

Indicators Used for the Assessment of the Reserve Adequacy of Emerging and Developing Countries – International Trends in the Mirror of Theories*

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The paper examines to what extent usage of the foreign currency reserve adequacy indicators applied by the International Monetary Fund (IMF) and investment banks can be mapped with those recommended in the academic literature. The theoretically relevant indicators differ substantially depending on the given country's (1) development, (2) freedom of capital movement, and (3) exchange rate regime. In order to examine the question, the authors compiled a broad database, covering more than 100 countries, based on the IMF's regular country reports. According to the results of the study, the IMF tends to use the short-term external debt and monetary aggregate indicators more often with the increase in income, while the role of the import rule gradually decreases as a function of income. There is a positive relation between the import rule and use of capital controls, while it is the other way round in the case of short-term external debt and the monetary aggregate indicators. For countries with a fixed exchange rate regime, the monetary aggregate and import indicators are used more often than for those with a floating exchange rate regime, while the use of short-term external debt is less frequent. The reserve indicators used for various combinations of country characteristics show group-specific features rather than being a simple aggregation of the indicators used for the individual country characteristics. The authors examined separately the group of countries of similar development level and exchange rate regime as Hungary, which do not apply capital controls, as well as the non-euro area region of the EU, where in its country reports the IMF assesses the reserve adequacy based on the self-elaborated composite metric – which attaches a high weight to short-term debt – on the one hand, and based on short-term external debt, on the other hand. However, the import rule and the monetary aggregate rules are less relevant or not relevant indicators. This differs substantially from the ratios reflected by the full sample, where – due to the large weight of the less developed countries –

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the IMF uses the import rule the most often. On the other hand, in investment banks' analyses, short-term external debt is the indicator monitored with the greatest emphasis, both in the case of Hungary and the group of the emerging countries.

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1. Introduction

An adequate level of foreign exchange reserves is not only important for central banks: the topic also commands interest in the academic literature, as well as among investment banks and international institutions. Recently, the 2007–2008 global financial crisis highlighted the importance of foreign exchange reserves (*IMF 2011*).

There is no single rule or even group of rules that can determine the optimal reserve level for each country in a straightforward and standard manner. Central banks keep foreign exchange reserves with a view to satisfying a number of objectives, such as preserving investor confidence, maintaining the exchange rate regime, satisfying the government's transaction-based foreign currency needs, meeting the banking system's foreign currency demand or financing the current account (*Antal – Gereben 2011*). As a result of keeping a reserve level that meets investors' expectations, the valuations that are able to orient and shape the opinion of those relevant to the market bear the utmost importance. Based on this, one of the most important valuations is the valuation of reserve adequacy by market investors, as they are the ones who are capable of materially influencing emerging market asset prices. Accordingly, our paper deals with the reserve indicators deemed most important by investment banks in respect of emerging countries; in addition, the international institutions, the analyses of which are public – such as the International Monetary Fund (IMF) for example – are also important, as the valuations published by such institutions may significantly influence investors' assessment of a country.

The main question that we examined was whether the individual reserve indicators are used in those countries where the academic literature regards them as more relevant. The literature recommends a number of indicators, based on which the expected level of foreign exchange reserves can be judged. Some of these are traditionally applied, simple indicators, such as the Guidotti–Greenspan rule resting on short-term external debt, the import rule and the monetary aggregate rules. The academic literature formulates a number of recommendations regarding the greater or lesser relevance of certain traditional indicators in the different types of countries. Our paper can be regarded as one filling a gap, as we have found

no example of previous examination of the question to what extent the practical experts follow the recommendations of the academic literature when using the reserve indicators. Our survey is also a pioneering one in the sense that we compiled a broad database, covering more than 100 emerging and developing countries, to examine the reserve indicators used in the IMF country reports prepared under Article IV (we did not examine the developed countries, as in their case the reserve adequacy is less relevant due to the strong institutional system). There are surveys which examine the IMF reports (*Roy – Ramos 2012*), but they do not examine the indicators used for reserve adequacy; they merely summarise the economic policy recommendations, and do so only by citing examples, rather than in a systematic way. Some of the literature examines how emerging or developed countries performed with the various reserves indicators during different crises, and – based on that – which indicator may be deemed the most important (e.g. *Bussiere et al. 2015*). By comparison, our survey is novel in the sense that – in addition to the emerging/developed dimension – we also examined other country characteristics upon using the individual indicators.

We focused more on the IMF's analyses than on banks' analyses, mostly due to methodological reasons: the organisation examines its member states' economic policy regularly, in separate analyses, also taking into consideration idiosyncratic factors characterising the countries. At present no database of a similar nature, covering a group of countries of a similar magnitude is available: thus, apart from the IMF's country reports, no research of this nature and level of detail can be performed using the data of other international organisations. In their valuation methodology, the leading credit rating agencies also apply indicators measuring foreign exchange reserve adequacy, which may also influence investors' assessment. However, the country reports of the credit rating agencies often contain no reference to reserve adequacy, or they do not select the indicators on a country-specific basis, and thus it is also not possible to compile a database of similar nature and size on the basis of these analyses.

In our analysis we present, primarily in a descriptive way, how frequently the individual reserve indicators are used and their connection with various country-specific features. In the analysis performed on the database compiled from the IMF reports, we compare the proportion of the individual indicators within the sub-samples to each other and examine the deviation of those by simple statistical tests. However, we do not deal with the question of whether or not the analysed reserve indicators are indeed optimal. For the purpose of the examined questions, the relevant issue is whether or not a given indicator is used. The analysis also does not deal with the degree of reserve adequacy in the individual countries.

On the other hand, we examine which indicators are regarded by investment banks and the IMF as the most important in the case of Hungary and the emerging

countries which resemble Hungary the most. We demonstrate that there are significant differences both in the sequence of the individual indicators and the frequency of their use within the reserve indicators applied by the IMF and investment banks. For example, use of the short-term external debt is more frequent in case of investment banks, followed by the import rule, whereas both the short-term external debt and the import rule are used less frequently in the IMF analyses than the IMF composite metric. The question as to the preference of which institutions may be deemed the most important for the purpose of a country's reserve adequacy may serve as the subject of future surveys.

The paper briefly presents the theoretical background and history of the three examined traditional reserve indicators (Chapter Two), followed by the presentation of the hypotheses to be tested, the features of the database compiled from the IMF reports and the methodology of the analysis performed on the basis thereof (Chapter Three). Chapter Four summarises the result of our surveys performed on IMF data, while Chapter Five deals with the reserve indicators used in investment banks' analyses.

2. Theoretical background of the reserve indicators

The purpose of reviewing the academic literature is to build up our hypothesis as to which indicator is relevant in which type of country. We briefly present the definition and historical background of the three traditional reserve indicators (the monetary aggregate rule, the import rule, the short-term external debt rule) in the chronology of their development. Additional reserve indicators are presented by *Antal and Gereben (2011)*, as well as by *Csávás and Csom-Bíró (2016)*.

2.1. Monetary aggregates

According to the *monetary aggregates rules*, the reserves must cover a given proportion of an indicator of monetary volume, the so-called *monetary aggregate*. The indicator captures the foreign exchange reserve requirement arising from the potential flight of capital by resident actors in a crisis situation, when the domestic actors' confidence in the national currency decreases and they start to liquidate their savings held in bank deposits or cash, by converting them into foreign instruments. This approach is based on the assumption that in a crisis situation it is not only external funding that may stop, but that domestic investors may also transfer assets abroad. This "*internal drain*" may be higher in magnitude than that originating from the current account deficit or from short-term external debt (*Obstfeld et al. 2010*). The monetary aggregates are the oldest ones among the indicators examined in this study; emphasising the importance of the foreign currency need arising from the demand of the resident sector dates back to the beginning of the 19th century (*Thornton 1802*). Up until the 1970s, in the period

before opening the capital accounts, the emphasis was on covering monetary aggregates by foreign exchange reserves (Rodrik 2006).

The most often used monetary aggregate is the *M2 monetary aggregate* (cash and bank deposits with maturity less than 2 years, also known as “*broad money*”). For this, the IMF prescribes a *20 per cent ratio*, while others, for example Wijnholds and Kapteyn (2001) proposed a *band of 5–10 and 10–20 per cent*, depending on the volatility of the foreign exchange reserve relative to the monetary aggregate and on the type of the given country’s exchange rate regime. There are examples for the use of other monetary aggregate categories as well: the *M3 aggregate* also includes, in addition to the banking system’s liabilities included in M2, for example, money market fund shares. The key requirement towards central banks operating a currency board is that the *foreign exchange reserve should cover the monetary base, i.e. the M0* (sum of cash holdings, central bank reserves and overnight deposits), and thus this can also be regarded as a monetary aggregate-based reserve indicator (Hanke – Schuler 2002).

The literature recommends the use of the monetary aggregates for countries with weak banking system and a high risk of capital withdrawal by domestic actors. The conversion of domestic deposits into foreign currency may be connected with the actors’ exchange rate expectations, if they anticipate a major depreciation of the national currency. The indicator is recommended rather for the fixed exchange rate regime, where the credibility of the exchange rate regime is yet to be established (IMF 2000). According to Wijnholds and Kapteyn, in the fixed exchange rate regime there is a higher probability that in an uncertain situation domestic actors will convert domestic liquid assets into foreign currency. The development level of the banking system is also an important factor. The low credibility of the banking sector and fears of bank collapse is relevant in a less developed banking sector, which may also justify the withdrawal of deposits and conversion into foreign currency assumed to be safer in a crisis situation. Of the central banks’ reserve objectives, the monetary aggregates can be mostly linked to the maintenance of the exchange rate regime.

2.2. Import rule

The import coverage ratio signals the foreign currency demand in a balance of payments crisis, when export sales opportunities narrow, no other foreign currency revenue is available and the foreign currency necessary for imports can only be provided from reserves. According to the more common version of the import rule, the reserves must provide coverage for *3 months of imports*. The origin of the rule dates back to the 1950s; it was first proposed by the IMF as a new rule, arguing that within the balance of payments the external processes represented the determinant factor (IMF 1958). When the indicator was first calculated, the reserves of the countries under review varied between 3 and 6 months’ imports,

while initially the IMF prescribed 3–5 months of imports; however, by now *the 3-month level is practically used exclusively*, which corresponds to the minimum of the former bands. However, as it is noted by Wijnholds and Kapteyn, the preferred 3-month level of the import rule has neither theoretical, nor empirical basis; it can be regarded as a rule based on certain tradition.

Upon quantifying imports, the IMF usually uses a forward-looking methodology, i.e. it examines the imports expected in the next period, while investment banks tend to calculate retrospective imports. The indicator considers both goods imports and services imports. The spread of the rule may have been attributable to the fact that it is easy to measure, as balance of payments statistics are available for a number of countries. The literature already declared many years ago that *the import rule is obsolete* (Wijnholds – Kapteyn 2001). The empirical surveys regarded it as a good indicator for the explanation of the economic downturn measured during the crises primarily in low-income, developing countries (IMF 2011). On the other hand, the studies examining the emerging countries did not find the import rule to be significant based on the crisis indicators, with regard to the crises of 1994–95 or 1997–98 (IMF 2000). When looking at the valuation methodologies of the major credit rating agencies, the import coverage ratio is included only in the valuation model of *Fitch Ratings* (2012), where the year-end reserve is determined as a proportion of import payments, without detailing the minimum coverage ratio.

