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The views expressed in this paper are those of the authors.

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ABSTRACT

In the run up to the financial crisis of 2007-2009 many emerging market economies, including Poland, were affected by considerable inflows of capital – capital that their financial systems found difficult to absorb. One of a number of policy options to respond to such inflows are currency-based measures (CBMs) directed at banks that are, in principle, motivated by (macro-)prudential concerns. These measures are bank regulations that apply a discrimination on the basis of the currency of an operation, typically foreign currencies. This paper presents and analyses a dataset of CBMs directed at banks in Poland between 2005 and 2013. We denote the motivations for imposing CBMs and assess their effectiveness by measuring their impact on capital flows. We find that there is evidence of negative impact of CBMs on capital inflows in the first quarter after the measure starts to be in effect. It means that actions have targeted capital inflows – despite the declared (macro-)prudential purpose of the measures. However, we also find that the model implies a stronger effect when the variable of unweighted CBMs is used. Moreover, the model implies a strong relationship between capital inflows and the exchange rate. However, we do not find the impact of CBMs on the exchange rate.

JEL Classification: F3, F65, G21, G28, G32

Key words: foreign currency-related measures, currency-based measures, currency risk, macro-prudential policy, capital flows, banking regulation, financial stability.

ACRONYMS

AEs Advanced Economies

AREAER Annual Report on Exchange Arrangements and Exchange Restrictions

BCBS Basel Committee on Banking Supervision

BIS Bank of International Settlements

CAD Capital Adequacy Directive

CBMs Currency-Based Measures

CBS Commission for Banking Supervision

CFMs Capital Flow Management Measures

EMEs Emerging Market Economies

ESRB European Stability Risk Board

EU European Union

FX Foreign Exchange

GFC Global Financial Crisis

IMF International Monetary Fund

MPMs Macro-Prudential Measures

OECD Organisation for Economic Co-operation and Development

PFSA Polish Financial Supervision Authority

I.   INTRODUCTION AND LITERATURE REVIEW

As the size and volatility of international capital flows have increased over the last years, the policy debate about the place of currency-based measures (CBMs) in the policy toolkit of emerging-market economies (EMEs) has intensified. The discussions on regulations imposing a different treatment between domestic and FX-denominated operations by banks stems from the fact that even that the restrictions on capital flows may reduce volatile inflows of capital in the country that is imposing them, these controls can have broader implications. The IMF has altered its position and currently suggests that these controls are a legitimate tool under certain circumstances, and may be introduced when a country faces a surge in net capital inflows, even after taking into account multilateral considerations (IMF, 2012). Some EMEs have increasingly resorted to and tightened their CBMs, especially to manage capital inflows (de Crescenzio et al., 2015).

In the run up to the financial crisis of 2007-2009 many emerging market economies, including Poland, were affected by considerable capital inflows which were difficult to absorb by their financial systems. The inflow of capital to Poland was channelled through the banking system and contributed to a significant expansion of credit, mainly mortgages, and caused an increase in real estate prices. As a result, large scale of capital inflows created a boom in the real estate market and the entire economy. Capital flows from western European banks were a main driver of the credit and demand boom in Poland. Western European banks financed much of the credit increase through loans, deposits, and capital provided to their local subsidiaries (Kabza, 2014).

One of a number of policy options to respond to such inflows are currency-based measures[1] directed at banks that are, in principle, motivated by macro-prudential

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[1] In the paper there is no assessment as to whether any of the measures in the dataset have a bearing on adherents' rights and obligations of the OECD Code of Liberalisation of Capital Movements and relevant decree under the rules on the free movement of capital set out in Articles 63 *et seq.* of the Treaty on the Functioning of the European Union.

concerns. These measures are bank regulations that apply a discrimination on the basis of the currency of an operation, typically foreign currencies.

The increased use of macro-prudential and capital flow management measures in the aftermath of the crisis has started a new thread in the literature that aims at assessing the impact of such policy tools on a range of economic variables, such as capital flows, credit growth, asset prices, output growth as well as categorising information on these regulations.

Currency-based measures encompass a broad category of measures. In the paper we define them after de Crescenzio et al. (2015) as regulations imposing a different treatment between domestic and FX-denominated operations by banks. This treatment is generally less favourable for operations in foreign currencies, compared to domestic currency-denominated ones. CBMs may be addressed at operations amongst residents, or at operations between residents and non-residents. Within this broad category, a sub-set of CMBs has the character of capital flow management measures (CFMs)[2], for example when these measures target operations abroad with non-residents. Also, among currency-based CFMs, those restrictions that apply to operations with non-residents only (discriminate on the basis of residency) are defined as traditional capital controls[3].

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[2] CFMs encompass a broad range of administrative, tax, and prudential measures that are designed to influence capital flows. They can be grouped into residency based CFMs and other CFMs. Residency-based CFMs include a variety of measures affecting cross-border financial activity that discriminate on the basis of residency – often referred to as capital controls. Examples of residency-based CFMs include for example taxes on flows from non-residents or unremunerated reserve requirements on such flows. Other CFMs are measures that do not discriminate on the basis of residency, but are nonetheless designed to influence capital inflows. This category would typically include a subset of prudential measures differentiating transactions on the basis of currency, such as limits on foreign currency borrowing and currency specific reserve requirements, and other measures typically applied to the nonfinancial sector, such as minimum holding periods and taxes on certain investments – IMF (2012a).
[3] As noted by the IMF discrimination is considered to occur when "(i) a measure explicitly differentiates on the basis of residency (of either the parties or assets involved), (ii) this differentiation treats non-resident transactions less favorably, and (iii) the less favorable treatment is not justified by relevant inherent differences in the non-resident transactions. The criterion in (iii) is a narrow concept that provides flexibility to differentiate between resident and non-resident transactions only where this is necessary to put the two sets of transactions on an equal footing." – IMF (2011).

There are two main objectives that currency-based measures could pursue. The first is exchange rate management: currency-based measures have been held out as a mechanism for avoiding overheating of the economy and excessive exchange rate appreciation associated with surges in net capital inflows (Pradhan et al., 2011). A second possible use of this measure is as a tool for macroprudential policy, i.e., systemic risk mitigation.

There are examples of cases where CBMs could be useful from a macroprudential perspective. First, when excessive foreign inflows pose a risk of creating domestic imbalances that cannot be directly addressed through domestic prudential regulation (for example, loan-to-value ratios or capital buffers at financial institutions), since the flows are not directly intermediated through the domestic financial system. In this case, it is proposed that controls on cross-border transactions may be useful (Ostry et al., 2012). A second example where CBMs may be useful from a macroprudential perspective relates to foreign (and/or foreign currency) borrowing in EMEs (Pandey et al., 2015). It has been indicated in the literature that, for EMEs, excessive foreign currency borrowing can lead to future financial crashes and generate suboptimal outcomes from a systemic risk perspective (Goldstein et al., 2004; Eichengreen et al., 2007). Given the evidence linking external debt, especially in foreign currencies, to financial fragility, currency-based measures (particularly on foreign borrowing) could be justified as a tool for macroprudential management. Particularly, these measures could allow the authorities to influence the level of short-term foreign currency borrowing, high levels of which have been associated with past EME crises (Pandey et al., 2015).

