Annex 2 to the consultation response of the Executive Board of the Riksbank: A new Sveriges Riksbank Act, SOU 2019:46

How robust is the Riksbank's financial independence – results from scenario analysis[1]

This memorandum summarises preliminary results of stress tests carried out on the Riksbank's balance sheet. First, we go through the Inquiry's proposal regarding equity. Thereafter, we discuss a conceptual framework for how equity is linked to the Riksbank's financial independence. Then we perform a quantitative impact analysis of how the Inquiry's proposal might work in practice, regarding both the scope for own earnings and self-financing, and how well the Riksbank can withstand losses in unfavourable scenarios.

We start by discussing the long-term earnings risks and show that variations in long-term real interest rates, average slope of the yield curve and outstanding amount of banknotes and coins have a crucial influence over the appropriate amount of equity to safeguard earnings. Given the considerable uncertainty regarding these variables, we examine the appropriateness of building a financing model based on equity.

We then perform stress tests that, with scenarios, show how short-term exchange rate and interest rate variation can lead to losses and reduce the Riksbank's equity. First we discuss a main scenario based on the National Institute of Economic Research's forecasts for the next 10 years. This shows that, in 5-10 years, the Riksbank's balance sheet will have converged towards the framework that is established by the Inquiry's proposal with regard to equity and indicates that the Riksbank's ability to finance its operations via a combination of equity and seigniorage is expected to be satisfactory. However, the loss-absorbing buffer will be very small. Then we show a more unfavourable scenario, in

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which interest rates rise and the krona appreciates more, which leads to equity falling so low that recapitalisation becomes necessary in accordance with the Inquiry's proposal.

We use a macroeconomic model to illustrate the uncertainty in developments and thereby the risks to which the Riksbank is exposed. This is done based on the current situation and on a situation in which interest rates and the balance sheet are at long-term levels. Given the framework established by the Inquiry, the risk of a recapitalisation occurring within a 10-year period is about 30 per cent. In a sensitivity analysis, we note that, with lower expected interest rate levels in the long term, this short-term risk decreases, although the risk is then greater that the earnings model is not compatible with financial independence or that large amounts of equity must be injected by the state to restore earning capacity. The sensitivity analysis also shows that the probability of low equity and recapitalisation can increase significantly with relatively minor changes to the size or composition of the Riksbank's balance sheet.

Finally, we consider adjustments and alternative financing models that might be able to offer better financial independence.

Most of this analysis was performed prior to the outbreak of the corona pandemic. We note that the crisis means that interest rates may be lower for an even longer period of time. At the same time, the Riksbank's measures to manage the crisis are further expanding the balance sheet. Both these factors make the Inquiry's optimistic assumptions about self-financing and risks more problematic. Even if the Riksbank will see higher profits in the short term if interest rates fall and the krona depreciates, the risks to the balance sheet will be greater and the Inquiry's model for self-financing will be even weaker in the longer term.

The Inquiry's proposal

The Inquiry proposes that when the system is introduced, the Riksbank shall receive a targeted equity of SEK 60 billion, which shall then be adjusted upwards with inflation. If reported equity falls below 1/3 of targeted equity, the Executive Board "shall" more or less automatically request recapitalisation by the Riksdag. However, the Riksbank shall check whether there is significant funds in the revaluation accounts before submitting the request.[2] In the event of a recapitalisation, capital is injected so that reported equity rises to 2/3 of targeted equity.

In accounting terms, equity is divided into three categories, *primary capital* of 40 billion, *reserve capital* and retained profits. The idea is that the primary capital is indexed with the outcome for inflation, and that the increase that arises from the indexation is annually taken from any profits and recorded as reserve capital. Once the amount has reached SEK 5 billion, it is transferred to primary capital.

In addition, a dividend model is proposed based on the current year's *reported profits*. First, the target level for equity is adjusted upwards with inflation. If equity, including

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[2] The revaluation accounts are recorded unrealised profits from changes in market value with regard to bond prices (interest rate effects), the gold price or exchange rates. These unrealised profits have not been recorded on the income statement, but are recorded on the Riksbank's liability side to reflect that these profits can constitute a loss-absorbing buffer. See Appendix 1 for a more detailed description of the revaluation accounts.

the profit for the year, is less than the target level, profit is retained to build up equity to the target level. If, on the other hand, equity exceeds the target level, the excess amount of the profit for the year shall be allocated as dividend. The model allows the Riksbank to make risk allocations for specific risks, which then affects the reported profit/loss and hence what can be allocated as dividend to the state.

As regards the transition to the proposed system, it is clear that the Inquiry, on the one hand, has a view that should logically mean that capital exceeding the target level should be immediately allocated as dividend, while, on the other, does not wish to run counter to the ECB's interpretation of EU regulations, according to which it is the Executive Board that decides on issues relating to equity.[3] As the dividend principle is based on the profit for the year, the Riksbank has the option to retain any surplus capital (difference between equity and the target level) even after the system has come into effect. The Inquiry writes that if the Riksbank has equity that exceeds the target level when the system is introduced, it is up to the Executive Board to decide how this surplus is to be handled. This is only partly true, however. If equity is to maintain its real value, the Riksbank must withhold inflation times the size of equity from the profit for the year. As described above, however, only inflation times primary capital can be withheld in this situation, which leads to a gradual erosion of the real value of the surplus capital.[4]

It may appear natural for the system at some point to converge towards the target level for equity, otherwise the initial capital will in practice become the target level and the mandatory level loses its significance. But this reflects the Inquiry's problem: proposing a system in which the Executive Board is given a targeted equity but at the same time not wishing to run counter to ESCB rules specifying that it is the Executive Board that decides on equity.

A conceptual framework for appropriate equity

To be able to discuss an appropriate level for equity, we must first consider why the Riksbank has the need to hold equity. The fundamental reason is to provide the Riksbank with financial independence, which is a prerequisite for being able to independently decide on monetary policy, given the framework set up by the Riksdag. How much equity is required depends on many circumstances. The Riksbank, in contrast to a private company, does not risk having liquidity problems as it can freely create money in the payment system. But if the Riksbank is to be able to perform its tasks, it cannot in practice do so to an unlimited extent. According to Del Negro and Sims (2015), a central bank should be considered insolvent if the discounted present value of expected future net profits cannot pay back the Riksbank's liabilities. If a central bank has large future profits, for example as a result of large future seigniorage revenue from banknotes and coins, the central bank may even have *negative* equity without this necessarily being a major problem.

The Czech central bank is currently in this situation, with substantially negative equity in the wake of monetary policy measures related to the exchange rate, but at the same

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[3] See for example paragraph 3.1.9 in ECB Opinion CON/2018/23 and paragraph 3.1 in ECB Opinion CON/2013/96.

[4] Until equity is at the target level again.

time with large expected future seigniorage revenue as a result of a large outstanding volume of banknotes. However, Archer and Moser-Boehm (2013) argue that there are negative signal effects of a central bank having negative equity, as the general public may find it difficult to estimate the value of the future seigniorage. According to this reasoning, central banks can therefore be recommended to always have positive equity, regardless of whether the solvency condition has been fulfilled.

Historically, the volume of banknotes in Sweden and comparable countries has been considerable, which has given rise to substantial seigniorage. But the Riksbank is facing a historic shift, where the volume of banknotes has fallen significantly in recent years and is now down on a very low level in an international perspective (See Chart 1a). Furthermore, revenue from the Riksbank's investments has decreased as interest rates in the global economy have been trending downwards for a long time. All in all, this has led to declining earnings (see Chart 1b).

Chart 1a. outstanding volume of banknotes, per cent of GDP
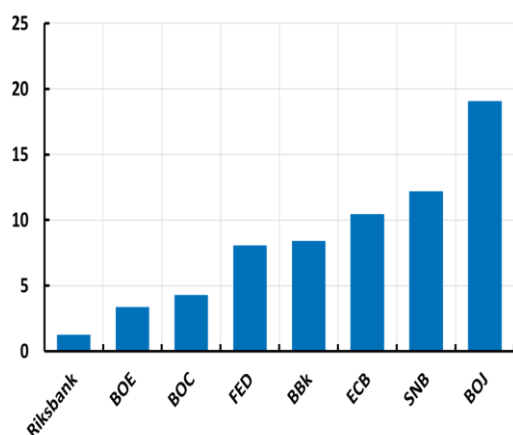
Source: Annual reports for each central bank (for 2017), and the OECD

Chart 1b. The Riksbank's reported profits, SEK bn at 2017 prices
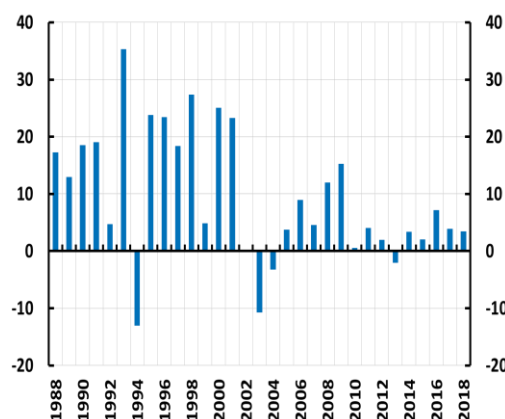
Source: Sveriges Riksbank and Statistics Sweden

The need for equity can be roughly split into four components, as illustrated in Figure 1. First, the Riksbank needs to have adequate average earnings to cover its costs, where equity in the absence of adequate seigniorage constitutes an interest-free capital (part 1a). In addition, there must be a reasonable surplus so that the Riksbank has profits that can be retained in order to build up equity in the event of losses (1b). A loss-absorbing buffer is then needed depending on the size of risk the Riksbank chooses to have on its balance sheet (2a). Finally, loss-absorbing buffers are required that provide future room for manoeuvre justified by, for example, monetary policy needs (2b). Buffers 2a and 2b are there to protect earning capacity, so that the Riksbank can build up its equity again with its own profits after a period of substantial losses.

