

# Digital Economy Outlook

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01  
The UK's FCA:  
An active role in  
promoting  
innovation

02  
Is the digital  
transformation  
the quintessence  
of financial  
inclusion?

03  
PSD2, a  
business model  
perspective

04  
Big Data to track  
geopolitical and  
social events

05  
Artificial  
Intelligence  
perspectives:  
How internet  
giants leverage  
AI

## Index

Summary	3
1 The UK's FCA: an active role in promoting innovation	4
2 Is the digital transformation the quintessence for financial inclusion?	6
3 PSD2, a Business Model Perspective: Financial APIs will foster business model innovations	8
4 Big Data to track geopolitical and social events	10
5 Artificial Intelligence perspectives: How internet giants leverage AI	13

## Summary

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### The UK's FCA: an active role in promoting innovation

**Providing support to FinTech businesses.** The Financial Conduct Authority (FCA) is promoting innovation and competition in the financial services market through several initiatives. They already provide direct support to innovator businesses to navigate the regulatory framework. Moreover, they are going to introduce 'regulatory sandboxes' where firms can experiment before entering the market.

### Is the digital transformation the quintessence for financial inclusion?

**The multiplier effect of the digital transformation on financial inclusion.** The digital transformation cuts across the fundamental factors behind a financial inclusion process. Its increasing importance provides a clear multiplier effect that has a positive impact on both the demand and the supply sides, helping countries to overcome their structural barriers.

### PSD2, a Business Model Perspective

**Financial APIs will foster business model innovations** PSD2 introduces major changes in the European payment landscape. From a business model perspective, financial services firms can become TPPs (Third-Party Providers: PISPs and AISPs) and bundle APIs to capture value by focusing on making payment systems "bigger & better"; or become ASPSPs and unbundle APIs to capture value by finding or creating "new" sources of revenue.

### Big Data to track geopolitical and social events

**Geostrategic analysis plays a crucial role in understanding our increasingly interconnected world, and it is becoming an additional and key element in the policy-making agenda.** We have developed a set of new tools to track and quantify the key geopolitical trends and their interconnections in the global economy. Using an innovative Big Data set on social, political and geopolitical events (GDELTA), we have designed several reports to track the current world geopolitical situation and to better understand the behaviour and driving forces of global-scale social systems.

### Artificial Intelligence perspectives: How internet giants leverage AI

**Artificial intelligence is one of the most promising exponential technologies**, and the area which is currently being hyped is "Deep Learning" technology, improved algorithms based on distributed neural networks that mimic the human brain, not following patterns but actually learning from data. There have been huge investments in this field, and potential applications awaken new expectations.

# 1 The UK's FCA: an active role in promoting innovation

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## Providing support to FinTech businesses

**The Financial Conduct Authority (FCA) is promoting innovation and competition in the financial services market through several initiatives. They already provide direct support to innovator businesses to navigate the regulatory framework. Moreover, they are going to introduce 'regulatory sandboxes' where firms can experiment before entering the market.**

### The Innovation Hub

London is becoming the centre of FinTech in Europe. Currently, the UK's FinTech sector is estimated to generate £20bn in annual revenue and it is expected to keep growing in the following years<sup>1</sup>. The British Government is acting as a catalyst by connecting regulators, businesses and academia in order to evolve this ecosystem<sup>2</sup>.

As part of this catalyst role, the Financial Conduct Authority (FCA) launched the Innovation Hub in October 2014 within 'Project Innovate', which aims to encourage innovation in the interests of consumers and to promote competition through disruptive innovation.

The Innovation Hub provides direct support to innovator businesses that are looking to introduce ground-breaking or significantly different financial products or services to the market. This support includes: help to understand the regulatory framework, assistance in preparing and making an application for authorisation and providing dedicated contact and supervisory support for up to a year after authorisation. Moreover, firms attempting innovative approaches to disseminate product information or deliver information to their customers may apply for "disclosure testing" support from the FCA. This support may include waiving or modifying the rules preventing testing or the way they are applied.

Through the Innovation Hub, the UK's financial regulator engages with those innovator businesses to better understand their needs and the possible benefits and risks of their products and services. This engagement allows the FCA to identify areas where the regulatory framework needs to adapt and structural barriers that should be removed to enable further innovation in the interest of consumers. As part of this work, the FCA has collaborated with the government on its plans to introduce regulation for digital currencies, and issued a statement on disproportionate de-risking that denies access of businesses to banking services.

### Regulatory sandboxes

Within 'Project Innovate', the FCA is also launching regulatory 'sandboxes' – safe spaces in which businesses, both authorised and unauthorised, can experiment with innovative services, business models and delivery mechanisms without immediately incurring all the normal regulatory consequences of engaging in such activity. By spring 2016, the sandbox unit will be open to start testing proposals.