Pasricha et al. (2015) analyse domestic and multilateral effects of capital controls and currency-based prudential measures before and after the global financial crisis (GFC) in 17 major emerging market economies (EMEs) over the period 2001-2011. One of their findings suggests that there is evidence of effectiveness of these measures before the GFC. However, the usefulness of these measures weakened in the post-crisis environment. Paper of de Crescenzio et al. (2015) contains an analysis of currency-

based measures directed at banks in a sample of 49 countries between 2005 and 2013. It shows that in the pre-crisis period (2005) emerging market economies had more CBMs in place than advanced economies (AEs), and these tools targeted inflows. The use of CBMs has increased in the post-crisis period, particularly among EMEs[4]. Moreover, despite the declared intent of the measures, tightening actions on net positions of banks, which include the most conventional macro-prudential measures (MPMs), were less frequent than those on capital inflows and those on assets and liabilities (although all countries claimed that actions were introduced with a macro-prudential purpose). Actions have mostly targeted capital inflows and FX liabilities (they did not target potential imbalances between inflows and outflows or assets and liabilities, which are typically managed by conventional measures on positions like conventional MPMs which include limits on the net FX position of banks, caps on LtV ratios, DSTI ratios, etc.). Currency-based measures in place (in addition to the common limit on the net FX position of banks) included for example: differentiated reserve for domestic and FX deposits, rules on FX accounts (mainly targeted accounts operated by residents with funds from abroad), measures limiting lending in FX, regulations of trading in FX derivatives, liquidity and maturity matching requirements differentiated by currency and regulations of lending in domestic currency to non-residents or of domestic currency accounts operated by non-residents[5].

While recognising the importance of strengthening national prudential regulations to improve banks' risk management and address broader systemic risk issues, the resort to CBMs needs to be carefully considered to analyse their overall impact on various variables. While some of these measures may enhance resilience to shocks,

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[4] While the pre-crisis period was characterised by a large use of conventional measures, such as the regulation of the net FX position of banks, other types of CBMs were also increasingly used in the post-crisis period, ranging from taxes on FX liabilities to rules limiting FX derivatives.

[5] Liquidity requirements are measures which force banks to put aside liquidity buffers denominated in the same currency of funding and may be differentiated by currency if the requirements apply differently in FX and domestic currency. Maturity matching requirements are measures which require banks to match the maturity of their assets and liabilities and may be differentiated by currency if the requirements apply differently in FX and domestic currency.

analysis on their actual impact is still limited. The assessment of the impact of currency-based prudential tools on a range of economic variables has become an interesting field to explore – especially given the development of the macroprudential policy and its instruments.

The objective of this paper is to provide a description and assessment of the effectiveness of currency-based measures imposed for macro-prudential purposes in Poland. The implementation of currency-based measures with a purpose of systemic risk mitigation in Poland is interesting for a number of reasons. CBMs were applied in a small open economy with fully liberalized capital flows, experiencing real convergence. Gradually introducing regulations that facilitated free movement of capital and opening of the capital account, culminating in Poland's membership in the European Union, resulted in an increase in cross-border capital inflows. At the same time, the EU membership removed the option of using capital controls.

The paper presents and analyses a dataset of currency-based measures directed at banks for macro-prudential purposes in Poland between 2005 and 2013. We assess the motivations for imposing CBMs (under the hypothesis that the capital inflows were one of the triggers for their imposition) and their effectiveness in Poland by measuring their impact on capital flows. Our key contribution is that we extend the literature on the effectiveness of currency-based measures used for macro-prudential purposes by focusing on CBMs targeting banks in Poland.

The remainder of the paper is organised as follows. Section II presents the financial stability considerations with regard to capital inflows to Poland between 2004 and 2014. Section III explains the data and methodology used in the paper and provides empirical results on the effectiveness of CBMs measures in Poland. Section IV concludes and highlights possible areas of future work.

II. CAPITAL INFLOWS AND FINANCIAL STABILITY CONSIDERATIONS – CASE OF POLAND

Background

Capital inflows to Poland were the consequence of gradually introduced regulations that facilitated free movement of capital, accompanied by the necessary changes in the prudential rules. Changes in the regulations were associated with Poland's soliciting membership in international economic and financial organizations and, in particular, the adoption of their standards and recommendations. Particularly it concerned membership in the Organization for Economic Cooperation and Development (OECD)[6], introduction of standards and guidelines of the Basel Committee on Banking Supervision (BCBS) to Polish prudential regulations, and finally, adaptation of Polish law to EU law, which was associated with the Poland's efforts to join the European Union (EU).

Recommendations, resolutions and declarations issued by the OECD are binding for the Member States and other countries that intend to join the OECD. For this reason Poland, before accession to the European Union, conducted an intensive process of economic liberalization. One of the most important areas was the free movement of capital. Due to the need to adapt to the OECD recommendations, Polish foreign exchange law was liberalized in 1990s, and the process ended in 2002 with the adoption of the (applicable today) foreign exchange law that abolished restrictions on foreign currency operations of banks. One of the consequences of these changes was a full liberalization of the provision of loans by banks in currencies other than zloty (PLN).

Parallel to the legislative changes there was a process of adjusting prudential standards to those of the Basel Committee and the EU directives. Standards and guidelines of the Basel Committee have the status of recommendations, and thus are

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[6] Poland became the 28th member of the OECD in November 1996 (OECD currently has 34 members).

not mandatory, even for its member countries[7]. While Poland is not a member of the Basel Committee, is indirectly bound to comply with the Basel standards and guidelines – the European Commission has an observer status with the Basel Committee, and as a EU regulator is committed to comply EU law with the standards and guidelines of the Committee. Thus these documents, as EU law, are binding for all EU member countries. In particular, Directive 93/6/EEC of 15 March 1993 on the capital adequacy of investment firms and credit institutions (Capital Adequacy Directive, CAD), referred to the currency risk by setting the capital requirement in this respect. The directive also sanctioned the activities of banks associated with making derivative transactions and estimation of the associated risks and capital requirement. Moreover, in 1996, the Basel Committee issued a standard on commercial activities of banks and capital requirements for market risk (including i.a. currency risk).

The process of adapting Polish law to international standards and EU law was gradual. The revised banking law of 1997 contained term financial operations on the list of banking operations. In particular, this meant that banks may include currency interest rate swaps (CIRS), which are used by banks as a hedge against market risk – in this case – foreign currency risk and interest rate risk[8]. These changes emerged in the Polish law due to Resolution No. 5/2001 of the Commission for Banking Supervision (CBS) dated 12 December 2001 on the scope and detailed procedures for determining capital requirements for particular risks, including for exceeding debt exposure limits, method and detailed rules for calculating the bank's solvency ratio, taking into account bank's linkages with other subsidiaries or entities operating within the same group as well as establishing additional items of bank's balance

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[7] Nonetheless, any assessment of the financial credibility of the country is conducted with reference to the compliance of the regulatory environment, regulatory and supervisory practice with the documents of the Basel Committee.

[8] This risk arises when the asset expressed in one currency is funded by the liability denominated in another currency – the currency position is opened then. If it is not closed, the Basel standards and EU law require to take account of currency mismatches in the calculation of capital adequacy, which is very costly.

sheet together with equity in calculation of capital adequacy, and scope and manner of their determination. The resolution largely implemented the provisions of CAD, while in terms of the calculation of capital requirement for foreign exchange risk the regulation was already in full compliance with the provisions of CAD.

