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Benoît Nguyen is an economist in the monetary policy research division who joined the Bank in 2009, and started in market operations. He started a PhD in 2014. He published a paper in the *American Economic Review*.

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Editorial

Michel Juillard, Researcher and senior advisor



What are structural models used for in central banks?

In economics as in other sciences, models are simplified representations of reality using the language of mathematics. It is important to note that a model is a simplification of a complex reality. No model has the ambition to explain all phenomena. Mathematics may be considered a barrier to entry, but its logic and rigour ultimately prove to be valuable.

A central bank needs different models for different purposes: time series models or VARs for near term forecasting, factor models to explore large datasets without much theoretical a priori, and structural models when

the specification of the model is informed by theory. Structural models are useful for policy analyses, scenarios and forecasting, when the forecast needs to be explained by relating possible future outcomes to currently operating economic mechanisms. Nowadays many structural models belong to the DSGE family, but large macroeconomic models, many of them in the Keynesian tradition, are also in use in central banks. The Banque de France and the ECB, for example, have recently chosen to build their large forecasting models in the tradition of FRB-US. Agent-based models are structural models, but from a very different methodological perspective.

“ We are still not able to routinely estimate policy-relevant DSGE models in their original nonlinear form. ”

A renewed research effort

The Great Recession and the financial crisis had a profound effect on structural modelling. The pertinence of these models was called into question as they failed to predict the occurrence of the crisis or the slow path to recovery. This has prompted researchers in academia and in policy-making institutions to develop DSGE models for several different areas including financial sector and financial frictions, labour market and involuntary unemployment, nonlinearities and the effect of large shocks. Several recent research projects at the Banque de France participate in this endeavour.

For example, a much greater emphasis on the financial sector and financial frictions was needed in macroeconomic models. The idea is to take into account the effects of possible shocks to the normal functioning of the

financial sector: perception of increased risk, variations in the value of collateral, and modifications of macroprudential regulations. The intention is also to integrate mechanisms where the financial frictions amplify the effect of shocks occurring in other parts of the economy. O. de Bandt and M. Chahad (2016) and S. Osotimehin and F. Pappadà (2016) address issues related to this theme.

Meaningful financial sector models are also necessary to analyse the effect of unconventional monetary policy measures. One of the aims of current modelling efforts is to develop models that are able to analyse the effect of unconventional monetary policy and, more generally, the role in the economy of the central bank's balance sheet (see for example Cahn *et al.*, 2017).

As long as the central bank sets monetary policy by controlling the short-term nominal interest rate, a simplified model is sufficient to delineate the transmission mechanism by directly describing the effect of interest rates on the real economy. However, when the central bank engages in purchasing securities, it is necessary to extend the model in order to track financial arrangements and intermediation.

Specific studies devoted to reinforcing our understanding of certain phenomena

Discussions around the policy mix and the respective responsibilities of monetary and fiscal policies in fighting the recession have been prominent and have triggered a renewed interest in the assessment of fiscal policy multipliers. Bussière *et al.* (2017) discuss the issue on the basis of a large multicountry macroeconomic model. Fève and Sahuc (2016) analyse the transmission mechanism of fiscal policy in the euro area.

The world that is emerging from several years of crisis is different from what it was before and, until now, the recovery has been particularly slow. Inflation is subdued, output growth is sluggish, and interest rates are at a record low when they are not still at the zero lower bound. Assessing these changes and whether they are long-lasting or transient is of absolute importance to modellers. As there are not many observation points of the new regime, the task is arduous. Cette *et al.* (2017) examine long-run prospects for productivity and the uncertainty surrounding such an exercise. Marx *et al.* (2017) investigate the disconnect between interest rates and the return on capital.

Methodological challenges

During the Great Recession and up to now, many central banks have set the short term nominal interest rate to zero or close to zero (above or below). In any case, the zero lower bound (ZLB) on nominal interest rates has been binding for several years. This has profound consequences for modelling, and particularly for DSGE models. Because these models are complicated to solve, until recently the dominant practice was to use a linear approximation of the original model. However, the zero lower bound acts as a major nonlinearity. During the first years of the crisis, a common practice was to estimate linear models, but only for normal periods up to 2007 and the onset of the crisis. Obviously, this can no longer continue.

