Trade Policy Uncertainty and Innovation: Firm Level Evidence from China's WTO Accession*

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Abstract

Major trade liberalization episodes are often followed with a surge of innovations. This paper proposes a novel channel that trade may affect innovation: a major trade liberalization largely removes policy uncertainty in the destination market, and therefore encourages firms to invest in innovation. To verify this linkage, we adopt a difference-in-differences method to examine the impact of TPU reduction on firm innovation due to China's WTO accession in 2001. We find that uncertainty reduction significantly encourages patent applications: sectors with larger reduction in uncertainty filed more patent applications after WTO accession. They also invest more in capital assets and imported more foreign intermediate inputs.

Keywords: Trade policy uncertainty, Innovation, Patent, WTO accession

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1 Introduction

Innovation drives economic growth. Thus, it is important to understand what affects firms' incentive to innovate. Recent studies document that a surge of innovation often followed major trade liberalization episodes. These studies emphasize that international trade can enhance innovation through competition (Bloom et al., 2015), enlarged access to foreign market (Bustos, 2011), or complementarity between imported intermediates and investment in research and development (R&D) (Boler et al., 2015). In this paper, we propose a novel channel that trade may affect innovation: a major trade liberalization largely removes policy uncertainty in the destination market, and therefore encourages firms to invest in innovation.

Market uncertainty hurdles innovation because innovation demands enormous and irreversible investment in advance but takes time to commercialize (i.e., to reap the benefit). Through trade agreements, future market conditions become more transparent and predictable. Thus, reducing trade policy uncertainty (TPU) can substantially promote trade (Pierce and Schott, 2015; Handley, 2014; Handley and Limao, 2014; Feng et al. 2015). Furthermore, as we will provide evidence in this paper, reducing TPU implies expected growth in market size, which translates into higher expected profit and consequently induces innovation. Such effect is particularly important for an export-oriented country/industry and implies an additional gain that trade can induce growth by promoting innovation.

We examine the impact of TPU reduction on firm innovation due to a major trade liberalization episode in the 2000s. China gained accession into the World Trade Organization (WTO) in December 2001, which largely reduced the huge uncertainty about the export market prospect. In particular, the U.S. effectively enacted the permanent normal trade relationship (PNTR) to China on January 1, 2002, thus completely removed Chinese exporters' concern of being levied the punitive column 2 tariffs.[1] Handley and Limao (2014) show that TPU reduction accounts

[1]The column 2 tariffs are also known as "non-NTR" tariffs, originally set under the Smoot-Hawley Tariff Act of 1930. Before the grant of PNTR, the threat of high tariff was real. In the 1990s, the U.S. Congress annually reviewed and voted on revoking China's MFN status and the House passed it three times. According to Handley and Limao (2014), if China had lost its MFN status, the average tariff it would have faced would increase from the ongoing 4% in 2000 to 31%. China's entry of WTO eliminated the possibility of sudden tariff spikes (Pierce and Schott, 2015).

for a large part of China's export boom to the U.S. In this paper, we show that it can explain to a large extent the recent surge in Chinese firms' innovation activities. In 2002, China filed around 50,000 applications in invention patents, ranked 7th in the world, while in 2012 the applications increased by more than ten fold and surpassed the U.S., Euporean Union, and Japan - the most innovative nations in the world (WIPO).[2] Such impressive achievements in innovation during the past decade is accompanied with equally impressive increase in China's foreign trade, both of which have greatly benefited from the reduction in TPU.

More specifically, we collect a large and unique panel of Chinese firms with information on their production, trade, and patent applications before and after China's WTO accession. We measure uncertainty for each industry as the pre-WTO gap between the column 2 tariff and the observed MFN tariff, following Handley and Limao (2014).[3] Given substantial variations in this uncertainty measure across industries, we adopt a difference-in-differences (DID) estimation approach for identification. We compare patent filing behavior of each manufacturer in industries experiencing greater uncertainty reduction (i.e., the treatment group) to those in industries experiencing less uncertainty reduction (i.e., the control group) before and after China's entry of WTO in 2001. We find that uncertainty reduction significantly encourages patent applications: sectors with larger reduction in uncertainty experienced faster growth in innovation after WTO accession. Importantly, reduction in import tariff uncertainty induced the surge in patents filings not only by expanding the export market (*the indirect market size effect*), but also by increasing the expected future export growth (*the direct uncertainty-reducing effect*). The overall effect of reducing market uncertainty is sizeable: a back-of-envelope calculation based on the benchmark model finds that moving an industry from the 25th percentile of TPU reduction level to the 75th percentile increases the implied growth in patent filings by 6.67%.

Our work suggests an important channel through which trade liberalization can stimulate

[2]In terms of R&D expenditures, it barely accounted for less than 0.6 percent of GDP in 1996, but rocketed to 1.8 percent of GDP in 2011 (WDI).

[3]Handley and Limao (2014) construct a theory-based measure of uncertainty, which slightly differs from the reduced-form measure used in Pierce and Schott (2015). Our results hold for both measures.

innovation and, ultimately economic growth. Departing from existing studies, we directly connect firms' innovation incentives to their expectations about the market environment. The IO literature has emphasized the efficiency loss caused by market uncertainty. For instance, Bloom et al. (2007) document that stock market volatility leads firms to delay investment. We view trade policy uncertain (TPU) as an important source of market uncertainty. We provide rigorous empirical evidence that the existence of TPU is not only harmful to export growth (as confirmed by the literature), but also discourages firms' investment in innovation. Our results are robust when we control for other determinants of innovation, such as competition, input trade liberalization, domestic reform, etc.