The literature recommends the import rule for those countries that have no access or limited access to the capital markets or apply capital controls (IMF 2016). One of the reasons for limited access to the international capital markets may be that their capital account is not liberalised, as they apply *capital controls*. However, it is possible even without controls that due to their low level of development or high risks, foreign investors are not willing to finance these countries. This indicator may also be relevant for *commodity exporter countries* in a crisis scenario when commodity prices fall, that is the export revenue may decrease to a larger degree than elsewhere. In addition, where the *import content of exports* is low, this indicator may be more relevant, as the decline in exports is not necessarily accompanied by an automatic fall in imports. The use of the import rule may be directly connected to the financing of the current account, as a reserve objective.

2.3. The Guidotti–Greenspan indicator

According to the *Guidotti–Greenspan rule*, the foreign exchange reserves must cover the short-term external debt, i.e. those debts maturing within one year. While earlier the balance of payments items were regarded as the main source of external vulnerability, after the 1997 crises in South-East Asia the focus moved to the volatility of capital transactions (Odenius – Rajan 2013). The idea of using short-term external debt as a reserve indicator emerged not long after the outbreak of these crises, as early as in December 1997, at a BIS meeting of central bank

governors (*Wijnholds – Kapteyn 2001*). Based on the experiences gained in the crises, it was *Pablo E. Guidotti (1999)*, former deputy governor of the central bank of Argentina, who first formulated, at the Bonn seminar of the G-33 group of developing countries held in March 1999, that the foreign exchange reserve must be sufficient to ensure that the country is able to live without new foreign borrowing for up to one year. Almost simultaneously with this, *Alan Greenspan (1999)*, former governor of the Federal Reserve (Fed) fine-tuned the rule in April 1999 at one of the World Bank conferences. According to that, the foreign exchange reserves must exceed the country's foreign currency debt maturing within one year.¹ It belongs to the history of the indicator that similar criteria had been recommended for reserve adequacy much earlier: *Keynes (1930)* noted in respect of the reserves of India that the foreign exchange reserve must cover the withdrawal of foreign funds as well.

The academic literature quickly started to use this indicator; a study was published as early as September 1999, which examined the role of the foreign exchange reserve ratio to short-term debts in earlier crises (*Rodrik – Velasco 1999*). In March 2000, the IMF already recommended the use of short-term external debt for the evaluation of reserve adequacy, and soon after this it started to use it (*IMF 2000*). There is no available information why exactly the *1-year threshold value was determined*; presumably this is attributable to statistical reasons (countries typically do not publish more detailed maturity breakdown of short-term foreign debt components).

The Guidotti–Greenspan rule has several modified versions as well. According to one of the alternatives, in addition to short-term external debt, the reserve should also cover the expected current account deficit of the coming year (*gross external financing requirement*). The reason for this is that the current account deficit may entail an additional foreign exchange reserve requirement. This modification is typically handled asymmetrically, i.e. when the current account has a surplus, it is not deducted from the amount of the short-term external debt (*IMF 2011*). The IMF also uses it in the country evaluations under Article IV, in the case of certain countries struggling with current account deficit. A further modified version of the short-term external debt is the *external debt service* which also takes into consideration interest payments, in addition to the principal components of the expiring external debt, although this reserve indicator is used less often. Furthermore, for some countries the IMF notes in its country analyses that it includes *part of the external inter-company loans that expire within one year* in

¹ Greenspan also proposed to expand the rule with additional elements, such as that the maturity of the external debt should be at least 3 years, or that the country should hold as much foreign exchange reserve as ensures with a high probability (e.g. with a probability of at least 95 per cent) that the country does not need to rely on external funds for at least 1 year. In the end, these additions did not become part of the Guidotti–Greenspan rule. Greenspan initially recommended only the short-term foreign currency debt, but the commonly used rule contains not only the foreign currency-denominated debt, but also that denominated in the national currency.

the short-term external debt, despite the fact that in statistical terms intra-group loans belong to the working capital category rather than to the debt category. The adjusted indicator assumes that in the case of a crisis, the outflow of inter-company loans may also generate risks. The valuation method of the credit rating agencies also includes the short-term external debt rule, particularly the adjusted versions of that. For example, Moody's, upon assessing certain countries' external vulnerability and reserve level, also adds non-residents' long-term deposits held with domestic banks to the short-term external debt and compares the reserves to this adjusted debt indicator (*Moody's 2013*). Standard & Poor's sets out from the gross external financing requirement defined on its own, i.e. it increases the disposable part of the reserve with the current account balance when determining the external liquidity ratio (*S&P Global Ratings 2014*), while Fitch also adds liquid liabilities, such as e.g. non-residents' long-term government securities holdings, to short-term external debt (*Fitch Ratings 2012*).

The Guidotti rule represents a relevant indicator in a crisis situation when external financing stops and the expiring external debt can only be repaid from foreign exchange reserves. A stop or turnaround in capital inflows (also known as a *sudden stop*) may generate substantial losses for a country's economy (*Reinhart – Calvo 2000*). If – for lack of foreign currency liquidity – the state or the private sector is unable to repay its external debt, it could necessitate a major adjustment in the real economy. All components of the short-term external debt carry rollover risk to a certain degree; accordingly, the indicator takes into consideration both domestic and foreign currency-denominated debt elements (*IMF 2000*). Several studies demonstrated that when the foreign exchange reserve falls short of the short-term external debt, there is a higher probability that an economic crisis or currency crisis may develop (*Furman – Stiglitz 1998; Calafell – Del Bosque 2002*). In relation to the period of the collapse of Lehman Brothers, more recent research has found that the Guidotti–Greenspan indicator provided a better explanation for the decline in GDP than traditional indicators (*Bussiere et al. 2015*).

The literature recommends the Guidotti–Greenspan rule to countries with access to international capital markets, and substantial, but uncertain cross-border financing. As a reserve indicator, short-term external debt is recommended to countries with access to foreign capital markets (*IMF 2016*). This assumes that the country's capital account is also liberalised, i.e. not only the current items of the balance of payments, but also the financing items are free, i.e. there are no capital controls. Since the liberalisation of capital flows, the volatility of capital transactions may be substantially higher than that of the current items, used e.g. by the import rule. The fact of liberalisation alone is not sufficient; the build-up of risks also requires external finance, and within that the degree of short-term debt must be high; higher short-term external debt carries higher rollover risk. The degree of uncertainty in external finance is more difficult to measure, and thus it is more the magnitude

of that may be important for the purpose of assessing the use of the indicator. The relevance of the indicator may be influenced, for example, by the ownership structure of the banking system: when the share of non-resident owners is higher, the banking system's foreign debt, and within that the short-term debt, may also be higher. Since the short-term external debt also includes the short-term external debt of the state and the banking system, in respect of central banks whose reserve objective is to satisfy the transaction foreign currency demand of the state or the banks, the prescription of the reserve requirement according to this indicator may be justified.

3. IMF data collection methodology, hypotheses

3.1. Compilation of the IMF database; theoretical considerations

For the purpose of analysing the indicators for the assessment of foreign exchange reserves in our study, we collected the country-specific data based on the country reports and analyses of the *International Monetary Fund* (IMF). We explain this by the fact that this organisation *regularly reviews the economic policies of its member states, in the course of which it considers both standard and country-specific idiosyncratic factors*. Within the framework of regular comprehensive economic policy consultations (usually annual) in accordance with Article IV of its Articles of Agreement, the IMF conducts consultations with its member states, as a result of which it formulates recommendations for them. During the supervision, the focus varies based on the individual circumstances of the countries; however, it is a general practice that the Monetary Fund *also analyses and assesses the optimal level of foreign exchange reserves within the framework of the exchange rate, monetary and fiscal policy*.

In selecting the countries to be involved in the analysis, we set out from the 189 member states of the organisation, of which we eliminated those countries *where certain factors do not permit the comparative analysis of international reserves*. One such criterion is the development level of the countries, because in the case of *developed countries*, the IMF's and investment banks' requirements cannot be compared with those related to emerging countries, since the holding of reserves in the case of developed countries is not a priority consideration mainly due to their strong institutional and regulatory systems, liquid money markets and flexible exchange rate regimes. Although after the crisis the reserve requirement of the developed countries also rose, it is a general view that they do not need substantial foreign exchange reserves and they mostly keep foreign exchange reserves for the event of market turbulences. (This is particularly true for the countries that issue the reserve currency, which can easily exchange the local currency into foreign currency in the foreign exchange market or conclude swap agreements with each other to ensure a sufficient foreign exchange reserve level and foreign

currency liquidity) (IMF 2011). The *participation* of the given currency in a currency union and the *explicit or implicit presence of dollarisation or euroisation* were two other factors for exclusion from our survey. The first is due to the fact that the member states of currency areas, due to losing the right to conduct an independent monetary policy, also entrust the central bank of the currency union to manage international reserves. Dollarisation or euroisation is also a form of surrendering monetary sovereignty, in the course of which a state abandons its national currency in part or in full and replaces it with a foreign, but stable currency as legal tender. In the last two cases, it is also not possible to examine the indicators that serve the determination of the optimal level of the foreign exchange reserves by countries. After eliminating these countries, roughly 120 member states served as a basis for our analysis.

In our research, we created our own database based on the data of the IMF's country reports and indicators relevant for the reserve adequacy indicators. A large part of the countries are subject to further review, in addition to country analysis under IMF's Article IV, due to their participation in IMF programmes, where the IMF also examines changes in the reserve level and reserve adequacy. Accordingly, we performed data collection for the purpose of analysing the reserve adequacy indicators using two types of IMF reports: the data sources included the country reports under Article IV and other country-specific analyses prepared by the organisation on countries participating in IMF programmes.² The latter are always published in consolidated form with country reports under Article IV, or as a separate report, but an independent, comprehensive economic policy analysis. In collecting the data, we made no difference between these two data sources. Almost half of the reviewed countries participate in some sort of IMF programme at present as well, and thus in the case of some of the programme countries the source of the data solely included the documents related to the programmes, i.e. we did not always use the country report under Article IV.

In view of the development of the countries and their different economic, financial and political situation, during the collection of the reserve adequacy ratios, we only examined the information and findings related to reserve adequacy, and ignored other factors in the reports. Based on their incidence, we collected the indicators into four main categories: short-term external debt, import rule, monetary aggregate and IMF composite metric. With the exception of the import rule, the other three categories also include other similar indicators or data adjusted for other items. We present these below.

