Lost in the Clouds:

The Impact of Changing Property Rights on Investment in Cloud Computing Ventures

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Our analysis seeks to understand the impact of changing allocations of property rights on investment in new firms. We focus on the Cartoon Network, et al. v. Cablevision decision in the U.S., which narrowed the protection enjoyed by content creators (e.g., movie studios) and gave greater rights to downstream technology firms, as well as decisions in France and Germany that took an opposite view. Our findings regarding relative venture capital investment in the U.S. and Europe, across Europe, and between the various judicial circuits of the U.S. suggest that decisions around the allocation of property rights can have economically and statistically significant impacts on investment and innovation.

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1. Introduction

Ever since the seminal work of La Porta et al. [2000], the extent to which the strength and allocation of property rights can affect the evolution of financial markets has been widely appreciated. One of the primary channels through which property rights have been shown to matter is through their impact on the ability of firms to access capital. An extensive literature has suggested that if property rights are insecure, businessmen are unlikely to be able (or willing) to raise external financing to exploit new opportunities.

Country-level studies consistently show that less secure property rights are correlated with lower aggregate investment and slower economic growth; for instance, see the series of studies which relate economic performance to the measure of "protection against expropriation risk" compiled by the consulting firm Political Risk Services (e.g., Knack and Keefer [1995]; Hall and Jones [1999]; and, Acemoglu, et al. [2001, 2002]). Similarly, survey-based evidence suggests that insecure property rights are a major deterrent to investment at a firm-specific level, at least in part because weak rights increase the difficult of collateralizing borrowing (e.g., Johnson, et al. [2002]).

But stronger property rights need not be inevitably associated with more growth. Acemoglu [2003] shows that while protecting the property rights of a small elite may be sufficient if they control the society's major investment opportunities, in other cases such a step might be extremely detrimental to growth.

The consequences of property rights are particularly critical when evaluating intellectual property policies. An extensive theoretical literature suggests that shifts in the design of such property right schemes—in particular, the relative protection offered to initial innovators and those who do follow-on work—can have dramatic impacts on the rate and direction of

technological progress. For instance, if all the rewards go to the initial innovators, other firms are unlikely to be able to access resources for follow-on innovations (e.g., Gilbert and Shapiro [1990]; Scotchmer [2004]; Hopenhayn, et al. [2006]; and, Boldrin and Levine [2008]).

The empirical literature on the impact of changes in the nature of property rights on the ability to finance innovation, however, remains inconclusive (see, for instance, Sakakibara and Branstetter [2001]; Branstetter, et al. [2006]; and, Lerner [2009]). Many of the difficulties stem from the difficulties of identifying appropriate "natural experiments." Legislation altering intellectual property rights is often undertaken in conjunction with other policy reforms or in response to shifting economic circumstances. Moreover, empirical studies to date have largely focused on the patent regime: given the long lag times between discoveries and commercial application in many technical fields, identifying what effects may exist empirically can be especially challenging.

The shorter time lags between the production and dissemination of creative activities and software suggest that examining the impacts of copyright law may be more promising. From a more practical perspective, the consequences of shifting copyright protection remains particularly controversial, given the intensity of real world controversies about the Digital Millennium Copyright Act and the proposed Stop Online Piracy Act.

This paper examines the effect of major but largely unanticipated changes in the allocation of copyright protection on venture capital (VC) investment in cloud computing companies. In particular, it examines the impact of the Second Circuit Court of Appeals' decision *The Cartoon Network, et al. v. Cablevision*, which was widely perceived as enhancing the property rights of cloud computing companies relative to the content owners such as major movie studios and

publishers. Meanwhile, decisions in French and German courts took substantially narrower views of these firms' property rights.

We focus on the impact of these decisions on VC investment because venture activity has been documented to have a positive impact on growth and innovation. Further, unlike corporate investment decisions, venture capitalists' decisions to invest in new firms are well-documented, and less likely to be affected by existing assets and capabilities of the firms. Thus, while VC represents only a fraction of total investment in this industry, it is a natural setting for understanding the impact of policy shifts.

To understand the impact of copyright protection changes on the willingness of venture capitalists to invest in cloud computing, we employ a difference-in-difference approach, hypothesizing that policy shifts affect investments in different geographies, sectors, and years in varying ways. Such analyses have been widely employed in the economics literature to examine the consequences of policy shifts.

To quantify the impact of copyright protection changes, we first analyze the effects on VC investment in cloud computing firms of the *Cablevision* decision in the U.S., which narrowed the protection enjoyed by content creators (e.g., movie studios) and gave greater rights to downstream technology firms using this content. We then examine court rulings in France and Germany, which were perceived as moving in the opposite direction. We find that VC investment in cloud computing firms increased significantly in the U.S. relative to the EU after the *Cablevision* decision, particularly in the geographies and sectors most affected by the decision. The *Cablevision* decision, along with court rulings in France and Germany, led to additional incremental investment in U.S. cloud computing firms that ranged from $728 million to approximately $1.3 billion over the two-and-a-half years after the decision. When paired with

the findings of the enhanced effects of VC investment relative to corporate investment, this may be the equivalent of $2 to $5 billion in traditional R&D investment.[3]

We also separately analyze the effects of the French and German court rulings on VC investment in cloud computing firms in these countries relative to that in other EU nations. We find that these rulings regarding the nature of copyright protection had significant negative impacts on investment. Specifically, we find that VC investment in cloud computing firms declined in Germany and France, relative to the rest of the EU, after the French and German rulings.

Taken together, our findings suggest that shifts in the allocation of property rights can have significant impacts on investment and innovation. At the same time, we must acknowledge that this is a partial equilibrium analysis, which does not allow us to assess social welfare. For instance, these decisions may have had different effects on the willingness of incumbent firms to invest, and may have shifted the mixture of investment away from basic research to more applied work.

The remainder of the paper is structured as follows. Section 2 justifies the use of venture financing as an indicator, and provides background on the *Cablevision* decision in the U.S. as well as on the French and German court rulings. Section 3 discusses the data used in our analyses, Section 4 presents our results from the analysis of the *Cablevision* decision, and Section 5 presents our results from the analysis of the French and German rulings. Section 6 concludes the paper.

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[3] As discussed below, on average a dollar of venture capital appears to be 3.1 times more potent in stimulating manufacturing industry patenting than a dollar of traditional corporate R&D (Kortum and Lerner [2000]).

2. Background

2.1. Venture Financing as an Indicator

VC investment is important due to the relationship with innovation and job growth. It might be thought that it would not be difficult to address the question of the impact of VC. For instance, one could look at regressions across industries and time, and examine whether, controlling for R&D spending, VC funding has an impact on various measures of innovation. But, even a simple model of the relationship between VC, R&D, and innovation suggests that this approach is likely to give misleading estimates: both venture funding and innovation could be positively related to a third unobserved factor such as the arrival of technological opportunities. Thus, there could be more innovation at times that there was more VC, not because the VC caused the innovation, but rather because the venture capitalists reacted to some fundamental technological shock which was sure to lead to more innovation.

Hellmann and Puri [2000] address these concerns by examining a sample of 170 recently formed firms in Silicon Valley, including both venture-backed and non-venture-backed firms. Using questionnaire responses, they find empirical evidence that VC financing is related to product market strategies and outcomes of startups. They find that firms that are pursuing an "innovator strategy" (a classification based on the content analysis of survey responses) are significantly more likely and faster to obtain VC. The presence of a venture capitalist is also associated with a significant reduction in the time taken to bring a product to market, especially for innovators. Furthermore, firms are more likely to list obtaining VC as a significant milestone in the lifecycle of the company as compared to other financing events.

The results suggest significant interrelations between investor type and product market dimensions, and a role of VC in encouraging innovative companies. Given the small sample size and the limited data, they can only modestly address concerns about causality, and as a result, the

possibility remains that more innovative firms select VC for financing, rather than VC causing firms to be more innovative.

Kortum and Lerner [2000], by way of contrast, examine whether these patterns can be discerned on an aggregate industry level, rather than on the firm level. The authors address concerns about causality in two ways. First, they exploit the major discontinuity in the recent history of the VC industry: in the late 1970s, the U.S. Department of Labor clarified the Employee Retirement Income Security Act, a policy shift that freed pensions to invest in venture capital. This shift led to a sharp increase in the funds committed to venture capital. This type of exogenous change should identify the role of VC, because it is unlikely to be related to the arrival of entrepreneurial opportunities. They exploit this shift in instrumental variable regressions. Second, they use R&D expenditures to control for the arrival of technological opportunities that are anticipated by economic actors at the time, but that are unobserved to econometricians. In the framework of a simple model, they show that the causality problem disappears if they estimate the impact of VC on the patent-R&D ratio, rather than on patenting itself.

Even after addressing these causality concerns, the results suggest that venture funding has a strong positive impact on innovation. The estimated coefficients vary according to the techniques employed, but on average a dollar of VC appears to be three to four times more potent in stimulating manufacturing industry patenting than a dollar of traditional corporate R&D. The estimates, therefore, suggest that VC, even though it averaged less than three percent of corporate R&D from 1983 to 1992, is responsible for a much greater share – perhaps ten percent – of U.S. industrial innovations in this decade. Moreover, the venture-backed firms'

patents are more frequently cited and litigated, which suggests that the results are not being driven by patenting for its own sake.

There also appears to be a strong relationship between VC and job creation. There are several ways to see this relationship. Perhaps the most straightforward way is to take a snapshot of the public markets. By late 2011, venture-backed firms that had gone public made up over 11 percent of the total number of public firms in existence in the U.S. Those public firms supported by venture funding employed six percent of the total public-company workforce – many of which were high-salaried, skilled positions in the technology sector.[4]

Puri and Zarutskie [2010], in a more academically rigorous analysis, look at job creation by venture-backed firms. They highlight that many of the firms that receive venture backing for the first time have no revenues and very modest employment. They compare the evolution of venture-backed and non-venture-backed firms using the records of the U.S. Census's Longitudinal Business Database, which tracks both public and private entities. After venture financing, they find very rapid employment growth in venture-financed firms relative to non-venture-financed firms. While the venture-backed firms (and by construction, the matching entities) have an average of about 20 employees at the time of the initial financing, five years later the venture-financed firms have on average about 80 employees, while non-venture-financed firms have grown to around 30 employees. Beyond the fifth anniversary of the financing, they continue to see greater employment growth by venture-financed firms relative to non-venture-financed firms.

[4] Lerner [2012].

2.2. The U.S. Litigation: *The Cartoon Network, et al. v. Cablevision*

Section 4 focuses on a key juncture in copyright policy in the United States: the 2008 appellate decision in *The Cartoon Network, et al. v. Cablevision*.[5] It will compare VC investment in cloud computing in the U.S. against that in the EU (where the decision did not have bearing) both before and after the *Cablevision* decision by employing a differences-in-differences approach.

In 2006, Cablevision announced the development of a Remote Storage Digital Video Recorder (RS-DVR). Similar in operation to a traditional recorder, the Cablevision RS-DVRs allow customers to record, pause, and replay television content on a hard drive. Unlike traditional DVRs, however, in which a consumer installs and uses an appliance in their own home, the Cablevision RS-DVR was located remotely, recording to and playing back from remote servers. When a consumer hit the "record" button on their remote, the RS-DVR would start to record, just as if that RS-DVR were right in their living room. In response, a consortium of U.S. television and copyright holders filed a complaint against Cablevision in May 2006 over alleged copyright infringement.

In March 2007, the District Court declared a summary judgment against Cablevision.[6] As the appellate court subsequently narrated:

> [P]laintiffs successfully argued that Cablevision's proposed system would directly infringe their copyrights in three ways. First, by briefly storing data in the primary ingest buffer and other data buffers integral to the function of the RS-DVR, Cablevision would make copies of protected works and thereby directly infringe plaintiffs' exclusive right of reproduction under the Copyright Act. Second, by copying programs onto … hard disks …, Cablevision would again directly infringe the reproduction right. And third, by transmitting the data … to …

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[5] The current suits being brought against DISH by CBS, ABC, NBC, and Fox are another important legal matter with respect to third-party copyright infringement is; however, we do not analyze the impact of these suits since they have yet to be resolved. (See Molloy [2012]).

