the balance of payments driven by foreign exchange reserve accumulation. For this to happen, foreign assets purchased by the central bank need to be replenished with additional funds transferred by the non-banking sector into domestic banks (as a result of capital inflows or of an increase in the current account surplus):

<sup>5</sup> The stability of the net foreign asset level may be explained by restrictions on commercial banks' currency mismatch. In theory, changes in net foreign assets may not result in a currency mismatch if offset by changes in the dollarisation of domestic assets and liabilities. For simplicity, in this note we ignored any potential changes in the level of dollarisation.

<sup>6</sup> We used quarterly data for 2001–2016 for the following countries: Bolivia, Brazil, Chile, Columbia, the Czech Republic, India, Indonesia, Israel, Korea, Malaysia, Mexico, the Philippines, Poland, Romania, Russia, South Africa, Thailand, and Turkey. See Ponomarenko (2017) for more details.

$$\uparrow \Delta NFA^{CB} + \Delta NFA^B = \uparrow (CA - \Delta NFA^{NBS})$$

Note that both a decrease in net foreign assets of the non-banking sector (not related to non-financial transactions) and an increase in the current account surplus (not accompanied by net foreign assets growth) imply an increase in domestic financial assets held by the non-banking sector. Thus, regardless of whether the balance of payments gets adjusted through capital inflows or an increase in the current account surplus, an expansion in broad money supply is likely to ensue.<sup>7</sup> Accordingly, the eventual transformation of commercial banks' balance sheet will be different from the initial one. In addition to sales of foreign exchange reserves to the central bank in exchange for interbank 'reserves', we take into account the subsequent replenishment of foreign assets held by commercial banks through additional deposits:

$$\uparrow\downarrow NFA^B + C^B + \uparrow R = C^{CB} + \uparrow D + Other$$

Foreign exchange reserve accumulation by the central bank will therefore lead to an expansion of money supply provided changes in the non-banking sector's external transactions take place. Notably, such changes are expected basing simply on a (rather realistic) assumption of stability of the level of foreign assets held by commercial banks.

## Indirect effects: credit

It is quite difficult to make an unequivocal prediction of what kind of effect foreign exchange reserve accumulation would have on the non-banking sector's credit (which is also a source of money supply<sup>8</sup>). On the one hand, banks' behaviour may change even if an expansion of the supply of interbank 'reserves' has zero effect on short-term interest rates. As shown above, banks' balance sheets would expand thanks to liquid assets ('reserves') and stable liabilities (deposits). This may encourage banks to behave in a more risky manner and encourage the creation of less liquid assets (such as long-term loans).

<sup>7</sup> For more details on money creation through external transactions, see Duc et al. (2008), Chung et al. (2015), Kuzin and Schobert (2015), and Ponomarenko (2017, 2019).

<sup>8</sup> See McLeay et al. (2014) for more details.

On the other hand, as money supply expands as a result of external transactions, demand for loans may weaken.

## Modelling results

The above discussion conceptually reflects potential effects from foreign exchange reserve accumulation, yet economic modelling must be employed to quantify their combined impact. To this end, we used Russian data to estimate a model<sup>9</sup> based on the above mechanisms of impact foreign exchange reserve accumulation has on commercial banks' balance sheet. To illustrate our modelling results, Figure 2 represents the paths of 2010–2013 money supply calculated based on various assumptions<sup>10</sup>:

- We used the actual changes of the Bank of Russia's foreign exchange reserves to calculate our *baseline* projection.
- We assumed faster than actual<sup>11</sup> foreign exchange reserve accumulation to calculate our projection for the *first scenario*.
- We assumed zero accumulation of foreign exchange reserves to calculate our projection for the *second scenario*.

Our modelling results demonstrate that foreign exchange reserve accumulation has led to an increase in money supply through external transactions in Russia, meaning that indirect effects prove to be substantial.

