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Welfare implications of digital financial innovation

Based on remarks by Luiz Awazu Pereira da Silva, with Jon Frost and Leonardo Gambacorta.[1]

At the Santander International Banking Conference: "Banking on trust: building confidence in the future"

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Introduction

"Banking without trust" would be an oxymoron. Trust among people, businesses and institutions is fundamental for the functioning of societies in general and of the financial system in particular.[2] Trust takes a long time to earn, but can evaporate very quickly. Trust hinges on people's experiences, but also perceptions. Trust can be reinforced by institutional arrangements. But maintaining trust hinges, crucially, on a sense of "fairness"[3], ie whether our economies and financial systems deliver outcomes that are consistent and efficient and do not deviate too much from Pareto improvements.

Achieving this in practice is complicated, especially in a rapidly changing "new world" with significant digital innovation. For example, in the "old world", competition was a safe way to ensure equal opportunities for market participants: new entrants would offer new options, price down goods and services, and improve consumers' welfare. But would this logic apply when very large tech firms are capable of establishing dominant positions through technology? Therefore, it is important to understand the distributional impact of changes whether they are driven by technological advances, crises or policies. That allows us to envisage preventively remedial actions that can smooth transitions and avoid excessive social disruptions like the fallout we have seen from globalisation and the global financial crisis. In the context of digital innovation in financial services, welfare outcomes may again change in important ways, and this too will impact societal trust.

These remarks address the welfare implications of digital financial innovation. These welfare implications, including the distributional consequences of innovation, are not yet very well understood or researched. Nonetheless, we can draw on economic theory, economic history and a budding branch of economic research to find answers. These in turn can help us to build policy that delivers on welfare and thus helps to build trust in our financial system.

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[2] See L Guiso, P Sapienza and L Zingales, "The role of social capital in financial development", *American Economic Review*, vol 94, no 3, June 2004, pp 526–56; and L Guiso, P Sapienza and L Zingales, "Trusting the stock market", *The Journal of Finance*, vol 63, no 6, December 2018, pp 2557–600.

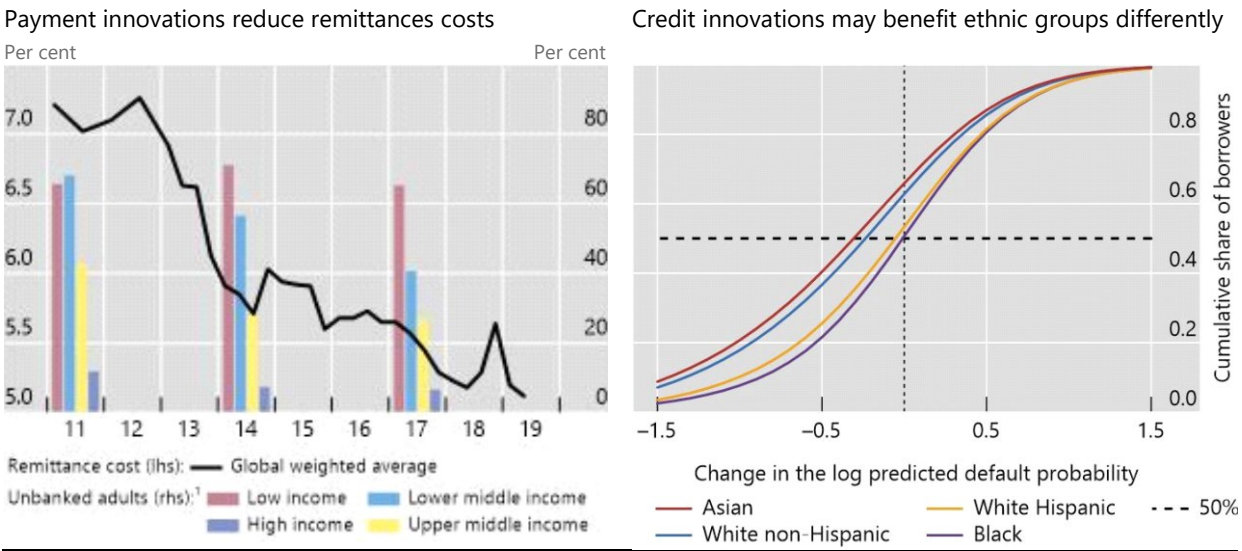
[3] Fairness "can motivate many economic decisions and affect confidence and our ability to work effectively together". See Chapter 2 in G Akerlof and R Shiller, "*Animal spirits*", Princeton: Princeton University Press, 2009.

