

TNITNEWS

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Economics in the age of big data (p.3)

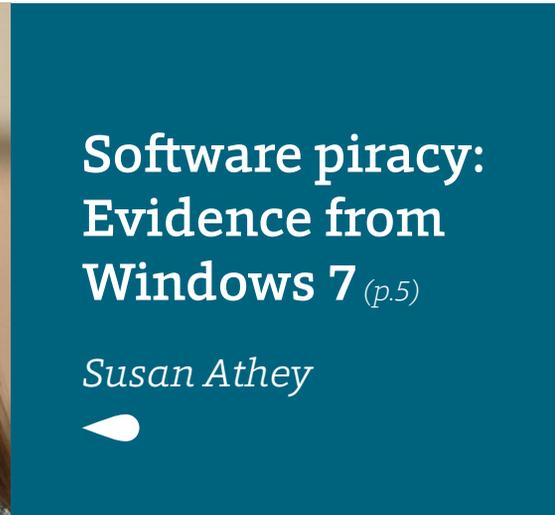
Jonathan Levin

This article draws on 'The Data
Revolution and Economic Analysis'
by Liran Eirav and Jonathan Levin



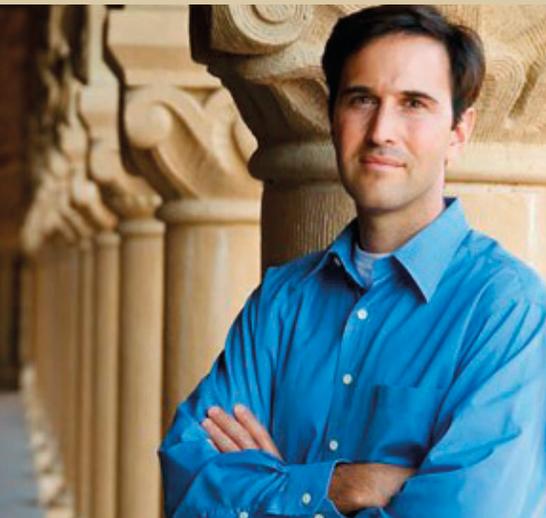
Software piracy: Evidence from Windows 7 (p.5)

Susan Athey



Management in America: Southern comfort from good practices? (p.7)

Nicholas Bloom



How, why, when, who, what ?

HOW much
ideological segregation
is there in online news
consumption? (p.9)

Matthew Gentzkow



TNIT 2013 Annual meet :
*Other research by TNIT
members*

➔ **Managing innovation
in a crowd**

Daron Acemoglu

➔ **The welfare effects
of vertical integration**
(Work in progress)

Michael Whinston



Dear Readers

We began this year with terrible news which has brought great sadness to our community. Suzanne Scotchmer, professor of economics and law at Berkeley and a member of the TNIT from 2005-2012 passed away on January, 30. We have lost her before time but she has left us her voluminous contribution in economic theory, her pathbreaking work on intellectual property, and decisive contributions to club theory and evolutionary game theory. We will dedicate the next issue of the TNIT newsletter to Suzanne who is missed a lot!

In this issue of the TNIT newsletter we unfold the work presented by the TNIT members at the Annual Meeting held in Redmond in October 2013. You will find pieces by Jonathan Levin, Susan Athey, Nicholas Bloom and Matthew Gentzkow covering areas as diverse as big data, software piracy, IT & management in America, and ideological segregation in online news consumption. You will also find an insight on the other research presented during the 2013 Annual Meeting.

A special thank you to Romesh Vaitilingam for his editorial contributions.

We hope that you enjoy reading about the research of our members, a truly outstanding group of researchers in the areas of intellectual property, the internet and software industries!

Jacques Crémer & Yassine Lefouili



Jacques Crémer



Yassine Lefouili

The Toulouse Network for Information Technology (TNIT) is a research network funded by Microsoft and managed by the Institut d'Économie Industrielle. It aims at stimulating world-class research in the Economics of Information Technology, Intellectual Property, Software Security, Liability, and Related Topics.

