



## Organization Science

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To cite this article:

Charles Eesley, Jian Bai Li, Delin Yang (2016) Does Institutional Change in Universities Influence High-Tech Entrepreneurship? Evidence from China's Project 985. *Organization Science* 27(2):446-461. <https://doi.org/10.1287/orsc.2015.1038>

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# Does Institutional Change in Universities Influence High-Tech Entrepreneurship? Evidence from China's Project 985

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**T**his paper contributes to institutional theory on cognitive and normative institutional change targeted at altering beliefs, behaviors, and ultimately firm performance. Prior work emphasizes institutional changes where the ideas and beliefs originate from those within the institutional context. Under examined are cases of institutional changes in beliefs and behaviors imposed from outside of the context, which may result in inconsistencies among cognitive, normative, and regulatory institutional pillars. Project 985 was a program implemented by the Chinese government that provided funding for a set of universities to build new research centers. We found that graduates of these universities subsequently expressed greater beliefs in innovation and founded more high-tech ventures, but that entrepreneurs influenced by the reform were not as financially successful as entrepreneurs who founded firms before the reform or from non-985 universities. We explain this surprising finding as caused by the fact that Project 985 was institutionally inconsistent with China's broader institutional environment. An important implication is that institutional changes may alter beliefs and behavior, but they must be consistent with the broader institutional environment to improve firm performance.

**Keywords:** institutional theory; entrepreneurship; innovation

**History:** Published online in *Articles in Advance* March 1, 2016.

## Introduction

A central tenet of institutional theory is that organizations that conform to their institutional environment are more likely to survive and grow. Adopting externally legitimated behaviors or organizational forms increases the commitment of internal participants and external constituents (Meyer and Rowan 1977). Such conformity improves organizations' ability to acquire necessary resources, which in turn contributes positively to organizational growth and performance (Stinchcombe 1965, Meyer and Rowan 1977, Khaire 2010).

A related but less well-understood question is whether institutional changes must also conform across the cognitive, normative, and regulatory aspects of institutions (Scott 2014) to have the intended impact on organizations. Whereas prior studies conclude that institutional changes can significantly impact organizations by altering incentives or redefining standards of appropriateness (Kerr and Nanda 2010, Dobbin and Dowd 1997, Sine and Lee 2009), such findings are based on the implicit assumption that such changes are *institutionally consistent*—that is, the proposed changes can be viably realized in practice by organizations within the institutional environment. We define institutional consistency as the degree to which the idea being objectified is aligned with the institutional environment. To our best knowledge, prior research has rarely

studied institutional changes that are *inconsistent* across aspects of the regulative, normative, and cognitive-cultural institutional environment (Scott 2014).

We address this gap by examining how institutional changes that are inconsistent with the broader institutional environment affect organizations. We do so by studying China's Project 985, an educational reform that attempts to institutionalize belief in the importance of innovation among university graduates. Our interest is in how Project 985 influences new ventures in an institutional environment where enforcement of intellectual property laws is limited and returns to alternative entrepreneurial actions such as political networking may be greater. Consistent with prior education literature on students' values and beliefs (Staton and Darling 1989, Stuart and Ding 2006), we focus on the important role of university teaching and research on socialization and the role of education in influencing beliefs and values (Golde 1998, Austin 2002, Gottlieb 1961).

Our findings are consistent with our theorizing regarding institutional inconsistency. We find that Project 985 did successfully instill a belief in the importance of innovation among students. When these students started ventures, their altered beliefs did lead to an increased likelihood to engage in technologically intensive activities. Yet, where we might have expected performance improvements from

innovation (Li and Atuahene-Gima 2002) and widespread adoption, we actually find the opposite: by spurring alumni entrepreneurs to innovate, Project 985 actually negatively influenced entrepreneurial performance. We argue that this is because Project 985 is inconsistent with the other aspects of institutional environment in China: given China's underdeveloped intellectual property regulations, the type of Silicon Valley-style entrepreneurial innovation that Project 985 advocated was not viable in actual business practice. Project 985 may have some success instilling the belief in innovation within the confines of the university, but such beliefs are unlikely to sediment—and therefore become institutionalized—in the broader institutional environment of China.

We contribute to the literature on institutional theory with the concept of institutional inconsistency. We extend prior theoretical and empirical research on the process of institutionalization and on the conditions under which some new ideas fail to be institutionalized. In particular, we detail a set of conditions identifying why and how institutionalization is likely to fail. Whereas prior research explores cognitive, normative, and regulatory dimensions of the institutional environment, we contribute by focusing on how these dimensions of institutions relate to one another and their inseparability from practical routines and behaviors within individuals and organizations. The regulative dimension includes formal rules, such as government regulations. The normative dimension refers to values, norms, and role expectations internalized through socialization. The cognitive dimension consists of symbols and frames through which individuals make sense of the world and draw meaning.

Our key contribution arises from an examination of why institutionalization may not proceed in cases where habituation and objectification relate to one stage of an organizational process (invention, in this case), yet are inconsistent with the institutional pillars governing the remainder of that process (i.e., commercialization). The result of failing to understand this aspect of institutionalization was unintended consequences (here, in the form of under-performing ventures) and organizations that act in a way that is inconsistent with broader institutions and therefore in a way that hinders their performance.

## Theory

Extant research conceptualizes institutionalization as a process consisting of three stages: habituation, objectification, and sedimentation (Berger and Luckmann 1966, Scott 2014). The first stage, habituation, is the development of patterned problem-solving behaviors and the association of such behaviors with particular situations (Tolbert and Zucker 1996). This is followed by objectification, during which general shared meanings regarding the habituated behaviors emerge (Zucker 1977). The final stage is sedimentation, during which

generalized meanings become a “given” part of the social reality (Berger and Luckmann 1966, Tolbert 1988). Overall, this framework of institutionalization provides a conceptualization of how institutions emerge out of repeated practices.

Institutional consistency is likely to occur in institutionalization processes that begin with habituation in a set of practitioners. That is because structures, meanings, and practices that emerge out of habituation are typically generalized from working responses to problems in the real lives of a particular set of practitioners (Tolbert and Zucker 1996). Thus, any ideas that pass to the objectification stage would have already been tested against the realities of social and economic life, such that the institutionalization of ideas that are not viable in the other dimensions of the institutional environment is highly unlikely. In other words, in institutionalization processes that begin with habituation from practice, the very process of habituation itself serves as the filter that excludes ideas and meanings that are inconsistent with the existing context from the process of institutionalization.

In contrast, institutional inconsistency may arise when institutionalization is initiated by actors who are not members of the relevant practitioner community. This is because nonpractitioners often have insufficient knowledge of the most suitable responses to situations and challenges that practitioners face within the relevant institutional environment. Compared to practitioners, nonpractitioners also have less incentive to ensure that the beliefs, structures, and practices they institutionalize are actionable in actual social and economic life. Consequently, nonpractitioners may attempt to institutionalize beliefs, structures, and practices that are irrelevant or even harmful for practice within the other aspects of the institutional environment. For instance, because policy makers in many emerging economies are typically not involved in day-to-day business dealings with foreign firms, they may institute regulations that are incompatible with the activities that firms must engage in to perform well in emerging economies. As a result, these firms must engage in a series of strategic maneuverings to satisfy the inconsistent demands of policy and the other dimensions of the institutional environment (Witt and Lewin 2007). Overall, institutional inconsistency is more likely when the actors initiating the institutionalization of certain beliefs, structures, and practices are not actively practicing such beliefs, structures, and practices.