We will talk in particular about implications of innovations in payments, credit markets, savings and insurance. We then discuss broader economic implications of digital innovation and conclude with some thoughts on what public authorities, the private sector and societies can do to respond.

Welfare implications of specific financial innovations

Let us be clear upfront: there is no doubt that innovation brings enormous potential for societal good and welfare. It suffices to mention the positive transformation that new technology in finance has brought to access to credit, rapidity and reliability in trade financing and insurance coverage. Indeed, technology represents a great opportunity for innovation and financial inclusion by providing access to financial services at a lower cost. Yet there are also other distributional effects. Even where there are Pareto improvements in outcomes, the relative differences between different groups may rise. Indeed, some observers argue that the use of new digital technologies in lending and insurance – but also areas like college admissions, advertising, and even prison sentencing – will increase inequality.[4] Let us illustrate this with examples from different areas in financial services.

Welfare implications of innovations: payments and credit markets — Graph 1



In the right-hand panel, the horizontal axis reports the change in the log predicted default probability as lenders move from traditional predictive technology (a "logit" classifier) to machine learning technology (a "random forest" classifier). The vertical axis reports the cumulative share of borrowers from each ethnic group that experience a given level of change.

[1] Adults without an account; for each income group, weighted average by population for a selected set of countries.

Sources: World Bank, Global Findex; World Bank, Remittance Prices Worldwide, remittanceprices.worldbank.org; Fuster et al (2018), see footnote 6 for full reference.

A first area is in payments (Graph 1, left-hand panel). Here, innovations are driving improvements in financial inclusion. This is likely to be Pareto-improving, and lower-income groups in particular may

[4] See C O'Neil, *Weapons of math destruction: how big data increases inequality and threatens democracy*, New York: Broadway Books, 2016.

benefit. Mobile money has already brought hundreds of millions of new customers into the financial system, especially in China, India and Africa. This has reduced the proportion of unbanked adults (left-hand panel). Technology is also helping to bring down the cost of cross-border payments over time, for instance in remittances (idem). In some cases, especially cross-border payments, this has been achieved by eroding the margins of incumbent financial institutions. Yet in other cases, this improvement is being achieved through greater efficiency. Digital identity (ID) and electronic know your customer (e-KYC) solutions may improve this further.

A second area is credit. Here, the evidence on welfare implications shows progress in financial inclusion, but also developments that need to be analysed further. In several countries, there is evidence that innovations such as fintech and big tech credit have served borrowers who are underserved by banks..[5] Yet as we know from the subprime crisis in the United States, and many further cases, getting access to credit is not always positive for borrowers in the longer term..[6] Moreover, even if the cost of credit declines overall, it may benefit some groups more than others. For instance, using data on US mortgages, one recent study finds that black and Hispanic borrowers are disproportionately less likely to gain from the introduction of machine learning in credit scoring models, suggesting that the algorithm may develop its own bias (Graph 1, right-hand panel, taken from that study)..[7] Borrowers to the left of the solid vertical line represent "winners" who are classed as less risky by the more sophisticated algorithm than by the traditional model. Reading off the cumulative share around this line, we see that about 65% of white non-Hispanic and Asian borrowers win, compared with about 50% of black and Hispanic borrowers.

