20598 – Finance with Big Data

Week 1: Introduction

Prof. Clément Mazet-Sonilhac
clement.mazetsonilhac@unibocconi.it

Department of Finance, Bocconi University

Outline

Introducing Ourselves

Your Professor (Me !)

Clément Mazet-Sonilhac – Office 2-d2-06

- I'm the **primary instructor** and course director
- I joined Bocconi two years ago as an Assistant Professor!
- Previously, I've been Visiting Scholar at MIT, research economist at Banque de France and associate researcher at Collège de France.

Your Professor (Me !)

Clément Mazet-Sonilhac – Office 2-d2-06

- I'm the **primary instructor** and course director
- I joined Bocconi two years ago as an Assistant Professor!
- Previously, I've been Visiting Scholar at MIT, research economist at Banque de France and associate researcher at Collège de France.
- In another life, I've worked as Research Physicist for the Commissariat à l'Energie Atomique, on nuclear fusion

Your Professor (Me !)

Clément Mazet-Sonilhac – Office 2-d2-06

- I hold a PhD in Economics from SciencesPo Paris, and Master's degrees in Mathematics and Physics from Ecole Centrale Paris.
- My research is in Economics and Finance and has been published in journals such as the American Economic Review, the Journal of International Economics and the Journal of Labor Economics

Your Professor (Me !)

Clément Mazet-Sonilhac – Office 2-d2-06

- I hold a PhD in Economics from SciencesPo Paris, and Master's degrees in Mathematics and Physics from Ecole Centrale Paris.
- My research is in Economics and Finance and has been published in journals such as the American Economic Review, the Journal of International Economics and the Journal of Labor Economics

$\Rightarrow$ **I'm NOT a data-scientist !**

Your Professor (Me !)

Clément Mazet-Sonilhac – Office 2-d2-06

- I hold a PhD in Economics from SciencesPo Paris, and Master's degrees in Mathematics and Physics from Ecole Centrale Paris.
- My research is in Economics and Finance and has been published in journals such as the American Economic Review, the Journal of International Economics and the Journal of Labor Economics

$\Rightarrow$ **I'm NOT a data-scientist !**

- You can reach me anytime via email or come to my office hours (Tue 2-4pm, to be discussed) with any question that you may have.

Your Teaching Assistant: Andrea Andolfatto

- Andrea is enrolled in PhD program in Economics and Finance
- Previously, he graduated from Collegio Carlo Alberto in Finance and Machine Learning
- Research: Modelling life cycle portfolio models with the usage of reinforcement learning
- He will help grading your PC Labs!

What about you ?

- Brief background
- What do you know about finance ?
- What do you want to do next year ?

This class :
Finance with Big Data

About this class (1)

- In this class we'll study finance – broadly speaking – and financial technology, with a focus on how big data and AI changed the way finance is practiced

About this class (1)

- In this class we'll study finance – broadly speaking – and financial technology, with a focus on how big data and AI changed the way finance is practiced
- We will focus on problems currently confronting finance professionals in :
  - Wealth Management
  - Banking and the future of banking
  - Venture Capital and Private Equity
  - FinTech, Blockchains and Smart contracts
- More on this later ! [Link to the syllabus]

Disclaimer

What this course is **NOT**

- This course is not intended to be a substitute for :
  - an econometrics course
  - a machine learning course

Disclaimer

What this course is **NOT**

- This course is not intended to be a substitute for :
  - an econometrics course
  - a machine learning course
- Instead, this course is designed as a complement to these courses

About this class (2)

- The teaching philosophy of this class deviates significantly from most of your earlier coursework

About this class (2)

- The teaching philosophy of this class deviates significantly from most of your earlier coursework
- Key principles that we're trying to implement is to have :
  - less face to face lectures, and more discussions
  - less material to learn by heart, and more space for your own thoughts
  - less pressure from exams, and more rewards to being creative
  - more space for your own experimentation

About this class (2)

- The teaching philosophy of this class deviates significantly from most of your earlier coursework
- Key principles that we're trying to implement is to have :
  - less face to face lectures, and more discussions
  - less material to learn by heart, and more space for your own thoughts
  - less pressure from exams, and more rewards to being creative
  - more space for your own experimentation
- This only works if **you're willing to take initiative !**
- If not, I recommend that you choose to be evaluated as a non-attending student.

About this class (3)

- By the way : you should soon start thinking about the topic of your Master thesis. If you want to write a thesis on FinTech or financial topics, this class will provide you with the necessary tools and mindset. Please contact me if you're interested in writing a thesis under my supervision.

About this class (3)

- Last year, I supervised 15 master thesis:
  - Predicting of Intraday Trends for Futures: Nowcasting through NLP
  - Deep Reinforcement Learning for Generalized Portfolio Management
  - Cryptocurrency Ponzi Schemes on the Ethereum Blockchain
  - Exploring the impact of AI on the music industry

About this class (3)

- Last year, I supervised 15 master thesis:
  - Predicting of Intraday Trends for Futures: Nowcasting through NLP
  - Deep Reinforcement Learning for Generalized Portfolio Management
  - Cryptocurrency Ponzi Schemes on the Ethereum Blockchain
  - Exploring the impact of AI on the music industry
- This year: maximum 5

Class Structure

Week	Topic
1	Introduction
2	Portfolio Theory
3	CAPM and APT
4	Data-driven finance
5	Asset Pricing with ML
6	Hackathon
7	Banking: Intro

Week	Topic
8	Banking with big data
9	Venture Capital: Intro
10	VC at the age of AI
11	Blockchains: Foundations
12	Smart contracts
13	Presentations
14	Presentations

Prerequisites

- This course **assumes** that you :
  - already have basic-to-intermediate Python programming skills
  - have completed the DSBA first-year curriculum
  - are curious about finance and digital technology
  - bring a hands-on, problem-solver mentality and are willing to explore
  - have a laptop at your disposition

Prerequisites

- This course **assumes** that you :
  - already have basic-to-intermediate Python programming skills
  - have completed the DSBA first-year curriculum
  - are curious about finance and digital technology
  - bring a hands-on, problem-solver mentality and are willing to explore
  - have a laptop at your disposition
- This course **does not assume** that you :
  - already have any knowledge in finance

Technical Prerequisites

- Obviously, have Anaconda Python (version > 3) installed and working properly
- Have an editor (Vim, Atom, VS Code) + good Jupyter notebooks mastering
- Specific packages and software for the blockchain/crypto part will be provided at later stage

Schedule

We will meet twice a week

Day	Time	Room	Class length	Class type
Monday	16:30-19:00	Aula 33	150 min	Lecture
Tuesday	8:30-10:00	Aula D	90 min	PC Lab

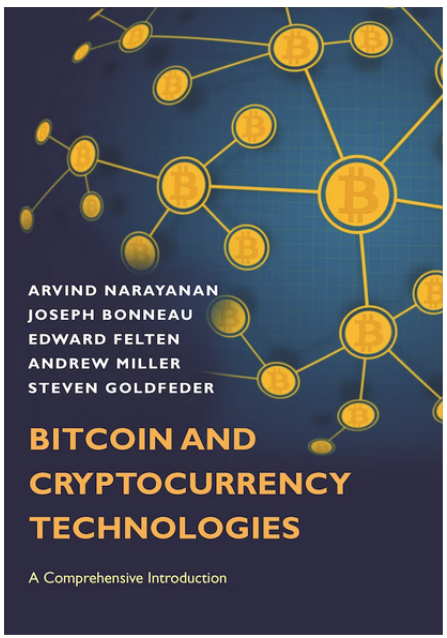
- Lectures : traditional 2 hours + discussion classes
- PC Labs : classes in which you'll actually get your hands dirty with code
- Updated week by week as we progress

Course Materials

- There is **no course textbook !**

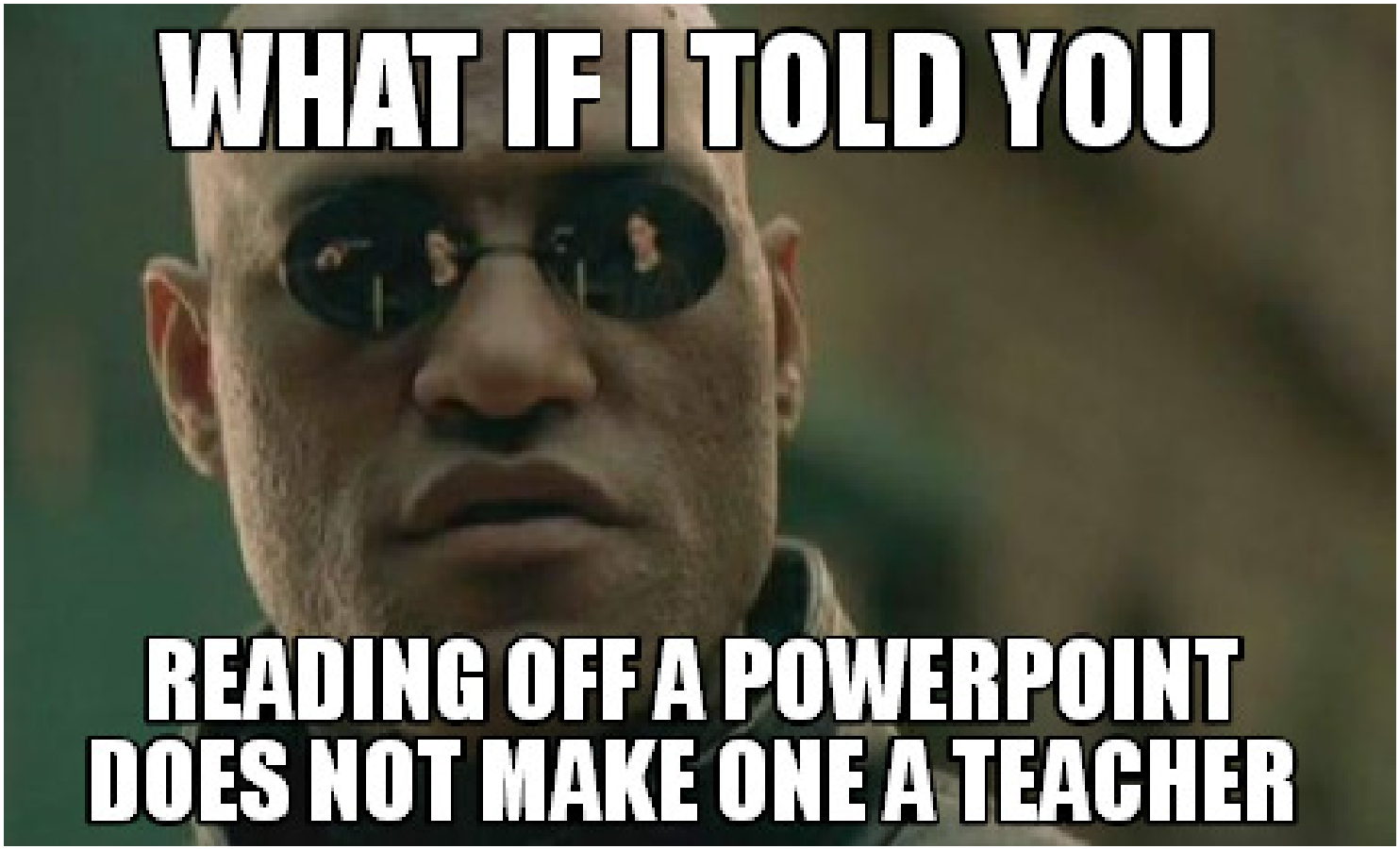
Course Materials

- There is **no course textbook !**
- We will draw on a large variety of sources, which will be referenced in the slides

