Dual Index Mortgages: Lessons from International Practice and Conditions of Development in Poland

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INTRODUCTION

This article is based on a report prepared for USAID as an answer to the National Bank of Poland's request to better understand Dual Indexed Mortgages (DIMs) and their inherent risks, as well as to provide suggestions regarding their related prudential regulatory and supervisory parameters. The work was supported by a cooperation between Abt Associates and the Urban Institute. The consultant is now a staff member of the World Bank.

DIMs are mortgage loans which amortize according to two independent indexes:

1. A financial index applied to loan rate and balance, reflecting the lender's cost of funds, improving the lender’s capacity to underwrite variable market-oriented rates, to reduce its interest-rate risks and to secure its profitability;

2. An index, applied to repayments, reflecting the changing income of the borrower, improving his capacity to afford the loan (despite high rates mostly caused by inflation) through stable effort ratios (debt service-to-income ratios), even when incomes fluctuate.

The flow of payments and amortization are separated from credit rates. In unstable economic conditions, DIMs can be an effective housing finance stabilizing tool. They are relatively inflation-proof, more affordable than conventional credits, and resistant to external shocks. They have a unique ability to self-adjust, providing credit affordability for the borrower, profitability for the lender, and reduced budgetary subsidies for government.

But DIMs are also complex products. If improperly understood, designed, underwritten or supervised, they can lead to severe contingent liabilities, as recently revealed in Mexico.

There is a growing body of experience with DIMs, including France, Mexico and Turkey. DIMs were also developed in Ghana in order to reduce the pressure for budgetary funding and subsidies in a context of liberalized high interest and inflation rates. Their experiences can provide guidance on appropriate parameters and indexation to help minimize risk. This article focuses on the recent experience in Poland.

Polish Housing Finance

The Polish housing finance system is facing decisive changes, as a growing number of competing primary lenders have entered the long-term mortgage business in a short space of time. Most of the advanced ones include in their menu of products a number of DIM variants. Poland is one of the few countries in the world with a mortgage market actively using DIMs.

Inflation rates have been steadily declining from 32% in 1994 to 12% at present, which is still relatively high and proves harder to reduce further. Inflation is traditionally quite seasonal (lower spot rates by mid-year vs. higher levels at the end and beginning of years). Interest rates on loans are still at 26% to 27%, reflecting high real rates in Poland. Incomes have traditionally exceeded inflation since the opening and growth of the Polish economy after the 1990-1991 shock therapy, when purchasing power fell by 20%.

This context was favorable to DIM loans as a transition instrument for the emerging mortgage market. They were catalyzed and developed on the one hand by the Mortgage Fund, which is a refinancing facility funded by the World Bank, USAID and the government of Poland for various participating...
banks, and by PKO BP, which is the largest retail bank and the largest mortgage lender.

Limits of Classical Credits

Classical or standard mortgage loans, whether fixed or variable rate, do not defer the payment of market-based interest due. In a high rate environment initial effort ratios (payment as a percentage of income) are unaffordable (see Figure 1) as there is a disequilibrium of real deflated payments between excessive initial ones and insignificant later ones.

Loan amounts must then be reduced, divided by a factor above 2 in Poland when compared with a no-inflation case. Extended terms do not help much. Effort ratios still rapidly decline, as do the deflated balance and credit risks. In an inflationary environment, such loans make more sense for medium-term credits of modest amounts such as complementary financing or renovation. They represent a solid product for lenders entering the mortgage business, notably under improving macro-economic conditions.

In unstable economies, fixed-rate, long-term credits create large interest-rate risks for lenders and affordability problems for borrowers. The anticipation of inflation is reflected through large rate premiums, which make credits more expensive. Prepayment risks are larger. Lenders face serious rate risks because available resources are shorter-term. Initial repayments are large and perhaps unaffordable. Their simplicity is a commercial bonus, but costly.

Variable rates are preferable if they correspond to more accessible, liquid and diversified resources. More lenders may then compete to offer a wider range of products. Indexed-rate mortgages may be gradually replaced by rollover adjustable-rate mortgages, instituting a longer period before adjusting the credit rate, which is fixed in the interim. Yet both versions may lead to hazardous volatile effort ratios under unstable conditions.

**DIM Loans**

DIMs represent a specific variety of variable-rate mortgage loan, which separate the flows of payments and amortization rates from variable credit rates.

- Payments are adjusted according to an index reflecting the incomes of borrowers. Examples include the National Wage Index in Poland (national quarterly for the Mortgage Fund, regional for PKO BP’s market-rate credits); the Minimum Wage Index in Mexico (revised periodically according to economic and political factors); the Consumer Price Index (in Mexico since 1996); the Index of Construction Cost in France (adjusting rental incomes, tied to inflation); or other income or cost-of-living indexes. The indexation should ensure more stable effort ratios, as with classical loans in a no-inflation world.

- Credit rates are usually adjusted to a financial index, which should reflect as closely as possible the cost of the funds that finance these long-term credits. Examples include the Interbank Rate (WIBOR or Warsaw Interbank Borrowing Rate); the Average Banking Cost of Funds (in Mexico the CPP); Treasury Bills (30-day CETE in Mexico, 13-week Treasury Bills for the Polish Mortgage Fund); monthly adjusted one-year deposit rates of the largest Polish banks for PKO BP’s market-rate loans, etc. A margin is added to or multiplied by the base rate in order to price the corresponding costs, risk and profit of the lender.¹

The first payment of a DIM is set according to the loan amount, the projected maturity
and the expected divergence between the two variable indexes, either in nominal or deflated values. Subsequent payments are indexed until the credit is amortized.

The process is automatic and self-adjusting. The crucial first payment is usually expressed as a percentage of the originated credit amount. The final maturity is shortened if the difference between the financial index and the income index is smaller than expected, and extended in the reverse case. The maturity therefore provides the crucial flexibility to build lender profitability and borrower affordability simultaneously in changing and unpredictable economic environments.