[6] *Twentieth Century Fox Film Corp. v. Cablevision Sys. Corp.*, 478 F. Supp. 2d 607 [S.D.N.Y. 2007].

> customers in response to a "playback" request, Cablevision would directly infringe plaintiffs' exclusive right of public performance.[7]

This decision attracted relatively little attention from the media and blogs, in large part because it was consistent with a series of earlier rulings that restricted the ability of third parties to distribute copyrighted material without authorization. For instance, in a 1991 case which anticipated many of the issues in the *Cablevision* case, a district court entered a declaratory judgment (i.e., a decision in advance of a trial, typically only issued when the undisputed facts reveal that one party will unambiguously prevail) in favor of seven major movie companies in a dispute with a firm that developed a system for the electronic delivery of movie video tapes.[8] Despite the fact that the firm, On Command, had legally purchased the videotapes that it transmitted to hotel guests, the court found that the firm's system infringed the studio's copyrights because it electronically transmitted the movies to hotel rooms (as opposed as physically renting the cassettes).

In August 2008, the District Court decision in *Cablevision* was reversed on appeal by the Second Circuit Court of Appeals.[9] The Circuit Court held that Cablevision's RS-DVR system did not infringe the plaintiffs' rights of reproduction and public performance on any of the three claimed grounds. The original decision was reversed, vacated, and sent back to be reconsidered by the lower court. In June 2009, the Supreme Court refused to hear the case, thereby effectively finalizing the Second Circuit's decision.

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7 *Cartoon Network, LP v. CSC Holdings*, 536 F.3d 121 [2d Cir. 2008].
8 *On Command Video Corp. v. Columbia Pictures Industries*, 777 F. Supp. 787 [N.D. Cal. 1991].
9 *Cartoon Network, op. cit.*

Because the Supreme Court never heard the appeal, the decision was only binding to the Second Circuit. But the decision was influential nationally, due to the historical sway that the circuit as had in copyright cases. As Carter [1991] argues:

> The Second Circuit is widely recognized as the nation's most important copyright court. Centered in the capital city of publishing and the arts, and mindful of the proud tradition of copyright scholars who have formed its treasure of precedent, the court regularly hears appeals raising issues in the forefront of copyright developments. The Second Circuit is not shy about its historic leadership role in shaping U.S. copyright law.

Moreover, the decision was particularly influential because the Second Circuit has historically been seen as sympathetic to copyright owners (as opposed to the 9th Circuit, based in San Francisco, which was seen as more sympathetic to firms seeking to exploit copyrighted material). The fact that this decision went "against the grain" by limiting the property rights of the copyright owners in favor of cloud firms lent it particular importance.

Consequentially, at the time of the decision, the ruling was perceived as likely to positively impact firms focusing on cloud computing. To cite two contemporaneous accounts:

- The Cablevision ruling is good for IT companies moving into cloud computing, said Dow Lohnes PLLC attorney James Burger, who represents technology companies in IP and content licensing matters. If the court had found Cablevision guilty of direct infringement for giving its customers the RS-DVR data storage system, system operators storing consumers' legally acquired entertainment media in the internet cloud could have faced the same claims.[10]
- [A] rule holding Cablevision liable merely because it housed and maintained the servers in this case could imperil a wide variety of innovative business models that rely on the use of remote computing, ranging from examples like Internet-enabled self-service photo processing and printing, to cloud computing services offered by companies like Amazon, Apple and Google.[11]

Thus, it is logical to hypothesize that the *Cablevision* decision would lead to increased VC investment in cloud computing in the U.S. relative to other counties where no comparable shift

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[10] Standeford [2009].
[11] Kwun [2008].

of copyright protection occurred.[12] It is important to note that to the extent that U.S.-based firms also do business in the rest of the world, or EU firms do business in the U.S., such international activity will dampen the hypothesized effect since the Internet is affected by both local and non-local regulations, and thus any estimates of the hypothesized effect are likely to be conservative. (It should be noted that in many cases foreign courts have deferred to the laws in which an Internet company is based when ruling on disputes involving these firms (Chander [2012])).

2.3. The French Litigation: M6, W9, France Television, TF1, and NT1 v. Wizzgo (2008)

In Section 5, we will also examine the impact of decisions in the French and German courts relative to those elsewhere in Europe. In May 2008, Wizzgo launched the first online DVR platform in France, which allowed users to view recorded copies of programs broadcast on domestic terrestrial television channels as long as they requested that the show be recorded before the programs started.[13] The copy was a faithful reproduction and included the original advertising.[14] In response, a consortium of French television and copyright holders, including M6, W9, France Television, TF1, and NT1, filed complaints against Wizzgo over alleged copyright infringement.

Wizzgo argued that its technological platform fell under two exceptions in French copyright law: transience and privacy copying. First, Wizzgo claimed that it provided users with a temporary and transient copy of a program, and only assisted users in saving private copies. Second, Wizzgo claimed that each copy of a recorded program was private. In France, copying copyrighted work strictly for personal use falls under the private copy exception as long as the

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[12] While there have been several copyright cases against online video recording service providers in Europe, we are unaware of any that has resolved such substantial uncertainty with respect to reproduction and retransmission rights in favor of such service providers as the *Cablevision* decision has in the U.S.

[13] International Law Office [February 19, 2009].

[14] Wizzgo [2009].

copyist and the user of the copy are the same person.[15] Throughout August and November 2008, the Tribunal de Grande Instance de Paris issued a series of injunctions, banning Wizzgo from using the plaintiffs' copyrighted works.[16] On November 25, 2008, the Tribunal de Grande Instance de Paris declared the final set of summary judgments against Wizzgo and levied a fine.[17] In response to the court's ruling and the fine ordered by the court, Wizzgo and similar companies halted operations.[18] Outside sources suggest that the French litigation is likely to have a negative impact on VC investment and to delay the development of related technology, such as cloud computing services. For example, a paper by European Digital Rights states that "[t]he [Wizzgo] case is a relevant example to further corroborate the idea that the current EU copyright policy hinders technology."[19] Some members of the popular press was similarly disappointed; for example, one member wrote that "[b]y closing the door to the Wizzgo arguments […] and the evolution of technology and uses, the French justice system is particularly reactionary and conservative."[20] Given the view that the French ruling was likely to have a negative impact on related technologies, it is logical to hypothesize that this ruling would lead to decreased VC investment in cloud computing in France relative to other counties in the EU.[21]

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15 International Law Office [February 19, 2009].

16 The Tribunal de Grande Instance issued five summary judgments against Wizzgo: (1) *Metropole Television v. Wizzgo* [August 6, 2008]; (2) *France 2 v. Wizzgo* [November 6, 2008]; (3) *TF1 v. Wizzgo* [November 6, 2008]; (4) *NT1 v. Wizzgo* [November 10, 2008]; and (5) *Metropole Television v. Wizzgo* [November 25, 2008]. International Law Office [February 19, 2009]; and ZDNet.fr [November 14, 2008].

17 International Law Office [February 19, 2009].

18 "The court ordered compensatory damages of more than €440,000 against Wizzgo for copyright infringement, which convinced other French online DVR platforms immediately to cease similar services." (International Law Office [February 19, 2009]).

19 European Digital Rights [2011].

20 "En claquant ainsi la porte à l'argumentaire de Wizzgo […] et l'évolution des technologies et des usages, la justice française se montre particulièrement rétrograde et conservatrice." (Caruana [2008]).

21 While there have been several copyright cases against online video recording service providers in Europe, we are unaware of any that has resolved such substantial uncertainty with respect to reproduction and retransmission rights in favor of such service providers as the *Cablevision* decision has in the U.S.

2.4. The German Litigation: RTL et al. v. Shift.tv and Save.tv

Shift.tv, founded in 2005, and Save.tv, founded in 2006, are subscription-based services that allow customers to select and store television content on servers from which users can download and stream stored programs.[22] Online video recording platform service providers operate sites that facilitate the receipt of TV signals through satellite reception stations, and transform and store these signals in customer-dedicated server space.[23] Customers select the content to be stored and can download and/or stream the content. In response to the services offered by these companies, two German television channels, RTL and SAT1, began judicial action claiming that the services constituted copyright infringement.[24]

A German District Court found that both Shift.tv and Save.tv infringed plaintiffs' reproductions rights by storing and copying the data streams provided by the plaintiffs on servers for playback by customers, on May 12, 2006 and May 9, 2007, respectively. The Dresden Court of Appeals ruled against Shift.tv on November 28, 2006, yet in favor of Save.tv on October 9, 2007.[25] On April 22, 2009, the Federal Court of Justice repealed both rulings and remanded them to the Dresden Appeals Court.[26] In doing so, the Federal Court of Justice considered the recording process and ruled on two issues: the right of reproduction and the right of retransmission. To the court, it was unclear whether Shift.tv and Save.tv recorded broadcasts on behalf of its users, or if the technology was automatic and users themselves recorded the programs. If the copying was not automatic, the Federal Court ruled that Shift.tv and Save.tv

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22 Poschenrieder [2008]; and International Law Office [June 11, 2009].

23 Bird and Bird [2009].

24 Three lawsuits: *SAT1 v. Shift.tv*; *RTL v. Shift.tv*; and *RTL v. Save.tv*. (See IRIS Legal Observations of the European Audiovisual Observatory [2011]).

25 Burghart [2010]; International Law Office [June 11, 2009]; IRIS Legal Observations of the European Audiovisual Observatory [2011]; and "OLG Dresden 14 U 801/07 Urteil vom 12.07.2011."

26 International Law Office [2009]; and IRIS Legal Observations of the European Audiovisual Observatory [2011].

would be liable for direct infringement of reproduction rights. Even if the copying was fully automatic, the defendants could be liable for infringement of the plaintiffs' retransmission rights to the public, which are harmed by retransmitting broadcasting signals simultaneously to a large number of customers.[27] Thus, the Federal Court instructed the Appeals Court, on a case-by-case basis, to rule on whether the reproduction process is automated and to clarify the extent to which the plaintiffs infringed retransmission rights.[28]

In July 2011, the Dresden Appeals Court ruled in favor of Save.tv and found that its online video recorder did not infringe RTL's rights of reproduction, though a similar ruling has not been reached for Shift.tv. The court found that from a technical standpoint, the user initiates an automated recording process to create a private copy of a television program.[29] However, the court did not resolve the issue of retransmission rights infringement.[30] As such, Save.tv requires a license for retransmission from RTL, yet it has been unable to do obtain such a license.[31] Thus, while Save.tv was not found liable of direct infringement, German law has blurred the issue by neither ruling completely in favor nor completely against companies like Save.tv and Shift.tv. While Save.tv does not infringe reproduction rights, the German courts have ruled that television channels can prevent these businesses from operating by refusing to issue licenses for retransmission.