Despite huge progress in algorithms and hardware performance, we are still not able to routinely estimate policy-relevant DSGE models in their original nonlinear form. Two bottlenecks exist: computing the solution to a nonlinear model with model consistent expectations and computing the likelihood of a medium-size nonlinear model using a particle filter. Research papers in which such computations are performed exist, but these methods have not yet been integrated into models regularly used for policy making.

It is worth noting that the recovery is under way and interest rates will not stay at the ZLB forever. However, the long episode of ZLB will remain in the estimation sample of future models for many years to come. It is therefore of crucial importance to develop estimation methods for models with occasionally binding constraints that can be used routinely.

Implementing some approximations to cope with these difficulties

The solution to this problem inevitably requires some approximations. A radical approximation

would be to ignore the constraint and keep using purely linear models. This approach would have the distinct drawback of ignoring the fact that the ZLB prohibited the central bank from lowering interest rates further in the midst of the crisis and aggravating the depth of the crisis. A milder approximation would be to take into account the constraint today but not in the expectation function, departing from the rational expectation hypothesis. The main consequence would be for agents not to take precautionary measures in the neighbourhood of the constraint, before coming up against it. In the same vein, it is also possible to take into account the constraint as binding in the future, but only in a scenario without future shocks. What is really difficult to assess is the effect of hitting the constraint in the future on the distribution of future possible outcomes and the consequences on agents' decisions today.

What econometric method should be used?

The Bayesian likelihood-based estimation approach has always been costly in terms of time and computer resources even for linearised models. Even if the model is linear in the variables, the nonlinearity in the parameters remains and the posterior distribution can only be recovered by lengthy simulations. Currently, alternative estimation methods are being explored, similar to the method of moments.

At the Banque de France, we are closely involved in the development of Dynare (Adjemian *et al.*, 2011), which is the most popular software tool to solve, simulate and estimate DSGE models, and is in use both in academia and in policy-making institutions. The latest version, released in June 2017, brings new particle filter features as well as other improvements. Clearly, the next step for this project should be to deliver efficient ways to estimate medium-size models with the ZLB.

Michel Juillard joined the Banque de France in 2008 after a career in academia. He is currently the senior advisor on modelling issues at the DGEI. He started the Dynare project in 1994 and remains closely involved. Author of several papers on modelling, he is a member of the editorial board of *Computational Economics* and of the *Journal of Economic Dynamics and Control*. He was president of the Society for Computational Economics in 2012-2013. In 2015, he received the David Kendrick prize.

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His research has featured in publications such as *Revue d'Économie Financière*, *Économie et Statistiques*, *Journal of Banking and Finance*, *International Journal of Money and Finance*, *European Journal of Finance*, *International Journal of Forecasting* and *Journal of the European Economic Association*. He is also the co-author with T. Bennani, L. Clerc, V. Coudert and M. Dujardin of a book entitled *La Politique Macroprudentielle* (Pearson publishers, with a foreword by Jean Tirole), which will be published in September.

“The point where the financial sector and the real economy meet is central to the macroprudential approach.”

Can you tell us about your career so far?

I began at the Banque de France in 2005 in the research department, where I first prepared and presented my doctoral thesis as part of a CIFRE agreement. I then broadened my experience as a researcher by contributing to policy work in the Monetary and Financial Analysis Directorate. From 2011 to 2013, I was seconded to the ECB and was able to put my PhD research at the disposal of European decision-making bodies while having to find practical applications for it: this European experience was crucial to my career development. Since my return to the Banque de France's Financial Stability Directorate at the end of 2013, my career has been further rounded out by my managerial duties as deputy head of the macroprudential policy division.

How is your PhD work useful to the Banque de France and the issues it faces?

The common thread of my thesis involved understanding the price dynamics of financial assets, assessing their instability, and being able to measure their liquidity. And since the financial markets are central to the tasks of a central bank, improving our appreciation of their dynamics is essential. My research was

underpinned by an analysis of Mandelbrot-type fractal processes,¹ which assume that identical phenomena can be observed repeatedly, but at different scales. For example, over the course of a day, we can observe “mini-cracks” in the price of an asset, which in themselves are inconsequential but whose dynamics are identical to those that appear on a larger scale when bubbles burst or financial crises emerge. Thus, by observing the infinitely small (high-frequency data), we can better understand what we see at a lower frequency, i.e. financial crises. My work has notably been applied to stock indices² in order to evaluate the potential effects of contagion between asset prices and thereby better measure the transmission of price volatility.³

By studying these intraday data, I was also able to better understand liquidity shortage phenomena and how market operators' reactions are affected by price uncertainties.⁴ This work has notably been applied to the money market in order to understand the extent to which the behaviour of market operators in the overnight interbank borrowing segment is either random or “informed”. The aim was to study how and to what degree greater transparency in the ECB operational framework of monetary policy (via its reform in 2004) improved the price discovery process in the short-term interbank market. The results of this reform were positive...until the 2008 crisis and the ensuing market consequences that we all know well.