The objective of these sandboxes is to deliver more effective competition in the interest of consumers by reducing the time and, potentially, the costs of getting innovations to the market, enabling access to finance and enabling more products to be tested while ensuring appropriate customer protection safeguards.

The system will work as follows: a sandbox unit will be created to consider the applications, monitor the testing process and establish the eligibility criteria. The criteria for using a sandbox will consider the scope -

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1: *Landscaping UK Fintech. Commissioned by UK Trade and Investment. (2014). London: Ernst & Young. Retrieved 1 December 2015 from <[http://www.ey.com/Publication/vwLUAssets/Landscaping\\_UK\\_Fintech/\\$FILE/EY-Landscaping-UK-Fintech.pdf](http://www.ey.com/Publication/vwLUAssets/Landscaping_UK_Fintech/$FILE/EY-Landscaping-UK-Fintech.pdf)>*

2: Chief Scientific Adviser, UK Government, (2015). *FinTech Futures: The UK as a World Leader in Financial Technologies*. London : Government Office for Science. Retrieved 1 Dec. 2015 from <[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/413095/gs-15-3-fintech-futures.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/413095/gs-15-3-fintech-futures.pdf)>

within financial services - of whether it is a genuine innovation, the consumer benefit, whether there is a legitimate need for a sandbox and the background research of the project. The FCA is aware that to achieve its objectives it must be flexible and study each case independently, as not all applications will face the same challenges. The process will start with a proposal sent by the firm and assessed by the FCA. If the proposal is considered to be eligible, the FCA and the firm will start collaborating, establishing the best sandbox option and, with the FCA's approval, entering the test and monitoring process. After receiving the final FCA report, the firm will decide whether or not to continue the new solution outside the sandbox.

The aim of the regulatory sandboxes is to test the innovations within a secure and controlled environment to verify their feasibility before entering the market. The FCA will work either with the industry to develop an industry-led virtual sandbox without entering the real market or with private-sector stakeholders setting up a not-for-profit umbrella company that allows unauthorised innovators to offer their services.

However, some regulatory challenges must be addressed to implement the regulatory sandboxes. In particular, identification of the barriers that can be lowered, the safeguards required to protect consumers and the financial system, and how to comply with existing regulation, taking into account that the FCA cannot modify the EU's legal framework.

In this regard, the FCA has stated that the government may consider appropriate changes to legislation, if required. Currently, two regulatory changes have been deemed feasible. First, an amendment to the 'Regulated Activity Order' to introduce a new regulated activity for sandbox testing, with a more flexible approach in areas where EU legislation does not apply or where the UK can implement additional rules. Second, changing the Financial Services and Markets Act 2000 (FSMA) conditions to implement an easier process for waiving rules for a firm within the sandbox.

### Next steps

The FCA is in initial discussions to identify potential ways to support the adoption of "RegTech": new technologies that facilitate the compliance of regulatory requirements in a more efficient way. It is soon to release a report with the results of its initial discussions.

The financial regulator will also build a programme of proactive engagement with large incumbents — which have had little engagement with the Innovation Hub so far — to make sure that their potential for consumer-friendly innovation is not being held back by regulatory considerations.

Moreover, the financial regulator aims to extend the remit of the Innovation Hub to the promotion of pro-innovation regulatory solutions to international standard-setters. The Innovation Hub will help UK-based firms to contact the right regulators when doing business abroad, and will seek memorandums of understanding with key regulators on this matter.