While both Save.tv and Shift.tv continue to operate in Germany, outside sources suggest that the German litigation—by raising questions about the allocation of copyright protection—is

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27 Burghart [2010]; and, Bird and Bird [2009].
28 IRIS Legal Observations of the European Audiovisual Observatory [2011].
29 *Ibid.*
30 *Ibid.*
31 VG Media, the German royalty collecting society, refused to grant Save.tv the necessary licenses to operate its business, arguing that online video licenses are not covered by its agreement with German broadcasters. (See IRIS Legal Observations of the European Audiovisual Observatory [2011]). In a November 2010 ruling on the dispute, the Appeals Court of Munchen found that "RTL is entitled to prohibit Save.tv from retransmitting its programmes." (See IRIS Legal Observations of the European Audiovisual Observatory [2011]).

likely to have a negative impact on investment in this and related technologies, such as cloud computing services. For example, "[a]lthough the Federal Court of Justice referred the case back to the Court of Appeal, it is already clear that the business model of Internet-based video recording can be operated legally only with the broadcasters' prior permission. It is doubtful whether a service operated on this basis can be profitable."[32] The popular press also reacted negatively: "[N]ew technology and innovation are impeded by [the 2009 judgment], which unnecessarily increases the technical deficits of Germany compared to other Internet-nations."[33] As with the French ruling, given the view that the German rulings were likely to have a negative impact on related technologies, it is logical to hypothesize that these rulings would lead to decreased VC investment in cloud computing in Germany relative to other counties in the EU.[34]

3. Data

3.1. Venture Capital Funding Data

In order to examine the differences in how VC investment in cloud companies varies between the U.S. and EU, and between France and Germany and other EU countries, we constructed a dataset that draws on historical investment figures captured by VentureXpert.[35] VentureXpert is one of the two most widely-used databases of VC investments in the U.S. and

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[32] International Law Office [June 11, 2009].

[33] "Moderner Technik und Innovation wird damit seiner Ansicht nach ein Riegel vorgeschoben, der die technischen Defizite Deutschland gegenüber anderer Internet-Nationen nur unnötig steigert. Mit dem neusten Urteil hingegen sei endlich ein Startschuss für weitere Entwicklungen gefallen." (See TVAnbieter.de [July 25, 2011].)

[34] While there have been several copyright cases against online video recording service providers in Europe, we are unaware of any that has resolved such substantial uncertainty with respect to reproduction and retransmission rights in favor of such service providers as the *Cablevision* decision has in the U.S.

[35] More specifically, the Thomson ONE's Private Equity module powered by VentureXpert was used.

EU.[36] It contains data on approximately 1.2 million global private companies and over 25,000 venture, buyout, and mezzanine funds.[37]

The dataset uses all private equity investments in the Thomson database from the beginning of 1995 through the end of 2010 classified as "Venture Capital Deals"[38] involving a portfolio company with a business description including the term "cloud." These criteria yielded data on investments in 280 companies. Independent research identified an additional 216 cloud computing-related companies,[39] 59 of which received VC investment from 1995 through 2010 captured in VentureXpert. Seventy-nine companies were removed from the list of 339 (280 + 59) companies appearing in VentureXpert based upon review of their business descriptions, and 17 were removed for lack of any data on investment amount.[40] As a result, the final dataset contains data on VC investments in 243 cloud computing companies.[41]

The unit of observation in the data extracted from VentureXpert is an investment by a particular VC fund into a particular portfolio company on a particular date. The dataset contains 2,009 observations on investments by 706 distinct funds into the 243 companies on 587 different dates. These data were then aggregated by calendar quarter of investment date by region (U.S.,

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36 Maats et al. [2009].

37 Thomson Reuters factsheet [2011].

38 Venture capital investments include start-up, seed, and early, expansion, and later stage deals.

39 This researched involved the review of numerous sources, including: Corbin [2011]; "The Top 20 Software as a Service (SaaS) Vendors," http://www.clouds360.com/saas.php; "The Top 20 Infrastructure as a Service (IaaS) Vendors," http://www.clouds360.com/iaas.php; "The Top 20 Platform as a Service (PaaS) Vendors," http://www.clouds360.com/paas.php; Kirilov [2011]; Geelan [2009]; "50 Top Cloud Computing Companies," http://www.cloudtweaks.com/2010/07/over-50-of-the-biggest-and-best-cloud-computing-companies, [2010]; Depena [2011]; Singh [2009]; and, "List of Top 'Cloud Computing Solution Providers to Watch in 2009," http://www.oncloudcomputing.com/en/2009/07/list-of-top-cloud-computing-solution-providers-to-watch-in-2009/, [2009].

40 Business descriptions from VentureXpert, Bloomberg, the company websites, and news stories were reviewed. Companies were excluded if cloud computing did not appear to be a primary part of their business or their business appeared to focus on pushing non-user-generated content to from the cloud to users (*e.g.*, security updates, games, licensed media content).

41 In identifying cloud computing companies for our analysis, we carefully reviewed all business descriptions as well as, when possible, company websites to ensure that the company was primarily a cloud computing company and that the company's business was one that had the potential to be affected by the rulings in France, Germany, and the U.S.

EU, and the rest of the world for the analysis of the *Cablevision* decision, and France, Germany, EU, and the rest of Europe for the analysis of the French and German rulings).

Appendix A summarizes the data used in the analysis of the *Cablevision* decision. As it shows, total VC investment in the identified U.S. cloud companies from the first quarter of 1995 to the end of 2010 amounted to $5.9 billion. This reflects average quarterly investment of $92.3 million over that time period. In the period immediately preceding the *Cablevision* ruling (Q1 2006 to Q2 2008), average quarterly investment in U.S. venture-backed cloud companies was $131.0 million, and subsequent to the ruling, that figure amounted to $184.7 million. Thus, average quarterly investment in U.S. cloud computing increased by approximately 41 percent after the *Cablevision* decision. Appendix A further shows that VC investment in the identified EU cloud companies from the first quarter of 1995 to the end of 2010 amounted to $242.3 million. This reflects average quarterly investment of $3.8 million over that time period. In the period immediately preceding the *Cablevision* ruling (Q1 2006 to Q2 2008), the average quarterly investment in EU venture-backed cloud companies was $7.0 million, and subsequent to the ruling, that figure amounted to $8.9 million. Thus, average quarterly investment in EU cloud computing increased by approximately 27 percent, as compared with 41 percent in the U.S., after the *Cablevision* decision.

Appendix B summarizes the data used in the analysis of the French rulings for three time periods: (1) the entire period for which data from VentureXpert were obtained (Q1 1995 to Q4 2010), (2) a short period preceding the Wizzgo ruling (Q1 2006 to Q4 2008), and (3) a short period following the ruling (Q1 2009 to Q4 2010). We focus on relatively short periods around the ruling to mitigate the bias that could be introduced from long-term investment trends prior to 2006.

In the period immediately preceding the Wizzgo ruling, there were no VC investments in French venture-backed cloud companies, and subsequent to the ruling, the average quarterly VC investment in French cloud companies was $0.45 million. In the EU as a whole,[42] for the period immediately preceding the Wizzgo ruling, the average quarterly VC investment in cloud companies was $5.9 million. Subsequent to the ruling, the average quarterly VC investment in EU cloud companies was $9.8 million.

Appendix C summarizes the data used in the analysis of the German rulings for four time periods: (1) the entire period for which data from VentureXpert were obtained (Q1 1995 to Q4 2010), (2) a short period preceding the 2006 German District Court ruling (Q1 2004 to Q2 2006), (3) a short period following the ruling (Q3 2006 to Q4 2008), and (4) a longer period following the ruling (Q3 2006 to Q4 2010). As with the French ruling, we focus on relatively a short period around the 2006 German District Court ruling (Q1 2004 to Q4 2008) to isolate the effect of this ruling as well as the other similar rulings discussed above that occurred in 2006 and 2007. We also investigate the effect over a longer time period (Q1 2004 to Q4 2010) since the litigation involving Shift.tv and Safe.tv, to our knowledge, has not yet been completely resolved. Thus, uncertainty likely exists regarding the viability of certain cloud computing business models in Germany.

In the period immediately preceding the 2006 German District Court ruling (Q1 2004 to Q2 2006), there were no investments in German venture-backed cloud companies, while the average quarterly VC investment in EU cloud companies was $3.5 million. Subsequent to the ruling, for the shorter period Q3 2006 to Q4 2008, there were also no investments in German venture-

[42] Other EU countries included in the analysis are: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

backed cloud companies, while EU cloud computing companies received average quarterly VC investment of $6.9 million. For the longer period Q3 2006 to Q4 2010, the average quarterly VC investment in German cloud companies was $0.30 million, while EU cloud computing companies received average quarterly VC investment of $8.2 million.

3.2. Supplemental Data

We augment the VC funding data with data on other factors that could influence investors' decisions to invest in cloud computing specifically, and in other sectors more generally. Such factors include macroeconomic conditions reflected in gross domestic product (GDP) measures and the feasibility of cloud computing as measured by broadband penetration.

Our GDP data are quarterly growth rates of real, seasonally adjusted GDP as a percent change over the previous quarter from the OECD.[43] These data are available for the U.S. from Q1 1995 through Q2 2011, and for the EU (27 countries), including France and Germany, from Q2 1995 through Q2 2011.

Data on broadband penetration, which is equal to the number of broadband subscriptions per 100 inhabitants, was obtained from the OECD for the U.S. and 21 of the 27 EU member states from Q2 2002 through Q4 2010.[44] To calculate an EU-specific measure of broadband penetration in each period, the broadband penetration rate of each EU member state was multiplied by its corresponding annual population to obtain the number of broadband subscribers. Next, the total number of EU broadband subscribers was obtained by summing over all EU member states; this total was then divided by the total EU population to obtain an EU-

[43] Data accessed through http://stats.oecd.org.
[44] Data accessed through http://stats.oecd.org.

specific measure of broadband penetration. Finally, quarterly broadband penetration rates were calculated by linearly interpolating the semi-annual series.

These supplemental data are summarized in Appendix A for the U.S., Appendix B for France, and Appendix C for Germany.

4. Estimation and Results – The *Cablevision* Decision

We first examine whether investment in venture-backed U.S. cloud companies shifted subsequent to the Q3 2008 *Cablevision* appeals court ruling. Each of these analyses are variants of difference-in-difference regression frameworks that rely on historical VC investment in both the U.S. and EU as controls in order to identify any statistically significant increase in VC investment in U.S. cloud companies post-*Cablevision*.

Our initial set of regression analyses are variants of the following regression model that accounts for the impact of a variety of factors on quarterly venture-backed investment in the identified cloud companies:

$$VC\ Ratio_{r,t} = \beta_0 + \beta_1(U.S.\ Indicator)_r + \beta_2(Q3\ 2008\ or\ After\ Dummy)_t + \beta_3(Effect\ of\ Cablevision\ on\ U.S.\ VC\ Investment)_{r,t} + \theta X_{r,t} + \varepsilon_{r,t}. \quad (1)$$

Specifically, the dependent variable, $VC\ Ratio_{r,t}$, is VC dollars invested in the cloud computing companies in region *r* at quarter *t* divided by VC dollars invested in information technology (IT) companies in region *r* at quarter *t*. We normalized our dependent variable this way because the volume of VC activity varies considerably over time due to factors that are largely exogenous to the issues being studied here. To cite one notable example, the volume of venture investment fell by almost 90 percent between 2000 and 2002; this decline was driven primarily by the collapse in the public valuations for internet and telecommunications stocks in 2000, and the subsequent inability of venture funds to exit many of their investments at attractive

prices. In other cases, funds have flowed to particular sectors, such as cleantech, potentially crowding out investment elsewhere. As a result, the bulk of our analyses examine VC investments in cloud computing as a share of all VC investments, though we also analyze the level of venture investment in cloud computing in a robustness check. Figure 1 depicts *VC Ratio* for the U.S. and EU annually from 1995 through 2010.

The explanatory variable *U.S. Indicator* equals one for investment in U.S. cloud computing companies and zero for investment in EU cloud computing companies. The explanatory variable *Q3 2008 or After Dummy* equals zero for all quarters before the U.S. Appellate Court decision in the *Cablevision* case in August 2008 and one in Q3 2008 and all quarters thereafter. The explanatory variable, *Effect of the Cablevision Decision on U.S. VC Investment*, a dummy variable capturing the interaction between the *U.S. Indicator* and the *Q3 2008 Dummy*, equals one for investment in U.S. cloud computing companies in Q3 2008 and thereafter, and zero otherwise. $X_{r,t}$ is a vector of other explanatory variables, including GDP growth and broadband penetration, that may be associated with investment in cloud companies.