Figure 1. Illustration of the central bank's need for equity when seigniorage is low
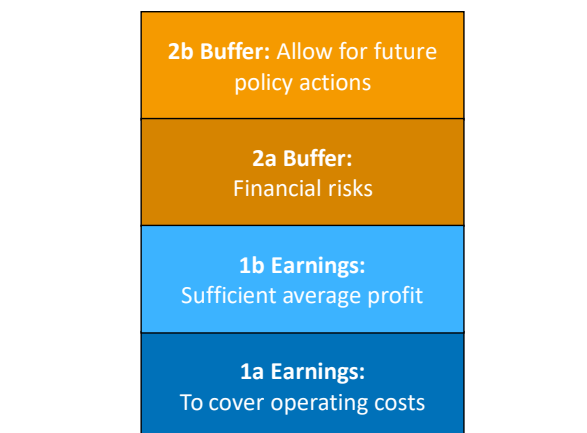
The Flam Inquiry proposed the introduction of an automatic recapitalisation framework, in which equity would be restored by the Riksdag without an active decision. If such a model could have been implemented, all needs apart from equity to create earnings to cover operational overheads (1a), could be abolished entirely. If there is a desire to avoid an annual capital injection to the bank, it is sufficient to tie just enough equity to cover running costs (and indexation). The present Inquiry abandons the proposal for automatic recapitalisation, thereby reintroducing the need for adequate buffers.

The basis of our continued analysis is a framework in which we imagine that the Executive Board, General Council and Committee on Finance wish to avoid the Riksbank having to be recapitalised too often. We formalise this by assuming that the probability of recapitalisation shall satisfy.

P(recapitalisation within a y-year period) < x.

The idea is that y and x will capture the preferences of the Executive Board, General Council and Committee on Finance, with some extra weight afforded to the Executive Board due to the ESCB legislation.

More equity gives the Riksbank greater scope for managing future crises without running the risk of speculation about a possible recapitalisation. But this may also have negative consequences for the state, for example the national debt will be higher, potentially leading to increased costs.

An interpretation of a narrow framework for equity for the central bank is quite simply that the owners do not wish to provide much room for manoeuvre as regards the size of the currency reserves and the amount of financial assets that can be purchased for various policy-related reasons. But this approach runs completely counter to practical experiences, EU regulations and the international discussion about the monetary policy tools needed to cope with the next large-scale recession (see Bernanke (2019) for a review). The current crisis in the wake of the Corona pandemic is a telling example of this.

Given this framework, we now ask the question, how much equity is needed to achieve satisfactory independence? We start by looking at the long-term issue of adequate earnings (1a and 1b in Figure 1).

Long-term stress tests – earnings capacity

In this section, we ignore the risk of temporary fluctuations in market prices and interest rates that could lead to unexpected losses for the Riksbank. Instead, we look at the average effect on earnings contributed by the return on equity. The exercise is based on the restrictive assumption that the Riksbank's current annual costs of about SEK 850 million will increase in line with inflation.[5] The question is how large equity needs to be to generate a return that can exactly fund these costs in a sustainable way (corresponds to the need for equity called 1a in Figure 1).

Table 1 shows a stylised balance sheet with the most important items for the Riksbank. The basis in the proposals of the various inquiries is that the net interest income of this asset and liability portfolio must be large enough to cover running costs.

Assuming that interest rate parity stays in a steady state (that is to say that permanent arbitrage gains cannot be made by borrowing kronor and investing in foreign currency or vice versa), the return on the foreign currency reserves is the same, on average, as the Swedish bond portfolio.

Table 1. Stylised balance sheet for the Riksbank

Assets	Liabilities
Gold (G)	Monetary policy liability (D)
Government bonds in SEK (OKV)	Banknotes and coins (M)
Foreign currency reserves (VR)	Equity (inc. revaluation acct.) (EK)
	Currency loans (D^{FX})

Let the average return to be designated by r^o, where return partly depends on the duration chosen by the Riksbank. Net interest income comes from

$$V = r^G G + r^o(OKV + VR) - rD - r^{RGK}D^{FX} \qquad (1)$$

When we investigate different long-term fluctuations of assets and liabilities, some variable of the balance sheet has to be residual, i.e. it is adjusted so that assets and liabilities become equal in size. This variable is the monetary policy liability D, which we assume comes from the difference between assets and other liabilities,

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[5] Any new operations in the areas of payments, preparedness and cyber risks, for example, may lead to even greater operating costs for the Riksbank.

$$D = G + OKV + VR - M - EK - D^{FX} \qquad (2)$$

If we put (2) in (1) and calculate a little we find that

$$V = r(M + EK) + (r^G - r)G + (r^o - r)(OKV + VR) - (r^{RGK} - r)D^{FX} \quad (3)$$

We assume that, in a long-run equilibrium, banknotes and coins will grow with inflation. In practice, banknotes and coins have fallen considerably over time, but we assume that this development will stabilise at some point in the future. To prevent the real value of equity from falling over time, part of the net interest income needs to be retained to build upon nominal equity. The amount of banknotes by assumption grows due to demand, and so all of seigniorage can be used to pay the costs. Under these assumptions, πEK kronor need to be reinvested to maintain the real value of equity. Bond purchases and foreign exchange reserves funded with the monetary policy liability can easily be adjusted upwards in level to maintain the same real balance sheet.

If the Riksbank must both maintain the real value of equity and fund its costs K, it must have

$$V \geq K + \pi EK \qquad (4)$$

To identify the lowest equity that gives sufficient earnings, we combine (3) and (4)

$$(r - \pi)EK + rM + (r^G - r)G + (r^o - r)(B + VR^n) = K + (r^{RGK} - r^o)D^{FX}$$

where $VR^n = VR - D^{FX}$.

The left side shows contributions to earnings. The first term is the real return on equity. The second term is the theoretic seigniorage that the Riksbank would have if it chose a passive strategy of receiving the repo rate on banknotes and coins in circulation.[6] The other terms on the left form the excess return (which can be negative) that the Riksbank receives for investing assets in gold and bonds. The right side shows the total costs for the Riksbank: partly the operational costs, partly the net cost for part of the foreign exchange reserves being borrowed from the Swedish National Debt Office.

We can now enter different values for key variables and, from this equation, calculate the minimum value for equity that is enough to fund the costs; see Table 2. Note that this is the equity needed under various scenarios to just cover the Riksbank's operating costs (part 1a in Figure 1). For the Riksbank to have earnings that can be consistent with a stable financial independence, the Riksbank needs to make a profit, which requires even more equity (see part 1b in Figure 1).

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[6] See Kjellberg and Vestin (2019). When the Riksbank issues banknotes, the banks' balance in the payment system is debited. If nothing else happens, the banks will pay the repo rate on this liability.

Table 2. Examples of equity needed to achieve self-funding under various assumptions and key variables.

Minimum equity, SEK billion	Short-term real interest rate	Spread between long- and short-term real interest rate	Banknote volume, SEK billion	Foreign exchange reserves and currency loans, SEK billion
85	1%	0	0	
170	0.5%	0	0	
125	1%	0	0	400 and 200
0	1%	0	28.3	
28.5	0.5%	0	28.3	

If the real interest rate is one percent, the banknote volume is zero, the spread is zero and nothing is invested in gold, the Riksbank needs to have SEK 85 billion to fund its costs of SEK 0.85 billion (row 1 in Table 2). A similar calculation led the Flam and Bonde Inquiries to recommend an interest-free capital on a similar level. These proposals were robust towards the decrease in the banknote volume, as they then automatically led to an increase in equity to compensate for the reduction.

Flam also assumed that the gold would be sold off. At present, the Riksbank's balance sheet includes SEK 60 billion in gold. However, the return on the gold is not realised, if the principle is that the gold is only to be used under extreme circumstances. All returns on the gold go straight into the revaluation account. If this yield is considered to be part of earnings, the remarkable situation arises in which the balance sheet must continually expand as the Riksbank never sells off its gold but instead pays its bills by increasing deposits from banks.

Calculations of this nature are highly sensitive to assumptions about the real interest rate. If the real interest rate instead is 0.5 per cent and the other conditions are unchanged, equity of SEK 170 billion will instead be needed to cover the costs (row 2 in Table 2). If the assessment of the long-term real interest rate is changed from one per cent to 0.5 per cent, the Riksbank must thus, under the proposal put forward, request a raising of the target level for equity from SEK 85 billion to SEK 170 billion. Under the assumption that the Riksbank makes an annual profit of SEK 3 billion (which is approximately the long-term profit level that current equity and cash volume plus a real interest rate of one per cent would entail), it would take about 30 years of retained profit for the new target level to be achieved – if this were even possible, as lower earnings due to the lower real interest rate should result in lower profits to be retained. Note that, at present, the real interest rate is approximately -2 per cent, and has been negative since 2012.[7]

In addition, if the Riksbank is to have foreign exchange reserves that are partly borrowed from the Swedish National Debt Office, further costs must be funded, as the interest on the Swedish National Debt Office's currency loans tends to lie slightly above the

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[7] See Diagram 1:8 in Monetary Policy Report, February 2020.

equivalent investment rate. Row three in Table 2 shows an example in which the Riksbank borrows SEK 200 billion of a total of SEK 400 billion, more or less like today's situation.

On the upside, we see that, if cash volumes, possibly including an interest-free e-krona, level off at a level of at least SEK 30 billion and then increase by inflation, the Riksbank will not need any equity for revenues to just cover costs (see row 4 in Table 2). However, positive equity will be required in case the real interest rate becomes lower than one (see row 5 in Table 2).

These examples illustrate that how much equity is needed to cover costs is a highly sensitive function of the volume of banknotes, real interest rate and spread. If the banknote volume (including interest-free e-krona) exceeds about SEK 30 billion, no equity is needed to achieve self-funding. That is to say that we can then assume that the Inquiry's proposals would, at any rate, manage self-funding (1a in Figure 1) in a large part of future possible scenarios. However, if the banknote volume goes down to zero, the calculation becomes very sensitive to real interest rate and spread. In addition, robust financial independence requires earnings that mean that the Riksbank, on average, not only can cover its costs but also makes a profit (1b in Figure 1) to have the possibility of making financial risk allocations or building up equity if needed.