A category of institutional change that may be specifically susceptible to institutional inconsistency is educational reforms that attempt to institutionalize a particular belief, often with the hope that the alumni holding this new belief will then behave in certain ways after graduation. An example of such a reform is Greece's New School program, which policy makers initiated with the explicit purpose of instilling beliefs regarding the importance of innovation, creativity, and entrepreneurship

within students (EACEA 2012). The logic behind both of these policy initiatives is that, by using educational reforms to impart to students the importance of innovation and entrepreneurship, policy makers can encourage these students to start innovative ventures. Yet, as we theorize here, since neither policy makers nor educators are actually involved in the practice of entrepreneurship, beliefs institutionalized within academic settings may yield unintended consequences in the other aspects of the institutional environment. More critically, we have little knowledge of how such reforms influence their target organizations when such reforms are inconsistent with other aspects of the institutional environment. As such, we ask the following question: How does institutional change that attempts to institutionalize beliefs actually affect the behavior and performance of their target individuals and organizations when such beliefs are inconsistent with the remaining institutional environment?

## Hypotheses

### Project 985

To answer our research question, we study how China's Project 985 influenced the beliefs of the alumni entrepreneurs, the behaviors of the firms they started, and the performance of these firms. Funded and implemented by the government of the People's Republic of China, Project 985 was launched on May 4, 1998 (China Education Online 2008). The reform allocated an additional 10–20% in research expenditures to a set of 39 universities.

Project 985 sought to foster a belief in the importance of innovation among students of affected universities (henceforth referred to as “985 universities”) with the explicit expectation that these students will then contribute to the development of China's innovative capability in the commercial arena (Ministry of Education of the People's Republic of China 1998). Specifically, Project 985 attempted to (1) establish the lack of technological capabilities as a critical problem that many Chinese firms face and (2) demonstrate that innovation is a credible solution to this problem. The following quote from a professor at a 985 university attests to this:

What we're trying to do... is two things. First, we need to make it clear to the students that Chinese companies are falling behind Western and Japanese companies because Chinese companies aren't technologically advanced... and this is a gap that you can't make up for by copying other people. Yes, [Chinese firms] have made a lot of money over the past 30 years, but [they] will never become like Apple or Google if they keep copying other people. So the second thing we need to make clear to students is that you can only close this gap by innovating yourself... you look at Baidu, you look at Alibaba, if Chinese people innovate, we can be like Apple and Google too.

To accomplish its goals, Project 985 created an environment that would foster a shared belief in innovation. The

specific actions that 985 universities undertook included creating courses on innovation and entrepreneurship, attracting accomplished researchers from overseas to provide role models and to transfer skills/knowledge, constructing facilities necessary for advanced scientific research, and the establishment of fellowships and awards that rewarded innovative research (Yang 2010, China Agricultural University 2010, Shanghai Jiaotong University 2012). We emphasize that 985 universities did not implement these changes sporadically. Rather, under the guidance of Project 985, the universities implemented the aforementioned changes in a concerted manner to create an environment in which students can become exposed to innovation and practice innovating.

By creating an environment that allows students to both learn about innovation and practice innovating, Project 985 is likely to positively influence students' beliefs regarding the importance of innovation. Such positive influence may originate from role models and from classroom practice. Because students often look up to teachers and mentors as role models of proper values and behavior (Prideaux et al. 2000), Project 985 may exert positive influences on students' beliefs regarding innovation by putting students into direct contact with researchers who espouse the importance of innovation and engage in innovative research in classrooms and laboratories. Classes are another way for educators to shape student beliefs, and Project 985 may also positively influence student beliefs regarding innovation both by directly conveying the importance of innovation in class and by presenting innovation as the way toward high performance in entrepreneurship. Most critically, by creating an environment where prominent researchers act as role models for innovation, where classes teach students about innovation, and where laboratories and other informal settings provide students with opportunities to practice innovation, Project 985 constructs a setting within which shared meanings regarding innovation are likely to emerge and become objectified among students. Thus, by creating an environment that allows students to learn and practice innovation, Project 985 contributes to the emergence of positive beliefs regarding the importance of innovation among students of 985 universities. Those who were students after the reform took effect subsequently become alumni of those universities and carry those beliefs with them to influence their careers and the behaviors they pursue in creating ventures.

Within the Chinese context, beliefs regarding intellectual property (IP) may be particularly indicative of beliefs regarding innovation overall. Whereas IP is critical for innovation and stimulates R&D in general (Moser 2005), IP may be particularly critical to innovation in the Chinese context. This is because many researchers and entrepreneurs in China do not understand the importance of IP and often feel no need to patent their innovations (Li 2008). In fact, whereas Chinese researchers produce



approximately 30,000 scientific and technological innovations each year, they only *apply* for patents for 10% of these innovations (Li 2008). In such an environment, entrepreneurs who understand the importance of IP and take measures to protect their innovations may gain significant performance advantages. Given how central IP is to innovation in entrepreneurial ventures, beliefs regarding IP are thus core to beliefs regarding innovation in general. As such, beliefs regarding the importance of IP are particularly indicative of beliefs regarding innovation in the Chinese context, and we specifically focus on Project 985's influence on entrepreneurs' beliefs regarding IP.

By creating an environment that enables students to learn and practice innovation, Project 985 is likely to positively influence students' beliefs regarding the importance of intellectual property. Given the centrality of IP to innovation in China, Project 985's attempts to foster a belief in the importance of innovation are likely to also instill in students both awareness and beliefs regarding the importance of IP. Indeed, an entrepreneur who graduated from a 985 university expressed the following sentiments:

Yes, Project 985... had a pretty big effect on how I view innovation and IP. The university brought in some overseas professors and opened new classes on innovation... and when you take these classes and communicate with these professors you start to see things differently. Before I had no idea what IP even was... I mean everyone in China downloaded stuff off of the internet and bought [pirated] CDs, and nobody really cared [about IP]. Now I'm starting to see that, if I want to make money off of my innovations, then IP is pretty important.

Overall, by positively influencing how students view innovation, Project 985 is likely to have a positive influence on the extent to which students believe that intellectual property is important. As such, we hypothesize the following:

**HYPOTHESIS 1 (H1).** *Alumni who graduate from 985 universities after the implementation of Project 985 are more likely to hold the belief that intellectual property protection is important.*

By fostering beliefs regarding the importance of innovation and IP, Project 985 is likely to predispose the alumni of 985 universities to engage in technologically intensive activities when they start ventures. Prior work on strategy and entrepreneurship suggests that the beliefs of managers and entrepreneurs often act as guides for how they interpret information and make decisions (Dutton and Dukerich 1991). Indeed, Rindova and Kotha (2001) and Tripsas (2009) found that firm beliefs regarding their identities guided their branding, business development, and retailing strategies. Project 985 alumni's belief in the importance of innovation and IP may guide their strategic decision making when they start companies. In particular, 985 alumni may be more predisposed to use innovation

to solve problems and create opportunities, such that the firms founded by 985 alumni are more likely to engage in technologically intensive activities.

More specifically, there are two mechanisms by which beliefs regarding IP and innovation are likely to lead to increased investment in technologically intensive activities. First, beliefs regarding IP and innovation may guide how the alumni entrepreneurs interpret information and recognize opportunities. Without beliefs in the effectiveness of innovation, alumni may be inclined to interpret the world in such a way that opportunities related to political connections, access to distribution channels, new markets, or low cost may be the key areas to look for potential opportunities. However, belief in innovation is likely to spur such individuals to look more favorably on entrepreneurial opportunities that involve R&D and innovation. Second, beliefs regarding IP and innovation may also guide how alumni entrepreneurs respond to competition. Without belief in innovation, the field of potential competitive responses may be narrowed to political networking, cuts in prices, new market segments, or different marketing tactics. Yet, with beliefs in innovation, individuals are more likely to consider increased investments in R&D to develop new or improved products as an attractive competitive response. In these ways, beliefs in innovation lead to an increased investment in technologically intensive activities. As such, we hypothesize the following:

**HYPOTHESIS 2 (H2).** *Firms founded by alumni who hold the belief that IP is important are likely to invest more in technologically intensive activities.*

Prior literature gives nuanced predictions regarding the link between investing in technologically intensive activities and performance (Teece 1986). One stream of research suggests that engaging in technologically intensive activities improves performance. Persistently engaging in technologically intensive activities may increase the firm's ability to identify and utilize novel innovations from the environment. In turn, this focus enables the firm to capitalize on emerging innovative opportunities and improves performance (Cohen and Levinthal 1990). Engaging in technologically intensive activities may also enable firms to form ties with key innovators in its environment, which may ensconce firms in advantageous network positions that would boost firm performance by increasing access to key information from diverse sources (Hargadon and Sutton 1997). Overall, this stream of literature suggests that consistently engaging in technologically intensive activities would generate competitive advantage and yield performance benefits.