² The category of non-preferential IMF loans includes the Stand-By Arrangement (SBA), the Flexible Credit Line (FCL), the Precautionary and Liquidity Line (PLL), the Extended Fund Facility (EFF) and the Rapid Financing Instrument (RFI). The Extended Credit Facility (ECF), the Standby Credit Facility (SCF) and the Rapid Credit Facility (RCF) belong to the preferential IMF loans and are available to countries in the low-income category.

In the IMF reports, *short-term external debt* usually means short-term external debt adjusted for 20 per cent of the estimated short-term part of inter-company loans; the unadjusted Guidotti–Greenspan indicator is used less frequently. Generally, however, it is not clear from the reports which of the above two indicators the short-term external debt corresponds to. On the other hand, in the case of certain countries short-term external debt is calculated not only alone, but also adjusted for other items (e.g. current account deficit or surplus, or the banks' foreign currency and non-resident deposits); we also allocated these other categories to the short-term external debt group.

In addition to the application of the traditional M2 rule, the *monetary aggregate* category also includes the monetary base and the M3 aggregate. Although it does not belong to monetary aggregates category in the narrow sense, in a few cases the indicator is also adjusted for other items (e.g. deposits, foreign currency deposits and the deposits of non-residents, or the monetary base adjusted for bank loans), which we also considered in this category.

In the case of the *IMF composite metric*, we consolidated several complex indicators in this category. The ARA indicators (*Assessing Reserve Adequacy or risk-weighted metrics*), developed for emerging countries define the required level of foreign exchange reserves on the basis of the weighted average of four indicators: (1) short-term external debt, (2) portfolio liabilities and other long-term external debt, (3) monetary aggregate, (4) exports (*IMF 2011*). The IMF uses certain versions of the ARA indicators depending on country-specific factors, and thus, similarly to the traditional indicators, the differences between the countries are important here as well. In a fixed exchange rate regime, other external debt and the monetary aggregate have higher weight, while in countries applying capital controls, monetary aggregates have higher weight (*IMF 2015*), i.e. in the case of these factors outflow was higher during previous crises.

Based on the review performed in 2013, in a country similar to Hungary, with a floating exchange rate regime and without capital controls, the weights are as follows: short-term external debt: 30 per cent; portfolio liabilities and other long-term external debt: 15 per cent; monetary aggregates and exports: 5–5 per cent (*IMF 2013*). For the purpose of defining the weights, the methodology considered the extreme values of the outflow observed in past crises. The weighted indicator designates a band; the authors regard the value between 100 and 150 per cent of the estimated value as an optimal level, and for the purpose of defining this band they also considered the results of the cost-benefit models.

Primarily due to their higher vulnerability to external shocks and their limited or zero access to international capital markets, the reserve adequacy of developing countries is examined not only through the traditional indicators, but also on the

basis of *cost-benefit analyses*, the purpose of which is to balance the marginal benefits and the costs of holding reserves (low-income and middle-income country reserve adequacy template or Assessing Reserve Adequacy in Credit-Constrained-Economies, ARA-CC) (IMF 2016; Dabla-Norris et al. 2011). The IMF also applies a separate composite metric in the case of small islands (risk-weighted measure for small island developing states), which also considers their specific features, e.g. more limited financial infrastructure, occurrence of commercial shocks or natural disasters (Mwase 2012).

In our database, we collected the information related to the indicators based on identical criteria for all countries, relying on the last two IMF reports. Within short-term external debt, the IMF composite metric, the import rule and the monetary aggregates indicators, we separated text, figure and table categories, where we indicated with the number 1 whether the given ratio appeared in the text evaluation (text), in the figure (figure) or in the tables summarising economic indicators (table).

For the further use of the data we took the intersection of the two datasets created on the basis of the two reports, where we no longer examined the table category. The statistical data related to foreign exchange reserves usually appear in the tables containing the selected economic indicators or the balance of payments data, forming standard elements of the report. For example, the import rule, regarded as a traditional indicator, appears in the tables for more than 90 per cent of the countries; however, the assessment of the reserve adequacy is included in other parts of the reports, independently of the tables, and not necessarily on the basis of the import rule. Conversely, at the same time: if the IMF assesses the adequacy based on one or several indicators, the indicators do not necessarily appear in the tables. Accordingly, we regarded the indicators in the table rather as data of informative nature, and at the intersection of the given indicator we only examined whether it appears either in the textual evaluation or in the figure, but in both reports. The explanation for our methodology is that the intersection returns a more robust result compared to the union of the reports, and we can also exclude the random use of the indicators.

The IMF started to use the IMF composite metric from 2011, and thus we took into consideration the characteristics (text, figure, table) examined under the indicators only on the basis of the reports issued after 2011. The data collection was closed with the reports published until 31 December 2016. Since we examined the intersection of the reports, we excluded from the sample those countries that had only one report after 2011 (e.g. Argentina, Egypt, Libya), or where the IMF did not examine any reserve indicator (e.g. Qatar), as well as those that failed to reach the level of development that would have permitted the examination of changes in foreign exchange reserves (e.g. Somalia). For some of the countries, we assume that we found no IMF report, because – although the consultation under Article IV exists

– the authorities did not approve the publication of the reports (e.g. Bahrain, Oman) (Roy – Ramos 2012). Due to the foregoing, our earlier sample of 120 elements was reduced to 105 countries.³ In order to perform a comprehensive analysis of the reserve indicators used by the IMF, we allocated another three features to each country: (1) the income category they belong to, (2) characterised by free or restricted capital flow, and (3) whether they use a floating or fixed exchange rate regime.

3.2. Hypotheses

We expect that the more developed a country is, the more frequently the Guidotti–Greenspan rule and the monetary aggregates are used, while the use of the import rule is less frequent. In the academic literature presented before, one of the factors that determines the use of the reserves indicators is access to foreign capital markets. This is not the equivalent of capital controls, as it more indicates the willingness of non-resident actors. It is difficult to measure this directly, and thus we use the development of the countries as a proxy. The more developed an economy is, the more it can be expected that it has access to external finance (*ceteris paribus*). The literature describes a positive relation between access to external markets and the Guidotti–Greenspan indicator; based on this, we expect a positive relation between income and the use of this indicator, while it is the other way round in the case of the import rule. Although the literature does not mention this factor directly, access to external markets is relevant in the case of the monetary aggregates rules as well, as the capital export of the resident actors assumes that the country has access to the capital markets not only on the liability, but also on the assets side. Based on this, similarly to the Guidotti–Greenspan indicator, we also expect a positive relation between the use of the income and the monetary aggregate indicator.

In the case of capital controls, our hypothesis is that the stronger the degree of the controls is, the less frequently the Guidotti–Greenspan indicator and the monetary aggregates are used, while the import rule is used more frequently. One of the conclusions that can be deduced from the academic literature is that in countries applying capital controls, the import rule is relevant, while the Guidotti–Greenspan indicator is not. In the case of monetary aggregates it can also be expected that where the degree of capital controls is higher, domestic actors are less capable of rescuing their savings abroad. Thus, here we expect a direct relation between the reserve adequacy indicator and the degree of capital controls, contrary to the development by income level, which is only used as a proxy.

As regards the monetary aggregates rule, we expect that it is used more frequently in countries with a fixed exchange rate regime. As mentioned earlier, the use of

³ The list of the countries and the IMF country reports used is included in the Annex.

monetary aggregates is recommended more for fixed exchange rate regimes. This is also corroborated by the statements made with regard to currency boards, which is also a special fixed exchange rate regime. However, in the case of the other indicators we do not formulate ex-ante hypotheses, as it is not clear from the academic literature whether the exchange rate regime should influence the relevance of the Guidotti–Greenspan indicator or the import rule. It is a relatively common statement that a fixed exchange rate regime justifies a higher reserve level, but this provides no guidance as to which indicator is more relevant. On the other hand, we examine the practice applied in the IMF reports based on this dimension as well (*Table 1*).

We did not build up a hypothesis for the *IMF composite metric*. This is partly attributable to the fact that the IMF developed this indicator for its own use, and thus we deemed it obvious that it would occur very frequently in the IMF country reports. In addition, the ARA indicator can be calculated and applied to all countries, irrespective of capital controls and type of exchange rate regime. Hence, in contrast to the other indicators, the examination of these dimensions is not applicable. Another important reason is that the justification of the composite metric in the literature differs substantially from that of the traditional indicators, and thus we had no opportunity to test the academic literature, just like in the case of the other reserve indicators.

Table 1
Hypotheses related to the connection of the individual country features to the use of reserve indicators

	Guidotti–Greenspan indicator	Import rule	Monetary aggregate
Development/access to capital markets	+	–	+
Capital control	–	+	–
Fixed exchange rate regime			+

Source: Own collection.

3.3. Income categories

For the categorisation of countries by income, we used the World Bank’s World Development Indicators database, where the organisation allocates the countries of the world to four income groups, based on the previous year’s per capita gross national income, adjusted for inflation and exchange rate effects (*calculated using the Atlas method*). According to the 2015 figures of the annually updated report, below USD 1,025 countries belong to the low-income category, between USD 1,026 and USD 4,035 to the lower middle-income category, between USD 4,036 and USD 12,475 to the upper middle-income category and above USD 12,475 to

the high-income category. Compared to the list of previous years, the category of several countries may change (positively or negatively); however, we did not examine the data on a time series basis and nor did we take into consideration the changes compared to previous years. 16 of the 105 countries included in our sample belong to the low-income group, 36 to the lower middle-income group, 36 to the upper middle-income group and 17 to the high-income group. The relatively even distribution of the countries permits a more detailed examination of the reserve adequacy indicators, as we can perform further observations within the individual groups without the number of countries in the sub-sample falling too low. We selected the database of the World Bank for the grouping of the countries by development level, as the IMF and investment banks often allocate countries to the emerging countries category, relevant for Hungary, differently, while the categorisation based on income groups is straightforward and covers all countries of the world.

3.4. Capital controls

For the measuring of financial openness, or more precisely, for the examination of the free flow of capital or the existence of capital controls, we selected the Chinn–Ito-index (“KAOPEN⁴”), which monitors the changes in the openness of capital markets in 182 countries in the period of 1970–2014. The capital liberalisation index measures the *de jure* openness, i.e. in the case of the selected countries it focuses on the regulatory aspects and restrictions affecting the current and capital account transactions (Chinn – Ito 2008). The index is compiled, based on the IMF’s publication entitled Annual Report on Exchange Arrangements and Exchange Restrictions (hereinafter: AREAER), by averaging the binary variables that present the restrictions applicable to the cross-border financial transactions in the period under review. In addition to its relative transparency, another advantage of the index is that we have access to a regularly updated database for a very wide range of countries.