A low real interest rate requires a lot of equity to reach sufficient earnings, while a high spread reduces the need. The long-term value of the real interest rate is a heavily debated question in the economic literature (see, for example, Holson et al, 2017), where factors such as demographics, for example, are presented as explanations for today's very low levels. If these explanations are correct, real interest rates may also remain very low going forward, which will threaten the funding model if banknotes and coins should fall below the critical level. The real interest rate has been negative for the last eight years, and market prices for inflation-linked bonds suggest that the market continues to believe that real interest rates will be very low for a long time. The spread, or the difference between long-term rates on the Riksbank's investment horizon and the short-term repo rate, have been very low, even negative, in recent years. Presumably, we can expect an upturn on the day central banks' programmes for government bond purchases around the world start to be wound up, but to which level is highly uncertain. Finally, it is very difficult to assess future demand for banknotes and coins (including the e-krona). On one hand, the strong decline seems to have slowed down, but on the other, this may be connected with temporary effects in conjunction with the banknote changeover.

The Inquiry certainly gives the Riksbank the right to request an increase of targeted equity to adjust for changes in banknote volume, for example. But, if the problem is that earnings have already become low, the Riksbank, in this case, will have no profits to retain to increase equity up to the target level, but will instead, sooner or later, be forced to request recapitalisation. One possible solution is to rapidly bind a large amount of equity in the Riksbank to anticipate rapid decreases in banknote volume or falls in the real interest rate, for example. The problem is just that the calculations above show that the amounts that would be needed could be very large, particularly because the levels for equity specified in Table 2 are only those needed to achieve an average profit equal to zero. One alternative would be to find an additional source of funding for the Riksbank that can be used under unfavourable circumstances.

Dynamic stress tests

Before we discuss the calculations, we try to illustrate why the composition of the Riksbank's balance sheet entails dynamic risks for the need for recapitalisation and we show with a few simple mathematical examples what effect this might have.

Intuition

The Riksbank has a cost-free capital comprised of the total of its equity and outstanding banknotes and coins. This creates a scope for investment, where the Riksbank can choose to allow the banks to pay interest on the deficit that the banking system would in this case have in relation to the Riksbank.[8] Alternatively, the Riksbank can choose to buy securities in Swedish or foreign currency and receive return on its investment. The higher average real interest rates are, the better the return for the Riksbank, and the less equity is needed to finance a given expenditure level.

The Riksbank can also choose to buy more assets than it has cost-free capital, thereby generating financial leverage. This can happen, for instance if it is required for the Riksbank to perform its tasks within monetary policy, financial stability and payments. If the average return on the assets bought by the Riksbank exceeds the financial costs, this helps to increase average profit. This will be the case, for example, if the yield curve is upward sloping on average and the Riksbank buys long-term bonds financed by short-term monetary policy liability, or "deposits from banks" as this liability item is called. At the same time, increased leverage means greater exposure to interest rate variations. If the Riksbank is "unlucky" (from a financial perspective), the repo rate has to be increased considerably. A short-term loss then arises when the locked-in bond rates are lower than the rising funding costs. If interest rates continue to be high in the longer term, the negative effect on profits becomes positive since the return on the cost-free capital rises as the portfolio is reinvested at higher interest rates.

We imagine the Riksbank buying a five-year bond for 100 billion and funding it with deposits from banks. The Riksbank then gets the interest rate, let's say 1 per cent, which is locked in upon purchase (we assume that the bond is held until maturity). The cost for the Riksbank will be the repo rate paid on deposits from banks. If the average repo rate during the bond's remaining maturity is, for example, 2 per cent, we see that interest expenditure will be higher than 1 per cent, leading to a loss for the Riksbank of an average of SEK 1 billion a year. If instead the repo rate is 0 per cent on average, the Riksbank makes a profit of SEK 1 billion a year.

Exchange rate risk also needs to be considered for unhedged foreign assets. Assume that the Riksbank buys a US government bond for USD 100 million and that the exchange rate is initially SEK 10 to the dollar so that the cost will be SEK 1 billion. Assume also that the exchange rate weakens to SEK 11 to the dollar. All else being equal, the krona value of the US bond has now risen by 100 million, which is realised as profit if the Riksbank sells the bond.

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[8] See Kjellberg and Vestin (2019).

Finally, the Riksbank has a considerable amount of gold on its balance sheet, and the development of the gold price will therefore be the last factor affecting return on the asset side.

## Equity and earnings based on the National Institute of Economic Research's (NIER) macro forecast

In the NIER's main scenario from December 2019, monetary policy is gradually normalised and interest rates rise towards 3 per cent approximately seven years ahead. The exchange rate gradually appreciates over the same time period. The Riksbank has locked in relatively low interest rates by purchasing Swedish government bonds. As the repo rate rises, the Riksbank's funding costs increase and lead to weak net interest income in the years to come. Overall, the NIER's forecast implies that the balances currently in the revaluation accounts for bonds and currency will decrease to zero a few years after the new regulatory framework has come into effect, see Chart 2b. However, the Riksbank's equity is expected in a short time to be approximately equal to the target level for equity, see Chart 2a. The gold price is not expected to move much, but the balance in the revaluation account for gold is nevertheless affected by the expected appreciation of the exchange rate.

Chart 2a. Equity, target level and recapitalisation level in the NIER's main scenario, SEK bn
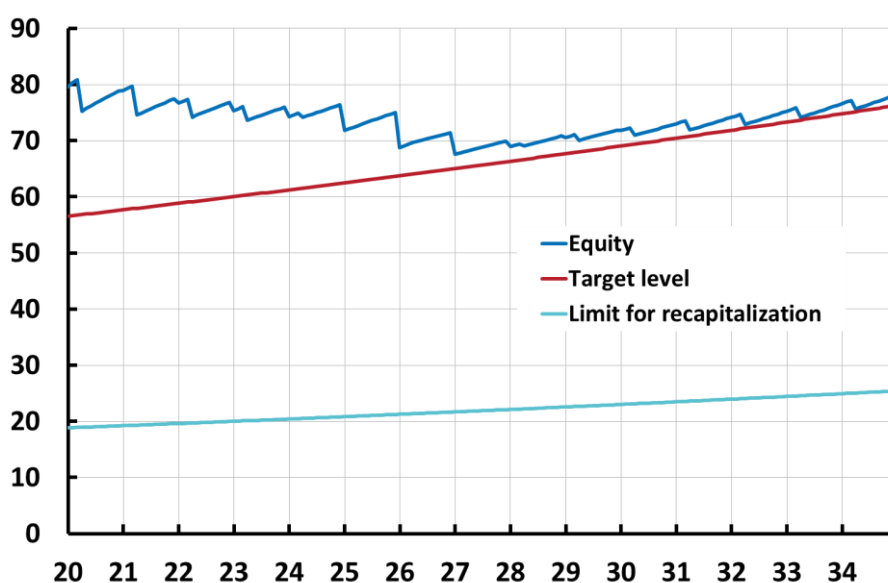
Note: The Riksbank's calculation of the effects on balance sheet items using the NIER's forecast from December 2019 and given the implementation of the Inquiry's proposal as from 2023. Monthly data.

Chart 2b. Balance in the revaluation accounts, SEK bn
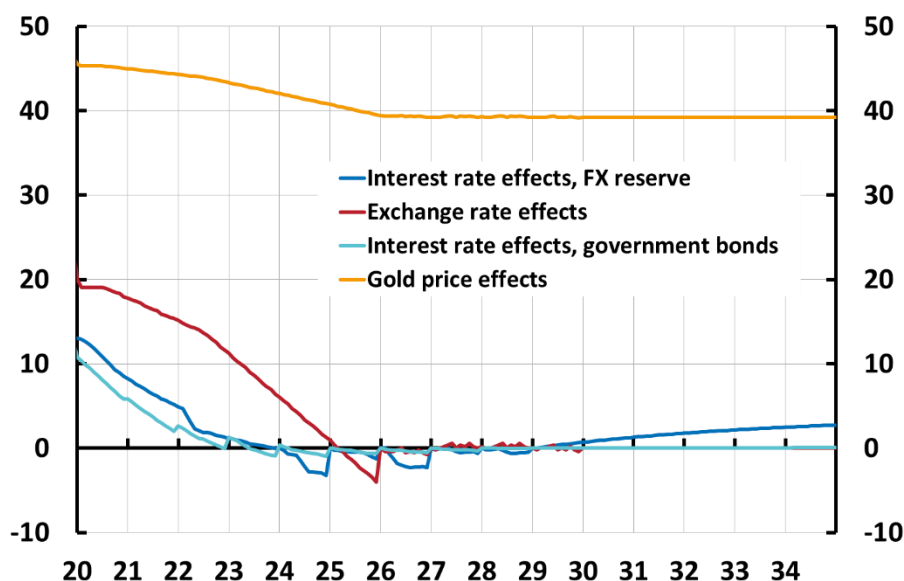
Note: The Riksbank's calculation of the effects on balance sheet items using the NIER's forecast from December 2019 and given the implementation of the Inquiry's proposal as from 2023. Monthly data. "Interest rate effect government bonds" is the sum of changes in value in the revaluation accounts for Swedish government bonds. "Interest rate effect currency reserve" is the sum of changes in value in the revaluation accounts for the currency reserve's foreign bonds calculated in foreign currency, but expressed in SEK excluding currency effect. "Currency effect" is the sum of all the revaluation accounts for foreign currency. The revaluation account for gold contains the gold price effect measured in SEK and assumes here an unchanged gold price in USD.

In essence, the funds currently in the revaluation accounts, apart from gold, are expected to go towards zero and can therefore not be seen as a long-term buffer for future financial risks. At the same time, we see that equity converges towards targeted equity and that the Riksbank will on average made a profit of around SEK 2-3 billion each year, which can be allocated as dividend to the state. This means that, in the main scenario, the Riksbank's assets generate a higher return than what is required to finance its running costs. However, it is not a high return considering the size of the balance sheet, or the time it would take to both compensate equity for inflation and build up equity by, for example, SEK 30 billion.[9]

When we reach steady state, the Riksbank's asset side consists of a currency reserve of just over SEK 400 billion and SEK 60 billion in gold, at current prices. If the Riksbank continues to use the National Debt Office for borrowing of half the currency reserve, this borrowing would cost SEK 400 million net per year.[10] At the same time, SEK 60 billion is invested in gold that can be assumed to yield zero in real terms. Running costs are around SEK 850 million, so the total costs that must be financed by the rest of the

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[9] If the volume of cash permanently decreases by SEK 10 billion, the Riksbank needs to increase equity by around SEK 30 billion (in real terms). This would mean even lower profits each year than these figures, which are contingent on the volume of cash growing in line with inflation.