Furthermore, we investigate the possible channels through which TPU reduction affects innovation. Firstly, studies focusing on some specific industries suggest positive effect of expected market size on innovation, such as Dubois et al. (2015) on the pharmaceutical industry. Is the TPU effect completely a market size effect? If so, we would expect the differential impact of TPU reduction on firms with different exposure to uncertainty disappear once we control for firms' export volume. The results, however, show that the differential effect of TPU is still present after we have explicitly controlled for market size. Secondly, patenting can be viewed as the outcome variable of innovation. Expenditures in R&D, fixed capital investment including machinery and equipment, and imported inputs are the input variables of innovation. How would TPU reduction stimulate inputs in innovation? We show that TPU reduction significantly increases the treated firms' capital investment and imported inputs.

To our knowledge, this is the first paper that identifies the causal effect of trade policy uncertainty on firms' innovation activities. A few studies examine the effect of policy uncertainty on investment, such as Rob and Vettas (2003) and Guiso and Pirigi (1999), our work differs from their in our focus on trade policy uncertainty and our interest in firm innovation. In this sense, we make a novel contribution to two strands of literature.

First, our study adds to the understanding of the impact of trade on firms' innovation incentives. The conventional wisdom emphasizes technology transfers embodied in products imported by developing countries (Coe and Helpman, 1995). Drawing on firm level data, recent studies show that international trade can promote innovation by either intensifying competition or enlarging access to foreign market. Bloom, Draca and Van Reenen (2015) find that import competition from China largely induced technical upgrading of firms in European countries, in terms of patenting, information technology and TFP. Bustos (2011) show that increased export sales due to trade integration can induce Argentinean exporters to upgrade technology. Regarding the prevalence of trade in intermediate goods, Boler, Moxnes, and Ulltveit-Moe (2015) point out that imported intermediates may complement investment in research and development (R&D), while Liu and Qiu (2016) find input tariff reduction discourages indigenous innovation by Chinese enterprises. Coelli, Moxnes, and Ulltveit-Moe (2016) exploit *ex ante* variations in firms' exposure to different markets and provide evidence that trade liberalization encourages firms' patent filings.

Second, our work contributes to the increasing attention on the impact of trade policy uncertainty. Most of the previous studies, however, focus on the direct impact of TPU on trade. The pioneering work by Baldwin and Krugman (1989) adopts a real options approach to explain the hysteresis of trade during large exchange rate swings. In a series of studies, Handley (2014), Handley and Limao (2014, 2015), Limao and Maggi (2013) emphasize the uncertainty induced by trade policies and examine its impact on trade and welfare. Following their approach, Feng Li and Swenson (2015) examine the effect of TPU reduction on the extensive margin of Chinese exports to the U.S. Taglioni and Zavacka (2013) find that importer uncertainty imposes a strong negative but nonlinear impact on foreign suppliers. Beestermöller, Disdier, and Fontagné (2015) study the uncertainty due to possible border rejection on Chinese agri-food exports. Besides the trade effect, TPU reduction also impose substantial impact on employment or regional economic development. Pierce and Schott (2015) links the sharp drop in U.S. manufacturing employment to the drop in U.S. trade policy that removed the tariff uncertainty on Chinese imports. They show that industries that are more exposed to the policy change experienced greater loss in employment. Chen and Potlogea (2015), on the other hand, show that Chinese cities that experience larger increase in their export to U.S. due to TPU reduction exhibit faster growth in population, output, and employment.

The rest of the paper is structured as follows. Section 2 describes the policy background and data. It also lays out our empirical strategy. Section 3 presents the estimation results. Section 4 discusses extensions and possible mechanism. We conclude in Section 5.

2 Policy Background, Data, and Empirical Strategy

2.1 Exceptional export growth after China's accession to the WTO

China's integration into the global trading system is regarded as one of the most important economic developments of the last two decades (Branstetter and Lardy, 2008; Handley and Limao, 2014). Figure 1 plots Chinese exports between 1990 and 2012, expressed as an index number relative to 1990. The nominal value of Chinese exports has increased by more than 23-fold between 1990 and 2008, far outpacing the growth of global trade during the same period.[4] Importantly, there is an obvious acceleration of export growth around 2001, when China officially entered the WTO. Before WTO, from 1990 to 2001, the annual nominal export growth rate was about 14%, While after WTO, from 2002 to 2008, the annual nominal export growth rate reached strikingly as high as 28%.

[Figure 1 about here]

A substantial proportion of the soaring Chinese exports can be attributed to the elimination of the high tariff threat after its WTO entry. Before it joined the WTO in December 2001, China was granted a temporary Normal Trade Relations (temporary NTR) which was subject to annual review in the U.S. Congress. Indeed, the House passed the bill to revoke China's NTR status three times. The threat of high tariff was real: had the temporary NTR been revoked, Chinese exporters would have faced the punitive column 2 tariffs. The column 2 tariffs are also known as "non-NTR" tariffs, which were originally set under the Smoot-Hawley Tariff Act of 1930 and substantially larger than the MFN tariffs under NTR status. The threat was also

[4] The inflation-adjusted export value in 2008 is more than 10-fold of that in 1990, growing much faster than total world export value.

substantial: if China had lost its MFN status, the average tariff it would have faced would increase from the ongoing 6.67% in 2000 to 31% (Handley and Limao, 2014).[5] Thus, although Chinese exporters were already levied the MFN tariffs before 2001, they faced substantial uncertainty. This concerned U.S. business leaders because "...the imposition of conditions upon the renewal of MFN as virtually synonymous with outright revocation. Conditionality means uncertainty."[6] The policy uncertainty varies substantially across six-digit HS products, as shown in Figure 2.

