# Intellectual Property Protection and Financial Markets: Patenting vs. Secrecy

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**Keywords: Trade Secrets, Intellectual Property, Stock Liquidity, Patents, TRIPS**
**JEL Codes: G14, G30**

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# 1 Introduction

Intellectual property (IP), whether in the form of patents or confidential information about customers or production processes, is the source of much of the value created by firms. This is particularly the case in advanced economies where innovation and the production of IP are substantial drivers of economic growth. The manner in which IP is protected and innovators rewarded for their creations remains a matter of debate. After a new product or process is discovered, its inventor can decide to keep the invention secret, with the risk of it being developed elsewhere or surreptitiously copied. Alternatively, patent protection can be sought and details of the invention disclosed.[1] Whether firms choose to patent or to keep their inventions secret will depend on factors such as the extent to which patent rights are enforced, the costs of firm opacity and of maintaining secrets. In the paper we study the trade-off innovative firms make in terms of disclosure and patenting decisions. In particular, we study the effect of exogenous developments that shift the trade-off between alternative modes of IP protection. We develop and test hypotheses with regard to the impact on firms' patenting propensity, their financing policies and various attributes such as stock liquidity.

Protecting intellectual property can be costly and both modes – patenting and secrecy – have their drawbacks. Even when a firm can receive a patent for its invention, it faces the cost of renewing its patent and of litigating possible violations. The disclosure that the patent requires can also leave the firm vulnerable to competitors inventing around the patent. Keeping a discovery secret provides a form of IP protection for many firms that choose not to (or cannot) patent their discoveries. In fact, surveys suggest that in many industries secrecy is considered more important than patents as a means of protecting IP (Scherer, et al., 1959; Taylor and Silberston, 1973; Mansfield, 1986; Levin, et al., 1987; Cohen, Nelson and Walsh, 2000). However, trade secrets, unlike patents, must be held in confidence if they are to be protected. The nature of trade secret protection is also narrower. A firm can sue someone for trade secret theft only if they misappropriate the idea – but

[1]Patents are often seen as a contract between society and the inventor: society benefits from disclosure and the inventor obtain exclusive rights over the technology for a period of time. The patent protection period in the US is now 20 years from the filing date of the patent application as a result of legislation to implement WTO agreements. Historically, patents were disclosed publicly only after they had been granted. This has changed, however, and the requirement under the American Inventors Protection Act of 1998 is that patent applications be open for public inspection 18 months after the filing date.

not if the same discovery is made independently. Literature suggests that smaller firms are more inclined toward secrecy than patent protection. Lerner (1995) finds that small firms are much less likely to patent in subclasses where large firms and those with extensive litigation experience have already patented. Along these lines, Friedman, Landes, and Posner (1991) suggest that firms may employ trade secrecy because it is more cost-effective than seeking formal protection. For instance, firms that innovate infrequently may eschew patent protection, and rely instead on secrecy.

The process of patenting can substantially affect the flow of information to outside investors. Patent applications, for instance, require detailed disclosure about the invention such that it could be reproduced (at least in principle) by a suitably skilled person.[2] Patent grants and related disclosures can lead to a significant reduction in information asymmetry since R&D investments may, in general, be harder for outsiders to value than other investments. We would expect the improved information environment to be manifest in greater stock liquidity and a lower cost of equity capital (Amihud and Mendelson, 1986; Amihud, 2002; Easley and O'Hara, 2003). A number of studies in the literature have documented the informational role of patent grants. For example, on the basis of interviews with a variety of practitioners and investors in the software industry, Mann (2005) finds that venture capitalists often take into account the information from patents of the portfolio firms in making their investment decisions. Moreover, Kogan, Papanikolaou, Seru, and Stoffman (2012) use stock market reaction to news about patents to assess the economic value of innovations, suggesting that patent grants do provide new information to the stock market.

Our main hypotheses concern the effect of strengthening (or weakening) of the IP protection provided by either of the usual forms of protection: patenting and trade secrets. We hypothesize that stronger patent protection would make it more attractive for firms to patent their inventions, rather than to keep them secret. As discussed, we expect an increase in patenting intensity to be accompanied by greater stock liquidity and more accurate analyst forecasts. The liquidity improvement may, in turn, make it more attractive for firms to raise capital in the form of equity financing. Further, the impact on firms are likely to be heterogenous, with the impact being stronger for smaller firms that, for instance, may have been deterred from patenting on account of

[2]From `http://en.wikipedia.org/wiki/Sufficiency_of_disclosure#cite_note-1`, the patent law requires the application to "contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to en able any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same." 35 U.S.C. 112(1).

litigation concerns. The strengthening of patent protection and reduction in litigation risk could mitigate these concerns and induce some smaller firms to choose patenting over secrecy.

Trade secrecy protection can also be strengthened by, for instance, giving firms greater ability to sue for the disclosure or misuse of a firm's confidential information. Not surprisingly, the implications of strengthening trade secrecy protection are quite the reverse of those from stronger patent protection. In particular, we might expect firms, especially small firms, to pull back on their patenting in favor of secrecy (even if there is no drop off in the level of innovation). They may also be more reluctant to release other types of information that could alert their competitors about their innovations. The opacity that results from a greater reliance on secrecy could reduce the extent to which the firm is followed by analysts and held by institutional investors. However, since firms may be optimally choosing to reduce information disclosure, we would not expect there to be a reduction in firm value or in R&D expenses associated with the more toward greater secrecy.

To test our hypotheses, we exploit two sets of natural experiments created by the passage of laws or their implementation. The first is the heightened protection provided to trade secrets across different states in the US, over a number of years. The results from these tests, such as on patenting and stock liquidity, can be given a causal interpretation since the legislative changes were exogenous to any particular firm and occurred at different points in time across various states. The second major exogenous change we study is the implementation of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). This had the effect of providing significantly greater intellectual protection to patents across the globe.

However, before turning to these two natural experiments, we examine an illustrative case: that of patent protection in the context of a particular industry, semiconductor manufacturing. The interesting aspect of the industry, as described in Hall and Ziedonis (2001), is that it moved over time from relying largely on trade secrecy to a much greater reliance on patents to protect IP. The change occurred in the late 1980s and 1990s on account of events such as the establishment of a centralized Court of Appeals that favored stronger patent protection as well as the resolution of certain influential cases that were resolved in favor of patentees. Consistent with our hypotheses, we document that the shift toward patenting in the semiconductor industry was also accompanied by a substantial increase in the liquidity of the stocks of the firms in the industry. Our control group here is the chemical-pharmaceutical industry that exhibited relatively little change in its patenting activity and the liquidity of its firms' stocks over the same period.

We next use state-level enactment of trade secret statutes as an exogenous source of variation in trade secret protection. We use a large firm-year panel dataset to examine the effect of trade secret laws on firms' method of IP protection. Supportive of our hypotheses, we find that stronger trade secret protection causes a reduction in stock liquidity as well as in firm patenting activity. There is little change in firm R&D expenditures. Furthermore, stronger trade secret protection lowers analyst forecast quality in terms of dispersion and accuracy, consistent with an increase in information asymmetry and stock illiquidity when firms rely more on trade secrets.

In line with predictions, trade secret protection has a greater effect on smaller firms. In particular, firms that are smaller in terms of total assets or market share reduced patenting significantly after the enactment of trade secret statues, while the effect on larger firms was insignificant. Smaller firms also experienced a relatively greater decrease in stock liquidity after the strengthening trade secret protection. The findings are generally consistent with smaller firms preferring secrecy to patenting: with stronger trade secret laws inducing more of them to opt for secrecy to protect their IP (Friedman, Landes, and Posner, 1991; Lerner, 1995).

The increase in information asymmetry and the lower stock liquidity would be expected to raise the cost of equity financing (Amihud and Mendelson, 1986; Amihud, 2002; Easley and O'Hara, 2003). Consistent with this, we find that the market reaction to seasoned equity offerings (SEOs) announcements is more after the enactment of trade secret statutes. Hence, the greater reliance on secrecy is accompanied by greater information asymmetry and an increase in equity financing costs.

Next, we exploit the exogenous change in patent protection caused by the implementation of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Using difference-in-differences approach, we find that the increase in the level of patent rights protection due to TRIPS increases patenting, stock liquidity and lowers frictions associated with equity financing. The effects are economically significant. For example, in a three-year period surrounding TRIPS implementation in the US, the bid-ask spread of treatment firms that applied for patents in 1993 or 1994 (treatment group) decreased by 5.1%, while that of the matched control group has no significant change during the same period. Supporting the idea that increased patenting reduces information asymmetry, we find that patenting firms have better information environment in terms of lower analysts' forecast dispersion and error after TRIPS.

To distinguish the causal effect of TRIPS on stock liquidity from other confounding events, we examine the heterogeneity of its effect among treatment firms. We find that the effect is larger for firms in industries with greater reliance on exports, consistent with the fact that TRIPS is designed to protect intellectual property in international trade. We also show that it is in industries where trade secrets are a less effective form of IP protection, that the effect on stock liquidity is larger, suggesting that firms benefit more from TRIPS when there is no effective alternative to patenting.

Moreover, we find that among patenting firms, those that smaller in terms of asset size or market share and those that are financially constrained, experienced a greater increase in stock liquidity around the implementation of TRIPS. These firms are more likely to raise equity capital after TRIPS. Further the market reaction to SEOs by these firms is less negative after TRIPS. These findings are supportive of the prediction that patent protection is more important for small firms and patent protection helps reduce financing friction.

This paper contributes to the emerging literature on finance and innovation (Hall and Lerner, 2009). There is a growing number of studies on the influence of different types of financing arrangement to corporate innovation (e.g., Atanassov, Nanda, and Seru, 2007; Chava, Oettl, Subramanian, and Subramanian, 2012; Chava, Nanda, and Xiao, 2013; Tian and Wang, 2011; etc.). Our paper, by contrast, studies how legal protection of intellectual property affects firms' financing. We find that while stronger secrecy protection reduces stock liquidity and impedes financing, stronger patent protection facilitates firms' equity financing by improving stock liquidity. Easier access to capital allows firms to invest more on innovative activities and enhance productivity. Bena and Garlappi (2012) show that imperfect competition in innovation causes laggard firms to have higher cost of capital. Our paper complements their study by showing that stronger IPR protection benefits small (and possibly laggard) firms more in improving their stock liquidity and reducing cost of capital. Our paper is also supportive of the notion that stock liquidity is endogenously determined given the cost and benefit (Balakrishnan, Billings, Kelly, and Ljungqvist, 2013; Dass, Nanda, and Xiao, 2013). As shown in our paper, when patent protection improves, firms are more likely to apply for and obtain patents and, thereby, reducing information asymmetry and enhancing stock liquidity.

Our paper also adds to the literature on intellectual property.[3] The enforcement of intellectual property protection is shown to contribute to economic growth (Gould and Gruben, 1996; Park and Ginarte, 1997; Falvey, Foster, and Greenaway, 2006). Potential mechanisms that have been discussed in the literature include the effect of IP protection on future innovation and R&D strategy (Taylor, 1994; Zhao, 2006; Lerner, 2009), technology transfer (Branstetter, Fisman, and Foley, 2006), international trade (Maskus and Penubarti, 1995), and foreign direct investment (Lee and Mansfield, 1996; Glass and Saggi, 2002), etc. A few studies examine the implications of IP protection for financing. Mann (2005) discusses the role of patent in financing in the software industry. He finds evidence that venture capitalists take into account the value of patents a portfolio firm holds when investing. Sichelman and Graham (2010) conduct a large survey among startups and find that many firms rely on patents to improve their likelihood of raising financing. Hsu and Ziedonis (2008) study venture-backed semiconductor firms and find that patenting is associated with higher funding-round valuations. All these papers suggest the importance of patents in raising venture capital.

To the best of our knowledge, our paper is the first to empirically study the implications of intellectual property protection for stock liquidity and equity financing by public firms. This is an important question because equity financing is a critical source of capital for innovative firms. These firms also face a greater challenge in that outside investors may find it difficult to value to innovative investments. Our findings provide policy makers and academic researchers with a useful perspectives on the impact of IP protection law on the information flow and financing arrangements of innovative firms.

# 2 IP Protection: Hypotheses and Natural Experiments

## 2.1 Hypotheses

Our main hypotheses and empirical predictions have been discussed above and are briefly summarized as follows. Firms protect their Intellectual property in one of two ways. The first is patent

[3]Please refer to Jaffe (2000), Gallini (2002), and Ziedonis (2008) for comprehensive survey of the literature on intellectual property right.

protection: in exchange for disclosing details of the innovation, the firm gets exclusive rights on the innovation for a period of time. The alternative is to rely on secrecy. Survey evidence indicates that both methods are used and that secrecy is often the preferred choice. These modes of protection have their costs and benefits: for patents, there are costs to apply and renew patents and to litigate patent violations. Secrecy has its costs as well. such as greater information asymmetry and stock illiquidity and the risk of independent discovery of the innovation by another firm.