[10] If we assume that the National Debt Office's borrowing cost in that foreign currency is on average 0.2 percentage points higher than what the Riksbank can invest at, for a given maturity and that currency's most liquid government bonds.

portfolio are around SEK 1.25 billion. If banknotes and coins remain unchanged at SEK 60 billion, the monetary policy liability will be SEK 140 billion. The real return from the currency reserve financed with short-term interest-bearing liability will be 140*spread. Assume for example that the spread is 0.5 percentage points. Revenue will then be SEK 0.75 billion. In addition, the Riksbank receives a nominal return from banknotes and coins that is 0.03*60=SEK 1.8 billion. Assuming that banknotes and coins grow in line with inflation, all of this sum can be used for profit allocation and cost recovery. In steady state, the profit will then be 0.75 + 1.8 - 1.25 = SEK 1.3 billion, which tallies well with the result in Chart 2a.

Alternative scenario with recapitalisation

What kind of scenario is required to trigger a recapitalisation? In the National Institute of Economic Research's scenario, the revaluation accounts for currency and bonds go to zero within a five-year horizon.

An initial question is how the balance of the revaluation account for gold should be considered here. The Inquiry states as follows:

"The Riksbank's request for restoration shall be for the amount that returns the Riksbank's equity to its basic level after restoration, unless unrealised profits on the balance sheet provide justification for not restoring equity or for restoring it at a lower level."

"The Committee proposes that the Riksbank shall make a request for recapitalisation if reported equity is less than a third of the targeted level, regardless of what funds there are in the revaluation accounts. … If there are substantial funds in the revaluation accounts, the Riksbank shall take this into consideration in its request and assess whether a smaller injection of capital is sufficient..."

How this is to be interpreted is an open question. In this case, the main question will be whether the revaluation account for gold should be included in equity. That is, assume that less favourable development than in the main scenario leads to losses of SEK 40 billion, and that these are realised so that equity falls below SEK 20 billion. Should this then trigger a recapitalisation, or should the revaluation account for gold of SEK 45 billion be regarded as part of the Riksbank's 'actual' equity, which would then amount to SEK 65 billion, and would not then justify recapitalisation? However, as long as an unrealised profit is recorded for gold, this can only act as a loss-absorbing buffer for gold price losses. If the gold were to be sold, the entire profit on the revaluation account would be realised and transferred to the year's account and any amount not allocated as dividends would be transferred to equity. However, a sale may be incompatible with the Riksbank's mandate.

Simple arithmetic examples of what is required to trigger a recapitalisation

Foreign currency exposure is currently around SEK 200 billion. A 10-percent appreciation of the currency therefore generates around SEK 20 billion in losses. A scenario in which the currency appreciates about 20 per cent more than in the main scenario would therefore be sufficient to trigger a recapitalisation, if the revaluation account for gold is not included in equity. In this context, it is worth pointing out that a change in the

exchange rate of 20 per cent is not a particularly dramatic swing. At present, this would correspond to a fluctuation in the euro exchange rate against the krona of SEK 11 to 9.

We currently have about SEK 800 billion in bond holdings, about SEK 500 billion of which is funded with monetary policy debt. Assume that bond holdings remain the same but funding costs rise by an average of one percentage point more than in the main scenario over a three-year period. Revenue is then unchanged but funding becomes SEK 5 billion more expensive per year, which results in 5 billion less in net interest income. So if the interest rate level rises by 2 percentage points on average, losses will be SEK 10 billion per year over a three-year period. We can thus imagine a scenario in which the average interest rate rises by an average of 2 percentage points above the National Institute of Economic Research's scenario, leading to interest expenses rising by a total of SEK 30 billion, at the same time as the exchange rate appreciates by 5 per cent more, giving a further SEK 10 billion in losses. This is sufficient to trigger a recapitalisation of the Riksbank.

If we instead consider a 10-year period, we see that this type of episode can occur several times in a row. Compare developments in recent years: we were constantly surprised by how low interest rates went, which led to profits from the bond portfolio. If the same thing occurs when interest rates are on the way up, we make equivalent losses several times in a row.

These simple examples take no account of the Riksbank's accounting rules and practice for profit allocation. We will now review these to be able to then run complete scenarios showing what is needed for a recapitalisation to be triggered under the Inquiry's proposals.

Profit allocation mechanism

The Riksbank has an arrangement whereby the General Council of the Riksbank sets the dividends to the state every year. Since 1988, a practice has been established whereby 80 per cent of an average of the last 5 years' dividend-qualifying profits are allocated.[11] This system has worked relatively well and fulfilled two purposes. The profit dividends have been fairly even and the Riksbank's equity has developed satisfactorily. This is because the dividend-qualifying profits have been approximately SEK 7 billion at current prices, which means that the Riksbank has been able to retain about SEK 1.4 billion of the profit each year. So that an equity of SEK 60 billion maintains its purchasing power (its real value), SEK 1.2 billion must be retained at 2-percent inflation, which is very close to the actual retained profit.

But this profit allocation rule has a weakness when we look forward as no account is taken of the level of equity in relation to the level of profit. Historically, as mentioned, this has worked well, but if the profit level going forward is instead SEK 3 billion, we see that retained capital in this case would only be 0.6 billion, which is only half of what is needed to safeguard the real value of the equity.

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[11] See Appendix 2 for a discussion of the difference between reported and dividend-qualifying profit.

Alternative scenario: Even greater interest rate rise and stronger exchange rate

To obtain a better picture, we use the Riksbank's model to simulate alternative developments for the balance sheet in the future, which take account of the actual allocation rules (both present and in the proposal), use of the revaluation accounts, etc.

Chart 3a-b shows a scenario in which Swedish and international interest rates rise more than in the main scenario and the exchange rate appreciates more substantially.[12]

Chart 3a. The alternative scenario has higher Swedish and foreign interest rates than the NIER-scenario, per cent
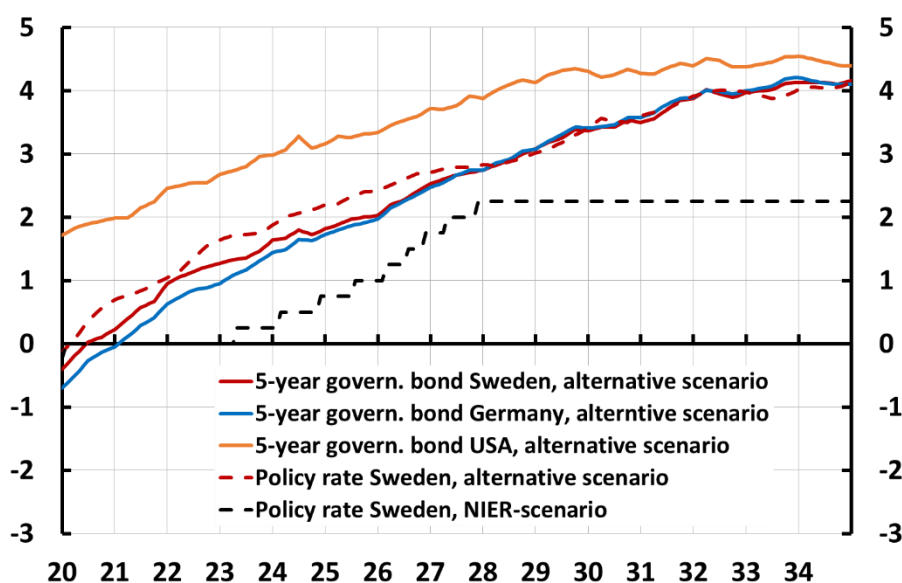
Source: Own calculations and National Institute of Economic Research forecast, December 2019 (extrapolated past 2029).

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[12] The scenario is constructed with the help of the same time series model used for the simulations described below.

Chart 3b. The alternative scenario has a stronger development of the krona exchange rate than the NIER scenario, index
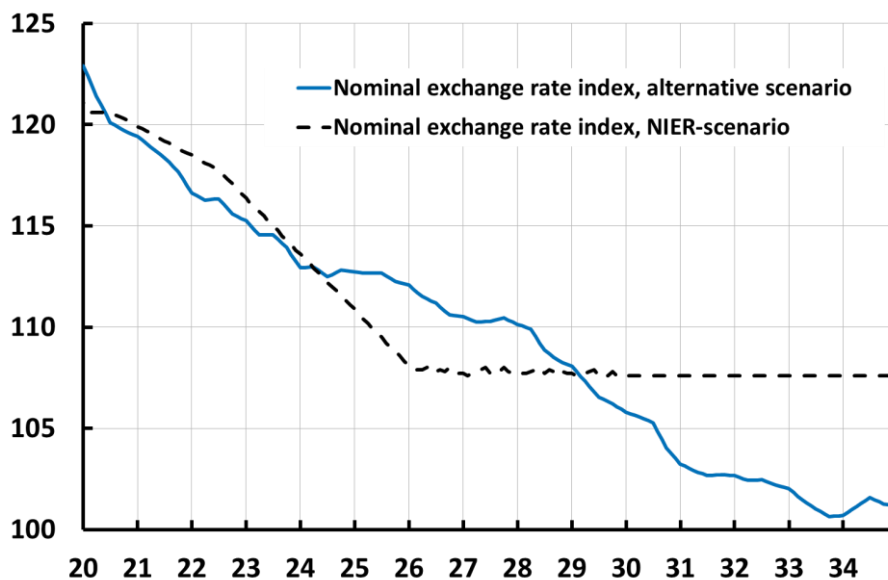

Source: Own calculations and National Institute of Economic Research forecast, December 2019 (extrapolated past 2029).

This scenario is just large enough to trigger a recapitalisation (Chart 4). When the revaluation accounts for interest rate and currency effects has gone to zero, additional unrealised losses will be transferred to the income statement in connection with the year-end, in accordance with the accounting rules which the Riksbank shall follow. More substantial interest rate rises and the krona appreciation therefore contribute to losses that reduce equity down to the level for recapitalisation. Note also that as the Riksbank consistently makes losses in this scenario, there is no scope for building up any loss-absorbing buffer in the form of financial risk allocations.