Thanks to the indexation process, initial payments remain affordable. Under inflationary conditions, initial payments are lower than interest due, thus generating a period of capitalization of interest, or negative amortization through rising nominal debt balances, from which the amount and duration will depend primarily on the rate of inflation. Meanwhile, the deflated balance should continue to decline steadily. Indexed payments would then exceed interest in order to eventually amortize the nominal balance.

The ratio of loan balance to housing value, the decisive element of an adequate guarantee for the lender, which reciprocally measures the build up of the borrower’s equity, also declines, as the capitalization of interest falls below inflation. However, there is still a residual risk of rising ratios during early years if (1) the capitalization was maximal due to a large difference between the rate index and the income index; and (2) home value appreciation rates fall significantly below the rate of inflation.6 Banks may choose to set more conservative loan-to-value ceilings for all credits like DIMs, as well as because of the complexity of foreclosure procedures.

Example of a DIM in Poland:

Figure 2 depicts the historical evolution of a DIM loan eligible under the Mortgage Fund’s underwriting standards. This loan is assumed to be originated in 1994, when the activities of the fund started.

- Loan amount equivalent to 25 months of household income (100,000 PLN for every 4,000 PLN of a borrowing family’s gross monthly income, based on 2 workers);
- First monthly payment equals either 1.0% or 1.2% of the loan (respectively 25% and 30% of effort ratio for the purpose of the simulation; the maximum standard accepted by the fund is 25%);
- Historical indexes of the Mortgage Fund applied since 1994, and a 4% nominal margin added to the base financial index by the primary bank;
- The first indexation of repayments applied at the beginning of the first quarter.3

The most affordable DIM (first monthly payment equals 1.0% of the loan vs. 2.3% for a classical loan) reveals rising nominal balances (80% of accrued negative amortization due to large inflation rates mostly in the early years, 1994 and 1995). But the deflated real balance has already amortized by 20%.

The negative amortization terminates in two years for a total maturity less than 11 years. Slightly less affordable DIMs (first monthly payment equals 1.2%) have amortized by 35% in real terms and at present no longer negatively amortize. The pattern of indexes has proved very favorable since 1994 with the Wage Index nearly equal to the Mortgage Fund’s base rate. This trend may not last due to the likelihood of slowing wages and higher real rates.

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Figure 2. Nominal and Real Balances of 1994 Vintage
MAIN CHARACTERISTICS OF
DIM CREDITS

1. Inflation-proof and affordable credits. Credit rates do not directly affect the affordability of DIMs since indexed payments eventually pay for inflation, assuming that in the long run incomes roughly keep pace with inflation. DIMs function as if there were no inflation, and they self-adjust to the variations in purchasing power and real rates. Optimal designs could support lending amounts of up to 25 times monthly income. DIMs are mainly useful during a transition phase with inflation before being gradually replaced by more conventional credit designs as stability is achieved.

2. DIMs are relatively resistant to external shocks, if safely designed and underwritten. DIM payments are indexed to stabilize effort ratios, whatever economic trends may occur, provided that the individual borrower's income keeps pace with the average Income Index. When shocks occur, whether higher interest rates and/or declining incomes, the amortization is automatically and smoothly adjusted. Many, though not all, adverse shocks could thus be absorbed. This shock resistance is all the more efficient if DIMs are safely underwritten and monitored (in contrast to the experience of the recent Mexican crisis).

3. Minimized interest rate and prepayment risks for DIMs. This characteristic requires that the financial index reflect the actual composition of mobilized liabilities over the long-term duration of credit portfolios. In case of partial prepayment, it would be easiest to let contractual indexed payments proceed normally, there being no particular costs for the bank. The reduced balance would then simply shorten the expected maturity. Banks could discourage frequent and small prepayments by fees or imposed minimum prepaid sums, but a limited prepayment ratio is unavoidable. It may even help banks to establish a small funding safety valve, in order to finance the growing portfolio balance more easily. Excessive prepayments, however, would make the cash flow management more delicate and would affect the size of the portfolio as well as the bank's profitability.

4. Credit risks can be minimized by the DIM's pattern of indexed payments. This judgment is relative to other credit designs for similar clients, creditworthiness procedures, and collateral guarantees, provided that DIMs are properly designed, mostly through reliable indexes and reasonable first-payment-to-loan ratios, as explained below. DIMs will achieve no miracle in very adverse economic conditions, as there is no free lunch in mortgage designs. Thus, the flexibility of the amortization period may distribute the risks of DIMs more evenly, but these risks cannot be eliminated. The main danger specific to DIMs is the risk of an over-stretched term and a resulting final capital loss (non-amortized capital in real terms). Careful design should help to avoid or limit this risk.

5. DIMs create higher liquidity needs—complicating asset/liability and cash flow management—due to:
   - Their long-term nature, with usually shorter-term funding possibilities;
   - An unpredictable capitalization of interests, depending on inflation and dual indexes, which ideally requires corresponding indexed liabilities. For a deposit bank, this would be sufficient growth of new deposits or rolled-over interests from current deposits; for a mortgage bank, the possible issuance of mortgage bonds initially deferring some part of due interests;
   - Their variable cash flow and maturity, making it more difficult to mobilize capital market investors.

6. DIMs are not simple. Good prior training is required to ensure technical competence on the part of those who manage DIMs so that they can be properly underwritten, funded and serviced. Most of the initial training by the Mortgage Fund focused only on the refinancing procedures. The Mexican experience also highlighted the dangers of a rapid boom in various DIMs offered by commercial banks without minimum regulations and close supervision of related risks. In Poland training efforts should be intensified at various levels, as the learning curve remains low.