The above resolution was subsequently replaced by Resolution No. 4/2004 of the CBS of 8 September 2004[9] which was associated with the adjustment of Polish law to the EU law (due to the accession process) and fully introduced provisions of CAD. Since then Polish law and prudential regulations for the banking sector were in full compliance with EU law, and standards of the Basel Committee. Polish rules and regulations were and are mandatory. Therefore, the banks activities based on these regulations have been consistent with the standards of the Basel Committee and EU directives[10].

*Capital inflows to Poland and their consequences*

After 2004, countries that were new members of the European Union – including Poland – experienced a rapid increase in debt in the non-financial sector. The strong increase in the level of credit is one of the basic elements of the process of catching up in economic development, because it involves the development of financial market within the household sector. It can also be a risk factor for the macroeconomic and financial development of individual economies due to excessive household debt – especially in foreign currency – and thus increases their vulnerability to financial crises.

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[9] Resolution on the scope and detailed procedures for determining capital requirements for particular risks and application of statistical methods and conditions that allows to obtain permission for their use, method and detailed rules for calculating the bank's solvency ratio, the scope and manner of accounting for banks' activities in groups in calculating capital requirements and capital adequacy ratio as well as establishing additional items of bank balance sheets included in equity in calculation of capital adequacy and scope, method and conditions of their determination.

[10] Including financing of foreign currency loans.

The inflow of capital was channelled through the banking system and contributed to a significant expansion of credit, chiefly mortgages, and caused an increase in real estate prices. As a result, large scale of capital inflow (see Figure 1) created a boom in the real estate market and the entire economy. Moreover, in contrast to foreign direct investment, capital inflows have not contributed to the growth of productive capital, as foreign funds were used mainly in the real estate sector. The influx of capital has also contributed to the growth of external debt and the growing dependence on foreign financing.

Figure 1. Capital inflows[11] to Poland between 2004 and 2014 (mln EUR)
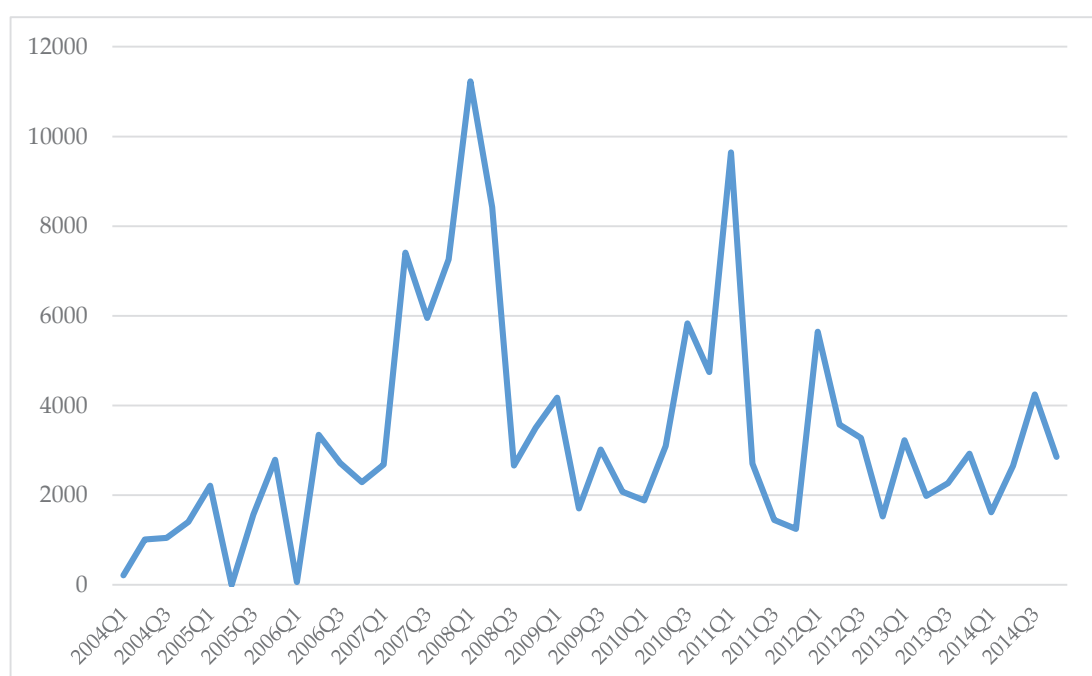
Source: own calculations based on the NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

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[11] Capital inflows are measured as the sum of absolute values of negative observations from assets and positive values of liabilities for following categories of the Financial account of the balance of payments: Portfolio investments (debt and equity, excluding transactions of the National Bank of Poland, Government transactions and Other Monetary Financial institutions), Other investments (excluding Trade credits and SDRs Allocation), and also absolute values of negative observations of financial derivatives. See equation (1), page 20.

Capital inflows from western European banks were a key conduit of the credit and demand boom in Poland (Bakker and Klingen, 2012). As a result of privatization and restructuring, many banks in Poland became subsidiaries of the institutions operating internationally, mostly large European banking groups (see Figure 2). Those banks were intermediaries for the inflow of foreign capital because they financed much of the credit increase through loans, deposits, and capital provided to their local subsidiaries.

Figure 2. Foreign owned banks in Poland (% share in total sector assets)
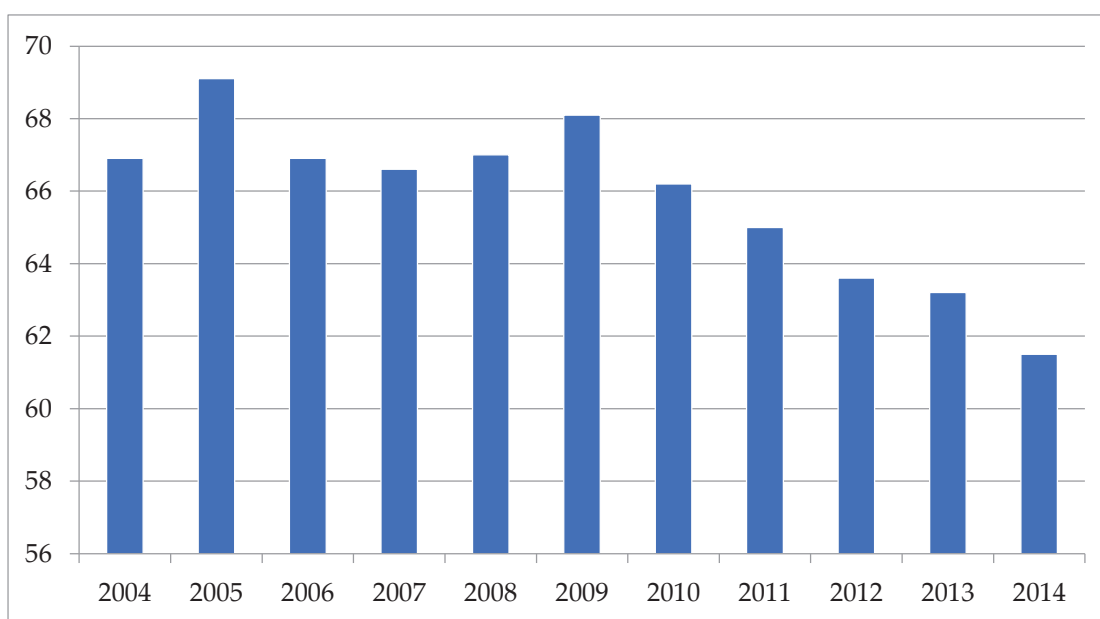
Source: own calculations based on the data from the Polish Financial Supervision Authority's website

The bank loan portfolio structure leaned much towards lending to households, in particular towards mortgage lending. Foreign currency (FX) mortgage loans, mostly denominated in Swiss francs, became very popular in Poland before the crisis (see Figure 3). These loans were attractive for borrowers because they induced lower interest rates than domestic currency loans. The interest rate difference between loans in zloty and in foreign currencies (mainly CHF) was often used by banks to sell the loans in spite of the fact that they were exposing households to risky FX positions – for banks they were profitable because of additional revenues related to foreign

exchange rate operations and high commissions. FX mortgage loans were cheaper as long as the exchange rate remained stable or appreciated—an expectation that was widely held at the time (both by borrowers and credit providers) (Kabza, 2014). When the interest rate differential narrowed in 2007, FX borrowing slowed down, but it picked up pace in 2008, as soon as the differential widened again. However, as long as FX loans were popular and the open FX position of the household sector was increasing, the appreciation of the zloty became a self-fulfilling prophecy.