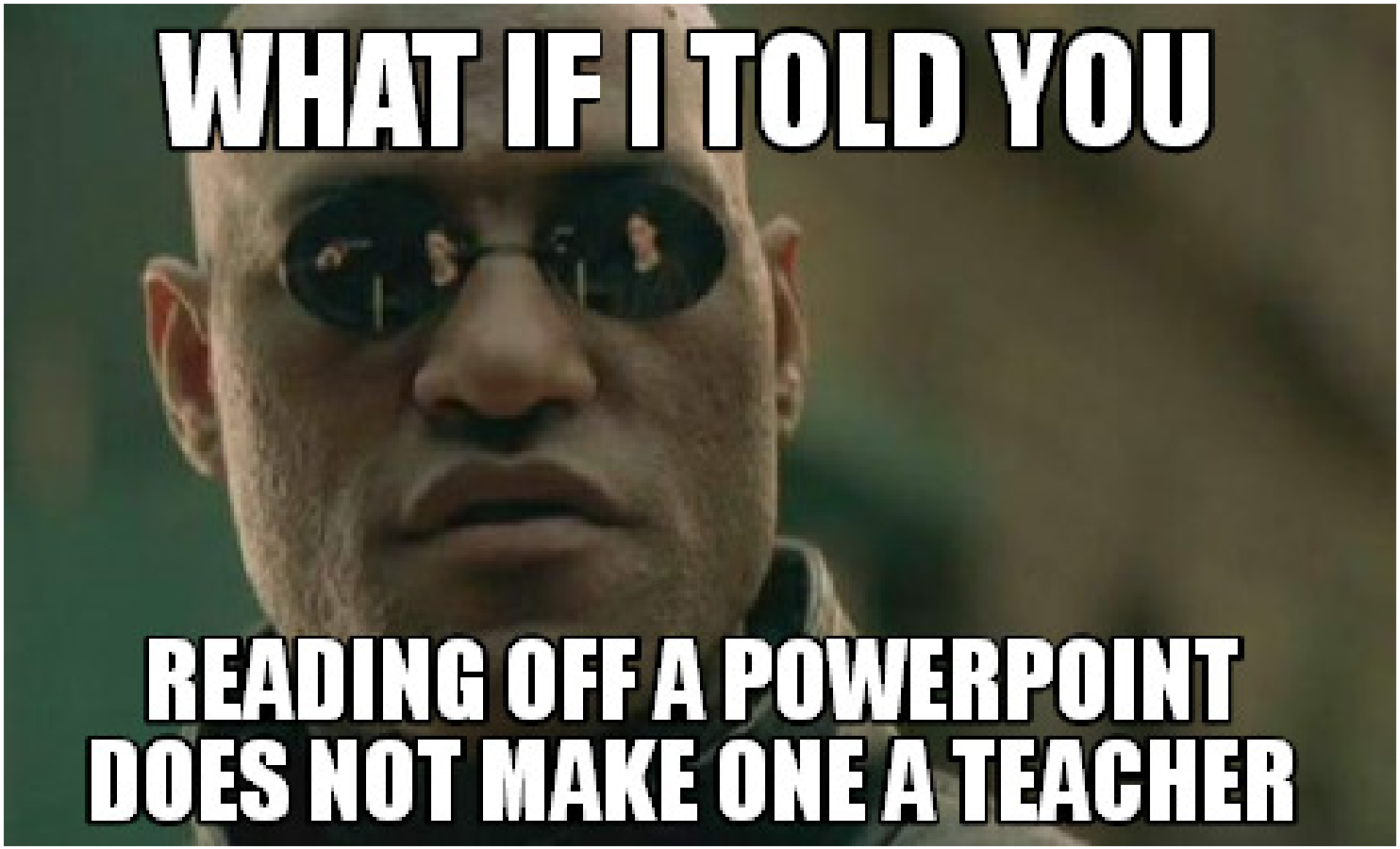


- The lecture and PC Labs slides (via Blackboard) are your primary course materials

Course Materials



Course Materials



- Same for students : slides $\neq$ knowledge
- Will be important to read articles, book chapters, etc.

Grading

Attending students

- **PC labs** account for 30% of the grade.
  - You will work in teams of 3 on the labs.
  - Only the 6 best grades count
  - Last year average: 29.8!

Grading

Attending students

- **PC labs** account for 30% of the grade.
  - You will work in teams of 3 on the labs.
  - Only the 6 best grades count
  - Last year average: 29.8!

- A **final project / paper presentation** accounts for 30% of the grade
  - Same: groups of 3
  - 20' + 5' of discussion
  - Launch around midterm

Grading

Attending students

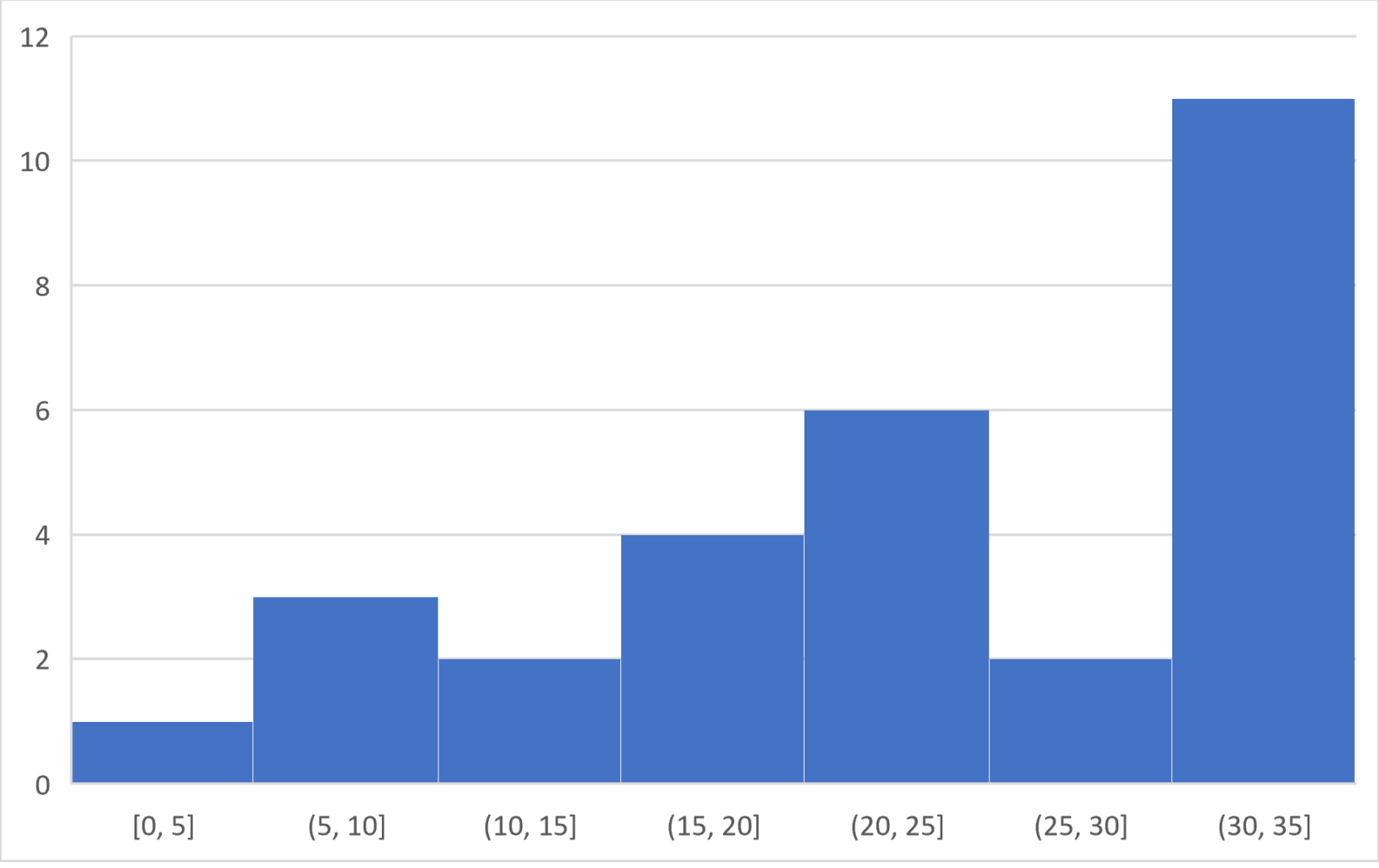
- **PC labs** account for 30% of the grade.
  - You will work in teams of 3 on the labs.
  - Only the 6 best grades count
  - Last year average: 29.8!
- A **final project / paper presentation** accounts for 30% of the grade
  - Same: groups of 3
  - 20' + 5' of discussion
  - Launch around midterm
- A **final written exam** accounts for 30% of the grade (MCQ)

Grading

Attending students

- **PC labs** account for 30% of the grade.
  - You will work in teams of 3 on the labs.
  - Only the 6 best grades count
  - Last year average: 29.8!
- A **final project / paper presentation** accounts for 30% of the grade
  - Same: groups of 3
  - 20' + 5' of discussion
  - Launch around midterm
- A **final written exam** accounts for 30% of the grade (MCQ)
- **Class participation**, as measured by quality of course engagement, comprises the final 10% of the course grade

Distribution of **participation** grades (Last year)



Participation grades explained

- not coming to class + not asking/answering question: grade is 0
- rarely coming to class (in-person or online) + not asking/answering question: grade is below 18
- coming to almost every class (in-person or online) + not asking/answering question: grade is 18
- coming to every class (in-person or online) and sometimes asking/answering questions: grade above 18
- coming to every class (in-person or online) and asking/answering questions at every class: grade is 31

Grading

Non-attending students

- **We don't check attendance in class**, and we understand that for various reasons (exchange, internship etc.) you may even choose not to attend any of the lectures at all

- Evaluation based on two elements :
  - A **final written exam** accounts for 50% of the grade (Q&A)
  - A **final project / paper presentation** accounts for 50% of the grade

$\Rightarrow$ The choice is yours !

Grading

Groups for next week

- Groups of 3 for the PC Labs must be organized by next Monday
- Send me an email with your 3 names

Frequently Asked Questions (1)

Q : Why the syllabus has changed since 2022 ?

The previous course was covering extensively blockchains and smart contracts. This was great, but not fully satisfactory for students who wanted to apply their quantitative skills to asset management, banking, insurance, hedge funds or venture capital. The course has been ***extensively redesigned to match your needs****.*

Frequently Asked Questions (1)

Q : Why the syllabus has changed since 2022 ?

The previous course was covering extensively blockchains and smart contracts. This was great, but not fully satisfactory for students who wanted to apply their quantitative skills to asset management, banking, insurance, hedge funds or venture capital. The course has been ***extensively redesigned to match your needs****.*

Q : What exactly are PC Labs ?

PC Labs are classes in which you'll actually get your hands dirty with code. You'll start with a dataset and some tasks to complete, with a lot of autonomy. You'll need to take initiatives, apply your quantitative skills to solve real-world problems. ***There is never a single good solution !*** *Coding language is Python.*

Frequently Asked Questions (2)

Q : What happen if I miss a PC Lab as an attending student ?

There are $\approx$ eight graded PC Labs. As an attending student, your grade is calculated as the arithmetic mean of your 6 best PC Labs results. This means that you can miss some PC Labs without negatively impacting your grade. If you are about to miss more than 2 PC Labs for a reason that is beyond your control, please contact me as soon as possible.

Frequently Asked Questions (2)

Q : What happen if I miss a PC Lab as an attending student ?

There are $\approx$ eight graded PC Labs. As an attending student, your grade is calculated as the arithmetic mean of your 6 best PC Labs results. This means that you can miss some PC Labs without negatively impacting your grade. If you are about to miss more than 2 PC Labs for a reason that is beyond your control, please contact me as soon as possible.

Q : What's the electronic device policy ?

Laptops *: Your computer is a source of great power, but also of great distraction. Bring it along for both lectures and labs, but keep it closed during lectures (unless advised otherwise).*

Phones *: There's nothing important going on in your mobile phone while you're sitting in class. Keep it in silent mode and out of reach.*

Electronic device policy explained: Sana et al., 2013

Computers & Education 62 (2013) 24–31

Contents lists available at SciVerse ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Laptop multitasking hinders classroom learning for both users and nearby peers

Faria Sana [a], Tina Weston [b,c], Nicholas J. Cepeda [b,c,*]

[a] McMaster University, Department of Psychology, Neuroscience, & Behaviour, 1280 Main Street West, Hamilton, ON L8S 4K1, Canada
[b] York University, Department of Psychology, 4700 Keele Street, Toronto, ON M3J 1P3, Canada
[c] York University, LaMarsh Centre for Child and Youth Research, 4700 Keele Street, Toronto, ON M3J 1P3, Canada

ARTICLE INFO

Article history:
Received 11 September 2012
Received in revised form
5 October 2012
Accepted 12 October 2012

Keywords:
Laptops
Multitasking
Attentional control
Pedagogy

ABSTRACT

Laptops are commonplace in university classrooms. In light of cognitive psychology theory on costs associated with multitasking, we examined the effects of in-class laptop use on student learning in a simulated classroom. We found that participants who multitasked on a laptop during a lecture scored lower on a test compared to those who did not multitask, and participants who were in direct view of a multitasking peer scored lower on a test compared to those who were not. The results demonstrate that multitasking on a laptop poses a significant distraction to both users and fellow students and can be detrimental to comprehension of lecture content.

effect simply reflects the difficulty of the questions created. The interaction was not significant, $F(1,38) = 0.79$, $p = .380$. These findings demonstrate a strong, detrimental effect of multitasking on comprehension scores. Overall, participants who multitasked scored 11% lower on a post-lecture comprehension test (Fig. 1).

