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INCOME-CONTINGENT REPAYMENT SCHEME FOR NON-PERFORMING MORTGAGE LOANS IN HUNGARY*

Edina BERLINGER – György WALTER

At the end of 2014, more than 23% of the foreign currency denominated mortgage portfolio in Hungary was overdue; about 20% was classified as non-performing and the tendency is worsening. In this paper, we propose a solution to effectively reduce the credit and systemic risk inherent to this portfolio – the proposed model can be applied to other mortgage portfolios in trouble as well. The main element of our proposal is income-contingent repayment complemented with effective incentives to motivate debtors to repay their debt. We demonstrate that the proposed scheme is attractive for both the debtors and the lenders; therefore, contrary to some recent policy measures, in this case there is no need for direct state intervention to force modifications to the existing legal contracts. In order to evaluate the possible effects, we simulated a realistic population of borrowers with different age, debt, loan-to-value, and income. Then we calculated the expected income paths, the repayments of the borrowers as well as the profit of the lenders on the basis of the non-performing FX mortgage portfolio. The results underpin that the proposed scheme creates significant value added and, most importantly, that it can effectively reduce the vulnerability of the entire economy to future shocks.

Keywords: FX mortgage loans, emerging markets, management of credit and systemic risk, PTI, income-contingent repayment, micro-simulation, Hungary

JEL classification indices: E42, G17**,** G21, G28

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Edina *Berlinger*, corresponding author. Associate Professor and Head of Department of Finance at the Corvinus University of Budapest, Chair of the Finance (sub)Committee of the Hungarian Academy of Sciences. E-mail: Edina.Berlinger@uni-corvinus.hu

György *Walter,* Associate Professor at the Department of Finance at the Corvinus University of Budapest. He is a member of Finance (sub)Committee of the Hungarian Academy of Sciences. E-mail: Gyorgy.Walter@uni-corvinus.hu

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1. INTRODUCTION

The high volume of non-performing mortgage loans has significantly contributed to the financial vulnerability of Hungary. In recent years, the government intervened in several forms in order to manage the escalating economic, social, and political problems. The costs of these provisions were mostly financed by the banking sector, but despite of these efforts, there are still significant risks in the system.

In this paper, we propose to introduce an income-contingent (IC) loan scheme for non-performing mortgage loans, building on the recommendations of Stiglitz et al. (2014). One of the major advantages of the proposed model is that there is no need for direct state intervention in order to force modifications to the existing legal contracts, as private parties have good incentives to join the new scheme voluntarily. With the help of a microsimulation model, we demonstrate the significant value added of this income-contingent scheme relative to the traditional one.

The paper proceeds as follows. Section 2 first reviews the relevant literature and the main tendencies in mortgage lending in Hungary, and then summarises the most important measures taken by the government so far, focusing on their costs and effects. Section 3 presents our proposal to solve the problem and also discusses the theoretical arguments behind it. Section 4 outlines the microsimulation model and investigates the possible effects of an IC scheme both at individual and portfolio level. Finally, Section 5 concludes with the main findings and formulates policy recommendations.

2. LITERATURE REVIEW

Credit dollarisation is a phenomenon when market participants borrow in foreign currency, get access to the broader capital market, and take significant exchange rate risk at the same time. Eichengreen – Hausmann (1999: 33) called it an "original sin", and they also warned that "dollarization eliminates all scopes for an independent national monetary policy". Interestingly, they also admitted that dollarisation may have positive effects as well, because by providing extra financing in illiquid periods it can attenuate business cycles, thus can even contribute to the stability of financial systems on emerging markets. The authors warn that dollarisation can only be beneficial if capital standards, prudential supervision, and regulation are strong. However, it seems that these prerequisites typically do not hold true for the most dollarised countries. Yeyati (2006) carried out a worldwide empirical analysis and demonstrated that dollarised economies suffer from lower

and more volatile growth, and a greater propensity to banking crises. He advocated an active de-dollarisation policy on these grounds.

Originally, the term dollarisation referred to Latin American countries where almost all loans were denominated in U.S. dollars. However, in the first decade of this century, Eastern European households and non-financial firms have also massively borrowed in euros and Swiss francs.[1] These countries showed heterogeneity in terms of their credit-to-GDP ratios in foreign currencies. Latvia and Estonia had a relatively high ratio; in Lithuania, Bulgaria, Hungary, and Romania, foreign currency credits were significant but less dominant, while borrowers in Poland, Slovakia, and the Czech Republic preferred to borrow in domestic currency *(Figure 1)*.

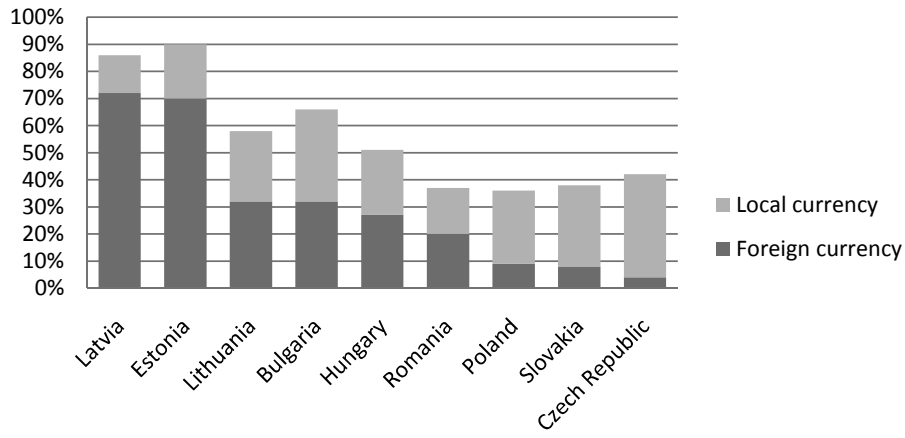

Figure 1. Private sector credit-to-GDP ratios in some EU New Member States in 2007

Source: Webpages of central banks.