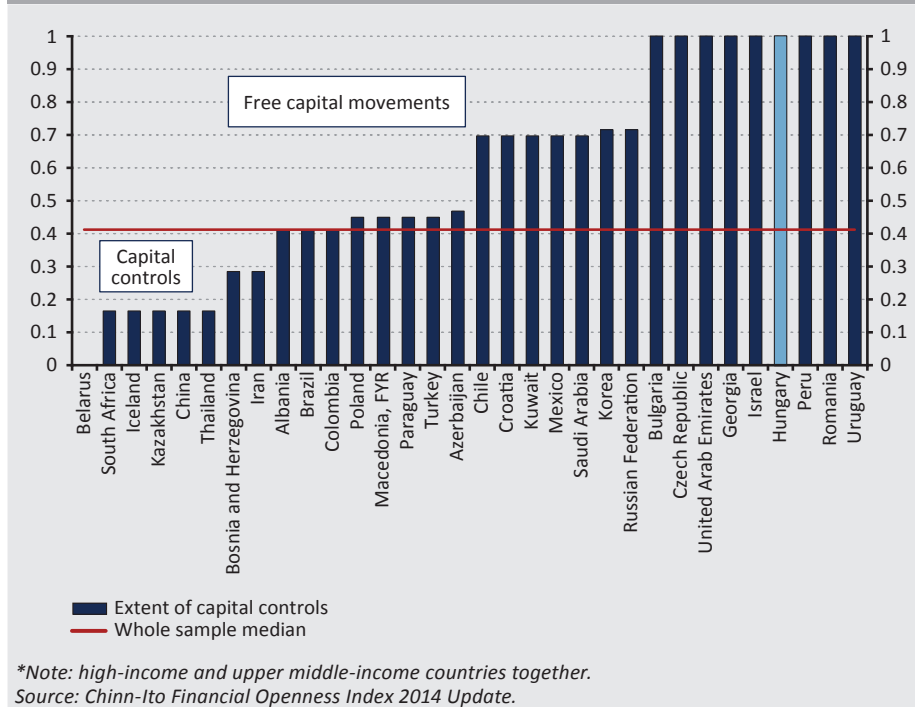
In the KAOPEN data series, the higher value denotes greater degree of openness, i.e., countries, mostly developed ones with fully open capital accounts, receive the highest value. In assessing the reserve adequacy ratios, we considered the 2014 values, where the maximum of the data series is 2.39, representing full openness of the capital market, while the minimum of the variable is –1.89. We use the version of the index that appears as a normalised value between 0 and 1, where 1 represents unrestricted capital flow, while 0 represents complete restriction (KA_OPEN). In measuring capital controls, we did not examine to what degree the values of the index are indeed reliable, i.e. the size of the actual capital flows, the

⁴ KAOPEN is the abbreviation for capital “openness” (Chinn – Ito 2008).

de facto openness and other indicators used for measuring capital controls (e.g. Quinn index).

The IMF experts calculate the ARA metric not only by differentiating between fixed and floating exchange rate regimes, but also by taking into consideration capital controls. For the determination of capital controls, they set out from the median of three different, but standard indicators (Chinn–Ito index, Quinn index and the IMF share index), where if it takes a value of 0.25 or below, they consider the given country as one having capital controls in place (IMF 2016). Analogously to this, we took the median of the Chinn–Ito indices calculated for 2014 in the group of countries under review (0.4128) to measure the openness of the capital market. Where the value exceeded the median value (>0.4128) we deemed capital flows to be free, while in the case of values equivalent to or lower than the median (≤ 0.4128) we deemed capital flows to be restricted and converted them into dummy variables (0 or 1). Of the 105 countries involved in the analysis, only Serbia was not included in the country list of the Chinn–Ito index. For the analysis of the raw data, we plotted the countries similar to Hungary, belonging to the high-income or upper middle-income category (Figure 1).

Figure 1
Capital flow in certain countries belonging to the higher-income* categories



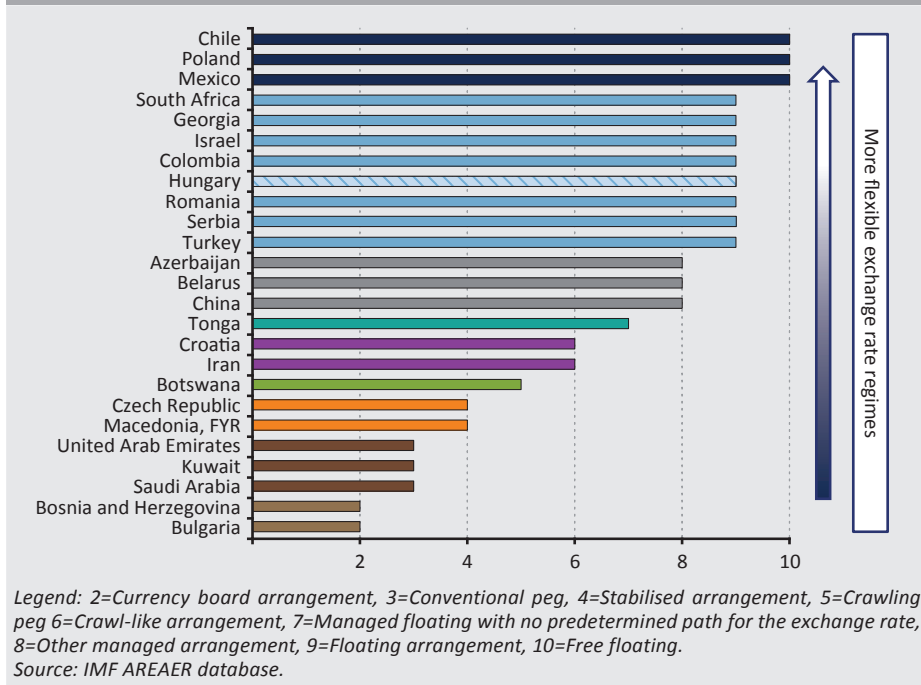
During the 2014 update of the index, the authors called the attention to the fact that since 2005 certain (mostly industrialised) countries reported the introduction of controls of capital movements against terrorist states within the framework of AREAER; however, due to the nature of such controls and in the absence of real restrictions, the authors treated these countries as ones not applying international sanctions (Chinn – Ito 2016). Hungary is also included among the 14 listed countries, thus it may happen that the AREAER database shows restrictions in certain categories of Hungary, while based on the Chinn–Ito index it received the highest value (2.39 or 1 in the case of KA_OPEN).

3.5. Exchange rate regime

The IMF publishes a report on exchange rate regimes and exchange controls annually (AREAER). Based on the classification system, last modified in 2008, there are three main categories: *hard/soft pegs*, *floating arrangements* and those interim countries that cannot be allocated to any of the categories, or the exchange rate regime applied by them often change (other managed exchange rate regime – *residual*). Since the revision performed in 2008, the IMF's classification system sets out from the *de facto* exchange rate regimes, beyond which it also indicates the *de jure* categories indicated by the countries and the explanation of those by the authorities. The three large categories comprise altogether ten exchange rate regimes. Upon the use of exchange rate peg, the volatility of foreign exchange reserves is higher as a result of the regular, and often intensive, foreign exchange market interventions performed to protect the exchange rate, while with the increase in the flexibility of the exchange rate regimes – when the objective is usually only to mitigate the swings in the exchange rate – the fluctuation of reserves decreases (Farkas 2010), thus it bears utmost importance even when reserve adequacy is analysed.

We allocated the 2015 data of the IMF's AREAER database to the countries included in our sample. The exchange rate categorisation of the countries may change annually, but we did not examine the changes which occurred in the individual years – particularly the differences between 2014 and 2015 – on a time series basis. Based on the IMF categories, we allocated the countries to the fixed or floating group, depending on which of the two main categories of the AREAER database they belong to (Figure 2). We examined the residual countries, belonging to the category of other managed exchange rate regime, one by one and decided on the basis of the information in the IMF country reports and the *de jure* category specified by the authorities of the given country for 2015, whether they are closer to the floating or fixed exchange rate category. Based on the methodology described above, of the 105 countries included in the sample, 47 apply floating exchange rate regimes and 58 apply fixed exchange rate regimes.

Figure 2
Exchange rate regimes in certain countries belonging to the higher-income categories



4. Results of the analysis of the IMF data

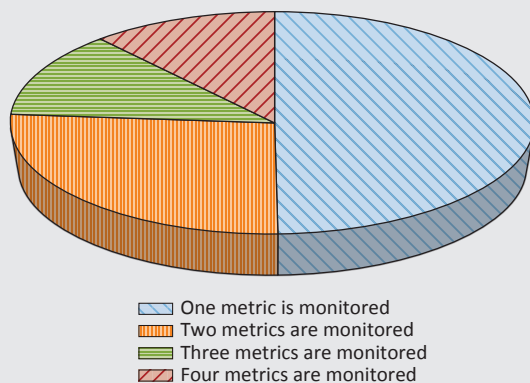
The primary objective of our analysis was to test whether the IMF monitors the individual indices in those countries where they are relevant in theory. In the following, we present the results obtained during the testing of our established hypotheses.

4.1. Incidence of the reserve indicators

As regards the incidence of the four main reserve indicators used by the IMF and analysed by us, for about 75 per cent of the sample they examine one or two indicators to assess the reserve adequacy (Figure 3). Examining the incidence of the indicators, we found that for almost half of our sample (52 countries), the IMF deems only *one indicator* relevant, and within that the ratio of the import rule is 70 per cent and the IMF composite metric is 23 per cent (the short-term external debt and the monetary aggregate appear only in one case each). For 70 per cent, the import rule appears for the low-income or lower middle-income countries, while the IMF composite metric appears only for the upper middle-income and high-income countries as a single indicator. For more than one quarter of our full

country group (28 countries), the IMF evaluates the reserve adequacy based on *two indicators*. The most frequent combination (ratio of almost 70 per cent) is the IMF composite metric and the import rule, where in 70 per cent of the cases we found countries belonging to the lower-income category and in 30 per cent higher-income countries. The ratio for the lower-income countries is attributable to the fact that in their case, in addition to the popularity of the import rule, the IMF tends to use a composite metric developed specifically for them.⁵ In the case of the higher-income countries, this is more attributable to the gradual omission of the import rule. The combination of the short-term external debt and the IMF composite metric is monitored by the IMF in 25 per cent of the cases when it examines two indicators, and this applies to the higher-income countries, almost without exception (examination of the import rule and the monetary aggregates is negligible). For more than 12 per cent of the sample (13 countries), the country reports include *three indicators*, with two larger groups being typical in that, i.e. the short-term external debt – IMF composite metric – import rule and the IMF composite metric – import rule – monetary aggregates. However, based on the analysis of the income categories, we were unable to draw any straightforward conclusions. For 11 per cent of the countries (12 countries), the IMF examined *four indicators*, with three-quarters of the countries belonging to the higher-income category.

Figure 3
Incidence of the reserve indicators based on the intersection of the examined IMF reports



Source: collected from the IMF country reports.

⁵ For example: low-income and middle-income country reserve adequacy template or ARA-CC metric, or risk-weighted measure for small island developing states.