Chart 4. Equity, target level and recapitalisation level with the alternative scenario, SEK bn
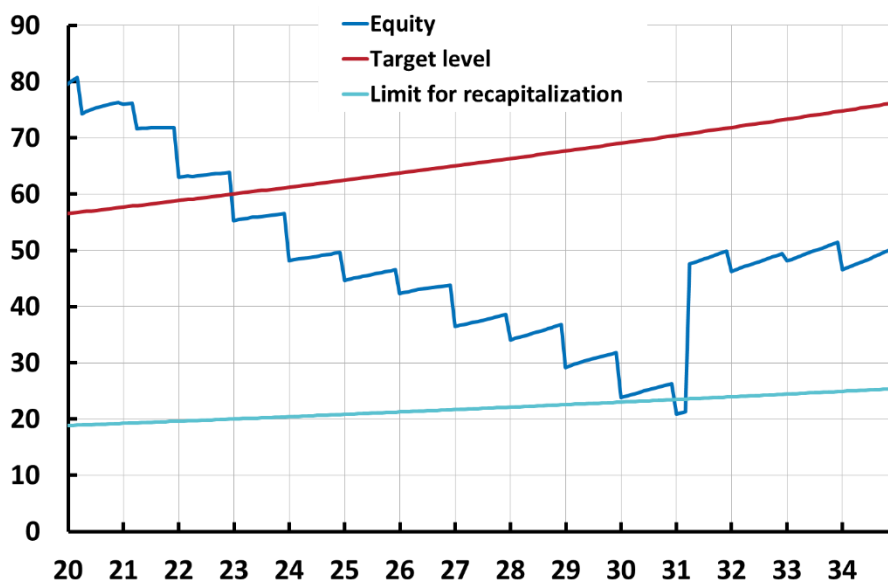
Source: Own calculations.

Calculations of probability based on simulations

To investigate the probability of a recapitalisation under the proposed system, we must gain an understanding of how all items on the Riksbank's balance sheet may develop in the future. Ideally, we would have a structural economic model that, based on a formalisation of the Riksbank's mandate, adjusted interest rates, the size of the foreign exchange reserve and the size of the bond portfolio, and that also determined the price of gold and demand for cash, based on the structural economic shocks that drive economic developments. The model would also, ideally, capture the effects of bond purchases for monetary policy purposes on interest rates.

This lies beyond what we can achieve in this memorandum, so instead we will have to be satisfied with making explicit assumptions for some of the balance sheet variables – the size of the foreign exchange reserves, the size of the Swedish bond portfolio and the amount of gold held by the Riksbank. We also assume that the volume of banknotes and coins in the period ahead will grow with inflation. To calculate the development of the Riksbank's profits, equity and profit allocation, we need to understand how short-term and long-term interest rates, the exchange rate and the price of gold may develop in the period ahead. For this purpose, we use an empirical macro model to simulate 10,000 alternative macroeconomic developments that show a covariation between the variables, which corresponds with historical patterns. We can now calculate the proportion of simulations in which at least one recapitalisation takes place within ten years.

The model is a time series model estimated using data on inflation, GPD and short-term and long-term interest rates for Sweden and abroad (the United States and Germany). We use a method that allows us to apply 'priors' to the variables' long-term levels. In an initial version of the model, we constrain the long-term levels to consider the Inquiry's

implicit assumptions. This means that we impose constraints on the models such that the long-term real interest rate is 1 per cent, the rate of inflation 2 per cent and the average slope of the yield curve is very low so that bond purchases funded by bank deposits do not contribute, on average, to the Riksbank's earnings. We assume that the real exchange rate in the long term moves towards the NIER's long-term forecast. We also assume that the volume of cash is just over SEK 60 billion and grows with inflation. Given this model, we estimate a relationship between the model's variables and the price of gold in dollars, and use this equation to calculate the price of gold in our model simulations.

Given a certain model simulation for interest rates and exchange rates, we calculate the development of the market value of the Riksbank's assets and comply, as far as possible, with the accounting rules actually applied in the Riksbank's bookkeeping, for example by using the revaluation accounts fully for the Swedish bond portfolio and approximatively for the foreign one. We can then investigate how the proposed profit allocation model and target levels for equity, including the recapitalisation rule, function in the various simulations if they are implemented from 2023.

The current time series model generates a distribution of interest rate development according to Chart 5a-b.

Chart 5. Distributions for interest rate and exchange rate development according to the time series model, percentiles for 10,000 simulations[13]
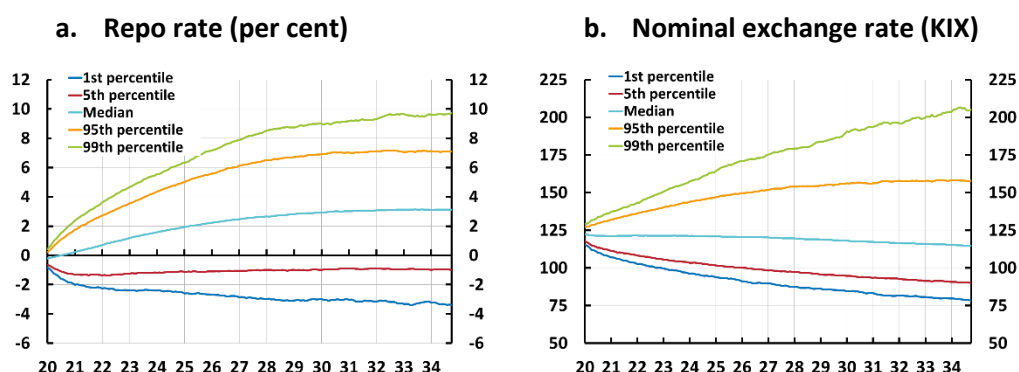
a. Repo rate (per cent)

b. Nominal exchange rate (KIX)

Note: The percentiles illustrate how the simulated scenarios are distributed across different interest rate levels. For example, the 1st percentile shows that one per cent of the 10,000 simulations has a lower interest rate level than the percentile value for that specific time point.
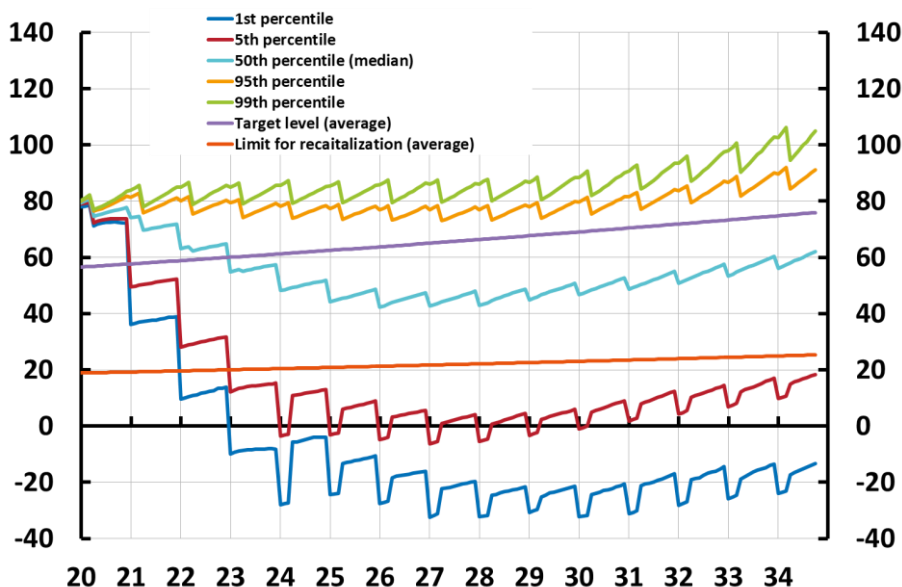
Note: The percentiles illustrate how the simulated scenarios are distributed across different levels for the KIX exchange rate index. For example, the 1st percentile shows that one per cent of the 10,000 simulations has a stronger exchange rate level than the percentile value for that specific time point.

We see that uncertainty over future interest rates and exchange rates is great, which reflects the major historical fluctuations that these variables have displayed. The Riksbank's own uncertainty band for repo rate forecasts in the next three years is even broader than the model's.

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[13] For example, the 1st percentile means that only 1 per cent of all simulations showed a lower development of a certain variable on the respective horizon.

The time series model's distributions of the financial variables give rise to distributions of equity in accordance with Chart 6.

Chart 6. Distributions of equity, percentiles in SEK bn for 10,000 simulations

Note: The percentiles illustrate how the simulated scenarios have generated a distribution for equity. For example, the 1st percentile shows that one per cent of the 10,000 simulations has a lower level for equity than the percentile value for that specific time point. Monthly data (which creates 'seasonal variation' from annual accounts and dividends).

The reason that equity can fall below SEK 20 billion, despite the rule for recapitalisation, is that the Riksbank is to take account of funds in the revaluation accounts before the petition is submitted for recapitalisation. Here, we have interpreted this as meaning that the sum of equity and the revaluation accounts, excluding gold, must fall below SEK 20 billion before recapitalisation takes place.[14]

To sum up, the probability of at least one recapitalisation is about 30 per cent during the first 10 years of the new framework. Figure 2 shows how changes in the exchange rate and the maximum interest rate adjustment relative to the starting point affect the risk of recapitalisation in these scenarios. Note that Figure 2 only shows a part of all the 10,000 simulated scenarios to focus on the cut-off point where recapitalisation starts to occur. As expected, the risk increases in line with the magnitude of appreciation and rate rises occurring. We note that the model has a relatively large spread for future interest rates and also that uncertainty over the exchange rate is great.[15] It is these two variables that are most important for understanding how this short-term uncertainty affects the risk that the Riksbank will make large enough losses to trigger a

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[14] However, this is not necessarily the interpretation the Riksbank would make in practice, as every revaluation account only functions as loss-absorbing capital for precisely the type of risk to which the revaluation account refers.

[15] Exchange rates do not seem to have such large effects partly because the revaluation accounts for currency effects act as a buffer for an appreciation of about ten per cent before they reach zero.

recapitalisation. Historically, interest rates have been both highly volatile and hard to predict.