A second stream of research acknowledges the long-term benefits of investing in innovation but also points out the short-term risks of engaging in technologically intensive activities. Technologically intensive activities are risky endeavors that often require significant upfront investments without generating profitable outcomes, such

that investing in innovation and R&D often compromises short-term performance without necessarily yielding long-term benefits (Laverty 1996). The yields to technologically intensive activities are also dependent on competitors' behaviors, such that engaging in such activities may actually result in lower performance in environments where competitors engage in innovation racing (Katila and Chen 2008). Finally, capitalizing on innovation often requires crucial complementary assets, and firms that do not possess such assets may develop key innovations only to have better-endowed competitors profit from such innovations (Teece 1986). Overall, this second body of literature emphasizes the contingencies that determine the degree to which firms can benefit from innovating and the risks that firms face when such contingencies are not favorably aligned.

Building on this second stream of research, we propose an additional contingency that may determine the returns to engaging in technologically intensive activities: the degree to which technologically intensive activities are supported by the rest of the institutional environment in which a firm operates. More than just requiring complementary assets, firms also need supportive institutions to leverage the fruits of R&D into profit and growth. These institutions include regulations that protect intellectual property, laws safeguarding contracts, financial institutions willing to invest in novel ideas, and courts that are capable of adjudicating business disputes, especially those involving innovation (La Porta et al. 1997, Kerr and Nanda 2010). In the absence of such institutional support, firms may reap more benefits by investing in relationships (i.e., such relationships may provide favors, disadvantage competitors, or guard against opportunism from government officials), rather than by investing in innovation (Peng and Luo 2000, Peng 2004).

Thus, we hypothesize that, by spurring innovation, Project 985 would actually harm the performance of firms founded by 985 alumni. This is so because the institutional changes attempted by Project 985 are inconsistent with other aspects of China's institutional environment. Entrepreneurs who choose to align their firm strategy with new institutional beliefs might expect to benefit just as institutional theory would predict that alignment with new institutions aid resource accumulation and firm performance and survival (Powell and Colyvas 2008). However, if the new institution is itself misaligned with the other pillars of the country's institutional environment, then in this case this alignment to the new institution should result in lower performance. Previous work examines the implications of ambiguity or contradictions but not the implications of institutional inconsistency per se. Prior work has examined institutional contradictions yet has mainly focused on their role in driving subsequent institutional change (Seo and Creed 2002). For example, in response to institutional ambiguity, prior work has shown that such ambiguous institutional environments may lead

to organizational variety (D'Aunno et al. 2000, Meyer et al. 1983), resistance to institutional change (Oliver 1991), or appearing to act in concert with institutional demands (Westphal and Zajac 1998). Yet, we expect that when organizations align themselves with an inconsistent institutional change, the resulting misalignment with the rest of the institutional environment will hurt firm performance.

Project 985 attempts to foster beliefs in the importance of innovation with the hope that alumni would found firms that actively engage in technologically intensive activities. Yet, the successful commercialization of innovation requires institutions that support, finance, and protect innovations. China currently does not possess well-developed institutions capable of effectively enforcing intellectual property protection, safeguarding contracts, and impartially adjudicating disputes involving intellectual property (Xin and Pearce 1996, Peng and Luo 2000, Li and Zhang 2007). Entrepreneurial ventures investing in technologically intensive activities consequentially face prospects of having the fruits of such investments pirated by competitors with very limited legal means of defending themselves. Even if these ventures do manage to profit from novel innovations, they may still need to expend such profit on networking with other managers and with government officials to protect themselves against opportunistic behavior (Peng and Luo 2000, Peng 2004) or to gain the favors, politically connected customers, connections, or advance information from political ties that may form a more reliable and lasting source of advantage in this institutional environment. Given the inconsistency between the practice of innovation and China's institutional environment, firms that engage in technologically intensive activities may not actually profit from activities, such that investment in activities is negatively related to performance. As such, we hypothesize the following:

**HYPOTHESIS 3 (H3).** *Firms that invest more in technologically intensive activities are more likely to exhibit lower performance.*

The implications of H2 and H3 together may be that many firms founded by 985 alumni might be expected to have lower performance.

## Methods

To examine the implications of institutional inconsistency, we take advantage of the Project 985 reform to explore an attempt to change beliefs and the implications for behavior and ultimately performance. We generate our sample through a survey of the alumni of Tsinghua University.

Sampling the Tsinghua alumni is attractive for several reasons. First, it allows us to control for differences in human and social capital across entrepreneurs. The Tsinghua alumni represent a well-defined population

of individuals with comparable talent, work ethic, educational history, and social capital. Sampling from the Tsinghua alumni thus enables us to control out alternative explanations related to differences between alumni of 985 and non-985 universities. Compared to a sample of graduates from universities across China, our sample also suffers less from potential biases that could affect identification of the effects of Project 985. For instance, a sample of university alumni from across China could create bias in estimates because non-985 alumni typically have very different levels of human and social capital in comparison to 985 alumni. Sampling Tsinghua alumni thus enables us to mitigate the likelihood that underlying differences between alumni of different universities will confound observed effects of Project 985. Our sampling procedure mitigates success bias by surveying all Tsinghua alumni and not just currently surviving or successful entrepreneurs.

Our research design uses differences-in-differences to examine the difference between treatment (Project 985 university) and control group (non-985 university) alumni and the difference between those graduating pre-reform and post-reform. Overall, our design improves on similar designs in prior work that do not sufficiently account for underlying differences between alumni from different universities (Gottlieb 1961). It also allows us an improvement over research designs that do not gather data on those not influenced by Project 985 over the same time period (Zhang et al. 2013). Since many of the Tsinghua alumni go on to non-985 universities for graduate degrees, this provides us with a control group observed over the same time period to control for other university or economic reforms and cultural changes over time. The effects of other economic reforms are controlled out because these reforms would influence both our treatment and control groups. We control for additional static differences between 985 and non-985 universities using our natural experiment and differences-in-differences estimation techniques. Our sample procedure ensures that our sample consists of individuals that are sufficiently similar on observable and unobserved dimensions—except whether they were affected by Project 985.

We take advantage of the fact that although every respondent in our sample had attended Tsinghua, not everyone received their *highest* degree from Tsinghua. The education literature emphasizes the greater impact of graduate programs on altering students' values and beliefs in comparison to undergraduate programs (Staton and Darling 1989, Stuart and Ding 2006). By immersing students in teaching and intensive research, graduate programs are particularly powerful in socialization and are likely to significantly influence the beliefs of students in ways that undergraduate programs do not (Golde 1998, Austin 2002, Gottlieb 1961). Professors typically use graduate students as their research assistants—particularly for tasks that go beyond data entry or cleaning lab equipment. Graduates

students also have more access to conferences and new research facilities relative to undergraduates. Whereas both undergraduate and graduate students may benefit from updated courses, undergraduates are more likely to take introductory courses, whereas graduate students can access advanced courses. Graduate students would then have opportunities to put their coursework into action through their greater involvement in research. In other words, the university from which the student received his or her highest degree is likely to have the greatest impact on his or her beliefs. As such, we test our hypotheses by comparing entrepreneurs that received their highest degrees from a 985 university to those that received their highest degree from a non-985 university.