Our main hypothesis is that shifts in the relative degree of protection and/or costs associated with IP protection can cause firms to switch between patents and secrecy. A move toward patenting (secrecy) is also expected to be accompanied by a greater (lower) stock liquidity and costs of raising equity capital. We expect these effects to be more evident for smaller firms that are more likely to choose secrecy over patenting to protect IP, since they lack the scale or resources to aggressively challenge patent violations.

To test our hypotheses we rely primarily on two exogenous legislative actions that affected the relative costs and benefits of one form of IP protection over the other. These are: (i) The greater protection of trade secrecy on account of state-level statutes that were enacted in a time-staggered fashion; (ii) The implementation of TRIPS, with the greater global protection provided to patents. We describe these below. We begin, however, by discussing the illustrative case of the semiconductor manufacturing industry, that experienced a large shift from reliance on secrecy to patenting over the course of the 1990s.

### 2.2 An Illustrative Case: Semiconductor Industry Shift from Secrecy to Patenting

Hall and Ziedonis (2001) [Hall-Ziedonis] contends that the rise in patent applications during the 1990s could reflect, at least in part, an increase in firms' propensity to patent (and to rely less on secrecy). The argument is that there were policy changes during this period that made patenting more attractive – even if the policy changes did not necessarily affect innovation activity as such. Hall-Ziedonis find support for their conjecture in the semiconductor industry, based on data from 110 semiconductor firms during 1975 to 1996, and interviews with managers and executives. Their view is that, driven by a rapid pace of technological change and short product life cycles, semiconductor firms had followed a strategy of relying more heavily on lead time, secrecy, and manufacturing or design capabilities rather than patents. Hall-Ziedonis point to the creation of the centralized Court of Appeals as one of factors driving the move to more patenting. They argue that by enforcing patents more strongly, the court created incentives for inventors to use litigation as a means of extracting royalties from prospective infringers. Another factor was the important "demonstration effects" associated with the successful patent infringement suits of Texas Instruments and Polaroid during 1985-1986 period.

We present the increase in patenting per firm in the semi-conductor industry over the 1990s in Figure **??**. Our comparison industry here is the patenting per firm done by Chemical -Pharmaceutical industry. The Chemical-Pharmaceutical industry has long relied on patenting rather than secrecy, possibly because of their ability to characterize the new products (or "molecules") better than in many other industries. Nor is secrecy feasible for pharmaceutical products intended for human consumption: they are heavily regulated and require rigorous testing before approval by the FDA. As indicated in Figure 1, there is little change over time in the per-firm patenting activity in the industry compared to the substantial increase in patenting by the semiconductor firms over the period.

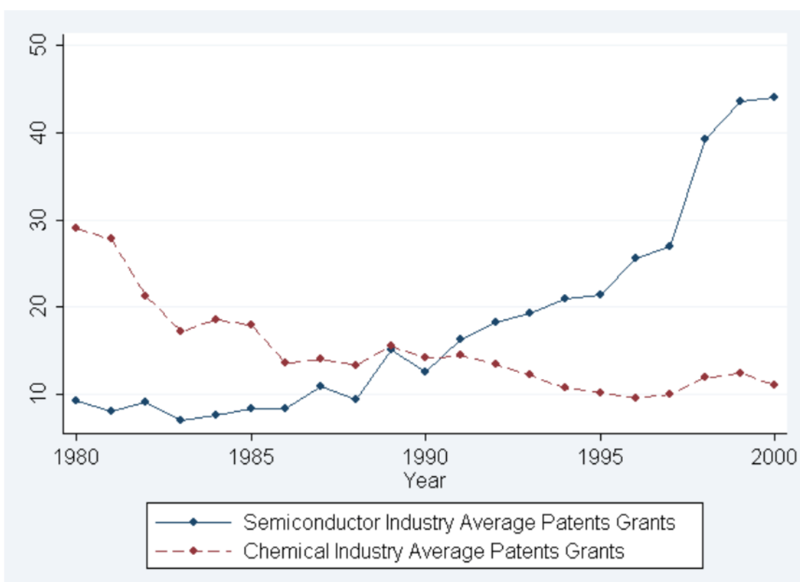


**Figure 1: Average Patent Grants for Firms in the Semiconductor and Chemical Industry 1980-2005**

In Figure **??** we present the stock illiquidity of the firms in these two industries. As can be seen, there is relatively little change in the liquidity of Chemical-Pharmaceutical industry firms over the 1980-2005 period, based on the Amihud-Mendelson and Turnover measures. There is, however, a substantial improvement in the liquidity of the semi-conductor industry firms over this time. Observe that the liquidity appears to track well the increase in patent grants in the industry. Regression results that relate firm-level liquidity to patent grants over this time period are consistent with the graphical patterns.[4] Overall, we regard the correspondence between patenting activity and stock liquidity to be supportive of our hypotheses.

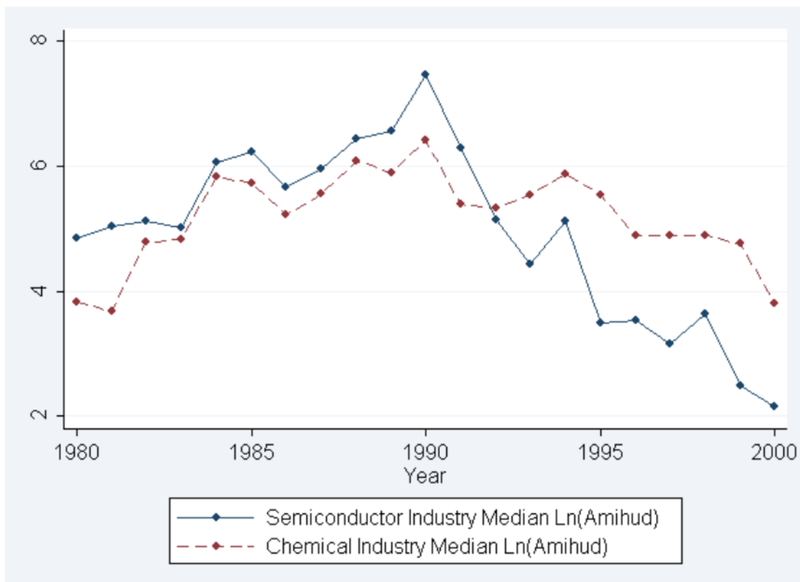


**Figure 2: Average Ln(Amihud) for Firms in the Semiconductor and Chemical Industry 1980-2005**

## 2.3 Trade Secrets Law

Trade secrets in the US have historically been protected by common law. In 1979, the National Conference of Commissioners on Uniform State Laws published the Uniform Trade Secrets Act (UTSA), which provides a comprehensive statute on trade secrets protection for enactment by the states.[5] The UTSA improves the trade secret protection in three aspects: substantive law, procedures, and remedies (Png, 2014). As each state has different level of trade secrets protection

[4]The regression results are unreported for brevity and are available upon request.
[5]"Uniform Trade Secrets Act Prefatory Note", *Uniform Laws Annotated*, Vol. 14.

under common law and state trade secrets statute improves the protection to different extent, Png (2014) compiles an index specifying six items that characterize the three aspects of trade secrets protection under UTSA:

- *Substantive law:*
  - *Whether a trade secret must be in continuous business use;*
  - *Whether the owner must take reasonable efforts to protect the secret;*
  - *Whether mere acquisition of the secret is misappropriation;*
- *Civil procedure:*
  - *The limitation on the time for the owner to take legal action for misappropriation;*
- *Remedies:*
  - *Whether an injunction is limited to eliminating the advantage from misappropriation;*
  - *The multiple of actual damages available in punitive damages.*

Table A1 shows the year of enactment of trade secrets statute in each state, the index that Png (2014) develops to measure the strength of trade secrets protection in each state prior to the enactment of statute and the improvement in trade secrets protection given by the statute. The index ranges from 0 to 1, with each increment of 1/6 representing one more item included in the trade secret protection. Details on the construction of the index are in the Appendix. According to Png (2014), there are 39 states that adopted trade secrets statute from 1980 to 2000. The enactment of trade secret statutes are concentrated in the 1980s. Specifically, twelve states enacted the statute from 1980 to 1985 and twenty one states enacted them from 1986 to 1990. We use this staggered enactment of trade secret statute as an exogenous shock to the protection of trade secret and examine its impact on the patenting propensity of firms and on their information asymmetry and stock liquidity.

## 2.4 TRIPS

Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) was negotiated at the end of Uruguay Round of the General Agreement on Tariffs and Trade (GATT) in 1994. The purpose was to enforce a global standard of intellectual property right protection among fellow WTO members in order to facilitate technology transfer and technological innovation.[6] The agreement requires member states to implement laws that enforce patent protection for at least 20 years.

An important principle of the agreement is national treatment. According to the agreement, "Each Member shall accord to the nationals of other Members treatment no less favorable than that it accords to its own nationals with regard to the protection of intellectual property". Hence, following the implementation of TRIPS, patents granted in the U.S. receive patent protection in other WTO member countries. This strengthens firms' exclusive right to profit from their technology products in international trade.

The implementation of TRIPS in the U.S. also affected the term of the patent protection. The Uruguay Round Agreements Act (URAA) enacted on December 8th, 1994 requires a twenty-year patent term in accordance with TRIPS. Prior to enactment, the patent term in the U.S. was seventeen years from the day the patent issued. After the enactment, patents filed on or after June 8th, 1995 are granted for a period of twenty years from the date of filing.[7] Therefore, patents granted after the law change would receive a longer period of protection, so long as the patent processing time is less than 3 years (the average processing time is about two years, through there is a fair amount of variation).

Therefore, the implementation of TRIPS in the U.S. and other WTO member countries strengthened patent protection along two dimensions: One by streamlining and providing more protection and enforcement of patent rights internationally; the second by increasing the protection term for the typical patent. With stronger patent protection, firms would would be more willing to disclose information on their innovations, while benefiting from an improvement in stock liquidity and lower information asymmetry. While TRIPS was implemented gradually through the transition period, the enactment and implementation of URAA in U.S. had a more definite timing. We therefore define our post-law-change indicator based on the date of when the twenty-year patent term was enforced (June 8th, 1995).

We believe that these two sets of legislative changes affecting IP protection were clearly exogenous to the patenting decisions of individual firms and to their stock liquidity and equity financing

[6] The objective and basic principles of TRIPS is stated in the Annex 1C of the WTO agreement http://www.wto.org/english/docs_e/legal_e/27-trips_03_e.htm.

[7] http://www.uspto.gov/web/offices/pac/mpep/s2701.html

decisions. In our empirical analysis we take these changes to be valid natural 'shocks' for testing our hypotheses.

# 3 Data

We extract patent data from NBER patent database. The NBER patent database provides information on patents granted from 1962 to 2006.[8] We use the assignee-GVKEY link provided by the NBER database to match the patent data to firms' accounting information and stock price information from Compustat and CRSP, respectively. We also use analyst forecast data from I/B/E/S. We include common stock (Share Code 10 or 11) traded in New York Stock Exchange, American Stock Exchange, or Nasdaq (Exchange Code 1-3) and exclude firms with total assets less than 5 million dollars.

## 3.1 Stock Liquidity

In this paper, one of our main variables of interest is stock liquidity. A stock is generally considered liquid if it can be traded readily without impacting the stock price and/or the trading cost is low. High stock liquidity has been shown to be related to lower cost of equity (Amihud and Mendelson, 1986; Amihud, 2002) as investors demand lower return given the the lower trading cost. Therefore, stock liquidity is generally a desirable feature for firms, especially those need to raise capital from the equity market. While there is a large body of literature studying the determinants of stock liquidity (see Easley and O'Hara, 2003), it generally reflects two types of costs. One is the adverse selection cost due to information asymmetry among market participants and the other is the transaction cost (including, for instance, market-market inventory costs). Stronger IP protection for, say, patents relative to trade secrets may have different implications for the information environment of the firm, and thus may have a different impact on stock liquidity. Given the generally accepted relation between stock liquidity and cost of equity capital, we focus on stock liquidity as the outcome variable in our empirical analyses.