Electronic device policy explained: Sana et al., 2013

- But more importantly

Participants scored higher on simple questions ($M = 0.69$, $SD = 0.14$, $n = 20$) than on complex questions ($M = 0.66$, $SD = 0.15$, $n = 20$). The interaction was not significant, $F(1,36) = 0.91$, $p = .347$. These findings suggest that peer multitasking distracted participants who were attempting to pay sole attention to the lecture. Those in view of a multitasking peer scored 17% lower on a post-lecture comprehension test (Fig. 3).

Outline


Disruptive digital
innovation

Long term technological trends

- Differently from what some economists might tell you, most disruptive innovations are quite predictable outcomes of long-term technological trends
- To briefly talk about those, we need to go back to the 1960's

Long term technological trends

- Differently from what some economists might tell you, most disruptive innovations are quite predictable outcomes of long-term technological trends
- To briefly talk about those, we need to go back to the 1960's
- Computers were around in the 60's already. However, they were *slightly* bigger

Feature	UNIVAC LARC (1961)	iPhone 6
Compute speed	500 kFlops	7,300,000 kFlops
Bits per word	48	64
Processors	2	2
Storage	97,500 machine words	35,360 *million* machine words
Weight	115,000 pounds (52 t)	192 grams
Main purpose	Hydrogen bomb calculations	WhatsApp, Facebook?


Univac Larc, 1961

The origins of digitalization

- The enormous advances in digital technology, such as the exponential growth in computational power and storage, have one single origin: **Miniaturization**

The origins of digitalization

- The enormous advances in digital technology, such as the exponential growth in computational power and storage, have one single origin: **Miniaturization**

- It doesn't take a genius today to explain how things have evolved from 1960 to 2000...
- ... but it is breathtaking to which extent a genius already foresaw most of it back then

The origins of digitalization

- The enormous advances in digital technology, such as the exponential growth in computational power and storage, have one single origin: **Miniaturization**

- It doesn't take a genius today to explain how things have evolved from 1960 to 2000...
- ... but it is breathtaking to which extent a genius already foresaw most of it back then

→ Physicist Richard Philips Feynman, Nobel Prize 1965

The origins of digitalization

- In December 1959, Richard Philips Feynman gave a talk at Caltech with the title "There is plenty of room at the bottom". You can find the PDF transcript here. Read it, Feynman is a very entertaining narrator !

I imagine experimental physicists must often look with envy at men like Kamerlingh Onnes, who discovered a field like low temperature, which seems to be bottomless and in which one can go down and down. Such a man is then a leader and has some temporary monopoly in a scientific adventure. Percy Bridgman, in designing a way to obtain higher pressures, opened up another new field and was able to

nothing; that's the most primitive, halting step in the direction I intend to discuss. It is a staggeringly small world that is below. In the year 2000, when they look back at this age, they will wonder why it was not until the year 1960 that anybody began seriously to move in this direction.

Why cannot we write the entire 24 volumes of the Encyclopaedia Brittanica on the head of a pin?

The origins of digitalization

- In December 1959, Richard Philips Feynman gave a talk at Caltech with the title "There is plenty of room at the bottom". You can find the PDF transcript here. Read it, Feynman is a very entertaining narrator !

I imagine experimental physicists must often look with envy at men like Kamerlingh Onnes, who discovered a field like low temperature, which seems to be bottomless and in which one can go down and down. Such a man is then a leader and has some temporary monopoly in a scientific adventure. Percy Bridgman, in designing a way to obtain higher pressures, opened up another new field and was able to

nothing; that's the most primitive, halting step in the direction I intend to discuss. It is a staggeringly small world that is below. In the year 2000, when they look back at this age, they will wonder why it was not until the year 1960 that anybody began seriously to move in this direction.

Why cannot we write the entire 24 volumes of the Encyclopaedia Brittanica on the head of a pin?

- One could call this a visionary idea that outlined the foundations of the science of nanotechnology

- Surprisingly, most historians agree that Feynman's talk was not particularly influential at its time, but in hindsight the relevance of these thoughts becomes clear.

"There is plenty of room at the bottom"

- Feynman starts with : *"Why cannot we write the entire 24 volumes of the Enyclopaedia Britannica on the head of a pin ?"*

- He goes on to explain that, in principle, one could do so comfortably if one were to have access to a technology to produce dots just about 100 atoms small. And one could do more :

  "...computing machines [...] : Why can't we make them very small, make them of little wires, little elements - and by little I mean little : For instance, the wires should be 10 or 100 atoms in diameter..."

  "...information cannot go any faster than the speed of light. So, ultimately, when our computers get faster and faster and more elaborate, we will have to make them smaller and smaller. But there is plenty of room to make them smaller."

A half century long journey to the bottom

Process	Year
10 µm	1971
6 µm	1974
3 µm	1977
1.5 µm	1981
1 µm	1984
800 nm	1987
600 nm	1990
350 nm	1994
250 nm	1996
180 nm	1999

Process	Year
130 nm	2001
90 nm	2003
65 nm	2005
45 nm	2007
32 nm	2009
22 nm	2012
14 nm	2014
10 nm	2016
7 nm	2018
5 nm	?

- In silicon, crystal nearest neighbor distance between atoms is 0.235 nm, and adverse quantum effects become dominant around 1 nm.
- Conclusion: we're not at the bottom yet, but not far away from it either

A half century long journey to the bottom

Process	Year
10 µm	1971
6 µm	1974
3 µm	1977
1.5 µm	1981
1 µm	1984
800 nm	1987
600 nm	1990
350 nm	1994
250 nm	1996
180 nm	1999

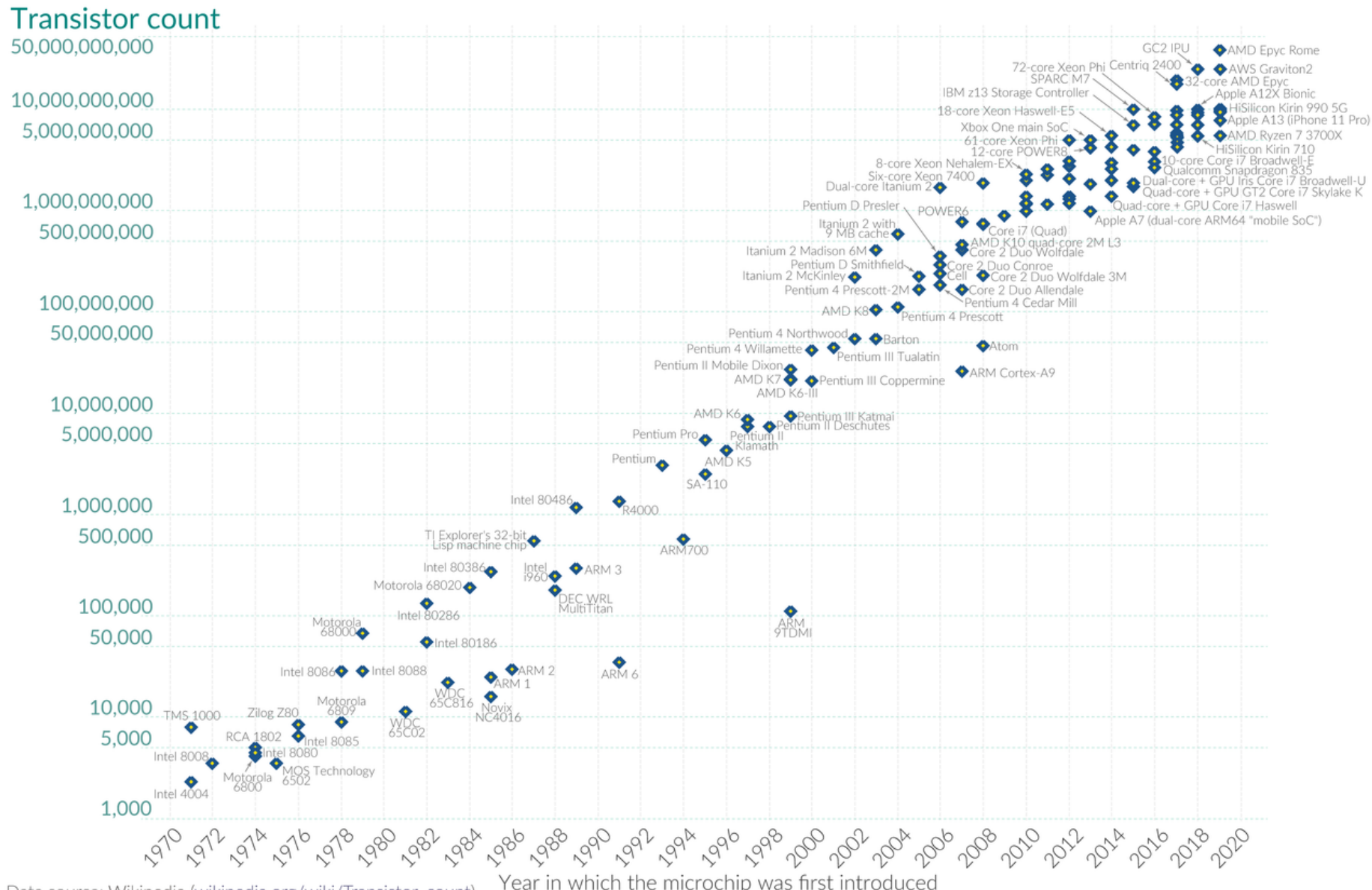
Process	Year
130 nm	2001
90 nm	2003
65 nm	2005
45 nm	2007
32 nm	2009
22 nm	2012
14 nm	2014
10 nm	2016
7 nm	2018
5 nm	?

- In silicon, crystal nearest neighbor distance between atoms is 0.235 nm, and adverse quantum effects become dominant around 1 nm.
- Conclusion: we're not at the bottom yet, but not far away from it either
- Update: IBM announced 2 nm nodes for 2024-25 production (2 nm is 4 atoms!)

Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

Our World in Data



Data source: Wikipedia (wikipedia.org/wiki/Transistor_count)

OurWorldinData.org – Research and data to make progress against the world's largest problems.

First long-term trend: Moore's Law

- Each round of miniaturization has been giving us as a free *miniaturization dividend* (Moore's Law)
  - shorter electric paths for the same money, and therefore:
  - faster computation
  - and more transistors, therefore more complex chips

$\Rightarrow$ Faster and more complex microchips in turn:

  - lower the cost of memory and solid state storage
  - enable faster and more efficient signal processing to grow network capacity

- Nothing of this is news. We're so used to it. Just remember, this miniaturization dividend that we've been receiving for nearly 50 years is no perpetuity

Second long-term trend: Internet adoption

- Exponential decline in computing and storage cost, paired with growing network capacity, have enabled **mass adoption of the internet**.
- The majority of today's internet users adopted the internet via smartphones, which essentially are low-cost, networked minicomputers

Second long-term trend: Internet adoption

- Exponential decline in computing and storage cost, paired with growing network capacity, have enabled **mass adoption of the internet**.
- The majority of today's internet users adopted the internet via smartphones, which essentially are low-cost, networked minicomputers
- 63% of world population was using the internet in 2021

Second long-term trend: Internet adoption

- Exponential decline in computing and storage cost, paired with growing network capacity, have enabled **mass adoption of the internet**.
- The majority of today's internet users adopted the internet via smartphones, which essentially are low-cost, networked minicomputers
- 63% of world population was using the internet in 2021, as compared to 14% in 2004.
- Consequences ?

Second long-term trend: Internet adoption

- Exponential decline in computing and storage cost, paired with growing network capacity, have enabled **mass adoption of the internet**.
- The majority of today's internet users adopted the internet via smartphones, which essentially are low-cost, networked minicomputers
- 63% of world population was using the internet in 2021, as compared to 14% in 2004.
- Consequences ? exponential data growth and mobile first !

Digital Disruption: The first wave

- Unsurprisingly, the vast improvements in information technology and the rapid adoption of the internet soon made a number of business models obsolete.

Which ones ?