4.2. Reserve indicators depending on income categories

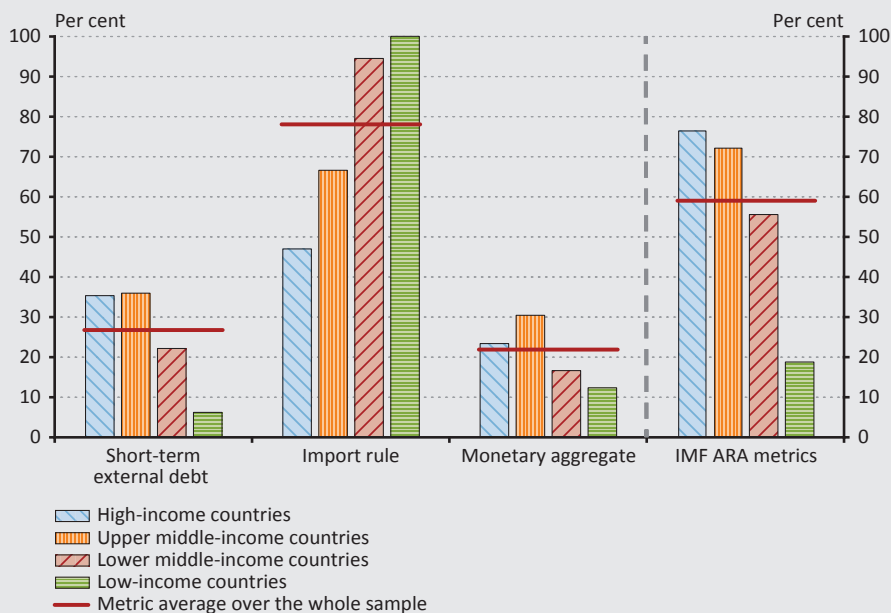
According to our first hypothesis, the more developed a country is, the more frequently the Guidotti–Greenspan rule and the monetary aggregates are used, while the import rule is used less frequently.

The results of our analysis performed on the basis of the IMF's country assessments show that there is a positive relation between the use of short-term external debt and monetary aggregates, and the increase in income (Figure 4). In the low-income group, the IMF hardly examines the reserve adequacy based on the *short-term external debt* indicator (the value around 6 per cent represents 1 country) and the use of the indicator also does not reach 25 per cent in the lower middle-income category. However, within the two higher-income categories, the short-term external debt is monitored in more than 35 per cent of the cases, which occurs both in the high-income and upper middle-income categories together with several indicators (except one country). That is, the application of the short-term external debt is more common and exceeds the average in the emerging countries. We obtained a similar result in the case of *monetary aggregates*: the incidence of the indicator is lower in the lower-income countries, and higher in the higher-income countries, and it is monitored usually on a complementary basis, together with at least one more indicator. The IMF country reports mention it mostly in the case of the countries belonging to the upper middle-income category (31 per cent), but the indicator is also used for almost 25 per cent of the high-income countries. On the other hand, the role of the *import rule* gradually decreases in parallel with the increase in incomes. For the purpose of evaluating the reserves, the IMF considers the import coverage ratio for all low-income countries under review, as a single indicator in the case of three-quarters of the countries. The ratio of the indicator is also very high, close to 100 per cent, for the lower middle-income countries. Within the group, it is a single indicator for more than 40 per cent of the countries, but in most of the cases it appears together with other indicators, mostly with the IMF composite metric. The use of the indicator substantially decreases in parallel with the increase in the development level: in the high-income category the incidence rate is merely 47 per cent. This may be attributable to the fact that for certain countries the reserve adequacy is presented in the reports through several indices. Our analysis in respect of the *IMF composite metric* concluded that the use of the metric increases in parallel with the development of the countries. While it is considered relatively rarely for the low-income countries, it may be regarded as a relevant indicator for more than half of the countries in the lower middle category, which may be the effect of the composite metric developed for the small islands and lower-income countries. The results are also confirmed by the statistical tests;

the use of all three traditional indices significantly differs when the countries are allocated to two groups based on income.⁶

When examining the indicators within the income groups, in the lower-income categories the import rule is followed by the IMF composite metric and monetary aggregates or short-term external debt, while in the case of the higher-income countries, the IMF metric takes the lead, followed by import rule, the short-term external debt and the monetary aggregates. In our view, the use of the three indicators examined on the basis of our hypothesis may be also influenced by the availability of data. While the import data are available, irrespective of the countries' development, for the evaluation of the reserve based on import coverage, the data necessary for the calculation of the short-term external debt or the composite indices are not necessarily available for the less developed countries.

Figure 4
Reserve indicators used in the IMF country reports by income categories



Note: The ratios show the percentage rate of the countries within the given group where the reports mentioned the given indicator.

Source: Own collection from the IMF country reports and World Bank World Development Indicators.

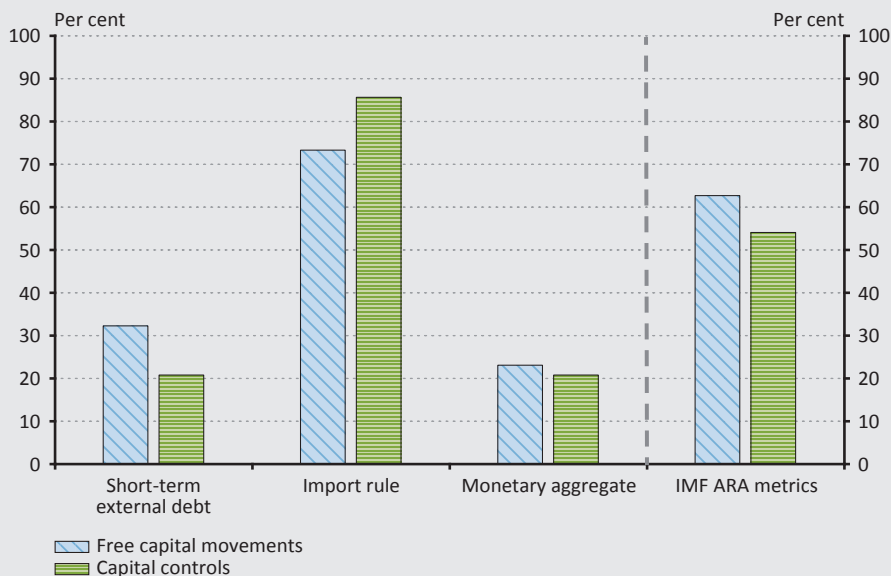
⁶ For the short-term external debt, the import rule and the monetary aggregates, the difference is significant at a significance level of 5, 1 and 10 per cent between the high and upper middle-income, the lower middle-income and low-income countries, respectively. For the results see Table 2 in the Annex.

4.3. Reserve indicators depending on the capital controls

According to our second hypothesis, the stronger the intensity of the capital controls is, the less frequently the Guidotti–Greenspan and the monetary aggregate indicators are used, while the import rule bears greater significance.

Our research results confirmed a positive relation between the import rule and capital controls; however, the short-term external debt and monetary aggregate indicators are less relevant in the countries applying capital controls (Figure 5). In 46 per cent of the 104 countries under review, there is some capital control in place, which we defined by comparing it to the Chinn–Ito-index median. We found that in the IMF reports, upon assessing the reserve adequacy, the short-term external debt and the monetary aggregates are used more often for countries characterised by free capital flows, while the import rule is typical in the case of more intense capital control, which supports the statements of our hypothesis (only for the monetary aggregates did we find no statistically significant difference). For the IMF composite metric, the differentiation between the free and restricted capital flow cannot be interpreted, as the ARA metric is also examined in the countries that apply capital controls, using a formula differing from the traditional one (changing the weight of the monetary aggregates).

Figure 5
Reserve indicators used in the IMF country reports in the case of free or restricted capital flows



Note: The ratios show the percentage rate of countries within the given group where the reports mentioned the given indicator.

Source: IMF country reports, own collection, Chinn–Ito Financial Openness Index 2014 Update.

On the other hand, the Chinn–Ito index also provides an opportunity to separately examine the countries that, based on this index, have the most liberalised capital flows, i.e. where the value of the index is 1. However, the narrowing to this more limited range does not significantly change the results: among them 70 per cent of the reports prepared under Article IV use the import rule, while the short-term external debt is used in only 30 per cent of the cases. This result is surprising in light of the fact that according to the academic literature we should see exactly the opposite relation between these two indicators. The excessive use of the import rule is presumably related to the fact that among countries with a Chinn–Ito index of 1, there are also some low-income and lower middle-income countries (e.g. Haiti and Guatemala).

4.4. Reserve indicators depending on the applied exchange rate regime

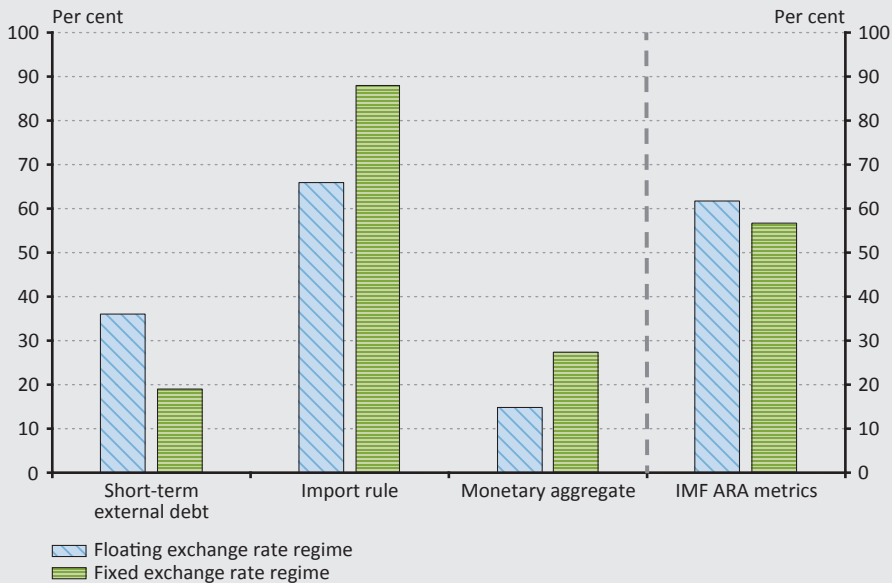
According to our third hypothesis, the more fixed exchange rate regime a central bank applies, the more frequently the monetary aggregates are used.