[Insert Figure 2 Here]

When China joined the WTO on December 11, 2001, the U.S. effectively enacted PNTR on January 1, 2002, which completely removed Chinese exporters' concern of sudden tariff spikes (Pierce and Schott, 2015). Thus, in our baseline analysis, we treat years from 2002 forward as being post-WTO. Due to the historic root of the Column 2 tariffs, the uncertainty measure can plausibly regarded as exogenous. Furthermore, the WTO entry of China immediately remove the revocation of such threat which varies substantially across industries, thereby creating large variations across industries for our empirical identification. Figure 3 shows that after 2001, manufacturing sectors with high pre-WTO column 2 tariffs grew much faster than those with low pre-WTO column 2 tariffs. Note the Figure 3 show the pattern for Chinese exports to the world, the same pattern holds even stronger when we focus on Chinese exports to the U.S.

[Insert Figure 3 Here]

2.2 A surge of patent applications in China

China established its patent system in 1985, when its first patent law took effect and its patent office, the State Intellectual Property Office (SIPO), started to accept patent applications.

[5]Pierce and Schott (2015) provides affluent evidence on the uncertainty caused by the annual review of China's NTR status.

[6]Tyco Toys CEO "China's MFN Status", Hearing before the committee on Finance, U.S. Senate, June 6, 1996, p. 97.

Figure 4 describes the overall trend of resident patent application since then. Since 1985 the number of patent applications at SIPO by Chinese residents grew stably at an average annual rate of 13%.[7] The growth of patent applications began to accelerate after China entered the WTO in 2001, with an average annual growth rate of 29%.

[Insert Figure 4 Here]

In practice, patents are classified into three categories: invention, utility model, and design. According to the Patent Law of China, invention patents refer to technical innovation on products or methods or both; utility model patents refer to technical proposals on the shape and/or structure of a product; and design patents refer to changes in the shape and/or color of a product. The three types of patents differ in their application procedure and requirements. An invention patent is subject to stricter examinations on its utility, novelty, and non-obviousness. And, compared with the existent technologies, an invention innovation must have "prominently substantive characteristics and significant improvement". In comparison, the utility model and the design patents are incremental innovation and are not subject to novelty and non-obviousness examinations. In general, both are granted based on registration. The requirement for a utility model patent is stricter than that for a design patent, in the sense that the former must be functionally useful and have "substantive characteristics and improvement" compared with existing technologies.

Figures 5 & 6 then show that the growth in patent application differ across industries. Figure 5 divides industries into two groups by the median value of uncertainty. Then it shows the differential trends over time of average patent filings per firm in the above-median TPU industries versus the below-median TPU industries. Clearly the pre-WTO trends of the high uncertainty group and the low uncertainty group are comparable, while they diverge in the post-WTO period. The treated group that experienced larger reduction in uncertainty exhibits more impressive growth in patent filings. This divergence suggests potential positive impact of market uncertainty reduction on firms' innovation incentives.

[7] The total number of patent applications was 4,065 in 1985, it reached 30,038 in 2001, and the applications surged to 801,135 in 2014.

[Insert Figure 5 Here]

To show the cross-sectoral difference in patent applications, Figure 6 reports the post-WTO annual growth rate of patent applications for each four-digit CIC industry from 2001 to 2007, as scatterplots against the level of pre-WTO uncertainty for each industry. The fitted line is clearly upward slopping, implying positive correlation between the reduction of pre-WTO TPU and the post-WTO growth of patent filings.

[Insert Figure 6 Here]

2.3 Estimation Strategy

We examine the link between reduction in trade policy uncertainty, in particular the removal of column 2 tariffs, and Chinese manufacturing firms' patenting behaviour. We exploit the fact that after China joined WTO, industries that had larger pre-WTO TPU (i.e., industries with higher column 2 tariffs) would experience larger growth in exports after the WTO entry, whereas industries with low pre-WTO TPU would experience smaller export growth after liberalization. The cross-sectional variation in pre-WTO uncertainty can be dated back to the 1930 Smoot-Hawley Tariff Act, and therefore is plausibly exogenous to the concurrent export patterns across industries. The differential degree of uncertainty reduction allows us to conduct a difference-in-differences (DID) specification. Essentially we compare patent applications of firms in industries experiencing greater uncertainty reduction (i.e., the treatment group) to those in industries experiencing less uncertainty reduction (i.e., the control group) before and after China's entry of WTO in 2001.

We estimate the following equation:

$$ln(PATENT_{ijt}) = \alpha_i + \beta TPU_j \cdot Post02_t + \mathbf{X}'_{ijt}\ \gamma + \mathbf{Z}'_{jt}\ \delta + \lambda_t + \varepsilon_{ijt}, \tag{1}$$

where the dependent variable $ln(PATENT_{ijt})$ is the innovation activity of firm i in industry j in year t. TPU_j measures the trade policy uncertainty faced by industry j before the WTO accession. $Post02_t$ denotes the post-WTO period, which takes a value of 1 for years from 2002 forward and 0 otherwise. α_i is the firm fixed effect, controlling for all time-invariant firm characteristics. It also controls for industrial and regional differences that does not vary over time but may affect industrial propensity to innovate. For example, certain industrial insitutional features may make firms in one industry more likely to innovate than other industries. If both innovation and uncertainty reduction are related to the business cycles or other yearly common shocks, we might overestimate the relationship between innovation and uncertainty. Thus, we add the year fixed effect, λ_t. We also include a set of time-varying firm-level variables ($\mathbf{X}_{ijt}$), and a set of time-varying industry-level variables ($\mathbf{Z}_{jt}$) that may affect innovation. ε_{ijt} is the error term. As suggested by Bertrand, Duflo, and Mullainathan (2004), standard errors are clustered at the firm level to deal with the potential heteroskedasticity and serial autocorrelation.