Due to the global financial crisis, employment, wages, real estate prices, foreign exchange, and interest rates changed adversely. Hence, the ratio of non-performing loans (NPL) increased sharply, which contributed to the further deepening of the crisis. In the most concerned countries, where currency loans were the most escalated and other macro conditions were also unfavourable, monetary policy became extremely difficult as any further devaluation of the home currency threatened to generate an economic and social catastrophe. The systemic risk due to FX loans has become one of the most severe problems in these coun-

[1] See e.g. Rosenberg – Tirpák 2008; Csajbók et al. 2010; Beer et al. 2010; Hudecz 2013.

tries, as was the case in Hungary. In this paper, we focus solely on Hungary, but concepts as well as the proposed strategy can be applied to other countries in a similar situation, too.

3. FOREIGN CURRENCY MORTGAGES IN HUNGARY

At the end of 2014, the total outstanding debt to the household sector amounted to USD 24.5 billion,[2] of which the mortgage portfolio was around USD 20.2 billion, or 16.5% of GDP. Of the total mortgage portfolio, more than 23% was classified as "under average", "dubious", or "bad" and 20% was non-performing (overdue for more than 90 days). The greater part of mortgages, about USD 12.7 billion, was denominated in foreign currency (CHF, EUR, and, to some extent, JPY) and about 24% of these loans (2.5% of the GDP) could be regarded as non-performing (MNB 2015).

The size of the average FX mortgage loan was around USD 28,000 and its average maturity was 14–15 years. In line with the heavy appreciation of the Swiss franc and the increase in interest margins, households faced growing debts in HUF, which together with the drop in incomes and employment boosted the payment-to-income (PTI) ratios and also the NPL ratios *(Figure 2)*. Almost all loan portfolios have been continuously worsening, but the worst tendency and the highest NPL ratio belongs to the FX mortgage portfolio (MNB 2014a, 2015).

Banks and debtors have made efforts to manage FX mortgages by voluntary renegotiations and restructuration of the loan agreements, but these private initiatives did not prove very effective as only one-third of the NPLs were restructured (MNB 2015). Government and other supervisory institutions (Central Bank, Financial Services Authority, Banking Association) also intervened in several forms to resolve the conflicts. Some of the supervisory measures aimed at restricting and discouraging FX lending (temporary restriction of all FX lending, upper limit on the loan-to-value ratios for retail mortgage loans, ban on purely collateral based lending, redefinition of applicable conversion rates, and other consumer protection type of provisions). Other provisions targeted a more prudential operation of the banks (capital adequacy and liquidity requirements). However, most of the legislative efforts were initiated to assist FX debtors with the catchword of "protecting homes" (MNB 2012). Six programmes were launched.

[2] Amounts were calculated at the 2014 year-end exchange rate, USD/HUF = 260.

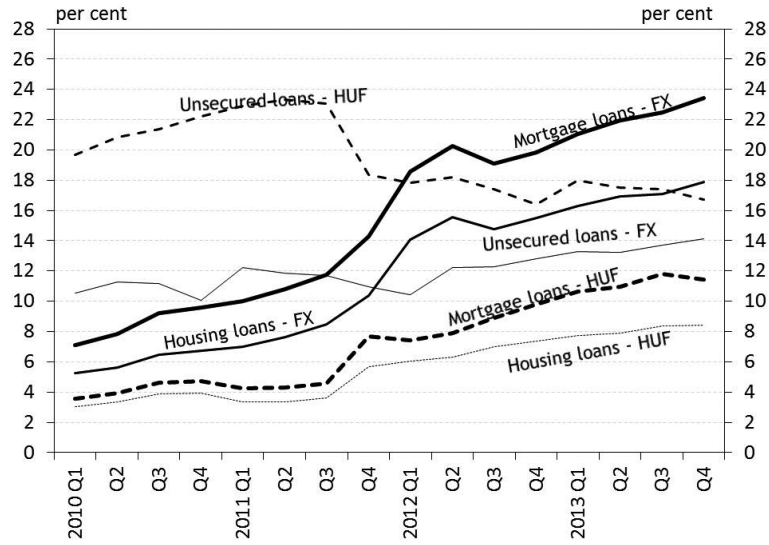

Figure 2. Ratio of non-performing household loans by products in the banking system

Source: MNB(2014a), chart 58.

1. In the framework of an early repayment scheme introduced in 2011, debtors could repay their loans at a fixed and highly preferential FX rate.
2. Since 2012, a freshly created new government agency (National Asset Management Agency, NAMA) has purchased mortgaged residential properties of the most deprived debtors from banks at a discounted price. Debts were cancelled and people could stay in their home while paying a favourable rental fee (NAMA 2014a, 2014b).
3. FX Rate Fixing Scheme was set up in 2011–2012 and borrowers could join it voluntarily in order to defer the repayment burden of the remaining FX loans. The difference between the fixed, preferential FX rate and the actual market rate is now collected on a special account as a HUF loan. The capital part of this deferred HUF loan has to be paid back by the debtor after a grace period of 60 months, while the interest part is financed 50–50% by the lender bank and the central budget.
4. The New Home Creation programme mainly targeted buyers of new homes, but to some extent, it also assisted home owners in trouble due to their FX loans.
5. In autumn 2014, a new FX loan relief package was accepted by Parliament, which relied on a Supreme Court's ruling. According to this, bid-ask margins

originally applied by the banks during currency conversions were unfair. They have to be recalculated retroactively on the basis of the MNB mid-prices and the difference should be reimbursed to the borrowers. Similarly, unilateral and unjustified increases in the interest rates are also to be refunded.

6. The latest development is that in 2015–2016, simultaneously with the settlement of loan charges deemed unfair, FX mortgage loans are to be converted to HUF in a lump sum at the market rate within the framework of the mandatory HUF conversion programme.

Table 1 summarises the estimated costs of these measures to the banks and the state. In order to compare different countries' strategies toward this problem see Bethlendi (2001).

As we can see from *Table 1,* both banks and the government contributed to the bail-out of FX debtors, but the costs of these programmes were mostly financed by the banking sector. This is especially true if we also take the bank levy into consideration, which is among the highest in Europe.[3] It is also remarkable that the by far the most expensive programme until now was the Early Repayment Scheme of 2011, which cost more than the operation of NAMA, the Exchange Rate Fixing Scheme, and the New Home Creation Programme all together. Moreover, as banks were obliged to accept early repayments at a highly preferential FX rate, the state both *de facto* and *de jure* intervened in contracts between private parties, which compromised the rule of law and legal certainty. Moreover, it is also clear that the beneficiaries of Scheme 1 were well-offs who could afford to repay their debt in a lump sum. It is also worth noting that the New FX Relief Package is expected to cost three times more to the banks than the Early Repayment Scheme. The Mandatory HUF Conversion programme is managed by the central bank of Hungary, which provides the necessary FX liquidity using its reserves. Thus, this measure has practically no direct costs, but being mandatory, it is again a retroactive change of private contracts enforced by the state.