We use three measures of stock *illiquidity*. The first measure is Amihud's (2002) illiquidity ratio (*Ln(Amihud)*). It is defined as $ln(AvgILLIQ \times 10^9)$, where $AvgILLIQ$ is an yearly average

[8]A detailed description of these data can be found in Hall, Jaffe, and Trajtenberg (2001)

of illiquidity, which is measured as the absolute return divided by dollar trading volume:

$$AvgILLIQ_{i,t} = \frac{1}{Days_{i,t}} \sum_{d=1}^{Days_{i,t}} \frac{|R_{i,t,d}|}{DolVol_{i,t,d}}.$$

where $Days_{i,t}$ is the number of valid observation days for stock $i$ in fiscal year $t$, and $R_{i,t,d}$ and $DolVol_{i,t,d}$ are the daily return and daily dollar trading volume, respectively, for stock $i$ on day $d$ of fiscal year $t$. This measure reflects the average stock price sensitivity to one dollar trading volume. Higher $AvgILLIQ$ is interpreted as lower stock liquidity.

The second measure is the yearly average of daily bid-ask spread:

$$\text{Ln(Bid-Ask Spread)}_{i,t} = ln(\frac{1}{Days_{i,t}} \sum_{d=1}^{Days_{i,t}} \frac{Ask_{i,t,d} - Bid_{i,t,d}}{(Ask_{i,t,d} + Bid_{i,t,d})/2}),$$

where $Days_{i,t}$ is the number of valid observation days for stock $i$ in fiscal year $t$, and $Ask_{i,t,d}$ and $Bid_{i,t,d}$ are the closing ask and bid prices of stock $i$ on day $d$ of fiscal year $t$. Higher *Bid-Ask Spread* is interpreted as lower stock liquidity. We do not use this measure for the empirical analysis of trade secrets law due to the limited data availability of bid/ask prices in the 1980s.

The third measure of illiquidity is the *negative* yearly average of daily trading turnover, which is calculated as:

$$-Ln(Turnover)_{i,t} = -ln(\frac{1}{Days_{i,t}} \sum_{d=1}^{Days_{i,t}} \frac{Vol_{i,t,d}}{Shrout_{i,t,d}}),$$

where $Vol_{i,t,d}$ and $Shrout_{i,t,d}$ are the shares traded and number of shares outstanding of firm $i$ in day $d$ of fiscal year $t$. Higher trading volume generally reflects higher stock liquidity. To be consistent with the other two measures, we use the negative value of turnover so that it measures the stock's illiquidity instead of liquidity.

## 4 Empirical Design

We test the impact of trade secret statute on stock liquidity using the following model:

$$\text{Stock Illiquidity}_{i,t} = \alpha_1 + \beta_1 \text{TS Law}_{s,t} + \gamma_1' CONTROL_{i,t-1} + \phi_i + \theta_t + \epsilon_{i,t}. \quad (1)$$

*TS Law* is the index representing the strength of trade secret protection for state $s$ in year $t$ shown in Table 2. Firm fixed effects ($\phi_i$) and year fixed effects ($\theta_t$) are also included in the model to control for factors invariant over time or across firms in the same year. For stock illiquidity we use two empirical proxies: *Ln(Amihud)* and *-Ln(Turnover)*. We control for a set of firm and industry characteristics lagged by one year that have been shown in the literature to be related to stock liquidity, including *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Tangibility*, *Cash*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*.[9] We perform this test for public firms from 1980 to 2000 since most of the trade secret statutes are enacted in the 1980s and early 1990s. As noted, we do not use *Ln(Bid-Ask Spread)* in this test due to poor data availability of bid and ask prices in the 1980s. We predict $\beta_1$ to be significantly positive, from our hypothesis that stronger trade secret protection would induce firms to reduce information outflow (such as disclosing their innovations) and thus increase their stock illiquidity. Panel A of Table 2 presents summary statistics for all the variables used in the analyses of trade secret and stock liquidity.

Similarly, we test for the effect of TRIPS on stock liquidity, we estimate the following difference-in-differences model:

$$\text{Stock Illiquidity}_{i,t} = \alpha_1 + \beta_1 \text{Post}_{i,t} + \beta_2 \text{Post}_{i,t} \times \text{Treated}_i + \gamma_1' CONTROL_{i,t-1} + \phi_i + \epsilon_{i,t}. \quad (2)$$

When estimating this model around TRIPS, $Post_{i,t}$ is a binary variable that equal to 1 if the observation is after the effective date when the twenty-year patent term is enforced (June 8th, 1995) and 0 otherwise. $Treated_i$ is the treated group indicator that identifies firms affected by TRIPS. A firm is categorized as treated firm if it had applied for patents from 1993 to 1994, the two-year period prior to the implementation of TRIPS in the U.S.[10] In addition, we control for the same set of control variables as in Model 1 as well as firm fixed effects ($\phi_i$) to control for all the time invariant firm characteristics. Our prediction is that $\beta_2$ should be significantly negative if patenting firms experience a reduction in stock illiquidity significantly more than non-patenting firms because of the legislative change in patent protection.

We match every treated firm with one control firm that is not affected by the change in patent law. We categorize a firm as a candidate control firm if it has not applied for any patents from 1993 to 1994. We note that it is possible that firms that did not use patent may pursue it after the new patent law motivated by the strengthened patent protection. Also it is likely that firms never use patent may also benefit from TRIPS through its strengthening protection of other forms

[9] All the variables are defined in the appendix.

[10] We use a two-year period because the typical processing time of patent applications is about 2 years. So firms that applied for patents in 1993 or 1994 are likely to have patents granted after the enforcement date of TRIPS.

of intellectual property such as copyright and trademark. Nevertheless, these possibilities should bias against finding significant difference between treated firms and control firms.

Firms are matched based on the characteristics mentioned above prior to the effective date of TRIPS in the U.S. using propensity score matching with 0.005 caliper. The probit model estimates used for computing propensity score are presented in Table A2 in Appendix B. Column 2 shows that after matching, most of the firm characteristics are not significantly different between the treated group and control group. In Panel B of Table 2, we present summary statistics for the treated group and the matched control group in the 7-year period around the implementation of TRIPS in the U.S. Most of the variables are very close between the two groups. The mean number of patent grants for the control group is close but not equal to zero, implying that firms that did not apply for patents within two years prior to TRIPS may have patents granted some time during the seven year period. As we have discussed, having control firms that may be affected by TRIPS should bias against our prediction.

# 5 Empirical Results

## 5.1 Trade Secrets Law

### 5.1.1 Trade Secret Statutes and Stock Liquidity

We begin by estimating the effect of state-level trade secret legislation on stock liquidity. Columns 1 and 4 of Table 3 present estimates using Model (1) specification. The other columns in the table test for heterogenous effects across firms. For column 1 and 4 regressions, the estimate of the $\beta_1$ coefficient on *TS Law* is positive for dependent variables *Ln(Amihud)* and *-Ln(Turnover)*, suggesting that average stock illiquidity is higher after strengthening of trade secret protection in the firm's headquarter state. For the full sample, the coefficient estimates indicate that the average increase in trade secret protection by the enactment of statute (0.44 increase in the index) corresponds to a 4.8% decrease for both *Ln(Amihud)* and *-Ln(Turnover)*. However, the estimate significant only for *-Ln(Turnover)* for the full sample. We next examine sub-samples where we might expect the effects to be larger.

Our hypothesis is that the liquidity effect of trade secret laws will vary across firms depending on the extent to which they rely on trade secrets to protect intellectual property. As noted, small firms are expected to be more reliant on trade secrets because it is costly to acquire patents and to protect against patent violations (Friedman, Landes, and Posner, 1991; Lerner, 1995). Greater trade secret protection may induce smaller firms, in particular, to increase their reliance on trade secrets, resulting in their stocks becoming less liquid. To test this, we reestimate Model 1 and interact *TS Law* with an indicator for firms with total assets or market share below the sample median. We present the results in columns 2, 3, 5, and 6 of Table 3, which indicates that the effect of trade secret statutes on stock liquidity is concentrated among small firms. The coefficient on the interaction term is strongly significant for the firms with low total assets and for those with low market share. The economic significance is also substantial. For instance, for firms with below-median total assets, an average increase in trade secret protection by the enactment of statute corresponds to a 44.5% increase in *Ln(Amihud)* and 10.3% increase in *-Ln(Turnover)*. These results are consistent with our prediction that small firms, since they benefit relatively more from stronger trade secret protection and are more likely to resort to shift more to secrecy, will experience a larger decrease stock liquidity after the enactment of trade secret statutes.

Lower stock liquidity is likely driven by larger adverse selection costs when firms retain more trade secrets. To test whether information asymmetry increase around the enactment of trade secret statutes, we estimate a model similar to Model 1 but replace the stock illiquidity measures with measures of analyst forecast quality as the dependent variable. Specifically, we focus on analyst forecast dispersion and analyst forecast error as measures of analyst forecast quality. Analyst dispersion is measured by the standard deviation of analysts' forecasts divided by analysts' median forecast error. To measure the analysts' forecast error we use the absolute difference between analysts' median forecast and actual earnings divided by actual earnings. Both are measured in percentage terms and we take natural logarithm of one plus these measures as dependent variables in our regressions. The results presented in Table 4 show that analysts' forecast dispersion and error increase after the enactment of trade secret statutes. An average increase in trade secret protection by the enactment of statute corresponds to 7.7% (9.8%) increase in analysts' forecast dispersion (error). The effect is similar between large and small firms, though low market share firms have a marginally greater increase in analyst forecast dispersion. The results are supportive of the hypothesis that information asymmetry increases after firms receive stronger trade secret protection.

### 5.1.2 Trade Secret Protection and Patenting Activity

Png (2014) shows that technological firms increase R&D expenditures after the enactment of trade secret statutes, suggesting that stronger trade secret protection encourages more investment in innovative activities. In the previous section, our finding is that small firms experience a greater decrease in stock liquidity, consistent with these firms being more to switch from patenting to secrecy after the strengthening of trade secret protection. We therefore test whether small firms indeed reduce patenting intensity after the enactment of trade secret statutes. In Table 5, we present the estimation of a model where the dependent variable is the log number of patent applications and the independent variable of interest is *TS Law* and the interaction with small firm indicators. The first column shows the estimates without the interaction and the coefficient on *TS Law* is significantly negative at 10%, suggesting that, on average, firms reduce patenting after the enactment of trade secret law. The estimated coefficient on the interaction term presented in column 2 and 3 is significantly negative and greater in magnitude than the estimate in column 1. This indicates that it is mainly small firms that reduce patenting after the strengthening of trade secret law. This is again consistent with our hypothesis that small firms rely more on trade secret after the statute, leading to greater opaqueness and lower stock liquidity. Note that the decrease in patenting occurs despite the overall increase in R&D documented in Png (2014).

### 5.1.3 Trade Secret Protection and Equity Financing

Stock liquidity is a important determinant of firm value (Fang, Noe, and Tice, 2009). One of the reason is because higher stock liquidity facilitates equity financing (Amihud and Mendelson, 1986; Amihud, 2002; Easley and O'Hara, 2003, Butler, Grullon, and Weston, 2005). Greater trade secrets protection may enhance the value of R&D investment, causing firms to strive for more external capital. On the other hand, the lower liquidity due to a greater use of secrecy may limit firms' ability to raise equity capital. We therefore examine firms' equity financing activity after trade secret statutes go into effect as well as the market reaction when firms announce their intention to raise equity capital.

We first estimate the following model to test how trade secret law changes the likelihood of

SEO:

$$\Pr(\text{SEO})_{i,t} = \alpha_1 + \beta_1 \text{Trade Secret Law}_{i,t} + \gamma_1' CONTROL_{i,t-1} + \phi_i + \theta_t + \epsilon_{i,t}, \tag{3}$$

where the dependent variable is the likelihood of firm $i$ issuing an SEO in year $t$. We control for the same set of firm characteristics used in Model 1, as well as firm and year fixed effects. The model is estimated using a conditional logit regression specification. Column 1 of Table 6 shows the estimates. The coefficient of $\beta_1$ is not significant, suggesting that firms on average are not more likely to issue a SEO after the trade secret statute. To show how the effects differ for small firms, we add an interaction between *TS Law* and indicators of small firms in columns 2 and 3. The results show that firms with lower total assets or market share are significantly more likely to issue SEOs after trade secret statutes go into effect. This result indicates small firms have a greater demand for equity capital. While the finding might seem counterintuitive on account of a potential increase in the cost of external equity financing, it is consistent with there being better investment opportunities given stronger trade secret protection.

Since small firms are more likely to raise equity capital despite their lower stock liquidity, we next examine how the stock market reacts to SEOs after trade secret statutes are enacted. We test the following model for all the SEO instances:

$$\text{SEO CAR} = \alpha_1 + \beta_1 \text{Trade Secret Law}_{i,t} + \gamma_1' CONTROL_{i,t-1} + \lambda_s + \theta_t + \epsilon_{i,t}, \tag{4}$$

where *SEO CAR* is the cumulative abnormal return (CAR) over the equal-weight market return over various horizons. $\lambda_s$ is the fixed effect for state $s$ and $\theta_t$ is the fixed effect for year $t$. In Table 7 we present estimates for CARs computed over four different horizons. Except for the three-day CAR around SEO announcement, all the other CARs over longer horizons are significantly lower for SEOs after trade secrets statutes go into effect. Based on estimates in column 4, an average increase in trade secrets protection is associated with 7.5% lower abnormal return over one year. This finding is suggestive that stronger protection on secrecy likely induces financing frictions by increasing information asymmetry, as reflected in the lower stock liquidity.[11]

[11] Note that we do not find stronger effect of trade secret law on SEO CAR for small firms. This is likely the outcome when firms make their optimal SEO decisions in equilibrium.