Countries applying fixed exchange rate regime use the monetary aggregates and import rule more often than those with floating exchange rate regime, while the use of short-term external debt is less frequent. Of the four indicators examined, we defined a prior hypothesis only for the monetary aggregates. In line with our expectations, in countries with a fixed exchange rate regime, the ratio of the application of monetary aggregates is higher in the IMF reports (*Figure 6*). The difference is material, i.e. almost twofold: some of the monetary aggregate indicators are mentioned in almost 30 per cent of the countries with a fixed exchange rate regime, while this ratio is merely 15 per cent for floating exchange rate regimes (the difference is significant in statistical terms as well). Our sample contains 3 countries, the central banks of which operate a currency board within the fixed exchange rate regime (Bosnia and Herzegovina, Bulgaria, Djibouti). In these cases, the monetary aggregate, specifically the monetary base, appears without exception, in line with the fact that for the currency boards the coverage of the central bank money with foreign exchange reserves is a minimum requirement. If we ignore these countries, it is still true that the use of monetary aggregates is more frequent in the case of the fixed exchange rate regimes than in the case of the floating exchange rate regimes. The use of the short-term external debt is substantially more frequent in the case of floating exchange rate regimes than at the fixed ones; there is no material difference in the case of the IMF composite metric, while the application of the import rule is more frequent in the case of fixed exchange rate regimes.⁷ This raises the question of why it is worth differentiating depending on the exchange rate regime in the case of the import rule and the short-term external debt. One possible theoretical explanation for the import rule is that with floating

⁷ In the breakdown by exchange rate regime, we obtained similar results as at the capital flows; based on this it may arise that we merely see the same results due to the connection of these two dimensions (two-thirds of the countries with fixed exchange rate regime belonged to our capital control category). However, if we break down the countries into capital controls/free capital flows categories, and examine the exchange rate regime within those, we end up with differences of the same direction in both groups as in the figure above. Thus, the differences observed for the exchange rate regime are not explained by the different degree of capital controls.

exchange rate regimes, in the case of a crisis the weakening of the exchange rate may temporarily reduce nominal imports, and thus the use of the import rule may be less relevant.

Figure 6
Reserve indicators used in the IMF country reports in the case of fixed and floating exchange rate regimes



Note: The ratios show the percentage rate of the countries within the given group where the reports mentioned the given indicator.

Source: Collected from the IMF country reports, 2015 data from the IMF AREAER database.

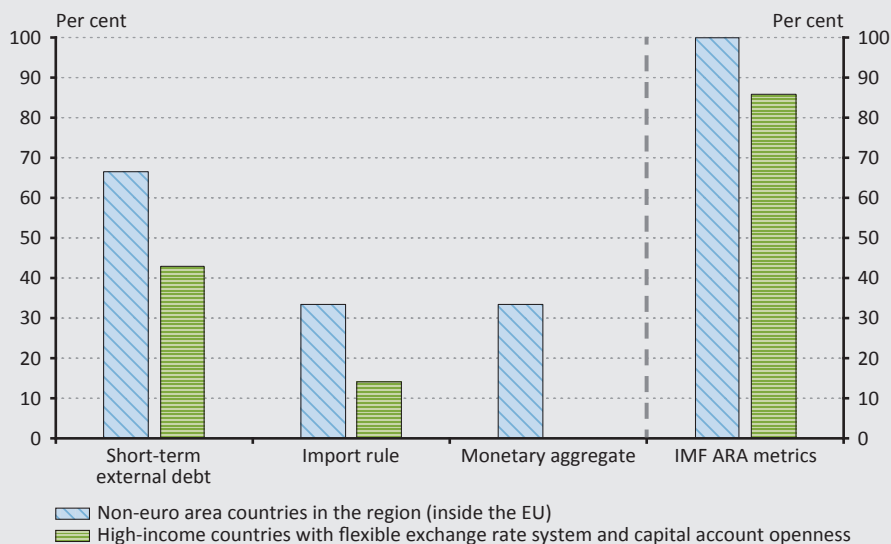
4.5. Reserve indicators along additional dimensions and in respect of Hungary

According to the results of our further analyses, the differences observed along the exchange rate regime and capital control dimensions are influenced primarily by these dimensions rather than by income. The three dimensions examined are related to each other; it is true for the higher-income countries that they tend to use a floating exchange rate regime and there are no capital controls. Almost half (25 countries) of the countries belonging to the high-income or upper middle-income categories (53 countries) similarly to Hungary, apply *de facto* floating, while the majority of them (28 countries) apply *de facto* fixed exchange rate regime. On the other hand, the ratio of free capital flows is almost 70 per cent within the higher-income countries. Accordingly, we allocated the countries to higher-income and lower-income categories, and then we considered within these two groups the incidence of the reserve indicators depending on the exchange rate regime and the capital controls. Apart from some exceptions, we found differences of similar

direction as in Figures 5 and 6, in both the capital flows (free, restricted) and the exchange rate regime (floating, fixed) categories, which means that for the majority of the indicators the differences observed at the capital controls and the exchange rate regime are caused not by the different development level of the countries.

In respect of the country group having similar characteristics as Hungary, and the regional non-euro area countries within the European Union, the IMF evaluated the reserve adequacy in the country reports under Article IV based on two indicators, i.e. the short-term external debt and the IMF composite metric. We examined the countries similar to Hungary in two types of groups: first we analysed the typical incidence of the reserve indicators along the dimensions used in our research, i.e. for the group of countries belonging to the high-income category, applying floating exchange rate regime, with free capital flows (group one) and then for those typical for regional non-euro area countries within the European Union (group two), relying on our IMF database. Group one represents about 7 per cent⁸ of our tested sample, while group two represents roughly 6 per cent⁹ of it. In the case of the countries belonging to group one, the IMF examines reserve adequacy based on one and two indicators (at a ratio of 57 and 43 per cent). The IMF composite metric and the short-term external debt are the most frequently used indicators (86 and 43 per cent),

Figure 7
Reserve indicators used in the IMF country reports in the countries with similar characteristics as Hungary and in the regional countries of the non-euro area



Source: Collected from IMF country reports.

⁸ The group includes Chile, South-Korea, Israel, Poland, Hungary, Seychelles Islands and Uruguay.

⁹ The group includes Bulgaria, the Czech Republic, Croatia, Poland, Hungary and Romania.

while the import rule is used less often (14 per cent) and the monetary aggregate is not relevant at all (0 per cent) (Figure 7). Reserve adequacy is analysed in the case of Hungary and Uruguay based on the short-term external debt and the IMF composite metric, in the case of the Seychelles Island based on the IMF composite metric and the import rule, while in the case of Chile, South Korea and Poland only on the basis of the IMF composite metric, and for Israel based on the short-term external debt.

In the case of the other group, we examined the reserve adequacy ratio of the EU non-euro area countries, most relevant for and at a similar development level as Hungary. As regards our three main dimensions (1) – with the exception of Romania and Bulgaria – the majority of the countries belong to the high-income category, (2) none of the countries restricts capital flows, (3) Poland, Hungary and Romania apply floating exchange rate regime. The results are very similar to those of group one; the IMF composite metric and short-term external debt can be regarded as the two most important indicators (100 and 67 per cent), while the import rule and the monetary aggregate occur at a lower, but identical rate (33 per cent each). The higher ratio observed for the import rule and the monetary aggregate, belong to the two upper middle-income countries, i.e. Bulgaria and Romania, since in the case of these countries the IMF examines all four indicators. (In the case of Bulgaria the use of the monetary aggregate is justified by the fixed exchange rate regime, or more precisely the currency board, while Romania is characterised by the floating exchange rate regime, thus our third hypothesis is not confirmed by Romania alone.) In the case of the Czech Republic and Poland, the IMF analyses reserve adequacy only on the basis of its own metric, while for Croatia and Hungary it uses the short-term external debt and the IMF composite metric. Only two countries, i.e. Poland and Hungary, are at the intersection of the two groups.

The analysis of the reserve adequacy is not a constant element of the European Commission's country reports; when it is used, the Commission gives preference to the traditional reserve indicators. In addition to our database resting on the IMF country reports, we also analysed the reserve adequacy of the non-euro area regional countries based on the country reports prepared by the European Commission between 2014 and 2016. In 2014, no reference to the reserve adequacy appeared in the reports at any of the six countries; the Commission analysed the then current level of the reserves in 2015 only for Croatia, and in 2016 for Bulgaria, Croatia and Hungary. In the case of Croatia, the short-term external debt and the import rule appeared in both annual reports; however, in 2016 the Commission added the monetary aggregates and the gross external debt as well to the evaluation criteria. The short-term external debt appeared in the case of Hungary, while the monetary aggregates appeared in the case of Bulgaria, operating a currency board, as relevant indicators, which also corresponds to the results of our research performed on the IMF data.

5. Reserve indicators used in investment bank analyses

Apart from the international institutions, investment banks also regularly analyse the reserve adequacy of individual countries. In this chapter, we present the reserve indicators used in the investment bank analyses and their frequency. We expanded the *Csávás – Csom-Bíró 2016* analysis related to the MNB, with additional banks and we also involved the emerging countries in the survey.

5.1. Data compilation

For the investment bank analysis, the first filter was represented by the selection of the range of banks. As a source, we primarily used the recommendations and analyses prepared regularly by large investment banks and sent directly to their clients. The database available to us contained the analyses of roughly 30 banks; however, the analyses of some banks contained no reference to reserve adequacy. *Our sample includes altogether 21 large banks operating on a global basis or in several countries.*¹⁰ In addition to the non-public bank analyses, to a lesser degree we also relied on the banks' websites as a source, and thus we could also examine publicly available analyses.¹¹ Based on the number of banks, the sample may appear small, particularly when compared to the database compiled on the basis of the IMF reports. However, the banks under review may be deemed significant based on their market weight; their combined share in the global foreign exchange market turnover is 75 per cent, based on the regular survey performed by Euromoney (*Euromoney 2015*). Since the analyses are prepared for the clients of the banks, who can take into consideration the analyses when they trade in the market, the ratio of the banks in terms of their potential market effect may be deemed significant. As regards the ratio of the banks under review in the domestic forint/foreign currency market, they have similarly high share in the spot foreign exchange turnover.

The period under review is 2014-2016, which is in line with the date of the IMF reports examined earlier, thus we could survey a relatively long period. When collecting the analyses of the individual banks, we followed the principle that wherever it was possible, at least two analyses should be included in the database. In the case of a few banks we found only one relevant analysis, and thus with a view to increasing the sample size, for some banks 3–4 analyses were involved in the examination. As a result of this, *our survey includes 48 different analyses*, i.e. a little more than two analyses per bank on average.

¹⁰ Bank of America, Bank Zachodni Santander Group, Barclays, Citibank, Commerzbank, Credit Suisse, Concorde, Danske, Deutsche, Erste, Franklin Templeton, Goldman Sachs, HSBC, JPMorgan, KBC, Morgan Stanley, Nomura, OTP, Societe Generale, UBS, Unicredit.

¹¹ Publicly available analyses: Bank Zachodni WBK 2016, Deutsche Bank Research 2016, Goldman Sachs 2013, JP Morgan 2016, Templeton 2015, UBS 2015.

Upon categorising the reserve indicators, we followed similar principles as in the case of the database compiled from the IMF reports. In addition to the Guidotti–Greenspan indicator, we also allocated the modified versions thereof (e.g. gross external financing requirement) to the short-term external debt indicator. In addition, of the traditional indicators, the import rule and monetary aggregates, as well as the IMF composite metric, also appear in the bank analyses. The monetary aggregate denotes the M2 monetary aggregate in all analyses. In the case of the IMF composite metric, the banks often import the data from the IMF reports, but there are also examples of own calculations. In addition to these four indicators, one bank uses a cost-benefit based optimising model, being its in-house developed model, thus we ignored this indicator for the purpose of the analysis (Goldman Sachs 2013).