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Economics in the age of big data

by Jonathan Levin

[More about J. Levin](#) 

Professor & Chair
at Stanford University

Photo: Thinkstock



Large-scale administrative datasets and proprietary private sector data can greatly improve the way we measure, track and describe economic activity. Liran Einav and TNIT member Jonathan Levin outline some of the opportunities and challenges for economic researchers in accessing and using these ‘big data’.

Twenty years ago, data on economic activity were relatively scarce. Economists of our generation were trained to work with small datasets and econometric methods that may turn out to be quite different from those that current graduate students will use. In this essay, we suggest some of the opportunities that big data offers and how economic research might adapt to take full advantage of them.

In his 2010 Ely Lecture to the American Economic Association, Hal Varian linked the expansion of economic data to the rise of ‘computer mediated’ transactions. As an example, consider retail transactions. A few decades ago, a store might have tracked daily sales, perhaps split by products or product categories. Scanners made it possible for retailers to record individual purchases easily and automatically, and if customers were using loyalty cards, to link purchases over time and create customer histories for use in marketing and promotions.

Nowadays, an Internet retailer records far more than a customer’s purchases: they track her search queries, the items she viewed and discarded, the recommendations or promotions she saw and the reviews she might leave subsequently. In principle, these data can be linked to other online activity, such as browsing activity, advertising exposure or social media consumption.

A similar evolution has occurred in industries such as financial services, healthcare and real estate, and also in business activity. As firms have moved their operations online, it has become possible to compile rich datasets of sales contacts, hiring practices and physical shipments of goods. Increasingly, there are also electronic records of collaborative work efforts, personnel evaluations and productivity measures. The same story applies to the public sector

in terms of the ability to access and analyze tax filings, government expenditures and regulatory activities.

What opportunities do these new data offer for economic research? One possibility is the creation of new economic statistics that allow for closer and more disaggregated tracking of economic activity. For example, during the financial crisis, there were relatively limited data available on how sharply consumer spending was dropping and how difficult firms were finding it to obtain credit and maintain their working capital.

Improved data can also facilitate and enhance the type of empirical research that economists have been doing for decades: documenting and explaining historical patterns of economic activity and finding research designs that make it possible to trace out the causal effects of different policies. In fact, more granular and comprehensive data are likely to allow a range of clever and novel research designs: for example, by matching individuals more finely to create plausible control groups; or by taking advantage of discrete policy changes that create discontinuities in a cross-sectional or time-series dataset with many closely spaced observations.

New data may also lead economists to adopt and develop new econometric tools. A natural candidate is the big data predictive modeling techniques that already are widely used in statistics and computer science. These tools have not yet caught on much with economists - perhaps because the emphasis they place on prediction seems so different from the causal identification framework that has dominated empirical microeconomics.

But in our view the distinction is not so sharp, and these techniques are likely to become quite popular, whether to construct single dimensional measures of heterogeneity for use in economic models

(for example, risk scores, credit scores and quality scores) or to construct matched samples or instruments for causal inference.

What challenges do economists need to overcome to take advantage of new data? A number of open issues revolve around data access. For a long time, empirical research in economics relied heavily on government survey data, which had the virtue that there were well-established (though sometimes cumbersome) protocols for accessing and using these data, and results could be verified or refined over time.

These systems are still being worked out for the US administrative data that recently have been used for research: from the Internal Revenue Service, Medicare or the Social Security Administration. Some European countries, such as Norway, Sweden and Denmark, have gone much further to facilitate research. Their experience suggests that broader access is possible, and that reducing barriers to data access can have a profound effect on the amount of research and the quality of what is learned.

Accessing private data creates other issues. Not every company wants to work with researchers. Many see it as potentially beneficial and a useful way to learn from outsiders; but others may view it as a distraction or worry about the publicity risks.

To mitigate these risks, researchers who collaborate with companies generally need to enter into contracts to prevent disclosure of confidential information, and may face some limits on questions they can investigate. Our experience has been that the benefits of working with company data generally far outweigh the costs, but that a fair amount of effort on both sides is required to develop successful collaborations.

Private sector data can also be limited. They often contain information only on a firm's customers, who may not be representative even within a particular industry. In addition, many private datasets are collected for transactional purposes, and may contain a specific set of information that is ideal for some purposes but not for others.