Digital Disruption: The first wave

- Unsurprisingly, the vast improvements in information technology and the rapid adoption of the internet soon made a number of business models obsolete.

Which ones ?

- Easy guess : Business models at instant risk of disruption were those that entailed at their core value proposition :
  - the delivery of information on physical media, or
  - the forwarding or broadcasting of information
- But many businesses had not even the slightest clue that information was the business that they were in...

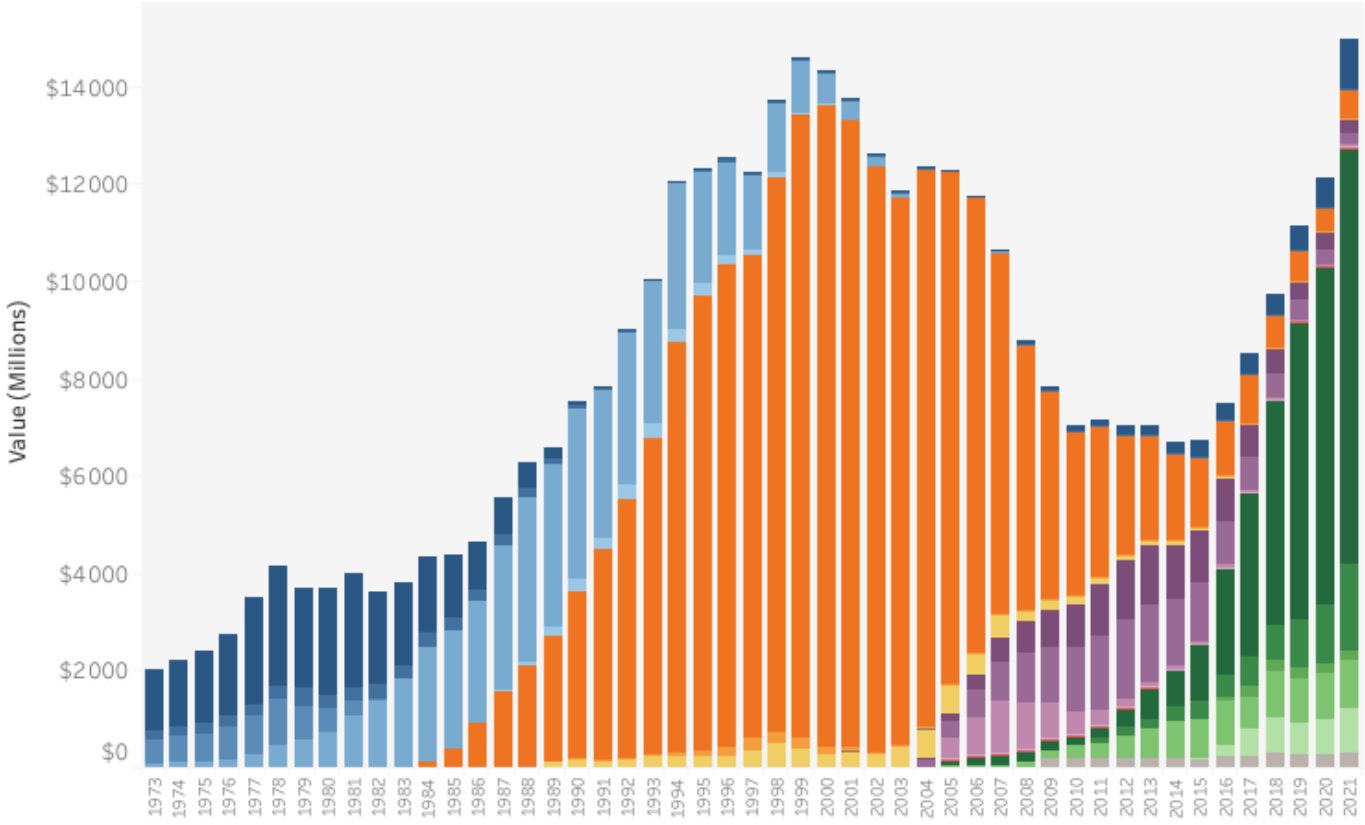
Records industry thought that they were **selling music**...

Records industry thought that they were **selling music**...

...when in fact their business model comprised of selling information on physical media.

U.S. Recorded Music Revenues by Format

1973 à 2021, Format(s): Tout
Source: RIAA



- Values are at recommended or estimated list price. Formats with no retail value equivalent included at wholesale price
- SoundExchange Distributions are estimated payments in dollars to performers and copyright holders for digital radio services under statutory licenses
- Paid Subscription includes streaming, tethered, and other paid subscription services not operating under statutory licenses.
- Limited Tier Paid Subscription includes streaming services with interactivity limitations by availability, device restriction, catalog limitations, on demand access, or other factors
- On-Demand Streaming includes ad-supported audio and music video services not operating under statutory licenses
- Other Ad-supported Streaming includes revenues paid directly for statutory services that are not distributed by SoundExchange and not included in other streaming categories
- Kiosk includes Singles and Albums
- Synchronization Royalties include fees and royalties from synchronization of sound recordings with other media
- Ringtones & Ringbacks includes Master Ringtunes, Ringbacks, and prior to 2013 Music Videos, Full Length Downloads, and Other Mobile
- Other Tapes includes reel-to-reel and quadraphonic
- Other Digital includes other digital music licensing
- Updated accounting standards beginning in 2016

Select Measure
(●) Revenue
( ) Revenue (Adjusted for Inflation)

Select Date Range
1973 à 2021

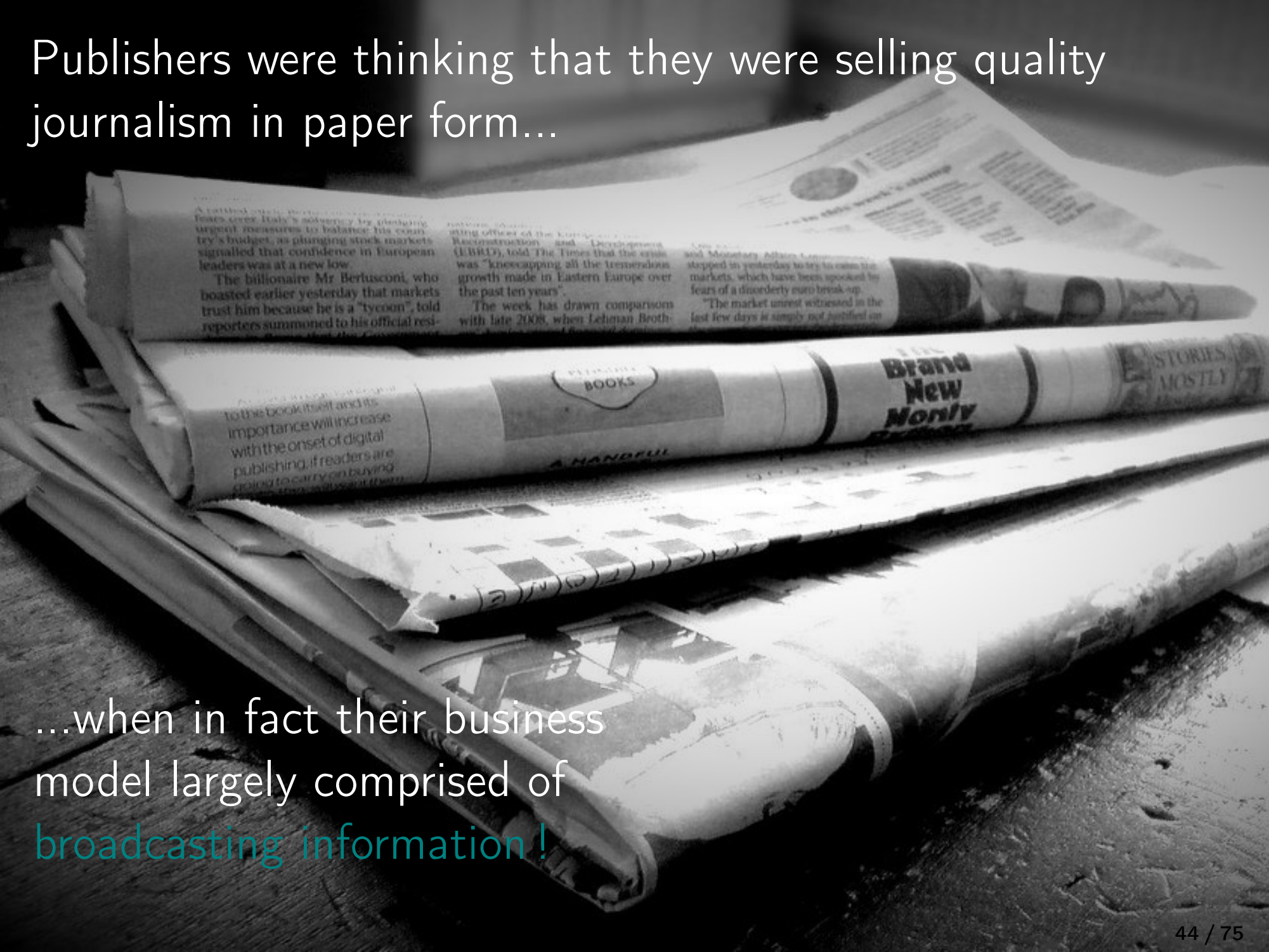
Select Format(s) - ESC to Hide
Tout

Format (Click to Highlight)
- LP/EP
- Vinyl Single
- 8 - Track
- Cassette
- Cassette Single
- Other Tapes
- CD
- CD Single
- SACD
- DVD Audio
- Music Video (Physical)
- Download Album
- Download Single
- Ringtones & Ringbacks
- Download Music Video
- Other Digital
- Kiosk
- Paid Subscription
- On-Demand Streaming (Ad-Support..
- Other Ad-Supported Streaming
- SoundExchange Distributions
- Limited Tier Paid Subscription
- Synchronization

Click to view revenue for single year

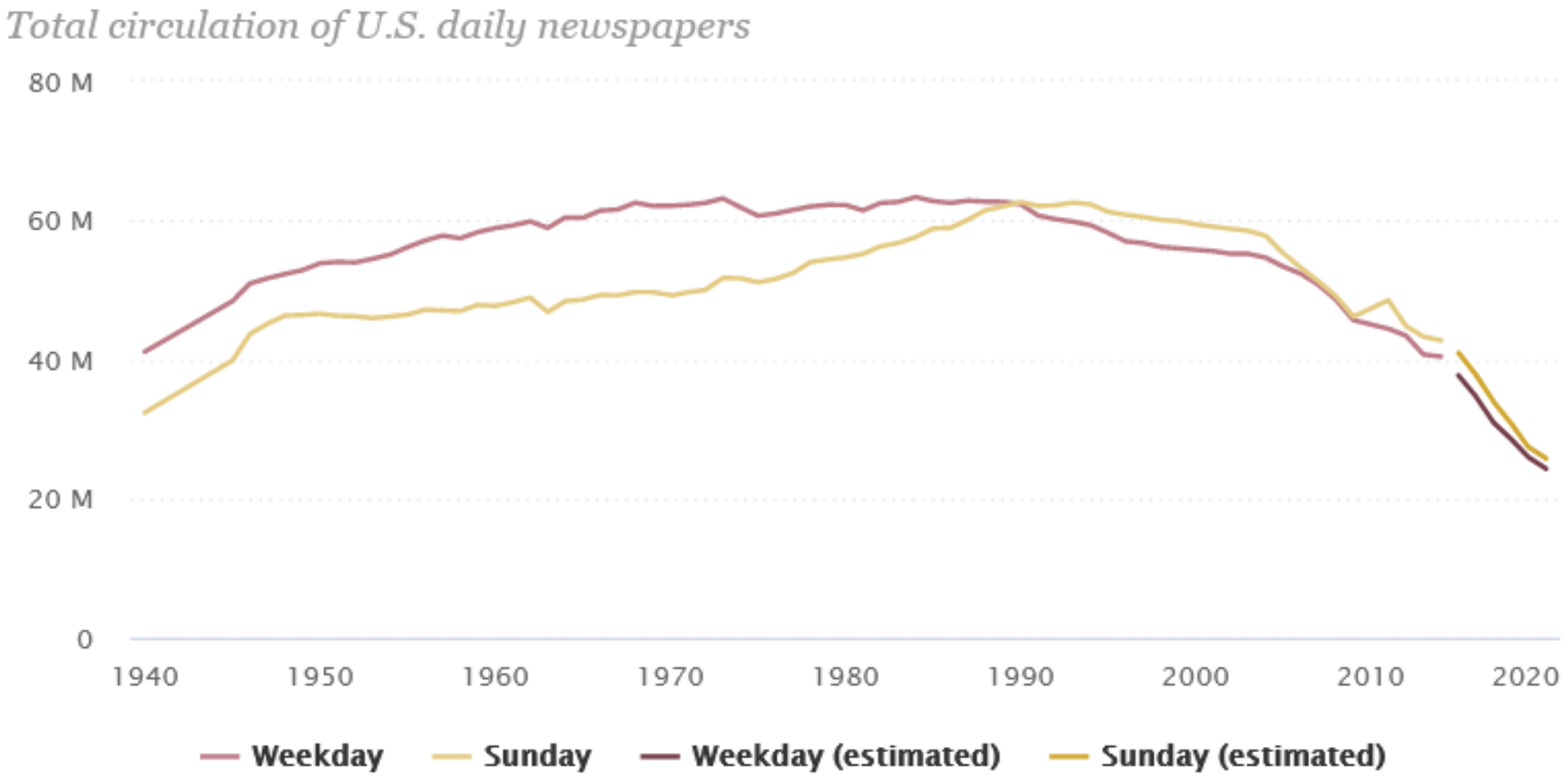
Publishers were thinking that they were selling quality journalism in paper form...