## 5.2 TRIPS

### 5.2.1 TRIPS and Stock Liquidity

In this section, we focus on TRIPS as our second natural experiment and examine the implications of stronger patent protection on firms' stock liquidity and financing. We follow a structure similar to that of our analysis of trade secrets law by examining TRIPS and stock liquidity first, followed by testing the heterogeneity of the effect of TRIPS, the effect on patenting activity and then studying the implications for equity financing.

The hypothesized mechanism is that stronger patent protection encourages greater reliance on patenting to protect firms' IP, making the firm more transparent and increasing stock liquidity. Figure 3 shows that patenting activity indeed increase after TRIPS. The average number of patent applications of the public firms increases in the year U.S. enacted laws complying with TRIPS. Since the average application-grant lag is about two years during that period (Hall, Jaffe, and Trajtenberg, 2001), our finding is that the number of patent grants increases sharply in the third year after TRIPS. Prior to 1998, patent-related information becomes public when the patents are granted (Kogan, Papanikolaou, Seru, and Stoffman, 2012). Therefore, we expect the increase in stock liquidity to take place as a bulk of patents are granted and focus on a seven-year window around TRIPS in our empirical tests.

We start by testing the impact of TRIPS on stock liquidity. As mentioned in Section 4, we estimate a difference-in-differences model specified in Equation (2). We categorize a firm as a treated firm if it applied for patents in the two-year period prior to the implementation of TRIPS and we match every treated firm with one control firm.

Table 8 presents estimates of the diff-in-diff models around TRIPS. In columns 1, 3, and 5 we present estimates from year t-1 to year t+1 surrounding the implementation of TRIPS in the U.S., while in columns 2, 4, and 6 we present the results from a sample over the years t-3 to year t+3. The results show that the coefficient for the interaction term is significantly negative at 1% level for all measures of stock illiquidity and for the alternative time windows. The effect is economically significant. For instance, in the three-year period surrounding the effective day of URAA, the bid-ask spread of treated firms decreased by 9.6%, while that of the matched control group increased by 3.9% during the same period. This is consistent with our prediction that patenting firms reduce stock illiquidity significantly more than non-patenting firm after the implementation of TRIPS. While stock liquidity of patenting firms have a significant increasing trend after TRIPS, the trend of the control group is not as clear. The estimate for the post-TRIPS indicator is significantly negative for *Ln(Amihud)* and *-Ln(Turnover),* but significantly positive for Ln(Bid-Ask Spread).

Figures 4 to 6 demonstrate the change in stock liquidity around TRIPS for the patenting and control firms. These figures show that there was no significant difference in the trend of stock liquidity between two groups prior to when TRIPS came into effect. Take Figure 5 for instance, after the patent law change, the bid-ask spread of patenting firms decrease dramatically while that of the control firms remain roughly at the same level in the following year. The patterns shown in the figures are consistent with estimates in the diff-in-diff model that after the implementation of TRIPS, firms that applied for patents experienced a significant increase in stock liquidity compared to firms that did not apply for patents.

A key identifying assumption for all diff-in-diff models is "parallel trends"(Roberts and Whited, 2010). It requires that prior to the exogenous shock to patent rights protection, there should be no significant difference in the trend of stock liquidity between treated firms and control firms. Otherwise, the difference in trends identified by the model could be due to some preexisting factors rather than the new law that strengthens patent rights protection. Based on Figures 4 to 6, it appears that the trend of stock liquidity of the two groups start to diverge only after the implementation of TRIPS and this is consistent with the parallel trends assumption. As a robustness check, we formally test this assumption using placebo tests. We re-estimate model (2) by assuming that treatment takes place in 1992 or 1993. If parallel trends assumption does not hold and stock liquidity of treated firms have been increasing more than control firms prior to the real treatment, $\beta_2$ will still be significantly negative. However, estimates reported in Table A3 in the Appendix show that $\beta_2$ is not significant in any specification of the placebo tests. This finding confirms our observation in the figures and suggests that prior to the new patent law there no significant difference in the trend of stock liquidity. .

Given the increase in information released on account of patenting in the post-TRIPS period, we expect information quality about future earnings to improve in the market. To show this we use the diff-in-diff model to test the change in information quality about earnings measured by the dispersion and error of analysts' forecasts around TRIPS. Estimates are reported in Table 9. Columns 1 and 2 show that analyst dispersion decrease significantly for patenting firms but not for control firms in both 3-year and 7-year windows. Similar results are found for analyst forecasts error as shown in column 3 and 4. Both the decrease in analyst dispersion and forecast error reflect lower information asymmetry of patenting firms as they release more information, including more earnings forecasts after TRIPS.

#### 5.2.2 Who is More Affected By TRIPS?

We expect the passage of TRIPS to have a greater impact on certain types of firms than others. First, the objective of TRIPS is to secure IP protection for firms across international markets and, hence, we might expect its benefits to accrue particularly to firms with products sold internationally. Therefore, we would expect firms in industries with a larger fraction of sales from export to be affected to a greater extent by TRIPS and to experience a larger liquidity improvement (or decrease in illiquidity) after the law was enacted. We test this prediction by estimating a difference-in-differences model among patenting firms, interacting *Post TRIPS* with export reliance of an industry. For each 4-digit SIC industry, we divide the total export value prior to TRIPS by the total sales of all COMPUSTAT firms in that industry in the same year.[12] Since the denominator only represents sales by public firms (and not all the firms in this industry), the ratio of export to total sales may be greater than one. In that case we winsorize the ratio at one. If industries with more exports benefit more from better IP protection, we expect the interaction term to be significantly negative, indicating a decrease in illiquidity. We present the estimation results in Panel A of Table 10. The interaction term is negative across all specifications and significant in three of the six specifications, supportive of our prediction that industries that are more reliant on foreign sales benefit more from TRIPS.

Further, industries that do not have a reliable alternative to patent (e.g., maintaining trade secrets) may benefit more from the strengthening of patent right. For an industry, trade secrecy may be a costly way to protect IP if disputes regarding trade secrets take place frequently. In that sense, industries that have experienced a substantial amount of trade secret litigations may

[12] The industry level export data is collected from the U.S. Census.

find patents more valuable especially when the protection is strengthened by TRIPS. We therefore estimate a difference-in-differences model among patenting firms, interacting *Post TRIPS* with the rank of trade secret dispute frequency of an industry. Lerner (2006) collects historical records of California and Massachusetts state cases in as well as federal cases on trade secret litigation and aggregates the number at the level of 3-digit SIC industry. We rank the industries based on the number of cases and interact it with the indicator of *Post TRIPS* in our regression.[13] The results in Panel B of Table 10 show that the interaction between *Post TRIPS* and *Trade Secret Dispute Rank* is negative and significant at 10% in four out of six specifications, indicating firms in industries with more trade secret disputes experience a greater increase in stock liquidity. This is consistent with our prediction that industries with more trade secret disputes are likely to find patents more valuable when patent protection is stronger. This result, along with the effect on export oriented industries, indicate that the increase in liquidity is caused by TRIPS rather than other confounding events.

The marginal benefit from an improvement in patent protection may be different across firms. Similar to the case of trade secret protection, we may expect larger firms may gain relatively little from a stronger patent protection: they may have the legal and other resources to litigate effectively even when the legal protection is weaker. Further, even in the absence of patent protection, we could imagine that the largest firms such as Google or Microsoft with significant market power could compete effectively against copycat firms. On the other hand, the marginal benefit of improved patent protection could be far greater for small firms. Given the vulnerable position of small firms, stronger patent protection could enable them to more effectively protect themselves from IP infringement through litigation (Lanjouw and Schankermanm, 2004). Moreover, it is possible that an extension in patent terms grants could be partculalrly helpful to small firms to exploit their technology. Small firms are also more subject to information asymmetry problem compared to large firms. Therefore, small firms are more likely to benefit from the improvement of patent protection compared with large firms.

[13] The rank of industries in descending order of number of trade secret cases is: Computer Programming (737), Miscellaneous Business Services (738), Insurance Agents, Brokers and Service (641), Electronic Components and Accessories (367), Professional and Commercial Equipment (504), Services to Dwellings and Other Buildings (734), Laundry, Cleaning and Garment Services (721), Eating And Drinking Places (581), and other. We rank these industries from 8 to 1 and the rest of industries are coded as 0. Please refer to Table 3 of Lerner (2006) for more detail.

To test whether smaller firms benefit more from the improvement in patent protection, we perform a diff-in-diff regressions among patenting firms where we interact *Post TRIPS* with an indicator of small firms. *Small Firm* is either indicated by firms with total assets or market share below the median prior to TRIPS.[14] The estimates of the model presented in Panel A of Table 11 show that the interaction term between *Post TRIPS* and *Low Ln(Assets)* indicator is significantly positive at 1% level in all specifications. Similar findings are shown for market share in Panel B. These results suggest that among patenting firms, firms that are small in terms of assets or market share benefit more from the strengthened patent rights protection and experience greater increase in stock liquidity.

#### 5.2.3 TRIPS and Equity Financing

With an increase in stock liquidity after strengthened patent rights, firms should benefit by gaining easier access to equity financing. This is especially important for small firms or financially constrained firms that may lack other sources of financing. In this section we ask whether firms take advantage of increased liquidity after TRIPS by raising equity capital. To test this we again estimate a Diff-in-Diff model. This time we use firms' SEO activities as the dependent variable. We estimate the following firm fixed effects logit model:

$$\text{Pr(SEO)}_{i,t} = \alpha_4 + \beta_7 \text{Post}_{i,t} + \beta_8 \text{Post}_{i,t} \times \text{Treated}_i + \gamma_4' CONTROL_{i,t-1} + \phi_i + \epsilon_{i,t}. \qquad (5)$$

*SEO* is a binary variable that equal one if the firm issues an SEO in that year and zero otherwise. Panel A of Table 12 shows the results. In columns 1 and 2 we estimate the model in the full sample and estimate the difference between patenting firms and non-patenting firms. The estimates show that patenting firms on average are not significantly more likely to raise equity capital following TRIPS. In columns 3 to 6, we estimate the model among patenting firms and test the difference between large firms and small firms and between constrained firms and unconstrained firms. The estimates show that firms with smaller size, those that do not pay dividends or have access to public debt, are significantly more likely to conduct a SEO after TRIPS.

In Panel B, we compare the market reaction to SEOs before and after TRIPS. We estimate pooled OLS models by regressing SEO CARs over different horizons on *Post TRIPS* indicator with

[14] Market share is defined as the fraction of sales the firm accounted for in the corresponding 4-digit SIC industry

a set of firm controls. The estimates show that the market reaction to SEO announcements over various horizons is significantly less negative after the passage of TRIPS. Announcements of SEOs after TRIPS are associated with a 9.7% higher abnormal return in the one year period post-SEO. This higher frequency of SEOs among small and financially constrained firms after TRIPS and the better market performance suggest that TRIPS plays a role in reducing financing frictions by improving stock liquidity.

## 6 Conclusion

In this paper, we examine the impact of the exogenous legislative events that strengthened the protection accorded by different forms of IP protection. In particular, we exploit the exogenous variation in laws that affected different models of IP protection: the passage of state statutes that strengthened trade secrets protection and the implementation of TRIPS, that strengthened patent protection. As we would predict, stronger secrecy protection encourages firms to move away from patenting and toward greater secrecy. This is accompanied by an increase in information asymmetry and a corresponding reduction in stock liquidity. By contrast, stronger patent protection causes firms to disclose more information by patenting their inventions and a greater willingness to release information – resulting in higher stock liquidity. Consistent with the notion that higher stock liquidity is associated with lower cost in raising equity capital, we find that SEOs after TRIPS (trade secret statute) are associated with higher (lower) abnormal return in various horizons.

Our findings provide policy makers and academic researchers with a new perspective for the discussion and future development of IP protection law. In particular, our findings show that IP protection plays a more important role in the financing of small firms, that are typically in a more vulnerable position in product markets and face greater frictions in raising capital. Therefore, our study has important implications for policies that aim to facilitate growth of small innovative firms.

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## Table 1: Trade Secrets Law in the US.