We use the number of patent applications as a direct measure for innovation, following the innovation literature (Aghion *et al.*, 2005; Hu and Jefferson, 2009; and Hashmi, 2013). Because of the zeros in patents we use the transformation $PATENT = 1 + PAT$ where PAT is the count of patent applications. Our key explanatory variable is the industry-level market uncertainty change. We construct this measure as the log difference between the column 2 tariff and the MFN tariff in 2001, for each 6-digit HS product. That is, $TPU1 = log(\tau_i^{col2}/\tau_i^{mfn})$. Alternatively, Handley and Limao (2014) propose a non-linear measure of trade policy uncertainty, which is based on firm decisions under general equilibrium. Their measure depends on the difference between the column 2 tariff and the MFN tariff in 2001, manified by the substitutability coefficient σ. That is, $TPU2 = 1 - (\tau_i^{col2}/\tau_i^{mfn})^{-\sigma}$. Handley and Limao use $\sigma = 3$ and we follow their pick. After getting the product-level measure of pre-WTO uncertainty, we then aggregate the uncertainty at 6-digit HS level to get industry-level measure of TPU, by taking simple average.

Note that our TPU measures are constructed with the U.S. column 2 tariff, while firms that innovate may not export to the U.S. We consider this specification because the U.S. is the most important export destination market for Chinese manufacturers, therefore any uncertainty regarding the U.S. market may be transmitted to firms that export to the U.S. and firms that do not. Nevertheless, since the policy shock is more relevant for firms exporting to the US market, we expect that the TPU reduction has stronger impact on these exporters. To verify this is indeed the case, we further include an indicator for exporters to U.S. and interact it with the TPU measures in the following specification:

$$PATENT_{ijt} = \alpha_i + \beta_1 TPU_j \cdot Post02_t + \beta_2 TPU_j \cdot Post02_t \cdot USEXP_i + \mathbf{X}'_{ijt}\gamma + + \mathbf{Z}'_{jt}\ \delta + \lambda_t + \varepsilon_{ijt}, \tag{2}$$

where $USEXP_i$ is one for firms that ever export to U.S., and zero otherwise. We expect a positive coefficient estimate β_2 for the interaction term $TPU_j \cdot Post02_t \cdot USEXP_i$. While a significant and positive β_1 implies spillovers to other firms.

2.4 Data

Our empirical analysis relies on data that include firm-level information on production, trade, and innovation, as well as industry-level information on market uncertainty and other industrial characteristics. To this end, we construct a unique dataset by merging three major data sources.

We use firm patenting as a direct measure of innovation activities. Patents reflect the actual output of the innovation process, while R&D expenditure measures the input that goes into the innovation process. We opt for patenting as our main measure also because the R&D expenditure information is only available for a very limited number of firms for a few years, while the patent data that we use is universal. Nonetheless, both measures are found to be strongly correlated.

Our patent data comes from the State Intellectual Property Office (SIPO) of China. The SIPO takes records on all patent applications in China. This dataset contains detailed information of all patent filings since 1985, including date of filing, official name and address of the applicant, and name and type of the patent. According to China's Patent Law, patents are classified into three categories: invention, utility model, or design. Patents are dated by application year.

Secondly, we collect firm-level production and financial information from *the Annual Survey of Industrial Productioin* (ASIP), provided by the National Bureau of Statistics of China (NBSC). The ASIP data is the most comprehensive firm-level dataset in China, including all non-state-owned enterprises with annual sales above 5 million RMB (around US $600,000 in 2002 exchange rate) and all state-owned enterprises. It covers all 31 mainland provinces and 425 manufacturing industries in 4-digit Chinese industry classification (CIC) system between the years 1998-2007. Based on 2004 census for industrial firms, firms in the ASIP surveys account for 90 percent of industrial output and 97.5 percent of exports (Brandt, Van Biesebroeck, and Zhang, 2012). The ASIP also survey firms in mining and public utility sectors, but we will focus on manufacturing firms. The ASIP data provides detailed information at the firm level, including location, ownership, and accounting information such as employment, capital stock, material inputs, wage bills, total revenue, and export revenue. We further clean the data according to the basic rules of the Generally Accepted Accounting Principles (Cai and Liu 2009, Feenstra et al. 2013).

Thirdly, firm-level import data are from the General Administration of Customs of China (GACC), from 2000 to 2006. From this dataset we are able to know whether and what does a firm import. We also know the value and quantity imported by a firm at 6-digit HS product level. In addition, the Customs data enable us to identify processing firms. Considering their specific production arrangement with foreign buyers, we drop all firms ever conducting processing trade, following Liu and Qiu (2016).[8]

Then we merge the three datasets by carefully matching firms' name and location. Our matched sample accounts for above 38% of total patent filings by all firms (including both manufacturing and non-manufacturing firms) in the SIPO data for the period 1998-2007.[9] There may be concerns about possible mis-matches, however, our matching approach, which

[8]Nevertheless, these processing firms account for a small proportion of patent filings in the manufacturing sector and including these firms won't affect our results.