Publishers were thinking that they were selling quality journalism in paper form...



...when in fact their business model largely comprised of broadcasting information !

US Newspaper circulation [data]



Print Media and Advertising Crisis

- It didn't help the traditional media at all that their advertising was, by nature of one-to-many media, not targeted :
- John Wanamaker (1838-1922) : *"Half the money I spend on advertising is wasted ; the trouble is I don't know which half."*
- In contrast, a search engine like Google can provide targeted matching of advertisers with consumers
- Unsurprisingly, advertising revenue of TV, radio and print media kept falling. The traditional media business model got disrupted by digitalization.

Building on the many-to-many architecture of the internet, new social media emerged...

...and soon Facebook could **forecast better than anyone else what people really liked**. Or whom.

Third (long-term) trend : Mobile *Appification*

Third (long-term) trend : Mobile *Appification*

- In 2007, the smartphone came into our life. This captivating new friend draws permanent attention because it is built to do that. Three key innovations:

Third (long-term) trend : Mobile *Appification*

- In 2007, the smartphone came into our life. This captivating new friend draws permanent attention because it is built to do that. Three key innovations:
- It dramatically reduces the burden involved in launching quasi-webpages in the form of specific internet-enabled mobile apps : it takes a a second to unlock, swipe, tap. Compare that to 3 minutes waiting for Windows Vista to boot
- One can interact via the app from almost everywhere, because of near-complete data network coverage
- Its intuitive user interface features and push notifications make it an ideal deployment platform for persuasive technologies.

Digital disruption : The second wave

- The prelude for the next round of disruption :
  1. Growing internet user base, more scope to exploit economies of scale
  2. Growing information advantage of tech firms over other players
  3. Growing willingness of users to trust technology if packaged as an app

Digital disruption : The second wave

- The prelude for the next round of disruption :
  1. Growing internet user base, more scope to exploit economies of scale
  2. Growing information advantage of tech firms over other players
  3. Growing willingness of users to trust technology if packaged as an app
- In consequence, further business models were at risk of digital disruption.

Which ones ?

Digital disruption: The second wave

- In consequence, further business models were at risk of digital disruption :

  1. Business models whose value creation depends on knowing customer characteristics or enjoying customer's trust

     → In particular : **information-centric** business models of intermediation

  2. Business models built around the provision of services for which a new, informed digital intermediary can create substitutes of better value proposition

Travel agencies are an excellent example of an information-centric intermediary...

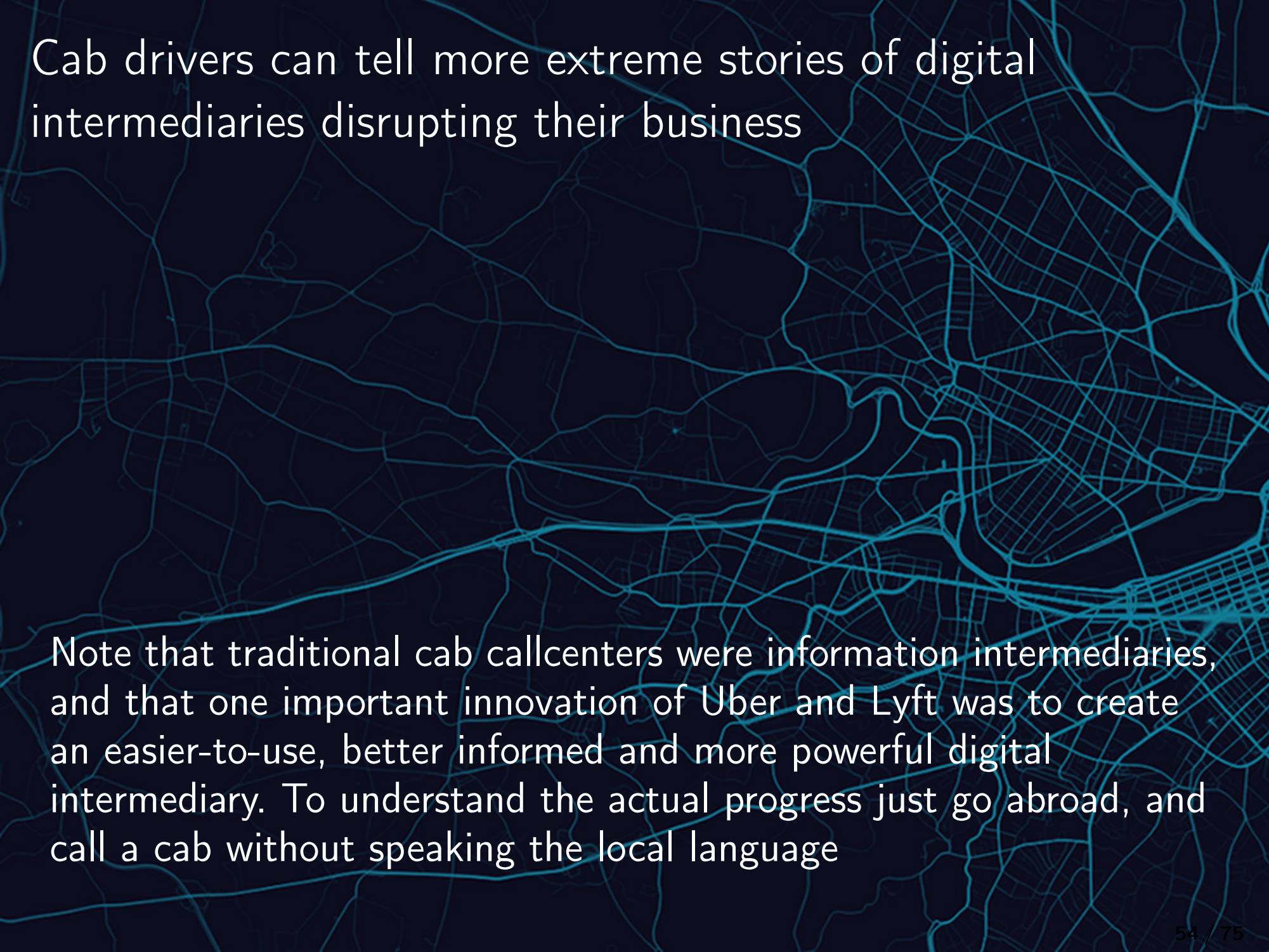
They match your preferences with touristic services that are available on the market. With better information and increasing returns to scale, large internet platforms like Expedia disrupted small agencies.

You would never ring a stranger's door to crash in her (or his) place for the night...

...unless you booked that via AirBnB

$\Rightarrow$ AirBnB is a perfect example of an informed digital intermediary that brings two parties (host and guest) together and enables mutual trust. As a result, private homes have become viable substitutes for hotel services.

Cab drivers can tell more extreme stories of digital intermediaries disrupting their business



Note that traditional cab callcenters were information intermediaries, and that one important innovation of Uber and Lyft was to create an easier-to-use, better informed and more powerful digital intermediary. To understand the actual progress just go abroad, and call a cab without speaking the local language

Business models currently at risk of disruption

- Let's repeat one more time what I said before, and think again :

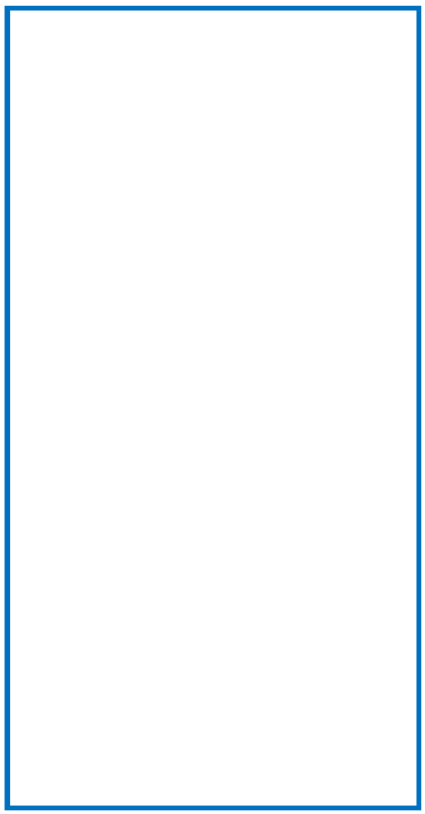
  Business models currently at risk of disruption are information-centric or trust-based business models of intermediation.

- This brings the following question :

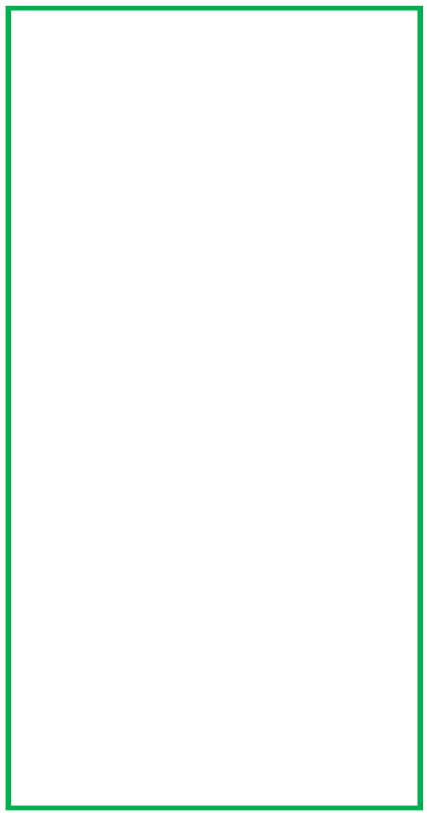

What are the business models of the finance industry, after all ?

What is the finance industry about ?

Informed intermediation between lenders and borrowers

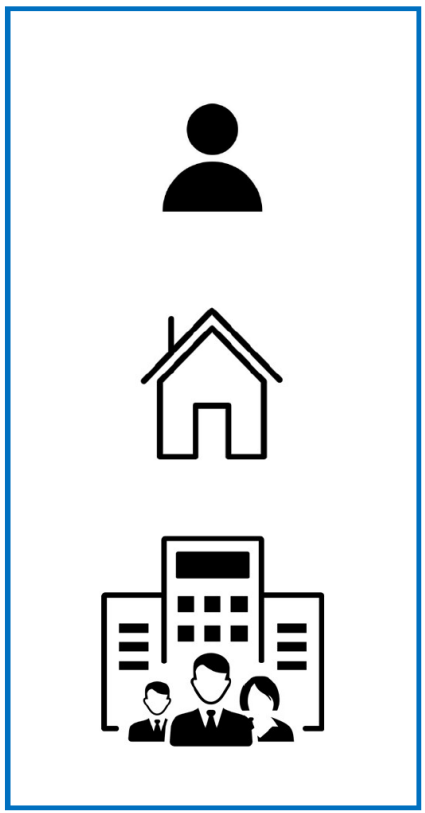


Savings = offer of money

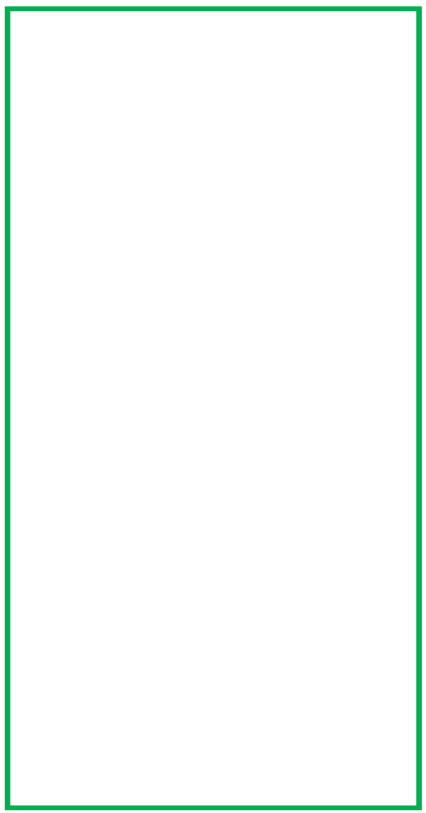


What is the finance industry about ?