Figure 2. Probability of recapitalisation given different exchange rate appreciation and interest rate changes
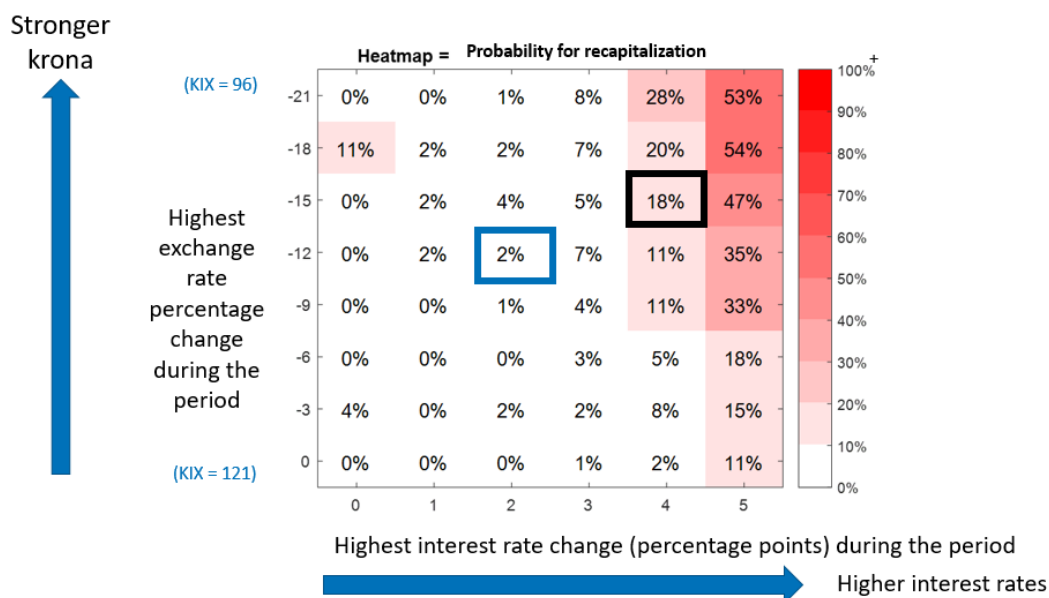
Note: The figure is based on the same simulation as Diagram 6 but presents here the proportion of scenarios with recapitalisation for different groups of scenarios, which are sorted on the basis of changes in the repo rate and exchange rate index over ten years (change from the start of the simulation). The blue box is for scenarios in which the repo rate has increased by about two percentage points and the krona has appreciated by about 12 per cent, which is where the NIER's main scenario would end up, for example. The black box is the group in which the alternative scenario above ends up.

Each cell in Figure 2 consists of the proportion of scenarios in which at least one recapitalisation occurred. For example, if we look at the group with the black box (-15, 4), we see that, of the scenarios indicating a 15 per cent appreciation of the exchange rate and a 4 per cent interest rate rise, there was recapitalisation in 18 per cent of cases. This corresponds to the alternative scenario we reported above, for example.

In the long term

Another calculation we can do is to start the same kind of simulation in a situation in which the Inquiry's assumption of long-term interest rate levels has already been fulfilled. In this situation, we assume that the Riksbank's holding of Swedish government bonds has decreased and is very small. This allows us to study what interest rate distributions the time series model's distributions result in around the long term levels, which gives us a view of recapitalisation in the really long term (which is not affected by today's initial position). We can also take the opportunity to examine how sensitive the risk is for different balance sheet sizes and volumes of cash.

Table 3 shows how probability is affected by variations in the size of the foreign exchange reserves and cash volumes. With foreign exchange reserves of SEK 450 billion,

of which SEK 180 billion is funded by the Swedish National Debt Office, and with a cash volume of SEK 60 billion, we get a probability of recapitalisation of just over 20 per cent.

If we instead cut the foreign exchange reserves to SEK 350 billion, the probability falls to 4%, which shows that the amount of equity sets clear limits to the size of the policy measures that the Riksbank can implement.

If the banknote volume falls to zero, we see that the probability again increases to 20 per cent, as the Riksbank's earnings capacity is affected negatively and the monetary policy liability becomes higher. According to the Inquiry's proposal, the Executive Board has the right to raise the target level to compensate for reductions of banknotes and coins. If this happens, the probability falls slightly, but the effect does not become so great, as it takes time for the Riksbank to retain profits and build capital up to the new target level.

Table 3. Probability of recapitalisation over ten years in which simulation starts from long-term levels

	At least one recapitalisation in 10 years	Several recapitalisations in 10 years	Both recapitalisation and large dividends (> SEK 5 bn) in 10 years
FX reserves = 450 FX loans = 180 Cash (real) = 60	21%	4%	7%
FX reserves = 350 FX loans = 180 Cash (real) = 60	4%	0.4%	1%
FX reserves = 350 FX loans = 180 Cash (real) = 0	21%	4%	1%

Note: The probabilities are calculated on simulations starting in a situation where interest rates are in long-run equilibrium and the time series model generates distribution for all variables with the aid of 10,000 scenarios. Each row represents such a simulation with different assumptions for the size of the foreign exchange reserves (FX reserves in SEK billion), the size of the foreign exchange loans (FX loans in SEK billion) and the volume of cash (in SEK billion).

The above result is contingent on the foreign exchange reserves not being hedged, apart from that part borrowed from the Swedish National Debt Office, as these loans have been raised in foreign currency and are thus automatically hedged. The larger the part of the foreign exchange reserves that is hedged, the smaller the total risk becomes and the smaller becomes the need for equity for buffering purposes. However, depending on how the hedging is carried out, an average cost may arise. In addition, there are other aspects of hedging that need to be weighed in, and the view taken by the Executive Board will be decisive for the total risk and capital requirement.

The intention behind hedging via the Swedish National Debt Office is that, if the state has raised loans in foreign currency as part of its funding of the budget deficit, the state receives the equivalent exchange rate risk.[16] Assume, for example, that the Riksbank purchases USD 10 billion, invests it in US government bonds with a 5-year maturity and funds this with an increase of bank deposits of SEK 100 billion. If the krona unexpectedly appreciates against the dollar, every percentage of unexpected appreciation will give rise to a loss of one billion kronor for the Riksbank. Now assume that the Swedish National Debt Office has borrowed USD 10 billion and has exchanged it for SEK 100 billion as part of national debt management. If the exchange rate strengthens unexpectedly against the krona, the Swedish National Debt Office will now gain SEK 1 billion instead. The Riksbank and Swedish National Debt Office can now reach an agreement to offset unexpected gains/losses, thereby safeguarding a predetermined krona revenue/cost. It should be possible to do this without cost, as both parties have needs that cancel each other out. If currency hedging is to take place when needs do not match, the market may have to be involved, whereby several questions concerning costs and which counterparties can be considered appropriate will arise. Under certain circumstances, the price stability target may also be in conflict with hedging currency risk.

Robustness exercise: Model with less structure at long-term interest rates

We now test re-estimating the model without imposing the Inquiry's view of long-term interest rates. This simulation is based on the situation at the end of 2019/beginning of 2020, just as the simulation above, where the probability of recapitalisation was around 30 per cent. We retain the idea of long-term equilibrium for Swedish inflation being 2 per cent.[17] But we do not lock the long-term real interest rate at 1 per cent, nor the difference between the 5-year government bond and the short-term repo rate. We instead allow historical data to determine these levels. Under these less restrictive conditions, the estimate of both the real interest rate and the slope of the yield curve for one thing differ in mean value from the earlier model, and for another thing are not estimated very precisely – that is, the data does not contain sufficient information to obtain a clear picture of what reasonable values of these variables might be. The model

[16] At present, the Swedish National Debt Office does not have any net borrowing in foreign currency, but foreign currency exposure in the debt is obtained with derivatives.
[17] Even this assumption can be questioned, as we are talking about the long run. One cannot rule out the possibility that the discussion of the lower bound for the repo rate will result in many countries raising their inflation targets going forward, even if this discussion does not appear relevant in the short term.

estimates a steady-state real interest rate between 0 and 1.2 per cent, and the slope of the yield curve at between 0 and 1 per cent.

All in all, the probability of recapitalisation is shown to be around 8 per cent over the coming 10-year period, see Table 3. This is due to several different effects. A lower real interest rate does lower earnings capacity in the longer run. But on the other hand, a lower long-term equilibrium tends in the simulations to lead to interest rates rising less compared with our earlier simulations, which reduces the losses in connection with the Swedish government bond portfolio. Moreover, a positive spread contributes to a much better earnings capacity. If, for instance, the spread is 0.5 per cent, SEK 200 billion in bonds financed with bank deposits will tend to generate SEK 1 billion a year in extra interest income for the Riksbank, which will lead to a better financial strength and to building up equity again after losses, which reduces the risk that equity will fall below the level that triggers recapitalisation. The effect on the probability of a recapitalisation is not linear. The greater the initial probability, the greater the reduction in probability we will see of a few further billion in earnings/equity.

But if we vary the size of the volume of cash, the foreign exchange reserve and the Swedish government bond portfolio, we can see in Table 4 below that the probability of recapitalisation may once again rise to higher levels.

Table 4. **The probability of recapitalisation over ten years where the simulation begins at end of 2019/start of 2020**

	Empirical long-term levels according to time series model	Long-term levels according to the Inquiry
Govt. bond portfolio reduced to zero **Cash grows with inflation**	7%	31%
Govt. bond portfolio reduced to zero **Cash falls to SEK 20 billion**	11%	39%
Govt. bond portfolio ≈ unchanged (buys SEK 45 bn/year) **Cash falls to SEK 20 billion**	32%	N/A

Note: The probabilities are calculated on simulations starting in a situation where interest rates are in long-run equilibrium and the time series model generates distribution for all variables with the aid of 10,000 scenarios. Each row represents one such simulation with different assumptions for the government bond portfolio in SEK and the volume of cash (in SEK billion).

An alternative to the Inquiry's proposal

The Riksbank has a special situation with regard to financial independence as the volume of cash has in recent years fallen to very low levels, at the same time as interest rates are close to zero. Base on the calculations we have made, we draw the conclusion that the Inquiry's proposed framework for equity risks being insufficient to guarantee both self-financing and sufficient buffers against major losses. The proposed model could potentially entail a need for larger capital injections from the state to maintain a

sufficient degree of financial independence (see the different scenarios for the Riksbank's long-term earnings capacity). In a situation where the need for equity may vary rapidly and substantially, it is inappropriate to legislate on a quantitative ceiling for equity, where all changes must be approved by the Riksdag.