How did a financial series specialist succeed in reorienting his work towards macrofinance and financial stability?

The turning point was the 2008 financial crisis. It considerably undermined many preconceptions and showed us just how much shocks affect the markets, and more generally, how much the financial system can have socio-economic consequences. Since then, it is not enough to simply understand market dynamics, particularly when (i) market prices no longer provide adequate information on the robustness of the financial system and (ii) do not allow us to foresee the emergence of the financial crises.⁵

¹ Idier J., 2011.

² Idier J., 2011.

³ Idier J., 2009.

⁴ Idier J., Jardet C. and Lefol G., 2009.

⁵ Idier J., Lamé G. and Mésonnier J.S., 2014.

Following the crisis, I directed my research towards studying the “macro” consequences of market dynamics. For example, my co-authors and I have demonstrated the strong interdependence between the interbank market and sovereign assets used as collateral.⁶ These interactions constitute one of the transmission channels of financial instability during periods of crisis and ultimately have an impact on a State’s refinancing capacity. My work on the ECB’s Securities Market Programme (SMP) is along the same lines. The SMP’s objective was to restore appropriate market conditions to allow adequate monetary policy transmission at a time when the euro area was experiencing a period of extreme stress. My co-authors and I constructed a model that could be used to evaluate at fifteen-minute intervals the impact of Eurosystem operators’ transactions on targeted sovereign bond markets. To this end, we analysed the intervention records and their timing, and the changes in intraday market conditions.⁷ By demonstrating the positive nature of these interventions and studying their transmission mechanisms, our results contributed to the design of other purchase programmes, in particular Outright Monetary Transactions (OMT) in 2012, which had significant “macro” consequences.

Assessing how financial instability can weigh on the economy as a whole, understanding its transmission channels and identifying who ultimately bears the risks from the financial system are essential. The point where the financial sector and the real economy meet is central to the macroprudential approach.

How do you manage to reconcile operational concerns with academic-style requirements?

We conduct research in an institution for which the public service mission is the very essence of its being. A pedagogical approach to our work and research is part of that mission; firstly directed towards the Banque de France’s authorities to help them make informed and sound decisions, and explain those decisions. This contributes to the credibility of the institution’s initiatives, which is essential to any national central bank that acts as the guarantor of monetary and financial stability.

Secondly, we must inform the general public in an accessible way. Researchers have a responsibility to contribute to economic and financial education in general, in order to explain central bank monetary policy or financial stability measures. Above all, this should allow each individual to effectively grasp the risks, particularly the financial risks, which they can be exposed to as a result of their decisions.

Lastly, while participating in numerous international working groups of the Eurosystem, European Systemic Risk Board or the Bank for International Settlements, we have learnt that we are more convincing and can better champion our positions with our peers when quality research is combined with pedagogical efforts.

This pedagogical spirit is what I would like to inspire first and foremost across my division. For researchers it is satisfying to see that our educational endeavours make our work useful and our efforts are thus rewarded.

What are your impressions so far of your first years jointly heading up a team of economist-researchers?

I draw great satisfaction from having succeeded in bringing together a team of a dozen economist-researchers devoted to the subject of macroprudential policy, and all committed to contributing to the general interest through their research. Autonomy, accountability, a spirit of initiative, creativity, teamwork and the trust that we all place in one another are the keys of this success. Our research and analyses now contribute to the work of the High Council for Financial Stability and international working groups, are presented at international conferences, and are widely published.

The progress made on the subject of macroprudential policy is already remarkable; and a number of papers and studies are currently being finalised. The collective academic publication entitled “*La Politique Macroprudentielle, prévenir le risque systémique et assurer la stabilité financière*” that will be published in September is another element in this momentum and will reinforce our pedagogical objective.

⁶ Avouyi-Dovi, S. and Idier, J., 2012.

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⁷ Ghysels E., Idier J., Manganelli S. and Vergote O., 2017.

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Benoît Nguyen is an economist in the monetary policy research division who joined the Bank in 2009, and started in market operations. He started a PhD in 2014. He published a paper in *American Economic Review*.