Informed intermediation between lenders and borrowers

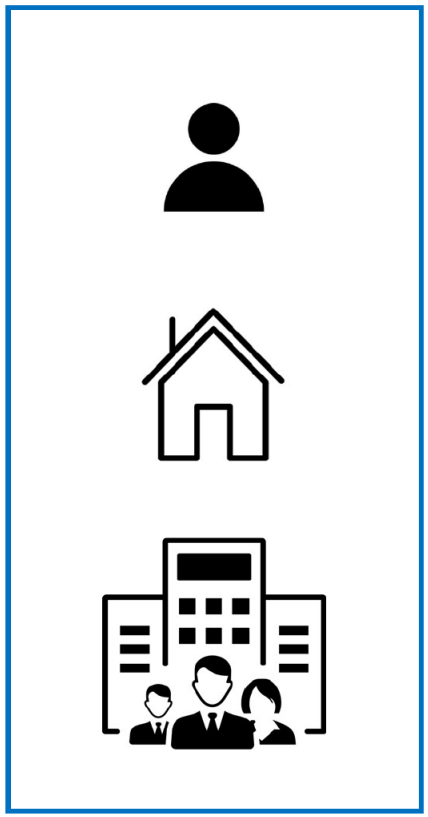


Savings = offer of money



What is the finance industry about ?

Informed intermediation between lenders and borrowers

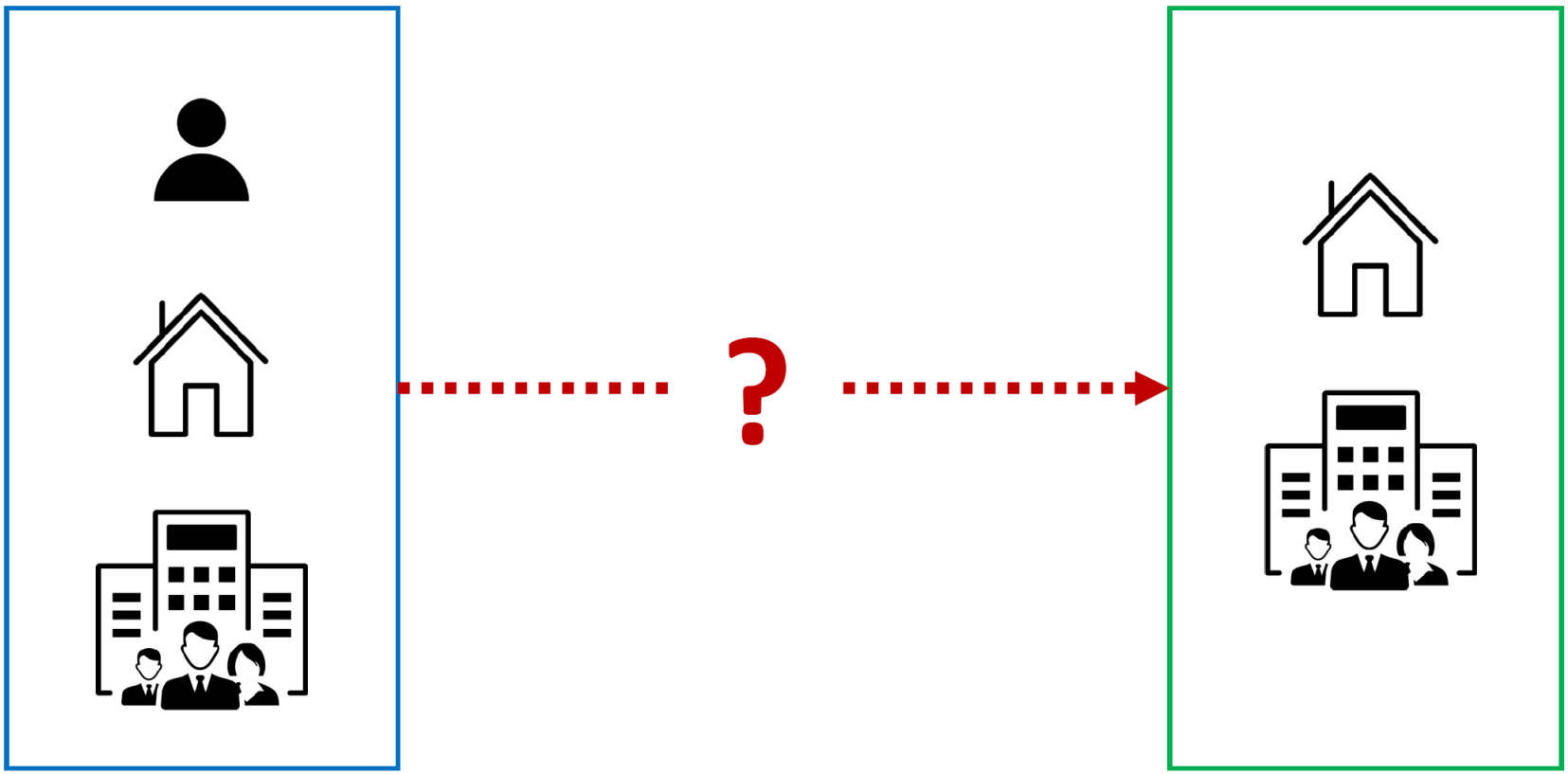


Savings = offer of money

Investment = demand of money

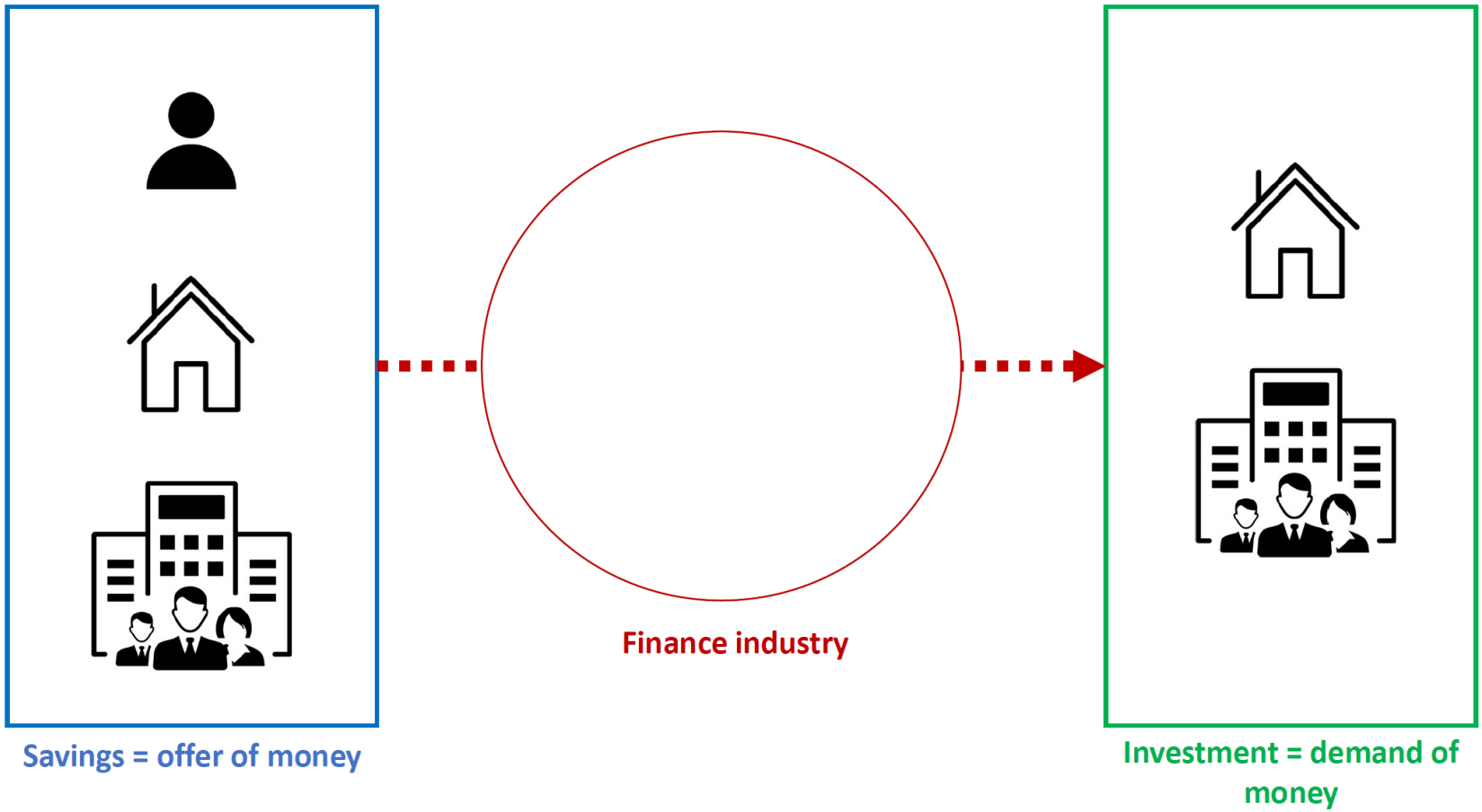
What is the finance industry about ?

Informed intermediation between lenders and borrowers



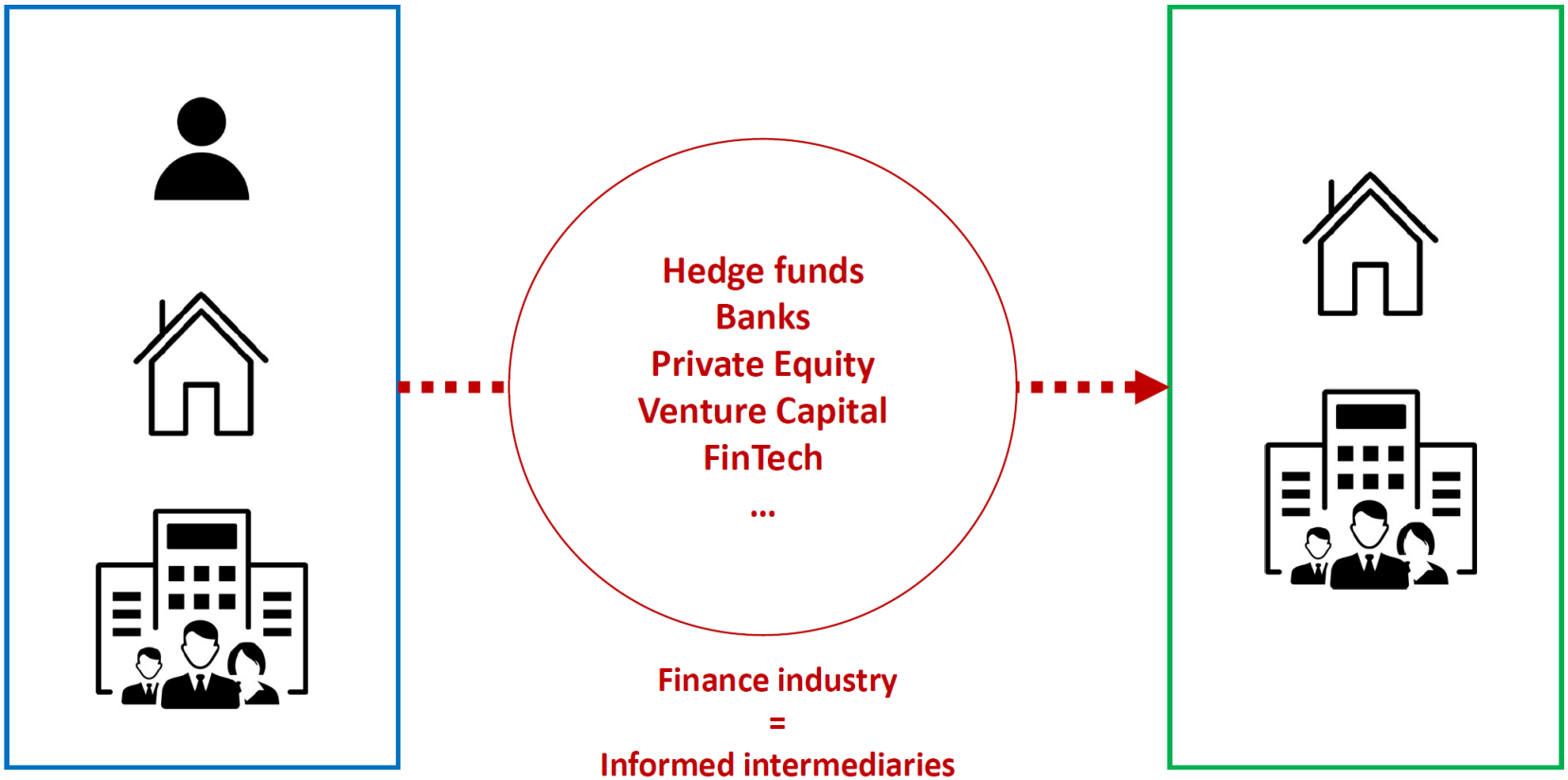
What is the finance industry about ?

Informed intermediation between lenders and borrowers



What is the finance industry about ?

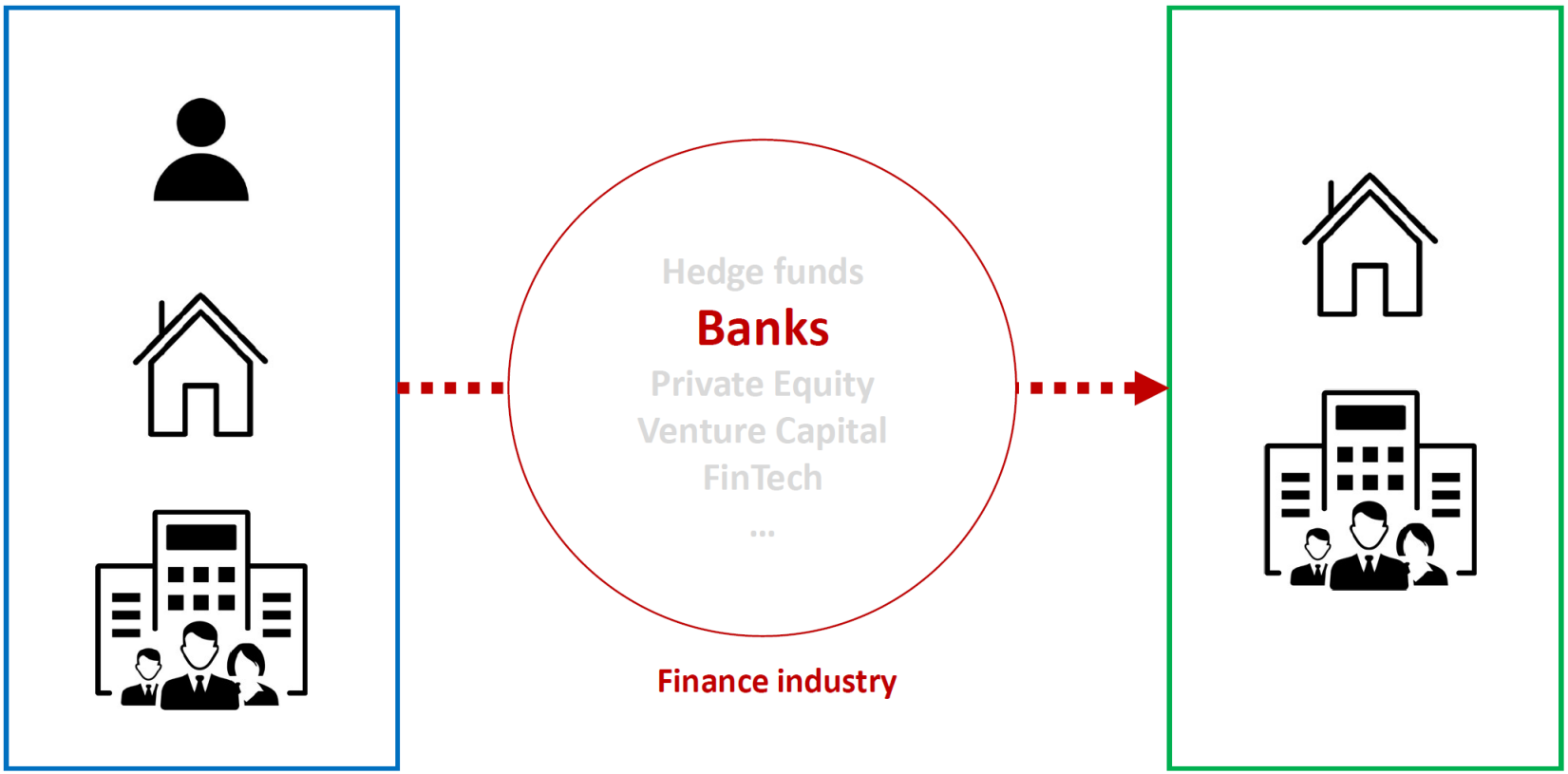
Informed intermediation between lenders and borrowers



$\Rightarrow$ Matching saving needs with demand of money

What is the finance industry about ?

Informed intermediation between lenders and borrowers



Banks as informed intermediaries

- Banks are informed intermediaries – this idea dates back at least to Leland and Pyle (1977). Read this classic paper!
- Their insight: the **bridging of informational asymmetries** is a key reason for financial intermediaries to exist. Pretty much all of the modern banking literature agrees with this view.

Banks as informed intermediaries

- Banks are informed intermediaries – this idea dates back at least to Leland and Pyle (1977). Read this classic paper!
- Their insight: the **bridging of informational asymmetries** is a key reason for financial intermediaries to exist. Pretty much all of the modern banking literature agrees with this view.
- We'll learn a lot more about financial intermediation and asymmetric information in a few weeks. But for now, it suffices to know that information matters in banking. A lot.
- That prompts two interesting questions: (i) Are banks at risk of disruption by digital intermediaries? (ii) If so, what (if anything) is preventing this from happening already?

Almost forgotten core business: Payments

- One key function of bank deposits is: they can be used like money to make payments.
- A certified check drawn on your checking account is practically as good as the green dollar bills themselves.
- Banks have become specialists in the payment business. Why is it important ?

Almost forgotten core business: Payments

- One key function of bank deposits is: they can be used like money to make payments.
- A certified check drawn on your checking account is practically as good as the green dollar bills themselves.
- Banks have become specialists in the payment business. Why is it important ?
- **Regulation** has helped to keep the circle of players in payment business manageable : one needs a banking license to connect to core payment infrastructure
- First hypothesis : one reason why banks haven't seen much disruption (yet) is because up to now they held a monopolistic position with respect to payments, which are a necessary ingredient to most financial intermediation concepts.

The rare blessing of tough regulation

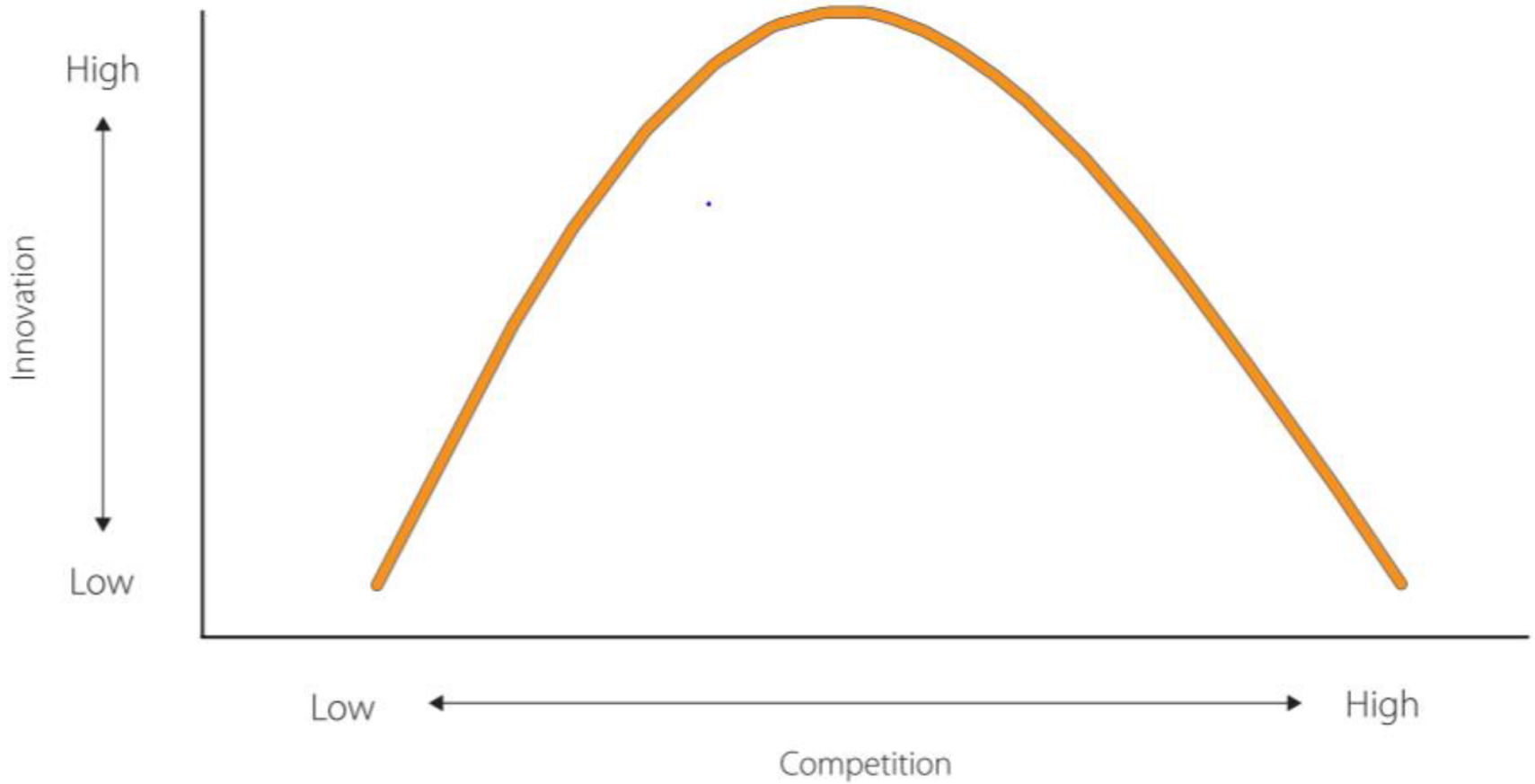
- A banking license is hard to come by
- It takes years of preparation to build a business from scratch that can handle all the regulatory norms that banks are required to comply with
- We will learn soon more why banks are so tightly regulated, and why this normally is a good thing, even though banks tend to hate it
- But tough regulation also creates really big barriers to entry for new players
- Second hypothesis : since banks are so tightly regulated and barriers to entry into full-fledged financial intermediation markets are particularly high, they have so far enjoyed some protection from disruptive digital innovation

The rare blessing of tough regulation

- If you think of developing a fully digital bank, be told : you wouldn't be the first to try. But the potential for success has never been as big as it is now

Regulation (Competition) vs. innovation ?

Aghion et al., 2002



Regulation (Competition) vs. innovation ?