7. The servicing aspects of DIMs are not detailed in this report, except for the need to track payment-to-balance ratios, although they may become a significant obstacle if banks have difficulty keeping track of the complex evolution of DIM flows. The usual procedures and computerized tools often appear inadequate to service DIMs (variable payments, variable maturity, negative amortization, etc.); any large-scale development would require lenders first to invest in back-office facilities and equipment.

8. The commercialization of DIMs may prove difficult, although it has been successful in some other countries with relatively difficult and unstable economic conditions. Counselors and loan officers should use realistic and simple computerized simulating tools to analyze demographic patterns (indexation of payments, capitalized interests, real amortization, variable maturity) through probable scenarios and examples. Clear and accurate
information to households represents an important element in commercialization. Options such as a capped maximum maturity could be considered, provided that the resulting risk is priced and limited, expressed as a percentage of remaining deflated debt to initial loan, even under an adverse economic forecast.

9. The accounting, regulatory and fiscal environment must be adapted to DIM characteristics, both to ensure some satisfactory profitability for lenders and to install some regulatory and supervisory safeguards and tools for sound development of these credits and their lenders. These could include capital adequacy, loan-loss reserves, deferred tax reserves, accounting of capitalized interest, etc. Before making final recommendations on these aspects, the functioning of performing DIMs must be analyzed, and methods and lessons identified.

10. DIM characteristics can represent a significant tool to expand mortgage lending in unstable and unpredictable economies undergoing a transition stage. Increasing the sustainability and affordability of mortgage credits supports the housing reform process and helps financial institutions to build a growing and secure portfolio of mortgage credits. If well designed, commercialized and implemented, DIMs can be very effective during a transition period. Their design can reduce the expected level of inflation and play an important stabilization role. In both these respects, their contribution to a sound monetary policy should be considered. They can help to sustain an ambitious housing policy with private, market-oriented mechanisms. DIMs have been designed as a key element of housing policy in countries where inefficient subsidies were to be eliminated from mortgage credits during inflationary phases, as in Mexico, Turkey and Poland.

11. DIMs are complex and require precise underwriting rules. They should be closely supervised and, to a lesser extent, regulated. Their characteristics can be exploited for the best but, if improperly implemented, they can have a negative impact on mortgage financing in terms of liquidity risk, credit risk, operational requirements, short- and long-term profitability of lenders, and capital adequacy requirements. In other words, if not well handled, they can fail to achieve their goals and lead eventually to a serious financial crisis, creating contingent liabilities for government.

ELECTION OF INDEXES

The choice of indexes is fundamental, as is the period of their adjustment. Ideally, indexes should:

- Reflect the evolution of borrower's incomes and the costs of lenders' funds;
- Be adjusted as often as necessary to reflect these changes (monthly or quarterly);
- Be well known, regularly published, not subject to administrative distortions, and easy to track and compare.

Indexed Credit Interest Rates Applied to Outstanding Balances

The selection of an adequate financial index is critical for any variable-rate credit, not only DIMs. It should represent a guarantee of transparency for long-term borrowers and vary according to the costs of available funds in the lending bank in order to minimize its rate risk. Banks should closely watch the interaction between their various types of liabilities, which are still subject to significant differences over long periods, in order to tailor the most adaptable financial index. Many banks, however, have not yet developed such risk-control policies. Furthermore, there is no optimal universal index that could be applied by all lenders.
Example of the Polish Mortgage Fund

DIHs eligible for the fund apply the fund's base rate. Banks would face no rate risk if actually refinancing their whole portfolio by the fund. However, some may prefer to fund some of their portfolio with other liabilities, and the fund's rate (based on three-month Treasury bills) may inaccurately reflect the costs of other mobilized funds.

Figure 3 illustrates the evolution of the deflated base rate, including the fund's own margin, along with the other deflated wage index. The evolution of the financial index is still relatively chaotic when measured in real terms, with some peaks (signals of tighter policy) and declines. The average trend is rising (quarterly rates between 0% and +4.5%), for a yearly average above 10% at the present time.

The fund has changed its financial index since 1996, from the former Central Bank's discount rate to short-term Treasury bills, a more market-oriented index. Short-term and liquid Treasury bills were then considered a better reflection of financial markets than the interbank market (Wibor).

The fund adds a margin of 2.1% to its published base rate, but the actual margins are negotiated with the borrower and can be as low as 0.8%. Banks can choose to either keep the higher margin on individual borrower loans (e.g., adding to profits) or pass the discount on through a reduced loan rate (for competitive reasons or to avoid an extended loan term).

Financial Index of PKO BP's Mortgage Loans Since Mid-1995

PKO BP's financial index is an average one-year deposit rate from the largest Polish banks. It is applied to the new generation of mortgage loans, which have not been subsidized or funded by the government since May 1995 (by contrast to earlier vintages). This choice of index is transparent and fits the nature of PKO's liabilities; it is the largest deposit bank. The choice is relatively neutral for borrowers; however, a banking crisis could result in unstable deposit rates. The index also does not reflect the possible regulatory changes of obligatory reserves, which affect the actual costs of funds. PKO BP's own structure of deposits may also differ from the average index in term and rate.

Diversity of Banking Situations and Strategic Financial Strategies

The financial index should integrate the expected asset/liability management tools, which should be soon enlarged in Poland by direct sales of portfolios or special collateralized securities like mortgage bonds, etc. Capital market investors could then compare the related risks and returns of mortgage credits with some conventional risk-free fungible assets, like Treasury bills or Wibor.

In conclusion, there is no one optimal financial index. Adjustments may be required according to the funding strategy and possibilities of each individual bank. For example, there are major differences between a specialized mortgage bank issuing bonds, a small participating bank dependent on the Mortgage Fund, and a universal bank with abundant deposits.

On the other hand, some minimum standardization is needed to facilitate funding by institutional investors. A compromise between these two requirements must be found. The index should be watched on a regular basis, and if necessary, changed for succeeding generations of credits.