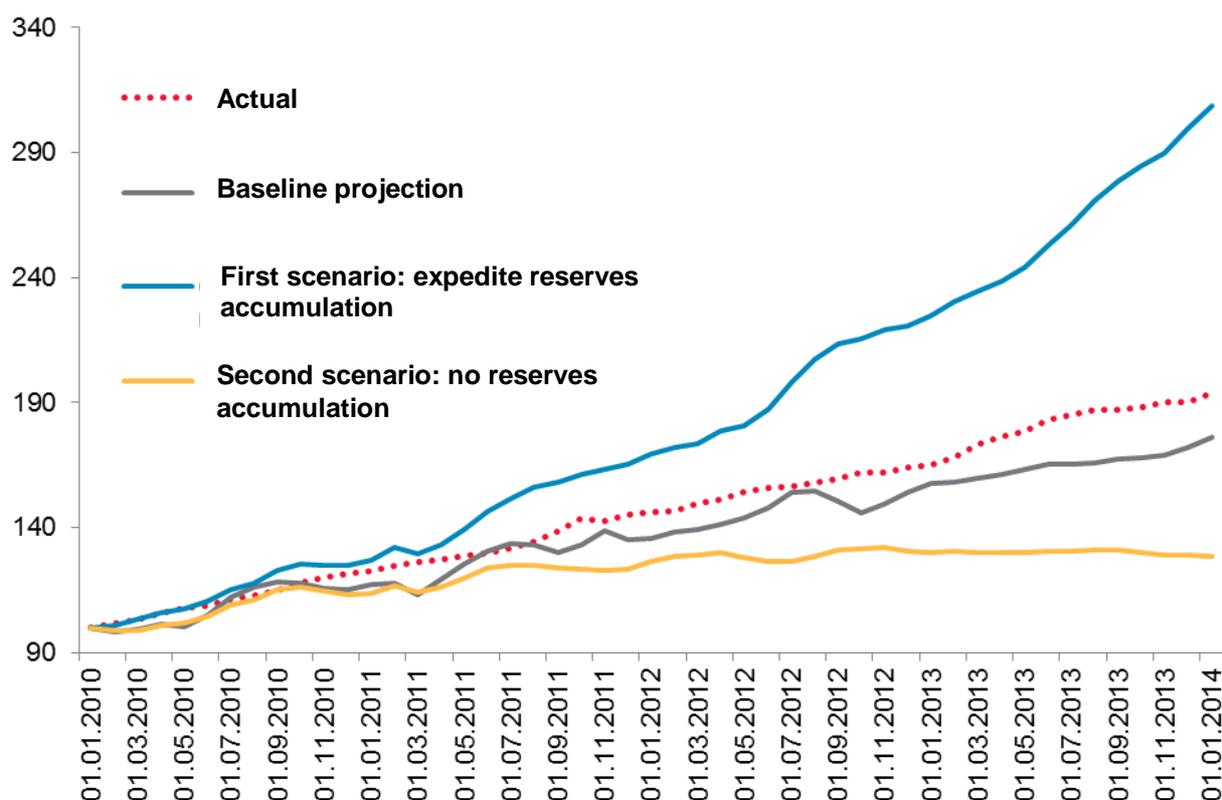
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<sup>9</sup> An agent-based model whose parameters have been set based on the accuracy of forecasts of the dynamics of broad money supply and credit with set values for foreign-exchange reserves, sovereign wealth funds, oil prices, the VIX indicator and the MIACR interbank interest rate during the periods of 2001–2008 and 2010–2013. See Khabibullin, Ponomarenko and Seleznev (2018) for more details.

<sup>10</sup> Besides changes in foreign exchange reserves, exogenous variables included the actual dynamics of sovereign wealth funds, oil prices, the VIX indicator and the MIACR interbank interest rate.

<sup>11</sup> We assumed that foreign exchange reserves would be replenished annually by an amount equivalent to 25% of broad money supply, roughly in line with the foreign exchange reserve dynamics observed between 2001 and 2007.

Figure 2. Actual and projected broad money supply dynamics (01.01.2010=100%)



## Foreign exchange reserve accumulation and fiscal policy

For simplicity and generalisation purposes, we considered the foreign exchange purchasing by the central bank above as a stand-alone transaction. In reality though, the Bank of Russia has been accumulating foreign exchange reserves in accordance with the fiscal rule since 2017. The fiscal rule sets forth a mechanism for accumulating and spending the National Wealth Fund (NWF) as actual oil prices deviate from the benchmark (\$40 per barrel of the Urals blend in 2017). Whenever the actual price exceeds the benchmark, the oil and gas fiscal windfall is converted into foreign exchange and funnelled into the NWF.