Figure 3. PLN and FX mortgages from 2004 to 2014 (mln PLN)
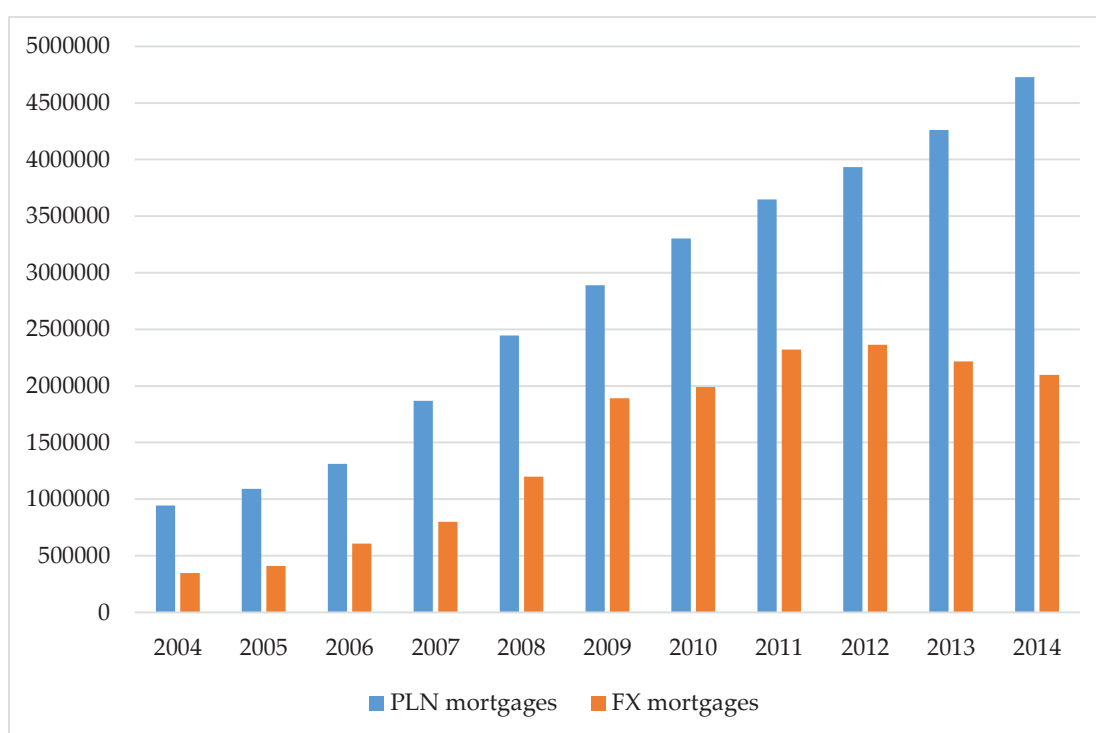
Source: own calculations based on the data from the National Bank of Poland's website

The authorities considered the expansion of such lending to be a systemic risk for the financial system because a deprecation of the Polish zloty, an increase in Swiss interest rates and/or a deterioration of macroeconomic conditions would undermine households' mortgage repayment capacity to a large extent. Moreover, as the growth of FX lending was partially financed by parent companies of banks operating in Poland, it also led to increasing liquidity risks for some Polish banks due to a growing dependence on foreign funding. Swap markets played an important role in funding

of these loans because banks used FX swap and cross-currency swap markets to hedge their FX balance sheet exposures related to FX loans. While subsidiaries of western European banks could obtain foreign currency financing for these loans from their parent banks, domestic banks financed these loans partly through swapping the Polish zloty deposits into foreign currency resources. In normal times, these swap markets worked well, as sufficient liquidity was provided by foreign banks[12]; western banks originated FX swap contracts and closed their open position in zloty through Treasury bond repo operations. However, after the markets' functioning disruption in the fourth quarter of 2008, the relevant basis swap spreads increased and stayed at increased levels for a longer time. This caused a rise in the costs of FX lending for banks, which they transferred to new customers[13]. Moreover, when zloty depreciated, rolling over swaps required a growing amount of domestic currency resources. This process caused severe liquidity strains in some domestic banks. Furthermore, ultimate borrower (a household) contracted FX debt but its income was in local currency, so the borrower was unhedged and this created credit risk. The flow of FX lending introduced also a significant disturbance into monetary policy transmission mechanism, since tightening of domestic monetary policy induced borrowers to substitute domestic currency loans for FX loans, rather than reducing the pace of lending activity (Brzoza-Brzezina et al., 2010). It also contributed to the increase in foreign currency lending.

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[12] Before the Lehman Brothers' failure, the additional cost in the form of the basis swap spread was close to zero (Bierut et al., 2015).
[13] Both FX and local currency loans in Poland have predominantly fully floating interest rates, set as the relevant interbank rate plus a fixed margin. Therefore banks were unable to pass these costs through to existing customers.

III.   EFFECTIVENESS OF PRUDENTIAL MEASURES IN DEALING WITH
         CAPITAL INFLOWS TO POLAND

The eradication of FX mortgage lending was possible due to supervisory actions[14] and other factors that reduced bank incentives to supply such products. The Polish authorities have taken several steps to address the risks associated with rapid growth in foreign currency lending. In 2005 the Polish Commission for Banking Supervision (CBS) took action to reduce the currency risk associated with FX loans by introducing new prudential recommendations for lending in foreign currency, which came into effect in July 2006 (known as Recommendation S)[15]. These recommendations aimed at further improving risk management and disclosure in line with good international practices. Recommendation S induced banks to enhance their risk management related to FX lending (by, inter alia, including depreciation buffers in the assessment of borrower creditworthiness and setting internal limits for particular exposures secured by mortgages) and to inform customers of the related risks.

The announcement about the pending recommendation had a deterrent effect, as the growth rate of foreign-denominated housing loans slowed in the first half of 2006 in favour of domestic currency loans even before the recommendation came into force in mid-2006 (the share of foreign currency loans in the sale of new loans decreased from nearly 60% in mid-2006 to less than 40% in mid-2007). A decreasing interest rate differential to the Swiss franc also contributed to the slowing down (NBP, 2007). Unfortunately, in subsequent periods, the provision of foreign currency loans

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[14] Different options for tackling the problem of FX mortgage loans were considered – for example, higher loan provisioning requirements were not introduced due to a conflict with the relevant provisions of IFRS/IAS. An outright legal ban on FX loans was also considered, but not implemented because it required being introduced through a parliamentary act. Additional capital requirements did not seem to be effective given significant surpluses in banks' regulatory capital. In general, the effectiveness of prudential measures could also be undermined by opportunities for regulatory arbitrage, i.e. the extension of FX loans by branches of credit institutions from other EU countries and/or cross-border lending. The principle of free flow of capital in the EU made it difficult to block these arbitrage channels. – see Bierut et al., 2015.