The Income Index Applied to Payments

Both the Mortgage Fund and PKO BP use official statistics from the Central Statistical Office (GUS), which are fairly reliable. Both use an average Wage Index for some...
representative industrial sectors. This base may differ from the actual income evolution of mortgage borrowers in Poland, many of whom are independent workers in the tertiary sector, but still represents a rather conservative estimate.

**Wage Index of PKO BP**

Before 1995, PKO BP was originating (and is still servicing) various generations of subsidized mortgage credits, mostly to cooperative members, on behalf of the Polish government. Most of these loans are DIMs, as they index repayments on borrowers' incomes, the financial index being six-month Treasury Bills. Effort ratios were successively regulated from an initial 25% level to a current 10%. The credit recovery was then made much lower than the level required to finally amortize the loans. The capitalized interest is paid by the state to PKO BP as a regressive subsidy, necessary to maintain the solvency of the bank.

Since the summer 1995, PKO BP has developed and funded its own portfolio of DIM loans, most of them at market-rate. Regional wage indexes from 49 regions are applied according to the locale of the lending agency. This approach has the advantage of offering a closer geographical match between borrowers' actual incomes and the index. On the other hand, regional indexes are adjusted according to administrative rules, to eliminate excessive differences from the national average. Their monitoring becomes complex, as there are as many different DIM products as there are indexes.

**Income Index of the Mortgage Fund**

Recorded wages are passed to DIM payments with a six-month delay, whereas the financial index is readjusted monthly from the previous month's rates. This time lag creates slight perturbations, as wages are subject to strong seasonal variations in Poland, increasing during the fourth quarter. Indexed payments are then applied during the countercycle, which causes effort ratios to fluctuate, resulting in "hills and valleys" which are not particularly good for borrowers.

Figure 3 illustrates the evolution of both Mortgage Fund's indexes, including quarterly variations of the National Wage Index. Very wide seasonal fluctuations are visible, as well as an average trend of significantly high purchasing powers. Figure 4 then illustrates the resulting effort ratios for different generations of similar DIM credits, which have originated at the beginning of each year since the starting fund's activities in 1994 until 1997. All loans had a first monthly payment equal to 1.0% of the originated amount and a targeted effort ratio value of 25%. The range of variations of effort ratios has already reached 5%—not dramatic, but consequential.

**Absence of a Reliable Income Index**

If no reliable income index can be identified, DIMs should not be developed. This was the main reason Hungarian authorities chose not to use DIMs; they used Differed Payment Mortgages instead.

Alternatively, a second-best index for DIMs could always be implemented for the highest income deciles of the population, using the latest monthly CPI, which could be applied to DIM payments after deducting a fixed security margin (for example, 5% annually). As long as income increases more than inflation minus 5%, effort ratios would stabilize or decline. The maturity would then depend only on the actual base rate and would not be contingent on relatively volatile real wages.

The resulting first payment ratio would turn out to be slightly higher than if the current Wage Index was used, but the affordability would not be too much reduced. The fact

![Figure 4. Effort Ratios for Various DIM Vintages](image-url)
that effort ratios should gradually decline, although less than with classical credits, would be an advantage which would improve the commercialization and security of loans. Problems would still appear, however, in case of a massive economic shock.

Adjust Both Indexes in Case of High Inflation

In the case of continuing high inflation, both DLM indexes should be adjusted more frequently and without delay. This may then require a change of selected indexes. As a general principle, it is better to adjust both indexes together as frequently and as regularly as possible. Since biannual adjustments may appear inadequate when rates are unstable (due to lag effects, interest rate risks, sharp jumps in payments, etc.), quarterly or monthly adjustments are preferable. Under hyperinflationary conditions, weekly revisions make sense, although they result in higher operational costs.

RECOMMENDATIONS FOR SOUND UNDERWRITING AND SUPERVISION

Figure 5 depicts the exponential relationship between the residual maturity of a DLM loan and the monthly payment-to-balance ratio, as predicted by the model, assuming different spreads between the financial rate (lender's margin included) and income index. Thus, a loan with an initial monthly payment-to-balance ratio of 0.8% with a margin difference of 10 percentage points (the square marker in the middle of the graph) will have a residual maturity of 30 years. As the monthly payment-to-balance ratio is increased to 0.9%, residual maturity falls to approximately 24 years; an increase to 1% reduces the residual maturity to approximately 17 years. A skyrocketing maturity means that the loan will never amortize. The higher the initial payment-balance ratio, the greater the likelihood that the loan will amortize. Once the ratio exceeds 1.5%, the loan is nearly certain to amortize in less than 10 years regardless of the evolution of the indices.

Some analytical conclusions are:

1. The best monitoring tool for DLMs is frequent observation of the payment-to-balance ratios. The residual term is exponentially tied to this value. Any supervisory authority, generally one like the Central Bank or a specific refinancing one like the fund, should require periodic statements of the various DLM generations.

2. The variable maturity is a limited protection against the risk of residual non-amortized balances. Under adverse conditions, extended terms reach diminishing returns. At a critical moment, the maturity may overextend without improving the evolution of payment-to-balance ratios, which should continue rising in order to amortize the credit, and real balances, which could continue to decline. No infinite extension of term could compensate for a major economic crisis, reflected by a DLM rate over the latest payment-to-balance ratio. As an example, for a 4% lender's margin and a difference between the fund's indexes of 6%, the monthly payment-to-balance ratio should always exceed 0.8%; otherwise, the loan will never fully amortize and loan-loss reserves should be made.

3. In order to ensure the amortization process, underwriters should make a conservative assumption on the average divergence between indexes. A minimum first-payment-to-loan ratio should then be set, while assuming a reasonable max-

Figure 5. Maturity, Payment/Balance and Indexes
mum term (e.g., 20 years). DIMs do not behave well with extremely long maturity terms, particularly above 25 years, as they become too sensitive to any unexpected, unfavorable change in indexes. They may generate larger funding needs, over-stretched terms and credit losses. This effect is exacerbated by larger margins.