For example, there is a computerized record of practically every physician visit in the United States, but it is generally an insurance claim that records the information necessary for payment, but not necessarily any type of actual health information, such as patients' biometrics or how they feel. It also is not easily linked to employment records, household financial information or social network indicators. It is possible that what we can learn from individual private datasets will prove to be far less than what might be learned from linking information that is currently separated.

A second challenge for economists is learning the skills required to manage and work with large datasets. Virtually all successful internet firms - and many firms in other sectors - are investing not

just in data storage and distributed data processing, but in skilled computer scientists and engineers. At Stanford, we have heard of computer science majors earning over \$200,000 in their first year out of college - talk about a skill premium!

Interestingly, however, even when these companies hire 'data scientists' to look for empirical patterns in their data, they generally focus on engineers rather than economists. Our expectation is that future economists who want to work with large datasets will have to acquire some new skills so that they can combine the conceptual framework of economics with the ability to implement ideas on large-scale data.

Finally, a big challenge in our view is that just having a lot of data does not automatically make for great research. In fact, with very large, rich datasets it can be non-trivial just to figure out what questions can be answered. While in the past, researchers could simply browse through their dataset and get a sense of its key features, large datasets require time and effort for conceptually trivial tasks, such as extracting different variables and exploring relationships between them.

Looking at our own experience over the last few years, and the experience of our students who have done successful projects with internet data from retail platforms (eBay), job matching platforms (oDesk, freelancer), lending platforms (prosper), sharing platforms (airbnb, taskrabbit) and financial management sites, one pattern is that most projects started with a relatively long and slow process of figuring out exactly what was in the data and how to work with it.

The situation may turn out to be different with administrative datasets to the extent that they end up being used by many researchers: over time, there will be common learning about advantages and drawbacks of the data, as well as various methods for organizing the data and exploring different questions. This may be one further difference between research with government datasets, which if access is increased may occupy many economists, relative to research with proprietary datasets that are likely to allow much more limited access.

Overall, it seems pretty clear to us that over the next few decades, big data will change the landscape of economic research. We don't think it will substitute for common sense, economic theory or the need for careful research designs. Rather, new data will complement them. How exactly remains to be seen.

This article draws on 'The Data Revolution and Economic Analysis' by Liran Eirav and Jonathan Levin.

Liran Eirav and TNIT member Jonathan Levin are at Stanford University.

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Software piracy: Evidence from Windows 7

by Susan Athey

Stanford University
and Microsoft Research

[More about S. Athey](#) 



How do consumers most commonly pirate software? Does software piracy vary across countries and intellectual property regimes? And can enforcement actions against popular pirating websites make a difference? TNIT member Susan Athey and Scott Stern look at evidence from Microsoft’s Windows 7 operating system.

In the summer of 2009, Microsoft planned to release a new version of its flagship operating system, Windows 7. The redesign of the core operating system, as well as the development of bundled applications and features, represented a significant investment, with approximately 2,500 developers, testers and program managers engaged on the project for several years.

Perhaps more than any other Microsoft product before it, Windows 7 was designed with a global market in mind. The company explicitly included a large number of features aimed at serving this global market, including putting a ‘multilingual user interface’ in the most advanced version, Windows Ultimate, and creating a low-priced version, Windows Home Basic, which was targeted specifically at emerging markets.

But just weeks after the release of the final version of the software and individualized product ‘keys’, a number of websites reported that one of the original equipment manufacturer master product keys had been hacked and released onto the internet. Over the course of 2009, a number of additional leaked methods for pirating Windows 7 appeared, and by 2012, there was a large number of country-specific unauthorized Windows installation web pages, often tailored to specific languages or countries.

In a recent study, we use anonymized telemetry data from Microsoft’s experience with Windows 7 to characterize the ways in which software piracy occurs; the relative incidence of piracy across different economic, institutional and technology environments;

and the impact of enforcement efforts on consumers’ choices about whether to install pirated versus paid software.

We document a range of findings. First, we document the importance of a distinctive form of software piracy: the global reuse of individual product keys, with sophisticated and active user communities that develop easy-to-follow instructions and protocols.

While the use of peer-to-peer networking sites has been associated for more than a decade with piracy of ‘smaller’ products, such as music or video, there is now a relatively direct way that any broadband user can access a fully functional version of Windows for free through the Internet.