[9]The SIPO data does not report the industry that each company belongs to so we cannot separate out all manufacturing firms.

is based on the names and location of firms, applies to all firms across industries and in the whole sample period. The degree of mismatch across industries does not seem to be correlated with the degree of market uncertainty reduction across industries. After all the matches and data cleaning, we have an unbalanced panel of 354,748 firms and a total of around 1.1 million observations, spanning 425 four-digit industries by the China Industrial Classification (CIC) between the years 1998-2007.

To measure the policy uncertainty (TPU) in the destination market, we follow Handley and Limao (2014) and take the log difference between the column 2 tariff and the MFN tariff in 2001, for each 6-digit HS product. Both types of tariffs are extracted from Feenstra, Romalis and Schott (2002). After getting the product-level measure of pre-WTO uncertainty, we then aggregate the uncertainty at 6-digit HS level to get industry-level measure of TPU, by taking simple average.

Table 1 presents the summary statistics and definitions of the main variables used in this study. The most important variables are patents and TPU. On average, each firm filed 0.096 patents each year during the sample period. The mean of TPU1 is 0.2575 and the mean of TPU2 is larger (i.e., 0.4936). However, the two TPU measures are highly correlated, with the correlation coefficient 0.9704.

[Insert Table 1 Here]

3 Empirical Analysis and Findings

3.1 Baseline Results

Our baseline estimation examines the link between trade policy uncertainty (TPU) and innovation activities of Chinese manufacturing firms. Figure 5 has already shown the trend of patent filings diverges after the WTO entry for high- versus low- pre-WTO TPU industries. For more rigorous empirical examinations, we adopt a DID estimation approach (equation (1)) and examine the heterogeneous responses of firms with different levels of uncertainty to trade liberalization. The baseline results are reported in Table 3, with robust standard errors clustered by firm. Column (1) starts with only the DID interaction term and firm and year fixed effects. Firm fixed effect λ_i controls all time-invariant cross-firm heterogeneity, therefore we identify the within-firm innovation response. Our regressor of interest is the interaction term between TPU and an indicator for post-WTO period: $TPU_j \cdot Post02_t$. Its coefficent is statically significant and positive, suggesting that firms in high pre-WTO uncertainty industries experienced larger increase in patent applications after WTO entry than firms in low pre-WTO uncertainty industries. Since high pre-WTO uncertainty industries experienced greater reduction in uncertainty due to WTO entry (and the grant of PNTR), our results imply that reduction in market uncertainty induces innovation.

In Column (2), we include firm level characteristics that may affect firm's patenting behavior, including firm age and its squared term, employment, capital-labor ratio, foreign equity share, and an indicator for exporter. The regression results show that larger firms and more capital intensive firms on average tend to have more innovation, while firm age and foreign ownership do not have statistically meaningful impact. Furthermore, exporters tend to have more innovation than non-exporters, consistent with empirical findings in the literature (e.g., Baldwin and Gu, 2004). Nonetheless, the coefficient for $TPU_j \cdot Post02_t$ remains significant and similar in magnitude.

Our TPU measure is largely determined by the historic Smoot-Harvley tariff, which implies plausible exogeneity because it was set decades ago. However, there are concerns that those tariffs may still coincide with other industry level characteristics that may affect the destination demand. In particular, it may not be uncertainty reduction *per se* but other industry characteristics that cause export growth from China. In particular, if these industries with high pre-WTO uncertainty happened to be industries that China has comparative advantages, our conclusion about the impact of uncertainty reduction on innovation may be misleading. For this reason, Column (3) follows Pierce and Schott (2015) and includes additional interaction terms that interact initial year (i.e., 2000) capital and skill intensity in U.S. industries with the Post02 dummy.[10] This interaction term accounts for the possibility that the relationship between firm patent filings and the comparative advantage factors changes after China's WTO accession. As indicated by Column (3), our main variable of interests, $TPU_j \cdot Post02_t$, keeps significant and similar in magnitude.

In Columns (1) to (3), we measure TPU as the natural log of column 2 tariff rates over the corresponding MFN tariff rates (i.e., $TPU1 = log(\tau_i^{col2}/\tau_i^{mfn})$).[11] Handley and Limao (2014) suggest a more structural-form nonlinear transformation with a theoretical foundation. In brief the meaure they proposed is: $TPU2 = 1 - (\tau_i^{col2}/\tau_i^{mfn})^{-\sigma}$, where σ is the elasticity of demand and we follow Handley and Limao to set $\sigma = 3$. Accordingly, Columns (4)-(6) test whether our results rely on the definition of uncertainty, by using this alternative TPU measure (TPU2). The TPU effect decreases a little but remain highly significant.

In summary, across all estimation specifications, estimates of β are positive and statistically significant, implying that market uncertainty reduction leads to an increase in the innovation of firms. The estimated effects are also economically significant. Taking the DID coefficient in the baseline specification in column (3) for example, moving an industry from the 25th percentile of TPU reduction level to the 75th percentile increases the implied growth in patent filings by 6.67%.[12]

[Insert Table 2 Here]

3.2 Other Determinants of Innovation

Table 3 considers competing explanations on the determinants of innovation that vary by industry and year and that may correlate with both our outcome variable (patent filings) and our regressor of interests (trade liberalization and the associated reduction in market uncertainty). More specifically, Columns (1)-(3) consider the effect of market competition.

[10] Sector-level factor intensities are from US NBER-CES database.