[15] Before that, in 2005, the Commission increased the risk weight on housing loans with loan-to-value ratios exceeding 50 percent to 100 percent (from 50 percent previously).

increased again, and the peak in sales occurred in 2008 (in the middle of 2008, the share of foreign currency loans in the sale of new loans reached 75%).

Therefore, the period 2007-2008 was characterized by strong growth in housing loans and indulgent lending standards, resulting in an accumulation of FX loans. This increased the vulnerability of banks to multiple types of risk, including indirect credit risk (due to FX exposure of borrowers) and rollover risk related to the hedging of FX balance sheet exposures by derivatives (on an aggregate level Polish banks had an open FX balance sheet position, but closed it fully with derivatives – Bierut et al., 2015). The strong growth of housing loans, and the availability of FX loans also contributed to significant increases in residential real estate prices.

In 2007, the authorities took the next step in order to reduce risks related to FX mortgage loans. A resolution raising risk weight of residential mortgage loans denominated in FX was introduced in April 2007 when the EU CRD directive was implemented. Polish authorities took this opportunity to introduce stricter risk weights for FX loans (relative to the directive), which took effect in mid-2008[16]. The risk weight (for the part of the loan below 50% of the value of the real estate used as collateral) for FX mortgage loans was increased from 50% to 75%[17]. At the same time, the risk weight for housing loans in zloty was lowered from 50% to 35%. The potential for policy leakages was a key driver behind the gradual tightening of the regulation. The step-by-step approach allowed the authorities to observe the effects of past policy actions and to respond accordingly. Policy leakages were perceived as a real threat due to the lack of any obligation on the part of home authorities to cooperate in preventing regulatory arbitrage[18].

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[16] This helped banks to withstand liquidity stress in 2008-09. The purpose of introducing liquidity limits was both micro- and macro-prudential, as they underlined the need for stable and sustainable funding of banks' credit portfolios.

[17] The standard 100% risk weight was applied to the rest of the loans.

[18] The experience of countries which introduced strict prudential tools to strive FX lending, only to see them being circumvented by banks with the help of their foreign parent companies, provided a stark example of the potential for regulatory arbitrage. – Bierut et al., 2015.

The intensification of the financial crisis in 2008 put an end to the fast credit expansion in Poland as banks tightened lending standards and consumer confidence worsened[19]. The Polish zloty depreciated by 30-40% with respect to major currencies, increasing the burden for borrowers with debts denominated in foreign currency. However, the quality of foreign currency mortgages did not worsen significantly owing to more stringent requirements for the assessment of borrower creditworthiness provided for by Recommendation S and a decrease in Swiss interest rates, which translated directly into lower debt service costs given the fully floating nature of mortgage interest rates.

Since the financial crisis, the rate of growth of mortgages in foreign currency has fallen in Poland compared with those in domestic currency. Although there has been no major pick-up in foreign currency lending or credit growth, macro-prudential and supervisory policies have been tightened. In order to further reduce the flow of FX loans in between end-2008 and early 2011 the authorities introduced i.a. more stringent DTI ratios for foreign currency-denominated loans to unhedged borrowers (Recommendation T[20] and amendments to Recommendation S). Another step taken by the Polish Financial Supervision Authority (PFSA) to limit new FX lending was an increase in capital requirements for FX mortgage loans – an increase in the minimum risk weight from 75% to 100% for overdue exposures secured by residential property, with the amount of principal or interest instalments depending on changes in exchange rates or foreign currencies other than the borrower's income – the relevant PFSA resolution was issued in June 2011, entering into force in June 2012. Furthermore, the regulator used strong moral suasion, coordinated with

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[19] After an initial strong tightening of lending policies in reaction to the GFC and an economic slowdown, banks again increased the supply of FX-denominated loans towards the end of 2009 and in 2010, but on a smaller scale than before the crisis. The other difference was that, in the case of FX mortgages, banks offered mainly euro-denominated loans instead of CHF loans, which dominated before the crisis.

[20] In line with the amendment to Recommendation T, explicit DTI caps for mortgage borrowers were lifted and banks were obliged to establish their own DTI limits, which the PFSA was (and still is) able to challenge as part of the regular supervisory process.

home authorities where necessary, to persuade banks to end FX mortgage lending, which was achieved by mid-2012.

In an effort to counteract foreign currency risks, Recommendation S was again amended in June 2013, introducing a 50 percent limit for the share of exposures open to FX risk in the entire bank's portfolio of retail credit exposures financing real estate; recommending to limit the borrower's exposure to FX risk by ensuring conformity of the currency of exposure with the currency of income used for repayment; introducing the obligation to identify reliable sources of financing long-term credit exposures, that finance the real estate, adequately to the currency of the exposure. The ESRB Recommendation 2011/1[21] on lending in foreign currencies provided significant support for the new measures, especially as it advocated the principle of reciprocity, which translated into an obligation of supervisory authorities from all EU countries to respect the relevant measures introduced by any EU country and thus limited the scope for regulatory arbitrage. The recommendations defined the problem of a significant share of foreign currency loans in total loans in the countries of Central and Eastern Europe, including Poland, and largely coincided with Recommendation S issued by the CBS five years earlier. The first four recommendations of the ESRB have been included in the Recommendations S and T in a more detailed manner.

The growth rate of FX housing loans declined substantially (below 10% y-o-y) in the third quarter of 2009 and turned negative in mid-2012. Since mid-2012, the issuance of foreign currency mortgage loans has been minimal and old loans are not renewed which means that the total stock of foreign currency loans is diminishing. Consequently, the share of FX mortgage credit in the total mortgage portfolio fell from 60% in 2008 to 48% in May 2014 (Bierut et al., 2015). From July 2014, borrowers are allowed to borrow only in the same currency as their income.

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[21] European Stability Risk Board (ESRB) non-binding recommendation on lending in foreign currencies ESRB/2011/1 which aims to address in a coordinated manner the growth of foreign currency lending to unhedged borrowers.

Despite the successful elimination of new FX mortgage lending, some risks stemming from the FX housing loan portfolios are observed by the authorities. The main legacy issues are: the increased credit risk of unhedged borrowers (the risk of a rise in loan servicing costs in case of zloty depreciation or a rise in foreign interest rates) and the need to hedge the FX risk stemming from the FX mortgage portfolio. Only part of FX mortgage lending is financed with FX liabilities, so the FX mortgage portfolio is the main source of the open balance sheet position of some Polish banks, which has to be hedged with derivatives. The maturity of these derivatives transactions is typically shorter than the maturity of the mortgage portfolio. Therefore banks have to roll over the hedging transactions systemically. Due to underdeveloped domestic interbank markets for such instruments, banks must rely on international financial markets. Markets' liquidity for such instruments may decrease significantly in times of market disturbances, which is the source of rollover risk. The risk materialized to some extent at the beginning of GFC, when liquidity decreased and the cost of such hedging rose significantly. However, Polish banks managed to continue these transactions, partly with foreign parent companies as counterparties.