Second, we document that the vast majority of ‘retail piracy’ can be attributed to a small number of widely distributed ‘hacks’ that are available through the internet. In addition, software piracy primarily focuses on Windows Ultimate, and piracy for this product is so pervasive that over 70% of the installations of this product worldwide are pirated.

This complicates potential efforts to deter piracy by offering ‘low-end’ versions of Windows at a greatly reduced price or free ad-supported versions. The best versions of Windows are used by pirates and they would be unlikely to choose an inferior product at the same price (zero).

Third, we evaluate how software piracy varies across different economic, institutional and technology environments. In addition

to traditional economic measures such as GDP per capita (and more nuanced measures, such as the level of income inequality), we also gather data characterizing the overall quality of the institutional environment, the ability of individuals within a country to take advantage of broadband and the ‘innovation orientation’ of a country.

Our results suggest that the level of piracy in a country is closely associated with its institutional and infrastructure environment. For example, piracy is negatively associated with a number of traditional measures of the strength of legal and political institutions; it rises with greater accessibility and speed of broadband connections (faster broadband reduces the time required for pirating); and it declines with the higher innovation intensity of an economy.

Most importantly, after controlling for a small number of measures for institutional quality and broadband infrastructure, it turns out that the most natural candidate as the main driver of piracy - GDP per capita - has no significant impact on the observed piracy rate. In other words, while the pair-wise correlation between piracy and GDP per capita is strongly negative, there is no direct effect from GDP per capita.

Poorer countries tend to have weaker institutional environments - and it seems that it is the environment rather than income per se that is correlated with the observed level of piracy. Importantly, this finding stands in contrast to previous research, which has not effectively disentangled the role of institutions from the role of income per se.

Finally, we take advantage of time-series variation in our data to investigate directly the impact of the most notable anti-piracy enforcement efforts on the rate of Windows 7 piracy. Specifically, during the course of our 2011 and 2012 sample period, a number of individual countries imposed bans on Pirate Bay, the single largest source of pirated digital media on the Internet.

Though such policy interventions are endogenous (the bans arise in response to broad concerns about piracy), the precise timing of the intervention is reasonably independent of the specific piracy of Windows 7. Hence, it is instructive to examine

how a change in the level of enforcement against piracy affects the rate of Windows 7 software piracy. Over a range of different anti-piracy enforcement efforts, we find no evidence for the impact of enforcement efforts on observed piracy rates.

Overall, our research offers the first large-scale observational study of software piracy. The analysis highlights the value of emerging forms of passively created data, such as the Windows telemetry data, and also the role of both institutions and infrastructure in shaping the total level of piracy.

This article summarizes ‘The Nature and Incidence of Software Piracy: Evidence from Windows’ by Susan Athey and Scott Stern

TNIT member Susan Athey is at Stanford University and Microsoft Research. Scott Stern is at MIT Sloan School.

[Full paper here](#) 

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Management in America: Southern comfort from good practices?

by *Nicholas Bloom*
Stanford University

[More about N. Bloom](#) 



In 2010, the US Census Bureau conducted the first large-scale survey of management practices in America, gathering data on more than 30,000 manufacturing plants. TNIT member Nicholas Bloom and colleagues find strong links between establishments' performance and the quality of their systems of monitoring, targets and incentives. They also show that American management practices are more structured in the South and Midwest than in the West or on the East Coast.

Business schools have long stressed the importance of good management, but until recently economists have been reluctant to concur given the paucity of data beyond case studies. But over the last few years, researchers have started to build international management databases, analysis of which makes it possible to explore the role of management practices in driving differences in firm and national performance.

One of the most detailed recent datasets comes from the US Census Bureau, which in 2010 conducted a large management survey of over 30,000 manufacturing establishments. We have conducted the first analysis of the data gathered by the Management and Organizational Practices Survey (MOPS).

The MOPS comprised 36 multiple-choice questions about the establishment and it took about 20 to 30 minutes to complete. The questions were divided into three parts: management practices (16 questions), organization (13 questions) and background characteristics (7 questions).

The management practices covered three main sections: performance monitoring, targets and incentives. The monitoring section asked firms about their collection and use of information to monitor and improve the production process – for example, how frequently were performance indicators tracked, with options ranging from 'never' to 'hourly or more frequently'.