From an analytical standpoint, this process appears two-staged. Stage one involves accumulation of oil and gas windfall revenues in the Federal Treasury's accounts at the Bank of Russia. As a result, the Bank of Russia's liabilities owed to general government increase and those owed to commercial banks decrease (*SWF* – sovereign wealth funds):

$$NFA^{CB} + C^{CB} = \downarrow R + \uparrow SWF + Other$$

In addition, the amount of deposits carried on commercial banks' balance sheets decreases too:

$$NFA^B + C^B + \downarrow R = C^{CB} + \downarrow D + Other$$

Therefore, accumulation of sovereign funds as such has a direct restraining effect on the money supply dynamics.

At stage two, the Bank of Russia increases its foreign exchange assets by purchasing foreign exchange reserves in the interbank foreign exchange market. As a result, the Bank of Russia's net foreign assets and liabilities owed to commercial banks increase:

$$\uparrow NFA^{CB} + C^{CB} = \uparrow R + SWF + Other$$

As a result (as discussed above), the inflow of funds through external transactions of the non-banking sector increases:

$$\uparrow \Delta NFA^{CB} + \Delta NFA^B = \uparrow (CA - \Delta NFA^{NBS})$$

The amount of deposits carried on commercial banks' balance sheets grows:

$$NFA^B + C^B + \uparrow R = C^{CB} + \uparrow D + Other$$

The combined effect of both stages will be to increase the net foreign exchange reserves and sovereign wealth funds. Meanwhile, the money supply will remain unchanged:

$$\uparrow NFA^{CB} + C^{CB} = R + \uparrow SWF + Other$$

$$NFA^B + C^B + \uparrow \downarrow R = C^{CB} + \uparrow \downarrow D + Other$$

Thus, as long as accumulation of budgetary funds is accompanied by a commensurate accumulation of foreign exchange reserves, both transactions cancel each other out to produce zero effect on money supply.

Note that the interlink between the foreign exchange reserve accumulation and budgetary fund accumulation transactions is not a given. For instance, during the periods of national wealth fund spending in 2009–2010 and 2014–2015 foreign exchange reserves did not shrink, which drove money supply growth as lending slowed down.

To illustrate how fiscal policy and the Bank of Russia's foreign exchange reserve management policy mesh with each other, Figure 3 shows money supply paths for 2010–2013 plotted based on different assumptions:

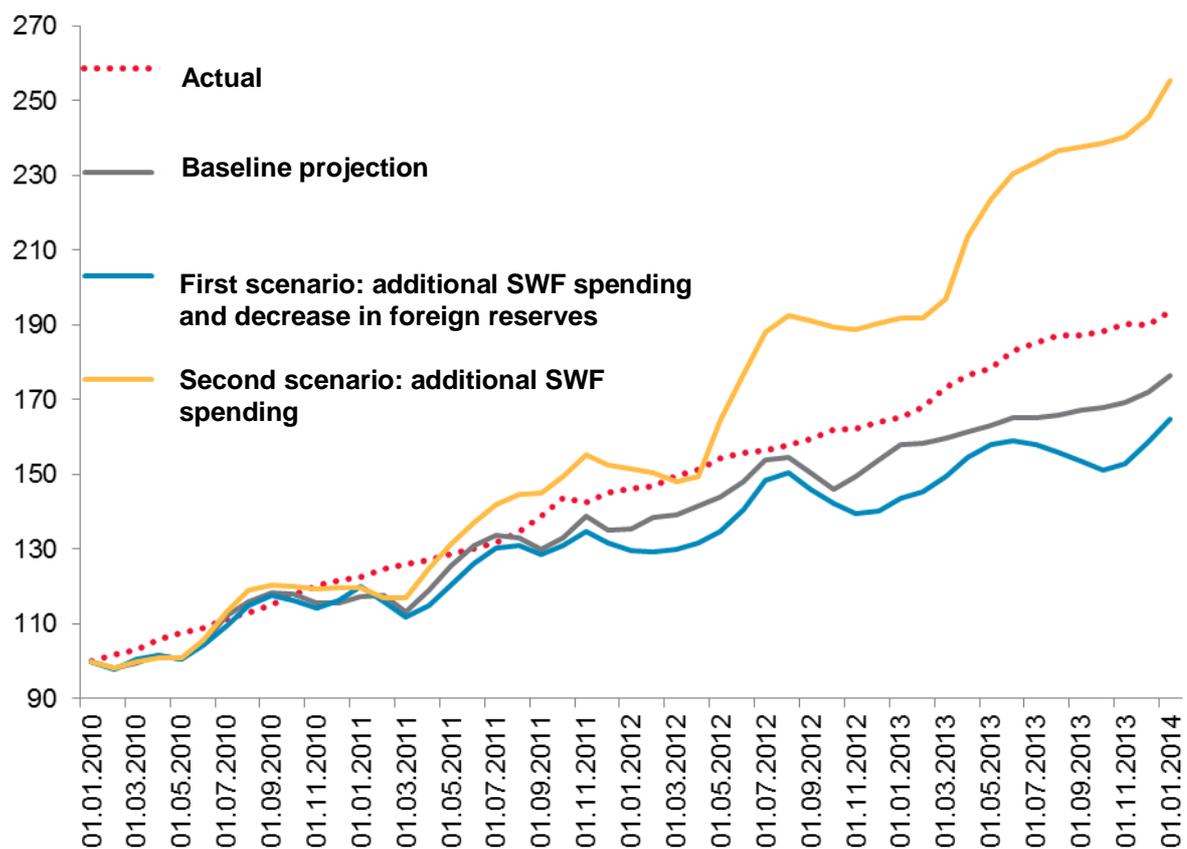
- To calculate our **baseline** projection, we used data on the actual dynamics of budgetary funds and foreign exchange reserves of the Bank of Russia.
- To calculate our **first scenario** projection, we assumed a faster<sup>12</sup> spending of sovereign wealth funds accompanied by a commensurate decrease in foreign exchange reserves.
- To calculate our **second scenario** projection, we assumed a faster spending of budgetary funds without a decrease in foreign exchange reserves.