[11] Note Pierce and Schott (2015) use the arithmatic difference between column 2 and MFN tariffs, while we use the log difference. Both measures generate very similar results.

[12] The magnitude is calculated as 0.0349*$(75th\ TPU - 25th\ TPU)\ /Change$ of average patent filings between post- and pre-WTO.

Column (4) considers input trade liberalization. Column (5) considers the domestic reforms during the WTO entry period. Column (6) considers the effect of MFN tariff reduction faced by Chinese exporters. Finally in Column (7) we control for all these innovation determinants in one regression. Note in all specifications, we have controlled the industry comparative advantage variables interacted with Post02, and these firm level characteristics that may affect firm's patenting behavior, as we do in the benchmark Table 2.

Industrial competition: The discussion about the relationship between competition and innovation dates back to Schumpeter (1943), who argues that competition lowers price-cost margins, thereby reducing the quasi-rents from innovation. On the other hand, the empirical work by Nickell (1996) and Blundell et al (1999), among others, show that competition indeed can induce innovation. Employing a sample of listed companies in the UK, Aghion et al (2005) suggest an inverted-U shape. However, Hashmi (2013) examines the Aghion et al hypothesis using US manufacturing firms, and he finds a mildly negative relationship. So we conclude that the net effect of competition on innovation is inherently ambiguous.

To measure competition, we construct a Herfindahl index, HHI_{jt}, to measure the degree of industry concentration for each of the 425 manufacturing sectors. Higher value of HHI indicates more concentrated market (less competition). To account for the nonlinearity of the relationship between competition and innovation, we include both the index and its quadratic term. In addition, to account for the geographic concentration, we also construct an Ellison-Glaeser(EG_{jt}) index (Ellison and Glaeser, 1997) as an additional control. Instead of HHI, Aghion et al. (2005) suggest using the Lerner Index (LI_{jt}), or price cost margin, to measure product market competition. The market concentration measures rely more directly on precise definitions of geographic and product markets. The advantage of the Lerner Index over HHI or EG is that when many Chinese firms operate in international market, market concentration measures based on only domestic sales data may be misleading. So in Column (2) we use the Lerner Index (and its quadratic term) to measure the degree of market competition. Note by construction, a higher value for LI_{jt} implies more competition. Columns (1) and (2) separately report the results: in either case, competition promotes innovation. The negative cofficient for the squared term of LI_{jt} implies the relationship is indeed an inverted U, consistent with Aghion et al.

Import Competition: Competition may also come from imports from foreign producers. Importantly, accommanied with its WTO entry, China substantially reduced its import tariff, with the average tariff dropping from 15.3 percent in 2000 to 9.8 percent in 2007. Trade liberalization is expected to intensity domestic competition and consequently affect innovation. Thus, Column (3) adds the industry-level average import tariffs, (τ^{o}_{jt}), to measure the pro-competitive effect of trade liberalization. We find that higher industry tariff is positively associated with firm innovation, but the effect is not statistically significant.

Intermediate Input: It has been widely accepted that increasing imports in intermediate inputs, due to lower input tariffs, can raise firm productivity (Amiti and Konings, 2007). Since foreign technology is often embodied in imported intermediate inputs, input trade liberalization may exert important effects on domestic firms incentive to innovate. On the one hand, it may promote domestic innovation as the cost of doing innovation becomes lower, especially when such innovation relies on imported technology. On the other hand, however, it may also substitute indigenous innovation because firms may simply purchase cheaper foreign technologies. To this end, we consider in Column (4) the reduction in industrial input tariffs (τ^{m}_{jt}), which is calculated using China 2002 Input-Output table following Goldberg et al (2010).[13] The results show a positive coefficient for input tariff, implying imported inputs is substituting rather than complementing indigenous innovation, consistent with previous research such as Liu and Qiu (2016).

Domestic reforms: Column (5) considers two important policy reforms in the early 2000s: the SOE reform and the FDI deregulation. China conducted a very large scale SOE reform in the late 1990s and early 2000s (Berkowitz et al 2016), which resulted in privatization or close-down of small and medium SOEs and entry of many private firms. To see whether this privatization campaign has any effect on innovation, we add an additional control

[13]Specifically, the input tariff for industry j in year t is defined as the weighted average of the tariffs of goods that are used as inputs for industry j, where the weight is the cost share of each input in the production of a good in industry j based on China's Input-Output Table of 2002.

variable $SoeShare_{jt}$, measured as the fraction of SOEs in each industry (Lu and Yu, 2015). Furthermore, China liberalized its regulation regarding foreign direct investment (FDI) as a commitment to the WTO. Entry of multinationals may intensity local competition, however, they may also bring in more advanced technology and spillover to domestic firms. Accordingly, we use FDI_{jt} to control for this effect, measured as the ratio of the number of foreign invested firms over all firms. As implied by Column (5), SOE reforme and FDI liberalization both promote innovation substantially.

MFN tariff reduction: Accompanied with the reduction in TPU, Chinese exporters also faced decreasing tariffs by importing countries, as shown by the decline in MFN tariffs. The response of innovation to export growth may simply be due to lower tariffs . Therefore, Column (6) controls for the average annual industry rate of applied tariff MFN_{jt}. Obviously, declining MFN tariffs faced by Chinese exporters substantially increases their patenting activities.

[Insert Table 3 Here]

Finally, we run a full-fledged model with the complete set of controls in Column (7), confirming the results that we have shown in previous Columns. In summary, across all specifications, the coefficient for $TPU * Post$ remains positive and statistically significant, implying a robust result that market uncertainty reduction leads to a substantial increase in firm innovation.