Column 1 presents the year in which states enacted a trade secrets statute. Column 2 shows an index compiled by Png (2014) measuring the strength of trade secrets protection under common law. Column 3 shows the increase in the protection after the enactment of statute. The index characterizes three aspects of the law of trade secrets: substantive law, procedure, and remedies. Details of the index can be found in Png (2014)

| State | Year | Common Law | Statute |
|---|---|---|---|
| Alaska | 1988 | 0 | 0.467 |
| Arizona | 1990 | 0.25 | 0.217 |
| Arkansas | 1981 | 0.5 | 0 |
| California | 1985 | 0.22 | 0.247 |
| Colorado | 1986 | 0 | 0.767 |
| Connecticut | 1983 | 0 | 0.467 |
| Delaware | 1982 | 0 | 0.467 |
| District of Columbia | 1989 | 0 | 0.467 |
| Florida | 1988 | 0.1 | 0.367 |
| Georgia | 1990 | 0 | 0.7 |
| Hawaii | 1989 | 0 | 0.467 |
| Idaho | 1981 | 0 | 0.467 |
| Illinois | 1988 | 0 | 0.7 |
| Indiana | 1982 | 0 | 0.467 |
| Iowa | 1990 | 0 | 0.467 |
| Kansas | 1981 | 0 | 0.467 |
| Kentucky | 1990 | 0 | 0.467 |
| Louisiana | 1981 | 0 | 0.4 |
| Maine | 1987 | 0 | 0.5 |
| Maryland | 1989 | 0.22 | 0.247 |
| Michigan | 1998 | 0.25 | 0 |
| Minnesota | 1980 | 0 | 0.467 |
| Mississippi | 1990 | 0 | 0.567 |
| Missouri | 1995 | 0 | 0.633 |
| Montana | 1985 | 0 | 0.567 |
| Nebraska | 1988 | 0 | 0 |
| Nevada | 1987 | 0 | 0.467 |
| New Hampshire | 1990 | 0.025 | 0.442 |
| New Mexico | 1989 | 0 | 0.467 |
| North Dakota | 1983 | 0 | 0.467 |
| Ohio | 1994 | 0.25 | 0.283 |
| Oklahoma | 1986 | 0.025 | 0.442 |
| Oregon | 1988 | 0 | 0.467 |
| Rhode Island | 1986 | 0 | 0.467 |
| South Dakota | 1988 | 0 | 0.467 |
| Utah | 1989 | 0 | 0.467 |
| Vermont | 1996 | 0 | 0.567 |
| Virginia | 1986 | 0.025 | 0.442 |
| Washington | 1982 | 0 | 0.467 |
| West Virginia | 1986 | 0 | 0.467 |

**Table 2: Summary Statistics.**

Panel A presents summary statistics of the main variables used in our analyses of trade secret statute. Panel B compares the summary statistics of the treated group and control group used in the analyses of TRIPS. We use propensity score matching for which the estimation is presented in the Appendix. We winsorize all firm and loan characteristics at the 1st and 99th percentiles. All the variables are defined in the Appendix.

**Panel A**

| | **N** | **Mean** | **Median** | **S.D.** |
|---|---|---|---|---|
| Ln(Amihud) | 45,844 | 5.399 | 5.511 | 2.967 |
| -Ln(Share Turnover) | 45,861 | 5.944 | 5.937 | 1.021 |
| Ln(Assets) | 46,147 | 4.750 | 4.517 | 1.948 |
| Leverage | 46,147 | 0.240 | 0.213 | 0.206 |
| Q | 46,147 | 1.913 | 1.325 | 1.657 |
| Profitability | 46,147 | -0.006 | 0.042 | 0.265 |
| Cash | 46,147 | 0.152 | 0.066 | 0.196 |
| Tangibility | 46,147 | 0.318 | 0.260 | 0.239 |
| Ln(Age) | 46,147 | 2.171 | 2.272 | 1.001 |
| Return Volatility | 46,147 | 0.036 | 0.032 | 0.021 |
| Ln(Number of Analysts) | 46,147 | 1.217 | 1.099 | 1.068 |
| Market Share | 46147 | 0.030 | 0.015 | 12.957 |
| Ln(Analyst Dispersion) | 27,188 | 2.218 | 1.993 | 1.160 |
| Ln(Analyst Error) | 31,794 | 3.135 | 2.960 | 1.508 |
| Ln(Patent Applications) | 46,147 | 0.495 | 0.000 | 1.049 |
| SEO Dummy | 46,147 | 0.063 | 0.000 | 0.243 |

**Panel B**

| | *Control Group* | | | | *Treated Group* | | | |
|---|---|---|---|---|---|---|---|---|
| | **N** | **Mean** | **Median** | **S.D.** | **N** | **Mean** | **Median** | **S.D.** |
| Ln(Amihud) | 4,744 | 4.941 | 4.800 | 2.847 | 6,341 | 4.418 | 4.218 | 2.707 |
| Ln(Bid-Ask Spread) | 4,679 | -3.529 | -3.546 | 0.851 | 6,227 | -3.665 | -3.673 | 0.813 |
| -Ln(Turnover) | 4,744 | 5.884 | 5.900 | 0.998 | 6,341 | 5.729 | 5.714 | 0.966 |
| Ln(Assets) | 4,744 | 5.227 | 5.006 | 2.029 | 6,343 | 5.265 | 5.013 | 1.990 |
| Leverage | 4,744 | 0.205 | 0.162 | 0.201 | 6,343 | 0.194 | 0.162 | 0.182 |
| Q | 4,744 | 1.924 | 1.340 | 1.774 | 6,343 | 2.118 | 1.583 | 1.644 |
| Profitability | 4,744 | 0.009 | 0.040 | 0.263 | 6,343 | -0.016 | 0.048 | 0.304 |
| Cash | 4,744 | 0.154 | 0.066 | 0.196 | 6,343 | 0.178 | 0.080 | 0.221 |
| Tangibility | 4,744 | 0.280 | 0.195 | 0.249 | 6,343 | 0.274 | 0.244 | 0.172 |
| Ln(Age) | 4,744 | 2.208 | 2.342 | 1.169 | 6,343 | 2.297 | 2.500 | 1.237 |
| Return Volatility | 4,744 | 0.035 | 0.030 | 0.022 | 6,343 | 0.034 | 0.030 | 0.019 |
| Ln(Number of Analysts) | 4,744 | 1.402 | 1.386 | 1.050 | 6,343 | 1.472 | 1.609 | 1.017 |

## Table 3: Trade Secret Law and Stock Liquidity of Small Firms

In this table, we show that the impact of trade secret statute on stock liquidity is concentrated among small firms. The dependent variables are measures of stock illiquidity including *Ln(Amihud)* and *-Ln(Turnover)* and the independent variables of interest are *TS Law* and its interaction with indicators of small firms. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm and year fixed effects are also included. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| Dependent Variables | *Ln(Amihud)* | | | *-Ln(Turnover)* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| TS Law | 0.109 | -0.431*** | -0.125 | 0.109*** | 0.032 | 0.085* |
| | (1.52) | (-4.79) | (-1.56) | (2.76) | (0.74) | (1.86) |
| TS Law × Low Ln(Assets) | | 1.442*** | | | 0.202*** | |
| | | (11.24) | | | (3.07) | |
| TS Law × Low Market Share | | | 0.637*** | | | 0.065 |
| | | | (5.67) | | | (1.05) |
| Low Ln(Assets) | | 0.061 | | | -0.021 | |
| | | (0.88) | | | (-0.62) | |
| Low Market Share | | | -0.291*** | | | -0.018 |
| | | | (-4.75) | | | (-0.54) |
| Ln(Assets) | -0.892*** | | -0.889*** | -0.089*** | | -0.087*** |
| | (-36.70) | | (-35.66) | (-6.60) | | (-6.36) |
| Leverage | 1.168*** | 0.653*** | 1.176*** | 0.055 | 0.004 | 0.056 |
| | (14.74) | (7.86) | (14.82) | (1.22) | (0.09) | (1.25) |
| Q | -0.443*** | -0.388*** | -0.442*** | -0.086*** | -0.080*** | -0.086*** |
| | (-42.63) | (-36.77) | (-42.39) | (-19.41) | (-18.43) | (-19.36) |
| Profitability | -0.743*** | -0.874*** | -0.746*** | -0.241*** | -0.254*** | -0.241*** |
| | (-14.04) | (-15.38) | (-14.09) | (-9.57) | (-10.06) | (-9.56) |
| Cash | -0.337*** | -0.326*** | -0.338*** | -0.076 | -0.076 | -0.078 |
| | (-3.79) | (-3.39) | (-3.82) | (-1.57) | (-1.57) | (-1.60) |
| Tangibility | 0.237** | 0.433*** | 0.236** | 0.142** | 0.160** | 0.141** |
| | (1.97) | (3.20) | (1.97) | (2.25) | (2.53) | (2.25) |
| Ln(Age) | 0.168*** | 0.034 | 0.155*** | 0.058*** | 0.042** | 0.056*** |
| | (5.22) | (0.91) | (4.83) | (3.30) | (2.36) | (3.20) |
| Return Volatility | 17.771*** | 22.003*** | 17.633*** | -2.377*** | -1.974*** | -2.392*** |
| | (23.70) | (29.36) | (23.55) | (-5.43) | (-4.60) | (-5.47) |
| Ln(Number of Analysts) | -0.311*** | -0.595*** | -0.312*** | -0.127*** | -0.156*** | -0.127*** |
| | (-15.61) | (-28.42) | (-15.68) | (-11.54) | (-15.25) | (-11.54) |
| Adjusted $R^2$ | 0.896 | 0.885 | 0.896 | 0.746 | 0.745 | 0.746 |
| Observations | 45,844 | 45,844 | 45,844 | 45,861 | 45,861 | 45,861 |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |

## Table 4: Trade Secret Law and Analyst Forecast

In this table, we show that stock opacity in terms of analyst forecast dispersion and forecast error increases after the enactment of trade secret statute. The dependent variables are *Ln(Analyst Dispersion)* and *Ln(Analyst Error)* and the independent variables of interest are *TS Law* and its interaction with indicators of small firms. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm and year fixed effects are also included. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| Dependent Variables | *Ln(Analyst Dispersion)* | | | *Ln(Analyst Error)* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| TS Law | 0.176** | 0.192*** | 0.120 | 0.222** | 0.274*** | 0.160* |
| | (2.53) | (2.64) | (1.59) | (2.53) | (2.96) | (1.66) |
| TS Law × Low Ln(Assets) | | -0.096 | | | -0.234 | |
| | | (-0.70) | | | (-1.48) | |
| TS Law × Low Market Share | | | 0.236* | | | 0.234 |
| | | | (1.85) | | | (1.57) |
| Low Ln(Assets) | | -0.011 | | | -0.016 | |
| | | (-0.16) | | | (-0.21) | |
| Low Market Share | | | -0.054 | | | -0.078 |
| | | | (-0.80) | | | (-0.99) |
| Ln(Assets) | 0.094*** | | 0.098*** | 0.104*** | | 0.107*** |
| | (3.84) | | (4.01) | (3.51) | | (3.56) |
| Leverage | 0.690*** | 0.743*** | 0.694*** | 0.671*** | 0.717*** | 0.675*** |
| | (7.28) | (8.00) | (7.33) | (6.45) | (6.99) | (6.49) |
| Q | -0.084*** | -0.087*** | -0.083*** | -0.071*** | -0.075*** | -0.070*** |
| | (-9.29) | (-9.71) | (-9.24) | (-7.02) | (-7.60) | (-6.97) |
| Profitability | -0.874*** | -0.871*** | -0.873*** | -0.332*** | -0.326*** | -0.331*** |
| | (-11.82) | (-11.85) | (-11.80) | (-5.96) | (-5.90) | (-5.94) |
| Cash | -0.125 | -0.126 | -0.128 | -0.412*** | -0.410*** | -0.414*** |
| | (-1.20) | (-1.21) | (-1.23) | (-3.52) | (-3.52) | (-3.54) |
| Tangibility | 0.701*** | 0.647*** | 0.701*** | 0.347** | 0.300* | 0.347** |
| | (4.71) | (4.36) | (4.73) | (2.04) | (1.79) | (2.05) |
| Ln(Age) | 0.095*** | 0.112*** | 0.093*** | 0.026 | 0.037 | 0.023 |
| | (3.02) | (3.56) | (2.94) | (0.68) | (0.95) | (0.60) |
| Return Volatility | 10.237*** | 9.794*** | 10.189*** | 1.511 | 1.119 | 1.461 |
| | (8.86) | (8.54) | (8.83) | (1.43) | (1.07) | (1.39) |
| Ln(Number of Analysts) | 0.207*** | 0.237*** | 0.208*** | 0.144*** | 0.173*** | 0.144*** |
| | (10.69) | (12.96) | (10.71) | (6.30) | (8.07) | (6.29) |
| Adjusted $R^2$ | 0.531 | 0.531 | 0.532 | 0.370 | 0.370 | 0.370 |
| Observations | 27,188 | 27,188 | 27,188 | 31,794 | 31,794 | 31,794 |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |

## Table 5: Trade Secret Law and Patenting Activities

In this table, we show that small firms tend to reduce patenting after the enactment of trade secret statute. The dependent variable is *Ln(Patent Applications)* and the independent variables of interest are the interaction between *TS Law* and the binary variable indicating firms *Ln(Assets)* or *Market Share* below the sample median. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm and year fixed effects are also included. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| | Dependent Variable: *Ln(Patent Applications)* | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| TS Law | -0.069* | -0.029 | -0.034 |
| | (-1.90) | (-0.60) | (-0.74) |
| TS Law × Low Ln(Assets) | | -0.113** | |
| | | (-2.36) | |
| TS Law × Low Market Share | | | -0.098** |
| | | | (-2.14) |
| Low Ln(Assets) | | -0.043 | |
| | | (-1.55) | |
| Low Market Share | | | 0.065** |
| | | | (2.49) |
| Ln(Assets) | 0.162*** | | 0.164*** |
| | (9.36) | | (9.39) |
| Leverage | -0.145*** | -0.043 | -0.146*** |
| | (-4.10) | (-1.36) | (-4.13) |
| Q | 0.027*** | 0.017*** | 0.027*** |
| | (5.71) | (3.61) | (5.67) |
| Profitability | -0.029 | -0.005 | -0.028 |
| | (-1.40) | (-0.27) | (-1.35) |
| Cash | 0.025 | 0.020 | 0.023 |
| | (0.63) | (0.50) | (0.57) |
| Tangibility | 0.082* | 0.043 | 0.082* |
| | (1.80) | (0.95) | (1.80) |
| Ln(Age) | 0.051*** | 0.074*** | 0.053*** |
| | (3.06) | (4.02) | (3.18) |
| Return Volatility | -0.216 | -1.102*** | -0.196 |
| | (-0.93) | (-4.97) | (-0.85) |
| Ln(Number of Analysts) | -0.006 | 0.049*** | -0.006 |
| | (-0.65) | (5.24) | (-0.62) |
| Adjusted $R^2$ | 0.845 | 0.841 | 0.845 |
| Observations | 46,147 | 46,147 | 46,147 |
| Firm Fixed Effects | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes |

### Table 6: Trade Secret Law and Seasoned Equity Offerings

In this table, we show that small firms are more likely to issue SEO after the enactment of trade secret statute. We estimate a conditional logit model where the dependent variable is *Ln(Patent Applications)* and the independent variables of interest are the interaction between *TS Law* and the binary variable indicating firms *Ln(Assets)* or *Market Share* below the sample median. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm and year fixed effects are also included. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| | Dependent Variable: *SEO Dummy* | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| TS Law | 0.085 | -0.226 | -0.128 |
| | (0.40) | (-0.96) | (-0.53) |
| TS Law × Low Ln(Assets) | | 1.042*** | |
| | | (3.19) | |
| TS Law × Low Market Share | | | 0.653* |
| | | | (1.93) |
| Low Ln(Assets) | | 0.072 | |
| | | (0.45) | |
| Low Market Share | | | -0.081 |
| | | | (-0.46) |
| Ln(Assets) | -0.452*** | | -0.430*** |
| | (-7.23) | | (-6.80) |
| Leverage | 2.240*** | 2.035*** | 2.251*** |
| | (9.00) | (8.58) | (9.07) |
| Q | 0.315*** | 0.346*** | 0.316*** |
| | (13.10) | (14.82) | (13.16) |
| Profitability | 0.527*** | 0.425*** | 0.526*** |
| | (3.55) | (3.05) | (3.54) |
| Cash | -1.447*** | -1.484*** | -1.473*** |
| | (-4.94) | (-5.18) | (-5.01) |
| Tangibility | -0.492 | -0.363 | -0.507 |
| | (-1.32) | (-1.02) | (-1.37) |
| Ln(Age) | -0.110 | -0.197** | -0.122 |
| | (-1.32) | (-2.47) | (-1.46) |
| Return Volatility | -11.259*** | -9.813*** | -11.442*** |
| | (-4.35) | (-3.88) | (-4.42) |
| Ln(Number of Analysts) | -0.203*** | -0.316*** | -0.203*** |
| | (-3.73) | (-6.30) | (-3.72) |
| Adjusted $R^2$ | 0.148 | 0.145 | 0.148 |
| Observations | 17,661 | 17,661 | 17,661 |
| Firm Fixed Effects | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes |

## Table 7: Trade Secret Law and Market Reaction to SEOs

In this table, we show that the stock market reacts more positively to SEOs after trade secret statute. The dependent variables are cumulative abnormal return over different horizons around SEOs and the independent variables of interest is *TS Law* . The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. State and year fixed effects are also included. *t*-statistics using robust standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| Dependent Variables | *CAR(-1,+1)*<br>(1) | *CAR(-1,+10)*<br>(2) | *CAR(0,+60)*<br>(3) | *CAR(0,+250)*<br>(4) |
|---|---|---|---|---|
| TS Law | 0.002 | -0.039** | -0.056* | -0.171** |
| | (0.24) | (-2.42) | (-1.65) | (-2.37) |
| Ln(Assets) | 0.001 | -0.001 | -0.005 | -0.004 |
| | (0.58) | (-0.31) | (-1.14) | (-0.44) |
| Leverage | 0.002 | 0.008 | -0.004 | -0.136** |
| | (0.20) | (0.63) | (-0.13) | (-2.00) |
| Q | -0.002 | -0.004* | -0.004 | -0.009 |
| | (-1.57) | (-1.73) | (-0.87) | (-0.89) |
| Profitability | 0.011* | 0.014 | 0.064*** | 0.119** |
| | (1.91) | (1.57) | (3.11) | (2.24) |
| cash | 0.016 | 0.026 | -0.004 | -0.010 |
| | (1.61) | (1.52) | (-0.13) | (-0.13) |
| Tangibility | 0.012** | 0.003 | -0.023 | 0.038 |
| | (2.19) | (0.32) | (-1.03) | (0.84) |
| Ln(Age) | 0.002 | 0.003 | -0.002 | -0.006 |
| | (1.09) | (1.06) | (-0.30) | (-0.47) |
| Return Volatility | -0.060 | 0.329 | -0.054 | 0.342 |
| | (-0.42) | (1.29) | (-0.10) | (0.31) |
| Ln(Number of Analyst) | -0.004** | -0.004 | 0.010 | 0.013 |
| | (-2.51) | (-1.25) | (1.40) | (0.88) |
| Adjusted $R^2$ | 0.012 | 0.018 | 0.029 | 0.038 |
| Observations | 2,424 | 2,424 | 2,426 | 2,426 |
| State Fixed Effects | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes |

**Table 8: Change in Stock Liquidity Around TRIPS.**

In this table, we present Diff-in-Diffs estimates where the dependent variable are measures of stock illiquidity including *Ln(Amihud)*, *Ln(Bid-Ask Spread)* and *-Ln(Turnover)* and the independent variables of interest is the interaction term between *Post TRIPS* and *Treated*. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm fixed effects are also included. Column 1, 3, 5 present estimates in the 3-year window while column 2, 4, 6 present estimates in the 7-year window around the law change. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| | *Ln(Amihud)* | | *Ln(Bid-Ask Spread)* | | *-Ln(Turnover)* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post TRIPS | -0.223*** | -0.264*** | 0.008 | 0.043** | -0.118*** | -0.166*** |
| | (-4.94) | (-6.62) | (0.38) | (2.16) | (-4.19) | (-6.73) |
| Post TRIPS × Treated | -0.174*** | -0.185*** | -0.059** | -0.088*** | -0.072** | -0.052* |
| | (-3.04) | (-3.70) | (-2.33) | (-3.51) | (-2.12) | (-1.75) |
| Ln(Assets) | -0.796*** | -0.841*** | -0.163*** | -0.261*** | -0.051 | -0.083*** |
| | (-9.96) | (-19.53) | (-5.37) | (-14.31) | (-1.06) | (-3.46) |
| Leverage | 0.512 | 0.916*** | 0.166 | 0.323*** | -0.259 | -0.105 |
| | (1.62) | (6.00) | (1.42) | (4.49) | (-1.52) | (-1.21) |
| Q | -0.337*** | -0.353*** | -0.080*** | -0.087*** | -0.072*** | -0.086*** |
| | (-11.06) | (-20.14) | (-8.38) | (-14.28) | (-6.41) | (-11.91) |
| Profitability | -0.327** | -0.454*** | -0.072 | -0.125*** | -0.123** | -0.172*** |
| | (-2.44) | (-5.62) | (-1.56) | (-4.38) | (-2.26) | (-4.31) |
| Cash | -0.030 | -0.302* | -0.002 | -0.048 | 0.222 | 0.005 |
| | (-0.11) | (-1.84) | (-0.02) | (-0.71) | (1.43) | (0.05) |
| Tangibility | 1.026** | 0.665*** | 0.200 | -0.029 | 0.386 | 0.333** |
| | (2.36) | (2.80) | (1.36) | (-0.28) | (1.59) | (2.51) |
| Ln(Age) | -0.274*** | -0.078** | -0.114*** | -0.104*** | -0.078** | 0.056*** |
| | (-3.98) | (-2.32) | (-4.77) | (-6.55) | (-2.13) | (2.84) |
| Return Volatility | 1.095 | 12.415*** | 0.235 | 4.827*** | -0.566 | -2.417*** |
| | (0.42) | (8.09) | (0.26) | (8.15) | (-0.38) | (-2.83) |
| Ln(Number of Analysts) | 0.011 | -0.192*** | 0.033 | 0.014 | 0.033 | -0.077*** |
| | (0.17) | (-5.72) | (1.29) | (0.84) | (0.90) | (-3.98) |
| Adjusted $R^2$ | 0.934 | 0.920 | 0.865 | 0.813 | 0.836 | 0.789 |
| Observations | 5,241 | 11,085 | 5,236 | 10,906 | 5,241 | 11,085 |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 | 3 | 7 |

**Table 9: Change in the Analyst Forecast Dispersion and Error Around TRIPS.**

In this table, we present estimates from Diff-in-Diffs models where the dependent variable are *Ln(Analyst Dispersion)* and *Ln(Analyst Error)* and the independent variables of interest is the interaction term between *Post TRIPS* and *Treated*. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm fixed effects are also included. Column 1, and 3 present estimates in the 3-year window while column 2, and 4 present estimates in the 7-year window around the change of patent law. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| | Ln(Analyst Dispersion) | | Ln(Analyst Error) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Post TRIPS | 0.053 | -0.011 | 0.152* | 0.075 |
| | (0.94) | (-0.24) | (1.79) | (1.32) |
| Post TRIPS × Treated | -0.223*** | -0.219*** | -0.096 | -0.217*** |
| | (-3.29) | (-4.08) | (-0.93) | (-3.09) |
| Ln(Assets) | 0.260** | 0.065 | 0.270* | 0.136** |
| | (2.37) | (1.34) | (1.84) | (2.26) |
| Leverage | 0.010 | 0.315* | -0.102 | 0.251 |
| | (0.02) | (1.73) | (-0.25) | (1.13) |
| Q | -0.052** | -0.077*** | 0.011 | -0.009 |
| | (-2.07) | (-4.78) | (0.41) | (-0.53) |
| Profitability | -0.334* | -0.451*** | 0.166 | -0.054 |
| | (-1.87) | (-4.41) | (1.04) | (-0.66) |
| Cash | -0.775** | -0.559*** | -0.322 | -0.774*** |
| | (-2.13) | (-2.68) | (-0.77) | (-3.37) |
| Tangibility | 0.815 | 0.718** | 1.311* | 0.578* |
| | (1.39) | (2.48) | (1.77) | (1.76) |
| Ln(Age) | 0.039 | 0.036 | -0.127 | -0.039 |
| | (0.42) | (0.96) | (-1.17) | (-0.84) |
| Return Volatility | 1.327 | 7.634*** | -8.192* | 0.273 |
| | (0.31) | (3.08) | (-1.90) | (0.13) |
| Ln(Number of Analysts) | 0.152 | 0.252*** | 0.264** | 0.302*** |
| | (1.62) | (5.93) | (2.13) | (5.59) |
| Adjusted $R^2$ | 0.595 | 0.559 | 0.456 | 0.421 |
| Observations | 3,559 | 7,537 | 4,084 | 8,606 |
| Firm Fixed Effects | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 |