For big techs in particular, the cost of enforcing loan repayments may decline given the threat of a downgrade or an exclusion from their ecosystem if in default. Empirical evidence from Argentina and China suggests that the combination of massive amounts of data and network effects may allow big techs to mitigate information and incentive problems traditionally addressed through the posting of collateral..[8] This could explain why, unlike banks', big techs' supply of corporate loans does not closely correlate with asset prices.

A third area is savings. A number of fintech firms say that innovations are "democratising" investment, and giving small consumer access to new savings products that they would not otherwise be able to use. Already, a growing literature finds that, to date, wealthier households earn higher returns on their wealth than less wealthy households, which results in greater accumulation over time..[9] Here we show preliminary evidence from Italy (Graph 2, left-hand panel). This divergence in the accumulation

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5 See J Jagtiani and C Lemieux, "Do fintech lenders penetrate areas that are underserved by banks?" *Journal of Economics and Business*, vol 100(C), 2018, pp 43–54; H Tang, "Peer-to-peer lenders versus banks: substitutes or complements?", *The Review of Financial Studies*, vol 32, issue 5,May 2019, pp 1900–38; H Hau, Y Huang, H Shan and Z Sheng, "Fintech credit, financial inclusion and entrepreneurial growth", unpublished working paper; and C De Roure, L Pelizzon and P Tasca, "How does P2P lending fit into the consumer credit market?", Deutsche Bundesbank, *Discussion Papers*, no 30, 2016.

6 See R Sahay, M Čihák, P N'Diaye, A Barajas, S Mitra, A Kyobe, Y Mooi and S Yousefi, "Financial inclusion: can it meet multiple macroeconomic goals?", *IMF Staff Discussion Notes*, no 15/17, September 2015.

7 A Fuster, P Goldsmith-Pinkham, T Ramadorai and A Walther, "Predictably unequal? The effect of machine learning on credit markets", 2018, mimeo.

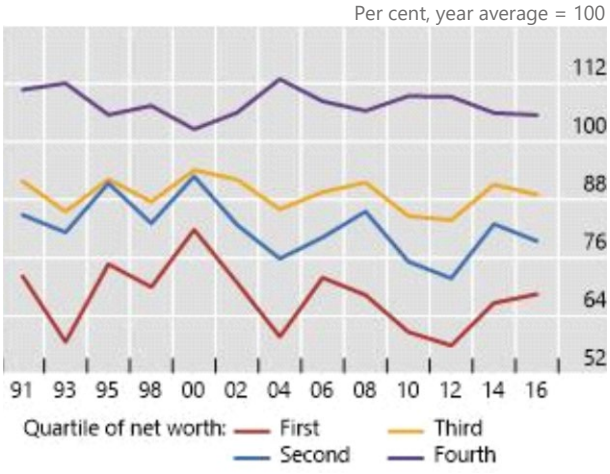
8 See J Frost, L Gambacorta, Y Huang, H S Shin and P Zbinden, "Big tech and the changing structure of financial intermediation", *Economic Policy*, forthcoming.

9 See eg J Campbell, T Ramadorai and B Ranish, "Do the rich get richer in the stock market? Evidence from India", *NBER Working Papers*, no 24898, August 2018; and A Fagereng, L Guiso, D Malacrino and L Pistaferri, "Heterogeneity and persistence in returns to wealth", *IMF Working Papers*, no WP/18/171, July 2018.

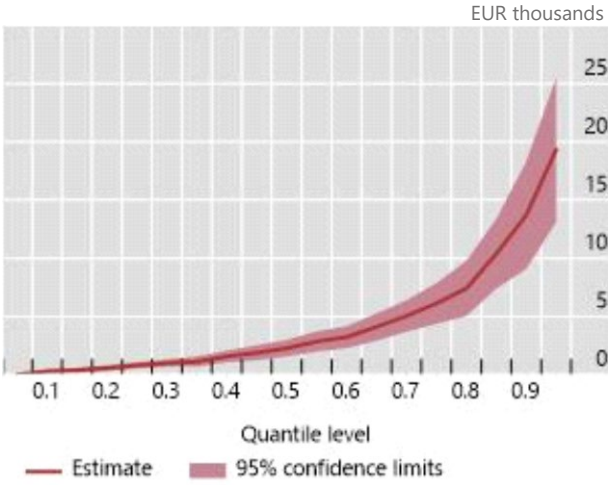
process is often called the "Matthew effect"..[10] This process was already recognised in the Gospel of Matthew, and reflects the old adage that "the rich get richer". Can innovation help address this? Perhaps, but the evidence so far shows that the rich may benefit by more. Researchers at the BIS and the Bank of Italy have for instance found that especially wealthy households are more likely to have benefited from remote banking in the past quarter-century; in fact, this benefit grows starkly when moving towards the top of the distribution (right-hand panel)..[11]