## 2 Is the digital transformation the quintessence for financial inclusion?

### The multiplier effect of the digital transformation on financial inclusion

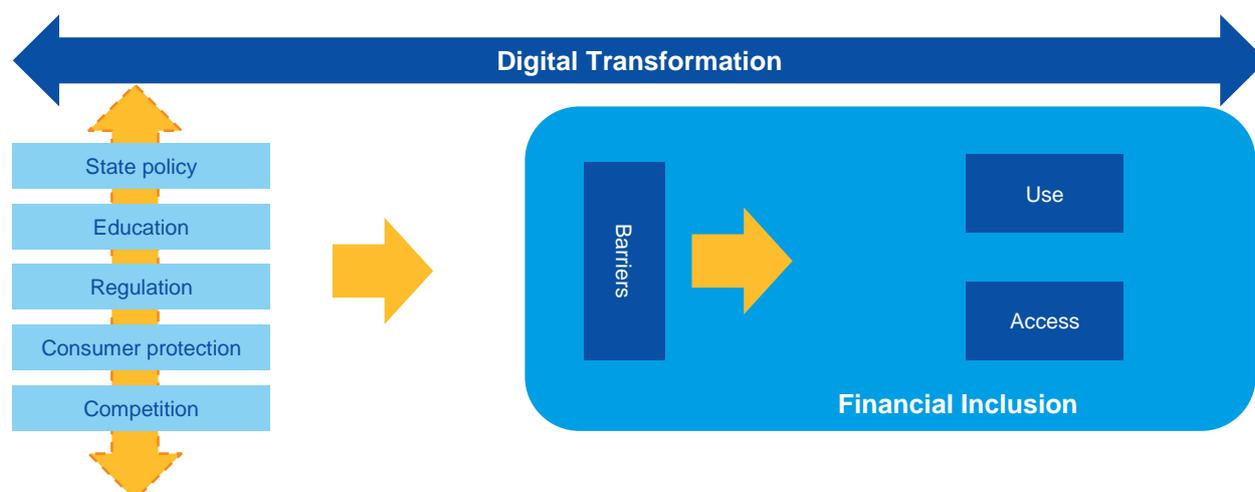
The digital transformation cuts across the fundamental factors behind a financial inclusion process. Its increasing importance provides a clear multiplier effect that has a positive impact on both the demand and the supply sides, helping countries to overcome their structural barriers.

#### Financial inclusion and the digital role

Financial inclusion is defined as the process to adapt the financial system for those groups of the population which, although willing to interact with financial institutions, are experiencing difficulties in accessing the system and using its financial products. In order to achieve there are structural barriers to overcome, such as income limitations, trust, cost of the service, geographical variables, documentary requirement and idiosyncratic issues, among others.

More access, more use and fewer barriers to the financial system synthesise the key variables to focus on the financial inclusion path. Behind this process, there are different enabling factors for increasing economic agents' participation in the financial system. (1) The role of the state is cornerstone in order to gather the main stakeholders in the financial ecosystem as well as to commit to the goal to remove the main barriers for banking penetration, especially those produced by its action. (2) Financial literacy is also an important factor, because it empowers people's capacity to better understand financial terminology and to take better decisions. Likewise, (3) generating a more competitive framework secured by (4) an efficient consumer financial protection net is also desirable. (5) Financial regulation is also relevant because it establishes the limits of what is and is not possible from a prudential perspective. Finally, supporting all these elements, (6) the digital vector cuts across all the financial inclusion process, bringing a potentially enormous multiplier effect (see Figure 2.1).

Figure 2.1  
The financial inclusion process and the role of the digital transformation



Source: BBVA Research

### The potential multiplier effect of the digital transformation for financial inclusion

The digital transformation has many ways to make a positive impact on financial inclusion strategies. On the one hand, technological diffusion affects the demand side of the market, providing more possibilities to access financial services by, for example, using people's mobile devices; this fits perfectly with the high level penetration of cell phones in emerging economies. In this case, digital transformation has the potential to help to overcome structural barriers to financial inclusion, such as geographical distance, bureaucratic processes, documentary requirements and providing time-efficient processes.

On the other hand, this digital vector could also affect the supply side of the market. The digital economy provides for the first time the opportunity to interact efficiently with low-income groups of the population, thanks to the potential economies of scale that technological advances provide nowadays. Digital transformation brings a low-cost framework for financial institutions, facilitating the evaluation process for opening a new client account or processing a loan, reducing an important barrier for traditional banks to offer low income financial services, as well as attracting non-financial institutions that provide some financial services, generating more competition and more value for the economy.

### Is the digital vector the quintessence for financial inclusion?

It is clear that digital advances have enormous potential to make a positive impact on financial inclusion policies around the world. The multiplier effects that the digital vector could provide to increase financial depth by using different supply and demand channels are evident and, in fact, they are currently happening in some geographical areas. How rapid could this be? How could the digital transformation become the quintessence for financial inclusion?

Although the digital transformation for financial inclusion is a process that could help to overcome supply and demand side barriers, it interacts with other variables that are important for the final impact of this new revolution. First, technology brings efficiency, but simultaneously produces new challenges to take into account. For instance, new technological financial products could generate the problem of lack of trust for those not familiar with the use of new technologies, or even more, raising more suspicions among those sensitive to privacy concerns. It is therefore clear that issues related to digital-financial literacy and regulation need to be analysed.

Finally, digital regulation for financial inclusion is the cornerstone in this interaction. The multiplier effects of the digital transformation will depend largely upon the regulatory room provided by financial authorities, which also depend on their digital knowledge and how comfortable they feel with these technological changes. In this regard, we have to keep in mind that the degree of digital resilience of the regulatory framework will also determine the degree of elasticity of financial inclusion to digital changes; that is to say, if the digital economy really has the potential to become the quintessence for financial inclusion.