This difference-in-difference model is designed to estimate parameter β_3, whether investment in venture-backed U.S. cloud companies rose subsequent to the *Cablevision* decision, controlling for trends in the U.S. relative to EU (captured by *U.S. Indicator*), and trends in cloud computing generally (captured by *Q3 2008 or After Dummy*) absent the policy.

The annual series plotted in Figure 1 shows a long-term upward trend in VC investment in cloud computing companies, particularly in the U.S., beginning well before the *Cablevision* decision. In order to focus more narrowly on the time period surrounding the *Cablevision* decision, our analyses focus on investment levels from 2006 to 2010. Doing so eliminates long-term investment trends prior to 2006 from influencing the results. Figure 2, which depicts the

quarterly difference between investment in U.S. and EU venture-backed firms, suggests that investment in U.S. venture-backed cloud companies was not systematically increasing, relative to EU firms, in the time period immediately preceding the 2008 *Cablevision* ruling; however, investment in U.S. venture-backed cloud companies increased, relative to EU firms, after the 2008 *Cablevision* ruling.[45]

Our first set of regression results are presented below in Table 1, and show that investment in venture-backed cloud computing companies is significantly higher in the U.S. than in the EU after the *Cablevision* decision.[46] The coefficient on β_3 in Model 1, which provides an estimate of the change in VC investment post-*Cablevision*, is equal to 0.0257. It indicates that the rise in average VC investment in cloud computing in the U.S. as a percentage of VC investment in IT in the U.S. from the period Q1 2006 through Q2 2008 to the period Q3 2008 through Q4 2010 was approximately 2.57 percent greater than the corresponding rise in cloud computing investment in the EU, or approximately 3.16 percent overall.[47] This estimate of β_3,

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[45] Figure 2 shows that the increase in VC investment in the U.S., relative to the EU, did not occur immediately after the 2008 *Cablevision* ruling. Such a delay is consistent with both the typical amount of time required to obtain VC investment and the fact that VC investment often involves multiple rounds of increasing size. Specifically, the VC investment process typically takes between 6 and 12 months (Madison Park Group [2008]) and a firm receiving VC investment may receive multiple rounds, with the average investment size in the first round equal to between $6 and $13 million, the average in the second round equal to between $8 and $15 million, and the average in later-stage rounds equal to between $15 and $23 million (Huggett [2012]). In addition, there are gaps between each round, with the average time between rounds of financing in 2010 equal to approximately 20 months (Sherman [2012]).

[46] Around the time of the *Cablevision* decision, some cloud services were launched, such as Microsoft Windows Azure on November 17, 2009 ("Microsoft Cloud Services Vision Becomes Reality With Launch of Windows Azure Platform," http://www.microsoft.com/en-us/news/press/2009/nov09/11-17pdc1pr.aspx), and these services may have had an effect on VC investment in cloud computing in the U.S. However, other cloud services, such as Amazon EC2 and Google Apps and Docs were launched much earlier in 2006, and appeared to have little or no effect on VC investment in the U.S. ("Google Introduces New Business Version of Popular Hosted Applications," http://googlepress.blogspot.com/2007/02/google-introduces-new-business-version_22.html; http://aws.amazon.com/about-aws/whats-new/2006/; and, "Google Announces Google Docs & Spreadsheets," http://googlepress.blogspot.com/2006/10/google-announces-google-docs_11.html.) Furthermore, any cloud services that were launched around the time of the *Cablevision* decision may have been in part launched because of the clarity afforded by the decision.

[47] $\beta_2 + \beta_3 = 0.0059 + 0.0257 = 0.0316$.

statistically significant at the 95 percent confidence level, implies an approximately $730 million increased VC investment in U.S. cloud computing companies after the *Cablevision* decision.

Model 2 is similar to Model 1, except that it incorporates variables that control for GDP growth and broadband penetration. As shown in column 2 of Table 1, the coefficients on these variables have the expected positive sign and are statistically significant. Interpretation of the other variables remains the same, and as shown in the table, the magnitude and significance of the *Effect of Cablevision on U.S. VC Investment* is almost identical to the magnitude and significance of the *Effect of Cablevision on U.S. VC Investment* in Model 1. The implied increase in U.S. VC investment of approximately $728 million is nearly identical as well.

To investigate the potential impact of outliers on our analysis, we ran Models 1 and 2 using a difference-in-difference quantile regression analysis. Quantile regression analysis allows one to estimate the relationship between a set of independent variables and a specific quantile, or percentile, of the response variable. One advantage of such an analysis is that the influence of large outliers is mitigated. Thus, for our context, it allows us to determine the extent to which our results are sensitive to quarters with very large or very small values of the dependent variable, *VC Ratio*. Results for median (quantile) difference-in-difference regressions are presented in Table 2.

Results for Model 3, the quantile regression version of Model 1, are presented in Table 2. These results are similar to those presented in Table 1 and imply that the rise in median (as opposed to average) VC investment in cloud computing in the U.S., as a percentage of VC investment in IT in the U.S. from the period Q1 2006 through Q2 2008 to the period Q3 2008 through Q4 2010, was approximately 3.4 percent greater than the corresponding rise in cloud computing investment in the EU. This estimate, which is statistically significant at the 95 percent

confidence level, implies an approximately $952 million increase in VC investment in U.S. cloud computing companies after the *Cablevision* decision.

Results for Model 4, the quantile regression version of Model 2, are also presented in Table 2, and are similar to those for Model 3 with an implied increase in U.S. cloud computing investment of approximately $904 million.

4.1. Additional Sensitivity Analyses and Robustness Checks

4.1.1. Alternative Control Group Specifications

We have also estimated a difference-in-difference model comparing investment in the U.S. to investment in the rest of the world (ROW) in order to examine whether the results are sensitive to the use of EU companies as a control group. Specifically, we have conducted analyses analogous to Model 1 using ROW investment (rather than investment in the EU) as a benchmark. These results are presented in Table 3 and are qualitatively similar, finding that the surge in investment in U.S. venture-backed cloud computing companies amounted to $779 million.

As an alternative approach to examining the robustness of our findings, we have examined the extent to which investment levels increased subsequent to the *Cablevision* ruling for a broad set of internet companies, rather than just the cloud companies included in the above analyses. We anticipate that there will be no effects for this set of internet companies since the Cablevision ruling should only affect cloud computing companies. The results associated with Models 6 and 7, presented in Table 4, are analogous to Models 1 and 2 except that they are run on the "internet-specific" companies rather than the cloud companies.[48]

[48] VentureXpert categorized 8,510 companies as being internet-specific. This list includes companies described as "internet communications," "e-commerce technology," "computer hardware," "internet software," "internet programming," "internet ecommerce," "internet content," and "internet services."

As the results in Table 4 show, investment levels in U.S. internet-specific companies either actually *decrease* in the U.S. following the Cablevision decision (Model 6), or are not statistically different in the time periods before and after the *Cablevision* ruling (Model 7). This suggests that the findings described above are specific to cloud companies, in particular, and do not reflect general trends associated with venture-backed investment in internet-specific companies.

4.1.2. Stationarity[49]

One assumption made in our regression analyses is that the data are stationary; that is that the data series do not depend on time and thus, that the mean, variance, and covariance of the data do not vary with time. To examine the extent to which increased U.S. investment subsequent to the *Cablevision* decision reflects an ongoing trend, perhaps attributable to factors not reflected in any of the data we collected, we have conducted a variety of tests. First, we ran a simple ordinary least squares regression on the difference between U.S. and EU investment levels against a time trend; this revealed that U.S. investment levels relative to EU investment levels were falling on average, but not significantly, during the Q1 2006 to Q3 2008 time period.

To more formally test for stationarity in our time series data, we conducted three well-known tests on our data from Q1 2006 through Q4 2010: the Dickey-Fuller, Phillips-Perron, and Kwiatkowski–Phillips–Schmidt–Shin tests. Using each test, we found no evidence of non-stationarity. As such, our data appear to be stationary, and thus, it is not necessary to adjust our regression equations or data.

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[49] A stationary time series is one whose statistical properties such as mean, variance, and autocorrelation, are all constant over time. Most statistical methods are based on this assumption, and violations of stationarity can lead to biased point estimates.

4.1.3. Autocorrelation

We also tested for the presence of autocorrelation in our regression analyses by conducting a test proposed by Jeffrey Wooldridge for panel data.[50] After correcting for autocorrelation, the estimate of the effect of Cablevision remains significant and positive, and the implied increase in U.S. cloud VC investment actually increases from that of Models 1 and 2.

4.1.4. Clustered Standard Errors

Clustering standard errors corrects for the lack of independence between observations. In our data, observations within a quarter may contain similar information. Without correcting for the non-independence of the data, the standard errors would potentially be too small, and thus the p-values would be too low. To correct for this, we clustered our standard errors by quarter. Although the p-values increase as expected, the estimate of the effect of Cablevision remains significant. Specifically, as Table 5 shows, the estimate of the effect of Cablevision remains significant in both Models 8 and 9; these models are analogs to Models 1 and 2, with the only difference being that the standard errors are clustered by quarter.

4.1.5. Tobit Regression Model

Given the fact that many of the observations in our dependent variable are equal to zero (32.8 percent), we run a Tobit model to account for potential censoring. Doing so, we find that the estimate of the effect of Cablevision remains significant and positive in Models 1 and 2. When Model 1 is run using ordinary least squares, we find that the coefficient on the effect of Cablevision is equal to 0.0257 and is significant at the five percent level. When we instead use a Tobit model, the coefficient on the effect of Cablevision is equal to 0.0241 and is significant at the ten percent level. (See Model 10 in Table 6 below.) Model 11, which is analogous to Model

[50] Wooldridge [2002].

2, shows that the estimate of the effect of Cablevision decision also remains significant when a Tobit model is used instead of using ordinary least squares.

4.1.6. Investment Levels (vs. Ratios)

We ran additional sensitivities based on an alternate specification of the dependent variable. Specifically, we ran regressions analogous to Models 1 and 2 but where the dependent variable was the total quarterly investment (in the U.S. or EU) measured in dollars, rather than measured in terms of a ratio relative to total IT spending. The total other IT VC investment and total other VC investment in a given region were controlled for by their inclusion as separate independent variables in the regression analysis. These regressions yielded results, presented in Table 7, comparable to those of Models 1 and 2.

In Model 12, the analog to Model 1, U.S. investment was, on average, $119.1 million higher each quarter after the Cablevision ruling (after controlling for EU differences), totaling $1.2 billion over the 2.5 subsequent years. The corresponding figures for Model 13, the Model 2 analog, which incorporates controls for GDP changes and broadband penetration, imply $126.8 million higher investment on a quarterly basis and $1.3 billion in total for the 2.5 years.

4.1.7. Investment Events (vs. Investment Ratios or Investment Levels)

We next ran regressions analogous to Models 1 and 2 where the dependent variable was whether a given VC deal was a cloud deal or not, rather than total quarterly investment measured in dollars or the ratio of total quarterly investment relative to total IT spending. In running these regressions, we used a logit model where, if a deal was a cloud deal, the binary dependent variable was set equal to one; otherwise, the dependent variable was set equal to zero. Our results, which are presented in Table 8, indicate that the effect of Cablevision on whether a VC firm provided financing to a cloud company is generally positive and significant, and suggest

that our principal results are not being driven by a small number of large VC investments. We also narrowed our sample to include only VC firms that had previously provided funding to a cloud company, and examined whether Cablevision affected the likelihood that such firms provided financing to cloud companies. Our results, which are presented in Table 9, show that when we restrict our sample, Cablevision continues to have a positive and significant impact on whether a VC firm provided financing to a cloud company.