The "Matthew effect": inequality in returns to wealth — Graph 2

Rate of financial returns of Italian households by net wealth quartile[1]



Effect on financial wealth of remote banking access[2]



[1] The figure indicates that households with wealth in the top quartiles of the distribution have consistently received higher returns on their investments than other wealth quartiles. [2] The figure indicates that remote banking access has a positive impact on household financial wealth, which increases exponentially moving towards the top of the financial wealth distribution.

Source: Frost et al (2019), see footnote 10 for full reference.

Last but certainly not least among the specific services is insurance. Use of big data in insurance is growing rapidly. In many cases, this too is leading to financial inclusion. Parametric insurance for crop failures, pay-per-use auto insurance and other new models could allow people who have until now been excluded from insurance markets to better pool risks and improve welfare. Firms claim that the use of data can even influence behaviour, and create incentives for better driving, better eating habits, more exercise, etc. But there is a dark side. In particular, the use of personal data could lead to very granular (micro-) pricing, and to the *exclusion* of high-risk groups. This "cream-skimming" could undermine the risk-pooling (solidarity) function of insurance..[12] There are also some signs from other business lines that sophisticated algorithms used to process personal data could develop biases against ethnic minorities..[13]

[10] See R Merton, "The Matthew effect in science", *Science*, vol 159, issue 3810, January 1968, pp 56–63.

[11] J Frost, L Gambacorta and R Gambacorta, "The Matthew effect and modern finance", 2019, mimeo.

[12] See International Association of Insurance Supervisors, *FinTech developments in the insurance industry*, February 2017.

[13] Evidence of concrete – albeit specific – racial discrimination by algorithms in the United States is provided in L Sweeney, "Discrimination in online ad delivery", *ACM Queue*, vol 11, no 3, April 2013. The complex and opaque algorithms render biases particularly difficult to detect, and therefore to prevent. See C Sandvig, K Hamilton, K Karahalios and C Langbort, "Auditing algorithms: research methods for detecting discrimination in internet platforms", 2014, mimeo.

Overall, thus, it is not yet clear how different groups will fare from financial inclusion. There is the potential both for important welfare gains – although we do not know how these gains will be shared – and for welfare losses for specific groups.

Broader economic implications of innovations

Even beyond specific financial services, there could be important distributional effects of digital financial innovation in the real economy.

One area is around competition and the use of market power. In many cases, digital markets may be characterised by network externalities and winner-takes-all effects. Especially those firms that can leverage their access to data, their large network of users and their breadth of activities (the "DNA loop") may rapidly establish a dominant position.[14] Mobile payments in China, for instance, are very concentrated, with two firms controlling 94% of the market.[15] Firms could use such dominant positions to charge higher prices and extract rents, or to extract valuable data. Firms may also use vast resources to purchase small competitors, creating a "kill zone" around their core businesses.[16] The risk of a winner-takes-all economy requires rethinking our competition and regulatory policies.