## 3 PSD2, a Business Model Perspective: Financial APIs will foster business model innovations

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### The Takeaway

**PSD2 introduces major changes in the European payment landscape. From a business model perspective, financial services firms can become TPPs (Third-Party Providers: PISPs and AISPs) and bundle APIs to capture value by focusing on making payment systems “bigger & better”; or become ASPSPs and unbundle APIs to capture value by finding or creating “new” sources of revenue.**

### Recent Developments

On 16 November 2015, the Council of the European Union adopted the revised Payment Services Directive (PSD2). According to the European Commission, “the new rules will protect consumers better when they make payments, promote the development and use of innovative online and mobile payments and make European payment services safer”. Member states now have two years to introduce the necessary changes into their national laws in order to comply with the new rules.

### Key Concepts of PSD2

The revised payment scheme prescribes the disappearance of some traditional players; while the revised information scheme postulates the emergence of new players: TPPs (Third Party Providers). Also, in both the payment and information schemes in the post-PSD2 world, all interactions (Access to Accounts – XS2A) will go through APIs (Application Programming Interfaces); which, put simply, are rules that govern how applications “talk” to each another. Not only will APIs allow standardised interactions amongst the various players in the payments ecosystem, but they will also enable and empower business model innovations.

**The disappearance of some traditional players.** Given the changes laid out in PSD2, some traditional players such as the merchant acquirers (e.g. WorldPay) and card schemes (e.g. MasterCard) will be challenged. For consumers, the payment experience will stay much the same in both the pre-PSD2 and post-PSD2 world: go to anydigitalstore.com, shop, and pay. For firms who initiate the payment (aka “PISPs” – Payment Initiation Service Providers), the back-end relationship changes: instead of interacting with merchant acquirers, the PISPs will interact directly with banks that manage the customers’ accounts (aka “ASPSPs” – Account Servicing Payment Service Providers).

**The emergence of new players: the TPPs.** We have already discussed one of the two Third Party Providers (TPPs) described in PSD2 above; namely the PISPs (merchants). Then there are the AISPs (Account Information Service Providers), which aggregate information from multiple ASPSPs; effectively “rolling up” multiple relationships into a single touchpoint for the customer. A couple of proxy examples of this concept can be found today in services like Mint (US and Canada) and Fintonic (Spain). AISPs will access information from different ASPSPs via open APIs at the request of customers. This “access” is referred to as “XS2A” in PSD2, which we will discuss next.

**XS2A will go through APIs.** On a customer’s request, ASPSPs must provide Access to Accounts (XS2A) to PISPs and AISPs via APIs under Regulatory Technical Standards (RTS) as defined by the European Banking Authority (EBA). Let’s parse some of this alphabet soup for the sake of clarity. In the payments scheme, customers give PISPs (the merchants or retailers) permission to execute payments without having to divulge the ASPSP (the bank) login details; using tokens. In the information scheme, customers give AISPs (the information aggregators) permission to pull information from multiple ASPSPs (the banks).

## Business Model Impact

According to Raymond Kurzweil, a well-known technology futurist, "once any domain, discipline, technology or industry becomes information-enabled and powered by information flows, its price/performance begins doubling approximately annually" and does not stop as technology further advances technological development. The result is exponential growth, which begins slowly, then accelerates. Seen from this perspective, PSD2 will not only regulate payments (supporting linear change) but also will lead the payment industry into the future (supporting exponential change); thus ensuring the "dynamic" nature of payment systems in Europe.

**The customers.** Exponential technologies are directly responsible for the proliferation of smartphones (and internet devices). In Europe, there will be 815 million smartphone users with 90% broadband connections (3G+ speeds) by the year 2020; meaning that there will be literally hundreds of millions of customers for digital financial products, services and experiences in Europe. With the advent of PSD2, many players will aggressively pursue a relationship with banking customers by becoming AISPs, competing for a share of customers' wallets (economies of scope). Given the fact that payments are seen as a gateway product/service, the prevailing logic dictates that whoever offers the best customer experience (CX) in payments will own the customers for other products/services and create additional upselling or cross-selling opportunities. To do so, AISPs need to have intimate knowledge of customers (big data) and build experiences by bundling (using information from ASPSPs).

**The infrastructure.** When Amazon launched AWS in 2006, it changed the game by destroying the "economies of scale" advantage of large companies. Today, every start-up has the ability to reach two billion customers and access to digital infrastructure that can scale to serve those customers. In PSD2, start-ups and other entrants will take advantage of this scale and massive customer reach to build platforms; more specifically, to build Customer Experience (CX)-focused platforms (or "marketplaces") to lead the customer relationship as AISPs. The AISP that puts together the best payment experience (with APIs and in accordance with XS2A) will find business opportunities in the PSD2 world. As a result, they would be looking to ASPSPs to provide banking APIs. Given this focus, banks and other financial institutions (ASPSPs) are poised to offer banking APIs as a service to AISPs.