Methodology

In order to create an adequate measure of imposed currency-based measures we follow the methodology proposed by Pasricha et al. (2015). In this paper, we count policy changes and then weight them by the share of the country's total international assets or liabilities that the measure is, in our opinion, designed to influence. That approach allows us to distinguish between measures which influence very significant portions of capital flows and negligible ones. As in Pasricha et al. (2015) the data for the weights are from the updated and extended Lane and Milesi-Ferretti (2007) database[22]. However, when it comes to measuring capital inflows to Poland

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[22] The last available data in this database are from 2011. Therefore, in case of currency-based measures in 2013 we used the last available values which was 2011.

we propose a new approach, which in our opinion better reflects the phenomenon. In order to capture the capital inflows from assets of the balance of payments and liabilities within the financial sector we construct the variable "capital inflows" as follows: we sum the absolute values of negative observations from assets, positive values of liabilities[23] and absolute values of negative observations of financial derivatives. For all analysed categories of the Financial account of the balance of payments the capital inflow in time t is calculated as follows:

$$Inflow_t = 1_{assets<0} * |assets_t| + 1_{liabilities>0} * liabilities_t + 1_{derivatives<0} * |derivatives_t| \quad (1)$$

where $1_{()}$ is an indicator function that takes the value of 1 when the condition $(.)$ is satisfied.

The study uses quarterly observations from Q1 2004 to Q4 2014. The data comes from NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

VAR model measuring the effectiveness of CBMs changes

In order to study the effectiveness of currency-based measures we construct a VAR (Vector Auto Regressive) model which contains variables of interest described above, exchange rate of the Polish zloty against euro, as well as exogenous variables aiming to control for their possible effects. In the baseline specification of our model we assume that the data generating process can be approximated with a following VAR model of order p:

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[23] In our analysis we use following categories of the Financial account of the balance of payments: Portfolio investments (debt and equity, excluding transactions of the National Bank of Poland, Government transactions and Other Monetary Financial institutions), Other investments (excluding Trade credits and SDRs Allocation). In the robustness check we also analyze similarly constructed variable, however only for the category "other financial corporations".

$$y_t = a_0 + A_1 y_{t-1} + ... + A_p y_{t-p} + B_1 x_{t-1} + ... + B_q x_{t-q} + \varepsilon_t \tag{2}$$

Where y_t is a (k x r) vector of endogenous variables, x_t is a (m x 1) vector of exogenous variables and matrices A and B are (k x k) and (m x m) matrices of coefficients. Similarly to Pasricha et al. (2015) in the baseline model we include following endogenous variables: the variable of describing the number of currency-based measures entering into force in a given quarter (in the case of Poland it is only an inflow tightening), the spot exchange rate of the Polish zloty against euro and the variable measuring the capital inflow. Moreover, in the model we have included three exogenous variables to control for various factors. Variables were chosen to maximize the log likelihood function of the VAR model. The set of time series considered for exogenous variables consisted of: GDP in the EU, the stock market index, the inflation rate in EU, VIX, EMBI sovereign spread, global GDP growth, CPI in USA, CPI in Poland and dummy variables for the GFC, quantitative easing in the EU, financial crisis in EU and quantitative easing in USA. In order to determine the lag structure of the model we compare Schwarz information criterion for up to four lags for endogenous variables. Having in mind the relatively short available time series, in case of exogenous variables we set the lag value to 1 to limit the number of parameters to estimate.
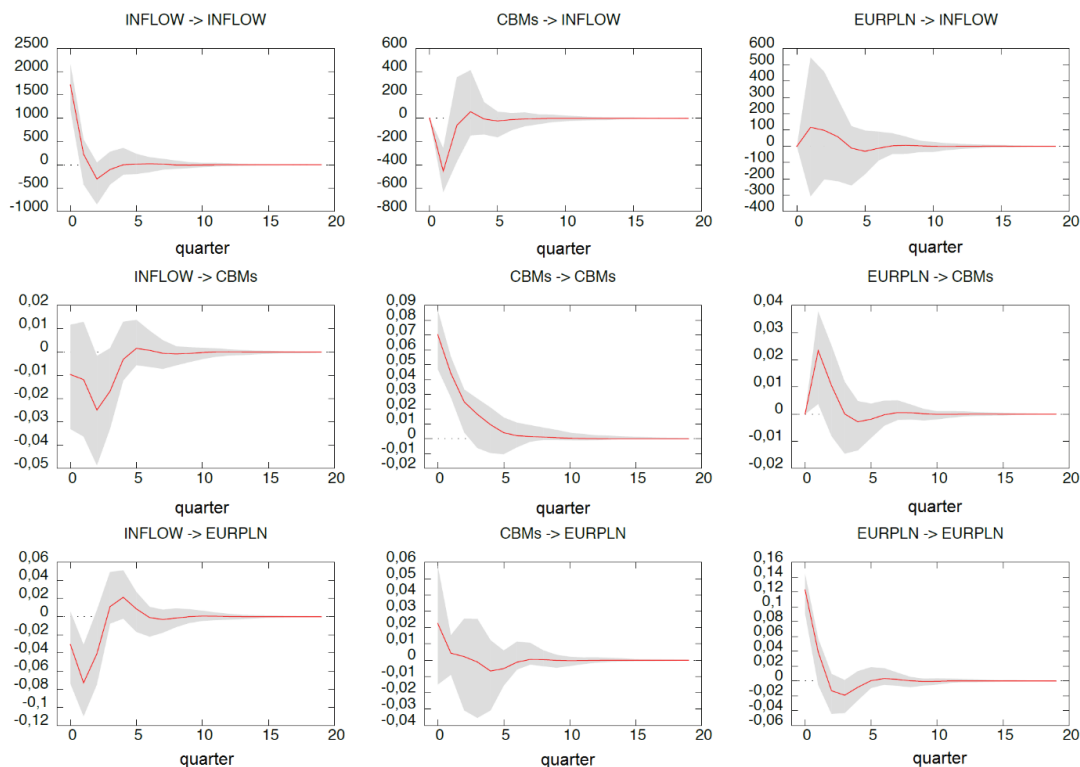
Results

In order to assess the effectiveness of the imposed currency-based measures in Poland we need to investigate impulse response functions, obtained using the Choleski decomposition, and statistical significance of estimations of parameters of interest. Having in mind that the ordering of variables influences the results we have analysed all six combinations of the ordering of our three endogenous variables and compared the results. In the baseline model the variable of capital inflow is ordered first, CBMs is ordered second and the exchange rate is ordered last. The analysis

shows that there is evidence of negative impact of CBMs on capital inflows in the first quarter after the measure starts to be in effect. In all analysed specifications of the model the impulse response function clearly showed the negative change in capital inflows one quarter after the CBM enters into force and the estimated parameter of the first lag of the CBM is statistically significant[24]. It means that despite the declared (macro-)prudential purpose of the measures, actions have targeted capital inflows and successfully reduced its inflow. Moreover, the model implies a strong intuitive relationship between capital inflows and the exchange rate, which can be observed both in impulse response functions and estimation significance. However, in contrast to Pasricha et al. (2015) we do not find the impact of CBMs on the exchange rate. Very similar results were obtained for the other five orderings of endogenous variables. Figure 4 shows impulse response functions for the baseline specification of the model. Estimated parameters and test results are presented in Appendix 1.

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[24] In the study we use HAC (heteroscedasticity auto-correlated consistent) standard errors. The parameter estimation is significant at 95% confidence level.

Figure 4. Cholesky decomposition impulse response functions for "Base model".
Grey areas show 90% confidence intervals.