“**Finance and monetary policy implementation issues are gaining a lot of importance in monetary policy research.**”

Can you tell us about your career?

I'm an economist in the monetary policy research division, specialised in financial economics and monetary policy implementation. I joined the Bank in 2009, and started in market operations. The division was in charge of market monitoring and foreign exchange operations. We were also involved in monetary policy operations, such as managing the central bank swap lines, or later the first bond-buying purchase programme in 2010. At the time, nobody would have bet that within six years, the Eurosystem would buy trillions of euro of government debt or set negative interest rates! “Market operations” was an extremely stimulating environment, especially at that time as central banks had to innovate and renew their policy instruments. Many experiments initiated by the central banks and the market reactions that we observed definitely deserve more research. I like the way Ben Bernanke put it in his last speech as the Chairman of the Federal Reserve. He said: “QE [...] works in practice but not in theory”. In 2013, I had the opportunity to join the DEMFI's monetary policy research division, and in parallel, I started a PhD in 2014.

How did a financial market expert succeed in reorienting his career towards monetary policy structural studies?

Moving from market operations to research was quite unusual and clearly challenging as I had no previous practical research experience. But I was eager to learn using quantitative tools or coding in new languages. I was also familiar with some of the incredibly rich data available at the Banque de France. My finance background also helped me a lot: finance and monetary policy implementation issues are gaining a lot of importance in monetary policy research.

My directorate environment is research-oriented, and both management and my colleagues are well aware that research takes time, and even more so at an early stage. So I am very thankful that I had – and still have – time to learn, discuss, make mistakes and improve. I have also had the chance to work with co-authors both inside and outside the Bank, which has been and still is a very rewarding experience for me.

How is your research useful to the Banque de France and more generally to the conduct of monetary policy?

With my co-authors, we explored different aspects of unconventional monetary policies. With Jean Barthélémy and Vincent Bignon (Barthélémy et al., 2017), we investigated the impact of the Eurosystem collateral framework – the extent to which assets more illiquid than money are accepted in exchange for central bank reserves – gathering granular data on the 200 or so biggest banks in the euro area. We found that not only the quantity but also the composition of the collateral deposited at the central bank had an impact on banks' lending behaviour. This result suggests that the collateral framework can make a contribution to monetary policy, and that tweaking the collateral eligibility rules may improve the transmission of monetary policy in times of crisis.

With Ralph Koijen, François Koulischer and Motohiro Yogo (Koijen et al., 2017), and thanks to the help of BDF DG Statistics, we used original and detailed data of investors' portfolio holdings to measure the “rebalancing channel” of the Eurosystem Public Sector Purchase Programme (PSPP). We built a new map of who holds what in the euro area, who sold to the Eurosystem, and towards which asset class investors reinvested. This

was important in assessing the redistribution of market risk in the financial system, and understanding how our purchase programme was functioning.

With William Arrata, a former colleague from market operations, we looked at the PSPP transmission channels (Arrata and Nguyen, 2017). We showed that besides the purchases made on individual bonds, expectations of the final size of the asset purchases are influential. This can help explain why bond yields sometimes go up in times of central bank asset purchases, and we think it is extremely relevant for the communication of exiting unconventional monetary policies.

With William Arrata, Imène Rahmouni-Rousseau and Miklos Vari (Arrata et al., 2017), we have just finished a new project on negative interest rates on the repo market. We investigate another aspect of the current low rate environment, namely why some money market rates in the euro area fell so low in negative territory and even below the deposit facility rate (DFR). We disentangle the contribution of excess liquidity and bond-level scarcity and contribute to the debate on monetary policy instruments.

Could you describe your research and that of your team and directorate?

There's a great variety of researchers in my directorate (DEMFI), including econometricians, macroeconomists, financiers and historians. Our research is very complementary and addresses a lot of fields and methods relevant to monetary policy. For instance, my research supplements previous work on the lender of last resort (Bignon and Jobst, 2017), or provides empirical results for the theoretical predictions made by other colleagues using macroeconomic

models (Sahuc, 2016). I had the opportunity to work with some of them as co-authors on monetary policy implementation topics and the assessment of unconventional monetary policy measures, for instance.