The results of our modelling demonstrate that budgetary fund spending considerably accelerates money supply growth if it is not accompanied by a decrease in foreign exchange reserves.

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<sup>12</sup> We assumed that during the period from 2010 through 2013, sovereign wealth funds would be spent by an amount equivalent to 15% of broad money supply, roughly in line with what was observed in 2009–2010.

Figure 3. Actual and projected broad money supply dynamics (01.01.2010=100%)



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## Appendix

For simplicity and generalisation purposes, we considered the purchasing of foreign exchange by the central bank above as a stand-alone transaction aimed at replenishment of foreign exchange reserves. Now let us look at a situation where this transaction comes in response to a change in external conditions and is aimed at exchange rate stabilisation.

We assumed that as a result of oil price growth, exporters generated higher revenues, which they placed on accounts in domestic banks. This will cause the trade surplus to swell. Besides, the non-banking sector will have more deposits and banks will hold more foreign assets.

$$\Delta NFA^{CB} + \uparrow \Delta NFA^B = \uparrow CA - \Delta NFA^{NBS}$$

$$\uparrow NFA^B + C^B + R = C^{CB} + \uparrow D + Other$$

Therefore, in the short term an increase in export revenues may cause broad money supply to expand. However, let us assume that commercial banks seek to keep their net foreign assets unchanged. In that case, the eventual transformation of the balance of payments will occur through either offsetting foreign trade transactions (a decrease in revenues of other exporters or an increase in imports)<sup>13</sup> or an increase in net foreign assets of the non-banking sector. In either case, the broad money supply and net foreign assets of the banking sector will contract. Thus, as a result of all of the above transactions, the balance sheet of the banking system will remain unchanged:

$$\Delta NFA^{CB} + \updownarrow \Delta NFA^B = \updownarrow (CA - \Delta NFA^{NBS})$$

$$\updownarrow NFA^B + C^B + R = C^{CB} + \updownarrow D + Other$$

To compare, consider a situation where the central bank proceeds with foreign exchange purchases in response to export revenue growth. In that case, the central bank

<sup>13</sup> This note leaves out any economic mechanisms leading to such transformation. Yet it could be noted that such a change in balance of payments indicators is essentially in line with a projected strengthening of the ruble that will occur as foreign exchange supply increases on the interbank forex market.

would buy commercial banks out of their 'surplus' foreign assets (against interbank 'reserves'), thus eliminating the need for further transformation of the balance of payments. This means that unlike a situation where the central bank refrains from interventions, the broad money supply will expand:

$$\uparrow \Delta NFA^{CB} + \updownarrow \Delta NFA^B = \uparrow CA - \Delta NFA^{NBS}$$

$$\updownarrow NFA^B + C^B + \uparrow R = C^{CB} + \uparrow D + Other$$