3.3 Validity of the DID Specification

In this subsection, we test the econometric validity of our DID specification with a battery of robustness checks in Table 4.

Expectation Effect: First, we check whether firms change their innovation behavior in anticipation of the coming WTO accession. If that is the case, our treated group and comparison group may not be ex ante comparable. Column (1) of Table 4 includes an additional control $TPU_j \cdot Year2000$, and Column (2) further controls $TPU_j \cdot Year2001$.[14] In both cases,

[14]China started to break through in its GATT/WTO membership application when China and the US reached an agreement about China's accession of the WTO on November 15, 1999.

the coefficient for $TPU_j \cdot Year2000$ are found to be insignificant, suggesting little expectation effect, while $TPU_j \cdot Year2001$ is significant and positvie.

Pre-WTO period: Column (3) runs a placebo test with time-varying TPU measures for the whole pre-WTO period (i.e., we restrict the sample to 1998-2001). As suggested by Topalova (2010), the premise is that we should not expect any significant effect of TPU during this period since it does not change much. Otherwise, it may imply some unobserved confounding factors are indeed taking effect and therefore bias our results. Column (3) confirms that the TPU has no effect prior to China's WTO entry.

Industry time trend: The DID estimation assumes that, conditional on $\left(\mathbf{X}'_{ijt}, \alpha_i, \lambda_t\right)$, innovation activities of the treatment and the control group follow the same time trend. This assumption allows us to use innovation activities of the control group as the counterfactual of the treatment in the post-WTO period. This may not hold because of some industry-specific confounding factors. To check this, we add an industry-specific linear time trend, $\lambda_i \cdot t$, which enables us to control for all unobserved industry characteristics. Column (4) presents the result, which remains similar to the baseline.

Flexible estimations: In Column (5), we estimate the most flexible specification, in which we replace the interaction term $\beta TPU_j \times Post02_t$ with a set of interaction terms between TPU_j and the year dummies, i.e., $\sum_{t=1999}^{2007} \beta_t TPU_j \times Year_t$. The estimated coefficients are either significantly negative or insignificant for yearly interactions before 2001, while they turn positive and significant for yearly interactions after 2001. Furthermore, the magnitude become stronger over time, which clearly indicates the pre-WTO similarity between the treatment (i.e. the high uncertainty industries) and comparison (i.e., the low uncertainty industries) and the increasingly promotive effect of TPU reduction on innovation.

Two-period estimation: The DID estimation and resulted statistical inference crucially depends on the accuracy of the standard errors. In the main analysis, we have followed Bertrand et al (2004) to cluster the standard errors at the firm level. As a robustness check, we now use another approach, also suggested by Bertrand et al (2004), to calculate the standard errors. In particular, we first collapse the panel structure into two periods (pre- and post-WTO period) and then use the White-robust standard errors. The regression results are presented in Column (6), again with qualitatively similar results to what we present before.

[Insert Table 4 Here]

3.4 Other Robustness Checks

In this subsection, we provide yet another set of robustness checks regarding various concerns on our sample. The results are presented in Table 5. In the first set of checks, we consider some sample issues, including firms that produce in multiple industries, or firms that enter or exit. In the second set, we separately consider firms by their ownership. Finally, as an additional placebo test, we consider processing exporters.

Multi-industry firms: In our sample, some firms produce multiple products spanning over different industries which may experience different exposure to uncertainty.[15] This may bias our estimation about the real effect of industrial TPU reduction. To check whether our results are contaminated, we restrict our analysis to a subsample of firms that produce products all belonging to the same 3-digit industry.[16] As shown in Column (1), for this subsample of "single-industry" sector, we still find a strong and significant impact of TPU reduction on firm innovation.

Surviving firms: Another issue is firm entry and exit. Firms' entry or exit decisions might be jointly determined with their innovation activities by unobservables such as productivity. That means entrants and exiters may exhibit differently. To circumbent this selection effect, Column (2) focuses on a subsample of surviving firms who operate in both pre- and post-WTO periods. Again this regression generates similar results as before.

Industrial level: In Column (3), we aggregate firm level innovation to 4-digit CIC industry level and examine the impact of TPU reduction at the industry level. It shows that

[15] Each firm reports one 4-digit industry, however, they may produce products that belongs to different 4-digit or even 3-digit industries.

[16] Firm-product information is also obtained from the NBSC for the period 2000-2006, which contains information about each 5-digit product produced by a firm.

at industry level, TPU reduction has even larger effect on industry innovation. This industry level estimation netting of the estimation on surviving firms also implies the proportion of innovations that can be accounted for by firm entry.

[Insert Table 5 Here]

Ownership: Columns (4)-(6) separately consider the heterogeneous responses of firms with different ownership. We consider three types of firms: state owned enterprises (SOEs), domestic privately-owned firms (POEs), and foreign invested enterprises (FIEs), including both Sino-foreign joint ventures and wholly foreign-owned enterprises. Interestingly, TPU reduction has significant effect on innovation by SOEs and POEs, while the effect is not significant for FIEs. The insignificance for FIEs is understandable given the fact that within multinational enterprises foreign affiliates generally specialize in production and sales while most innovation activities are done by parent firms (Antràs and Yeaple 2014).

Processing firms: Column (7) provides another placebo test, using a subsample of processing firms. Processing firms are mainly doing process & assembly work for foreign buyers, by importing duty-free intermediate inputs.[17] Because of this special arrangement, processing firms may not respond to the TPU policy shock in the same way as normal trade firms (Liu and Qiu, 2016). Column (7) shows that processing firms do not respond actively to the policy shock.