One of the most important conclusions we can draw from assessing these measures is that regardless of the enormous burden levied on the banking sector and the drastic state intervention into legal contracts (early repayment at preferential rate and mandatory HUF conversion), the total household leverage remained significant, therefore low-income people continue to have difficulties in repaying their debts even in HUF, hence systemic risk remains an important issue.

[3] The bank levy was introduced in 2010 as 0.5 percent of banks' assets over HUF 50 billion. Since 2010, several banks in Hungary have produced massive losses.

Table 1. Most important programmes targeting FX mortgages

Program	Timing	Affected exposure (bn USD)	Costs to the banks (bn USD)	Costs to the state (bn USD)	Total costs banks+state (bn USD)
1. Early Repayment Scheme[1]	from Sept 2011 to Dec 2011	5.65	1.08 (total value difference)	0.46 (total tax reduction)	1.54
2. National Asset Management Agency[2]	from Jan 2012	0.16	0.09 (total value difference)	0.07 (total invested capital) 0,005 per year (operational costs)	0.16
3. FX Rate Fixing Scheme[3]	from May 2012	6.5	0.09 (total interest rate subsidy)	0.09 (total interest rate subsidy)	0.18
4. New Home Creation Program[4]	from 2012	–	–	0.00003 per year (interest rate subsidy)	0.00003 per year
5. New FX Relief Package[5]	2015	12.7	0.73 (margin) 2.73 (interest rate)	–	3.46
6. Mandatory HUF Conversion	2015-16	12.7	–	–	–

Note: Calculations are made using official estimations given in HUF, and conversions are based on the actual USD/HUF rate.

[1] HSFA (2012). USD/HUF was 240 at the end of 2011.

[2] NAMA (2014a), (2014b). The estimate for yearly operational costs was based on year 2013. USD/HUF was 220 at the end of 2013.

[3] MNB (2014b). Data are accummulated until the end of 2014. USD/HUF was 260.

[4] Ministry of National Economies (2012). The estimate for yearly subsidy was based on year 2012. USD/HUF was 220 at the end of 2012.

[5] http://www.portfolio.hu/vallalatok/penzugy/mnb_ennyit_bukhatnak_a_bankok_csak_az_arfolyamres_miatt.202134.html, USD/HUF was 260 at the end of 2014.

Source: Compiled by the authors.

4. THE PROPOSED STRATEGY[4]

When formulating our proposal to manage non-performing mortgage loans denominated in home or foreign currency, we followed some basic principles:

– *The policy goal is to reduce overall systemic risk:* The main objective is not to redistribute realised profits and losses in the name of social justice (this is rather a political issue), but to reduce the country's exposure to future shocks in order to diminish macro-level financial vulnerability.

[4] A more detailed discussion of the proposal can be found in Berlinger – Walter (2013, 2014).

– *There is a need for state intervention:* Systemic risk can be viewed as a negative externality. Contracting parties (lenders and borrowers) benefited from the transaction, while they contributed to the instability of the financial system. As a consequence, the costs of the increased systemic risk are paid by other, non-contracting players (e.g. tax payers). Due to the large number of stakeholders and the high transaction costs, it cannot be expected that the problem of negative externalities will be solved by private contracting. Thus, in defence of the public interests, state intervention can be justified.
– *Legal contracts should be respected:* Debtors must be regarded as responsible actors; therefore, they have to repay their debt and have to bear all corresponding risks provided that they were properly informed before signing the contract. On the other hand, any compulsory retroactive modification of existing contracts between lenders and borrowers should be avoided as it runs counter to the rule of law. A new scheme can be applied if and only if contracting parties agree on the changes.

The borrowers' ability to pay principally depends on the repayment burden, which can be measured as the ratio of the repayment to the net income (PTI, payment-to-income ratio) (Banai et al. 2015). In case of FX mortgages, PTI depends on three risk factors: (1) net income, (2) exchange rate, and (3) interest rate of the loan. The basic idea of our proposal is to reduce the sensitivity of the non-performing portfolio to all of these factors:

– income risk is to be hedged *via* income-contingent (IC) repayment;
– FX risk is to be dissolved by HUF conversion of NPLs;
– interest rate risk is to be diminished by fixing the margins at lower levels.

In contrast to fix repayments, IC repayments are automatically and continuously adjusted to the actual income of the borrower over the whole maturity of the loan. Repayment is a monotone increasing function of income. In a pure IC scheme, repayments are calculated as a fix percentage of actual incomes. The maturity of the loan is not predetermined; it depends on the income path of the given borrower and the interest rate over time. The more someone earns, the quicker he/she is able to repay his/her debt. Another distinctive feature of IC loans is the (more or less) direct involvement of the tax authority in the collection mechanism.[5]

[5] For a detailed discussion of the role of IC schemes in student lending, see Barr (2012). A less flexible type of IC repayment mechanism was proposed by Modigliani (1976), specifically in relation with mortgage loans.

Until recently, IC loans were applied only in state-managed student loan schemes, at least at mass level. However, Stiglitz et al. (2014) proposed to expand its scope to other retail lending situations, for example in the case of unemployment, maternity leave, research sabbatical, or any other kind of temporary financing problems. Stiglitz (2013) proves within the framework of an optimisation model that IC loans are an effective tool of income smoothing over the lifetime and that its application increases welfare, especially in the case of high uncertainty, asymmetric information, or other market failures.

In relation to repayment cash-flows, IC schemes have two important characteristics, namely:

– *Patience:* the maturity and, more importantly, the average duration of the loan repayments increase significantly, hence most of the repayments are due in the later years.
– *Flexibility:* as the repayment automatically adjusts to income, temporary low income does not lead to default. On the other hand, high income periods speed up the repayment and hence effectively reduce the lender's exposure.