The Riksbank proposes an alternative framework, where the current profit allocation model is confirmed in law, in which 80 per cent of a 5-year average of the profits is allocated, but with a few important modifications:

- The Riksbank should have the possibility, if needed, to use an alternative source of earnings (for instance, a reserve requirement).
- The Executive Board of the Riksbank shall assess the need for equity and the financial risk allocations.
- The Executive Board of the Riksbank shall be able to decide to allocate less than the normal allocation rule, if the need for equity is greater than the existing equity.
- The Executive Board of the Riksbank shall have the possibility to made a submission regarding a capital injection from the state, regardless of the size of the equity.
- Unlike today, the normal reported profit for the year would be used when calculating the allocation.

With such a framework, a reserve requirement can be used to manage the self-financing problems, if the volume of cash falls further or interest rates become lower than the Inquiry is assuming.

The risk of equity becoming too low cannot be remedied simply without injecting further capital or reducing the financial risks. For instance, the probability of low equity is at around the same levels as the Inquiry's proposals if we apply the Riksbank's proposal.[18] But this proposal increases the flexibility to enable retaining profits in situations where equity is too small. We also consider it to be intuitive, reasonable and simple to build where possible on the principle for allocating profits that has been used for a long time and with good experiences.

Finally, a profit allocation principle based on an average gives a more even flow of dividends. This is visible in Chart 7, where we compare how it would look if one applied these different alternatives to profits in recent years.

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[18] All calculations exclude discretionary decisions on financial risk allocations, as these have been difficult to implement in the model calculations.

Chart 7. Comparison of the proposed profit allocation principles, SEK bn
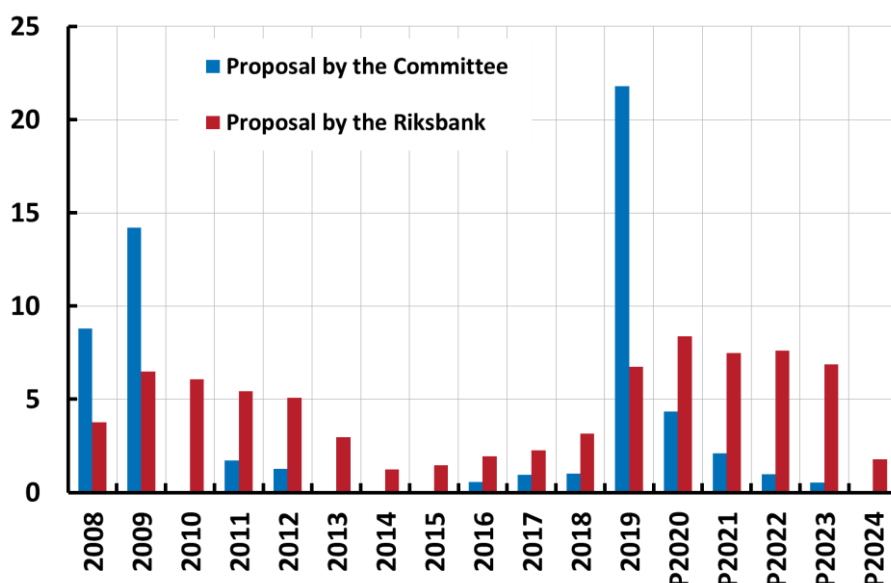
Note: Shows dividends if the various proposals are applied to historical data, and a forecast for the future. The Riksbank's proposal is to confirm in law a variation of the current profit allocation principle, where 80 per cent of a 5-year average of the reported profits is normally allocated. The forecast is based on the NIER's main scenario for interest rates and exchange rates.

The actual profit allocation has been fairly even, as a result of applying the 5-year average and settlement of exchange rates. The Inquiry's proposal entails instead using the revaluation accounts to attain an evenness in the dividends paid, but as the foreign currency reserves have a fairly high turnover, this leads to some market gains being realised, which thus affects the results on which the profit allocation is based. We consider that if one uses the Inquiry's proposal and calculates how the dividends would have looked historically, they would have been much more volatile than the actual profit allocations made. The calculations are made under the assumption that no risk allocations are used, as these could possibly have been used to attain more even dividend payments.

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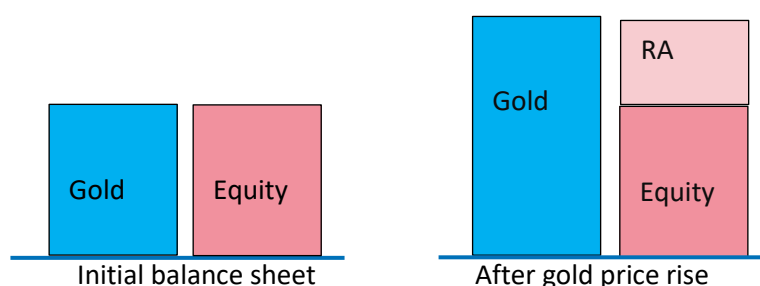
Appendix 1: Revaluation accounts

When the Riksbank does the annual accounts and adopts the balance sheet and reported profits, market valuation of the asset side is used, in accordance with accounting practices in the Eurosystem. This means that unrealised profits and losses must also be dealt with on the liability side. An alternative would be to let equity capture all the variation in market prices. If, for example, the gold price rose, equity would also increase by the same amount (all else being equal) and this would be reported as profit. In practice, the Riksbank uses revaluation accounts to even out the reported profit.

To understand how a revaluation account works and is used, we continue with gold as an example. Assume a fictitious balance sheet in which gold is the only asset and equity is initially the only item on the liability side of the balance sheet.

Gold

The gold has a recorded acquisition value which we can call G^A. Assume that the market value of the gold rises to $G>G^A$. The Riksbank will then report the entire increase on the gold's revaluation account, see Figure A1. In the annual accounts, the balance on the revaluation account must not be negative. Any negative balances are instead realised as a loss that is thus charged to the profit/loss for the year. In the absence of other compensatory revenue or profits, this leads to an impairment of equity. This asymmetrical management of unrealised losses and profits can be seen as a precautionary principle, in which unrealised losses are charged to the reported profit/loss to allow scope for it to be realised later on.

Figure A1. Illustration of rising market value and revaluation account for gold

On condition that the Riksbank does not change its holdings of gold, the effect of the use of the revaluation accounts will be that the income statement is not affected by gold price variations, as long as $G > G^A$. As a result, the only effect will be that the annual change to the asset item gold and the liability item revaluation account gold will be exactly the same. Note that the revaluation account for gold refers to the difference between market value and acquisition value measured in SEK. The gold price is listed in USD and converted into SEK when the krona value of the gold is calculated, and the acquisition value is calculated in SEK. Thus, any exchange rate changes and changes in the gold price will both give rise to a change in the balance of the revaluation account for gold. Note also that the acquisition value is given in nominal terms, which means that if the gold price increases with inflation, the whole of the nominal price rise will go

into the revaluation account. One way of considering why this accounting principle is reasonable is that the gold is an asset that the Riksbank manages on behalf of the state for use only in extremely exceptional circumstances. As long as $G > G^A$, the practical consequence of this use of the revaluation account will be the same as reporting the gold separately.

Swedish bonds

As regards Swedish bonds, revaluation accounts are used in a slightly more complicated way. When it matures, a bond pays out a nominal sum that is known in advance. For simplicity's sake, let us exemplify with a theoretical bond that has a 0% coupon, that is a bond whose only disbursement is SEK 100 on its maturity date. Assume now that the Riksbank buys the bond when it has 5 years left to maturity, that the market expects a repo rate of 1 per cent until the maturity date and that the risk premium is 0. The bond will then cost about SEK 95 to buy on the market. This bond does not give any direct return the coupon (the annual disbursement) is 0%. However, we know that the Riksbank will get a price increase of SEK 5 in total during the bond's maturity period as it has to cost SEK 100 at maturity. The Riksbank has chosen to report the yield from the bond holding as annual interest income, equivalent to the yield[19] that applies when the bond is purchased. The plan will therefore be to report SEK 1 as interest income each year up to maturity, on condition that the Riksbank does not sell the bond. At the same time, the Riksbank values its asset side in market prices, and the price of the bond, as we know, will rise towards SEK 100 of necessity. So as not to double count price increases and interest income, a plan is set up for how the acquisition value of the bond is to be adjusted until its maturity. For simplicity's sake, a linear model is used in which the acquisition value is adjusted each day by (100 minus acquisition price) divided by the number of days until maturity when the bond was purchased. In the revaluation account – one account per bond number – the difference between the actual market price and the adjusted acquisition value is recorded. If the bond is sold, the balance on the revaluation account is entered on the profit and loss account for the year.

Slightly loosely expressed, the idea is that if the price of the bond increases more than could be expected, the surplus value will be recorded in the revaluation account. However, we know that the revaluation account will be emptied at some time during the bond's remaining maturity period, as the market value at maturity must be SEK 100. If the balance in a revaluation account for a bond is negative at year-end, it will be set to zero in accordance with the above reasoning for gold. At this point, the profile for how the acquisition value is to be adjusted up until maturity must also be changed, in order to ensure that the balance is zero at maturity.[20] Assume now that just before the annual accounts year 3, the yield falls to 0.5 per cent, and the value of the bond rises to SEK 99. As the adjusted acquisition value is only SEK 98, SEK 1 is now recorded in the RA. Assume further that at the end of year 4, the yield on (the then 1-year) bond rises to 2 per cent, for example because the Riksbank has raised the repo rate to that level and the

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[19] Yield refers to the constant interest that gives the bond's market price if it is used to discount all the bond's disbursements. The yield will then be the average interest for the holder if the bond is held until maturity.

[20] For system-technical reasons, it was not previously possible to change the amortisation pan when the revaluation account was set to zero, the consequence of which was that the revaluation account had a positive balance when the bond reached maturity, which was then realised as profit.

market now expects that this new level will apply until the bond reaches maturity. The market value of the bond will now be about SEK 98, while the adjusted acquisition value according to plan is SEK 99. The RA will then be -1 and must be set to zero. We then take a realised loss of SEK 1, set the RA to zero, set the adjusted acquisition value to the market value and recalculate the amortisation plan to 2 per cent per year. The revaluation account then develops as illustrated in Table A1. Note that the recorded interest income will now be SEK 6, while a loss of SEK 1 is recorded year 4 (which leads to the revaluation account being set to zero. The net interest income will thus be the SEK 5 which we could anticipate would be the case from the beginning.

