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Louis Bachelier

INTERNATIONAL FINANCIAL RISK FORUM'S SPECIAL EDITION

WITH

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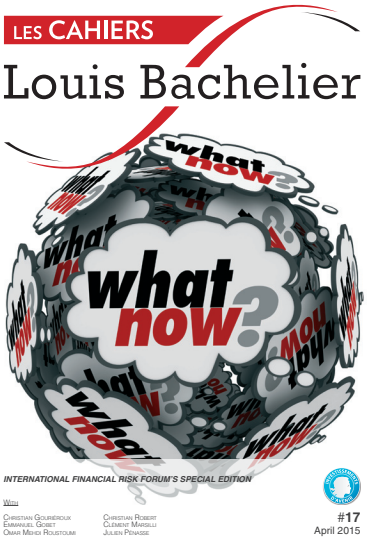

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Modelling risk in stressed situations

Analysis of the risks present in a portfolio of assets or in the balance sheet of a financial institution relies on dynamic models describing changes in the characteristics of financial assets (yields, interest rates) and those of macroeconomic risk factors (market indices, GDP) or individual risk factors (bankruptcy indicator, account closure, lapse).

These models are used to calculate risk measures, such as Value at Risk (VaR), or to set reserve levels in the framework of the new Basel 3 or Solvency 2 regulations. As these models are usually estimated on historical data, the measures of risk and reserves which are directly derived from them correspond to standard situations. It quickly became necessary to compare these results with those of non-standard, "stressed" situations. These sensitivity studies are based either on scenarios or on analysis of the responses to certain shocks. It is important to distinguish these two types of approach.

Analysis by scenario or analysis by response to shocks

In an analysis by scenario, the estimated model is kept unchanged and risk measures are calculated unstressed, that is to say, conditional on the information on the present and the past of the relevant variables, and stressed, given in addition an unfavourable future development of some of these variables. This approach was followed, for example, in the recent stress tests imposed by the European Central Bank.

In an analysis by response to shocks, the information used in the calculations is unchanged, as is the model, but the model parameters are altered. The risk measures are then compared with the initial estimated values and those calculated with these stressed values.

These shocks are often too "macro-economic"

In modern approaches, the shocks can involve error laws not being interpreted as innovations or other scalar or functional parameters of these models. For example, some parameters may be interpreted as tax rates, others as inflation targets in the central bank's key interest rate setting behaviour. We can then analyse the consequences in terms of the risk of these rates or inflation targets changing. Within such a perspective, one often looks for shocks on parameters having economic interpretations. Thus we can look for innovations construed as exogenous productivity shocks. When shocks affect the parameters defining the behaviour of the central bank, we will also attempt to shock other parameters at the same time in order to consider alterations in agents' behaviour in response to or in anticipation of these policy changes by the

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Christian Gouriéroux

Christian Gouriéroux is professor of Economics at the University of Toronto, director of the Finance-Insurance laboratory at CREST (Center for Research in Economics and Statistics in Paris), and head of the AXA chair on "Large Risks in Insurance". His current research interests are in Financial Econometrics, especially in credit risk, term structure of interest rates, longevity, hedge funds and regulation. Christian has received the Koopman's price in Econometric Theory and the silver medal of CNRS (the French National Research Found) for his research in Economics.

central bank. This is the famous 'Lucas critique' [Lucas (1976)].

It would clearly be possible to combine these two approaches in order to see the effects of a change in economic policy in a non-standard situation.

Outstanding questions

Once the objective is to compare risk measures such as VaR, the calculations can only be made in analytical form and require generating the future trajectories of the variables. These trajectory generators, often mistakenly called scenario generators, are usually easy to identify when information concerns only the present and past of the variables, but become more technical when future changes in not strongly exogenous variables are fixed.

Both types of analysis – by scenario and by response to shocks – presuppose that the initial model is well specified both for the past and for the stressed environment. They also assume that the parameters are identifiable in these two environments. Thus the analyses may not provide answers to questions such as the development of risk in a permanent low interest rate environment, or the risks associated with Greek exit from the euro.

With regard to low rates, for example, the models usually used to describe changes in interest rates are incompatible with the stress hypothesis. Moreover, even if these models were modified to obtain compatibility, one would have too few comparable past low rate situations to accurately identify the parameters. Such questions can only be answered by experts' "visions" of the future, with no real quantified support, or else by giving the same response as Wiplosz: "Wait and see", that is, let's wait until we have sufficient information to be in a position to provide reasonable answers.

Adapting shocks to the structure of the enterprise

The methods of analysis and the trajectory generators are often based on methodologies dating from the 1980s, without clearly distinguishing between the two types of analysis discussed above, but also without a clearly explaining, in the case of portfolios that include derivatives, the consistencies or inconsistencies between generators subject to historical probability and risk-neutral probability. In addition, financial institutions often leave it up to service companies to perform these tests, and so do not really make the effort to construct and understand their own model. They thus make the same mistake as was made in the construction of ratings, a mistake that was an important component of the 2008 financial crisis.

With regard to defining the shocks to be implemented, they are often suggested by the European Central Bank or by supervisors from their own models, which differ significantly from the risk models of banks and insurance companies. Furthermore, these latter models may themselves be very different from each other. The proposed shocks then have very different interpretations, as well as consequences in terms of future risks. Whereas the proposed scenarios or shocks are "top-down", the results based on individual models are "bottom-up". Lastly, non-standard extreme situations depend on the environment. This dependence must be taken into account and the stresses must be regularly updated in a coherent way. These non-standard situations also depend on the balance sheet structures of companies. The stresses should take these into account and differentiate between commercial banks, investment banks and insurance companies. In other words, these shocks are often too "macro-economic". This will become clear when the stresses are applied to property assets, where it is well known that price changes are very heterogeneous, depending on the type of property and location.

Find the Christian Gouriéroux's interview on www.louisbachelier.org

Rare events: how does one calculate the unpredictable?

What do the Chernobyl explosion, the fall of Lehmann Brother and a Greek state on the brink of insolvency have in common? All these events were unthinkable for many experts. And yet their consequences have been far-reaching. Assessment of the risk of extreme events has thus become a problem that calls for the development of new mathematical tools.

Key points

- Risk assessment of extreme events requires specific methodologies.
- The splitting method breaks down a rare event into a series of current and readily observable events. It thus facilitates the calculation of its probability and intensity.
- By providing information about the origin of a crisis, the splitting method contributes to understanding rare events, as well as helping to prevent them.

Based on an interview with Emmanuel Gobet and on the paper "Rare event simulation using reversible shaking transformations" by Emmanuel Gobet and Gang Liu.

Risk management is often centred on major risks. Conversely, rare events, whose probability of occurrence is extremely low, are often viewed as too unlikely to be worth considering. But recent events have contradicted the empirical laws of statistics, redefining the boundary between the possible and the impossible.

In view of recent crises, risk management policies have been called into question. They now need to take account of "rare" events, variously in order to quantify the probability of such a risk, to evaluate its consequences and to take preventive measures. But a rare event is by definition difficult to observe: its probability of occurrence is 0.0001. How then can it be successfully assessed?

Statistical methods for quantifying a probability are based on historical observations. However, if the event rarely, if ever, occurs, statisticians do not have any observations for its quantification. The paper by Emmanuel Gobet aims to provide a methodology that can respond to such a situation, when one has a model of it.

Sub-dividing rare events

An event is always the conjunction of several random phenomena. Before the subprime crisis, for example, observers noted an increase in property prices in the United States and a lack of quality buyers in this market. The modelling of these phenomena can then be used to simulate the event. However, very many simulations are needed before one can generate the desired critical scenario. The process is time consuming and calls for significant computing capabilities. To overcome these difficulties, advanced Monte Carlo techniques, known as preferential sampling, can introduce a bias to scenario generation so as to increase the occurrence of rare events. But using them is still very complex.

If an event has never occurred, statisticians do not have the observations needed for its quantification

Emmanuel Gobet has therefore developed a so-called splitting method to simplify the simulation of rare events. The principle is simple: breaking down a rare event into several non-

Emmanuel Gobet

Emmanuel Gobet was successively assistant professor and professor at Pierre and Marie Curie University (UPMC), at Ecole Polytechnique, at Grenoble INP-Ensimag. He is currently a professor in applied mathematics at Ecole Polytechnique. His works concern mainly the probabilistic numerical methods, the stochastic analysis, the statistics for stochastic processes and financial mathematics. He collaborates regularly with financial institutions, insurance companies and energeticians.

Méthodologie

When a rare event is described by a random trajectory entering into a critical configuration, existing work in the literature develops interacting particle systems techniques to evaluate rare probability. But this is done on the basis of a Markov hypothesis regarding the process, with an important and tricky role for its sampling frequency. In the present study, the authors have eased these two constraints, and developed a new methodological framework that functions directly in terms of the trajectories. The two resulting algorithms provide excellent numerical results.

rare events. "To assess the risk of a loss of 30 billion euros in a portfolio, millions of scenarios have to be simulated before one observes this particular case," Emmanuel Gobet says. "The method aims to assess the risk of a smaller loss, for example, 30 million, which is more plausible and more easily observable. We then select scenarios corresponding to the loss we are looking for; we alter them (using "shaking transformations"), and then use them to generate scenarios with greater losses. The operation is repeated until the desired event is reached."

Knowing the origin of the event

Making use of two algorithms, one based on ergodic transformation, the other combining selections and transformations of trajectories, this technique allows both the frequency and intensity of rare events to be quantified. One of its features is that it resolves the problem of temporality and the choice of the sampling frequency of trajectories. Other methods calculate the probability of a risk at a given frequency: daily, weekly, monthly, etc. The choice of this frequency is often arbitrary, but it is not neutral. Opting for a weekly rather than monthly frequency can affect the results.

The splitting method developed here does not rely on a single frequency, but analyses the complete trajectory of a scenario: each of them corresponds to a new curve. It thus sheds light on the origin of the rare event, by providing information on the chronology that has preceded it. It is thus possible to know which sector or agent has the greatest likelihood of producing such a scenario. "It is a monitoring tool that allows us, for example, to see which bank is the most sensitive in the context of a stress test," Emmanuel Gobet explains.

Guarding against risks of all kinds

The splitting method can be applied to many problems. Work is thus being carried out to assess losses in a credit portfolio and to calculate the risk of joint corporate default. The authors also use it to test the risk model, in other words, to estimate the consequences of an inappropriate use of a financial model. But its applications can go well beyond the field of finance. "The theme of risk has today become transversal," Emmanuel Gobet points out. "Whether financial, economic, environmental or industrial, risk needs to be quantified and evaluated."

This splitting method is a further tool for understanding extreme scenarios, particularly by shedding light on their origin and their consequences. Such information is obviously valuable for regulators in defining prudential rules and avoiding new crises.

Find the
Emmanuel Gobet's interview
on www.louisbachelier.org

IN THE EYES OF OUR PARTNERS

How can regulatory stress tests be made relevant ?

By Omar Mehdi Roustoumi

The regulatory stress tests carried out in 2014 were widely commented on and criticized by observers and professionals. After pointing out certain inconsistencies in the scenarios, Omar Mehdi Roustoumi, manager and head of the Quantitative Finance division at MPG Partners, proposes ways of improving them through the inclusion of systemic risk and the use of new Big Data of the Data Science technologies.

The second half of 2014 featured a series of stress tests announced by the EBA (European Banking Authority). The exercise was conducted on a sample of 124 European banks whose businesses cover at least 50% of the domestic banking sector in each EU Member State concerned. The ECB welcomed the results, because "only" 25 banks failed this regulatory stress test.

Stress tests as defined by the EBA follow a so-called "bottom-up" approach and aim to ensure consistency and comparability of results from methodologies common to all banks.

Macroeconomic scenarios and market scenarios intended to represent a state of crisis were drawn up by the ECB. This state of crisis is defined in relation to a "normal" state. The macroeconomic scenarios concern property prices, the unemployment rate, inflation, stock market prices (the CAC 40 in France), interest rates and the recession. The market scenarios involve implementing shocks on risk factors that affect the bank's various trading books. These scenarios are applied to all the banks. Once these scenarios were presented, a number of bilateral exchanges took place between each bank and representatives of the ECB in order to agree on the perimeters and methodologies for implementation of the stress tests.

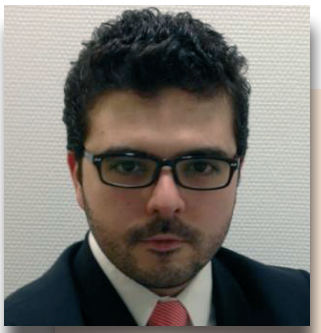
The ECB subsequently paid particular attention to these stress tests, by challenging banks and examining the results in detail.

Stress test credit risk, counterparty risk and market risk

All assets exposed to credit risk and counterparty are concerned by this stress test. It is a matter of calculating the probability of default (PD) and loss given default (LGD) based on the scenarios adopted. Specifically, it is necessary to link the time series of default rates to the macroeconomic risk factors affecting each portfolio, and then to project these rates onto every quarterly time interval over a three-year period using ECB data. Models of changes in the default rate are mostly based on econometric time series models: autoregressive (AR) models, vector

RECOMMENDATIONS

- Anticipate the next stress test exercise by the EBA and the IMF through the introduction of relevant models and methodologies that incorporate Systemic Risk.
- Use "realistic" crisis scenarios.
- Improve the reliability of the stress test production process by adopting the new Big Data technologies.



Methodology by Omar Mehdi Roustoumi

The main requirements in this wave of stress tests consisted of a minimum of 8% core capital – known as CET1 (Common Equity Tier 1) – which must be held in the case of a central macroeconomic scenario. This capital is then projected over a period of three years on a quarterly basis for most banks.
The minimum requirement for capital goes down to 5.5% in the case of a so-called crisis or "adverse" scenario, also determined by the EBA, for each country and for all countries together, carried out on a projection horizon of three years (from 2014-2016).
The exercise involves expressing these scenarios in terms of the cost of risk – the risks covered being counterparty risk, market risk, and sovereign risk – and the cost of financing.

autoregressive (VAR) models, vector error correction models (VECM), etc.
Market stress tests for a bank involve giving shocks to its market risk factors, by replicating stress scenarios observed during major crises. Further hypothetical shocks are also applied in accordance with "normal" and "adverse" scenarios. It is then a matter of calculating the impacts in terms of profit and loss on the bank's various trading portfolios.

Inconsistent scenarios

As with previous stress tests, this recent series has been widely criticized by specialists in the banking sector. The case of the French State loan rates is one example. The worst scenario proposed by the ECB is a borrowing rate of around 4% in 2016. However, during the 2008 crisis, the rates reached almost 6%. It therefore seems strange to implement a stress test with a lower rate than the last crisis. A borrowing rate of 7% or 8% would have been more reasonable as an extreme scenario, especially as other European countries have experienced even higher rates. In terms of recession, the worst scenario proposed by the ECB is a 2% fall in GDP. But in 2009 it had already fallen by 2.5%. These criticisms also apply to other macroeconomic scenarios. Regarding market stress tests, many of the relative shocks specified by the ECB are inconsistent, such as shocked volatility rates of 10,000%. The market scenarios, unlike the macroeconomic scenarios, are those of a massive crisis. An effort to homogenize these scenarios and make them consistent should be made by the ECB.

Incorporating systemic risk more satisfactorily

In seeking to measure the effects of macroeconomic and market scenarios on the exposure of a bank taken alone, the contagion effects that can occur when a bank fails or a country defaults are not taken into account.
In 2008, the bankruptcy of Lehman Brothers triggered a chain reaction that weakened the financial system and led to a crisis from which it is still struggling to emerge. It is therefore important to examine the systemic consequences of the failure of a large bank. Some studies based on graph theory provide some interesting ways of controlling this Systemic Risk. Were JP Morgan to go bankrupt tomorrow, there would be disastrous effects on many more than the 25 banks that failed the stress tests. Without taking this risk into account, the implementation of stress tests remains incomplete.

Issues around the quality of data

The conditions of production of these stress tests are also open to questioning. In general, stress tests are modelled and produced by risk teams on data replicated from the front office. The collection and aggregation of data is carried out from a variety of sources, at different frequencies and with different techniques. The same applies to its storage.
This diversification leads to problems of completeness, reliability and data integrity as well as making the calculations very cumbersome. The production and certification of data also becomes complicated and sometimes impaired. At a time when banks are considering industrialising the calculations of stress tests and all regulatory metrics, the means of production are often of another time, thus calling into question the relevance of the results and sometimes even the possibility of obtaining results. Few banks are currently able to apply stress tests on past positions, as has been requested by the regulator.
It is high time for banks to benefit from the technological arsenal offered by Big Data and Data Science, in order to optimize the entire stress test production process and make it more reliable, as well as all the other measures of regulatory or economic risk.

Find the
Omar Mehdi Roustoumi's interview
on www.louisbachelier.org

How can extreme systemic risk in financial markets be measured?

The way financial markets are structured is such that an isolated crisis can rapidly become widespread. Given this situation, can the collapse of a single asset lead to a fall in the entire market? How great is the degree of contagion? How can we measure the systemic risk borne by financial markets? Christian Robert and his co-author have developed statistical tools to provide a fresh look at the measurement of such extreme risk.

Key points

- The majority of studies measure the effects of a stress scenario generated by a specific asset. The work of Christian Robert and Alexis Bienvenüe analyses the extreme dependencies that exist between assets so as to represent the market as a whole.
- The degree of dependence between two assets changes over time, and may increase in times of crisis.
- The probability that the market as a whole is impacted by the fall of a single asset is not zero. There is a real issue of contagion.

Based on an interview with Christian Robert and on the papers "Systemic tail risk distribution" (being finalized) and "Likelihood based inference for high-dimensional extreme value distributions" by Alexis Bienvenüe and Christian Robert.

Studies of systemic risk, and its measurement and regulation, have multiplied since the 2008 financial crisis. The regulators and central banks, along with the academic community, have tried to characterize its many facets. Indeed there are numerous measures of systemic risk. These may variously concern financial institutions – through analysis of market or accounting data –, financial markets and their infrastructure, and the degree of interconnection between institutions and markets. All of these measures can help identify those players likely to contribute most to the problems faced by a financial system in times of crisis.

Measuring the degree of contagion …

In his paper, Christian Robert focuses on the systemic risk carried by an asset market and seeks to measure the extremal dependencies between assets during a crisis. What is the degree of contagion? To what extent does the collapse of one asset cause a sharp drop in other assets? How many products would be affected by such a fall? More specifically, the aim is to model the joint evolution of assets in times of crisis, so as to obtain the distribution of the number of assets undergoing significant losses when the price of at least one asset falls. "We do not give priority to any one financial product over another," Christian Robert says. "Instead, we look at the dependencies between assets, in the case of a loss scenario for at least one of the assets. This approach is similar to the one developed by Hartmann, Straetmans and de Vries (Journal of Empirical Finance, 17, 241-254, 2010) in

> *There is a risk of generalized and extreme decline of all assets*

Christian Robert

Christian Robert is professor of statistics and actuarial science at Institut de science financières et d'assurances (University Claude Bernard Lyon 1). He is also Director of the Laboratory of Actuarial and Financial Sciences and co-holder of the BNP Paribas Cardif "Management de la Modélisation" chair. His research interests and areas of expertise concern extreme value theory and statistics, actuarial theory and practice, and statistical finance.

Méthodologie

The authors study the distribution of the number of assets undergoing significant losses, conditional on at least one of the assets suffering a substantial loss. The difficulty stems from the large number of assets considered for representing the market (more than 100).
The authors make use of estimation techniques developed in the theory of extreme values and apply them to a high-dimensional context. They adopt a maximum-likelihood parametric approach to identify the most appropriate structure for the multivariate tail dependence function. They begin with a CAPM in which the betas are stochastic and the dynamics of market risk are given by a GARCH process, and thereby construct the dependence function. It can be shown that after normalization of stationary distributions, the vector of the betas has an exchangeable distribution that can be modelled by an Archimedean copula.

the context of foreign exchange markets."

…by taking account of the entire market

Various measures have already been introduced to quantify the consequences of the fall of an asset in the market (such as Contagion VaR), but they have focussed on one or possibly two specific assets. The specificity of the work presented here is that it uses the theory of extreme values in a high-dimensional context to represent the market as a whole: around a hundred assets are considered in this application. Initially, the approach adopted, based on a CAPM (capital asset pricing model), is used to obtain a theoretical distribution of the affected assets, and then this is compared to an empirical distribution calculated from US equity market data. The two results are consistent and point to two main conclusions.

It is evident, first, that the dependence between two assets changes over time, especially in times of crisis, when it may increase. This parameter is not always included in systemic risk calculations. "The sensitivity of an asset to market risk is often left constant in measures of systemic risk," Christian Robert says. "But we show that this sensitivity changes in times of crisis. Risk calculations must therefore be based on random sensitivity coefficients."

Risk of generalized decline

The study also found that the distribution of assets affected by the fall of at least one asset is distinctive. Intuitively, it would be plausible that the distribution of the number of assets affected during a crisis event decreases with the number of affected assets: it would then be more likely that one asset is affected rather than two, two assets affected rather than three, and so on. Yet the distribution obtained does not match this pattern at all. Risk does not decrease continuously. On the contrary, it increases significantly as one approaches the tail of the distribution, and takes into account almost all of the assets. Specifically, these results show that the probability that the entire market is impacted by the collapse of one asset is not zero. There is a risk of generalized and extreme decline of all assets.

By showing the links that exist between the assets of a financial market, and their changes in times of stress, the study reveals a real contagion issue that should probably be better integrated into stress test construction models. The stress tests recently carried out by the European Central Bank allowed the strength of each bank considered in isolation to be assessed. But there is a risk that all institutions undergo a crisis at the same time, and it would therefore be useful to aggregate the loss scenarios in order to assess the consequences for the market of a general fall.

Find the
Christian Robert's interview
on www.louisbachelier.org

How can economic forecasts be improved?

What will happen tomorrow? Will the economy improve? Will consumption pick up? The economic future is a matter of major concern variously for government, management and finance, and having reliable forecasts is vital for them. Clément Marsilli has developed a methodology that estimates the evolution of growth by means of the analysis of different frequency data.

Key points

- Estimating GDP growth involves analysing a variety of data with variable characteristics.
- The models developed allow multi-frequency data to be managed and the most relevant data to be selected.
- The quality of forecasts is improved, especially for the very short term.
- But the models have trouble predicting rare events, whether they be periods of strong economic expansion or of recession.

Based on the paper "Variable Selection in Predictive MIDAS Models" by Clément Marsilli and on an interview with him.l'auteur.

Politicians, industrialists and investors scrutinize estimates of growth and make their decisions on the basis of the figures released. The quarterly publication of GDP by INSEE is thus eagerly awaited. But if economic forecasting is an essential exercise, it is also highly complex.

The calculation of such indicators is based on a mass of data, of very different types and frequency. It firstly draws on macroeconomic data: industrial production, household consumption, etc. This information, so-called "hard data", is released on a monthly or quarterly basis. The calculation of GDP also incorporates data from surveys, so-called "soft data", such as the business climate, planned investment or the level of household confidence. This data is often published monthly. These two categories are supplemented by data on financial markets. These latter variables are distinctive in being available on a continuous basis and being extremely volatile. Consequently they are often ignored by prediction models, although they have a genuine impact on the real economy.

Handling multiple frequencies

Predicting changes in economic conditions thus raises many issues. How does one introduce data of various types and frequency into a single model? How does one select the most relevant data from the mass of information available? Within the data selected, how does one take account of their different value in terms of prediction? For not all the data selected has the same impact on growth. It is necessary to weight the data in accordance with its varying predictive power.

It is always difficult to foresee a crisis

In his work, Clement Marsilli has thus endeavoured to define a method capable of selecting the relevant variables for economic forecasting, in the context of multi-frequency data. To do so, he uses a MIDAS model. The distinctive feature of this model is that it can optimally and parsimoniously weight high

Clément Marsilli

Clément Marsilli is a research economist in the international macroeconomics department at the Banque de France, where he is responsible for developing forecasting tools and conjunctural monitoring of advanced economies. He also teaches at Sciences Po. He obtained his PhD in Applied Mathematics from Université de Franche-Comté in 2014, in which his research focused on mixed frequency models for economic forecasting. His main research fields are macroeconomic modelling and time series econometrics.

Méthodologie

MIDAS (Mixed Data Sampling) multi-frequency technology, on which the work of Clement Marsilli is based, was developed by Ghysels and co-authors over the last decade in response to the temporal aggregation constraints inherent in economic and financial modelling. MIDAS may be seen as a functional extension of Almon distributed lag models. The models developed by Clement Marsilli incorporate into the same equation the MIDAS regression, which allows predictive analysis, and the selection of explanatory variables (using the Lasso or the Bayesian Spike and Slab process). A cross-validation method of performance over a recent period allows the best indicators to be automatically selected. These models thus constitute effective operational forecasting tools.

frequency data with a view to aggregating it. Calculation is thus simplified and the results are improved because the informational weight of each set of data is better taken into account. The MIDAS model is then combined with other techniques in order to improve the selection of variables and hence the quality of economic predictions.

Improving data selection

Two methodologies have been developed: the Lasso augmented MIDAS model and the Bayesian MIDAS model. The first introduces Lasso penalization into a mixed frequency model. This technique has the advantage of introducing sparsity, i.e. it has strong variable selection power. The second method uses the Bayesian technique with a MIDAS model. The introduction of parameter distributions helps establish the probability of a variable being relevant for the prediction.

These two methods were then applied to US data for the period 2000-2012, in order to test their predictions. The results were then compared with those obtained by two "traditional" methods.

Financial volatility: a key variable

The Lasso and Bayesian MIDAS models prove to be very effective for forecasting in the current period (nowcasting), and also for intra-quarterly calculations, for example. In general, they get good results for forecasts up to six months. As well as the quality of their forecasts, the advantage of these methods is that they empirically measure the contribution of each factor in terms of growth. The study shows that financial volatility has a strong influence on the macro-economic conjuncture. This variable is always deemed relevant by the MIDAS models and seems particularly important during periods of uncertainty. The same applies for industrial production and consumption.

On the other hand, whatever the methodology used, the models always have difficulty capturing rare events, whether they be stages of rapid expansion (high points) or of recession (low points). Thus, during the bursting of the Internet bubble in 2000 and the 2008 crisis, the forecasts made by the models tested were far higher than reality. Anticipating these "non-standard" periods remains a challenge, but apart from these peaks, the margin of error of forecasts is quite small.
Although the calculation of macroeconomic indicators is the main purpose of the Lasso and Bayesian MIDAS models, they could also be used for financial applications. By estimating the market closing price from intra-day data, or by defining an optimal portfolio through anticipated changes in asset prices, they could be valuable tools for investors.

Find the
Clément Marsilli's interview
on www.louisbachelier.org

Are stock returns predictable?

The analysis of certain variables can, to some extent, anticipate changes in asset prices. But this theoretical principle is sometimes difficult to apply due to insufficient data. Given this situation, Julien Pénasse proposes that local and foreign information be shared in order to improve the predictability of returns.

Key points

- Investor behaviour, like premium risk formation processes, are relatively similar from one country to another.
- The same economic mechanism underlies the predictability of different markets.
- Consequently, international data can provide information on the evolution of assets in domestic markets.
- Including this data improves the predictability of stock returns and reduces long-term risk.

Based on an interview with Julien Pénasse and on his paper "Return Predictability: Learning from the Cross-Section".

Understanding the causes of changes in asset prices and anticipating these fluctuations is one of the most topical research issues in financial economics. Several studies have shown that a number of economic variables have predictive power with regard to asset returns: analysis of their changes can allow future returns to be anticipated. For equities, this is particularly the case for the dividend-price ratio. "The price of a stock fluctuates more than the amount of expected dividends," Julien Pénasse emphasizes. "This means that the discount rate varies with time. Shares are long-duration assets. Even a small change in the discount rate thus has significant effects. This discount rate reflects expectations and especially the risk premiums demanded by investors. It is these risk premiums that are predictable, not the returns themselves."

Yet predicting stock returns through changes in different variables is still a challenge. Although the predictive nature of the dividend-price ratio of shares is acknowledged, it remains difficult to detect in practice. The reason is that since an insufficient amount of data is available, most analysis is carried out on a country by country basis.

The data is available but not used in a relevant way

A single mechanism for all countries

How then can the field of the data be expanded? How can the intelligibility of the dividend-price ratio be facilitated and be made more visible? Is it thus possible to improve the predictability of stock returns? These are the issues addressed in the work of Julien Pénasse. He provides a methodology that analyses the predictability of returns, through cross-sectional information. Instead of considering each country in isolation, he integrates them into a single model, denoted as the exchangeable model. "The data is available, but not used in a relevant way," Julien Pénasse says. "We see similar situations in most countries. If the same economic mechanism accounts for the predictability of different

Julien Pénasse

A former student at the Ecole Normale Supérieure de Cachan and graduate of ESSEC, Julien Pénasse is a postdoctoral researcher at the Ecole Polytechnique. He defended his thesis in economics and finance at ESSEC and the University of Tilburg. He also collaborates in the "Allocation of Long-term Assets" research initiative (Collège de France/CNP/Caisse des Dépôts). Prior to his thesis, he spent nearly six years in a trading room, as a financial analyst then a trader at Natixis. His thesis is concerned with bubbles and speculative behaviour, especially in the art market, and Bayesian econometrics applied to finance.

Méthodologie

The series of returns and predictors constitute a panel of fifteen countries covering forty years on average. With panel data, econometricians generally estimate a model for each country separately. They may also process the data as a panel, i.e. assume that the same process generates each country's data. The main innovation involves using a random coefficient model, which means that the coefficients of the different countries share the same distribution. To estimate the parameters of the France "model", one can fruitfully make use of the distribution of the parameters in all the other countries. The two preceding approaches correspond to particular cases, in which the variance of the parameters is either so large that one can analyse the countries separately, or so low that one can view them as a single process.

markets, then information about market X also tells us about changes in market Y."

In terms of mathematics, it involves applying the regression of stock returns on the dividend-price variable to several countries so as to share information. Julien Pénasse assumes that the processes of different countries are random variables that have the same distribution in common.

The model is applied to the equity markets of fifteen OECD countries. Over the period 1990-2010, these forecasts are compared out-of-sample with the realized returns, to determine whether an investor could exploit predictability in real time.

Relatively homogenous markets

Although the gains are relatively modest, in line with the previous literature, it appears that the methodology developed has a positive impact on the estimation of yields. Forecasts based on the exchangeable model are more accurate than those of traditional approaches, which ignore cross-sectional information.

The study also analyses investors' behaviour, illustrated by changes in the risk premium, to determine whether it varies greatly from country to country, or conversely, whether the markets are relatively homogeneous. Earlier papers indicated significant heterogeneity between countries. But in Julien Pénasse's view these differences are mainly due to chance. Indeed the findings of his study point to a relative homogeneity between countries. The process of investors' expectations and, therefore, the risk premium formation process are fairly similar from one market to another. Predictability is thus rather low in the countries studied, and risk premiums lie between 1% and 5%.

Except for the United States

The only exceptions are the United States and, to a lesser extent, the UK. These two countries are distinguished by a risk premium and a predictability that are well above average. In the US, for example, the risk premium is nearly 8% – a figure that reflects the outperformance of the US equity market, as well as the greater volatility of risk premiums. American investors therefore have an incentive to invest more heavily in stocks, but also to carry out arbitrage operations in the market more aggressively.

Finally, the fact of incorporating international data in the calculation of expected returns modifies investors' allocation strategies. Since the expected returns tend to be similar from one country to another, the level of allocation to shares is also comparable.

Analysing each market separately means that much relevant information is ignored. Indeed equity markets have relatively similar premium risk formation processes. It is in the interest of investors, therefore, to include all available information in their analysis of expected returns on assets. Estimates are thereby improved and shares consequently become relatively less risky.

Find the
Julien Pénasse's interview
on www.louisbachelier.org

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Opinions & Débats N°10

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