We improve the accuracy of responses in several ways. We chose to develop and administer our survey in collaboration with our partners at Tsinghua then followed up with respondents to ensure the accuracy of our data. We develop our survey based on the procedures utilized in an earlier alumni entrepreneurship survey conducted by the Massachusetts Institute of Technology (Hsu et al. 2007). A university-conducted survey has advantages over surveys conducted by unrelated institutions or the government in that respondents are typically more willing to disclose personal and financial information in a survey conducted by his or her alma mater. To further ensure the validity and measurement equivalence of our survey, we translated our survey from English to Chinese and back (Brislin 1970). Additionally we conducted in-depth pilot interviews with 42 entrepreneurs, investors, professors, and government officials to better understand the context of our study and improve the appropriateness and precision of our survey instruments. Finally, we conducted follow-up interviews with some of our respondents in person and over the telephone to gain better understanding of their answers. Overall, we developed and administered our survey in a manner that reduced inaccurate responses and followed up with respondents to gain contextual understanding of our data.

We sent our survey to all the Tsinghua alumni that graduated between 1947 and 2007 with an address on record. The survey could be returned online, via email, or via conventional mail. We received a total of 2,966 surveys, including completed surveys from 723 alumni who founded entrepreneurial ventures. The response rate is 11%. Of these 723 entrepreneurs, 570 received his or her highest degree from a 985 university, and 153 received a degree from a non-985 university. Of these entrepreneurs, 255 completed the set of the questions on the entrepreneur section of the survey needed for H1. Missing data from the *revenues* and *R&D intensity* questions brings our number of complete observations to 110 (when both *R&D intensity* and *revenues* are included) to 184 (without *R&D intensity* included) for the H2 and H3 regressions. *T*-tests of means and inserting dummy



variables for missing observations provided reassurance that these missing data points are not systematic.

Our sample is very similar to the population of Tsinghua alumni in aspects such as academic major, gender, and degree. For instance, the school reports that 62.5% of students major in engineering disciplines, 11.9% major in sciences, and 12.9% major in humanities (architecture, medicine, and law comprise the remainder). Within our sample, 62.2% major in engineering, 10.6 major in sciences, and 13.7 major in humanities.

To further rule out the possibility of systematic nonresponse biases in our survey, we performed a test using the extrapolation procedure. This is a commonly used method to assess nonresponse bias (Donald 1960, Filion 1975). The survey is split on the basis of survey return dates. The test examines mean characteristics of respondents who were among the first 90% to complete the survey and compares them with the last 10% of respondents who answered after multiple reminders. This method rests on the assumption that nonrespondents share characteristics with late responders. We ran *t*-tests of the null hypothesis that the average (observed) characteristics of respondents and nonrespondents are roughly the same statistically. Older founders appear to have been equally likely as younger founders to respond. The 10th, 25th, 50th, 75th, and 90th percentiles of graduation years are also similar. These results (available from the authors) offer reassurance that there were no systematic nonresponse biases in the survey.

## Variables

**Dependent Variables.** To test Hypothesis 1, we use *IP importance* as our measure of the alumni's beliefs regarding the importance of IP protection. *IP importance* measures, on a scale of 1 to 6, the importance that the respondents attribute to IP protection. *IP importance* was generated from the following survey question: rate on a scale of 1 to 6 the degree to which you believe that intellectual property is important. This measure is thus tightly linked with our theoretical construct of entrepreneurs' beliefs regarding IP and innovation. *Product newness* is the entrepreneur's report of how new the product they planned to commercialize was (rated on a scale of 1 to 4 in terms of being available everywhere three years ago, being commonly available in the market three years before, rarely available, or not available at all in the market three years before). We also measured the importance of product development time using the variable *importance of development time*. This survey question asked, on a scale of 1 to 6, the degree to which respondents believe that making time to develop products is important. Since innovative products typically take time to develop, entrepreneurs' beliefs about the length of product development time is reflective of their beliefs regarding the importance of innovation. To increase the robustness of our results, we also run our analysis using

an alternative measure of beliefs regarding innovation by creating an index using factor analysis on *IP importance*, *product newness*, and *importance of development time*. After confirming that these factors load on a single factor with an eigenvalue greater than one, we create an *innovation index* from the factor weightings.

To test Hypothesis 2, we follow prior research and use  $\ln(R\&D\ intensity)$  as our measure of the degree to which entrepreneurs decide to have their firms engage in technologically intensive activities (Kim et al. 2008). *R&D intensity* is the ratio of R&D expenditure to total sales in the most recent year the firm was in operation, as reported on the survey. Entrepreneurs who engage in technology innovation will generally invest more in R&D, making  $\ln(R\&D\ intensity)$  a good measure of the degree to which entrepreneurs engage in innovation. Because R&D intensity figures are skewed in their distribution, we took the natural logarithm of R&D intensity.

To test Hypothesis 3, we use  $\ln(revenues)$  as our measure of performance.  $\ln(revenues)$  is the reported revenues drawn from the firm in the most recent year the firm was in operation. If the firm failed or merged before the time of the survey, then this is for the year prior to the failure or the merger. We use  $\ln(revenues)$  as our measure of performance for several reasons. First, revenue is an effective measure of performance for firms across industries, because all firms ultimately need revenue for survival. Revenue is an antecedent outcome to other key financial measures such as profitability and cash flow (Davidsson et al. 2007). Second, revenue is especially relevant as an aim of policy initiatives (Ahlstrom 2010). Third, revenue is a more accurate performance measure than profitability, employees, or survival. Profitability is often "managed" by executives to meet investor expectations. In particular, firms in China often report inaccurate profitability figures to avoid taxes, such that reported profitability figures are rarely accurate reflections of firm performance. Moreover, our collaborators at Tsinghua reveal that Chinese entrepreneurs are extremely hesitant to reveal profitability figures, such that asking for such figures is considered culturally taboo. Survival is a similarly coarse measure of performance because it captures only the existence of a firm. Because revenue has a stronger relationship to the firm's economic contribution than alternative performance measures such as survival, revenue is also the more pertinent measure for our study. Indeed, we find that revenue is often used in studies of new firm performance (Baum and Bird 2010, Hmieleski and Baron 2009). Cho and Pucik (2005) add nuance to the previous findings of a positive link between innovation and firm performance (Kleinschmidt and Cooper 1991). They show that there is no direct effect of innovation on market value or profitability, but rather the effect is mediated by product quality and growth. For all the reasons above, we utilize revenue as our measure of performance. Because the distribution of revenues tends



to be skewed, we took the natural log of the revenue figures. To increase the robustness of our results, we also measure performance using  $\ln(\text{firm size})$ , which is the natural log of the firm's employee count during the most recent year.<sup>1</sup>

**Independent Variables.** The independent variable we use to test Hypothesis 1 is the differences-in-differences (henceforth abbreviated as DID) estimator. DID allows us to estimate the causal influence of Project 985 on alumni. The DID estimator is the interaction of two variables; *treated* and *post985*. The dichotomous variable *treated* is coded as 1 if the respondent received his or her most advanced degree from a 985 university and 0 (control group) if he or she did not. For respondents in the treatment group, *post985* indicates that the respondent received his or her most advanced degree after his or her university was affected by Project 985. For individuals in the control group, *post985* indicates that the respondent received his or her most advanced degree after the matching 985 university was affected by the reform. H1 is tested using DID, since we are interested in the effect of the institutional change on beliefs.

H2 and H3 also include DID estimators; however, we are more interested in the specific underlying mechanism of the results. Hypothesis 2 was that firms founded by alumni who hold the belief that IP is important are likely to invest more in technologically intensive activities. The independent variable we use to test Hypothesis 2 is *IP importance*, which is the dependent variable we test for in Hypothesis 1. The independent variable we use to test Hypothesis 3 is  $\ln(\text{R\&D intensity})$ , which is the dependent variable we test for in Hypothesis 2. Together, our three hypotheses form a path from institutional change to beliefs to behaviors then finally to performance.

**Control Variables.** We control for overseas work and education experience as indicated from the survey using the dichotomous variable *overseas* when we test all three hypotheses. Overseas experiences expose respondents to advanced technology, new research fields, and entrepreneurial firms (Huang 2008). Such exposure may exert an effect on beliefs about intellectual property and R&D intensity. *Overseas* measures whether the respondent has overseas work or education experience.