The targets section asked about the design, integration and realism of production targets – for example, what was the timeframe of production targets, ranging from 'no production targets' to 'combination of short-term and long-term production targets'.

The incentives section asked about non-managerial and managerial bonus, promotion and reassignment or dismissal practices – for example, how were managers promoted, with answers ranging from 'mainly on factors other than performance and ability, for example, tenure or family connections' to 'solely on performance and ability'.

We aggregate the responses into a single summary measure of structured management scaled from 0 to 1: 0 represents an establishment that selected the bottom category (little structure around performance monitoring, targets and incentives) on all 16 management dimensions; and 1 represents an establishment that selected the top category (an explicit focus on performance monitoring, detailed targets and strong performance incentives) on all 16 dimensions.

The organization section of the survey covered questions on the decentralization of power from the headquarters to the establishment manager. This asked, for example, where decisions were made on pay increases, ranging from 'only at headquarters' to 'only at this establishment'. A second set of questions asked

about an establishment's span of control and reporting levels, for example, how many employees reported directly to the establishment manager.

A final set of questions asked about the use of data in decision-making (with response options ranging from 'does not use data' to 'relies entirely on data'); and how managers learn about management practices ('consultants', 'competitors', etc.).

Our initial analysis of these data shows several striking results. First, structured management practices for performance monitoring, targets and incentives are strongly linked to more intensive use of information technology (IT). Plants using more structured practices have higher levels of investment in IT per worker and more investment in IT overall, and they conduct more sales over electronic networks.

Second, more structured practices are tightly linked to better performance: establishments adopting these practices display greater productivity, profitability, innovation and growth.

Third, the relationship between structured management and performance holds over time within establishments (establishments that adopted more of these practices between 2005 and 2010 also saw improvements in their performance) and across establishments within firms (establishments within the same firm with more structured practices achieve better performance outcomes).

Fourth, there is a substantial dispersion of management practices across the establishments: 18% of establishments had adopted at least three quarters of these more practices, while 27% of establishments had adopted less than a half.

Fifth, more structured practices are more likely to be found in establishments that export, that are larger (or are part of bigger firms) and that have more educated employees. Establishments in America's South and Midwest have more structured practices on average than those in the Northeast and West. The reasons for this geographical difference are not yet clear, but it may be partly explained by such factors as firm size and industry, and state-specific policies.

Sixth, management practices appear to have become more structured between 2005 and 2010. Breaking down the 16 dimensions into sub-groups, we find that most of the rise in structured management has come in data-driven performance monitoring. This could reflect the increasing use of IT, which makes it easier for establishments to collect, display and analyze performance data.

Establishments with high scores on performance monitoring measured a wide range of indicators (production, cost, waste, inventory, defects, energy use, absenteeism, deliveries on time, etc.), reviewed them with managers and non-managers on at least a daily basis and displayed the measures prominently around the establishment. Establishments with low scores collected very little performance data, evaluated them infrequently and typically did not publicly display the information.

The other sub-sets of questions were incentives and targets, which focus on practices around pay, promotions, hiring and firing, alongside the range, depth and effectiveness of targets. These also appear to have become more structured.

To investigate the sources of these improvements in management, we examine where the managers learned about new practices. The most common source, reported by over half of the establishments, is a firm's headquarters. This suggests that one explanation for the more structured management of multi-establishment firms is the ability of individual establishments to learn from others within the same firm.

Trade associations and conferences are noted by just under half of establishments as a source of new management practices. Next come consultants, reflecting the role of paid management consultants in helping firms adopt modern practices. And after that come customers and suppliers, which each account for more than a third of respondents' reported sources of new practices.

This article summarizes 'IT and Management in America' by Nicholas Bloom, Erik Brynjolfsson, Lucia Foster, Ron Jarmin, Megha Patnaik, Itay Saporta-Eksten and John Van Reenen.

TNIT member Nicholas Bloom, Megha Patnaik and Itay Saporta-Eksten are at Stanford University. Erik Brynjolfsson is at MIT. Lucia Foster and Ron Jarmin are at the US Census Bureau. John Van Reenen is at the London School of Economics.

[Full paper here](#) 



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HOW

why, when,
who, what ?