It's the diversity between the more policy-oriented and the more fundamental research that allows us collectively to seek academic publication while contributing to the policy-making process. That's also possible thanks to a rotating system, in which each of us takes responsibility for a six-week period for the contributions to policy work – like preparing the material for the Governors ahead of each ECB Governing Council meeting. We also share the directorate's contribution to the BDF's different

communication channels: Rue de la Banque, posts for the new blog, etc.

Could we say that your concerns in terms of research are essentially driven by academic publication or by their operational impacts?

Good research is pair-reviewed and its outcome is academic publication. That is what we are aiming for in the division. So far my background has led me to deal mainly with monetary policy implementation issues. These can contribute to clarifying operational options and providing quantitative exercises that might be useful in the policymaking process. Framing a paper

for academics that could also be useful for operational purposes is equally worthwhile, and there is excellent literature in the field of monetary policy implementation, especially in the US.

For each research project, we also like to share views with BDF colleagues in market operations or in the statistics departments for instance. This is facilitated by working with colleagues in other BDF directorates. For instance, we worked closely and frequently discussed our research on asset purchases with BDF colleagues in charge of the PSPP. We are also happy when we can help colleagues with our research, or test specific hypotheses with them, which is mutually beneficial.

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Using DSGE models to assess unconventional monetary policy

Cahn (C.)

Christophe Cahn is a graduate of the *École Centrale Paris* and has a PhD from the Paris School of Economics. He is the Deputy Head of the *Observatoire des entreprises* (the Banque de France Companies Observatory). He has previously worked in the Forecasting, Structural Policy Analysis and Monetary Policy departments. His main research focuses on corporate finance, monetary policy and economic modelling and he has had articles published in *the Journal of Money, Credit and Banking*, *Oxford Economic Papers* and *Empirical Economics*, among others.

“**The Enhanced Credit Support policy package was useful in combating the crisis (2008-2009)**”

Dynamic Stochastic General Equilibrium models (DSGEs) have been deemed useless as policy evaluation tools because they allegedly ignore the frictions at the root of the financial crisis. In a recent paper, Christophe Cahn, Julien Matheron and Jean-Guillaume Sahuc show that these criticisms might be misplaced. Building on the recent breakthroughs in the analysis of banking frictions, they propose the first full-blown assessment of the effects of Longer Term Refinancing Operations (LTROs) on the euro area economy. Counterfactual simulations performed using their framework suggest that these unconventional monetary policy measures were useful in combating the crisis.

A DSGE model to investigate the effects of unconventional monetary policies

Christophe Cahn, Julien Matheron and Jean-Guillaume Sahuc study the effects of the 2008-2009 policy package consisting of the adoption of the fixed rate full allotment (FRFA) tender procedure and the lengthening of the maturity of central bank funding via LTROs.

To conduct their policy analysis, they implement a DSGE model which includes frontier developments in the modelling of the banking sector. Only such a DSGE model can fully take into account the far-reaching, causal implications of these unconventional measures.

Some specific characteristics of the model

In the model, depositors are never sure *ex ante* that the bank to which they lend will act in their best interest. As a consequence of this

fundamental trust issue, bankers charge a higher interest rate on loans than they pay on deposits. This credit spread increases in times of crisis, thus triggering an adverse loop with potentially dire macroeconomic consequences. This mechanism accords well with standard descriptions of the bank lending channel and rationalises how disruptions in the latter can threaten the proper transmission of monetary policy in times of crisis.

In this framework, the central bank can take up an intermediation role and provide a substitute for interbank and deposit funding. In effect, LTROs in the model work their way into the real economy precisely by putting an end to the adverse loop triggered by the recession.

The Enhanced Credit Support policy package contributed to averting a major credit crunch

Christophe Cahn, Julien Matheron and Jean-Guillaume Sahuc estimate their model using euro area data. In short, this step consists in assigning to the model parameters values maximising the probability that observable fluctuations in key macroeconomic variables (inflation, GDP, investment, credit spreads, etc.) were indeed generated by the model. This empirical step ensures that the results drawn from the DSGE model are based on an objective and transparent, data-driven procedure.

Their results suggest that the Enhanced Credit Support policy package was useful in combating the crisis. In particular, absent these measures output growth would have been about 2.2 percentage points lower on average over 2009, credit spreads would have jumped by an extra 400 basis points, and the zero lower

bound on the nominal interest rate would have been hit in mid-2009. All in all, the Enhanced Credit Support policy package contributed to averting a major credit crunch, which would have otherwise resulted in a negative inflation episode.