4.1.8. Investment Rounds (vs. Investment Ratios or Investment Levels)

We also ran regressions analogous to Models 1 and 2 where the dependent variable was the number of rounds of VC investment received within a given quarter (in the U.S. or EU), rather than total quarterly investment measured in dollars or the ratio of total quarterly investment relative to total IT spending. Our results, which are shown below in Table 10, indicate that the effect of Cablevision on the number of U.S. VC investment rounds is positive and significant, and suggest that our principal results are not being driven by a small number of large VC investments. These results thus provide further evidence that decisions around copyright protection can have significant impacts on VC investment.

4.1.9. Cloud Company Identification

We have also tested the sensitivity of our results to the list of cloud computing companies included in our dataset. Our results are robust to the use of a smaller set of companies, that is, one that includes those with "cloud" in their VentureXpert business descriptions but does not include additions based on review of third party cloud computing company lists.

Our research also revealed specific types of cloud companies that are likely to be differentially affected by the *Cablevision* decision. In particular, there exist three general types of cloud computing services: infrastructure-as-a-service (IaaS), software-as-a-service (SaaS), and

platform-as-a-service (PaaS). IaaS providers are the most likely to be affected by the *Cablevision* decision because their customers can store files, some of which may be copyrighted, on their servers. SaaS providers, in contrast, are the least likely to be affected by the *Cablevision* decision because they generally provide pre-packaged software solutions that are unlikely to be tasked with storing copyrighted materials on the providers' servers. And finally, PaaS providers form a middle ground between IaaS and SaaS providers in which the consumer, rather than the provider, creates the software using tools and/or libraries from the provider. Some customers may create services that store or access copyrighted material, while others may not; thus, it is unclear whether PaaS services are likely to be affected by the *Cablevision* decision.

Table 11 provides results from three regressions where we investigate the differential impact of the *Cablevision* decision on VC investment in IaaS, PaaS, and SaaS companies. In Model 26, we run a regression in which only VC investment in IaaS companies is included in the denominator of our dependent variable, and we find results consistent with our hypothesis articulated above; that is, we find a significant and positive impact of the *Cablevision* decision on VC investment in IaaS companies. Model 27, which estimates the impact of the *Cablevision* decision on PaaS companies, also finds a significant and positive impact of the *Cablevision* decision. And finally Model 28, which estimates the impact of the *Cablevision* decision on VC investment in SaaS companies, provides results that are consistent with our expectation that SaaS companies should be unaffected; that is, we find an insignificant, although positive impact of the *Cablevision* decision on VC investment in SaaS companies. Thus, we find that those cloud companies that are the most likely to be affected by the *Cablevision* decision experience an increase in VC investment in the U.S. relative to the EU after the decision.

4.1.10. Second Circuit Court Analysis

We ran additional regressions using a logit model, similar to Models 14, 15, and 16 in Table 8, to determine whether investment in cloud companies headquartered in states under the jurisdiction of the Second Circuit Court increased compared to the rest of the U.S. The Second Circuit Court of Appeals has jurisdiction over the states of New York, Connecticut, and Vermont; since the Second Circuit Court sets binding precedent for district courts in these states, we expect to see an even bigger increase in investment in cloud companies located in these states after the *Cablevision* decision. While this decision, as discussed above, was likely to have a broader impact, the effect of the decision should be most substantial here.

Anecdotal evidence suggests that this ruling has indeed effected firms' location decisions. For instance, high-profile (and controversial) video streaming company Aereo chose to locate in New York with a "model engineered specifically to take advantage of 2008 ruling from the U.S. Court of Appeals for the Second Circuit in a copyright case against Cablevision" (Bario [2013]).

Our results, presented in Table 12, support our hypothesis. We find a positive and significant impact of the *Cablevision* decision on investment in cloud companies in states under the Second Circuit's jurisdiction in Models 29, 30, and 31.

5. Estimation and Results – The French and German Rulings

To determine whether investment in venture-backed French and German cloud companies declined subsequent to the Wizzgo and 2006 German District Court rulings, we ran regressions similar to those that were run to analyze the impact of the *Cablevision* decision. For France:

$$VC\ Ratio_{r,t} = \beta_0 + \beta_1(France\ Indicator)_r + \beta_2(Q1\ 2009\ or\ After\ Dummy)_t + \beta_3(Effect\ of\ Wizzgo\ Decision\ on\ French\ VC\ Investment)_{r,t} + \theta X_{r,t} + \varepsilon_{r,t}. \quad (1)$$

And for Germany:

$$VC\ Ratio_{r,t} = \beta_0 + \beta_1(Germany\ Indicator)_r + \beta_2(Q3\ 2006\ or\ After\ Dummy)_t + \beta_3(Effect\ of\ German\ Decisions\ on\ German\ VC\ Investment)_{r,t} + \theta X_{r,t} + \varepsilon_{r,t}. \quad (2)$$

The dependent variable, $VC\ Ratio_{r,t}$, is VC dollars invested in the cloud computing companies in region *r* at quarter *t* divided by VC dollars invested in information technology (IT) companies in region *r* at quarter *t*, computed for both the country in question and the rest of the EU excluding France and Germany.

The explanatory variable *France Indicator* (*Germany Indicator*) equals one for investment in French (German) cloud computing companies and zero for investment in German (France) and EU cloud computing companies. The explanatory variable *Q1 2009 or After Dummy* (*Q3 2006 or After Dummy*) equal zero for all quarters before the French (German) Court ruling in November 2008 (May 2006) and one in Q1 2009 (Q3 2006) and all quarters thereafter. The explanatory variable, *Effect of Wizzgo Decision on French VC Investment* (*Effect of German Decisions on German VC Investment*), a dummy variable capturing the interaction between the *France Indicator* (*Germany Indicator*) and the *Q1 2009 Dummy* (*Q3 2006 or After Dummy*), equals one for investment in French (German) cloud computing companies in Q1 2009 (Q3 2006) and thereafter, and zero otherwise. $X_{r,t}$ is a vector of other explanatory variables including GDP growth and broadband penetration that may be associated with investment in cloud companies.

This difference-in-difference model is designed to estimate the parameter β_3, which provides an estimate of the effect of the French and German rulings on investment in French and German cloud computing, respectively, controlling for trends in France and Germany relative to

the EU (captured by the country indicators), and trends in cloud computing generally (captured by *Q1 2009 or After Dummy* and *Q3 2006 or After Dummy*) absent the policy.

In order to focus more narrowly on the time period surrounding the French ruling, we analyze investment levels from 2006 to 2010. Doing so helps to eliminate long-term investment trends prior to 2006 from influencing the results. Similarly, in order to focus more narrowly on the time period surrounding the 2006 German District Court ruling, we first analyze investment levels from 2004 to 2008. We also investigate the effect over a longer time period, 2004 to 2010, because additional court rulings were made in 2006, 2007, and 2009, and because the litigation involving Shift.tv and Safe.tv, to our knowledge, has not yet been completely resolved.

Our first set of regression results are presented below in Table 13, and show that investment in venture-backed cloud computing companies is lower in France than in the EU after the Wizzgo ruling. The coefficient on β_3 in Model 32, which provides an estimate of the effect of the Wizzgo ruling on VC investment in French cloud computing companies, is equal to -0.0185. This indicates that the increase in average VC investment in cloud computing in France as a percentage of VC investment in IT in France from the period Q1 2006 through Q4 2008 to the period Q1 2009 through Q4 2010 was approximately 1.85 percent lower than the corresponding rise in cloud computing investment in the EU. This estimate of β_3, statistically significant at the 90 percent confidence level, implies that VC investment in French cloud computing companies decreased, relative to the rest of the EU, by an average of $2.0 million per quarter after the Wizzgo ruling, or approximately $16 million in total for 2009 and 2010.

Model 33 is similar to Model 32, except that it incorporates variables that control for GDP growth and broadband penetration. As shown in column 2 of Table 13, the coefficients on these control variables have the expected positive sign and are statistically significant. Interpretation of

the other variables remains the same, and as shown in the table, the magnitude and significance of the *Effect of Wizzgo Decision on French VC Investment* are almost identical to its magnitude and significance in Model 32.

Analogous regression results for Germany are presented in Table 13 and show that investment in venture-backed cloud computing companies is lower in Germany than in the EU after the 2006 German District Court ruling, both when a shorter post-ruling period is used (Q3 2006 to Q4 2008) and when a longer post-ruling period is analyzed (Q3 2006 to Q4 2010). Model 34, which estimates the estimate of the effect of the 2006 German District Court ruling on VC investment through the end of 2008, shows that the effect of the 2006 German District Court ruling (as well as other similar rulings that followed later in 2006 and 2007) on VC investment in German cloud computing companies is equal to -0.0115. This indicates that the change in average VC investment in cloud computing in Germany as a percentage of VC investment in IT in Germany from the period Q1 2004 through Q2 2006 to the period Q3 2006 through Q4 2008 was approximately 1.15 percent lower than the corresponding rise in cloud computing investment in the EU. This estimate, statistically significant at the 95 percent confidence level, implies that VC investment in German cloud computing companies decreased, relative to the rest of the EU, by an average of $0.5 million per quarter after the 2006 German District Court ruling, or approximately $3 million in total from 3Q 2006 through 4Q 2008.

Model 35 is similar to Model 34, except that it incorporates variables that control for GDP growth and broadband penetration. As shown in column 4 of Table 13, the coefficients on these control variables have the expected positive sign. Interpretation of the other variables remains the same, and as shown in the table, the magnitude and significance of the *Effect of German*

Decisions on German VC Investment is almost identical to its magnitude and significance in Model 34. The implied decrease in German VC investment is nearly identical as well.

As described above, the litigation involving Shift.tv and Safe.tv, to our knowledge, has not yet been completely resolved; as such, uncertainty likely exists regarding the viability of certain cloud business models in Germany. To investigate whether this ongoing legal uncertainty continued to depress VC investment in German cloud computing in 2009 and 2010, we also analyzed a longer post-ruling period (Q3 2006 to Q4 2010). These results, presented in Models 36 and 37 in Table 13, show that the magnitude and significance of the *Effect of German Decisions on German VC Investment* is similar to the estimates in Models 34 and 35.

5.1. Additional Sensitivity Analyses and Robustness Checks

5.1.1. Alternative Control Group Specifications

We have also estimated a difference-in-difference model comparing investment in France and Germany to investment in the rest-of-the-world (ROW) in order to examine whether the results are sensitive to the use of EU companies as a control group. Specifically, we have conducted analyses analogous to Model 32 (France) and Models 34 and 36 (Germany) using ROW investment, rather than investment in the remainder of the EU, as a benchmark. These results are presented in Table 14 and are qualitatively similar, finding that the decrease in investment in French (German) venture-backed cloud computing companies, relative to the rest of the EU, amounted to an average of $0.9 million ($0.2 million) per quarter after the Wizzgo (German) ruling.

5.1.2. Stationarity[51]

To examine the extent to which the decrease in French and German investment subsequent to the French and German rulings, relative to the EU, reflects an ongoing trend, perhaps attributable to factors not reflected in any of the data we collected, we have conducted a variety of tests. First, we ran a simple ordinary least squares regression on the difference between French and EU investment levels against a time trend, as well as on the difference between German and EU investment levels against a time trend. This revealed that French investment levels relative to EU investment levels were falling on average, but not significantly, during the pre-ruling time period, and that German investment levels relative to EU investment levels were increasing on average, but not significantly, during the pre-ruling time period.

To more formally test for stationarity in our time series data, we conducted three well-known tests on our data: the Dickey-Fuller, Phillips-Perron, and Kwiatkowski–Phillips–Schmidt–Shin tests. Using each test, we found no evidence of non-stationarity. As such, our data appear to be stationary, and thus, we do not adjust our regression equations or data.

5.1.3. Autocorrelation

We also tested for the presence of autocorrelation in our regression analyses by conducting a test proposed by Jeffrey Wooldridge for panel data.[52] After correcting for potential autocorrelation, the estimate of the effect of the French and German rulings remains significant and negative, and the implied increase in French and German cloud VC investment is qualitatively similar.