Our sample includes 30 emerging countries altogether. As regards the countries under analysis, the nature of the analyses limited the range of countries. Less than half of the analyses relates only to one country, among them mostly to Hungary. The rest of the analyses examine many countries together. The developed countries were excluded from the sample in this examination as well; the analyses typically allocate the countries to the emerging category.

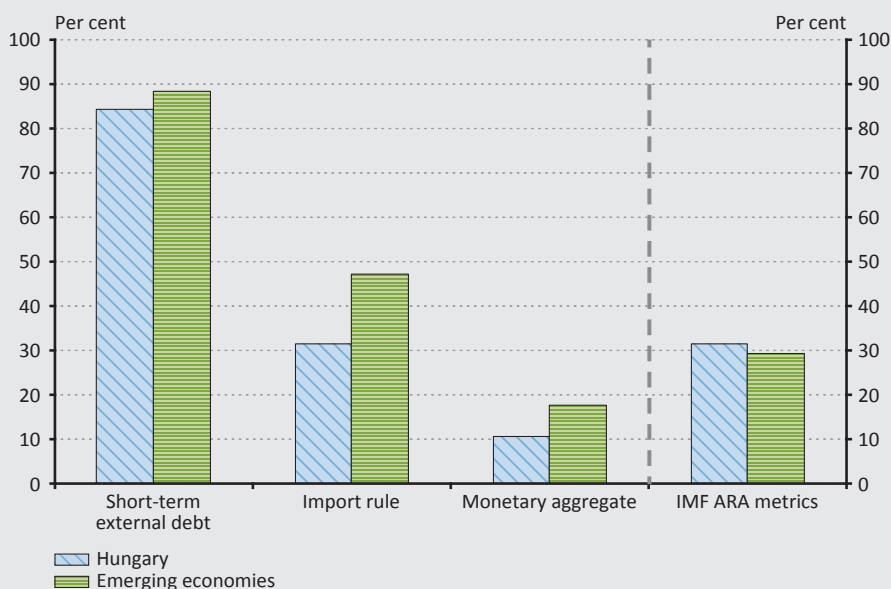
While in the case of the analyses dealing with the given country separately, the banks may select the indicators to be used based on country-specific factors, in the case of the combined analyses covering several countries, this is usually not the case. This does not permit an analysis of which country-specific factors the banks apply to differentiate between the countries in respect of the indicators used. On the other hand, we divided the samples into two parts: analyses related to Hungary and generally to emerging countries. In the case of Hungary, we examined the analyses of 19 banks, and in the case of emerging countries those of 17 banks, and thus the range of the banks is mostly identical. As regards the number of the analyses, we examined 33 and 26 of them, respectively. Analyses which also assessed the MNB's reserve adequacy were included in both groups, however, the two sub-samples only overlap to a small degree.

During the analyses we evaluated it as a hit, if the given indicator appears in the analysis of a bank, be it *in text, on a figure or in a table*. However, if a given bank uses the same indicator in two separate analyses related either to Hungary, or to a group of emerging countries, we treated it only as one hit for the given indicator. Thus, the overrepresentation of the banks included in the databases with several analyses can be avoided. If the same bank indicated two different indicators in its two different analyses, we evaluated it as a hit. In accordance with this, we compare the hit rates not to the number of analyses, but to the number of banks that provided the analyses.

5.2. Results

In the case of the emerging countries and Hungary, the vast majority of the large investment banks monitor short-term external debt, and almost all banks use it for the assessment of reserve adequacy. The banks assess the reserve adequacy of emerging countries based on several indicators, of which the short-term external debt is the most popular one. The same applies to the analyses examining Hungary: more than 80 per cent of the banks monitor this indicator (Figure 8). Thus, the short-term external debt rule is not only the most popular among the banks, but it can be stated that almost all banks under review use it for the assessment of reserve adequacy. In the case of the emerging countries, the next one in the line is the import rule, with almost half the banks using this indicator. However, in the case of Hungary, the second most popular indicator, lagging well behind the short-term external debt, is the IMF composite metric applicable to emerging countries. The incidence rate is around 30 per cent, i.e. almost one-third of the banks use this indicator. In the case of the emerging countries we find a similar ratio, although here this indicator is ranked only third in terms of incidence. The result related to the IMF composite metric may be interesting in the sense that of the examined indicators this is the newest one, nevertheless the large banks have already started to use it. The monetary aggregates indicator, taking the fourth place, is the last one in both groups, it is mentioned only by 2–3 investment banks.

Figure 8
Incidence of the individual reserve indicators used by the banks



Note: Ratio of the banks mentioning the given indicator within all banks, several banks mentioned more than one indicator. 48 analysis of 21 banks, published in 2014–2016, based on 30 emerging countries in total. Source: Bank analyses.

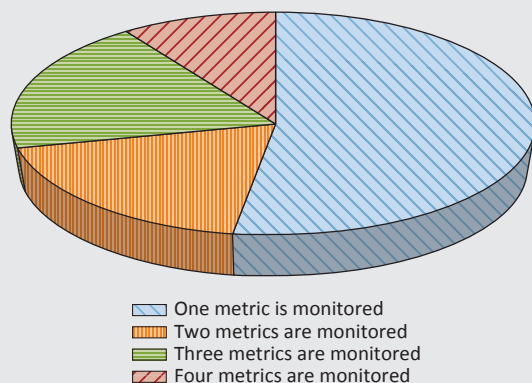
In the case of Hungary, the import rule is used less frequently than for the other emerging countries. The banks examine the individual indicators in a similar ratio for Hungary and for the entirety of the emerging countries. Significant difference can be seen in the case of the import rule, which is mentioned almost one and a half times more frequently for the emerging countries than for Hungary. Despite the relatively small sample size, this can be regarded as a substantial difference. The difference is attributable to three more hits, which is not negligible relative to the total number of the banks (due to the partially overlapping sample, we did not examine the difference between the use of the individual indicators by statistical tests, as they typically assume that the two sub-samples are independent of each other).

The significantly different ratio of the import rule, observed in the case of Hungary and the rest of the emerging countries, may be attributable to country-specific factors. Although we do not examine it by tests similar to the previous chapter, the difference related to the import rule is presumably attributable to country-specific factors examined earlier. In order to confirm this, we examined to what extent the average characteristics of the emerging countries under review differ from those of Hungary. As regards income, we found that about 20 per cent of the emerging countries under review – which were included in the previous analysis based on the IMF reports – belong to the high-income, half of them to the upper middle- and the rest of them to the lower middle-income category. Since Hungary is in the high-income category, one reason for the difference may be that the income of the emerging countries is lower on average, which showed a higher incidence rate for the import rule in the IMF's practice as well. The difference may be also attributable to the fact that about 70 per cent of the emerging countries belong to the free capital flows category, while 30 cent of them apply capital controls, which also justifies the higher relevance of the import rule. As regards the exchange rate regime, the emerging market group is less heterogeneous; almost 85 per cent of them apply a floating exchange rate regime (the high ratio of the countries with floating exchange rate regime is presumably attributable to the fact that currencies with fixed exchange rate are less relevant in the focus of the investment banks for the purpose of the exchange rate analyses). The inclusion of the countries with fixed exchange rate regime in the investment banks' sample may also explain the higher incidence of the application of the import rule.

Based on the combined use of the indicators, in addition to the short-term external debt, the banks tend to use the other indicators only as a complementary indicator. Similarly to the IMF reports, we also examined the incidence rate when the banks examine an indicator alone or together with other indicators. The picture is similar in the sense that about half of the banks mentioned only one indicator (*Figure 9*). The most important difference is that in the case of the banks that mentioned

only one indicator, practically all banks mentioned the short-term external debt. In the case of the banks that examine two indicators, it can be also stated that there was only one example, when these two indicators did not include the short-term external debt (combination of the import rule and the IMF composite metric). At each of the banks that examine three indicators together, the combination included the short-term external debt, the IMF composite metric and the import rule. The results suggest that in addition to the short-term external debt rule, banks tend to use the rest of the indicators only as complementary.

Figure 9
Incidence of reserve indicators based on bank analyses



Note: Ratio of the banks mentioning the given indicator within all banks, several banks mentioned more than one indicator. 48 analysis of 21 banks, published in 2014–2016, based on 30 emerging countries in total.

Source: Bank analyses.

The sequence of the individual indices differs significantly from the results obtained from the IMF reports, which suggests that the IMF is only partially able to orient banks' expectations. In the banks' analyses, the most popular indicator is the short-term external debt, followed by the import rule, while the IMF metric is ranked third. By contrast, in the IMF reports, in the case of the countries similar to Hungary, the most frequently used indicator was the IMF metric, followed by the short-term external debt and the import rule. The different results could be attributable to the different range of countries under review. However, if we filter the IMF reports to the countries examined in the banks' analyses, the sequence identified in the IMF reports does not change.¹² Accordingly, the difference in the two types of analyses is not attributable to the composition effect by countries. The prevalence of the IMF

¹² The incidence rate of the IMF index is almost 90 per cent, while the short-term external debt was monitored by the IMF in half of the countries, the import rule appears at 30 per cent and the monetary aggregate at one-sixth of the countries.

composite metric in the IMF reports may be attributable to the fact that IMF gives preference to its own indicator, which may be regarded relatively self-explanatory. Nevertheless, the different sequence suggests that although the banks also started to use the IMF composite metric, the IMF is only partially able to orient the banks' expectations as regards the type of indicators used for the assessment of reserve adequacy.

6. Summary

The literature recommends several criteria for which countries the reserve indicators measuring the foreign exchange reserve adequacy are relevant and for which ones they are less relevant. The main question examined in our paper is whether the individual reserve indicators are used in those countries where the academic literature regards them more relevant. For the analysis of the issue, we compiled a broad database, covering more than 100 countries, based on the IMF country analyses under Article IV and the reports related to the IMF programmes. We examined four indicators, namely short-term external debt, the IMF's composite metric, the import rule and the monetary aggregate.

The result of the analysis performed on the basis of the IMF country reports shows that the most frequently used indicator is the import rule, followed by the IMF composite metric and the short-term external debt. The use of the indicators significantly varies as function of income: the IMF tends to use the short-term external debt and the monetary aggregates more often for the higher-income countries, while the role of the import rule gradually decreases. This is in line with our hypothesis derived from the academic literature, according to which the use of the indicators depends on the access to capital markets, which is explained by the development level. The use of the IMF composite metric increases in parallel with the development level of the countries; however, the use of the composite metric for determining the optimal reserve level is becoming increasingly common in the case of the developing countries as well.