4. The features of the amortization process mean that the early years are of greater importance. Excessively affordable first payments may reveal major problems, if an economic crisis occurs during the early years of the loan’s life. On the other hand, even large adverse shocks would affect older DIM generations relatively little. A substantial shock in length and magnitude would also extend the final maturity longer if occurring during the very first years since the origination rather than later.

5. Conservative assumptions about indexes should be made to set the first payment, to announce a longer maturity than the actually expected one. Simulating tools should be cognizant of this aspect. They should also not assume a large decline in inflation rates, in order for clients to understand the capitalization of interest.

6. DIMs may also require a lower initial loan-to-value ratio, as there is a small risk that nominal housing values may fall below credit balances, which would trigger more defaults. This event may simultaneously require a sudden adverse drift between indexes and falling deflated housing prices during the early years of a DIM’s life. The risk is small but larger than for classical credits. But it is no higher than that carried by a classical credit in a no-inflation economy. Standard loan-to-value limits should be adjusted rather according to the enforceability and foreclosure of the mortgage title than as a function of a DIM’s specific conditions.

**RECENT WORLDWIDE EXAMPLES OF APPLIED DIM POLICIES**

**The Polish Mortgage Fund**

DIMs were targeted with a maximum 25% effort ratio. They were commercialized until 1995 with maximum amounts equivalent to 36 times borrowers’ gross monthly incomes. This large amount would require a 0.69% first-payment ratio, leading to excessive terms and final losses if the base rate exceeds the Wage Index by only 4% before adding the 4% lender’s margin. This level of disparity is, in fact, plausible. In western economies, the difference often exceeds 4%. In emerging economies, real base rates vary even more.

The fund then improved its policy by setting a minimum first-payment ratio of 0.92% in order to keep reasonable final terms for DIMs (less than 20 years in a pessimistic scenario, less than 15 years in a favorable scenario). The historical evolution of DIM rates depicted by Figure 3 represents a favorable earlier cycle. A subsequent economic phase may differ, with more stable real incomes but higher real interest rates. As an example, if the observed indexes since 1997 were to continue, the recent DIM generations face amortization problems with a 0.92% first payment ratio. The fund has recently decided to increase the first payment ratio up to 1.20%.

There is no possible right forecast in these matters. The past cycle cannot be considered a safe forecasting base. Underwriters should apply various scenarios to test their impact on resulting DIM cash flows, and they should maintain a conservative worst-case scenario. Payment-to-balance ratios should be expected to rise, initially slowly and then at an accelerating rate, during the loan’s life. If they stabilize and decline, the term may require an excessive extension or may not fully amortize.

Figure 6 illustrates a typical DIM (expected first payment: 1.0%), eligible for the Mortgage Fund and originated in Poland at the beginning of every year since 1994 until 1997. The first quarterly indexation applied to payments is favorably supposed to occur at the first month; at worse it would occur after a quarter. All vintages reveal a favorable evolution, despite limited seasonal variations. The trend is a bit less favorable for the latest generation. Figure 7 shows the corresponding evolution of deflated balances, which have safely declined (far less for 1997 vintage). The less favorable evolution of the 1997 vintage, due to higher real base rates, supports the recent change of minimum first payment ratios, now set at 1.20%.

**PKO BP’s Market-rate Credits**

Their minimum first-payment-to-loan ratio on the initial 1995 generation was 0.57%. Assuming deposit rate change equal to the Wage Index change, maturity is 22 years for a contractual maximum 4% margin. If deposit rates exceed the Wage Index by only 2% yearly, maturity is 35 years. At 3%, the credit is never amortized, unless clients are “advised” to pay more than indexed sums, contractually presented as a required minimum. But cash flows then become unpredictable. The ratio was raised to 0.75% for the next generation. Shocks are better resisted, but loans do not amortize if deposit rates exceed Wage Index by 6%. At the end of 1997 the ratio was raised to 1%.

**Various DIMs in Mexico**

During the last 15 years Mexico has had more experience with DIMs than any other country. There has been a particular boom since 1991, mostly driven by the following:
1. The FOVI Program, targeted at medium-income borrowers. OVI is a funding facility that, since 1984, has been maintained by the Central Bank, which finances DIMs loaned by banks and backs a portion of the final credit risks. The Minimum Wage is the payment index, and the CPP (average banking cost of funds) is the financial index. Banks can only charge regulated low fees for the origination and collection of payments. The minimum first-payment-to-loan ratios have recently been 0.75% and 0.90%, with and without fees. The government covers any debt after this period.

2. Commercial banks originate mortgages for higher income households (the top 10% of the income distribution). Prior to 1995 most commercial DIMs also indexed payments according to the Minimum Wage Index. Their base financial index was either the CPP or CETE (one-month Treasury bill). They could switch from one to another, at their discretion. They applied large margins on DIMs (more than 10% until 1993, subsequently 8%–7%). The minimum first-payment ratios were relatively low (between 1.0% and 1.3%). By law, the maximum maturity was capped from 20 years initially to 30 years since 1993, and the government did not guarantee any remaining balance.

Average annual gaps between the indexes varied between 9% and 24%, with an average of 16.7%, net of lender’s margin. This occurred mainly because of irregular and limited administrative readjustment of minimum wages. According to our model, the minimum payment ratios should, on average, have exceeded 1.4% (without accounting for the margin in the applied credit rate) and 2% (accounting for them), even after applying the higher maximum legal maturity (30 years) since 1993. Results vary according to the exact generation of the production.

The commercial banks did not realize until too late the effects of diverging indexes on their DIM portfolios. Mexican banks tried to adjust their underwriting conditions in 1993-94 by introducing longer maturities and lower margins, but this move was still insufficient to restore the quality of portfolios. In 1994 they restructured many loans by substituting the inflation rate for the minimum
wage index to reduce the negative amortization build up. Meanwhile, the portfolio size was growing rapidly; it was already 8% of the total portfolio in July 1994 and 16% after the 1995 devaluation shock, because of sustained new production by competing banks and capitalization of interest.