We control for educational level when we test all three hypotheses. Having a graduate degree may shape the respondents' beliefs regarding innovation or predispose the respondent to pursue an innovative entrepreneurial opportunity. Educational level is thus likely to exert an effect on our dependent variables. We control for educational level using two variables: *master's* and *Ph.D.* *Master's* is a dichotomous variable that indicates the respondent holds a master's degree. *Ph.D.* is a dichotomous variable that indicates the respondent holds a doctoral degree.

We control for respondents' political connections when we test all three hypotheses. In China, entrepreneurs who

possess political connections can better safeguard themselves against opportunistic behavior or gain information or favors (Xin and Pearce 1996, Peng and Luo 2000, Park and Luo 2001). Since political connections may act as a substitute for formal IP regulations, political connections are likely to positively influence entrepreneurs' beliefs regarding the importance of IP and the degree to which their firms engage in innovation. Entrepreneurs who possess political connections may also use these connections to gain performance advantages. We measure political connections using three variables: *govindex*, *student leader*, and *Communist Party*. *Govindex* is a dichotomous variable that indicates the respondent's parents had been government officials. *Student leader* is a dichotomous variable that indicates the respondent participated in student government. We insert this control because student government participants in China often have more opportunities to meet government officials and are likely to possess more political ties. *Communist Party* is a dichotomous variable that indicates the respondent is a member of the Chinese Communist Party.

For added precision, we control for the prestige of the university from which the respondents received their highest degree when we test all three hypotheses. We measure this control using *highest university rank*, a discrete variable that indicates the national ranking of the university from which the respondents received their highest degree. We used the overall score provided by the Netbig Chinese University Rankings (<http://rank.netbig.com>), a ranking system that is similar to the *U.S. News and World Report* in methodology and is generally accepted as authoritative by Chinese society.<sup>2</sup>

We control for prior entrepreneurship experience when we test all three hypotheses because prior entrepreneurship experience may influence beliefs about innovation and R&D intensity and may positively influence firm performance. We do so using *serial*, a dichotomous variable from the survey that indicates the respondent has prior experience working in an entrepreneurial firm.

We control for *firm age* by subtracting the year that the firm was most recently in operation from the founding year. Older firms may be more or less likely to have entrepreneurs who believe in the importance of innovation (given increasing competition) or increased R&D intensity or performance.

We control for *firm size* when we test all three hypotheses. We do so because the respondents' views of IP and their likelihood to engage in innovation may be influenced by firm size. Larger firms have greater resources to protect intellectual property or to spread fixed costs of R&D over. We measure firm size using the variable  $\ln(\text{firm size})$ . This is a continuous variable that is the logarithm of the number of employees in the entrepreneurial venture during the most recent year. We take the logarithm to account for the skewed distribution because of a few firms growing very large.

To control for macroeconomic effects, which may influence beliefs, R&D behaviors, and also performance over time, we control for GDP and take the natural log to account for the skewed nature of this measure.  $\ln(GDP)$  is China's GDP during the year that performance is measured.

Finally, we control for industry effects when we examine test hypotheses on R&D intensity and performance (Hypotheses 2 and 3). We do so because the characteristics of the industry may be correlated with both R&D intensity and firm revenues in a systematic way. We control for industry by including *industry fixed effects* in our econometric models. Industry categories were self-reported by the entrepreneur: (1) Internet; (2) Aerospace; (3) Drugs; (4) Biotech; (5) Medical Devices; (6) Chemicals; (7) Materials; (8) Consumer Products; (9) Electronics and Computers; (10) Machinery; (11) Other Manufacturing; (12) Energy; (13) Electric Utilities; (14) Telecommunications; (15) Finance; (16) Management and Finance Consulting; (17) Publishing; (18) Software; (19) Law, Accounting, Miscellaneous Business; and (20) Services.

### Statistical Analyses

Our goal is to understand the path by which Project 985 affects alumni beliefs regarding innovation, the innovative behavior of firms they found, and ultimately the performance of these firms. As such, the statistical analysis we conduct is composed of two separate parts. The first part attempts to infer the causal relationship between Project 985 and alumni beliefs using a DID research design. The second part then attempts to understand how beliefs in innovation and IP affected R&D investment and how R&D investment in turn affected revenues.

**DID Design.** To infer a causal relationship between Project 985 and alumni beliefs regarding innovation and IP, we utilize a DID research design. We do so because the DID design enables the estimation of Project 985's impact separate from differences across universities and from the time trend, thereby reducing the confounding effects of omitted variables. The DID design consists of the treatment group and the control group and divides each of these groups into those graduating before the reform was implemented (pre-reform) and those graduating after the reform was implemented (post-985). The treatment group consists of alumni that are affected by Project 985 because they graduated from Project 985 universities. The control group consists of alumni that are not directly influenced by the reform because they attended non-985 universities. The two groups are matched up along key attributes, such that the two groups are nearly identical in every attribute other than attending Project 985 universities. The pre-post differences exhibited by the control group with respect to alumni beliefs regarding IP are then subtracted from the pre-post differences exhibited by the treatment group. This allows us to isolate the impact on

the alumni who graduated from 985 universities after the reform was implemented, controlling for both time trends and differences between 985 and non-985 university alumni. In this manner, omitted variables stemming from differences between 985 and non-985 universities are controlled for using the difference between treatment and control groups, and omitted variables stemming from time trends are controlled for using difference between observations pre- and post-Project 985. Overall, the DID design controls for confounding effects of time trends and differences across universities to better isolate the causal effects of Project 985 on alumni beliefs.

**DID Matching.** To control for omitted variables stemming from differences between 985 and non-985 universities, we match individuals in treatment and control groups by the characteristics of the universities where these individuals received their highest degrees. Matched-pair analysis enables precise control of the effects of confounding variables (Mukhopadhyay and Kekre 2002). However, matched-pair analysis also involves a trade-off between controlling for confounding factors and sample size. Increasing the number of factors in matching is better for controlling the confounding factors but reduces sample size (Mukhopadhyay and Kekre 2002). To control for confounding factors without sacrificing sample size, we match individuals in the treatment and control groups using three key attributes of the universities where individuals received their highest degrees: (1) the universities' national ranking, (2) geographic location, and (3) academic specialty (e.g., technical institute, agricultural institute, etc.). We conduct matched-pair analysis using these three elements because our field interviews revealed that these elements significantly influence innovative behavior and performance of entrepreneurial firms.

**DID Statistical Analysis.** We wish to construct a model that compares how the treatment group changed post-Project 985 to how the control group changed post-Project 985 with respect to our dependent variable for alumni beliefs regarding innovation and IP, *IP importance*. To do so, we examine how individuals in the *post985\*treated* group, i.e., the entrepreneurs that received their highest degree from a 985 university after the implementation of Project 985, are different from all other individuals in our sample. Given that *IP importance* is a discrete ordinal variable, we estimate an ordinal logit model of the effect of *IP importance* on *post985\*treated* in the following manner:

HYPOTHESIS 1.  $IP\ Importance = ordinal\ logit(Post985, Treated, Post985 * Treated, Controls, Error)$ .

**Effects on R&D Investment and Revenue.** Whereas the DID analysis allows us to identify the effect of the institutional change, for our subsequent hypotheses, we are also interested in the mechanism from institutional change to beliefs and then from beliefs to behavior and performance.

To understand how Project 985 ultimately affected the innovation behavior and performance of firms founded by the 985 alumni, we do separate analyses on the direct effects of *IP importance* on  $\ln(R\&D\ intensity)$  and of  $\ln(R\&D\ intensity)$  on  $\ln(revenues)$  (Hypotheses 2 and 3). Because  $\ln(R\&D\ intensity)$  is a continuous variable, we test Hypothesis 2 by estimating a linear regression model of the effect of *IP importance* on  $\ln(R\&D\ intensity)$ .  $\ln(revenues)$  is a continuous variable also, so we test Hypothesis 3 by estimating a linear regression model of  $\ln(R\&D\ intensity)$  on  $\ln(revenues)$ . The models are presented below:

HYPOTHESIS 2.  $\ln(R\&D\ Intensity) = ols(IP\ Importance, Controls, Error)$ .

HYPOTHESIS 3.  $\ln(Revenues) = ols[\ln(R\&D\ Intensity), Controls, Error]$

## Results

Descriptive statistics (available from the authors) of entrepreneurs who graduated before and after Project 985 show that they are similar. Regression analyses (available from the authors) show that the overall rate of entrepreneurship did not increase as a result of Project 985; however, the rate of entrepreneurship among Ph.D. degree recipients and graduate students did increase. This supports the idea that students in their terminal degrees were influenced the most. The table provides evidence against the idea that the marginal individual founding a firm after the reform was less academically talented or possessed less social capital. We present a pairwise correlation matrix in Table 1.

Hypothesis 1 posits that entrepreneurs affected by Project 985 are more likely to hold the belief that innovation and IP are important. Table 2, Model 2-1 shows just the control variables. Here we find negative and significant coefficients on *govindex* and *serial*, which indicates that entrepreneurs who had more existing government ties and experienced entrepreneurs were less likely to report beliefs in the importance of innovation. Table 2, Model 2-2 shows that the effect of *post985\*treated* on *IP importance* is highly and positively significant ( $p < 0.001$ ). The results presented in Model 1-2 strongly support Hypothesis 1. The negative and significant coefficient on the post-985 dummy variable indicates that entrepreneurs who graduated after the reform from non-985 universities were significantly less likely to express belief in the importance of IP. Since the GDP coefficient is insignificant, this does not appear to be an overall trend with economic growth. The negative and insignificant coefficient on the *treated* variable suggests that over the entire time period, attending a 985 university did not have a significant effect on beliefs regarding innovation and IP. This effect only appears after the reform.

Hypothesis 2 posits that entrepreneurs who believe IP to be important are more likely to invest in innovation

Table 1 Correlation Matrix of Variables

	Mean	Std. dev.	Min	Max	IP Imp.	$\ln(R\&D\ int.)$	$\ln(Rev.)$	Post985	Treated	Post* Treated	High. univ. rank	Overseas	Govindex	Student leader	Comm. party	Ph.D.	Masters	Firm age	$\ln(GDP)$	Serial	Firm size
IP Importance	3.832	1.415	1	6	1																
$\ln(R\&D\ Intensity)$	2.699	1.124	0	4.868	0.089	1															
$\ln(Revenue)$	5.884	2.444	0	11.63	0.066	-0.405	1														
Post985	0.337	0.475	0	1	-0.049	0.227	-0.308	1													
Treated	0.782	0.415	0	1	-0.114	-0.031	-0.066	0.325	1												
Post* Treated	0.327	0.471	0	1	-0.037	0.249	-0.325	0.978	0.368	1											
Highest univ. rank	5.792	8.421	1	21	0.058	0.05	-0.009	-0.267	-0.958	-0.308	1										
Overseas	0.168	0.376	0	1	0.129	0.008	0.026	0.016	-0.083	0.025	0.059	1									
Govindex	0.614	0.489	0	1	0.006	-0.057	0.106	-0.167	-0.222	-0.185	0.184	0.085	1								
Student leader	0.861	0.969	0	3	0.107	0.027	-0.032	0.081	-0.076	0.078	0.104	0.257	-0.072	1							
Comm. party	0.564	0.498	0	1	-0.063	-0.022	-0.042	0.034	0.117	0.016	-0.081	-0.138	-0.164	0.06	1						
Ph.D.	0.069	0.255	0	1	0.005	0.171	0.018	0.218	0.144	0.226	-0.156	0.19	0.056	0.201	0.004	1					
Masters	0.574	0.497	0	1	0.096	0.137	-0.031	0.274	-0.163	0.258	0.179	0.013	0.057	0.084	-0.191	0.077	1				
Firm age	4.545	3.048	0	15	0.137	-0.153	0.422	-0.176	-0.071	-0.181	0.025	-0.063	0.256	-0.005	-0.211	0.092	0.068	1			
$\ln(GDP)$	28.62	0.735	27.91	28.62	0.088	-0.083	-0.032	0.087	-0.004	0.085	0.01	0.055	0.103	-0.144	-0.057	0.033	0.091	0.158	1		
Serial	0.396	0.491	0	1	-0.191	-0.019	0.014	-0.063	0.133	-0.046	-0.161	-0.04	-0.023	0.053	0.181	0.018	-0.203	-0.152	-0.099	1	
Firm size	53.515	233.709	1	2,000	0.186	-0.163	0.358	-0.139	-0.02	-0.135	0.009	0.112	-0.018	-0.046	-0.006	-0.052	0.020	0.031	0.027	-0.117	1



**Table 2 Regression Table for Hypothesis 1**

Variables	Hypothesis 1: Entrepreneurs' beliefs	
	DV: <i>IP Importance</i>	
	Ordinal logit model	
	Model (2-1)	Model (2-2)
<i>Post985</i>		−1.128*** (0.307)
<i>Treated</i>		−0.211 (0.670)
<i>Post * Treated</i>		1.143*** (0.333)
<i>Highest Univ. Rank</i>	0.016 (0.012)	0.010 (0.036)
<i>Overseas</i>	0.229 (0.275)	0.211 (0.271)
<i>Firm Age</i>	0.031 (0.024)	0.029 (0.026)
<i>ln(GDP)</i>	0.450 (0.637)	0.484 (0.637)
<i>ln(Firm Size)</i>	−0.031 (0.092)	−0.033 (0.094)
<i>Ph.D.</i>	0.485+ (0.271)	0.469+ (0.276)
<i>Masters</i>	−0.124 (0.140)	−0.136 (0.152)
<i>Govindex</i>	−0.449* (0.202)	−0.457* (0.218)
<i>Communist Party</i>	−0.381 (0.247)	−0.383 (0.235)
<i>Student Leader</i>	0.252 (0.258)	0.274 (0.258)
<i>Serial</i>	−0.341* (0.147)	−0.334* (0.144)
Industry fixed effects	N/A	N/A
Number of observations	255	255

Note. Robust standard errors.

\*\*\*, \*\*, \*, and + indicate statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

and engage in technologically intensive activities. Table 3, Model 3-2 show that the effect of *IP importance* on *ln(R&D intensity)* is positive and significant ( $p < 0.05$ ). This result support Hypothesis 2 and also refutes the alternative explanation that social desirability bias is driving the observed effects. Social desirability bias is typically defined as the tendency to respond to questions in a manner that will be viewed favorably by others. Our results show that beliefs regarding innovation and IP are associated with the actual behavior of greater investment in R&D, indicating that our respondents are not simply saying one thing while acting in a different way. The coefficient on *treated* in Model 3-2 is positive and significant, which indicates that firms founded by 985 alumni were more likely to invest more heavily in R&D overall. The coefficient on *post985* indicates that the time effect was that firms founded by university graduates after

**Table 3 Regression Table for Hypothesis 2**

Variables	Hypothesis 2: Innovation	
	DV: <i>ln(R&amp;D Intensity)</i>	
	Ordinal logit model	
	Model (3-1)	Model (3-2)
<i>IP Importance</i>		0.097* (0.021)
<i>Post985</i>		−0.595** (0.201)
<i>Treated</i>		1.151* (0.495)
<i>Post * Treated</i>		0.940** (0.282)
<i>Highest Univ. Rank</i>	0.018* (0.008)	0.073** (0.026)
<i>Overseas</i>	−0.293 (0.218)	−0.286 (0.190)
<i>Firm Age</i>	−0.061+ (0.031)	−0.051 (0.036)
<i>ln(GDP)</i>	0.107 (0.286)	−0.825+ (0.429)
<i>ln(Firm Size)</i>	−0.182* (0.069)	−0.167* (0.066)
<i>Ph.D.</i>	0.182 (0.145)	−0.035 (0.171)
<i>Masters</i>	0.230 (0.184)	0.036 (0.212)
<i>Govindex</i>	0.152 (0.150)	0.234 (0.184)
<i>Communist Party</i>	0.175 (0.150)	−0.043 (0.163)
<i>Student Leader</i>	−0.310* (0.151)	−0.241 (0.145)
<i>Serial</i>	0.111 (0.285)	0.007 (0.292)
Industry fixed effects	Yes	Yes
Number of observations	145	129

Notes. Robust standard errors. The number of observations differs in Tables 3 and 4 because of missing data on *revenues* and *R&D intensity*.