## Bottom line

PSD2 will drive changes in the European payment landscape and banks, and other financial services players will have to make the necessary adaptations. Broadly speaking, banks and other incumbents will either have to lead payments CX by bundling APIs or be part of other CX platforms by unbundling APIs, or even do both.

**Bank-led CX.** Digital platforms are built with "Big Data" and APIs (bundling or unbundling key APIs). Under PSD2, banks could become AISPs by curating the "right" payment APIs for customers. Since banks have a wide array of data available, especially "decision data," incumbents should be well-positioned to compete. As mentioned, as banks accumulate more information they have opportunities to become exponential organisations.

**Banks in every CX.** PSD2 also forces the unbundling of business models and "products". In the Directive, banks have to choose a focus: own/operate a payment platform (AISPs) or offer payment infrastructure as a service (ASPSPs). As ASPSPs, it may be interesting for them to atomise or unbundle banking functions/processes into APIs so that they may be consumed easily by AISPs. By making the most banking APIs available individually, banks (or their APIs) can, in theory, be part of every customer experience.

## 4 Big Data to track geopolitical and social events

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The increasing role of geopolitics and its interconnectedness across the globe have become key elements in the policy agenda in 2015

**Geostrategic analysis plays a crucial role in understanding our increasingly interconnected world, and it is becoming an additional and key element in the policy-making agenda.** The world is changing and the balance of power with it. The global economy's centre of gravity is moving to the Asia-Pacific region (it will concentrate around 75% of the increase in GDP in the next ten years). The traditional post-Cold-War unipolar US dominance is being increasingly tested and multipolarity and multilateralism are both increasing their weights. New actors will arise and will start to make new demands. Moreover, social, political and economic systems are becoming increasingly interconnected with the new technologies facilitating the spread of social dynamics. Technological progress has led to a seismic change in our societies and economies where the number, size and types of social networks are growing and will continue to do so, triggering the ways and the speed in which risks propagate, transcending borders and sectors.

For all these reasons, **we have developed a set of new tools to track and quantify the key geopolitical trends and their interconnections in the global economy.** Using an innovative Big Data set on social, political and geopolitical events (GDELT), we have designed several reports to track the current world geopolitical situation and to better understand the behaviour and driving forces of global-scale social systems.

### Quantifying social trends using Big Data...

The Global Database of Events, Language and Tone (**GDELT**) **Project is a real-time global open database<sup>3</sup> of human society according to the world's news media, reaching deep into local events, reactions and emotions of every part of the world in near-real time.** All this information is freely available to research, analyse, visualise and even forecast human society according to global news coverage. It also includes a comprehensive and high-resolution catalogue of geo-referenced socio-political events from 1979 to the present. The GDELT Project monitors every accessible print, broadcast, and online news report around the globe every 15 minutes in over 100 languages. Information is processed using a vast pipeline of algorithms to identify hundreds of categories of events (from protests to appeals for peace), thousands of emotions (from anxiety to happiness), millions of narrative themes (from women's rights to clean water access), as well as locations, people, organisations and other indicators.

To work with this huge database and extract the particular information we are looking for, we use **Google BigQuery, a cloud-based analytics database** build on GDELT (among other databases), which uses Google's infrastructure **to enable interactive SQL queries against multi-petabyte datasets** and archives with tens of trillions of rows.

**The exploitation of data from GDELT through Google BigQuery has allowed us to release several reports by means of Big Data Analysis<sup>4</sup>** (Geo World Report with monthly geo updates, Geo Mena Report and global hot topics), which illustrate our geo-strategic analysis in a visual and comprehensive way in an attempt to understand the social, political and geostrategic trends in parallel with the dynamics of the global economy. Below we show some examples.

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3: Further information can be found on the webpage <http://www.gdelproject.org/> and in the paper Leetaru, K. and Schrodt, P., 2013. Global Database of Events, Language, and Tone (GDELT).

4: See our geostrategic analysis in the following link: <https://www.bbvaesearch.com/en/category/themes/geostrategy/>.