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[51] A stationary time series is one whose statistical properties such as mean, variance, and autocorrelation, are all constant over time. Most statistical methods are based on this assumption, and violations of stationarity can lead to biased point estimates.

[52] Wooldridge [2002].

5.1.4. Investment Levels (vs. Ratios)

We ran additional sensitivities based on an alternate specification of the dependent variable. Specifically, we ran regressions analogous to Models 32 and 33 for France, and Models 34 – 37 for Germany, where the dependent variable was the total quarterly cloud VC investment measured in dollars, rather than measured in terms of a ratio relative to total IT spending. Total other IT VC investment and total other VC investment in a given region were controlled for by their inclusion as separate independent variables in the regression analysis. The results of these regressions, presented in Table 15, show that the French and German rulings continue to have a negative and significant impact on cloud VC investment, although both the French and German results imply a larger decrease in cloud VC investment, relative to the EU, as compared to the regressions in which cloud VC investment is measured in terms of a ratio relative to total IT spending.

5.1.5. Investment Rounds (vs. Investment Ratios or Investment Levels)

We also ran regressions analogous to Models 32 and 33 for France, and Models 34 – 37 for Germany, where the dependent variable was the number of rounds of VC investment received within a given quarter (in France, Germany, or the EU), rather than total quarterly investment measured in dollars or the ratio of total quarterly investment relative to total IT spending. Our results indicate that the effect of the French and German rulings on the number of French or German VC investment rounds is negative and significant in Germany, and negative, although insignificant in France. This suggests that our principal results are not being driven by a small number of large VC investments and provides further evidence that decisions around copyright protection can have significant impacts on VC investment.

6. Conclusions

The impact of property rights, and in particular its implications for investment, is an important issue in corporate finance. In this paper, we set out to address the impact of these changes in one particular case: by looking at the impact of unexpected judicial decisions that shifted the allocation of copyright protection on VC investment in cloud computing companies. We do so by analyzing the joint effects of the *Cablevision* decision and the French and German rulings on VC investment in the U.S. relative to the EU and across the U.S., as well as by separately analyzing the effects of the French and German court rulings on VC investment in French and German cloud computing companies. To that end, we constructed a dataset on VC investment in cloud computing companies and estimated multiple difference-in-difference regression models.

Our findings suggest that decisions around the allocation of copyright ownership can have significant impacts on investment and innovation. Specifically, we find that the *Cablevision* decision, along with court rulings in France and Germany, led to additional incremental investment in U.S. cloud computing companies compared to the EU experience. In addition, we find that French and German court rulings led to reduced investment in French and German cloud computing companies compared to all other EU countries. The more granular analyses, such as of the impact on funding in the Second District, support that the shift in the allocation of copyright protection has a major impact on investment.

Taken together, our findings suggest that shift in property rights can have significant impacts on investment. While we cannot assess the broader social welfare impact of these changes, since we cannot observe investment by large corporations or the long-run consequences of these shifts in property rights, the findings shed empirical light on an important issue.

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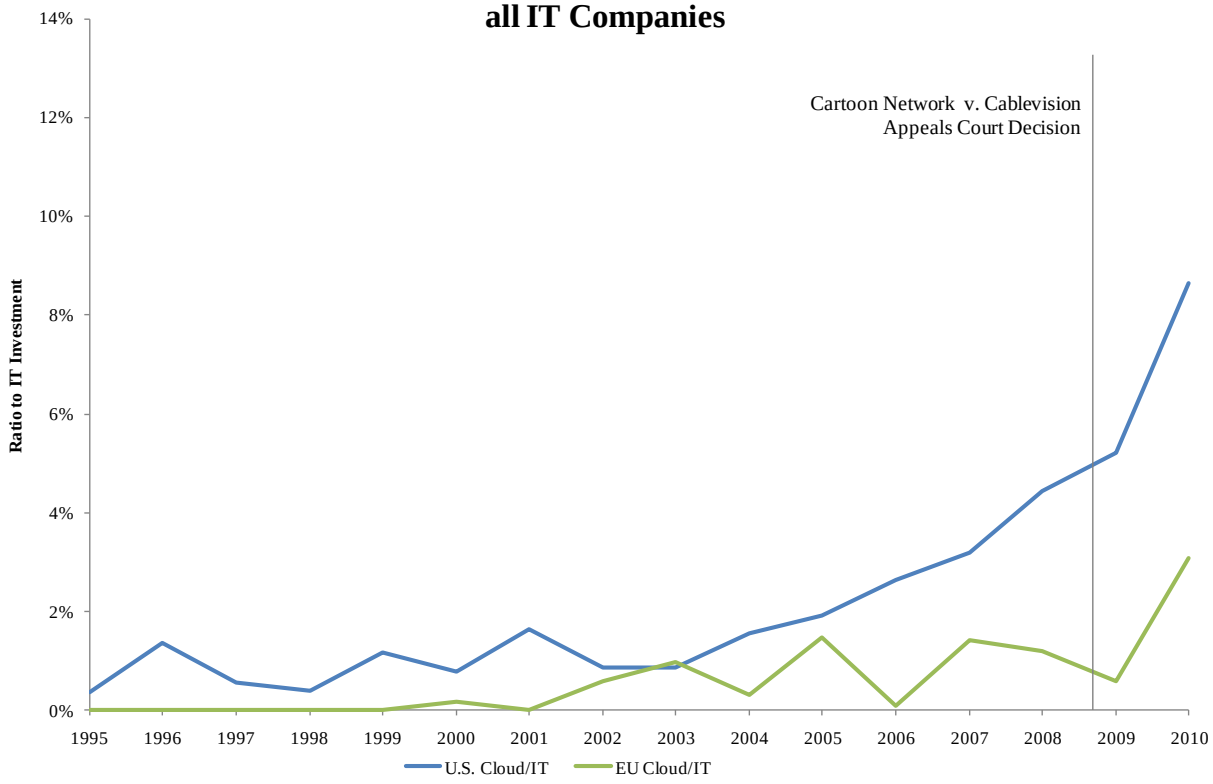
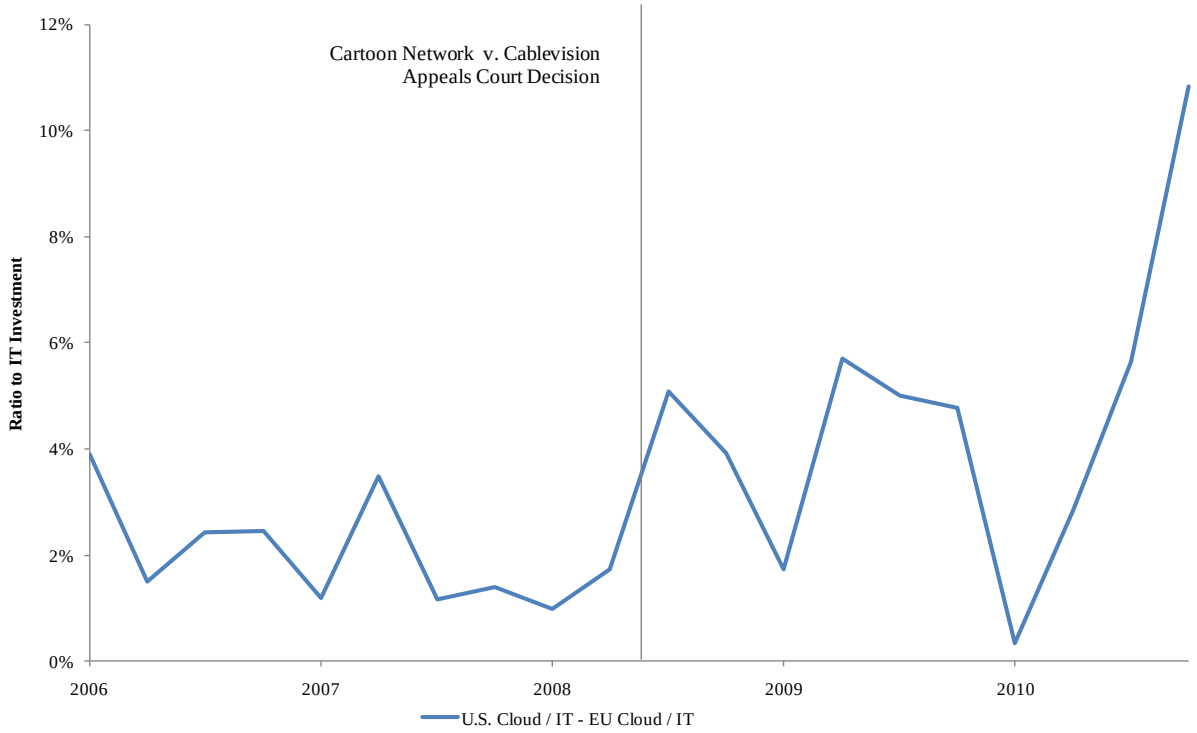
Figure 1
Ratio of Investment in Cloud Computing Companies to Investment in all IT Companies



Source: Private Equity Investment data Jan 1995 - Dec 2010 from Thomson ONE.

Figure 2
Difference in the Ratio of Investment in Cloud Computing Companies to Investment in all IT Companies in the U.S. and EU



Source: Private Equity Investment data Jan 2006 - Dec 2010 from Thomson ONE.

Table 1
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(1)	(2)
U.S. Indicator	0.0202***	0.0129***
	(0.0048)	*(0.0045)*
2008 Dummy[3]	0.0059	-0.0094
	(0.0080)	*(0.0090)*
Effect of Cablevision on U.S. VC Investment	0.0257**	0.0256**
	(0.0114)	*(0.0095)*
Percent Change in GDP		0.0093***
		(0.0030)
Broadband Penetration Rate		0.3754***
		(0.0900)
Constant	0.0117***	-0.0629***
	(0.0038)	*(0.0167)*
Observations	40	40
Adjusted R-Squared	0.544	0.699
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$730**	**$728**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 2
Cloud Computing Quantile Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(3)	(4)
U.S. Indicator	0.0204*	0.0099
	(0.0105)	*(0.0066)*
2008 Dummy[3]	-0.0014	-0.0174
	(0.0085)	*(0.0149)*
Effect of Cablevision on U.S. VC Investment	0.0335**	0.0318*
	(0.0138)	*(0.0160)*
Percent Change in GDP		0.0058
		(0.0061)
Broadband Penetration Rate		0.3594***
		(0.0792)
Constant	0.0112	-0.0556***
	(0.0075)	*(0.0142)*
Observations	40	40
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$952**	**$904**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 3
Cloud Computing Regression Results: U.S. vs. Rest of World[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model
Independent Variables	(5)
U.S. Indicator	0.0257***
	(0.0045)
2008 Dummy[3]	0.0042
	(0.0044)
Effect of Cablevision on U.S. VC Investment	0.0274***
	(0.0092)
Constant	0.0062*
	(0.0034)
Observations	40
Adjusted R-Squared	0.706
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$779**
Length of Time Period	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 4
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Internet-Specific VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(6)	(7)
U.S. Indicator	0.1094***	0.0806***
	(0.0274)	*(0.0282)*
2008 Dummy[3]	0.1185**	0.0501
	(0.0446)	*(0.0574)*
Effect of Cablevision on U.S. VC Investment	-0.0857*	-0.0793
	(0.0491)	*(0.0501)*
Percent Change in GDP		0.0152
		(0.0147)
Broadband Penetration Rate		1.2995***
		(0.4465)
Constant	0.2030***	-0.0441
	(0.0238)	*(0.0804)*
Observations	40	40
Adjusted R-Squared	0.303	0.370
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 5
Cloud Computing Regression Results with Clustered Standard Errors: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(8)	(9)
U.S. Indicator	0.0202***	0.0129***
	(0.0010)	*(0.0010)*
2008 Dummy[3]	0.0059	-0.0094
	(0.0057)	*(0.0068)*
Effect of Cablevision on U.S. VC Investment	0.0257*	0.0256*
	(0.0109)	*(0.0111)*
Percent Change in GDP		0.0093**
		(0.0018)
Broadband Penetration Rate		0.3754***
		(0.0234)
Constant	0.0117***	-0.0629***
	(0.0026)	*(0.0040)*
Observations	40	40
Adjusted R-Squared	0.579	0.738
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$730**	**$728**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Clustered standard errors (by quarter) are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 6
Cloud Computing Tobit Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(10)	(11)
U.S. Indicator	0.0240***	0.0148***
	(0.0064)	*(0.0049)*
2008 Dummy[3]	0.0075	-0.0128
	(0.0096)	*(0.0093)*
Effect of Cablevision on U.S. VC Investment	0.0241*	0.0244**
	(0.0123)	*(0.0097)*
Percent Change in GDP		0.0098***
		(0.0033)
Broadband Penetration Rate		0.4649***
		(0.1113)
Constant	0.0079	-0.0835***
	(0.0057)	*(0.0222)*
Observations	40	40
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$714**	**$718**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 7
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Cloud Computing VC Dollars