\*\*\*, \*\*, \*, and + indicate statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

the reform overall invested less in R&D compared to firms founded by graduates before the reform. The coefficient in Model 3-2 on *post \* treated* indicates that those graduating from 985 universities after the program started are more likely to engage in technologically intensive activities than those graduating from 985 universities before the reform. Thus, there are some effects of Project 985 that go beyond what the *IP importance* variable is able to capture alone (i.e., possibly via skills, knowledge, or social networks).

Hypothesis 3 posits that firms that investment more technologically intensive activities will exhibit lower performance. Table 4 tests this hypothesis. Model 4-3 show

**Table 4 Regression Table for Hypothesis 3**

Variables	Hypothesis 3: Performance			
	DV: $\ln(\text{Revenues})$			
	OLS model			
	Model (4-1)	Model (4-2)	Model (4-3)	Model (4-4)
$\ln(R\&D \text{ Intensity})$			−0.528** (0.162)	−0.529** (0.167)
<i>Post985</i>		2.190** (0.760)		2.153 (1.869)
<i>Treated</i>		−0.885 (0.935)		−1.893 (1.435)
<i>Post * Treated</i>		−2.515** (0.721)		−1.941 (1.929)
<i>Highest Univ. Rank</i>	−0.019 (0.014)	−0.070 (0.042)	−0.001 (0.021)	−0.090 (0.069)
<i>Overseas</i>	0.105 (0.274)	0.110 (0.268)	−0.155 (0.499)	−0.216 (0.505)
<i>Firm Age</i>	0.342*** (0.052)	0.326*** (0.054)	0.300*** (0.057)	0.296*** (0.059)
$\ln(GDP)$	−0.262 (3.223)	−0.119 (3.251)	−3.379 (2.289)	−3.288 (2.299)
$\ln(\text{Firm Size})$	0.931*** (0.113)	0.940*** (0.117)	0.799*** (0.143)	0.790*** (0.144)
<i>Ph.D.</i>	−0.485 (0.455)	−0.420 (0.421)	0.022 (0.755)	0.010 (0.762)
<i>Masters</i>	0.643* (0.243)	0.743** (0.256)	0.476 (0.369)	0.384 (0.397)
<i>Govindex</i>	−0.896*** (0.251)	−0.963*** (0.267)	−0.671 (0.364)	−0.723 (0.365)
<i>Communist Party</i>	0.646* (0.279)	0.621* (0.303)	0.978** (0.367)	0.946* (0.371)
<i>Student Leader</i>	−0.090 (0.309)	−0.125 (0.300)	−0.446 (0.329)	−0.485 (0.331)
<i>Serial</i>	0.471 (0.273)	0.455 (0.281)	0.620 (0.374)	0.602 (0.378)
Industry fixed effects	Yes	Yes	Yes	Yes
Number of observations	184	184	110	110

Notes. Robust standard errors. The number of observations differs in Tables 3 and 4 because of missing data on *revenues* and *R&D intensity*.

\*\*\*, \*\*, \*, and + indicate statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

that the effect of  $\ln(R\&D \text{ intensity})$  on  $\ln(\text{revenues})$  is negative and significant ( $p < 0.01$ ). This result supports Hypothesis 3. Furthermore, as Models 4-2 and 4-4 show, the effect of *post985 \* treated* on  $\ln(\text{revenues})$  is significant when  $\ln(\text{revenues})$  is excluded, but this significance disappears when  $\ln(\text{revenues})$  is included. This suggests that the effect of Project 985 on performance is going through firm investment in R&D, which confirms our theoretical arguments that Project 985 negatively affects

performance by objectifying a belief that cannot be viably practiced in China's institutional environment.

We use path analysis as a confirmatory technique to confirm the validity of our proposed causal model (Anderson and Gerbing 1988). We used four variables to perform the path analysis: the DID estimator (*post985 \* treated*), *IP importance*, log of *R&D intensity*, and log of *revenue*. The result of the path analysis confirms our previous results and provides further evidence supporting our hypotheses: (1) The direct effect of the DID estimator on *R&D intensity* is positive ( $\beta = 1.320$ ,  $p < 0.01$ ). The indirect effect of the DID estimator on *R&D intensity* that passes through *IP importance* is also positive ( $\beta = 0.125$ ,  $p < 0.1$ ). (2) The direct effect of *IP importance* on *revenue* is positive ( $\beta = 0.052$ ), which is not shown to be significant. However, the indirect effect of *IP importance* on *revenue* that passes through R&D is negative ( $\beta = -0.050$ ,  $p < 0.05$ ). (3) *R&D intensity* has a negative direct effect ( $\beta = -0.465$ ,  $p < 0.01$ ). The direct and indirect relationships among these four variables and their statistical significance increase the reliability of the results shown by our regression models (available from the authors). Overall, the results show a partial mediation effect that the 985 reform has on both direct and indirect effects of *R&D intensity*. There may be additional ways beyond the direct impact on beliefs that the 985 program impacts the entrepreneurs. Overall, all of our hypotheses receive support.

### Robustness

To check the robustness of our results concerning beliefs, we develop multiple measures of beliefs regarding innovation (*importance of development time*, *product newness*, and *IP importance*) and combine them into an index. We rerun our analysis on beliefs using *innovation index* in place of *IP importance* and find that Project 985 positively and significantly affected *innovation index*. We find robust results using our measure of firm size,  $\ln(\text{firm size})$ , as an alternative measure of performance.

We control for effects particular to the time period during which the respondents' firm is founded or privatized. We measure this by *year founded*, which is a discrete variable that indicates the year during which the 985 alumni founded or privatized their current venture. Including *year founded* in our analyses did not change our results.

We reran the analysis that focuses on only the subset of firms older than 5, 7, and 10 years. We found consistent results with our main results at each time frame. Thus, the results do not support the idea that our results are simply because of innovative companies taking longer to generate revenues but eventually generating more revenue. We observe that *post985 \* treated* has a negative effect on  $\ln(\text{revenues})$  at the 10th, 25th, 75th, and the 90th quantiles. These results do not support the interpretation that 985 is

generating firms that are lower performing on average but generating a few very successful outlier companies.

To test whether Project 985 decreased traditional networking with government officials (Park and Luo 2001, Li and Zhang 2007) we use a question on the survey that asked, “Who were the most important people you solicited advice from in the first two years after founding the company?” We use the count of the number of current and retired government officials (*consult government*). As results (available from the authors) show, *post985\*treated* is negatively and significantly related ( $p < 0.05$ ) to *consult government*, which suggests that 985 alumni, post-reform, are significantly less likely to consult with government officials. *Consult government* is associated with higher firm performance ( $p < 0.05$ ). We ran placebo regressions by choosing a different year or different (random) universities for the Project 985 reforms. The results lose significance when the wrong year or universities for Project 985 are chosen.

To test whether our results hold in both developed and undeveloped regions, we ran interactions with three measures. We use *urban* (defined as a 1 if the respondent is in a city with a population of more than five million), *coastal* (measured as whether the respondent is in a city in a coastal province), and finally *BSG* (measured as whether the respondent is in Beijing, Shanghai, or Guanzhou, which are the three largest and most developed urban centers in China) as measures of more developed regions. The results (available from the authors) show that the coefficients are not statistically significantly different.

Whereas Project 985 did result in increased publications (Zhang et al. 2013) it is not likely that broad trends in increasing patenting are driving our results (Hu 2010). This increase would equally affect our entire sample of treated and control firms and also is controlled out with our time (*post*) variables.