## Table 10: Foreign Sales, Trade Secret Disputes, and Change in Stock Liquidity Around TRIPS.

In this table, we present estimates from Diff-in-Diffs models among treated firms where the dependent variable are measures of stock illiquidity including *Ln(Amihud)*, *Ln(Bid-Ask Spread)* and *-Ln(Turnover)* and the independent variables of interest is the interaction term between *Post* and *Export* (Panel A) or *Trade Secret Disputes Rank* (Panel B). The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm fixed effects are also included. Column 1, 3, 5 present estimates in the 3-year window while column 2, 4, 6 present estimates in the 7-year window around the implementation of TRIPS. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

**Panel A: Foreign Sales**

| | *Ln(Amihud)* | | *Ln(Bid-Ask Spread)* | | *-Ln(Turnover)* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post | -0.356*** | -0.336*** | -0.069** | -0.039 | -0.181*** | -0.173*** |
| | (-4.87) | (-5.40) | (-2.30) | (-1.31) | (-4.58) | (-5.33) |
| Post × $\text{Export}_{pre}$ | -0.245 | -0.432*** | -0.040 | -0.088 | -0.233** | -0.159* |
| | (-1.38) | (-2.98) | (-0.56) | (-1.25) | (-2.15) | (-1.84) |
| Adjusted $R^2$ | 0.923 | 0.908 | 0.868 | 0.818 | 0.848 | 0.797 |
| Observations | 2,143 | 4,749 | 2,141 | 4,678 | 2,143 | 4,749 |
| Firm Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 | 3 | 7 |

**Panel B: Trade Secret Dispute**

| | *Ln(Amihud)* | | *Ln(Bid-Ask Spread)* | | *-Ln(Turnover)* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post TRIPS | -0.370*** | -0.417*** | -0.053*** | -0.030* | -0.195*** | -0.207*** |
| | (-9.57) | (-12.27) | (-3.07) | (-1.75) | (-8.87) | (-11.61) |
| Post TRIPS | -0.023 | -0.024 | -0.026*** | -0.029*** | -0.019* | -0.020** |
| × Trade Secret Dispute Rank | (-1.14) | (-1.32) | (-3.62) | (-3.89) | (-1.87) | (-2.32) |
| Adjusted $R^2$ | 0.935 | 0.921 | 0.877 | 0.823 | 0.854 | 0.811 |
| Observations | 3,547 | 7,877 | 3,542 | 7,740 | 3,547 | 7,877 |
| Firm Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 | 3 | 7 |

## Table 11: Firm Size and Change in Stock Liquidity Around TRIPS.

In this table, we show that small firms and financially constrained firms experienced greater increase in stock liquidity after TRIPS. We present estimates from Diff-in-Diffs models among treated firms where the dependent variable are measures of stock illiquidity including *Ln(Amihud)*, *Ln(Bid-Ask Spread)* and *-Ln(Turnover)*. In Panel A and B, and the independent variables of interest is the interaction term between *Post TRIPS* and empirical proxies for small firms including *Low Ln(Assets)* and *Low Market Share*, both measured in 1994. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm fixed effects are also included. Column 1, 3, 5 present estimates in the 3-year window while column 2, 4, 6 present estimates in the 7-year window around the implementation of TRIPS. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

**Panel A: Firm Size Measured by Ln(Assets)**

| | *Ln(Amihud)* | | *Ln(Bid-Ask Spread)* | | *-Ln(Turnover)* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post TRIPS | -0.178*** | -0.227*** | -0.017 | 0.024 | -0.128*** | -0.176*** |
| | (-5.12) | (-6.75) | (-0.86) | (1.19) | (-5.93) | (-9.56) |
| Post TRIPS × Low Ln(Assets)$_{pre}$ | -0.458*** | -0.462*** | -0.110*** | -0.155*** | -0.173*** | -0.095*** |
| | (-6.36) | (-7.35) | (-3.40) | (-4.96) | (-4.26) | (-2.81) |
| Adjusted $R^2$ | 0.937 | 0.923 | 0.877 | 0.825 | 0.856 | 0.812 |
| Observations | 3,547 | 7,793 | 3,542 | 7,656 | 3,547 | 7,793 |
| Firm Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 | 3 | 7 |

**Panel B: Market Share at 4-digit SIC Level**

| | *Ln(Amihud)* | | *Ln(Bid-Ask Spread)* | | *-Ln(Turnover)* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post TRIPS | -0.223*** | -0.289*** | -0.012 | 0.033 | -0.154*** | -0.184*** |
| | (-5.56) | (-7.62) | (-0.55) | (1.57) | (-6.21) | (-9.23) |
| Post TRIPS × Low Market Share$_{pre}$ | -0.351*** | -0.317*** | -0.120*** | -0.175*** | -0.113*** | -0.074** |
| | (-4.83) | (-4.95) | (-3.73) | (-5.57) | (-2.82) | (-2.18) |
| Adjusted $R^2$ | 0.936 | 0.922 | 0.878 | 0.825 | 0.855 | 0.811 |
| Observations | 3,532 | 7,758 | 3,527 | 7,621 | 3,532 | 7,758 |
| Firm Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 | 3 | 7 |

## Table 12: SEO Activity and Market Reaction Around TRIPS.

In Panel A, we present estimates from Diff-in-Diffs models from logit model with firm fixed effects where the dependent variable a binary variable that equal one if the firm has an SEO in that year. In Columns 1 and 2 we estimate the regression in the matched sample and the variable of interest and the independent variable of interest is the interaction term between *Post TRIPS* and *Treated*. In Columns 3 to 10 we present estimates among the treated group and the variables of interests are the interaction term between *Post TRIPS* and *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm fixed effects are also included. Column 1, 3, 5 present estimates in the 3-year window while column 2, 4, 6 present estimates in the 7-year window around the implementation of TRIPS. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

**Panel A: Likelihood of SEO Around TRIPS**

| | Dependent Variable: SEO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Post TRIPS | 0.793*** | -0.005 | 0.584* | -0.118 | 0.917** | 0.109 | 1.322*** | 0.550** | 1.187*** | 0.500** |
| | (2.75) | (-0.03) | (1.65) | (-0.55) | (2.49) | (0.51) | (4.10) | (2.48) | (4.05) | (2.40) |
| Post TRIPS × Treated | 0.149 | 0.151 | | | | | | | | |
| | (0.43) | (0.75) | | | | | | | | |
| Post TRIPS × Low Ln(Assets)$_{pre}$ | | | 0.875** | 0.735*** | | | | | | |
| | | | (2.07) | (2.72) | | | | | | |
| Post TRIPS × Low Market Share$_{pre}$ | | | | | 0.193 | 0.273 | | | | |
| | | | | | (0.45) | (1.01) | | | | |
| Post TRIPS × Dividend Dummy$_{pre}$ | | | | | | | -1.005** | -0.736** | | |
| | | | | | | | (-2.12) | (-2.47) | | |
| Post TRIPS × Public Debt Dummy$_{pre}$ | | | | | | | | | -0.873 | -0.861*** |
| | | | | | | | | | (-1.47) | (-2.71) |
| Pseudo $R^2$ | 0.241 | 0.130 | 0.299 | 0.146 | 0.290 | 0.139 | 0.300 | 0.144 | 0.295 | 0.146 |
| Observations | 796 | 2934 | 531 | 1936 | 528 | 1922 | 531 | 1890 | 531 | 1944 |
| Firm Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of Years | 3 | 7 | 3 | 7 | 3 | 7 | 3 | 7 | 3 | 7 |
| Sample | Full | Full | Treated | Treated | Treated | Treated | Treated | Treated | Treated | Treated |

In Panel B, we show that the stock market reacts more positively to SEOs after TRIPS. The sample consists of SEOs in the seven-year period around TRIPS. The dependent variables are cumulative abnormal return over different horizons around SEOs and the independent variables of interest is *Post TRIPS*. The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. State and year fixed effects are also included. *t*-statistics using robust standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

**Panel B**: Propensity Score Matching Estimate

| Dependent Variables | *CAR(-1,+1)*<br>(1) | *CAR(-1,+10)*<br>(2) | *CAR(0,+60)*<br>(3) | *CAR(0,+250)*<br>(4) |
|---|---|---|---|---|
| Post TRIPS | 0.006** | 0.011** | 0.045*** | 0.097*** |
| | (2.34) | (2.30) | (4.53) | (4.59) |
| Ln(Assets) | 0.000 | 0.000 | 0.010** | 0.016 |
| | (0.34) | (0.03) | (2.18) | (1.63) |
| Leverage | 0.010 | 0.006 | -0.009 | -0.094 |
| | (1.23) | (0.42) | (-0.30) | (-1.55) |
| Q | 0.000 | -0.001 | 0.005 | 0.003 |
| | (0.13) | (-0.42) | (1.22) | (0.40) |
| Profitability | 0.003 | 0.009 | 0.062*** | 0.070 |
| | (0.54) | (1.01) | (3.30) | (1.52) |
| cash | 0.001 | -0.010 | -0.010 | -0.048 |
| | (0.13) | (-0.63) | (-0.33) | (-0.65) |
| Tangibility | 0.010* | -0.016 | -0.009 | 0.032 |
| | (1.66) | (-1.60) | (-0.43) | (0.74) |
| Ln(Age) | 0.002 | 0.002 | -0.007 | -0.013 |
| | (1.14) | (0.66) | (-1.43) | (-1.15) |
| Return Volatility | -0.110 | 0.569** | 0.479 | 0.897 |
| | (-0.68) | (2.05) | (1.02) | (0.90) |
| lanalyst_n | -0.003 | 0.003 | 0.000 | -0.003 |
| | (-1.58) | (0.80) | (0.07) | (-0.20) |
| Adjusted $R^2$ | 0.005 | 0.005 | 0.019 | 0.011 |
| Observations | 2,055 | 2,055 | 2,057 | 2,057 |
| Number of Years | 7 | 7 | 7 | 7 |