Interestingly, absent LTROs/FRFA, the Eurosystem would have lowered its policy rate further, leading to a significantly lower three-month Euribor rate. This result suggests that standard and unconventional monetary policies were actually complementary. According to the authors' simulation, resorting to LTROs allowed the ECB to save some ammunition for use in the event of further negative shocks (which unfortunately materialised in the form of the sovereign debt crisis).

All in all, beyond the specific case of the 2008-2009 LTROs, this analysis suggests that the various forms of liquidity provision at extended maturities (VLTROs in 2011-2012, TLTROs in 2014) might have played a role in dissipating the risks to the banking sector.

To conclude, this study, among many others, shows that DSGE models incorporating state-of-the-art developments in the modelling of financial frictions are among the most appropriate tools to conduct this essential task.

On the share of inheritance in aggregate wealth: Europe and the United States, 1900-2010

Alvaredo (F.), Garbinti (B.) and Piketty (T.) "On the share of inheritance in aggregate wealth: Europe and the United States, 1900-2010", *Economica*, Volume 84, Issue 334, 2017.



Bertrand Garbinti graduated from ENSAE and has a Ph.D from the Paris School of Economics. He was a researcher at Crest before joining the Micro Economic Analysis Division and is presently working on household behaviour (savings, transmission and accumulation of wealth). He is an expert in household behaviour.

“Several forces tend to imply that low-growth societies also have higher inheritance shares”

Facundo Alvaredo, Bertrand Garbinti and Thomas Piketty provide a clearer conceptual framework as well as a more reliable data series in order to estimate and compare the evolution of the inheritance share in aggregate wealth in Europe and the United States over the 1900-2010 period. They stress that although their estimates represent an improvement upon the previous literature, these estimates should still be viewed as exploratory. The broad patterns and orders of magnitude that they find appear to be robust. However they insist on the need to collect additional historical data from inheritance and probate archives.

There is substantial uncertainty regarding the relative magnitude of inherited wealth and self-made wealth in aggregate wealth accumulation. Uncertainty also exists as to how this changes over time and across countries. The 1980s saw a famous controversy between Modigliani and Kotlikoff-Summers. Modigliani, (a strong life-cycle advocate) argued that the share of inherited wealth was as little as 20-30% of US aggregate wealth whereas Kotlikoff-Summers showed that the inheritance share was as large as 80%, if not larger. Particularly confusing was the fact that both sides claimed to use the same data, namely US data from the 1960s-1970s. The disagreement arose both from the lack of adequate long-run series on inheritance and from definitional issues.

A very high inheritance share in aggregate wealth accumulation in Europe during the 19th century and until World War I

Alvaredo et al. find that the inheritance share in aggregate wealth accumulation was very

high in Europe during the 19th century and until World War I (over 70% around 1900-1910, and possibly even more than 80% in some countries). It then fell abruptly following the 1914-1945 capital shocks (destructions, inflation, taxation). By around 1970-1980 the share of inherited wealth had fallen to less than 40%. It has been rising substantially in recent decades and it seems to be about 50-60% in 2000-2010.

A lower inheritance share in aggregate wealth accumulation in the United States than in Europe during the 19th century and until the eve of World War I

The US pattern also appears to be U-shaped, albeit less marked. The inheritance share in aggregate wealth accumulation was lower in the United States than in Europe during the 19th century and until the eve of World War I (less than 60% in the United States compared with over 70% in Europe). This is likely to reflect a "New World" effect (migrants usually did not arrive with much inheritance and had to save on their own). However the US inheritance share was rising fast in the late 19th and early 20th centuries. The shocks caused by the 1930s and World War II led to a much less pronounced downturn than in Europe, and consequently the US inheritance share became higher than in Europe by the mid-20th century. In recent decades, the inheritance share seems to have increased substantially in the United States. However there is significant uncertainty about the exact levels and trends, due in particular to the limitations of US estate tax data, which covers only a small fraction of all decedents and thus cannot be used to produce aggregate series.

Why are long-run evolutions needed?

Alvaredo et al. also emphasise the existence of significant variations within Europe. France and Germany follow a particularly marked U-shaped pattern, while the UK pattern is in some ways closer to the US evolution.

In brief, the general conclusion of Alvaredo et al. is that there are substantial variations in the inheritance share over time and across countries, and that care should be taken not to interpret averages over one or two decades as steady-state outcomes. Wealth accumulation takes time, spanning several generations, and therefore it is important to have a very long run perspective on these issues.