## Discussion

By examining China’s Project 985, we address the gap that prior research rarely examines cases where the attempted institutional change is inconsistent with other regulatory, normative, and cognitive-cultural institutions (Scott 2014). We find that institutional change that is inconsistent with other dimensions of the institutional environment may influence beliefs and behaviors yet result in unexpected, negative effects on organizational performance. Our main contribution is to develop the concept of institutional inconsistency and the impact on failure of institutional changes.

## Contributions to Institutional Theory

We contribute to this emerging stream of literature on the multiple levels and contradictions in institutions using the concept of institutional consistency. The concept of institutional consistency along with change that originates

internal (versus external) to the context provides predictions on when institutional change results in an increase (or decrease) in firm performance.

Prior research segments institutionalization as a process consisting of habitualization, objectification, and sedimentation (Berger and Luckmann 1966, Scott 2014). Structures, meanings, and practices that emerge out of habituation are typically consistent with other institutions because they are often generated from working responses to problems encountered by practitioners (Tolbert and Zucker 1996). We contribute by asserting that the link between the tenets of an idea and the appropriate practices for carrying out the idea is weakened if the advocates of the idea are not also the practitioners.

In the social movement literature, the actors who spur a particular movement are generally the ones who practice the main tenets of the movement (Hiatt et al. 2009). This reinforcing process leads to the coalescence of a new idea, at which point the new idea is “institutionalized” (Tolbert and Zucker 1996). Although foundational, the work in institutional theory rarely theorizes about boundary conditions that allow institutional change to have its intended outcomes. Furthermore, existing work does not examine the middle stage, including the links between institutional change, influences on beliefs and changes in actions and outcomes. Without these steps in the process, we might expect that all sequences of institutional change would progress to full sedimentation. Yet, only a few practices reach the full institutionalization and sedimentation stage. In the case of Project 985, we find that the reform affected beliefs and behaviors, but it was institutionally inconsistent with the broader institutional environment.

When changes that are institutionally inconsistent are put into place, the advocates often objectify ideas in a way that suits their own interests. The practitioners are left to somehow make the idea “work” in practice. We find that the advocates of the belief in innovation—the government officials and 985 universities—do not have a direct interest in the performance of individual entrepreneurial ventures. The officials and 985 universities advocate a form of innovation that is not aligned with the practical realities of operating a start-up in China. One of the entrepreneurs we interviewed expressed this sentiment:

The biggest problem with the Chinese educational system is that they teach you completely useless things in universities. Completely useless! When you’re running a company in China, you can’t do what scientists in a lab do, and you can’t do what you Americans do. But the innovation they teach you in school...that’s not how you make good products and make your customers happy and make your suppliers happy. I left Tsinghua wanting to start an innovative firm. When I started my company, I suddenly realized I don’t know how to innovate. You ask me how I innovate...I can tell you that whatever it is I do, I didn’t get it from the school...I had to figure it out myself.



We contribute to the line of prior theoretical work examining institutional contradictions, alignment, and ambiguity. Prior work in this area shows that institutional contradictions are an essential driver of institutional change (Seo and Creed 2002, Powell and Colyvas 2008) and that organizations may strategically resist institutional changes (Oliver 1991). However, prior work rarely examines cases where institutional inconsistent changes are initiated from outside of the relevant practitioners. We contribute to this literature by documenting the practices that resulted and performance outcomes to show that those who aligned themselves with the new inconsistent institution suffered as a result.

China lacks well-developed regulatory institutions that protect intellectual property (Li and Zhang 2007), safeguard contracts (Peng and Luo 2000), and adjudicate disputes impartially (Xin and Pearce 1996). The lack of these institutions inhibits the ability of Chinese entrepreneurs to profit from their innovations. In response, Chinese entrepreneurs often build personal relationships with other businessmen and the government to protect themselves against opportunistic behavior (Peng and Luo 2000, Peng 2004). For resource-constrained entrepreneurs, the necessity of such activities may reduce their capacity (or need) to innovate. One of the entrepreneurs we interviewed expressed similar sentiments:

I know that a lot of [Chinese] people are hyped about technology entrepreneurship, but I think that the kind of technology entrepreneurship that happens in Silicon Valley won't work [in China]. People forget that China is still a command economy, and Silicon-Valley style innovation doesn't work so well in a command economy. So even if you innovate, you still have to play by the command economy rules...and that's hard.

Prior work by sociologists and political scientists has generally argued for the benefits of institutional complexity (Greenwood et al. 2011), heterogeneous institutions, institutional polycentrism (Batjargal et al. 2013), or institutional contradictions (Seo and Creed 2002). Heterogeneous, contradictory institutional forces have been credited with providing innovation opportunities, as well as fostering further rounds of institutional change to address the contradictions (Seo and Creed 2002, D'Aunno et al. 2000). Yet, much less work examines negative implications of institutional inconsistency.

### Limitations and Future Research

Our results should be interpreted with the following limitations in mind as areas for future research. We examine a single instance of institutional change in a single country and using the alumni of a single university. We do not examine other potential outcomes, such as innovation outputs, technological capability, or academic papers (Zhang et al. 2013).

Future work should examine other examples of inconsistent institutional change. One area for developing

boundary conditions may be to examine more versus less developed regions. Cases where multiple institutional changes are made simultaneously or in quick succession may be needed to extend the theory in this direction. Another remaining question is if there are strategies that individuals or organizations might use to identify inconsistent institutional changes and avoid their negative influence. Relatedly, boundaries on the theory may be developed. For instance, future research may establish just what level of inconsistency has to exist before it becomes harmful. Alternatively, there may be minimum levels of corresponding changes in the other institutions that are required.

Future work examining other outcomes of this type of institutional change may want to examine outcomes such as firm survival (in additional analysis, we found no significant effects on survival), technology transfer, fundraising, or more radical innovation. A limitation of our study is the relatively small sample size and limited information on these alternative outcomes.

Prior work on institutions and entrepreneurship has examined the influence of regulatory institutions such as entry regulations, antitrust policies (Dobbin and Dowd 1997) and other regulations (Sine et al. 2007, Hiatt and Park 2013). However, we know relatively less about institutional changes that influence the cognitive and normative institutional environment (Haveman et al. 2007). Our study adds to the growing dialogue on the institutionalization of *ideas*—beliefs, schema, assumptions, identities, etc.—within the literature on institutions and organizations. Our contribution is the following insight: the process by which an idea becomes institutionalized is contingent on the coupling of the actors advocating the idea and the actors enacting the idea. These represented important and previously unexplored boundary conditions on institutional theory, especially as it relates to belief changing institutions.

Technology transfer and faculty spin-off firms have been a focus of prior work on academic entrepreneurship (Dahlstrand 1997, DiGregorio and Shane 2003, Rothaermel et al. 2007). Intellectual property and technology licensing office (TLO) policies have also been examined (Sine et al. 2003, DiGregorio and Shane 2003). Yet much of this work neglects institutional theory and also firms started by alumni (for an exception, see Astebro et al. 2012).

Prior work in institutional theory has argued that the mechanism of institutional change is from habituation to objectification and finally to sedimentation (Tolbert and Zucker 1996). We contribute to this literature by examining a case where institutional change has been constrained and has not worked at the objectification stage. This resulted in the failure of the institutional change to spur commercially successful innovation and entrepreneurship. Institutional change may influence beliefs and behaviors but if it is inconsistent with broader institutions, such reforms are likely to have unintended consequences.

## Endnotes

<sup>1</sup>The authors thank an anonymous reviewer for the suggestion to justify revenues as a performance measure and to test robustness to alternative measures.

<sup>2</sup>[https://en.wikipedia.org/wiki/Chinese\\_university\\_ranking\\_\(Netbig\)](https://en.wikipedia.org/wiki/Chinese_university_ranking_(Netbig)).

## Acknowledgments

The authors would like to acknowledge funding from the Stanford Technology Ventures Program (STVP), the Stanford Center at Peking University (SCPku), and from the Research Fund for International Young Scientists of NSFC [Grant 71150110491].

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