	Model	
Independent Variables	(12)	(13)
IT U.S. Minus Cloud VC Investment	0.0532	0.0590**
	(0.0327)	*(0.0267)*
Total VC Investment Minus IT Minus Cloud VC Investment	0.0087	-0.0004
	(0.0106)	*(0.0115)*
U.S. Indicator	-71.1660	-87.7535
	(108.5990)	*(84.7400)*
2008 Dummy[3]	7.2783	-24.2030
	(8.8634)	*(26.8703)*
Effect of Cablevision on U.S. VC Investment	119.1098*	126.8498**
	(59.3409)	*(51.4516)*
Percent Change in GDP		20.6457**
		(9.2363)
Broadband Penetration Rate		713.7737*
		(376.2864)
Constant	-37.2162	-170.5333**
	(22.5880)	*(71.7582)*
Observations	40	40
Adjusted R-Squared	0.750	0.803
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$1,191**	**$1,268**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 8

Cloud Computing Regression Results: U.S. vs. EU[1,2,3]

Dependent Variable: Whether a Deal is a Cloud Deal (0/1)

	Model				
	(14)	(15)	(16)	(17)	(18)
U.S. Indicator	0.782***	0.767***	0.760***	0.678***	0.670***
	(0.000)	*(0.000)*	*(0.000)*	*(0.071)*	*(0.068)*
2008 Dummy[4]	0.526***	-0.203	4.278***	-0.228	2.071***
	(0.000)	*(0.126)*	*(0.210)*	*(0.167)*	*(0.527)*
Effect of Cablevision on U.S. VC Investment	0.131***	0.174***	0.174***	0.238	0.240
	(0.000)	*(0.001)*	*(0.001)*	*(0.329)*	*(0.327)*
Percent Change in GDP			5.184***		3.647***
			(0.036)		*(0.283)*
Broadband Penetration Rate			569.057		448.008
			(0.000)		*(0.000)*
Constant	-4.267***	-3.756***	-160.030***	-5.869***	-127.201***
	(0.000)	*(0.010)*	*(0.284)*	*(0.082)*	*(1.061)*
Quarter of Year Fixed Effects?	No	Yes	Yes	Yes	Yes
VC Firm Fixed Effects	No	No	No	Yes	Yes
Observations	28,699	28,699	28,699	28,699	28,699
Pseudo R-Squared	0.0164	0.0276	0.0277	0.276	0.276
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:

[1] A logit model was used. If a deal is a cloud deal the binary dependent variable is equal to one; otherwise, it is equal to zero.

[2] Clustered standard errors (by region) are provided under the point estimates in italics.

[3] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.

[4] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 9

Cloud Computing Regression Results: U.S. vs. EU[1,2,3]

Dependent Variable: Whether a Deal is a Cloud Deal (0/1)

Data are Restricted to Investments by VC firms Which Have Done at Least One Cloud Deal Previously

	Model				
	(19)	(20)	(21)	(22)	(23)
U.S. Indicator	-0.054***	0.013***	0.013***	-0.127	-0.127
	(0.000)	*(0.003)*	*(0.003)*	*(0.101)*	*(0.101)*
2008 Dummy[4]	-0.884***	-1.584***	17.742***	-1.772***	6.345***
	(0.000)	*(0.001)*	*(4.249)*	*(0.295)*	*(1.561)*
Effect of Cablevision on U.S. VC Investment	1.220***	1.217***	1.214***	1.475***	1.475***
	(0.000)	*(0.012)*	*(0.012)*	*(0.310)*	*(0.310)*
Percent Change in GDP			7.819***		3.593***
			(1.612)		*(0.475)*
Broadband Penetration Rate			78.141***		83.760***
			(6.404)		*(1.108)*
Constant	-2.345***	-1.278***	-46.826***	17.045***	-16.397***
	(0.000)	*(0.069)*	*(5.335)*	*(1.214)*	*(2.167)*
Quarter of Year Fixed Effects?	No	Yes	Yes	Yes	Yes
VC Firm Fixed Effects	No	No	No	Yes	Yes
Observations	5,539	5,539	5,539	4,512	4,512
Pseudo R-Squared	0.00670	0.0212	0.0212	0.156	0.156
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:

[1] A logit model was used. If a deal is a cloud deal the binary dependent variable is equal to one; otherwise, it is equal to zero.

[2] Clustered standard errors (by region) are provided under the point estimates in italics.

[3] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.

[4] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 10
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Number of Rounds of VC Investment

	Model	
Independent Variables	(24)	(25)
U.S. Indicator	15.5***	13.4***
	(1.9)	*(1.5)*
2008 Dummy[3]	0.8	-3.7
	(0.8)	*(2.4)*
Effect of Cablevision on U.S. VC Investment	6.5*	6.6**
	(3.8)	*(2.9)*
Percent Change in GDP		2.2**
		(1.0)
Broadband Penetration Rate		102.7***
		(33.9)
Constant	1.2***	-19.0***
	(0.3)	*(6.4)*
Observations	40	40
Adjusted R-Squared	0.787	0.845
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 11
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: For Each of IaaS, PaaS, and SaaS, Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model		
	IaaS	PaaS	SaaS
Independent Variables	(26)	(27)	(28)
U.S. Indicator	0.0026	0.0057***	0.0151***
	(0.0034)	*(0.0013)*	*(0.0037)*
2008 Dummy[3]	-0.0016	0.0000	0.0081
	(0.0028)	*(0.0005)*	*(0.0073)*
Effect of Cablevision on U.S. VC Investment	0.0117**	0.0061**	0.0089
	(0.0050)	*(0.0030)*	*(0.0087)*
Constant	0.0039	0.0003	0.0074
	(0.0026)	*(0.0003)*	*(0.0026)*
Observations	40	40	40
Adjusted R-Squared	0.389	0.546	0.448
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors (by quarter) are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 12

Cloud Computing Regression Results: 2nd Circuit Court vs. Rest of U.S.[1,2,3,4,5]

Dependent Variable: Whether a Deal is a Cloud Deal (0/1)

	Model		
Independent Variables	(29)	(30)	(31)
2nd Circuit Indicator	-1.148***	-1.205***	-1.200***
	(0.181)	(0.179)	(0.179)
2008 Dummy[4]	0.626***	-0.228	1.029*
	(0.079)	*(0.206)*	*(0.569)*
Effect of Cablevision on 2nd Circuit VC Investment	0.704***	0.708***	0.716***
	(0.084)	*(0.087)*	*(0.086)*
Percent Change in GDP			0.418**
			(0.180)
Broadband Penetration Rate			1.861
			(6.720)
Constant	-3.430***	-2.031***	-4.363***
	(0.132)	*(0.202)*	*(1.313)*
Quarter of Year Fixed Effects?	No	Yes	Yes
Observations	29,356	29,356	29,356
Pseudo R-Squared	0.0143	0.0277	0.0251
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:

[1] A logit model was used. If a deal is a cloud deal the binary dependent variable is equal to one; otherwise, it is equal to zero.

[2] Clustered standard errors (by state) are provided under the point estimates in italics.

[3] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.

[4] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

[5] 2nd Circuit Court's jurisdiction covers the states of New York, Connecticut, and Vermont.

Table 13
Cloud Computing Regression Results: France and Germany vs. the EU
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars[1]

	Model					
Independent Variables	(32)	(33)	(34)	(35)	(36)	(37)
France Indicator	-0.0125***	-0.0207***				
	(0.0041)	*(0.0060)*				
Q1 2009 Dummy[2]	0.0223**	0.0175*				
	(0.0092)	*(0.0091)*				
Effect of the Wizzgo Decision on French VC Investment	-0.0185*	-0.0176*				
	(0.0095)	*(0.0089)*				
Germany Indicator			-0.0031*	-0.0026	-0.0031*	-0.0029
			(0.0018)	*(0.0020)*	*(0.0017)*	*(0.0028)*
Q3 2006 Dummy[3]			0.0115**	0.0103*	0.0205***	0.0098
			(0.0049)	*(0.0053)*	*(0.0053)*	*(0.0094)*
Effect of German Decisions on German VC Investment			-0.0115**	-0.0133**	-0.0156**	-0.0233***
			(0.0049)	*(0.0054)*	*(0.0073)*	*(0.0065)*
Percent Change in GDP		0.0042**		0.0020		0.0025
		(0.0020)		*(0.0017)*		*(0.0016)*
Broadband Penetration Rate		0.1406**		0.0270		0.1181
		(0.0641)		*(0.0317)*		*(0.0821)*
Constant	0.0125***	-0.0137	0.0031*	-0.0010	0.0031*	-0.0102
	(0.0041)	*(0.0112)*	*(0.0018)*	*(0.0042)*	*(0.0017)*	*(0.0089)*
Observations	40	40	40	40	56	56
R-Squared	0.500	0.535	0.396	0.418	0.256	0.311
Implied Quarterly Decrease in Cloud VC Investment ($ Millions)	-2.0	-1.9	-0.5	-0.5	-0.6	-0.9
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2010	1Q 2004 - 4Q 2010

Notes:
[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level. Robust standard errors are provided under the point estimates in italics.
[2] Decision by Tribunal de Grande Instance of Paris in November of 2008. The 2009 Dummy variable is set equal to one for all quarters after 4Q 2008.
[3] Decision by the German District Court against Shift.tv on May 12, 2006. The 2006 Dummy variable is set equal to one for all quarters after 2Q 2006. Additional decisions include an Appeals Court ruling against Shift.tv on November 28, 2006, a District Court ruling against Save.tv on May 9, 2007, an Appeals Court ruling in favor of Save.tv on October 9, 2007, and a Federal Court decision in which the cases against Shift.tv and Save.tv were remanded back to the Appeals Court on April 22, 2009.

Table 14
Cloud Computing Regression Results: France and Germany vs. ROW
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars[1]

	Model		
Independent Variables	(38)	(39)	(40)
France Indicator	-0.0057*		
	(0.0028)		
Q1 2009 Dummy[2]	0.0117***		
	(0.0037)		
Effect of the Wizzgo Decision on French VC Investment	-0.0079*		
	(0.0045)		
Germany Indicator		-0.0012	-0.0012
		(0.0008)	*(0.0008)*
Q3 2006 Dummy[3]		0.0056*	0.0104***
		(0.0033)	*(0.0026)*
Effect of German Decisions on German VC Investment		-0.0056*	-0.0054
		(0.0033)	*(0.0056)*
Constant	0.0057*	0.0012	0.0012
	(0.0028)	*(0.0008)*	*(0.0008)*
Observations	40	40	56
R-Squared	0.467	0.239	0.111
Implied Quarterly Decrease in French Cloud VC Investment ($ Millions)	-0.9		
Implied Quarterly Decrease in German Cloud VC Investment ($ Millions)		-0.2	-0.2
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2004 - 4Q 2008	1Q 2006 - 4Q 2010

Notes:
[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level. Robust standard errors are provided under the point estimates in italics.
[2] Decision by Tribunal de Grande Instance of Paris in November of 2008. The 2009 Dummy variable is set equal to one for all quarters after 4Q 2008.
[3] Decision by the German District Court against Shift.tv on May 12, 2006. The 2006 Dummy variable is set equal to one for all quarters after 2Q 2006. Additional decisions include an Appeals Court ruling against Shift.tv on November 28, 2006, a District Court ruling against Save.tv on May 9, 2007, an Appeals Court ruling in favor of Save.tv on October 9, 2007, and a Federal Court decision in which the cases against Shift.tv and Save.tv were remanded back to the Appeals Court on April 22, 2009.