### ...enriches our geostrategic analysis with sophisticated tools

**The geopolitical panorama in 2105 is dominating the world agenda and posing tough challenges for the entire world.** The Syrian civil war, the expansion of ISIS in the Middle East and North Africa (as well as its recent attacks in Paris), the proxy war in Yemen, the instability in Afghanistan, the power vacuum in some African countries, the Ukraine-Russia conflict and, to a lesser extent, the territorial maritime disputes in the South China Sea are threatening the world's stability and security with important spill-overs to the remaining countries. One significant and direct consequence in Europe of the Syrian war is the refugee crisis that we are facing nowadays, which became an internal political crisis threatening European unity, its identity and the Schengen Agreement. All these events are illustrated in Figure 1, where we show our **geo-referenced conflict intensity index** for the Middle East, Eastern Europe and North Africa<sup>5</sup>. This index captures all observations in the media related with conflict events<sup>6</sup>, such as armed attacks, destruction of property, assassinations, insurgencies, civil war, armed clashes, etc. The index is calculated as the ratio of observations related to conflicts per day in each country, divided by the total number of all events recorded in GDELT during the same period and in the same location. These ratios are interpreted as real-time intensity or diffusion indices, showing the behaviour of this instability variable over time, and making them comparable among countries. In order to correct for the exponential rise in media coverage over time and the imperfect nature of computer processing of the news, we normalise events to a reference point in time. Figure 2 represents a map illustrating **the current European refugee crisis, tracing the geo-referenced inflows and outflows of refugees across Europe, the Middle East and North Africa in 2015**<sup>7</sup> and offering critical insights into the scale and geographical distribution of this humanitarian crisis and its potential to trigger instability and unrest in some areas such as the Balkans and Eastern Europe.

Figure 1

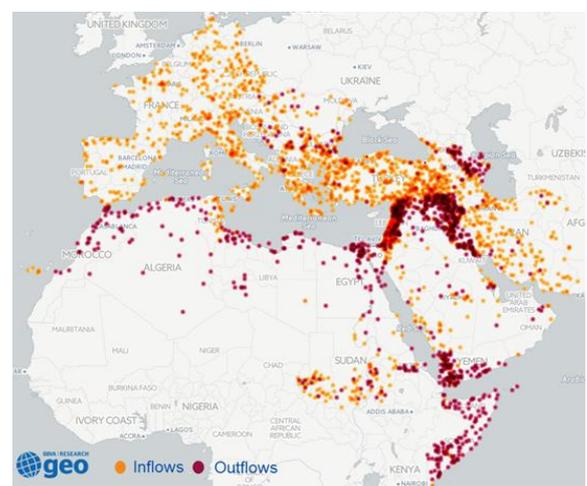
#### BBVA Conflict Heat-map (Jan to Nov 15) (Number of conflicts/total events)



Source: BBVA Research and [www.gdelt.org](http://www.gdelt.org)

Figure 2

#### BBVA Refugee Flows Map (Jan to Nov 15) (Media coverage of refugees' inflows and outflows)



Source: BBVA Research and [www.gdelt.org](http://www.gdelt.org)

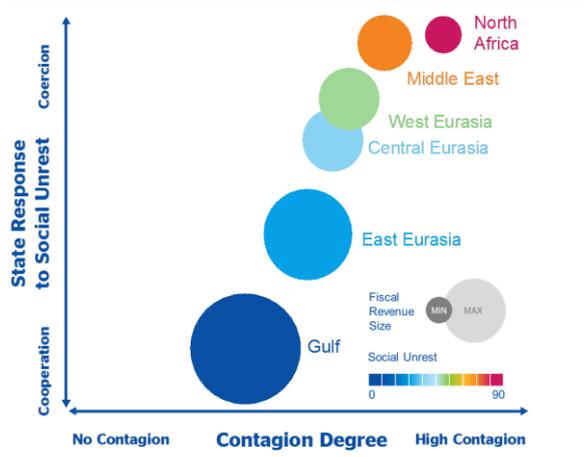
5: See the evolution of conflict in a dynamic way in the following link: <https://www.bbva.com/en/publicaciones/geo-world-conflict-social-unrest-october-update/>.

6: Conflicts events match with categories 18 to 20 according to the Conflict and Mediation Event Observations (CAMEO) taxonomy. Further information at: <http://data.gdeltproject.org/documentation/CAMEO.Manual.1.1b3.pdf>.

7: This analysis has been cited in top referenced blogs such as Forbes (see it at <http://www.forbes.com/sites/kalevleetaru/2015/10/05/mapping-the-global-flow-of-refugees-through-news-coverage/>) and O'Reilly ([https://www.oreilly.com/ideas/analyzing-the-worlds\\_news\\_exploring\\_the\\_gdelt\\_project\\_through\\_google\\_bigquery](https://www.oreilly.com/ideas/analyzing-the-worlds_news_exploring_the_gdelt_project_through_google_bigquery)).