Source: own calculations based on NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

Robustness check

In this section we estimate similar specifications of the model and check whether results of our analysis change drastically. The main change in "Alternative specification 1" is the use of different construction of the variable describing capital inflows. In that specification we construct the variable similarly to the "base model" (see equation 1), however we include only capital flows for "other financial corporations". Moreover, in this specification the set of three exogenous variables which maximizes the log likelihood function is different[25]. Impulse response functions are generated using Cholesky decomposition and the "Inflow" variable is

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[25] The set of variables can be inferred from the Table 2 showing estimation of parameters of the model.

ordered first. Figure 5 shows impulse response functions for the model in "Alternative specification 1" and estimations of the model parameters are reported in Table 2 in Appendix 1. Similarly to the "base model" the statistically significant decrease of capital inflows can be observed one quarter after the currency-based measure becomes effective.

Figure 5. Cholesky decomposition impulse response functions for "Alternative specification 1". Grey areas show 90% confidence intervals.
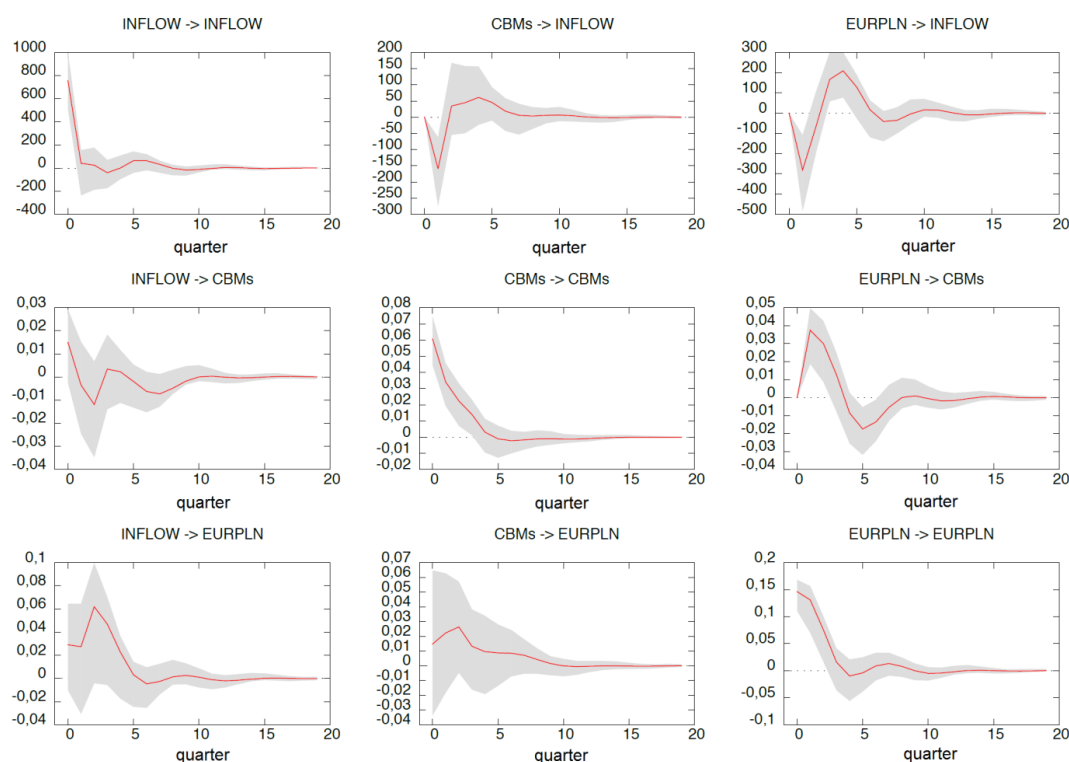
Source: own calculations based on NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

In "Alternative specification 2" we modify the "base model" by using an unweighted "CBM" measure, where all reported CBMs are equally weighted. Figure 6 shows Cholesky decomposition of the VAR model in "Alternative specification 2" and Table 3 in the Appendix shows the model estimation. It can be observed that directions of changes are identical to ones in the "base model" and the strength of the impact of

CBMs on the inflow is even stronger. The rest of tested and compared specifications of the VAR model are available on request.

Figure 6. Cholesky decomposition impulse response functions for "Alternative specification 2". Grey areas show 90% confidence intervals.
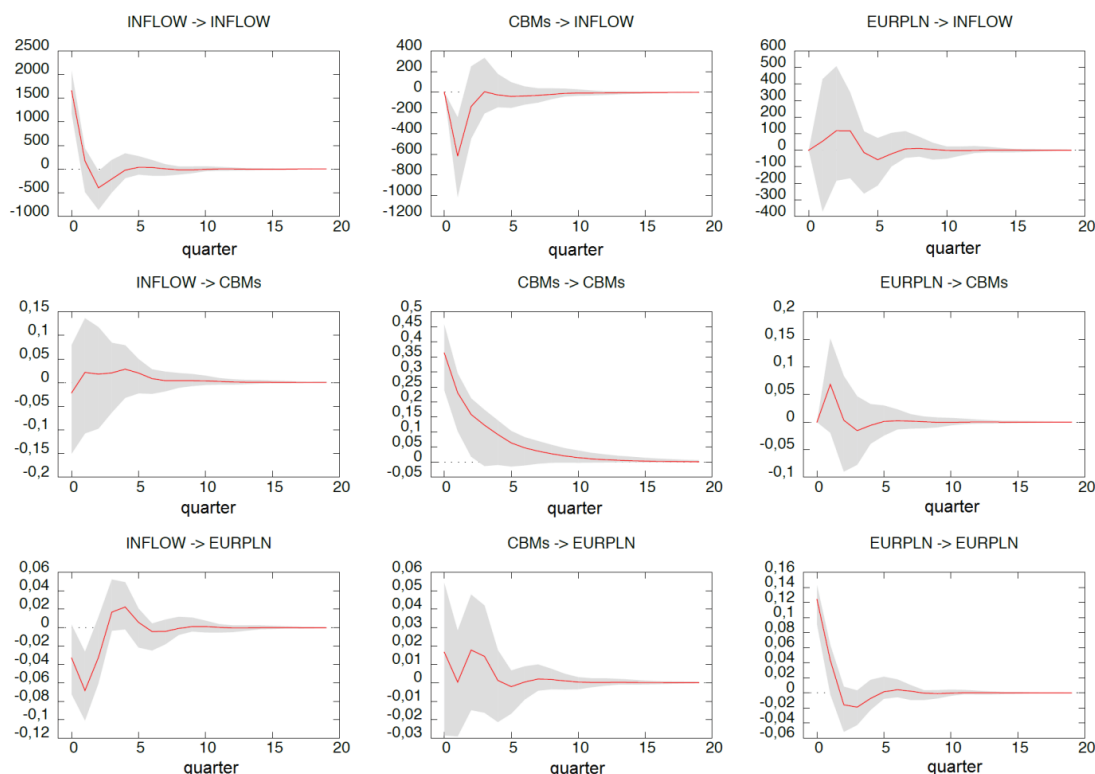

Source: own calculations based on NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

Both specifications presented in the robustness analysis repeat the conclusions drawn from the base model that the imposition of CBMs in Poland significantly decreased capital inflows. Moreover, models confirm the expected result that increase of capital inflows cause the currency appreciation, which in turn indicates that the constructed measures of capital inflows are correctly specified and the model captures interactions between variables of interest.