A second, and related, area is price discrimination. For a range of digital services, firms with access to big data and predictive analytics can use this to identify the highest price that individual users would be willing to pay, and to adjust financial offers accordingly.[17] As an example, they may recognise that a client who has been searching online for hospitals in the area is willing to pay more for health insurance. Alternatively, firms may choose not to offer a mortgage if they expect a couple is likely to get divorced. The distributional effects of this granular price discrimination could be significant, as this would raise big techs' profits at the expense of customers. Moreover, while it is likely that wealthier clients would pay a higher price for most services than others, this wealth transfer may nonetheless lead to greater concentration of wealth among big tech firms' shareholders over time. Indeed, we are already seeing that the proportion of technology companies in overall stock indices is rising, and that margins are much higher (Graph 3). On a very basic level, this implies a transfer to previous shareholders. Similarly, there are welfare questions from the use of price discrimination, which may be efficient but not fair.

[14] See Bank for International Settlements, "Big tech in finance: opportunities and risks", *Annual Economic Report 2019*, June, Chapter III.

[15] See Financial Stability Board, "FinTech and market structure in financial services: market developments and potential financial stability implications", 14 February 2019.

[16] See *The Economist*, "Into the danger zone: American tech giants are making life tough for startups", 2 June 2018.

[17] See O Bar-Gill, "Algorithmic price discrimination when demand is a function of both preferences and (mis)perceptions", *University of Chicago Law Review*, vol 86, no 2, March 2019.

Big techs[1] have a rising share in overall market capitalisation and higher profitability

Graph 3

[1] The sample comprises Alibaba, Amazon, Apple, Baidu, eBay, Facebook, Google, Kakao Corp, Line, Microsoft, NTT Docomo, Rakuten, Samsung and Tencent. [2] Average profit margin.

Source: Bloomberg.

A third area is in labour markets. In the past, the financial sector paid a substantial premium in labour markets, which allowed it to attract the best and the brightest.[18] Are the same dynamics at work today with technology? The evidence to date shows that tech companies seem to be among the highest-paying firms these days, and the premium has risen substantially in recent years (Graph 4). This could be another form of skills-biased technological change.[19] While a premium for scarce talent and creativity may be justified in the initial phase of development of a sector, a longer-run disparity in wages may reflect distortions in competition. Moreover, inequality may increase due to the booming remuneration of senior executives, as observed for the financial sector, and could relate to principal-agent problems.[20]

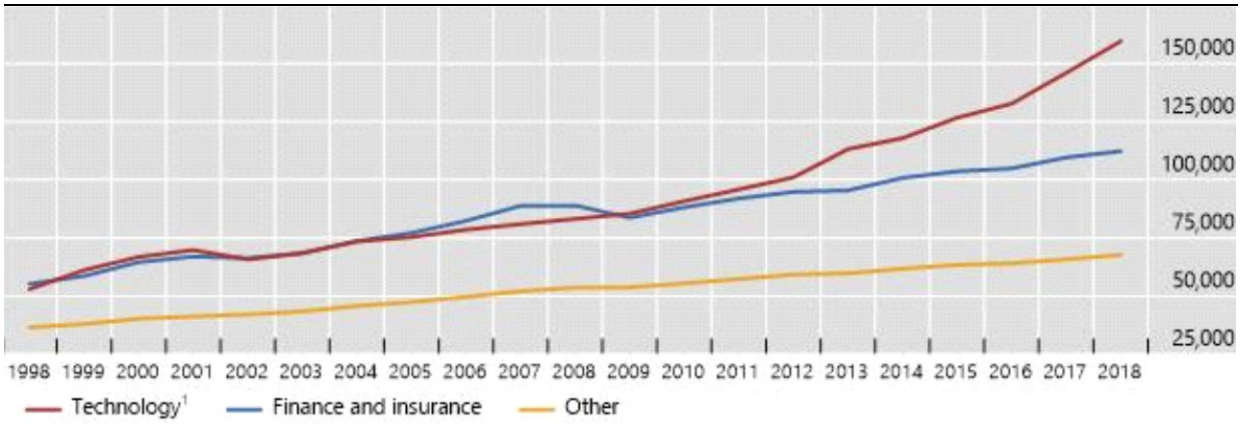
[18] See T Philippon and A Reshef, "Wages and human capital in the US finance industry: 1909–2006", *The Quarterly Journal of Economics*, vol 127, no 4, November 2012, pp 1551–1609. Empirical evidence shows that financial deregulation was the main determinant of both demand for skill and the high wages in the US financial sector in the period 1993–2006, along with other factors such as technology, non-financial corporate activity and financial globalisation, which play a secondary role. These results thus suggest that the increase in relative wages in finance is driven neither by faster growth in the cost of skilled labour, nor by increased relative skill intensity, nor by compositional changes within the group of skilled workers.