The 1995 devaluation finally detonated the long-standing debt bomb, gradually built up through excessive capitalization of interest. The divergence between DIM indexes in 1995 was wide (52% CPP and 17% Minimum Wage Index). A costly public program in 1996 had to rescue the portfolio of commercial DIMs by injecting long-term funds, revised credits, and providing subsidies on payments in an attempt to save the banking system. The consequences for the banking and housing finance systems were dramatic. These subsidies may be necessary, but they are regressive and generate moral hazard among households and banks.

The devaluation shock of 1995 could have been absorbed through DIM balances for most vintages had these loans been more safely underwritten. Payment-to-balance ratios above 1.5% (net of lender’s margin) would have resisted this brutal but temporary shock, with the mortgages amortizing within 30 years. In Mexico, however, in a climate of growing competition for affordable mortgage schemes, overly optimistic assumptions were made regarding the evolution of indexes without corrective measures being taken by supervisory authorities. To be maintained, DIMs must operate in a safe zone, using conservative assumptions and following a realistic vision of the instrument’s specific behaviors and possibilities.

**DIM PARAMETERS AND DIM FUNDING**

**Danger of Excessive Margins**

The margin directly influences the relationship between payment-to-balance ratios and the variable maturity; the larger the margin, the more sensitive and less affordable the loan (direct impact through DIM rate). Their free determination should still be encouraged, however, in order to allow banks to pay for the following:

- High and uncertain operational costs, for example, for new entrants;
- Large and unknown credit risks during the emerging phase of mortgage credits in Poland;
- Need to return satisfactory results expected by shareholders and necessary for their internal growth.

Growing competition in Poland has kept margins at lower rather than excessive levels. Banks could offset higher margins through shorter terms or higher initial payments, but at the expense of borrower affordability. If this were not possible, the payment of margins could be separated from the accrued interest of the debt balance; that is, the margins actually paid for servicing costs, not partially capitalized as part of overall interest. The amortization would then not depend on this margin. However, overall effort ratios would no longer be stable, but would have higher initial values and thus lower overall affordability.

**Monitoring DIM Portfolios Under Adverse Circumstances**

Payment-to-balance ratios may face unfavorable drifts in the case of unexpected divergence between indexes. As explained above, the extended maturity only marginally compensates for this effect beyond a critical point. If the evolution is just seasonal (see prior examples in Poland), no change is needed. If an adverse trend observed over longer periods on an average basis looks serious and the revised residual maturity becomes too long to enable full amortization, the following actions could be taken:

- The bank could voluntarily lower its margin to enable DIM amortization by reasonable extended terms.
- The bank could propose various incentives to clients for partially prepaying their credits. Doing so could help raise the corresponding payment-to-balance ratios to sustainable levels of amortization.

Under adverse circumstances, supervisors should oblige banks to establish special reserves, different from ordinary loan-loss ones, equal to the net present value of the expected DIM residual balance after a term extended, for example, by five years. The reserve should be maintained until payment-to-balance ratios improve enough to permit a full amortization; for example, due to a more favorable cycle of indexes or to specific actions agreed upon by the parties. Reserves could be reduced by a corresponding debt write-off. They should also be tax-deductible, for banks to be encouraged to establish them in an early stage. Supervisors should watch the evolution of payment-to-loan ratios and assumptions made about expected indexes.

**Prudential Regulation for Credit Risks**

DIM credits should follow the general existing prudential regulation of credit risks, including proportional loan-loss reserves of credit balance (capitalized interests included) according to the length of the delay in payments (capitalized interests included). There is no reason to differentiate provisions for the initial capital or for capitalized interest, such as is still the case in Poland with higher requirements on interest.

Loan-loss reserves on any mortgage loan including DIMs could be immediately tax-de-
ductible, although not the case in Poland, as the formal foreclosure procedures should be first started, although this would represent a last-resort judiciary and costly solution. Net results should not be worsened by non-deductible reserves.

Analysis of DIM Resistance to Shocks

Economic shocks are significant only if they change the relative average difference between indexes. Both the timing and the magnitude matter; the earlier, the more important the divergence. Very large adverse shocks would not significantly extend the final maturity if they occur at a late stage. Thus, older generations of DIM credits are more protected than more recent ones, which deserve more monitoring attention. The duration of the shock also matters. A brutal but short shock (high real rates and falling purchasing power), may be better absorbed by DIM mechanisms than a smoother but longer-lasting drift.

A well-underwritten DIM is capable of absorbing nearly any short-term shock; even a sudden 20% shock, triggered by a devaluation, for example, would require less than a five-year term extension.

If we suppose a DIM with a 1.0% first payment ratio, 3% of expected difference between base indexes plus a 4% lender’s margin (resulting in a 7% expected DIM rate), the impact on the amortization measured by extended years of a serious shock, equivalent to an extra yearly 5% difference between indexes, would be seen in Table 1.

Unexpected long-term shocks would remain under control if they occur during the second half of the DIM’s life. If a shock is permanent and occurs during the critical initial period (first three years), the stretched term of the DIM could only absorb limited but significant shocks, equivalent to an additional yearly 4%. Beyond this limit, DIMs may not amortize, and special reserves should be made. The limit would naturally be higher for higher monthly payment-to-loan ratios.

These points can be illustrated by using the prior examples of historical DIM vintages in Poland originated since 1994 until 1997, eligible for the fund, and applying two realistic forecast scenarios:

- An optimistic one (Scenario I) which just repeats last year’s cycle for both indexes, including their seasonal variations;
- A pessimistic one (Scenario II) which repeats last year’s cycle of base financial index but supposes incomes equal to inflation (with no purchasing power gains, which is very conservative in Poland).