[More about M. Gentzkow](#) ↓

[Back](#)

by *Matthew Gentzkow*

is the Richard O. Ryan Professor of Economics and Neubauer Family Faculty Fellow at the University of Chicago Booth School of Business.

HOW much ideological segregation is there in online news consumption?

How does the internet affect the likelihood of citizens being exposed to information that may contradict their existing views? As news consumption increasingly moves online, the answer to this question has important ramifications for politics. Guaranteeing exposure to information from diverse viewpoints has long been a central goal of media policy in the United States and elsewhere.

The answer is by no means obvious: while internet access makes it easier to read a wide range of opinions, it is also easier for people to 'self-segregate' themselves ideologically. Many US commentators believe that what has emerged is the latter outcome - a series of 'echo chambers' in which like only listen to like.

Cass Sunstein for example, says that 'People sort themselves into innumerable homogenous groups, which often results in amplifying their pre-existing views. Liberals reading mostly or only liberals; conservatives, conservatives; Neo-Nazis, Neo-Nazis.' He concludes that this leads to a reduction in the 'unplanned, unanticipated encounters that are central to democracy itself.'

In research with my colleague Jesse Shapiro, we measure the degree of ideological segregation in the market for online news and compare it with other news sources. Analyzing data on the news consumption habits of a panel of internet users, we define for each news outlet the share of users who report their political outlook as 'conservative' among those who report being either 'conservative' or 'liberal'.

We then define each individual's conservative exposure as the average share of conservative users on the outlets she visits. For example, if all she visits is the New York Times, her exposure is defined as the share of conservative users on that site. If she visits both the New York Times and Fox News, her exposure is the average of the share of conservative users on those two sites.

Next, we define the isolation index as the difference in the average conservative exposure of conservatives minus the average conservative exposure of liberals. If conservatives only visit Fox News and liberals only visit the New York Times, the isolation index will be 100. If both conservatives and liberals get all their news from CNN's site, the two groups will have the same conservative exposure and the isolation index will be zero.

Our results indicate that the degree to which liberals and conservatives are isolated from each other's opinions is low in absolute terms. The average internet news consumer's expo-

sure to conservatives is 57%. The average conservative's exposure is 60.6%, similar to a person who gets all her news from USA Today. The average liberal's exposure is 53.1%, similar to a person who gets all her news from CNN.

News consumers with extremely high or low exposure are rare. Although many people go to sites with ideologically tilted audiences, such as Fox News or the Huffington Post, these are typically part of a news diet with heavy doses of more moderate sites. A consumer who got news exclusively from the New York Times would have a more liberal news diet than 95% of internet news users, and a consumer who got news exclusively from Fox News would have a more conservative news diet than 99% of internet news users.

Nevertheless, the segregation of online news is higher than for some other media: the isolation index for the internet is 7.5 percentage points, which compares with 1.8 for broadcast television news, 3.3 for cable television news, 4.7 for magazines and 4.8 for local newspapers. But the segregation of online news is lower than national newspapers, for which the index is 10.4. We estimate that eliminating the internet would reduce the ideological segregation of news and

Further analysis indicates that on the demand side, these key facts do not require correlation between taste for news and ideology, nor explicit taste for balance among news consumers. On the supply side, there are strong incentives for high-quality news sites to locate closer to the ideological center - but the more that the advertising market values exclusive readers, the stronger the incentives to differentiate ideologically.

FURTHER READING:

Matthew Gentzkow and Jesse Shapiro (2011) 'Ideological Segregation Online and Offline', Quarterly Journal of Economics 126(4): 1799-1839.

Matthew Gentzkow and Jesse Shapiro (2013) 'Ideology and Online News'

[Full paper here](#) ↓

TNIT 2013 Annual meet : Other research by TNIT members

Managing innovation in a crowd

by *Daron Acemoglu* (MIT)
with *Mohamed Mostagir and Asuman Ozdaglar*

[More about D. Acemoglu](#) ↓

Crowdsourcing is an emerging technology where innovation and production are sourced out to the public through an open call. This study develops a crowdsourcing model that considers two kinds of innovation tasks: structured and unstructured.