Modigliani's conclusions – with a large majority of wealth coming from life-cycle savings – might have been right for the immediate post-war period (though somewhat exaggerated). However Kotlikoff-Summers' estimates – with inheritance accounting for a significant majority of wealth – appear to be closer to what we generally observe in the long-run, both in the 19th and early 20th centuries, and in the late 20th and early 21st centuries.

Finally, Alvaredo et al. also stress that there are many different possible steady-state levels for the inheritance share. There are several forces which tend to imply that low-growth societies also have higher inheritance shares. But other effects can go in the other direction. Depending on the evolution of demographic parameters, social tastes for leaving bequests, the generosity of public pension systems, etc., very different equilibrium levels for the inheritance share can be observed in different countries.

Solving endogenous regime switching models

Barthelemy (J.) and Marx (M.) (2017), "Solving Endogenous Regime Switching Models", *Journal of Economic Dynamics and Control*, Volume 77, pp. 1-25, April 2017.



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“The higher probability that the central bank reacts more strongly to inflation has a stabilising effect on volatility.”

Many structural changes that affect the economy result from rational decisions, and thus depend on the state of the economy at the time of the decision. Examples are numerous: macroeconomic fluctuations may influence changes in monetary policy regimes, policy regimes, defaults or financial crises. Most of the literature considers purely random changes. Jean Barthélemy and Magali Marx fill the gap and propose a flexible method to solve rational expectations models in which structural parameters can switch across multiple regimes according to endogenous transition probabilities.

A regime switching model for understanding economic behaviours

It is reasonable to model economic behaviours as the alternation of several states in which the reactions of the agents (firms, government or central bank) have different values. A particular example is an alternation between a regime in which the central bank is highly concerned by the level of inflation, and another regime in which the central bank is more concerned by growth. Agents are rational, and therefore integrate in their decisions the expectation of the probability that the central bank becomes

more concerned by the level of inflation (as compared to the level of growth).

These models, called regime switching models, have been studied extensively in recent periods. However, it is generally assumed in the existing literature that the probability that the central bank is more concerned by the level of inflation is exogenous, *i.e.* independent of economic variables. This restriction seems unrealistic; actually, if the level of inflation becomes higher, it appears logical that the central bank would become more concerned.

Regime switching with transition probabilities depending on economic variables

Jean Barthélemy and Magali Marx develop a method to solve such models that incorporates rational expectations and regime switching, in which the transition probabilities may depend on economic variables and embed a flexible algorithm giving second order expansion of the solution. The strategy relies on a perturbation approach, based on the fact that the shocks affecting the economy are small enough. As a by-product this approach provides the conditions that ensure that the model is determinate, *i.e.* that a unique bounded equilibrium exists.

The probability of the reaction to inflation becoming stronger as the level of inflation increases

Jean Barthélemy and Magali Marx illustrate their method using an example where the reaction of the central bank toward inflation can be more or less hawkish. In their setup, the probability to switch to a more hawkish environment increases with the level of inflation. They show in particular that the higher probability that the central bank reacts more strongly to inflation has a stabilising effect on volatility.

There are two mechanisms at play. First, agents are rational, and when the level of inflation increases, they take into account the threat that the central bank may react more aggressively toward inflation. This expectation effect softens the consequences of a shock and stabilises the volatility. Simultaneously, the occurrences of a stronger reaction to inflation increase with the level of inflation. As a consequence the duration of a stronger reaction increases, and this induces a selection effect which reinforces the stabilisation.

The macroeconomic effects of shocks to large banks' capital

Mésonnier (J.-S.), Stevanovic (D.) "The macroeconomic effects of shocks to large banks' capital", *Oxford Bulletin of Economics and Statistics*, forthcoming.



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“ An unexpected drop of 1% in the banking system's capital buffer triggers a strong fall in the growth of bank credit to firms. ”

The leverage of a bank can be defined as the ratio of its equity capital to its total assets. Recent analyses of the credit boom and bust of the 2000s in the United States and the main developed economies suggest that fluctuations in the leverage of large financial institutions play a significant role in explaining macroeconomic volatility. However, little is known about the magnitude of the macroeconomic effects of shocks to large banks' leverage. Jean-Stéphane Mésonnier and Dalibor Stevanovic propose a simple approach for quantifying the macroeconomic effects of a shock to the leverage constraints of large US banking groups.

The lack of detail on the macroeconomic effects of shocks to large banks' leverage mainly reflects a problem of measurement. As banks continuously adjust their actual leverage to a time-varying desired target, which depends primarily on their own financial health and on their business model, micro-data are required to properly assess banks' leverage constraints and their effects. However, pure bank-level analyses by nature ignore the possible feedback effects between banks' financial health and the macro-economy. New empirical approaches are therefore required, to bridge the gap between micro- and macroeconomic data and models.

Disaggregated information and macroeconomic aggregates are combined

Jean-Stéphane Mésonnier and Dalibor Stevanovic propose a simple approach for quantifying the macroeconomic consequences of a shock to the leverage constraints of large US banking groups, called bank holding companies (BHCs). They propose an innovative method of combining disaggregated information on the balance sheets of large US banks and macroeconomic aggregates.

The commonly held view is that banks, like other types of firms, dynamically adjust their capital-to-assets ratio in order to meet a pre-specified target level. Of course, banks are highly regulated companies, and large BHCs in the US in particular have had to comply with the successive capital requirements set by the Basel Committee over the past three decades, which relate banks' minimum equity capital to their risk-weighted assets. That said, regulatory constraints on large banks' unweighted leverage ratios have not been very binding since the early 1990s in the United States, which suggests that their actual leverage ratios have largely been determined by market discipline in recent decades. The severity of a bank's leverage constraints can be measured

as the gap between its actual capital ratio and its economic capital ratio – that is, the one that reflects the risk aversion of creditors and the risk exposure of the institution. However, this gap, which is referred to as the bank's capital buffer, is unobserved and has to be estimated.

Constructing a relevant macroeconomic measure of the capital buffer of large US banks

Jean-Stéphane Mésonnier and Dalibor Stevanovic exploit an unbalanced panel of balance sheet ratios for some 100 US large bank holding companies over the period 1990-2013 to estimate individual bank capital buffers, and then aggregate them to construct a relevant macroeconomic measure of the capital buffer of large US banks. The resulting aggregate bank capital buffer (ABCB) fluctuates widely over the last two and a half decades: it notably drops during each of the three recessions seen during the period in the US, and in each case remains in negative territory for a couple of years after the end of the recession. The ABCB also strongly co-moves with popular measures of credit conditions and credit supply, like bond credit spreads, the tightening index from the Fed's SLOOS, and the share of bank loans made under commitment.

The capital buffers of large US banks help to explain the fluctuations in credit aggregates

The authors then plug the estimated ABCB series into a small-scale macroeconomic model (a structural VAR model) together with the relevant macroeconomic and financial variables, in order to assess the impact of a negative bank capital buffer shock on economic activity, while accounting for possible feedback effects between aggregate bank leverage and the macroeconomy. They find robust evidence that their aggregate measure of the capital buffer of large US banks is important for understanding fluctuations in credit aggregates as well as in the US business cycle. In particular, an unexpected drop of 1 percentage point in the banking system's capital buffer triggers a significant and persistent fall in the growth of

bank credit to firms. Commercial and industry loans in particular contract by some 6 per cent after one year. In terms of economic activity, GDP growth also falls significantly, with the maximum impact reached after 2 quarters.

Probable reduction of the role of the banking system in amplifying macroeconomic fluctuations

Over the period studied by Jean-Stéphane Mésonnier and Dalibor Stevanovic, the regulatory constraint on bank leverage was slack, so the desired capital ratio targeted by an individual institution can be interpreted as an economic capital ratio, which is driven by market forces and fluctuates widely. This situation may have changed with the progressive implementation up to 2018 of

the new Basel III regulation on bank leverage. The findings of the authors suggest that an unexpected and rapid implementation of heightened regulatory constraints on bank leverage could have significantly contractionary effects in the short run. However, the new Basel regulations did not catch the industry by surprise as they were thoroughly discussed with banks in advance and then implemented very progressively. After adjustments, and provided the new leverage regulation is tough enough, the constant regulatory leverage ratio may become binding, while the time-varying economic one may no longer be binding. As a consequence, one may expect fluctuations in the aggregate bank capital buffer of large banks to be dampened. The role of the banking system in amplifying macroeconomic fluctuations should diminish accordingly.

A supplement to *The Research Newsletter*, focusing in particular on research publications covering the November 2016 – April 2017 period, can be consulted on the Banque de France's website at the following address: <https://publications.banque-france.fr/en/second-quarter-2017>

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