Figures 8 and 9 depict the evolution of their real balances and terms for vintages originated with a 1.00% first payment ratio. Under Scenario I, all vintages nicely amortize within a term between 10.5 and 12.5 years. Under Scenario II, only the 1994 generation amortizes within 12 years. The 1995 vintage needs 15 years, the 1996 vintage more than 20 years and the 1997 vintage would never amortize. By simulating the same scenarios to DIMs originated with a higher 1.20% first payment ratio (revised standard of the fund), all vintages would amortize in less than 14 years under Scenario II and less than 10 years under Scenario I.

These simulations support the need to regularly monitor the evolution of DIM vintages and adjust their underwriting conditions. What was well functioning in 1994 may not be workable any longer in 1997.

Capped Maturity Option

It is not worth overextending the possible maturity of DIMs, as the marginal utility of any additional extended year declines to infinitesimal values in relation to payment-to-balance ratios and amortization. Most of the contribution made by an extended term is completed after five to seven years. Beyond this range, households may make further efforts, but additional payments would not appreciably amortize the deflated balance.

An appealing contractual option would be a cap of the maximum DIM maturity under any economic circumstances, provided prior due payments had been correctly paid. The extension could be limited to five or seven years, to be added to the initial announced term. The bank would take on additional credit risk, which should be small if initial payment-to-loan ratios are safe.

A possible variant would share the costs of this option by a final write-off of any residual balance through a public guarantee—essentially what is done in the FOVI program. Public involvement would be offered only to lenders offering DIMs that are deemed to be prudent. This support could be seen as economic insurance, to be used only if the current stabilization process fails and if inflation recurs. In the worst case, the guarantee should represent only a very small percentage of the net present value of the initial capital.
Capitalization of Interest

The capitalization of interest should not be capped. As long as payment-to-balance ratios do not decline, a large accrued amount of negative amortization would simply reflect the expected functioning of DIMs in a high inflation environment. A cap would break the indexed pattern of payments and might lead to higher effort ratios and defaults. This option was initially used by Mexican authorities before being abandoned after 1992. Should the amortization process be threatened, the negative amortization might be excessive; however, this fact would reflect an improper initial design. Other remedies should be applied.

Partial Indexation Option

If inflation is relatively moderate, certain DIM variants may be implemented. One version is to index payments only partially, on an income or inflation index. This variant was developed in Mexico (70% of the Minimum Wage), before being abandoned. Since 1995 PKO BP has also developed a partially indexed DIM: during a preliminary phase, payments are only indexed according to 50% of the evolution of the financial base rate; if monthly payment-to-balance ratio falls below 0.75%, a next phase of indexation is planned.

Such variants look attractive during a preliminary phase (declining effort ratios), but they lead to a dangerously sensitive next phase, as the DIM rate (difference between applied indexes) then contains an element of residual inflation (the non-indexed part), which can turn out to be volatile and large. Future cash flows and final terms are then blurred, and credits are no longer inflation-proof.

A prudential lender should set a large premium on overcoming this danger which would affect affordability. With moderate inflation, the complexity of these loans may not be worthwhile compared with simple classical credits. Preferably, it should be avoided, or implemented with a large minimum percentage of indexation (above 80%). A safer option could be developed by deducting a constant margin of security from an integrally applied index. In this case,
credits are made independent of changing inflation rates.

**Management of Larger Liquidity Risks**

No general recommendation can be easily made regarding this issue. The rule is that DiMs leverage specific and larger funding needs, which may differ but adequate answers according to each bank's situation and strategy. Long-term liquidity risks should be incorporated in the more general concept of cash flow management because both the maturity and balance of DiM credits may vary considerably. The most adequate funding source would be similarly indexed liabilities, with similar flow characteristics; that is, indexed repayments, with some deferred interest and a variable maturity.

**Mortgage Fund Role**

The fund has played a pioneering role for the promotion of DiMs in Poland. It provides long-term lines to participating banks that are parallel to DiMs, including some negative amortization and possible variable terms. Most prepayment risks are also passed through the fund's lines. This solution is made possible by budgetary contributions to the fund. However, its actual refinancing conforms to a strict administrative structure, in terms of both eligibility and procedures, which Polish banks have often perceived as constraining despite progress. This partially explains its modest use.

**Sale and Securitization of DiM Credits**

It is relatively difficult to securitize DiMs because of their fluctuating cash flows and terms, which are not well accepted by institutional investors. Negative amortization may be less of a problem, as stable deflated flows and yields could meet the expected returns of long-term investors like insurance companies or pension funds, which must also pay some inflation-adjusted cash flows to their clients. The problem rather stems from the deflated fluctuations and variable terms generated by DiMs. The issue can be significantly reduced, though never fully eliminated, by taking the following steps:

- Diversify DiM vintages in pools in order to stabilize flows.
- Only sell DiMs that exceed reasonable payment-to-balance ratios to ensure a final amortization and minimize the possible effects of a variable maturity. For example, for ratios over 1.5%, terms will not vary by more than two years even if the indexes vary widely.

Although funding of DiMs by specialized mortgage banks issuing mortgage bonds is possible, the limitations these institutions have on funding sources and the constraints under which they operate (matching of cash flows and balances) suggest that cash flow management would be a delicate financial exercise with a more complex and costly agenda of bond issuance.

**Funding of DiMs by Universal Deposit Banks**

Universal banks rely primarily on deposits, the average term of which is limited (six months or less). Hence, they are concerned with funding long-duration assets like DiMs. During an emerging phase, banks may still find sufficient deposits and take very limited transformation risk, provided that the financial index applied to DiM would reflect the average evolution of their deposit rates. Should DiMs capitalize more interest than expected, other banking activities should not be blocked as a result of DiM portfolios consuming the available liabilities.

The interbanking market looks too volatile, illiquid and short term to represent an exclusive funding source for DiMs in Poland.

But it still represents an accessible funding security valve, which could match unexpected flows. Smaller banks have too limited an access. Deposit banks should therefore cap their growing Dim portfolio as a given percentage of their current deposit stock in order to keep a reasonable security margin of funding. This ratio could depend on the average mismatch of terms between deposits and DiMs, the proportion of rolled-over interests from deposits and the estimated evolution of DiM balances and cash flows.

**Treatment of Deferred Interests and Lender Profitability**

How should capitalized interests be accounted by lenders?

From an accounting perspective, DiM interest can either be recorded as income on a cash basis (only as received) or an accrual basis. Gross results are much improved by using the accrual basis during the early years, though in the long run, there is not much difference. Provided that DiMs are safely underwritten and supervised, capitalized interest should be accounted on an accrual basis.

Banks should be required to keep both cash and accrual accounting presentations.

Should the income-tax be applied on deferred or paid interests?

Refinancing through the Mortgage Fund allows banks to pay taxes on a cash basis. To some extent, the question is not vital. Even if banks pay taxes on a cash basis, they should still be required to set aside 100% reserves for deferred taxes as currently required by international auditors. Benefits and dividends are then not affected. Equity, however, is improved since such reserves are treated as Tier 2 equity for capital adequacy requirements; also improved are net initial
cash flows. This might help to develop mortgage banks when issuing some mortgage bonds with capitalised interests.

CONCLUSION

DIMs can be very efficient mortgage instruments in a period of economic transition and uncertainty, as they both respect the necessary and lasting affordability of borrowers and the net profitability of lenders after considering all related financial risks. But any improper understanding, implementation or regulation may easily lead to serious contingent liabilities. Their introduction must be carefully prepared, particularly according to the main recommendations formulated in the article. There is no free lunch in the mortgage business.

NOTES

1 Monthly average of nominal yields from the latest four weekly tenders (treated as an effective refinancing cost by the fund). The fund's margin (2.1% as maximum but possible discounts) is added to publish the base rate.

2 In Poland, growing housing demand should at least stabilize prices in urban centers. But credit defaults could precipitate a fall in prices. In the U.K., many non-performing mortgage credits resulted in forced sales.

3 The least favorable case occurs if the indexation cannot be applied before the beginning of next quarter. The first indexation of repayments always occurs between these two cases. The resulting difference on the final amortization may be significant because of the indexation process, which may amplify the initial difference. Yet in this example, the gap is less than 5% of the deflated capital after three years. DIM loans originated in 1993 would reveal a larger difference because the Income Index applied during the first quarter 1993 was particularly large.

4 In practice, there is a mild influence (the more inflation, the longer maturity) because Mortgage Fund's DIMs are not purely indexed. The National Income Index is applied through DIM payments with a six-month delay, whereas interest rates are adjusted only one month after Treasury bills. The higher inflation, the larger the actual divergence between DIM indexes and the longer maturity.

5 See the article by Bernstein in this issue. The analytical model used in this report can also help the reader understand the optimal resistance of DIMs.

6 As DIM balances regularly decline in real terms, there is no particular additional reason to prepay them at an early stage, unlike classical credits. As interest rates are variable, borrowers find few advantages in negotiating the financial terms, except for an initial high margin (not the case in Poland with limited 3%-5% margins). If the maturity is not extended too much, borrowers should not feel any particular pressure to prepay their DIM loans.

7 This was paid separately as a servicing fee, not subject to interest capitalization.

8 Similar in nominal and deflated values, and including the lender's margin.

9 An advanced mathematical model about DIM sensitivity has been developed and could be made available upon request.
APPENDIX

An Analytical Model for DIMs

The first DIM payment is set according to the loan amount, the projected maturity and the expected divergence between deflated indexes (approximate gap between the cost of money and purchasing power).

It can be determined by the usual annuity formula applied to classical loans:

First payment/loan (annuity factor) = interest rate/ [1 - (1+ interest rate)^-maturity]]

by replacing the interest rate by the average difference between both indexes: 8:

DIM first payment/loan = DIM rate/ [1 - (1+ DIM rate^-expected maturity)]

where DIM Rate = (1 + expected credit rate)/(1 + expected income index growth) - 1,

expected (real base rate- real income growth) + nominal added margin.

The formula can be extended at any time during the DIM amortization:

DIM payment/last balance = revised DIM rate/ [1 - (1+ revised DIM rate^-residual maturity)]

Note the DIM rate can differ from the initial value because of some irreversible trends of indexes.

Any aspect of DIM underwriting, servicing and monitoring can be predicted and visualized by means of a simple model, without unduly complex computerized simulations. Exact relations can be determined among the residual maturity, the divergence between indexes (including bank's margin), and payment-to-balance ratios (notably, starting payment-to-loan one). One should not rely on a single optimistic economic forecast but test the situation under several scenarios. Among various possible uses:

- Determination of the first payment according to expected indexes, margin, and desired term;
- Estimation of the residual maturity and likely amortization at any time;
- Determination of a prudential underwriting frame and close monitoring of portfolios;
- Rapid identification of problems, visualization of cost-effectiveness, measure of impacts including prepayments, changed margin, capped maturity, partial indexation, delayed index, etc.

Measurement of DIM parameters should be carried out according to the chosen frequency of adjustments; if quarterly, like the Mortgage Fund, all rates and margins should be expressed in quarterly equivalents.

For example, given that:

- The yearly margin of the primary bank = 4%
- The expected difference between base indexes = 3% yearly (before lender's margin)
- The expected maturity of DIM = 12 years (or 48 quarters)

Then, the result is:

<table>
<thead>
<tr>
<th>DIM yearly rate</th>
<th>DIM quarterly rate</th>
<th>First quarterly payment</th>
<th>Monthly first payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7%</td>
<td>1.71%</td>
<td>3.07% of loan</td>
<td>1.02% of loan</td>
</tr>
</tbody>
</table>