Table 15
Cloud Computing Regression Results: France and Germany vs. the EU
Dependent Variable: Cloud Computing VC Dollars[1]

	Model					
Independent Variables	(41)	(42)	(43)	(44)	(45)	(46)
French/German IT Minus Cloud VC Investment	0.0203*** *(0.0067)*	0.0195*** *(0.0062)*	0.0119 *(0.0079)*	-0.0129* *(0.0069)*	0.0144* *(0.0078)*	0.0144* *(0.0073)*
Total French/German VC Investment Minus IT Minus Cloud VC Investment	0.0002 *(0.0010)*	-0.0007 *(0.0010)*	-0.0005 *(0.0027)*	-0.0020 *(0.0023)*	-0.0022 *(0.0036)*	-0.0033 *(0.0032)*
France Indicator	1.6962 *(3.2316)*	-3.0309 *(4.1813)*				
Q1 2009 Dummy[2]	10.3236** *(3.8434)*	8.0265** *(3.9036)*				
Effect of the Wizzgo Decision on French VC Investment	-9.9446** *(3.8490)*	-8.1107** *(3.4266)*				
Germany Indicator			1.8987 *(2.4262)*	1.9702 *(2.3332)*	1.8041 *(1.8319)*	1.6259 *(1.9181)*
Q3 2006 Dummy[3]			3.7146 *(2.5231)*	3.9986 *(2.4620)*	7.5471*** *(2.3380)*	6.7182** *(2.6475)*
Effect of German Decisions on German VC Investment			-3.7622 *(2.5160)*	-4.9726* *(2.8590)*	-7.2437*** *(2.3567)*	-9.0964*** *(2.7749)*
Percent Change in GDP		2.7005** *(1.0572)*		1.5993 *(1.0032)*		1.4356 *(0.8902)*
Broadband Penetration Rate		63.7616** *(31.1572)*		9.6318 *(16.3778)*		18.5790 *(12.9991)*
Constant	-3.8858 *(3.8896)*	-14.9104*** *(5.1048)*	-2.3038 *(2.7809)*	-3.9396 *(2.4841)*	-2.1293 *(2.0958)*	-4.3394** *(1.8465)*
Observations	40	40	40	40	56	56
R-Squared	0.571	0.628	0.448	0.495	0.472	0.513
Implied Quarterly Decrease in French Cloud VC Investment ($ Millions)	-9.9	-8.1	-3.8	-5.0	-7.2	-9.1
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2010	1Q 2004 - 4Q 2010

Notes:
[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level. Robust standard errors are provided under the point estimates in italics.
[2] Decision by Tribunal de Grande Instance of Paris in November of 2008. The 2009 Dummy variable is set equal to one for all quarters after 4Q 2008.
[3] Decision by the German District Court against Shift.tv on May 12, 2006. The 2006 Dummy variable is set equal to one for all quarters after 2Q 2006. Additional decisions include an Appeals Court ruling against Shift.tv on November 28, 2006, a District Court ruling against Save.tv on May 9, 2007, an Appeals Court ruling in favor of Save.tv on October 9, 2007, and a Federal Court decision in which the cases against Shift.tv and Save.tv were remanded back to the Appeals Court on April 22, 2009.

Appendix A - *Cablevision* Decision
Summary Statistics for Investment Levels and Regression Variables

	Q1 1995 - Q4 2010						Pre Cablevision: Q1 2006 - Q2 2008						Post Cablevision: Q3 2008 - Q4 2010					
	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total
VC Investment in U.S. Cloud ($ Millions)[1]	$92.3	$88.0	$0.0	$71.8	$406.5	$5,906.3	$131.0	$39.9	$72.9	$125.8	$191.1	$1,309.7	$184.7	$84.9	$58.8	$176.6	$369.4	$1,847.1
VC Investment in U.S. Cloud as % of VC Investment in U.S. IT[1]	2.2%	2.3%	0.0%	1.6%	11.5%		3.2%	0.9%	1.8%	3.0%	4.6%		6.3%	2.4%	3.1%	6.1%	11.5%	
VC Investment in EU Cloud ($ Millions)[1]	$3.8	$7.4	$0.0	$0.0	$34.0	$242.3	$7.0	$7.7	$0.0	$4.5	$20.5	$69.9	$8.9	$11.5	$0.0	$3.7	$34.0	$88.7
VC Investment in EU Cloud as % of VC Investment in E.U. IT[1]	0.7%	1.4%	0.0%	0.0%	6.4%		1.2%	1.2%	0.0%	0.9%	3.6%		1.8%	2.2%	0.0%	0.8%	6.4%	
Real U.S. GDP Growth Rate Prior Quarter[2]	0.6%	0.7%	-2.3%	0.7%	2.0%		0.4%	0.5%	-0.4%	0.4%	1.3%		-0.1%	1.2%	-2.3%	0.5%	1.0%	
Real EU GDP Growth Rate Prior Quarter[2]	0.5%	0.6%	-2.6%	0.5%	1.2%		0.7%	0.4%	-0.3%	0.7%	1.0%		-0.3%	1.1%	-2.6%	0.3%	1.0%	
U.S. Broadband Penetration Rate[3]	17.7%	7.4%	5.4%	18.6%	27.7%		20.7%	2.6%	16.6%	20.8%	23.9%		26.1%	0.8%	24.7%	25.9%	27.7%	
EU Broadband Penetration Rate[3]	15.0%	8.4%	2.0%	15.8%	26.0%		18.2%	3.0%	13.5%	18.5%	22.2%		24.6%	1.0%	22.8%	24.9%	26.0%	

Notes and Sources:
[1] Thomson ONE Private Equity data, Jan 1995 to Dec 2010.
[2] OECD real GDP growth from the previous quarter.
[3] OECD broadband penetration rate.

Appendix B - French Ruling
Summary Statistics for Investment Levels and Regression Variables

	Q1 1995 - Q4 2010						Pre-Wizzgo Decision: Q1 2006 - Q4 2008						Post-Wizzgo Decision:: Q1 2009 - Q4 2010					
	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total
VC Investment in French Cloud ($ Millions)[1]	$0.056	$0.321	$0.000	$0.000	$2.199	$3.561	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.445	$0.854	$0.000	$0.000	$2.199	$3.561
VC Investment in French Cloud as % of VC Investment in French IT[1]	0.05%	0.28%	0.00%	0.00%	1.70%		0.00%	0.00%	0.00%	0.00%	0.00%		0.38%	0.72%	0.00%	0.00%	1.70%	
VC Investment in EU Cloud ($ Millions)[1]	$3.645	$7.301	$0.000	$0.000	$32.645	$233.303	$5.900	$7.388	$0.000	$3.070	$20.500	$70.800	$9.840	$12.037	$0.000	$3.707	$32.645	$78.720
VC Investment in EU Cloud as % of VC Investment in E.U. IT[1]	0.91%	1.88%	0.00%	0.00%	8.79%		1.25%	1.41%	0.00%	0.65%	3.83%		2.76%	2.87%	0.00%	1.97%	8.13%	
Real French GDP Growth Rate Prior Quarter[2]	0.41%	0.51%	-1.58%	0.53%	1.31%		0.19%	0.69%	-1.45%	0.37%	1.07%		0.10%	0.71%	-1.58%	0.34%	0.60%	
Real EU GDP Growth Rate Prior Quarter[2]	0.53%	0.61%	-2.33%	0.62%	1.34%		0.31%	0.90%	-1.84%	0.69%	1.04%		-0.03%	1.00%	-2.33%	0.30%	0.75%	
French Broadband Penetration Rate[3]	18.01%	10.44%	1.57%	18.84%	33.66%		22.54%	3.75%	16.31%	22.95%	27.64%		30.95%	1.91%	28.30%	30.92%	33.66%	
EU Broadband Penetration Rate[3]	13.61%	7.31%	1.78%	14.97%	22.62%		17.75%	2.83%	12.88%	18.14%	21.41%		21.57%	0.87%	20.15%	21.60%	22.62%	

Notes and Sources:
[1] Thomson ONE Private Equity data, Jan 1995 to Dec 2010.
[2] OECD real GDP grwoth from the previous quarter
[3] OECD broadband penetration rate.

Appendix C - German Ruling
Summary Statistics for Investment Levels and Regression Variables

	Q1 1995 - Q4 2010						Pre-German District Court decision: Q1 2004 - Q2 2006						Post-German District Court decision: Q3 2006 - Q4 2008						Post-German District Court decision: Q3 2006 - Q4 2010					
	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total
VC Investment in German Cloud ($ Millions)[1]	$0.087	$0.690	$0.000	$0.000	$5.473	$5.473	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.304	$1.290	$0.000	$0.000	$5.473	$5.473
VC Investment in German Cloud as % of VC Investment in German IT[1]	0.15%	1.15%	0.00%	0.00%	8.86%		0.00%	0.00%	0.00%	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%		0.49%	2.09%	0.00%	0.00%	8.86%	
VC Investment in EU Cloud ($ Millions)[1]	$3.645	$7.301	$0.000	$0.000	$32.645	$233.303	$3.514	$7.094	$0.000	$0.000	$22.710	$35.140	$6.913	$7.728	$0.000	$4.545	$20.500	$69.126	$8.214	$9.671	$0.000	$4.483	$32.645	$147.846
VC Investment in EU Cloud as % of VC Investment in E.U. IT[1]	0.91%	1.88%	0.00%	0.00%	8.79%		1.18%	2.73%	0.00%	0.00%	8.79%		1.46%	1.46%	0.00%	1.30%	3.83%		2.04%	2.23%	0.00%	1.59%	8.13%	
Real German GDP Growth Rate Prior Quarter[2]	0.32%	0.88%	-4.01%	0.36%	1.95%		0.44%	0.57%	-0.15%	0.29%	1.51%		0.27%	1.03%	-2.17%	0.62%	1.22%		0.24%	1.36%	-4.01%	0.62%	1.95%	
Real EU GDP Growth Rate Prior Quarter[2]	0.53%	0.61%	-2.33%	0.62%	1.34%		0.71%	0.23%	0.36%	0.75%	0.99%		0.19%	0.94%	-1.84%	0.64%	1.04%		0.09%	0.94%	-2.33%	0.41%	1.04%	
German Broadband Penetration Rate[3]	17.21%	10.31%	3.14%	16.55%	31.93%		10.10%	3.16%	6.01%	9.71%	15.01%		22.72%	3.81%	16.55%	23.07%	27.44%		26.17%	4.91%	16.55%	27.16%	31.93%	
EU Broadband Penetration Rate[3]	13.61%	7.31%	1.78%	14.97%	22.62%		9.54%	2.83%	5.52%	9.40%	13.97%		18.61%	2.18%	14.97%	19.00%	21.41%		19.93%	2.26%	14.97%	20.54%	22.62%	

Notes and Sources:
[1] Thomson ONE Private Equity data, Jan 1995 to Dec 2010.
[2] OECD real GDP grwoth from the previous quarter
[3] OECD broadband penetration rate.