[19] For a discussion of "superstar firms" and the falling labour share of income, see D Autor, D Dorn, L Katz, C Patterson and J Van Reenen, "Concentrating on the fall of the labor share", *Quarterly Journal of Economics*, forthcoming.

[20] See J Kay, "Rise in US and UK inequality principally due to financialisation and executive pay", *Financial Times*, 21 January 2015.

Wage differential between the technology and the financial sector increases

US wages per full-time equivalent employee, in US dollars — Graph 4



[1] Average of publishing industries (includes software) and information and data processing services. The figure shows that in the last decade the average salary for employees in the technology sector has increased approximately 50% more than the wages in the financial sector.

Source: Bureau of Economic Analysis.

Overall, market power and wage outcomes are thus important concerns. Some ask whether big techs are "the new robber barons"..[21] This reveals an image problem, especially after several incidents that have dented corporate reputations. The comparison is not entirely appropriate, as the "robber barons" of the 19th and early 20th centuries often had an explicit monopoly on the goods or services they were offering..[22] Yet the political debate is in some ways similar. It would be a pity if the opportunities that technology represents for financial services are reduced for lack of attention to its distributional implications.

What can be done?

In closing, we would like to consider what can be done to maximise the welfare benefits of these innovations and contain the negative effects. The punchline is that it will require cooperation.

First, there is clearly a link between financial stability, competition policy and issues concerning the proper use of data in finance. Data are said to be the new "digital oil", control over which provides a significant advantage. An environment with hazy data rights controlled by big corporations is no longer tenable. There are complex trade-offs between policy goals. Bringing together the public sector authorities responsible for these areas – ie financial regulators, competition authorities and data protection authorities – is an important first step, and work in this area is ongoing..[23]

Second, for regulation, the basic rule should be: "same activity, same regulation". For example, the KYC, anti-money laundering and cyber security rules for banks need to be extended to any banking

[21] See eg R Reich, "Facebook, Google and Amazon are the new robber barons. Bust Them Up", *Newsweek*, 11 March 2019.

[22] For a historical perspective on policy responses to large firms' market power and conduct in the United States, see N Lamoreaux, "The problem of bigness: from Standard Oil to Google", *Journal of Economic Perspectives*, vol 33, no 3, Summer 2019, pp 94–117.

[23] See BIS (2019), op cit.

activity conducted by big techs. Contestability needs to be measured by more sophisticated metrics than just "price" or "firm size". Regulations need to lower entry costs, favour the availability of public technological infrastructures and promote the interoperability of applications. In a nutshell, the efforts of competition policies and regulation should promote a "race to the top" in the provision of digital financial services, where the network externalities benefit all.

Third, we see a strong role for the private sector to consider welfare implications in designing innovations. To take a long-term view on the impact of digital financial innovation is in the self-interest of these same firms. Indeed, if companies want to build on a foundation of societal trust, they need to make sure collectively that financial innovations are benefiting ordinary people and leading to outcomes that are socially Pareto-neutral or -improving, and are also perceived as such. Firms should at least aim for outcomes that can be made Pareto-compatible with the appropriate set of corrective policies.

Finally, for the hard societal questions of how resources should be distributed, and redistributed with tax policy and transfers, the responsibility is clearly with governments. These are political questions, and it is up to our political systems to answer them. Yet by providing research insights, we can help support an informed debate by citizens. Given that the technological revolution knows no borders, and that many firms – both banks and big techs – operate in markets around the world, there is a lot of value in having this discussion at an international level.