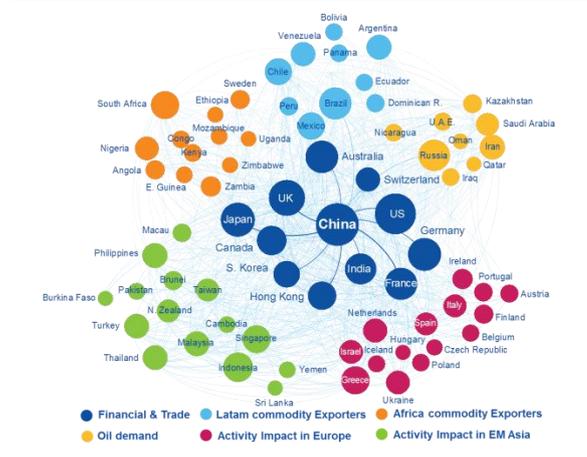
Figure 3 shows a **deeper analysis, modelling social unrest dynamics**. We use Big Data to do an **empirical assessment of social unrest dynamics in the Eurasian countries**<sup>8</sup>, building up several real-time indices of social unrest escalation by social agents, divided into several stages consistent with the Unrest Lifecycle Theory (vindication, protest and conflict) and alternative measures of state response (repression and cooperation). Our results show that Eurasia is a fairly volatile region in which shock generation and inertia are related. Social reactivity is also relevant, but it is stronger at the initial stages of unrest while it decays as the intensity of shocks increases. Repressive state response is a fact but it also decays in intensity as the conflict escalates along the unrest cycle, falling even into an accommodative mode due to the state’s limited enforcing ability. We compare the results with the MENA region. It suggests that Eurasia carries similar though milder dynamics in all terms: volatility and reactivity of social unrest, state response and enforcing inability and contagion.

Figure 3  
**Modelling social unrest dynamics: fiscal revenues, state response and social unrest**



Source: BBVA Research and [www.gdelt.org](http://www.gdelt.org)

Figure 4  
**China slowdown: concerns and contagion (Media coverage of China slowdown network)**



Source: BBVA Research and [www.gdelt.org](http://www.gdelt.org)

Figure 4 shows a **network diagram of how countries are mentioned in context with one another in coverage of China’s economic slowdown**. This visualisation was done by extracting all the mentions of each country in the context of the Chinese slowdown and it was then plotted by using modularity, PageRank and Force Atlas 2 layout algorithms. Each country is displayed as a node and the thickness of the line drawn between any pair of countries indicates the frequency with which those two countries are mentioned together in news coverage about this issue. Countries mentioned more frequently together are displayed closer to each other in the network. Moreover, the modularity technique finds the natural clusters within the network where countries that are mentioned more often with each other than with the others. This visualisation offers a proxy of how countries are contextualised with respect to China’s stagnation, their interconnectedness and how risks will promulgate.

Summing up, **the use of Big Data offers tremendous opportunities for research. We have exploited it to enrich our analysis and to incorporate in our models non-linear behaviour and feedback effects of human interaction** which have important links to the economy, and which enable us to improve our study and forecasts. Our sophisticated analysis of global media discussed above provides powerful insights about our hot topics analysis across the world, assessing their global impacts and enabling us to construct fragility indices and early warning systems.

8: This analysis has been cited in top referenced blogs such as Forbes (see it at <http://www.forbes.com/sites/kalevleetaru/2015/11/10/visualizing-russian-sanctions-and-chinas-economic-slowdown-through-massive-news-mining/>).

## 5 Artificial Intelligence perspectives: How internet giants leverage AI

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**Artificial Intelligence (AI) is one of the most promising exponential technologies. Among the different fields comprising AI, Deep Learning, which involves improved algorithms based on distributed neural networks that mimic the human brain, is arguably the most hyped. There have been huge investments in this area, and potential applications are raising new expectations.**

### Going 'smart'

Artificial Intelligence (AI) can be defined as a part of computer science that aims at designing "intelligent" computer systems. These are systems with characteristics that are usually associated with intelligence in human behaviour, such as understanding language, learning, reaching its own conclusions etc. Sometimes the term is used broadly, as it also related to other disciplines, such as neuroscience or philosophy, which study human intelligence. Since we still lack a complete understanding of the neurological mechanism of intelligence, AI is a fast evolving technology.

In computer science, AI includes a wide set of disciplines (machine learning, deep learning, neural networks) and it has multiple applications (natural language processing, speech recognition, robotics). The term itself was coined in the 1950s - although the idea of machines acting like humans is much older - and since then it has gone through a period of hyped expectations and later disenchantment. It finally seems to have caught up with the hopes thanks to deep learning, the latest development in AI, one step beyond machine learning.

Machine learning was in vogue in the 1990s and 2000s, and focused on solving specific problems with easy to collect labelled data. Deep learning is more ambitious, as it aims to build 'smart' machines that operate like the human brain. This is achieved through the development of massive distributed neural networks (AI processing methods that allow self-learning from experience) that analyse huge amounts of data at high speed. Unlike machine learning, deep learning does not follow a logical set of instructions but makes decisions through pattern analysis.