IC loans are similar to equity financing, when the provider of the financing receives a part of the profit (here future incomes). In this setting, outside financing does not increase the leverage of the borrower, hence default risk is practically eliminated. However, income-contingent repayments are not a panacea to all kinds of financing problems. When we switch from fix to IC loans, we minimise default risk, but at the same time we increase the cash-flow risk of the lender and we also increase the moral hazard as borrowers will be tempted to make less efforts or to hide their incomes (Tirole 2006). It has been extensively elaborated theoretically in the field of corporate finance that debt-like financing (fixed repayment) is the optimal choice from an incentive perspective, because it motivates the lender (the agent) to do his/her best in order to maximise the value of the underlying investment. This is a robust result as it is true (1) for limited liabilities and risk neutral borrowers (Innes 1990), (2) for unlimited liabilities and risk-averse borrowers (Hermalin – Katz 1991), and also (3) for limited liabilities and risk averse borrowers (Dewatripont 2003). Intuitively, the incentive-optimality of the fixed repayment scheme is due to the fact that all the excess returns over the fix repayment will remain in the borrower's pocket, which is why he/she becomes highly motivated to succeed.

It is also important to emphasise that when running an IC scheme, the efficiency of the tax mechanism is also a key factor. The involvement of the tax authority may take different forms, ranging from the complete management of the IC scheme (as in Australia) to some services of income verification (as in

the U.S.) (Stiglitz 2014). The tax authority contributes to the success of the IC scheme by increasing the operational efficiency due to the economy of scale, and the enforcement power of the collection mechanism. These two effects are reflected in low administrative costs and low default rates, which are essential in terms of long-term financial sustainability.

Based on the above considerations, we can conclude that an IC scheme can be preferred to a fixed one, if:

– default risk is a more important concern than moral hazard (e.g. in crisis time, or in the case of long-term and unsecured loans, such as student loans, or when moral hazard can be effectively eliminated in other ways);
– cash-flow risk can be reduced or managed (e.g. it can be diversified within a big portfolio or the lender has easy access to liquid capital markets);
– the tax system is well developed or there is a strong commitment to improve it.

In our opinion, default risk definitely dominates moral hazard in relation to the non-performing mortgage loans in Hungary. The loan portfolio is so large that in the case of some external (or internal) shocks, individual defaults can easily reach an unmanageable critical level which, in turn, can lead to a widespread economic and social breakdown. Moreover, if many mortgages were executed at the same time, the real estate prices would fall significantly, hence collateral values would melt down. In this situation, especially when there is a massive oversupply on the labour market, fears that people would be reluctant to work harder seem less relevant. Similarly, cash-flow risk is much easier to manage than default risk and systemic risk. And finally, the Hungarian tax system is developed enough to support the Hungarian income-contingent student loan scheme since 2001, therefore the necessary institutional capacity is also available.

It is remarkable that in the Hungarian student loan system based on IC repayments, the calculated interest rate risk premium is around 1.5–2.0% per year and it is more than enough to cover the administrative costs and also the default losses. This highlights the efficiency and the effectiveness of its operation (Hungarian Student Loan Center 2014). International experience with IC lending also confirms that provided that the scheme is well-designed and well-managed, it is much cheaper and also much more effective than traditional, ad hoc and face-to-face renegotiations between bank and client (Stiglitz et al. 2014).

When designing an IC scheme, incentives to motivate the borrowers to repay must be the main focus. In our proposal, the elements of the incentive system are the following:

– *Mortgages are maintained until full repayment:* borrowers can keep their real estate and can live in their own home while they are fulfilling their obligations on time according to the IC repayment scheme. If a borrower is overdue for more than 90 days, his/her estate will be sold and he/she will lose it irrevocably. At the same time, borrowers will have the opportunity to keep their homes even if they earn a little for a long time.
– *There is a minimum repayment requirement:* borrowers are required to repay at least a given percentage of the actual minimum wage. Experience with the Hungarian student loan system also underpins that a minimal repayment requirement helps to keep contact with the borrowers and to make them more disciplined.
– *Disciplined debtors have a lower interest rate:* borrowers repaying regularly benefit from a lower interest rate in line with their lower risk (risk adjusted interest rate margins). This is an important tool to attract borrowers to enter the new income-contingent scheme and to keep them disciplined.
– *Borrowers possess an attractive early repayment option:* in case borrowers have some out of ordinary funding (inherited income, prize, project, etc.) they can choose to repay their debt in a lump sum at face value without any extra fee. This way, they can get rid of the accumulating interest rates. In the Hungarian student loan scheme, the early repayments are much higher than regular repayments,[6] which reflects the effectiveness of the scheme in motivating quick repayment.

Thus, the incentive problems in our proposed IC scheme can be effectively tackled because mortgages create strong incentives to repay by their nature. Of course, setting up a new IC scheme may require the introduction of new systems of accounting, asset-liability-management (ALM), etc. It is also clear that switching to an IC scheme would also influence the risk profile and the long-term profitability of the portfolio, as the scheme would be shifted to a path of lower risk and lower return. However, based on the positive experience with the existing, highly innovative IC schemes, we believe that these challenges can be met in this case as well. In the following part, we show that the proposed strategy creates significant value added for both the borrowers and the lenders.

[6] See Hungarian Student Loan Center (2014).

5. MODELLING AND SIMULATIONS

In this analysis, we concentrate on the non-performing loans, i.e. those debtors who are currently overdue for more than 90 days. In accordance with our proposal, these loans should be converted into HUF, and should be repaid in an income-contingent way.

With the help of a micro-simulation model, we compared the operation of the income-contingent scheme to the fixed one by assuming that non-performing loans are terminated, collaterals are sold and credit losses are written off, as it follows from the usual banking practice.

In principle, banks can also renegotiate and restructure the non-performing loans on their own; but this scenario was not taken into consideration for the following reasons:

– Non-performing loans are overdue for more than 90 days, hence we can assume that banks have already done their best to renegotiate and restructure these loans, but these efforts proved to be unsuccessful. As a consequence, we can assume that there is little room for further improvements using traditional banking techniques.
– IC repayments are by their nature a tool of continuous, built-in renegotiation and restructuring.
– The exact costs and the effectiveness of permanent renegotiations are difficult to estimate both in theory and in practice, and reliable data are not available; our starting point is that operating an IC scheme is much cheaper than dispersed individual renegotiations.