Structured tasks have unknown difficulties, but these difficulties come from a known distribution: they can be performed by any worker who possesses the necessary skills to complete them. On the other hand, unstructured tasks have no precise measure of difficulty, and the skills required to complete them are not well understood: they are usually completed by a worker through chance, human intuition and guesswork.

Whether a task is structured or unstructured is an unobservable attribute in the model developed in this paper. At the center of crowdsourcing is a resource allocation problem: there is an abundance of workers but a scarcity of high skills. This problem is exacerbated by the fact that the type and exact difficulties of innovation tasks may not be known in advance, so tasks that require skilled labor cannot be identified and allocated ahead of time.

The researchers show that when the pool of tasks consists of only structured tasks, the solution to the problem takes the form of a skill hierarchy, where tasks are first attempted by low-skilled labor, and high-skilled workers only engage with a task if workers with lesser skills are unable to finish it. If the pool of tasks contains both structured and unstructured tasks, then the optimal solution is generally not a hierarchy.

The paper next focuses on the optimal hierarchies for structured tasks. Organizing these hierarchies in crowdsourcing is difficult because firms have little information about the skills of the workers, and workers may have an incentive to misrepresent their skills. This complicates the firm's problem, since it now wants to find an optimal assignment of workers to tasks even though it knows neither the difficulties of the tasks nor the skills of the workers.

The researchers develop a dynamic pricing mechanism for tasks that uses the concept of self-selection. Each time a task is attempted and not finished, its price (reward on completion) goes up. By correctly setting the prices, the mechanism provides an incentive for workers to sort themselves into an optimal hierarchy - that is, workers participate in the same level of the hierarchy that would be produced if the firm had knowledge of the workers' skills, ultimately leading to the desired optimal matching between workers and tasks.

[Full paper here](#) ↓

The welfare effects of vertical integration

by *Michael Whinston* (MIT)
with *Gregory Crawford, Robin Lee and Ali Yurukoglu*

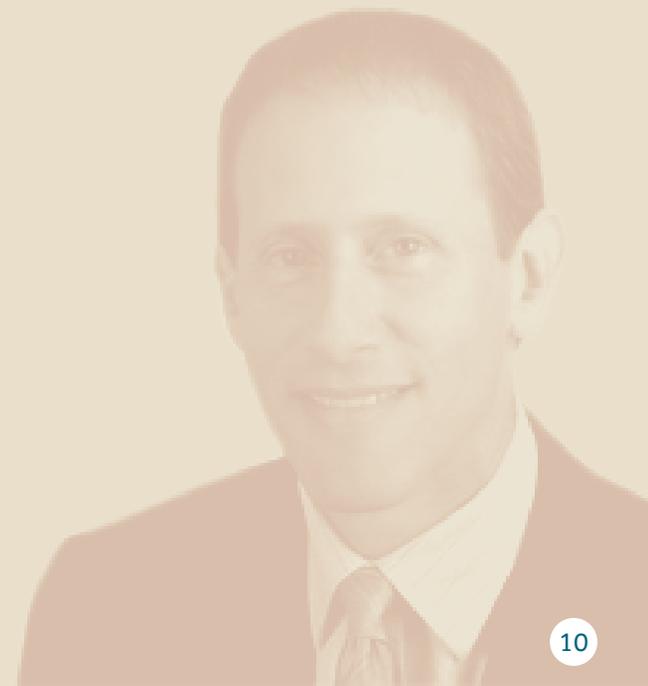
[More about M. Whinston](#) ↓

Work in progress

This study investigates the welfare effects of vertical integration in US multichannel television markets. Vertical integration in this market can enhance efficiency by aligning investment incentives and/or reducing 'double marginalization', but it can also increase market power by encouraging raising rivals' costs.

The researchers measure these competing effects in the carriage, channel placement and pricing decisions of regional sports networks (RSNs) by affiliated and unaffiliated cable and satellite television distributors. They carry out descriptive analyses that compare integrated and non-integrated RSNs and distributors' prices and carriage, investment levels and viewership ratings. They then estimate a model of viewership, subscription, distributor pricing, bargaining and investment in RSN quality.

The research team uses the estimated model to analyze the welfare effects of simulated vertical mergers and de-mergers and the closing of the so-called 'terrestrial loophole' by the US Federal Communications Commission.



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