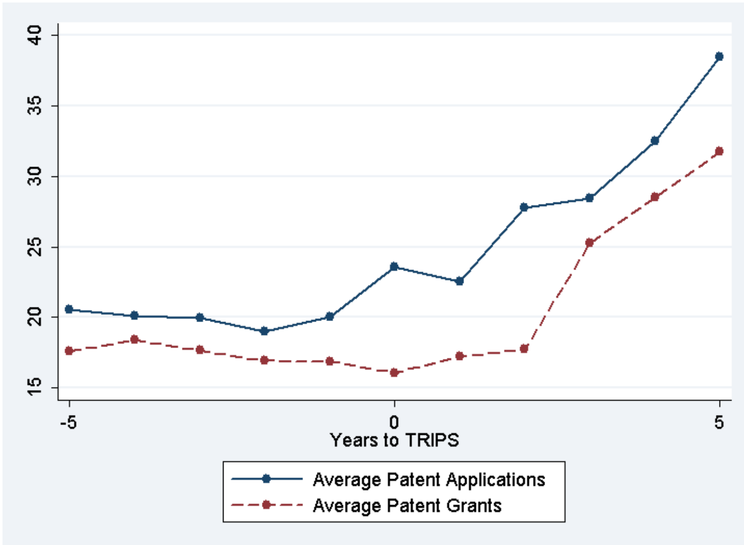


**Figure 3: Patent Applications and Patent Grants Around TRIPS**

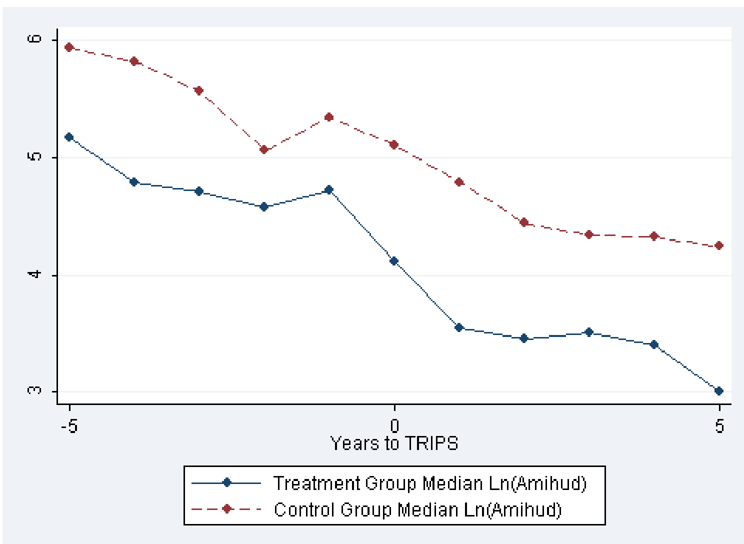


**Figure 4: Ln(Amihud) Around TRIPS**

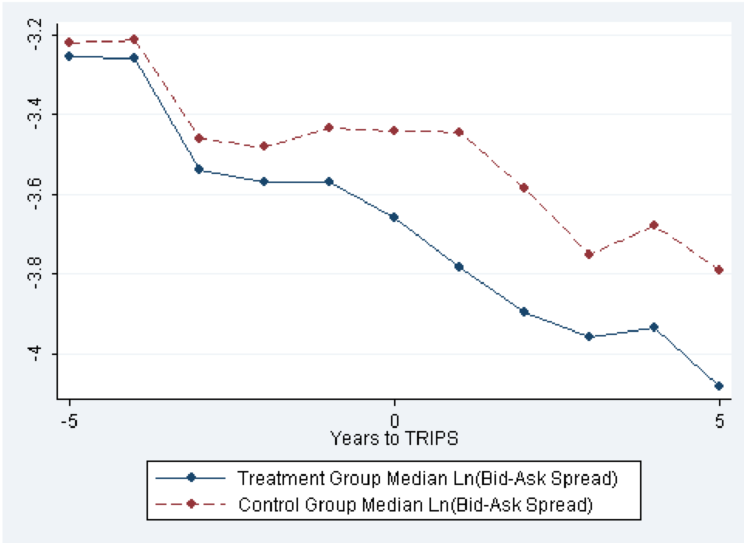


**Figure 5: Ln(Bid-Ask Spread) Around TRIPS**

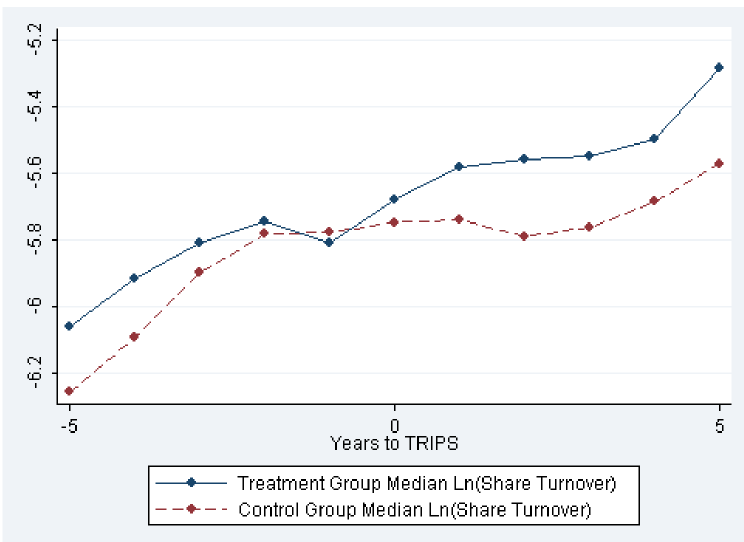


**Figure 6: Ln(Share Turnover) Around TRIPS**

# Appendix: Variable Definitions

- *Treated*: is a binary variable that equals to 1 if the firm has applied for patents in 1993 or 1994 and 0 otherwise.
- *Ln(Amihud)* is defined as $ln(1 + AvgILLIQ \times 10^9)$, where $AvgILLIQ$ is an yearly average of illiquidity measured as the absolute return divided by dollar trading volume:$AvgILLIQ_{i,t} = \frac{1}{Days_{i,t}} \sum_{d=1}^{Days_{i,t}} \frac{|R_{i,t,d}|}{DolVol_{i,t,d}}$ where $Days_{i,t}$ is the number of valid observation days for stock $i$ in fiscal year $t$, and $R_{i,t,d}$ and $DolVol_{i,t,d}$ are the return and dollar trading volume of stock $i$ on day $d$ in the fiscal year $t$.
- *Ln(Bid-Ask Spread)* is defined as $ln(Bid\text{−}Ask\ Spread_{i,t})$ where where $Bid\text{−}Ask\ Spread_{i,t} = \frac{1}{Days_{i,t}} \sum_{d=1}^{Days_{i,t}} \frac{Ask_{i,t,d} - Bid_{i,t,d}}{(Ask_{i,t,d} + Bid_{i,t,d})/2}$ where $Days_{i,t}$ is the number of observations for stock $i$ in fiscal year $t$, and $Ask_{i,t,d}$ and $Bid_{i,t,d}$ are the closing ask and bid prices of the stock $i$ on day $d$ of year $t$.
- *-Ln(Turnover)* is defined as $-ln(\frac{1}{Days_{i,t}} \sum_{d=1}^{Days_{i,t}} \frac{Vol_{i,t,d}}{Shrout_{i,t,d}})$ where $Vol_{i,t,d}$ and $Shrout_{i,t,d}$ are the trading volume in shares and number of shares outstanding for firm $i$ in day $d$ of fiscal year $t$. (We use "negative" turnover so that it measures illiquidity.)
- *Ln(Analyst Dispersion)* is defined as $ln(1 + 100 \times \frac{SD(AnalystForecast)}{|MedianForecastedEarnings|})$.
- *Ln(Analyst Error)* is defined as $ln(1 + 100 \times \frac{|ActualEarnings - MedianForecastedEarnings|}{|ActualEarnings|})$.
- *Ln(Patent Grants)* is the logarithm of one plus the number of patent grants in the year.
- *Ln(Assets)* is the natural logarithm of total assets.
- *Leverage* is the sum of long term debt and debt in current liabilities divided by total assets.
- *Q* is the sum of total assets and the difference between market value and book value of total common equity, divided by total assets.
- *Profitability* is equal to EBITDA divided by total assets.
- *Cash* is the cash and equivalent divided by total assets.
- *Tangibility* is the net total value of property, plant and equipment, divided by total assets.
- *Ln(Age)* is the natural logarithm of firm age in years.
- *Return Volatility* is the standard deviation of daily stock returns in the fiscal year.
- *Ln(Number of Analysts)* is the natural logarithm of one plus maximum number of analysts following the stock for the year. It is coded as 0 if there is not coverage from I/B/E/S.
- *Market Share* is the fraction of sales the firm accounted for in the corresponding 4-digit SIC industry.
- *Dividend Dummy* is a binary variable that equals to 1 if firms pay dividend to common or preferred stockholders and 0 otherwise.
- *Public Debt Dummy* is a binary variable that equals to 1 if firms have available S&P credit rating and 0 otherwise.

**Table A1: Construction of Trade Secret Law Index.**

This table is from Png (2014). It describes the construction of the Trade Secret Law Index.

| Dimension | Item | Coding | Sources |
|---|---|---|---|
| Substantive Law | Whether information must be in actual or intended business use tobe protected as trade secret. | =0 if information must be in actual or intended use, =1 otherwise | ULA (Uniform Laws Annotated); Pedowitz et al. 1997; Malsberger et al. 2006 |
| Substantive Law | Whether reasonable efforts are required to maintain secrecy. | =0 if reasonable efforts required, =1 otherwise. | ULA (Uniform Laws Annotated); Pedowitz et al. 1997; Malsberger et al. 2006 |
| Substantive Law | Whether information must be used or disclosed for it to be deemed to have been misappropriated. | =0 if information must be used or disclosed, =1 if includes mere improper acquisition or no requirement | ULA (Uniform Laws Annotated); Pedowitz et al. 1997; Malsberger et al. 2006 |
| Civil Procedure | Limitation on the time for the owner to take legal action for misappropriation. | Number of years divided by six | ULA (Uniform Laws Annotated); Pedowitz et al. 1997; Malsberger et al. 2006 |
| Remedies | Whether an injunction is limited to eliminating the advantage from misappopriation. | =0 if yes, =1 otherwise | Pedowitz et al. 1997; Malsberger et al. 2006 |
| Remedies | Multiple of actual damages available in punitive damages. | Number of years divided by three | Pedowitz et al. 1997; Malsberger et al. 2006 |

**Table A2: Propensity Score Matching Regressions and Summary Statistics.**

This table presents probit regressions used for propensity score matching in the year prior to TRIPS. The dependent variable equals to 1 if the firm has applied for patents in 1993 or 1994 (treatment group) and 0 otherwise (control group). Column 1 presents estimates in the entire sample in the year before TRIPS including 1,178 treatment firms and 3,293 control firms. Column 2 presents estimates in the matched sample, where 1,033 treatment firms are matched to 786 control firms.

| | *Pre-Match* (1) | *Post-Match* (2) |
|---|---|---|
| Ln(Assets) | 0.059*** | -0.011 |
| | (2.76) | (-0.36) |
| Leverage | -0.413*** | 0.087 |
| | (-3.28) | (0.46) |
| Q | 0.101*** | 0.029 |
| | (6.21) | (1.04) |
| Profitability | -0.200*** | -0.023 |
| | (-2.85) | (-0.23) |
| Cash | 0.917*** | 0.414** |
| | (7.06) | (2.22) |
| Tangibility | -0.560*** | 0.178 |
| | (-5.95) | (1.05) |
| Ln(Age) | 0.164*** | 0.031 |
| | (8.47) | (1.13) |
| Return Volatility | -2.271* | -3.423* |
| | (-1.73) | (-1.72) |
| Ln(Number of Analysts) | 0.169*** | 0.001 |
| | (4.99) | (0.02) |
| Pseudo $R^2$ | 0.098 | 0.005 |
| Observations | 4,471 | 1,819 |

### Table A3: Placebo Test: Diff-in-Diff Regressions around 1992 and 1993

This table presents estimates from the Diff-in-Diff regressions using annual data in the 3-year window around 1992 or 1993 to test the parallel trends in stock liquidity prior to the implementation of TRIPS. In column 1 to 3 (4 to 6), we use 1993 (1992) as the event year and match treatment firms with control firms in the preceding year. *Post* equals to 1 if the observation is in or after year 1993 (1992). The following lagged firm characteristics are also included in the regressions: *Ln(Assets)*, *Leverage*, *Q*, *Profitability*, *Cash*, *Tangibility*, *Ln(Age)*, *Return Volatility*, and *Ln(Number of Analysts)*. Firm fixed effects are also included. *t*-statistics using robust, firm-clustered standard errors are in brackets. *, ** and *** indicate significance better than 10%, 5%, and 1% respectively.

| | 1992-1994 | | | 1991-1993 | | |
|---|---|---|---|---|---|---|
| | *Ln(Amihud)* | *Ln(Spread)* | *-Ln(Turnover)* | *Ln(Amihud)* | *Ln(Spread)* | *-Ln(Turnover)* |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post | -0.185*** | -0.010 | -0.075*** | -0.131* | -0.010 | -0.044 |
| | (-3.81) | (-0.49) | (-2.76) | (-1.85) | (-0.30) | (-1.37) |
| Post × Innovative | -0.035 | -0.029 | 0.049 | -0.108 | -0.011 | -0.019 |
| | (-0.57) | (-1.13) | (1.41) | (-1.40) | (-0.28) | (-0.49) |
| Ln(Assets) | -0.567*** | -0.114*** | 0.009 | -0.514*** | 0.005 | 0.099 |
| | (-5.86) | (-3.54) | (0.21) | (-4.69) | (0.10) | (1.64) |
| Leverage | 0.966*** | 0.268* | -0.084 | 0.767** | 0.197 | -0.152 |
| | (2.59) | (1.76) | (-0.42) | (2.12) | (1.06) | (-0.82) |
| Q | -0.244*** | -0.047*** | -0.054*** | -0.263*** | -0.056*** | -0.058*** |
| | (-6.74) | (-4.97) | (-3.92) | (-7.01) | (-4.55) | (-3.75) |
| Profitability | -0.166* | -0.058* | -0.049 | -0.435 | -0.138 | -0.088 |
| | (-1.65) | (-1.76) | (-0.97) | (-1.40) | (-1.00) | (-0.90) |
| Cash | -0.354 | -0.249 | 0.012 | -0.707* | -0.213 | -0.106 |
| | (-1.26) | (-1.64) | (0.08) | (-1.75) | (-1.41) | (-0.54) |
| Tangibility | 0.378 | 0.055 | 0.242 | 1.132* | 0.241 | 0.275 |
| | (0.70) | (0.29) | (0.97) | (1.89) | (0.98) | (0.87) |
| Ln(Age) | 0.070 | 0.018 | 0.083** | -0.122 | -0.092** | 0.025 |
| | (0.85) | (0.55) | (2.53) | (-1.23) | (-2.53) | (0.58) |
| Return Volatility | 4.325* | -0.082 | -2.367 | 5.741** | -0.688 | -2.182 |
| | (1.69) | (-0.08) | (-1.60) | (2.10) | (-0.70) | (-1.51) |
| Ln(Number of Analysts) | 0.027 | 0.024 | 0.023 | 0.113 | 0.080** | 0.043 |
| | (0.37) | (0.86) | (0.61) | (1.33) | (2.15) | (1.05) |
| Adjusted $R^2$ | 0.945 | 0.916 | 0.852 | 0.934 | 0.918 | 0.833 |
| Observations | 4,378 | 4,205 | 4,378 | 3,979 | 3,096 | 3,979 |
| Firm Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |