Risks and efficiency gains of a tiered structure in large-value payments: a simulation approach

Summary of Working Paper no. 337 Ana Lasaosa and Merxe Tudela

Only a few banks are direct members of the Clearing House Automated Payment System (CHAPS), the UK large-value payment system. The vast majority of banks access the system indirectly as second-tier banks, through any of the few direct members (settlement banks). We describe a system in which a very small proportion of banks are direct members as a highly tiered system. The degree of tiering affects both how risky and how efficient the UK system is. Recent research has classified the various risks and benefits of tiering in large-value payments, but much less progress has been made in quantifying these risks and benefits. This paper seeks to fill this gap. It does not attempt to establish the relationship between normal and stressed liquidity needs, or how liquidity insurance should be regulated.

In order to gauge how the degree of tiering in CHAPS affects risks and benefits, we need to be able to vary the degree of tiering while holding other factors constant. A simulation approach allows us to do this. We create artificial versions of CHAPS where we increase the degree of tiering by reducing the number of direct members. We then use the simulation results to quantify the impact of tiering on concentration risk (a large settlement bank being a potential single point of failure), on credit risk (how exposed settlement banks are to second-tier banks) and on how much liquidity the system needs for it to operate.

The results show that, in a more tiered system, concentration risk would rise substantially. The credit risk incurred by direct members extending unsecured intraday overdrafts to their customer banks for their payments business would not be substantial under normal circumstances. The likelihood of contagion of credit problems to the broader financial system would be remote in our more tiered system. More importantly, our analysis has shown that the increase in credit risk brought to the system by settlement banks leaving CHAPS bears little relationship to the values settled by each individual bank. The key determining factor of the size of settlement banks' intraday credit exposures to second-tier banks is the timing of intraday payments of second-tier banks — a variable that central banks do not observe directly.

Increasing the degree of tiering in CHAPS leads to substantial savings in the amount of liquid assets that settlement banks need to post every day. Only a small proportion of these savings are due to settlement banks settling payments across their own books. Moreover, the clear relationship between changes in values settled and liquidity needs shown by our simulations make it possible to project what would happen if current second-tier banks joined CHAPS as direct members. We estimate that the liquidity needs could increase by £8 billion in aggregate if as many as five large banks (in terms of values of payments processed) joined CHAPS — the opposite case to the one analysed so far. While this figure is significant, it is only a fraction of the £17 billion spare liquidity posted on average in the system as a whole every day.

Monetary policy shifts and inflation dynamics

Summary of Working Paper no. 338 Paolo Surico

Several researchers working on the macroeconomics of inflation have recently suggested that inflation persistence — the tendency for inflation to change only sluggishly — was very apparent in the past, but is now much reduced or absent. In the United States, the high-persistence period was in the 1970s, while for the United Kingdom it was before 1992. There is independent evidence that these periods were ones where monetary policy was relatively weak in the response to inflation.

This paper investigates the relationship between the monetary policy regime (and in particular the way in which interest rates respond to inflation) and the properties of the inflation process through the lens of the New Keynesian Phillips Curve (NKPC). Specifically, we ask what are the consequences of pooling observations from different policy regimes for the estimates of the NKPC and for the estimates of the reduced-form process of inflation (ie a backward-looking specification). This is an important policy issue, because the degree of persistence of inflation at the Phillips curve level has an impact on the appropriate monetary policy reaction. It is crucial for policymakers to know how important this is.

Using artificial data simulated from a sticky price model, this paper shows that the estimates of a NKPC featuring both forward and backward-looking components are severely biased downward when two conditions are met. First, the data are generated under a passive monetary policy regime, which is a regime where the nominal interest rate is not moved sufficiently in response to movements in inflation. Second, the empirical analysis, as is the case for the estimates currently available in the literature, neglects the possibility of a passive policy regime and hence implicitly limits the solution of the model to the case in which monetary policy is active. In the passive monetary policy case, the hypothesis of no backward-looking component is strongly rejected in spite of the fact that the data generating process does not exhibit any exogenous or endogenous persistence. The slope of the Phillips curve takes a value that is not statistically different from zero. Moreover, the sum of the autoregressive coefficients in the reduced-form process of inflation is close to one and, most importantly, is significantly different from the value of zero that would emerge in the unique rational expectations equilibrium (ie determinacy). In contrast, when the analysis is restricted to determinacy the estimates on the artificial data match the 'true' coefficients of the model which have been used to generate such artificial data.

Following the literature, determinacy is defined as the unique rational expectation equilibrium. This equilibrium is characterised by the private sector's expectations that whenever actual inflation differs from target the monetary authorities will take the appropriate actions to bring it back immediately. Indeterminacy, in contrast, can be associated with several possible outcomes for inflation and output gap. It is worth emphasising, however, that indeterminacy does *not* imply an explosive path for inflation; rather it implies that the private sectors hold the expectations that the gap between actual inflation and its target value will persist for some time in the future.

The results presented here suggest some caution is needed when interpreting the estimates of the structural NKPC obtained using a pool of observations that mixes different monetary policy regimes. The reason is that inference can be distorted in an important dimension if the econometrician does not recognise that at some points in time monetary policy may be reacting weakly to movements in inflation. In particular, it is possible to introduce additional elements of persistence that are not present in the data generating process of inflation and thus are not an intrinsic, structural feature of the economy. This result can thus provide a rationale for the empirical regularity that inflation persistence coincides with specific monetary policy regimes.

The integrated impact of credit and interest rate risk on banks: an economic value and capital adequacy perspective

Summary of Working Paper no. 339 Mathias Drehmann, Steffen Sorensen and Marco Stringa

Credit and interest rate risk are two of the most important sources of risk for commercial banks. Credit and interest rate risk reflect the possibility, respectively, of a borrower failing to repay her debt and of a fall in a bank's profitability due to a change in interest rates. While banks and regulators are aware of the importance of both risks, they tend to manage these risks separately. However, credit risk and interest rate risk are intrinsically related to each other and not separable. And ignoring this interdependence may potentially have relevant implications for banks' stability, especially during severe downturns.

In this paper we propose a general framework to measure the combined impact of interest rate and credit shocks on banks' economic value and profitability. In line with the literature, this framework incorporates the integrated impact of credit and interest rate risk on banks' assets. But liabilities and off balance sheet items also need to be taken into account to obtain a complete picture of the risks faced by a bank. For example, a bank subjected to a downgrade may face higher funding costs, which may adversely affect the banks' profitability. Hence, we model the whole portfolio.

The proposed framework also accounts for the asset-liability repricing mismatch. This mismatch is the result of one of the defining functions of the banking system: borrowing money at short maturities to lend to households and companies at longer maturities. This mismatch is the key source of interest rate risk for commercial banks as changes in the default-free interest rates tend to feed through more quickly on interest paid on liabilities than interest earned on assets. As a result, net interest income may decrease following an interest rates rise unless the bank has fully hedged this risk through, for example, off balance sheet items. Hence the need to include these instruments.

But net interest income is also affected by credit risk. This is because credit spreads, ie the compensation for credit risk, can be adjusted to reflect changes in the banks' own or borrowers' credit risk. And the timing of such an adjustment depends also on the above repricing mismatch. We capture both effects when modelling the bank's net interest income.

Our framework also captures other forms of interaction between credit and interest rate risk. For example, we do not only capture the direct impact of changes in macroeconomic variables, such as unemployment, on the possibility of borrowers defaulting, but also their indirect impact via potential changes in default-free interest rates.

We use two conditions to measure a bank's exposure to credit and interest rate risk. We first look at banks' economic value — the economic value condition. This provides a long-term view of banks' health based on the risk-adjusted present value of future net cash flows. This necessitates a framework which takes account of the above-mentioned repricing mismatch and the complex interdependence of interest rates and credit risk. And contrary to Basel II and standard credit portfolio models, the proposed economic value condition does not only capture default risk but all sources of credit risk, including changes in the value of net assets due to movements in credit spreads.

The economic value condition is not a sufficient metric to assess banks' exposure to credit and interest rate risk. For example, a particular path of profits may lead a bank to be undercapitalised in the short run because of severe losses which are outweighed by future profits. From an economic value perspective this bank would be solvent but because of market or regulatory constraints the bank may find it difficult to continue to operate. Therefore our second condition — the capital adequacy condition — aims to estimate whether a bank would be sufficiently well capitalised in the short to medium term by projecting the bank's net profits and capital requirements.

We apply the framework to assess the exposure to credit and interest rate risk of a hypothetical but realistic bank in a severe macro-stress scenario. This scenario implies, among other changes, a sharp rise in the risk-free yield curve. The stability of the bank is not threatened in the stress scenario as both the economic value and capital adequacy conditions hold. But the simulation confirms that interest rate and credit risk have to be assessed simultaneously as well as jointly for the whole portfolio.

During the first year in the stress scenario, the bank experiences not only an increase in bad loans, but also a fall in net interest income. The latter is due to the compression of margins between short-term borrowing and long-term lending. The negative impact of rising bad loans is partially offset once the bank starts to reprice assets, reflecting both the change in the risk-free yield curve and the deterioration in credit quality. Were — as would be the case for most stress tests routinely run — net interest income not to be taken into account in our stress scenario, the hypothetical bank would underestimate the fall in net profits in the first year, but overestimate it in the third year.

Financial innovation, macroeconomic stability and systemic crises

Summary of Working Paper no. 340 Prasanna Gai, Sujit Kapadia, Stephen Millard and Ander Perez

The financial system has been changing rapidly in recent years. Resale markets for capital have deepened, and sophisticated financial products and contracts, such as credit derivatives and asset-backed securities, have mushroomed. At the same time, macroeconomic volatility has fallen in developed countries. This paper examines the implications of these developments for the likelihood and potential scale of system-wide financial crises.

We develop a theoretical model of system-wide crises in which instability is associated with distress selling of assets (the forced selling of assets at a low price). The set-up attempts to capture the key features of intermediation in the modern financial system. Though the model also applies to traditional banks, it is especially relevant to the activities of hedge funds, private equity firms, and other non-bank financial institutions.

Consumers channel funds through financial intermediaries to firms who manage investment projects in the productive sectors of the economy. Intermediaries have financial control over projects and form equity-type contracts with consumers. But these contracts are subject to potential default. This imposes financial constraints on them which limit the ability of intermediaries to insure against bad outcomes for investment projects.

Our results suggest that if an adverse economy-wide shock hits the productive sectors, intermediaries may be forced to sell assets to less-productive sectors of the economy to remain solvent. This distress selling causes the asset price to fall. In turn, this creates a feedback to net worth which affects the balance sheets of all intermediaries, potentially leading to further asset sales. Since intermediaries do not account for the effect of their own sales on asset prices, the allocation of resources implied by the market is inefficient. For sufficiently severe shocks, this spillover effect is capable of generating a system-wide financial crisis that may be self-fulfilling.

The model suggests that recent developments in the financial system may have made crises less likely as they widen access to liquidity and allow assets to be traded more easily. But by relaxing financial constraints facing borrowers, they imply that, should a crisis occur, its impact could be more severe than previously. We demonstrate how these effects may be reinforced by greater macroeconomic stability. As would be expected, our model predicts that reductions in volatility make crises less likely since severe shocks occur less frequently. However, greater stability also makes mild downturns less likely. As a result, consumers are more willing to lend, allowing intermediaries to increase their borrowing and investment in firms. But if a crisis does then ensue, losses will be greater. Overall, our findings thus make clear how financial innovation and increased macroeconomic stability may serve to reduce the likelihood of crises in developed countries, but increase their potential impact.

Evolving international inflation dynamics: evidence from a time-varying dynamic factor model

Summary of Working Paper no. 341 Haroon Mumtaz and Paolo Surico

Several industrialised countries have had a similar inflation experience over the past 30 years: inflation was typically high and volatile during the second half of the 1970s and the first half of the 1980s but low and stable in the most recent period. National inflation rates have moved together for most of the sample with the notable exception of the years between 1975 and 1987. These observations suggest the following question: how has comovement of inflation rates evolved over time?

This paper uses a statistical model to describe the comovement in inflation across countries and to investigate if the degree of comovement has changed across time. Our estimates suggest that there was a significant decline in the level, persistence and volatility of inflation across our sample of countries. We find that this historical decline in the level and persistence of inflation was common across most G7 countries, Australia, New Zealand and Spain — ie this decline coincided with an increase in comovement in inflation rates as identified by our statistical model.

To interpret further our results, we discuss a number of possible reasons behind the decline in the level and persistence of inflation and the increase in comovement of inflation. Candidate explanations of the former include: an improvement in monetary policy; an improvement in fiscal policy; an increase in productivity and the onset of globalisation. The increase in comovement may be the result of a change in the practice of monetary policy that occurred over a similar period in most countries in our sample and/or the onset of globalisation.

That elusive elasticity and the ubiquitous bias: is panel data a panacea?

Summary of Working Paper no. 342 James Smith

The elasticity of substitution between capital and labour — a measure of the ease with which capital can be substituted for labour in the production process — is often assumed to be one. This is a standard simplifying assumption. But empirical studies frequently find that this elasticity takes a smaller value. Recent work, based on capital demand equations for the United States and Canada, has found that the elasticity may indeed be close to one — or perhaps even larger. The aim of this paper is to test whether applying a similar approach to UK data will yield similar results.

We start with a simple linear relationship between the optimal capital-output ratio and the real user cost of capital. But, because it is costly for firms to change the amount of capital they employ (for example because it takes time to learn how to use new machinery), we interpret this relationship as a long-run phenomenon. However, estimating a long-run relationship of this kind can lead to biased estimates. To ameliorate the influence of these biases analysis for the United States and Canada have applied methods based on the use of a single time series. In this paper we extend this approach in two important ways: first by exploiting variation across industries (panel estimation); and second by exploiting variation in the elasticity of substitution across different physical capital assets.

Given the flexibility of our theoretical framework, and the robustness of the different estimators we use, we are in a position to provide a sound statistical investigation of the possibility of a unit elasticity in UK data. So what do our results tell us? Estimates for the elasticity of substitution based on aggregate data are very similar to those found in previous studies for the United Kingdom: close to 0:4. Do these results simply reflect methodological differences in constructing UK data? By matching UK data as closely as possible to the data used in those studies we are able to eliminate this possibility. However aggregation biases could still affect our estimates. In addition, a single time series may not be enough to purge our estimates of the biases inherent in estimating this long-run relationship. To address these possibilities we use panel data. We find that, once we account for some of the problems commonly encountered when using dynamic panel methods, our estimates are close to the benchmark estimate using aggregate data. Thus we can provide a strong rejection of a unit elasticity of substitution between capital and labour in UK data.

Efficient frameworks for sovereign borrowing

Summary of Working Paper no. 343 Gregor Irwin and Gregory Thwaites

There is no supranational authority that can enforce sovereign debt contracts. Consequently, the decision by a government to default on its debts is often as much a question of willingness to pay as it is of ability to pay. Debt restructurings, which change both the size and the timing of payments made to creditors, are therefore brought about through negotiation between the parties to the contract, rather than by court adjudication. When a sovereign decides whether to default it has to weigh the benefit against the cost. The main benefit comes in the form of a reduced repayment, which is often referred to in understated terms as a 'haircut' for creditors. The cost comes in a number of different forms, such as loss of reputation, or loss of current and future access to private capital markets. Moreover, sovereign default is often associated with costly currency crises and banking crises. The multiple costs of default, and the partial extent of the haircut that can be achieved in practice, both serve to limit the incentive that the sovereign has to default and underpin the very existence of sovereign debt markets.

National and international policymakers have some control *ex ante* over the size and form of the cost of default and the distribution of bargaining power in the event of a default. This paper presents a theoretical model of strategic default to assess how policymakers should exercise their control over these levers. We consider a world in which the sovereign issues fixed interest debt to finance an investment with uncertain returns. After both the productivity of the investment and the resulting income stream are known, the sovereign must decide whether to repay the debt in full, or to seek a restructuring. If the sovereign takes the second option we assume it must pay a deadweight cost, to reflect the loss of reputation and the economic disruption that ensues following a default. It must then negotiate over the size of the haircut, which is ultimately determined by the distribution of bargaining power. These factors — the deadweight cost and the distribution of bargaining power following a default — are the two key dimensions by which the 'framework for sovereign borrowing' is characterised in our model. We assess the welfare-maximising values for both these policy parameters.

We find that, if there are no restrictions on the distribution of the bargaining power, the deadweight costs of default should be driven to zero. Both deadweight costs and the need to settle with creditors can dissuade a debtor from defaulting. However, the latter is more efficient, as resources denied to the debtor are reallocated to creditors rather than being destroyed.

Assuming creditors are competitive and risk-neutral, this should benefit the debtor through lower interest rates. If the debtor is risk-averse, then in the event of a restructuring the optimal outcome requires bargaining power to be shared between the debtor and its creditors. This is because shifting bargaining power to creditors has two conflicting effects on the debtor's welfare. On the one hand, by dissuading default and lowering interest rates, it allows a sovereign to borrow more at a lower cost. But on the other, if creditors capture too much of the available resources after a default, the risk-sharing benefit of default is diminished, as creditors receive additional resources from the debtor when the latter needs them most. The optimal regime should balance this tension.

In constrained policy settings we find that, whenever welfare can be raised by marginally *increasing* the deadweight costs of default, welfare is also improved by shifting bargaining power to creditors. It follows that for any given value of the deadweight cost, if bargaining power is optimally allocated between the parties, it must be welfare-improving to reduce the deadweight cost. Moreover, starting from any situation where the welfare impact of marginally raising the deadweight cost is positive, there is always a step increase in the allocation of the bargaining power to creditors which is sufficient to ensure that the impact of raising the deadweight cost becomes negative. Taken together, these results mean that, so long as creditor bargaining power can be increased, *lower* deadweight costs can always raise social welfare *ex ante*.

The analysis shows that, once debt has been contracted, the debtor's trade-off between creditor bargaining power and deadweight costs changes fundamentally. With the interest rate on debt fixed, the incentives of the debtor change so that it no longer cares whether, after a default, resources are transferred to creditors or are wasted in the form of deadweight costs. There is therefore a need to design mechanisms that allow debtors to commit to the *ex-ante* optimal combination of policy parameters.

In sum, these results suggest that domestic and international policymakers should pay careful attention to the impact of their policies, not just on the deadweight costs of default, but also on the allocation of bargaining power in the event of a restructuring. The final result, in particular, suggests that in equilibrium the deadweight costs of default may tend to be too high, and the allocation of bargaining power inefficiently skewed towards the debtor. A challenge for all policymakers, therefore, is to find credible policies that can both reduce deadweight costs and shift bargaining power towards creditors. In due course this should raise welfare.

International monetary co-operation in a world of imperfect information

Summary of Working Paper no. 344 Kang Yong Tan and Misa Tanaka

This paper examines the role of information sharing in a two-country open economy general equilibrium model. In our analysis, central banks cannot observe productivity shocks abroad. Introducing imperfect information in this way allows us to separate the welfare gains from two different types of international monetary co-operation: gains from information sharing between central banks, and gains from setting co-ordinated monetary policy rules under perfect information.

There are three key findings from our analysis. First, setting a self-oriented monetary policy rule which responds to unexpected shocks in a predictable manner leads to welfare gains, even if central banks do not have perfect information about the world economy. Second, we find that better information about the state of the world economy has ambiguous welfare implications in this stylised model. On the one hand, better information allows policymakers to respond appropriately to common shocks; but on the other hand, because the better information allows policymakers to respond to a wider set of shocks, this can generate spillover effects which are not necessarily internalised. Third, our simulations show that gains from international monetary co-ordination under perfect information are greatest when productivity shocks are negatively correlated between countries.

On the basis of our model, we conclude that information sharing between central banks, by itself, does not necessarily guarantee welfare improvement. But information sharing does allow policymakers to respond appropriately to common shocks.

Summary statistics of option-implied probability density functions and their properties

Summary of Working Paper no. 345 Damien Lynch and Nikolaos Panigirtzoglou

Financial markets can provide policymakers with timely information about aggregate market expectations of future asset prices and returns. Options, which give investors the right, without obligation, to buy/sell assets in the future, possess information about the likelihood that market participants attach to alternative future outcomes for asset prices. The previous decade has seen much development in the methods of extraction of distributions of the probabilities that market participants attach to future asset prices from options prices. Time series of the statistics that summarise these 'option-implied distributions' can be examined to consider the behaviour of market views over time.

The focus of this paper is on the properties of these summary statistics for option-implied probability density functions (pdfs). These statistics provide us with various measures of aggregate expected uncertainty, asymmetry (or balances of risk) and expectations of extreme movements. We estimate a daily time series of option-implied pdfs (in terms of logarithmic changes in asset prices) and their summary statistics for various equity indices (FTSE 100 and S&P 500) and interest rates (three-month sterling Libor and Eurodollar). The series begin in 1985 for S&P 500 and three-month eurodollar interest rate futures; 1987 for three-month sterling interest rate futures; and in 1992 for FTSE 100.

We found that markets reacted to, but did not predict, the major episodes of financial crisis since the mid-1980s. The implied summary statistics were found to be highly persistent suggesting the impact of shocks on market views does not die away quickly. A shock to market beliefs can be expected to persist for about 60 weeks for equity indices and 30 weeks for interest rates. Interestingly, there was little extra information to be gleaned from the implied pdf summary statistics, as opposed to non pdf based measures such as the 'at-the-money' implied volatility and 'risk reversal', about views of expected uncertainty and asymmetry. But this was not the case for measures of expectations of extreme movements in asset returns where the statistics from the implied pdfs differed from other standard market measures/indicators of expectations of extreme market moves.

Potential relations were investigated between the estimated summary statistics, both within and across asset classes, and between UK and US markets. Implied uncertainty about equity returns was found to significantly influence absolute equity returns and tends to lead perceptions about asymmetry and extreme equity index movements. In contrast, implied uncertainty for interest rates was found to both influence, and respond to, changes in interest rates. Internationally, expected uncertainty was found to be strongly correlated between the United Kingdom and the United States, for both equity and interest rate markets. Implied balances of risk about future US interest rates were found to influence those of UK interest rates. And uncertainty about US equity returns tended to influence implied views about balances of risk and expectations of extreme moves in UK equity returns.

Finally, we related the summary statistics to other financial and economic variables such as output, investment, inflation, aggregate equity market earnings, corporate spreads (an indicator of the prospects for corporate default) and the slope of the yield curve (an indicator for the market outlook for economic activity and/or expectations of future inflation). The slope of the yield curve had a causal effect on interest rate uncertainty, and, in the United States, corporate credit spreads tended to lead implied uncertainty about equity returns. There was no incremental predictive power in option-implied summary statistics for economic variables beyond that in past values of the macroeconomic variables themselves, and past returns on the underlying financial asset. However, the data sample we examined is relatively short, covering just one business cycle in the case of the United States. Similarly for the United Kingdom, data for FTSE 100 implied pdfs were only available from 1992. Ideally, a more complete assessment of the information content of options prices for future economic conditions would require a data sample covering a number of business cycles.