Economic models mostly rely on the concept of the representative (average) agent. However, in many cases, we are interested not only in the average, but also in the whole distribution of outcomes. It is especially true when there is a nonlinear structure between inputs and outputs. Analysing the whole distribution is also a relevant issue in the field of risk management, where we typically have to deal with worse-than-average scenarios. In these situations, micro-simulation can be a useful tool for revealing the inner structure of the problem and to understand the effect of some extreme, but realistic parameter junctures. Micro-simulations can be static or dynamic, probabilistic or behavioural, discrete or continuous, etc. The scale of freedom is large also in terms of the selection of the relevant driving factors and the determination of the connections between them. However, it is a basic requirement in any micro-simulation that the multivariate distribution of the factors correspond to the available statistical data as much as possible (O'Donoghue 2001). Michelangeli – Pietrunti (2014) applied a micro-simulation to investigate

the financial vulnerability of Italian households. Our simulation, presented in the following section, is similar to their approach in many respects, for example by connecting different databases with Bayesian estimations, by focusing on the debt size and the payment-to-income ratio as main factors, and by classifying households into four categories according to their disposable income, etc. The basic difference between the two studies is that we did not have access to granulated survey data; therefore, we had to rely on our assumptions to a greater extent.

5.1 General terms, notations, and assumptions

The micro-simulation model was calibrated to real-world data, but in order to focus on the main relationships, we made some simplifying assumptions. For example, cash flows are modelled on an annual basis and growth factors (income growth rate, interest rate of the loan, inflation, refinancing cost, risk margins, etc.) are supposed to be constant.

In the new income-contingent scheme, the repayments are due both in the active and the retirement periods. The net nominal income (J) of a given debtor increases from now ($t=0$) until retirement ($t=N$) according to the growth rate, which is composed of the real income growth rate (w) and inflation (i). At retirement, a reduction in incomes is supposed to be in line with the replacement rate (h- first pension income / last net wage income). Then, the pension grows by the same rate as the wage income previously, until the death of the borrower ($t=L$).

$$J_t = J_{t-1}(1+w)(1+i) \quad ha \quad t \neq N$$
$$J_N = hJ_{t-1} \tag{1}$$

Loan repayment (T_t) is purely income-contingent, hence it equals α percentage of the actual income (net income or pension), until the debt (H_t) is paid back or until the death of the borrower at the latest.

$$T_t = \min\left(\alpha J_t; H_t(1+y)\right) \quad ha \quad t \leq L$$
$$T_t = 0 \quad ha \quad t \leq L \tag{2}$$

The debt of a borrower at the end of year t (H_t) is increased by the accumulating interest rate (y) and is decreased by the repayments (T_t), but it cannot become negative:

$$H_t = \max\left(H_{t-1}(1+y) - T_t; 0\right). \tag{3}$$

The interest rate of the loan (y) is the sum of the base rate (BUBOR)[7] and a fixed risk margin (c).

$$y = BUBOR + c \tag{4}$$

The year when the total debt becomes 0 (full repayment is reached) is denoted as t^*. But the maturity of the loan (M) cannot be longer than the lifetime of the debtor (L).

$$M = \min(t^*; L) \tag{5}$$

We also suppose that the nominal value of the collateral (F_t) is increased by inflation (i) and decreased by the depreciation rate (a).

$$F_t = F_{t-1}(1+i)(1-a) \tag{6}$$

In the case of the borrower's demise ($t=L$), the collateral is executed, i.e. the real estate is sold, and the outstanding debt is reduced by the sale revenue. When calculating the sale revenue, we suppose that the bank cannot sell the collateral at its nominal value but at a reduced price decreased by a d liquidation discount. If the balance (= revenue-debt) is positive, it is inheritable otherwise the remaining debt is written off and the deficit is considered as the loss of the bank.

As we can see, banks have two types of incomes: repayments from the debtors and eventually the sale of the collaterals. If all of these incomes are calculated at present values and are compared to the currently outstanding loan, we receive the so-called profit of the lender (also at present value) (Π).

$$\begin{aligned} \Pi &= \mathrm{PV}(\text{repayments}) + \mathrm{PV}(\text{collateral}) - \text{outstanding loan} \\ \Pi &= \sum_{t=1}^{M} \frac{T_t}{(1+f)^t} + \frac{\min(H_M; F_M(1-d))}{(1+f)^M} - H_0 = T_0 + F_0 + H_0 \end{aligned} \tag{7}$$

We must note that in practice, this excess income over the refinancing costs is not a pure profit, as this must cover all the administrative expenses and also the credit risk.

Cash flows are discounted at the banks' refinancing cost (f), which is the sum of the base rate ($BUBOR$) and a fixed margin reflecting the credit risk of the bank (b). In case the government provides a preferential refinancing at rate (p) to support the programme, the refinancing cost can be even lower.

[7] BUBOR: Budapest Interbank Offer Rate.

$$f = \min\left(BUBOR + b; p\right) \tag{8}$$

However, if the bank refused to participate in the IC scheme and sticks to the original, fixed repayment schedule, non-performing loans would be managed in the usual way: positions are closed, collaterals are sold out, and the remaining debts are written off. In this case, the profit of the lender (Π') is defined in the following way:

$$\Pi' = F_0\left(1-d\right) - H_0\,. \tag{9}$$

The difference between the two values (Π–Π') is due to the extra effort the bank takes in order to get repaid by entering into the income-contingent scheme instead of closing its positions right now. This is why we call this difference as the value added of the income-contingent scheme (VA).

$$VA = \Pi - \Pi' \tag{10}$$

Having simulated the cash flows of the bank, the ex-post return can also be determined by calculating the rate at which the present value of future cash flows is just equal to the current value of the outstanding loan (IRR, internal rate of return). If all debtors were able to fully repay their debts, collaterals would not be executed at all and ex-post return would equal the interest rate of the loan (y). Otherwise, the internal rate of return is less than the interest rate of the loan.