Further results confirmed a positive relation between the import rule and capital controls; however, the short-term external debt and monetary aggregate indicators are less frequent in the countries applying capital controls, which corresponds to the recommendations in the academic literature. Use of the import rule may be deemed excessive in the case of countries characterised by fully free capital flows, which may be attributable to the fact that there are also low-income and lower middle-income countries among them. Furthermore, we found that for countries applying fixed exchange rate regimes the monetary aggregates and import rule are used more often than for those with floating exchange rate regimes, while the use of short-term external debt is less frequent.

In the group of countries with similar development level as Hungary, with similar exchange rate regime and not applying capital controls, and in the non-euro area EU countries, the IMF assesses the reserve adequacy in the country reports based on two indicators, i.e. the short-term external debt and the IMF composite metric, while the import rule and the monetary aggregates are less relevant or not at all relevant indicators. The country reports prepared by the European Commission for the EU member states do not always contain an assessment of the foreign exchange reserves and the reserve adequacy, and thus we could draw conclusions only on the basis of some regional countries. The Commission prefers the traditional indicators, and the use of these corresponds to the IMF's practice.

Apart from the international institutions, the large international banks also assess the reserve adequacy of emerging countries based on several indicators. Based on 48 various analyses prepared by 21 banks acting globally or in several countries, we examined a total of 30 emerging countries for which reserve indicators are used the most often by investment banks. According to our results, the vast majority of the large investment banks monitor the short-term external debt both in the case of the emerging countries and Hungary. In the case of the emerging countries, after the import rule the IMF composite metric is the third most popular indicator, while in the case of Hungary the banks mentioned these two rules at an equal rate. That is, in the case of Hungary the use of the import rule – presumably due to country-specific factors – is less frequent than in the case of the other emerging countries. However, in the case of banks examining more than one index, it can be stated that the other indicators appear only as a complementary index in addition to the short-term external debt. Thus, the sequence of the individual indicators differs from the results obtained from the IMF reports, which suggests that the IMF only partially orients banks' expectations.

Annex

Table 1

IMF member states involved in the analysis and reports underlying the used data*

* The table continues on the next page

Country	Report 1		Report 2	
	Date	Name	Date	Name
Afghanistan	July 2016	ECF	November 2015	Article IV / SMP
Albania	September 2016	EFF	June 2016	Article IV / EFF
Algeria	May 2016	Article IV	December 2014	Article IV
Angola	November 2015	Article IV	September 2014	Article IV
Aruba	May 2015	Article IV	October 2010	Article IV
Azerbaijan	September 2016	Article IV	June 2014	Article IV
Bahamas	July 2016	Article IV	July 2015	Article IV
Bangladesh	January 2016	Article IV	November 2015	ECF
Barbados	August 2016	Article IV	February 2014	Article IV
Belize	October 2016	Article IV	March 2016	Article IV
Bolivia	December 2016	Article IV	December 2015	Article IV
Bosnia and Herzegovina	September 2016	EFF	October 2015	Article IV
Botswana	April 2016	Article IV	July 2014	Article IV
Brazil	November 2016	Article IV	May 2015	Article IV
Bulgaria	November 2016	Article IV	May 2015	Article IV
Burundi	March 2015	ECF	September 2014	Article IV / ECF
Cabo Verde	November 2016	Article IV	September 2014	Article IV
Chile	December 2016	Article IV	August 2015	Article IV
Colombia	June 2016	FCL	May 2016	Article IV
Comoros	December 2016	Article IV	February 2015	Article IV
Costa Rica	May 2016	Article IV	February 2015	Article IV
Czech Republic	July 2016	Article IV	July 2015	Article IV
South Africa	July 2016	Article IV	December 2014	Article IV
Djibouti	July 2016	Article IV	December 2015	Article IV
United Arab Emirates	July 2016	Article IV	August 2015	Article IV
Ethiopia	October 2016	Article IV	September 2015	Article IV
Belarus	September 2016	Article IV	May 2015	Article IV
Fiji	February 2016	Article IV	November 2015	Article IV
Philippines	September 2016	Article IV	September 2015	Article IV
Gambia	April 2015	RCF / ECF	September 2015	Article IV

Country	Report 1		Report 2	
	Date	Name	Date	Name
Ghana	October 2016	ECF	January 2016	ECF
Georgia	January 2015	SBA	August 2013	Article IV
Guatemala	August 2016	Article IV	September 2014	Article IV
Guinea	November 2016	ECF	July 2016	Article IV
Guyana	July 2016	Article IV	September 2014	Article IV
Haiti	June 2015	Article IV / ECF	January 2015	ECF
Honduras	November 2016	Article IV / SBA / SCF	January 2016	SBA / SCF
Croatia	June 2016	Article IV	May 2014	Article IV
India	March 2016	Article IV	March 2015	Article IV
Indonesia	March 2016	Article IV	March 2015	Article IV
Iraq	December 2016	SBA	July 2016	SBA
Iran	December 2015	Article IV	April 2014	Article IV
Island	June 2016	Article IV	March 2014	Article IV
Israel	September 2015	Article IV	February 2014	Article IV
Jamaica	November 2016	EFF / SBA	June 2016	Article IV / EFF
Yemen	September 2014	Article IV / ECF	July 2013	Article IV
Jordan	September 2016	EFF	June 2014	Article IV / SBA
Cambodia	November 2016	Article IV	November 2015	Article IV
Kazakhstan	September 2015	Article IV	August 2014	Article IV
Kenya	March 2016	Article IV / SBA / SCF	October 2014	Article IV
China	August 2016	Article IV	August 2015	Article IV
Kyrgyz Republic	June 2016	ECF	February 2016	Article IV / ECF
Rep. of Congo	October 2015	Article IV	October 2014	Article IV
Korea	August 2016	Article IV	May 2015	Article IV
Kuwait	December 2015	Article IV	December 2014	Article IV
Lao People's Democratic Republic	February 2015	Article IV	December 2013	Article IV
Poland	July 2016	Article IV	January 2016	FCL
Lebanon	July 2015	Article IV	July 2014	Article IV
Liberia	December 2016	ECF	January 2016	ECF
Macedonia	November 2016	Article IV	September 2015	Article IV
Madagascar	August 2016	ECF	November 2015	RCF
Hungary	April 2016	Article IV	April 2015	Article IV
Malawi	June 2016	ECF	December 2015	Article IV
Malaysia	May 2016	Article IV	March 2015	Article IV

Country	Report 1		Report 2	
	Date	Name	Date	Name
Maldives	May 2016	Article IV	March 2015	Article IV
Morocco	August 2016	PLL	February 2016	Article IV
Mauritania	May 2016	Article IV	February 2015	Article IV
Mauritius	March 2016	Article IV	May 2014	Article IV
Mexico	November 2016	Article IV	May 2016	FCL
Moldova	November 2016	EFF / ECF	January 2016	Article IV
Mongolia	April 2015	Article IV	March 2014	Article IV
Mozambique	January 2016	Article IV / PSI / SCF	August 2015	PSI
Myanmar	September 2015	Article IV	October 2014	Article IV
Nicaragua	February 2016	Article IV	December 2013	Article IV
Nigeria	April 2016	Article IV	March 2015	Article IV
Russian Federation	July 2016	Article IV	August 2015	Article IV
Pakistan	October 2016	EFF	January 2016	Article IV / EFF
Papua New Guinea	November 2015	Article IV	December 2014	Article IV
Paraguay	May 2016	Article IV	February 2015	Article IV
Peru	July 2016	Article IV	May 2015	Article IV
Romania	May 2016	Article IV	March 2015	Article IV
Rwanda	June 2016	PSI / SCF	January 2016	PSI
Solomon Islands	March 2016	Article IV / ECF	April 2015	ECF
São Tomé and Príncipe	December 2016	ECF	June 2016	Article IV / ECF
Seychelles	January 2016	EFF	July 2015	Article IV / EFF
Sierra Leone	December 2016	ECF	July 2016	Article IV / ECF
Sri Lanka	December 2016	EFF	June 2016	Article IV / EFF
Suriname	June 2016	SBA	October 2014	Article IV
Samoa	July 2015	Article IV	June 2013	RCF
Saudi Arabia	October 2016	Article IV	September 2015	Article IV
Serbia	December 2016	SBA	September 2016	SBA
Sudan	October 2016	Article IV	December 2014	Article IV
Tajikistan	February 2016	FSSA	May 2012	ECF
Tanzania	July 2016	Article IV / PSI	February 2016	PSI
Thailand	June 2016	Article IV	May 2015	Article IV
Tonga	June 2016	Article IV	April 2015	Article IV
Turkey	April 2016	Article IV	December 2014	Article IV
Trinidad and Tobago	June 2016	Article IV	September 2014	Article IV

Country	Report 1		Report 2	
	Date	Name	Date	Name
Tunisia	June 2016	EFF	October 2015	Article IV / SBA
Uganda	June 2016	PSI	November 2015	PSI
Ukraine	September 2016	EFF	August 2015	EFF
Uruguay	February 2016	Article IV	March 2015	Article IV
Vanuatu	October 2016	Article IV	June 2015	Article IV / RCF
Vietnam	July 2016	Article IV	October 2014	Article IV
Zambia	June 2015	Article IV	January 2014	Article IV
Abbreviations:				
<i>ECF – Extended Credit Facility</i>				
<i>RCF – Rapid Credit Facility</i>				
<i>EFF – Extended Fund Facility</i>				
<i>SBA – Stand-By Arrangements</i>				
<i>FSSA – Financial System Stability Assessment</i>				
<i>SCF – Standby Credit Facility</i>				
<i>PLL – Precautionary and Liquidity Line</i>				
<i>SMP – Staff-Monitored Program</i>				
<i>Source: Collected from IMF country reports.</i>				

Table 2						
Test results						
	high-income and upper middle-income category		low-income and lower middle-income category		Z-score	P-value
	r	n	r	n		
Short-term external debt	0.36	53	0.17	52	2.20	0.015
Import rule	0.60	53	0.96	52	-4.95	0.000
Monetary aggregate	0.28	53	0.15	52	1.62	0.054
IMF composite metric	0.74	53	0.44	52	3.20	0.001
	free capital flow		restricted capital flow			
	r	n	r	n		
Short-term external debt	0.32	56	0.21	48	1.32	0.095
Import rule	0.73	56	0.85	48	-1.56	0.061
Monetary aggregate	0.23	56	0.21	48	0.29	0.385
IMF composite metric	0.63	56	0.54	48	0.86	0.196
	floating exchange rate regime		fixed exchange rate regime			
	r	n	r	n		
Short-term external debt	0.36	47	0.19	58	1.98	0.025
Import rule	0.66	47	0.88	58	-2.70	0.004
Monetary aggregate	0.15	47	0.28	58	-1.62	0.054
IMF composite metric	0.62	47	0.57	58	0.50	0.309

Note:
n denotes the number of observations in the given category, while *r* denotes the use rate of the given reserve indicator within that.
Z-score denotes the test statistics used for the testing of the difference between the ratio of the two sub-samples.
P-value denotes the significance level of the z-score test statistics, calculated by the Welch one-way t-test.

Source: Collected from IMF country reports.

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