Outside Econ and Finance too [Link to the study]

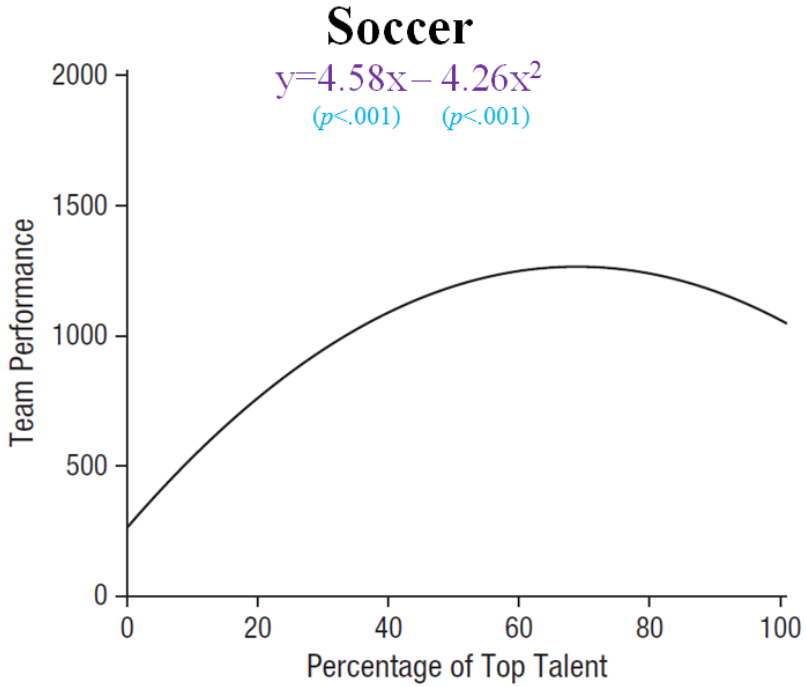


Fig. 2. Results from Study 2: team performance during the 2010 and 2014 FIFA (Fédération Internationale de Football Association) World Cup qualification periods as a function of the percentage of top talent on the team's roster.

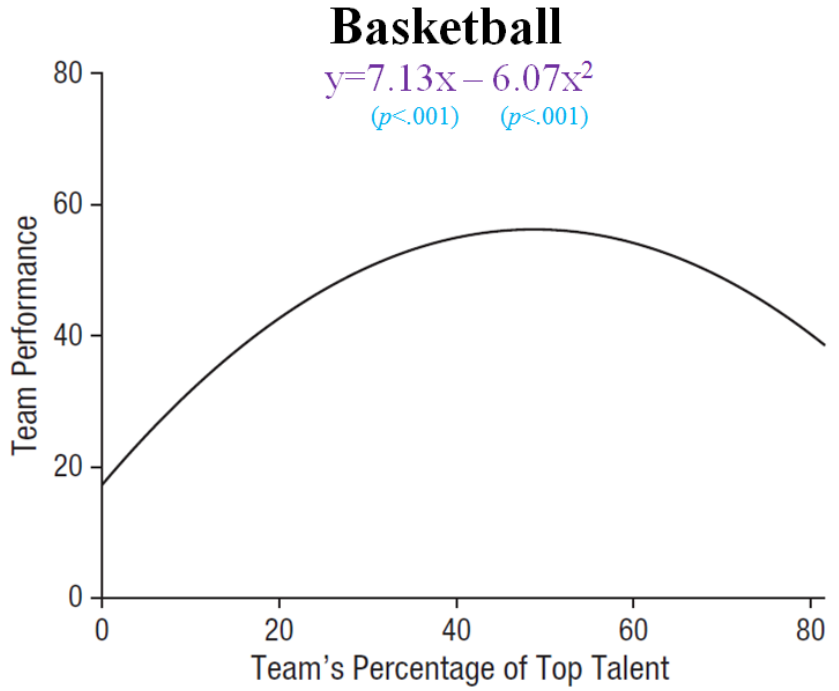


Fig. 3. Results from Study 3: team performance in the National Basketball Association from 2002 through 2012 as a function of the percentage of top talent on the team's roster.

Regulation vs. innovation ?

- For quite some time, the debate in regulation was all about how to limit risk taking by intermediaries. This was clearly necessary. But more recently the tone has shifted

- Regulators and legislators understand quite well that regulation offers a comfortable protection against disruptive innovators

- They have been pushing banks to create the necessary space for innovations :

Regulation vs. innovation ?

- For quite some time, the debate in regulation was all about how to limit risk taking by intermediaries. This was clearly necessary. But more recently the tone has shifted
- Regulators and legislators understand quite well that regulation offers a comfortable protection against disruptive innovators
- They have been pushing banks to create the necessary space for innovations :
- In Europe, the European Payment Systems Directive 2 (PSD2) has just come into effect few years ago (2017, but PSD3 is coming!). It requires banks to offer an API to all account and payment functions that can be used by lightly regulated external electronic intermediaries.
- Worldwide, regulators have remained exceptionally lenient as far as the regulation of cryptocurrencies and cryptoassets is concerned.

Regulation vs. innovation ?

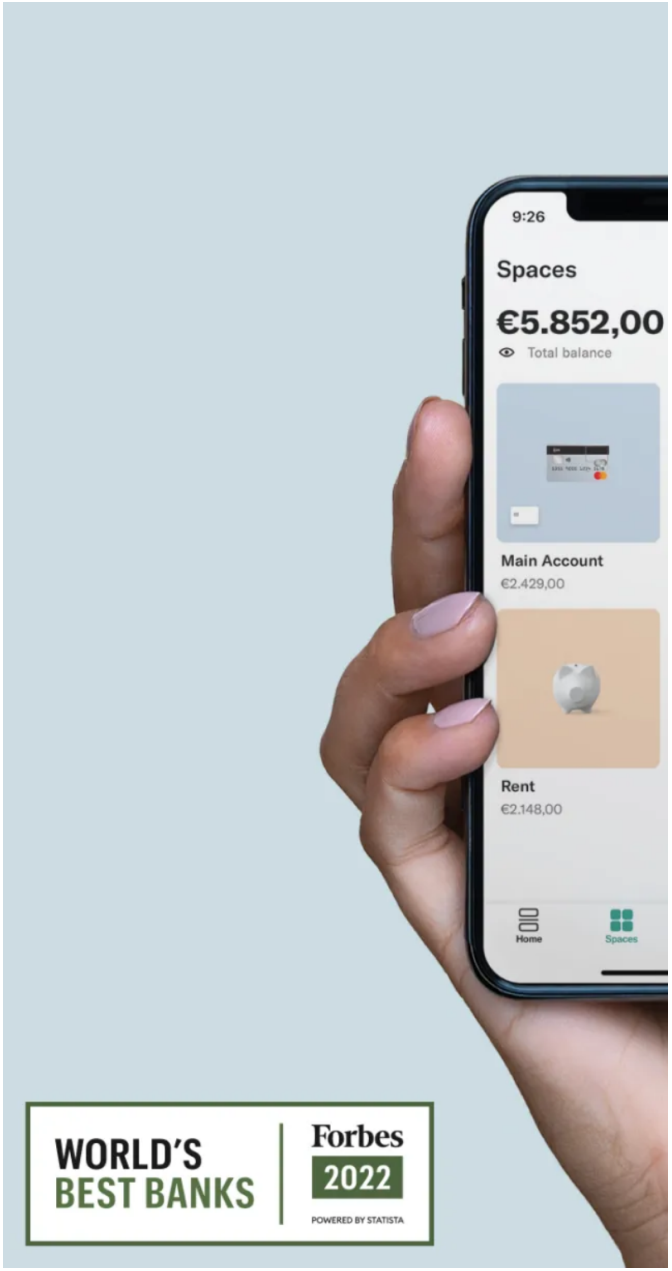
- For quite some time, the debate in regulation was all about how to limit risk taking by intermediaries. This was clearly necessary. But more recently the tone has shifted
- Regulators and legislators understand quite well that regulation offers a comfortable protection against disruptive innovators
- They have been pushing banks to create the necessary space for innovations :
- In Europe, the European Payment Systems Directive 2 (PSD2) has just come into effect few years ago (2017, but PSD3 is coming!). It requires banks to offer an API to all account and payment functions that can be used by lightly regulated external electronic intermediaries.
- Worldwide, regulators have remained exceptionally lenient as far as the regulation of cryptocurrencies and cryptoassets is concerned.
- Reason : substantial concern of choking a potentially promising new technology (even if that means that fraudsters would have an easy life for a while)

FinTech ?

Old FinTech

- Banks, funds and venture capitalists have not been averse to using technology as it provided huge cost saving opportunities
- They were among the first industries to adopt computers and use them for account processing
- E.g., many banks were quick in deploying internet banking, making their existing business functions accessible via a website.
- In this context, **FinTech was the word used to refer to the new digital technologies adopted by incumbents players**
- It was and remains a tool for the production, not the disruption, of standard banking services

Today's FinTech = *Big Data Finance*



- New data (alternative data) and new methods (Machine learning) are available
- Jamie Dimon, CEO of JPMorgan Chase, wrote in 2016 that *"Silicon Valley is coming"*
- Incumbents are massively investing + tons of new entrants !
  - In 2019 alone $55 billion have been invested in FinTech firms worldwide
  - Firms like Revolut and N26 are currently disrupting banking

Today's FinTech

Before vs. After

Wealth Management

- Before :
  - Portfolio and wealth managers relied on custom models
  - Human portfolio managers estimate clients' risk aversion
- Today :
  - Algorithm and new data outperform old tools
  - Automated market decisions

Credit Lending (e.g., N26, Prosper, etc.)

- Before :
  - Labor-intensive operation
  - Human credit officers
  - Biased, inefficient process
- Today :
  - Quant credit-rating models
  - Many startups issue online loans
  - End of banks' monopoly

\+ many other fields : payment services (TransferWise), etc.

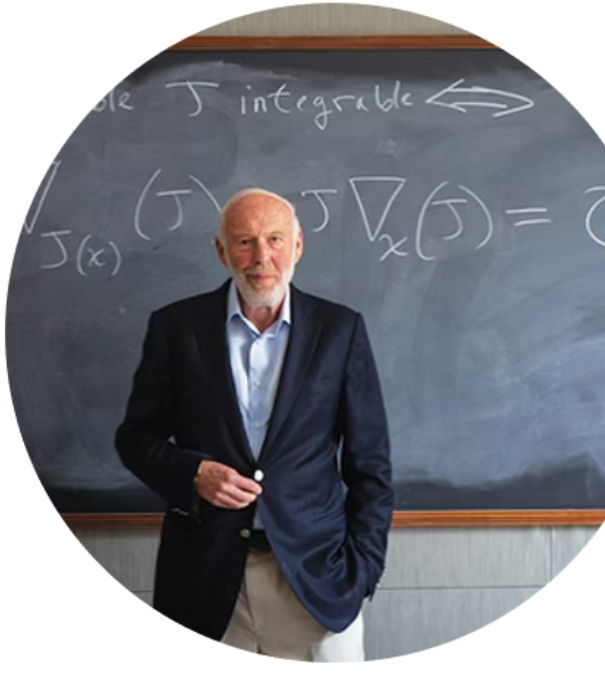
Today's FinTech

Before vs. After

- Wealth Management: Aladdin (Asset, Liability and Debt and Derivative Investment Network) by BlackRock
  - As of 2020, Aladdin managed $21.6 trillion in assets
  - about 7% of the world's financial assets
  - keep track of about 30,000 investment portfolios.

Today's FinTech

Before vs. After



Today's FinTech

Blockchain minus Hype

- Closely tied to the *new* FinTech is the rapid evolution of Blockchains like Bitcoin, Ethereum, Algorand
- Blockchains have also enabled a new form of fundraising, ICOs – we'll look at them later, but be told that there's a lot of hype

Today's FinTech

Blockchain minus Hype

- Closely tied to the *new* FinTech is the rapid evolution of Blockchains like Bitcoin, Ethereum, Algorand
- Blockchains have also enabled a new form of fundraising, ICOs – we'll look at them later, but be told that there's a lot of hype
- Despite all the hype, I believe that there is at least one fundamental aspect in blockchain that will prove of long-term significance. It has the ability to shake the core foundations of our existing financial intermediation industry
- Blockchain is the first technology that can provide a network in which rights of any kind can be electronically assigned : property rights, control rights, ownership of financial assets. Payments is one important, but maybe not even the most important, application of this principle
- We will hear more in this course about Blockchain, and we'll get our hands dirty with code such that we can truly understand its potentials and issues.

Today's FinTech : The dark side ?

- Market inefficiency
- Fraud
- Biased algorithm
- Much more: we also will talk about all that

What does it means for you ?

- Tech comes first at all of these new players. **They hire more machine learning engineers than bankers with tie**
- Employment demand is shifting into Fintech space: traditional areas, like credit trading, still exist, but even those are being redone by Fintech.

$\Rightarrow$ Taking this course is a great start

Take away

- The big picture: things have started moving a lot, and they likely will disrupt the existing world of finance
- The details: we'll learn about many of these players, their strategies and problems as this class proceeds

Discussion