5.2 Individual scenarios

The input parameters of the model can be grouped into three categories:

- *Debtors' attributes:* age, debt, LTV (loan-to-value), and income.
- *External macro-economic conditions:* depreciation of the collateral (real estate), inflation, liquidation discount of the collateral, BUBOR, growth rate of incomes, retirement age, replacement ratio of pensions, and refinancing cost of the bank.
- *Decision / control variables:* repayment rate and risk margin for the non-performing loans.

The parameters of the first two categories are exogenous, hence they cannot be influenced by the stakeholders (debtors, banks, state), while decision variables can be discussed during the design and implementation of the system and the final calibration should be the result of a consensus adopted by all the parties.

Table 2 presents the parameter values we applied for the calculations. We also indicated how the given representative value was determined.

Depending on the income of the borrowers and the number of co-borrowers within the contract, we defined four different scenarios: A: One borrower earning a minimum wage, B: Two borrowers earning minimum wages, C: One borrower earning an average income, D: Two borrowers earning average incomes. When examining the effects of introducing an income-contingent repayment scheme, output variables for each scenario were calculated.

Output variables from the borrowers' perspective: monthly net (disposable) income (J_0), PTI (payment-to-income) ratio (relative to the net income) in the fixed scheme (PTI_{fixed}), PTI (payment-to-income) ratio (relative to the net income) in the income-contingent scheme (PTI_{ic}).

Table 2. Parameter values

	Parameter value	Remark
Debtors' attributes		
Expected lifetime of debtors (L)	30 years	average[1]
Debt outstanding (H_0)	USD 33,000	pessimistic estimation[2]
Loan to value ratio ($LTV= H_0/F_0$)	100%	pessimistic estimation
Monthly net average income (J_0)	USD 623	average[3]
Monthly net minimum wage (J_0)	USD 270	actual regulation[4]
External conditions		
Depreciation of real estates (a)	2%	accounting standard
Inflation (i)	3%	realistic estimation
Liquidation discount of the collateral (d)	0.4	realistic estimation
BUBOR (12 months)	3.5%	actual value
Annual growth rate of incomes (w)	3.5%	realistic estimation
Retirement age	65 years	actual regulation
Replacement ratio of pension (h)	0.8	realistic estimation
CONTROL VARIABLES		
Repayment rate relative to the net income	30%	assumption
Risk margin of non-performing loans (c)	4%	assumption
Refinancing cost of the bank (f)	BUBOR+0.5%	assumption

Notes: [1] The age of an average debtor is currently 44 years based on the portfolio of one of the major mortgage/retail banks. At this age the expected additional average lifetime for women is 34, for men is 26 years. Thus the average remaining lifetime of men and women is around 30 years.
[2] The average debt is around USD 28,000 (total portfolio/number of contracts=3.4 billion/120,000). To be prudent, we calculated with a higher-than-average debt (around the 80% quantile).
[3] The average gross income in Hungary in 2014 January–September was HUF 234,000, hence the monthly net average income was HUF 153,270 (without family tax alleviations).
[4] The monthly net minimum wage in Hungary in 2014 is HUF 66,480 (without family tax alleviations).

Source: Authors own calculation.

Output variables from the lender's perspective: maturity of the loans (M), total amount of collaterals sold relative to total bank income ($F_0/(F_0+T_0)$), profit of the lender under income-contingent repayment (Π), value added (Π-Π'), ex-post annual return (IRR).

Table 3 presents the output variables resulting from the model calculations based on the parameter values in *Table 2*.

We can see from *Table 3* that PTI ratios in the fixed scheme range widely between 116% (scenario A) and 25% (scenario D), hence it is not surprising that NPL ratios are currently so high in the lower income categories. The major advantage of the IC scheme is that PTI is automatically fixed and is constant across all income categories and over the whole maturity of the loan (20% to the gross income, thus 30% to the net income). In this way, by the introduction of the IC scheme, the repayment burden is significantly alleviated in scenarios A, B and C. This is partly due to the longer maturities and, more importantly, to the expected income growth which enables future repayments to increase as well.

The results show that except for scenario A, debtors are able to fully repay their obligations during their expected lifetime. Even in the most unfavourable case (scenario A), borrowers repay the capital and the refinancing costs, and it is only the risk margin (4%) which is not fully refunded. The repayment is financed partly from the sale of the collateral (at the end of the borrower's life), which accounts for only 23.79% of the total income of the bank. However, if the bank decided to promptly terminate the overdue contract and to sell the collateral immediately, then its revenue would be much less, which is reflected in the highly

Table 3. Output variables for different scenarios

Scenarios	A one min. wage	B two min. wages	C one avg. income	D two avg. incomes
BORROWER				
Monthly net income, USD (J_0)	270	541	623	1,246
PTI fixed, %	116	58	50	25
PTI income-contingent, %	30	30	30	30
LENDER				
Loan maturity, years (M)	–	30	22	9
Collateral/ total income, % $F/(F+T)$	23.79	0	0	0
Profit, USD (Π)	978	17,820	13,657	5,554
Value added, USD (Π– Π')	14,178	31,020	26,857	18,754
Ex post annual return, % (IRR)	4.17	7.5	7.5	7.5

Source: Authors own calculation.

positive value added of the income-contingent scheme (*VA*=USD 18 thousand, which is more than the half of the actual debt, H_0=USD 33 thousand).

We can also observe that as the income of the debtor(s) grows, the expected maturity of the income-contingent loan decreases sharply. While in some cases the maturity can be very long (30 years or more) depending on the loan portfolio's composition, the average maturity under the IC scheme can be fairly close to the actual maturity of the fixed loans (15 years). Collaterals are executed only in scenario A; in the other cases, debts are repaid solely from future incomes. It is interesting to note that the profit of the lender is not a monotone function of the income, because as income grows, the maturity of the loan decreases, hence the borrower pays less risk margin in total. Two borrowers on minimal wages (scenario B) are able to fully repay their debt, but only in 30 years, therefore they pay a lot of risk premium and this is why they become the most profitable clients. Not surprisingly, the value added is closely related to the profit of the lender, thus it shows a similar pattern. The ex-post return equals the interest rate of the loan (7.5%) in scenarios B, C and D, where debtors fully repay. However, in scenario A, the ex-post return is somewhat lower, because the debtor will not be able to repay all its obligations and a part of it will be written off as the loss of the lender.

Of course, in special cases, the bank might get into worse scenarios than presented above, for example in the case of higher LTV, early death of the debtor, lower incomes, or due to external parameters changing adversely relative to our assumptions. From this aspect, the most powerful macro-economic factors are the growth rate of real incomes and the real interest rates; more precisely, it is their long-term relation that matters the most. In our model, we prudently assumed a real income growth rate of 0.5% being lower than the real interest rate (4%–3%=1%).

5.3 Portfolio effects

In order to analyse the portfolio level effects of the introduction of the IC scheme, we simulated the total non-performing mortgage portfolio presently denominated in foreign currency described in the reports of the MNB (MNB 2014a, 2015). This portfolio includes about 120,000 contracts with a total volume of USD 3.4 billion. The estimated structure of the portfolio is presented in *Table 4*.

Unfortunately, in the other dimensions, detailed statistics were not available. Hence, when building up the micro-simulation model, parameters were adjusted to the available aggregated statistics as closely as possible. If no data were available, then we made realistic assumptions.

Table 4. The estimated structure of the non-performing FX mortgage portfolio (2013, USD)[8]

Debt	Frequency, %	Number of contracts	Portfolio size
6,000	14	16,800	100,800,000
16,000	32	38,400	614,400,000
26,000	24	28,800	748,800 000
36,000	12	14,400	518,400,000
50,000	11	13,200	660,000,000
70,000	4	4,800	336,000,000
100,000	2	2,400	240,000,000
140,000	1	1,200	168,000,000
	100	120,000	3,386,400,000

Source: MNB (2011: 15).

We created a population of borrowers by simulating their main attributes: age, debt, LTV, and income,[9] while external macro-economic conditions and control variables presented in *Table 2* remained unchanged. We also assumed that the four attributes were independent from each other. In reality, the relationship between income and the other three variables (age, debt, LTV) is rather positive as older people typically earn more and high earners can get higher debt and higher LTV. The more these correlations are strong, the lower potential losses are, because high ages, debts and LTVs are expected to be compensated by higher incomes. Hence, if we set aside correlations and suppose independencies, the simulation can be considered as more or less pessimistic, which meets the requirement of prudency.

Age: We assumed that the age of the debtors follows a normal distribution with a mean of 44 years and a standard deviation of 6 years. We also introduced a lower bound for age at 25 years. For the sake of simplicity, we assumed that debtors within the same contract were completely identical. We supposed that all borrowers work until the age of 65, and then live 9 years as pensioners.[10] Early death was not modelled because this type of risk is hedged via life insurance contracts corresponding to the loan contract.

Debt (H_0): Debt size was estimated according to *Table 4*.

[8] We supposed that in the case of the non-performing loans, the weights of the categories are the same as in the case of the whole FX mortgage portfolio.

[9] Simulations were run in an Excel VBA program for 10,000 loan contracts, and this population was then multiplied by 12.

[10] This is consistent with *Table 2,* remark 1.

Table 5. Estimated frequency of the income scenarios

Scenarios	A one min. wage	B two min. wages	C one avg. income	D two avg. incomes
Monthly net income, USD (J_0)	270	541	623	1,246
Frequency, %	30	40	20	10

Source: Estimation of the authors.

Loan to value ratio (LTV): We assumed that the distribution of the LTV ratios is normal too, with a mean of 1.2 and a standard deviation of 0.2. As LTV cannot be negative, we introduced a lower bound of 0.

Monthly net incomes (J_0)*:* Although there are publicly available reports on the distribution of the incomes of the entire Hungarian population, these statistics cannot be used here because the income of this special group (non-performing borrowers) might be totally different; certainly, lower income categories are over-represented. Thus, as no reliable statistics on the income of non-performing borrowers were found, we assumed that only four income scenarios (A-B-C-D) existed, exactly the ones we defined in the previous section. Frequencies were estimated according to some experts' opinion *(Table 5)*.

Income paths were simulated by supposing that the annual real wage growth rates were independent and normally distributed stochastic variables with a mean of 0.5% and a standard deviation of 0.2%.

Having created an artificial but realistic population, we calculated the performance measures from the lender's point of view as defined in *Table 3*. In this parameter-setting, 67% of the borrowers were able to fully repay in their lifetime and there was no need for selling out the collateral. Moreover, those individuals who could not fully repay their obligations proved to be profitable for the bank in 87% of the cases because collaterals were enough to compensate the capital and its accumulated financing cost, and even a part of the risk premium. If we take a helicopter view of the whole portfolio, it turns out that the aggregate profit (*Π*) is around USD 0.45 billion, which is more than 13% of the portfolio's actual face value.

However, if, contrary to our proposal, the banking sector decides not to participate in this programme, and defaulted debt contracts are terminated immediately by executing the mortgages at a liquidation discount of 40%, then according to our calculations about 48% of the portfolio face value would be immediately lost (USD 1.64 billion).[11] Thus, if our assumptions hold, the value added result-

[11] The price impact of the increased selling activity was not taken into consideration.

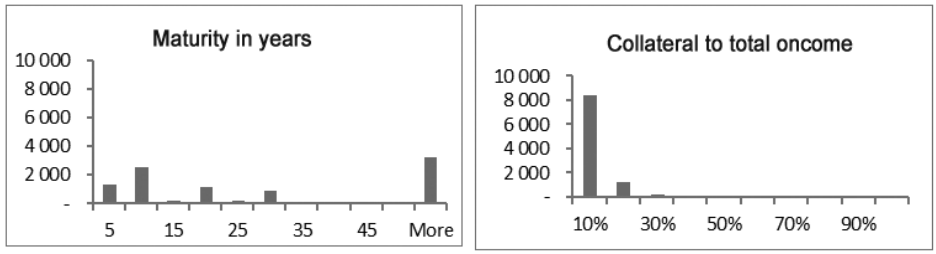

Figure 3. Maturities and the weight of the collateral

Source: Micro-simulation.

ing from the fix-to-IC switch is 0.45+(–1.64)=USD 2.1 billion. It is important to emphasise that the introduction of the IC scheme does not increase the credit risk of the banks, as all the risks are already present in the system.