One of the enabling factors behind the development of AI is the increased computational power related to the use of graphics processor units (GPUs). Besides, the availability of large datasets coming from social networks, mobile phones, and fast-growing sensors linked to the emergence of the Internet of Things (IoT) can feed the AI engines and allows them to operate at peak performance. Neural networks, the core technology behind deep learning, were designed 25 years ago, but computational power and available data were not sufficient to obtain results as powerful as the ones we are witnessing today.

One of the most remarkable advantages of deep learning is its flexibility. As deep learning algorithms learn, they can be "trained" for very different tasks, automating and enhancing complex descriptive and predictive analysis. In this sense, they are evolutionary algorithms. Therefore, the true revolution lies in the shift from a computing model based on commands to one in which machines are capable of observing and learning.

### Big bets on AI

AI is an area in which research and business applications are deeply related. Some of the biggest internet players already rely on these algorithms to offer their services and they are boosting AI research by hiring scientists, buying patents and investing in start-ups. We will now cite some examples confirming this trend.

**Google's** core business is intrinsically related to algorithms. Its search engine and advertising allocation rules can be enhanced with improved technology, such as **RankBrain** (the new algorithm that interprets Google's search and refines queries). Thus, it is not surprising that Google has invested heavily in AI. Just as Google

Maps would not have been conceived without powerful algorithms that combine different types of data, the autonomous car project would not be possible without AI.

Google is also attracting many academic researchers in the field. Jeff Dean, the designer of neural networks, was one of Google's earliest engineers. Geoffrey Hinton, from the University of Toronto and formerly working for Microsoft, is currently working for Google too. Andrew Ng, a researcher from Stanford University, was the founder of Google's deep learning project before joining Baidu.

The company based in Mountain View has acquired several start-ups related to algorithmics and robotics. In December 2013 it bought, along with other robotics start-ups, [Boston Dynamics](#) (one of the most advanced companies in this area) and in January 2014 the UK deep learning firm [Deep Mind](#) (for USD650mn), which has demonstrated computer systems capable of playing computer games.

Google's latest move in this field has been opening its software library [TensorFlow](#) (the software at the heart of its operations) to attract talent to work with it, as it did previously with Android. Another new development is that Google has started discussions with [BlackRock](#) for a joint venture to explore AI's uses in improving investment decisions.

[Apple's](#) virtual assistant Siri is also based on machine learning software. In October 2015, Apple acquired two AI related start-ups, [VocallQ](#), focused on voice recognition, and [Perceptio](#), which specialises in image recognition.

In December 2013, [Facebook](#) set up a massive lab devoted to AI, operating in California, London and New York, led by NYU professor Yann LeCun, one of the top researchers in the deep learning area. Facebook has also open-sourced some of its projects around [Torch](#) (an open source machine learning software library).

Image recognition, photo tagging, a virtual assistant (called [M](#)) and article ranking in news feeds are some of the applications that Facebook is giving to AI.

[Amazon's](#) recommendation engine is one of the best known applications of machine learning, which has been working since the 1990s. Amazon offers Amazon Machine Learning Service as part of the company's suite of Amazon Web Services (AWS), for any business to use its technology, and it is designed for developers with no experience in machine learning.

[Baidu](#), the Chinese internet giant, has opened a research laboratory on deep learning in California, and has built a computer vision system using deep learning, that claims a 5.98% error rate (in experiments, humans achieved an estimated error rate of 5.1%)

[Microsoft](#) has bet on its Project ADAM (Active Directory Application Model) for image recognition. ADAM is testing a different computing approach, as it runs on standard central processor units (CPUs) instead of GPUs.

If we take a look at the [start-up ecosystem](#), during 2014 venture capitalists invested over USD300mn in AI<sup>9</sup>. The specialist research firm, [Venture Scanner](#), identifies 630 companies across 46 countries, with a total USD1.87bn in funding<sup>10</sup>.

In conclusion, all the big Internet players are making moves in the deep learning space, and we can also find an interesting landscape among start-ups. Deep learning has multiple uses; hence almost every data-intensive industry is potentially interested in its development. Of course, the financial services industry is part of this group, and some players are already developing customer-oriented applications to offer money management advice or virtual assistants, to mention some examples. Moreover, AI might be used in the near future to improve the efficiency of internal processes and increase security in banking.

9: "Artificial Intelligence", *Bloomberg QuickTake*, July 2015. Retrieved 20 November 2015 <<http://www.bloombergview.com/quicktake/artificial-intelligence>>

10: "Artificial Intelligence Sector Analysis (Landscape Overview)", *Venture Scanner*, January 2015. Retrieved 18 November 2015 <<http://insights.venturescanner.com/2015/01/12/artificial-intelligence-sector-analysis-part-i/>>

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