Table A1. Example with a revaluation account for a bond, SEK

Year	Interest income	Adjusted acquisition value	Market value	RA	Realised loss
Date of purchase	-	95	95		0
1	1	96	96		0
2	1	97	97		0
3	1	98	99	1	0
4	1	98	98	0	1
5 - maturity	2	100	100	0	0

In general, this means that if interest rates develop approximately as expected, this will result in the revaluation account having a balance close to zero (it does not have to be exactly zero as the amortisation plan is linear while the forward curve, approximate future expectations of the repo rate, can sometimes have substantial curvature). If, on the other hand, the actual price increase of the bond exceeds the amortisation plan, the difference is recorded in the revaluation account. Most bonds also have an annual coupon payment. The acquisition value is then adjusted so that we still have the effect that the yield is recorded as interest income and the difference between market prices and accrued acquisition value is recorded in the revaluation account.

As with the gold, the negative balance in a revaluation account must, in accordance with accounting rules, be set to zero and transferred to the accounts, that is, charged to the year's profit/loss and in the event of a loss lead to an impairment of reported equity. As different assets (gold as well as individual bonds) have different revaluation accounts, a positive balance in one account for a bond cannot be used to offset a negative balance in another, but individual accounts must all be set to zero at year-end.

Foreign government bonds

Foreign bonds are handled in exactly the same way as Swedish bonds, calculated in foreign currency. That is, an amortisation plan is set up in foreign currency and the yield on the bond in foreign currency is counted as interest income in foreign currency. The

balance in the revaluation account, in foreign currency, is calculated depending on how the market price in foreign currency moves in relation to the adjusted acquisition value calculated in foreign currency. When profit and the annual accounts are to be calculated, the value of the interest income and balance in the RA are converted to SEK according to the current exchange rate. As regards the foreign bonds, however, there is an additional effect in that the market value calculated in SEK is also affected by the development of the exchange rate. An example is if market prices measured in foreign currency move in accordance with the amortisation plan so that the balance on the revaluation account is 0. If the krona exchange rate depreciates at the same time, the krona value of the bond will have increased. This effect is recorded separately on a revaluation account for currency, and there is such an account for each foreign currency. It means for example that if we have five different US bonds, there will be five separate revaluation accounts calculated in dollars for the bonds, and a common revaluation account for currency effects for the USD exchange rate in SEK.

Are revaluation accounts the same as reported equity?

What happens to the balance on revaluation accounts according to the Inquiry's proposal, that is, to what extent are these balances the same as equity for the Riksbank?

We have three "types" of revaluation account.

1. **Gold:** Here it is straightforward; as long as the gold price is at least as high as it is today, the current balance on the gold's revaluation account (around 45 billion) will be maintained in the future. As the Riksbank only performs gold transactions only in exceptional cases, the current balance will not be realised, and thus the profit is therefore never affected and these funds are not allocated – and these funds will therefore be a buffer to future gold price reductions. As the market value of gold is far above the acquisition value, we can note that if the gold is ever divested, it will lead to very substantial realised profits and hence dividends, according to both the current and the proposed profit allocation model.

2. **Swedish bonds:** As described above, a positive balance on a revaluation account for a Swedish bond means that the yield has gone down so that the price of the bond has risen more rapidly than the adjusted acquisition value. But this means that the price of the bond up until maturity will increase more slowly than the adjusted acquisition value, as the final value for both the bond price and the adjusted acquisition value must be 100, which results in a gradual reduction of the balance on the revaluation account. In the accounts, we continue to book the yield at purchase as interest income. If the reason for the unexpectedly rapid price increase of the bond was that the market expects a lower repo rate than was the case when the bond was purchased, the Riksbank's profit will be higher than expected as some of the bond purchases are funded by reserves. This profit is realised gradually during the bond's maturity as the reported net interest income will be higher. The conclusion is that positive balances on Swedish bond revaluation accounts are not a robust buffer that can be equated with equity that is available to the Executive Board in the future, as they will gradually, by definition, be cleared and no later than at the bond's maturity will be zero.

3. **Foreign bonds:** The funds that are reported on revaluation accounts for separate foreign bonds will meet the same fate as Swedish bonds and thereby will not be available to the Executive Board. Another principle applies as regards exchange rate gains, however. The balance on these accounts (one per currency) will be retained even when a bond matures or is sold, provided that the received amount is reinvested *in the same currency*. This effect explains why the profit allocation for 2019 would have been so considerable if the new rules had been applied: The Riksbank rebalanced the currency reserves and divested EUR in conjunction with this – which led to a one-off realisation of the large cumulative profits arising from the depreciation of the krona against the euro during a prolonged period. If we do not change the composition of the portfolio going forward, each current balance on the revaluation accounts for foreign currency will remain, as long as the exchange rate does not appreciate and thus wipe out the positive balance. The conclusion is therefore mixed: on condition that the currency reserves are not rebalanced and that the exchange rate does not appreciate, funds will remain in the currency accounts going forward, while the funds booked on the revaluation accounts of individual foreign bonds will disappear.

The fact that the revaluation accounts must not be negative at year-end causes a complication. Assume that equity is SEK 60 billion and the balance on RA for currency is zero. Assume further that the exchange rate appreciates, which generates an unrealised loss of SEK 40 billion (far from an impossible scenario). As RA must not be negative over year-end, this loss must be entered in the accounts and results in an equity of SEK 20 billion, which immediately triggers a recapitalisation of the Riksbank, even though the Executive Board is "certain that" the exchange rate will depreciate next year back to its previous level, which would make the recapitalisation unnecessary. The Riksbank now received SEK 20 billion from the state and its equity is 40 billion. Next year, the exchange rate does depreciate and generates an unrealised profit of SEK 40 billion which goes into RA and is therefore not allocated. As equity = 40 < target level, the Riksbank can now refrain from profit allocation for many years and build up equity to SEK 60 billion, while 40 billion is locked in RA, as long as this is not realised due to a rebalancing of the portfolio – or wiped out by a new appreciation of the krona.

Appendix 2: Reported and dividend-qualifying profit

Here, we describe the concepts of reported profit and dividend-qualifying profit. Reported profit can be found in the Riksbank's annual report. Dividend-qualifying profit is the term the General Council of the Riksbank uses to determine how large the year's dividend is to be.

Reported profit

Reported profit is based on the market valuation of the asset side. However, the revaluation accounts are used in accordance with the principles described in appendix 1.

So how does this impact the three main assets? *Gold* is certainly booked at market value but, assuming that no gold has been sold over the year, the entire increase in the value of the gold is transferred, in full, to the revaluation account and thus never makes a positive contribution to the reported profit/loss for the year. On the other hand, in the event that gold has a negative balance in the revaluation account at the end of the year, this must be emptied and a corresponding sum taken into account, which is to say charged against the profit/loss for the year.

Swedish bonds generate a reported interest income equivalent to the return that was locked in the last time the adjustment plan for the acquisition value was changed. In other words, this is the yield on the bond on purchase date or the yield on the last emptying of the revaluation account (see description above). Changes to the market value of the bond in addition to the adjustment in the acquisition cost are added to the existing revaluation account (one per bond issue). Negative balances at the end of the year are entered on the profit and loss account, just like in the case of gold, and then the acquisition cost is adjusted to the current market price and the amortisation plan is adjusted as if the bond had just been acquired.

Foreign government bonds generate interest income in foreign currency according to the same principle as Swedish government bonds, and the amortisation plan is in foreign currency. This interest income is converted to Swedish kronor according to the current exchange rate. Changes in the bond's price in foreign currency in addition to the amortisation plan are added to the revaluation account for the foreign bond (one per bond issue). The value of the sum of these bond accounts is converted into kronor and is designated "unrealised price effect in foreign currency" in the accounts. The fact that the exchange rate fluctuates also causes a direct change in value to the bond. This is reported separately in a shared revaluation account for all assets in the same currency. For example, a US government bond has a reported acquisition value in dollars that follows its amortisation plan. The reported acquisition cost in kronor then initially becomes the acquisition cost in dollars times the exchange rate. Subsequently, we can imagine setting up an amortisation plan in kronor for the bond in which we translate the dollar plan to kronor at the current exchange rate. When the exchange rate moves, the krona value is adjusted in relation to this plan, which then ends up in the revaluation account for dollars.

A further item in the balance sheet is the difference between realised profits and losses. Realised profits primarily come from adjustments of the foreign exchange reserves, where management involves actively buying and selling bonds to reach certain targets

(foreign currency exposure, average maturity of the holding etc.). Realised losses come both from sales of assets and from the restoration of negative revaluation accounts.

On the liability side, we find *currency loans* from the Swedish National Debt Office. These are recalculated according to the prevailing exchange rate and the yield at the time the loan was raised times the outstanding amount of the loan in foreign currency converted into kronor at the current exchange rate, is booked as interest expenditure. *Deposits from banks* generate an interest cost equal to the repo rate (which is negative if the repo rate is negative).

At the end of the year, all krona-valued interest income is totalled, and then krona-valued interest expenses are deducted from this. Next, the absolute value of the total of all negative revaluation accounts is deducted. This becomes the unappropriated earnings. In addition, the Executive Board of the Riksbank can decide to allocate part of this profit as a risk provision for future financial risks. The reported profit becomes the unappropriated earnings minus any risk provisions.

Calculating the dividend-qualifying profit

The General Council uses the reported profit as a basis for its dividend decision, but makes a number of adjustments. Exchange rate effects are excluded, price effects from the bond portfolios are added (which means that revaluation accounts are not used) and gold price effects are excluded. The practice is then to allocate 80 per cent of the mean value of the last five years' dividend-qualifying profit.

On one hand, the dividend-qualifying profit varies slightly more year to year than reported profit does. On the other hand, the exchange rate effects are discounted, which reduces variation as the exchange rate is relatively volatile. The use of a 5-year average reduces variation and results in a relatively even dividend. The foreign exchange reserves tend to increase heavily in value when things are going badly for Sweden, and then the risk is greatest that the foreign exchange will have to be used. In such a situation, it is important that the central bank does not need to pay dividends as a result of the weaker exchange rate, and perhaps even sell foreign exchange for this purpose. Discounting exchange rate effects avoids such a scenario.