Of course, this impressive performance is also due to the cheap state refinancing. It is worth calculating the costs of this support affecting the state budget. If the banks' refinancing costs are around BUBOR+2%=3.5%+2%=5.5%, the state refinancing at 4% induces an annual public cost of 1.5% based on the portfolio's face value. Therefore, in the first years the total public costs would be around USD 0.05 billion, but later on as debts are gradually paid back it will significantly decrease. However, these costs are not effective while banks are able to pay back the refinancing loans (no default event occurs) because the interest rate of the refinancing loans (4%) exceeds Treasury bond rates (3.5%). In our opinion some state support in the form of cheap refinancing can be justified, especially if we also consider the spillover effects.

Finally, in order to gain an insight into the inner structure of the portfolio performance, it is also worth examining the distribution of the output variables (*Figures 3, 4* and *5*).

It can be seen in *Figure 3* that loans are repaid within 35 years, except for those that cannot be repaid at all. Moreover, 38% of the loans are repaid within 10 years; hence, the average maturity of the repaid loans is fairly short, being around 15 years, exactly as in the fixed scheme. In case the borrowers take advantage of their early repayment option, maturities can be even shorter.[12] Another advantage of the IC scheme is that the sales of the collaterals are postponed and dispersed in time; therefore, adverse price impacts on the real estate market are minimised. The weight of collateral revenues is remarkably low within the total income of the bank; cash-flows are dominated by the income-contingent repayments.

[12] We did not model the early repayment behaviour of the debtors.

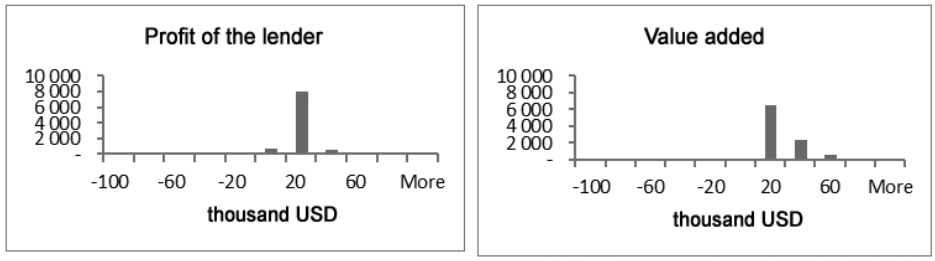

Figure 4. Profits and the value added of the IC scheme

Source: Micro-simulation.

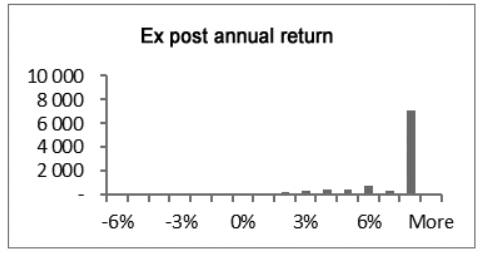

Figure 5. Ex post annual returns

Source: Micro-simulation.

Figure 4 presents the distribution of the lender's profit and the added value of the IC scheme relative to the fixed one.

In more than 80% of the cases, the lender's profit on one contract is between USD 0 and 20 thousand (the average face value is USD 28 thousand). The value added is calculated as the difference between profits in the IC and the fixed schemes. Given that profits in the fixed scheme are negative (due to the forced sale of the collaterals), value added of the IC scheme is even higher than the profit. Both *Figure 4* and *Figure 5* underpin that banks can improve their positions significantly by entering the IC scheme.

As we could also see in *Table 3,* when debtors fully repay on finite time horizon, the ex-post annual return of the lender equals the interest rate of the loan (7.5% in our model). Of course, there are some cases when the ex-post annual return is negative, but this risk is practically negligible.

6. CONCLUSIONS AND POLICY IMPLICATIONS

We showed that if certain conditions hold, IC repayments are more favourable than fixed ones not only in student lending, but also in the case of non-performing mortgage loans. We proposed to convert the Hungarian non-performing household mortgages denominated in foreign currencies into HUF, to lower the interest rate margins, and, most importantly, to introduce income-contingent repayments for the remaining debts. This would be a voluntary scheme to which contractors (banks and borrowers) can switch only if both of them agree.

We have also shown within the framework of a micro-simulation model that with the help of an income contingent (IC) scheme, the vast majority of non-performing loans can be repaid, while borrowers are not overburdened. The proposed scheme is attractive for all the stake-holders.

It is attractive for the borrowers because payment-to-income (PTI) ratios in the lower income categories could drop to one-third or even to one-fourth. Default risk is practically eliminated, while low earning borrowers can keep their home over their lifetime, and the property remains inheritable to their children.

It is attractive for the lenders because low PTI ratios and strong incentives to repay (mortgage right, minimum repayment requirement, lower interest rates for good borrowers, and early repayment option) lead to low NPL ratios, which creates high value added for the banks (USD 2.1 billion for a portfolio of USD 3.4 billion). Cash-flow risk can be managed by portfolio diversification and/or by refinancing on the capital markets or by the state. The price impact on the FX market and on the real estate market is also minimised as HUF conversions and sales of the collaterals are postponed and dispersed over time. Finally, it is also clear that this mass volume income-contingent repayment is much cheaper than endless bilateral negotiations between bank and client.

It is also attractive for the state because systemic risk is effectively reduced at a fairly low public cost. State support to the scheme consists of the operation of the collection mechanism by developing the tax system, the cheap refinancing for the banks, and assisting HUF conversions in order to attenuate the price impact on the FX markets. In this way, the state can exploit synergies between banking system, tax system, student lending, etc., and can attenuate negative externalities without intervening into private contracts by force. The technical problems of practical implementation can also be resolved, based on the international and Hungarian experience with student lending.

Our proposal, first presented in Berlinger – Walter (2013, 2014), was discussed among experts, but it was not accepted by the Hungarian authorities. By May 2015, the conversion of foreign debt loans and the compensation of exchange rate and interest rate changes were accomplished. According to the first unofficial

MNB comments, the average decrease in debts and debt services is significantly less than it was expected: only 20% instead of the initially forecasted 30%. This raises the question whether these measures have really solved the problem of non-performing mortgages, or whether new packages will become necessary in the near future again. We believe that the roots of solvency problems (too high indebtedness, weak and volatile incomes) are still present, and thus the idea of the implementation of an IC scheme remains a topical issue.

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