IV.   CONCLUSIONS

In the run up to the financial crisis of 2007-2009 Poland was affected by considerable capital inflows which were difficult to absorb for the Polish financial system. The inflow of capital was channelled through the banking system and contributed to a significant expansion of credit, mainly mortgages, and caused an increase in real estate prices. As a result, large scale of capital inflows created a boom in the real estate market and the entire economy. Capital flows from western European banks were a main driver of the credit and demand boom in Poland.

Foreign currency mortgage loans, mostly denominated in Swiss francs, became very popular in Poland before the crisis. The growth of FX loans was fuelled by lower interest rates abroad and expectations of further appreciation of the Polish zloty. However, FX borrowing exposed the banking system to an increased credit risk in the case of adverse macroeconomic developments. The expansion of FX lending was seen as a source of systemic risk also because it increased liquidity risks for the Polish banking sector and the importance of foreign funding. It also generated macroeconomic risks, related for example to lower effectiveness of monetary policy due to substitution effects and the fact that capital inflows related to FX lending were ultimately channelled into the residential real estate market, contributing to a strong increase in prices. Moreover, a high share of foreign ownership in the banking sector, together with the ease of conducting cross-border banking operations, reduced the importance of domestic resource constraints (i.a. the level of domestic savings). The possibility of cross-border activity for the EU banking groups present in Poland made the threat of regulatory arbitrage quite important, influencing the scope of viable policy actions. In order to eradicate FX mortgage lending, Polish supervisory authorities resorted to (macro-)prudential measures in a form of currency-based measures – by introducing a series of new prudential recommendations for lending in foreign currencies.

In this paper we denote the motivations for imposing currency-based measures directed at banks in Poland between 2005 and 2013, and assess their effectiveness. We find evidence of negative impact of CBMs on capital inflows in the first quarter after the measure becomes effective. This indicates that these measures have targeted capital inflows – despite their declared (macro-)prudential purpose. We also find that the model implies a stronger effect when the variable of unweighted CBMs is used and similar effect when the capital inflows only for "other financial corporations" are analysed. Moreover, the model confirms a strong intuitive relationship between capital inflows and the appreciation of the Polish zloty. Results obtained in all presented specifications not only prove the main thesis that currency-based measures effectively limited capital inflows to Poland, but also shows that proposed construction of the variable describing capital inflows correctly captures macroeconomic relationships. However, in the study we did not find the impact of CBMs on the exchange rate described in the literature, as well as we could not test for the structural change of the effectiveness of CBMs after the global financial crisis due to the very small number of observations in the pre-crisis period.

The paper complements the literature on the effectiveness of currency-based measures used for macro-prudential purposes. The further study may be developed by including the assessment of the impact of imposing CBMs in Poland on credit growth and asset prices.

Currency-based measures can be part of countries' set of regulations to manage capital flows and part of financial sector regulation to address risks arising from presence of international banking groups in host-countries' financial sectors, high interconnectedness and complexity of large financial institutions, or a combination of both and other aspects.

APPENDIX 1

1. Base model

Table 1: Estimations of parameters of the VAR model in the base specification.

Standard errors are presented in brackets.

	INFLOW	CBMs	EURPLN
const	−104603***	−3.059	1.639
	(31763.800)	(-2.172)	(2.391)
INFLOW_1	0.111	−3.170e-07	−3.709e-05***
	-0.078	(5.137e-06)	(1.234e-05)
INFLOW_2	−0.148	−3.899e-06	−9.544e-06
	(0.173)	(9.556e-06)	(2.410e-05)
CBMs_1	−6773.130**	0.566***	−0.039
	(3033.150)	(.12044)	(0.221)
CBMs_2	3513.720	0.0123	−0.151
	(2189.230)	(0.096)	(0.175)
EURPLN_1	940.902	0.190***	0.316
	(1964.510)	(0.061)	(0.212)
EURPLN_2	1674.390	−0.082	−0.165
	(1640.390)	(0.067)	(0.153)
EUCPI_1	−133.412	.022***	0.027***
	(-130.255)	(.006)	(0.008)
EMBI_1	−1.078	−4.092e-04***	8.720e-04**
	(-3.204)	(1.173e-04)	(4.008e-04)
EUGDP_1	0.035***	2.750e-07	−2.680e-07
	(-0.010)	(5.1803-07)	(7.555e-07)

 * - parameter estimation significant at 10% level of significance,

** - at 5% level of significance,

*** - at 1% level of significance.

Source: own calculations based on NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

2. "Alternative specification 1"

Table 2: Estimations of parameters of the VAR model in the "Alternative specification 1". Standard errors are presented in brackets.

	INFLOW	CBMs	EURPLN
const	−4527.420	−3.118***	2.688
	(7475.570)	(0.718)	(1.692)
INFLOW_1	0.171	−2.440e-05***	−1.200e-06
	(0.111)	(8.616e-06)	(2.419e-05)
INFLOW_2	−0.047	−1.324e-05	6,100e-05*
	0(.162)	(1.360e-05)	(3.109e-05)
CBMs_1	−2159.740	0.500***	0.150
	(1770.740)	(0.131)	(0.255)
CBMs_2	2410.870*	−0.022	0.098
	(1380.830)	(0.059)	(0.186)
EURPLN_1	−1918.680***	0.256***	0.895***
	(484.896)	(0.070)	(0.165)
EURPLN_2	2162.820***	−0.198***	−0.327*
	(666.524)	(0.068)	(0.163)
GlobalCrisis_1	−642.050	−0.032	0.234*
	(381.376)	(0.023)	(0.116)
USCPI_1	18.574	0.016***	−0.005
	(34.491)	(0.004)	(0.007)
VIX_1	26.476*	−0.007***	−0.003
	(13.946)	(0.002)	(0.004)

* - parameter estimation significant at 10% level of significance,

** - at 5% level of significance,

*** - at 1% level of significance.

Source: own calculations based on NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

3. "Alternative specification 2"

Table 3: Estimations of parameters of the VAR model in the "Alternative specification 2". Standard errors are presented in brackets.

	INFLOW	CBMs	EURPLN
const	−107334.000***	−2.471	3.494
	(27996.300)	(0.562)	(33142.000)
INFLOW_1	0.09	3.191e-05	−3.449e-05**
	-0.086	(3.317e-05)	(1.301e-05)
INFLOW_2	−0.164	1.353e-05	−5.730e-06
	(0.159)	(4.314e-05)	(2.519e-05)
CBMs_1	−1720.240**	0.610***	−0.015
	(818.199)	(0.114)	(0.050)
CBMs_2	787.551	0.126	0.010
	(665.382)	(0.085)	(0.043)
EURPLN_1	432.980	0.549**	0.348
	(1857.650)	(0.268)	(0.232)
EURPLN_2	1704.770	−0.512	−0.225
	(1639.550)	(0.306)	(0.166)
EUCPI_1	41.870	0.120**	0.021*
	(148.854)	(0.044)	(0.011)
EMBI_1	−0.258	−0.001***	8.083e-04*
	(3.202)	(5.558e-04)	(4.234e-04)
EUGDP_1	0.032***	−2.573e-06*	−6.633e-07
	(0.009)	(1.331e-06)	(7.026e-07)

* - parameter estimation significant at 10% level of significance,

** - at 5% level of significance,

*** - at 1% level of significance.

Source: own calculations based on NBP balance of payments statistics, Bloomberg and the Central Statistical Office of Poland.

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