3.5 Heterogenous Effects

In previous sections, we have established the average effect of TPU reduction on firm patenting, by exploring the differential effect on firms exposed to high pre-WTO TPU versus those exposed to low pre-WTO TPU. However, firms with different characteristics may respond differently. We have discussed the difference across firms with different ownership in the last sub-section.

[17] We define a firm as processing firm if its processing exports account for more than 50% of total export value. The results are not sensitive to this choice of processing share.

In this section, we further explore three important dimensions of heterogeneity. The results are presented in Table 6.

Distance from technology frontier: First, as shown in Aghion et al. (2009), firms' response to competition crucially depends on their current distance to the technology frontier: only when they are close to the frontier, they will respond by increasing innovation. Since distance to technology frontier is an essential determinant of the cost of innovation, we explore whether firms also respond differently to TPU reduction according to their distance to technology frontier. More specifically, we divide firms by quantiles based on their total factor productivity (TFP) before WTO accession. We estimate firm TFP using the Levinshon and Petrin (2003) method.[18] Quantiles are constructed within each CIC 4-digit industry. Column (1) presents regression results using the sample of fifth quantile (i.e., firms that are most distant from the frontier), while Column (2) presents the results for the first quantile (i.e., firms that are closest to the frontier). Consistent with the insight of Aghion et al. (2009), firms in the first quantile respond much more sensitively to TPU shock, while firms in the fifth quantile doesn't innovate in response to TPU reduction.

[Insert Table 6 Here]

Types of patents: Next, we consider different types of patents. In practice, Chinese firms can apply for three types of patents: invention, utility model, and design. As we have discussed in the data section, patents differ in their application procedure and requirements. An invention patent is subject to stricter examinations on its utility, novelty, and non-obviousness. It is also expected to have "prominently substantive characteristics and significant improvement". In contrast, the utility model patents are incremental innovation and are subject to less stringent examinations, and the design patents are regarded as easiest to obtain. Thus, in Columns (3)-(5), we separately consider firms' innovation response in three types of patents. Interestingly, comparing across columns, TPU reduction has exert very large impact on firms invention incentive, the impact on utility model and design, however, is not significant. This

[18] Firm TFP is estimated within each 2-digit CIC industry. We deflate firm value added, employment, fixed assets, and intermediate inputs using deflators provided in Brandt et al. (2012).

is not surprising, since invention requires firms to invest large amount of investment prior to commercializing and therefore expose firms to highest level of uncertainty, compared with the other types of patent.

Exporters: The last two columns of Table 6 consider the heterogeneous response of exporters and exporters to U.S., compared with other firms. Although non-exporting firms may benefit from reduced uncertainty through spillover externalities, exporters are directly exposed to TPU, so they are expected to respond more to TPU shocks. Following the empirical specification in equation (2), Column (6) adds to the baseline model an additional interaction term between $TPU_j \cdot Post02_t$ and an exporter indicator EXP_{jt}. Column (7) specifically looks at firms that export to the United States, with an interaction term between $TPU_j \cdot Post02_t$ and an exporter indicator $USEXP_{jt}$. In particular, our TPU measures are constructed with the U.S. column 2 tariff, since the policy shock is more relevant for firms exporting to the US market, we expect that the TPU reduction has stronger impact on these exporters. The results, as shown in Columns (6) and (7), confirm our expectation. In particular, Column (6) shows that exporters belonging to the high TPU group on average respond more to TPU reduction compared with exporters belonging to low TPU group. While for non-exporting firms, high TPU group respond more than low TPU group, but the effect is imprecisely estimated. Column (7) shows that the effect is even stronger for exporters to the U.S.

4 Mechanism and Further Discussions

Market expansion: In this section, we extend our discussion to investigate the possible mechanisms that TPU shock could affect firms' innovation behavior. One important hypothesis about the effect of TPU reduction is that it enlarges the market. As confirmed by Handley and Limao (2014), Pierce and Schott (2015), TPU reduction does induce export growth to a large extent. Therefore it may be simply viewed as a market expansion effect. If so, then we would expect that after controlling for firms export, the TPU effect will largely disappear. The left panel of Table 7 examines this hypothesis. Column (1) controls for firm level export value, Column (2) controls for industry level export value, while lastly Column (3) controls for industry level export growth interacted with the $Post02$ dummies. In all specifications, the TPU effects remain substantial and significant. Thus the removal of uncertainty does not simply reflect expected growing market, but also implies other subtle effects that worth further exploration.

Technological input: Patent application measures the output of innovation, on the other hand, innovation can be realized by different ways of inputs. So it worth to ask how TPU reduction affect firms inputs into innovation. Based on data availability, the right panel of Table 8 explore three major inputs. First, Column (4) of Table 7 considers the R&D expenditure. The result shows that TPU reduction has no significantly different effect on the treatment versus comparison. But this is probably due to our data limitation: we only have firm R&D expenditure from 2001, which does not allow for much variation before and after 2002. Secondly, capital intensity could be used as an alternative measure of technology (Bernard, Jensen and Schott, 2006), so in Column (5), we consider firms' fixed investment.[19] The result implies TPU reduction does induce more capital investment by high exposure treatment group. Finally, we examine whether uncertainty reduction can lead to more imports of intermediate inputs by the treatment group after WTO accession. The result confirms that it does.

[Insert Table 7 Here]

Decisions to patent: TPU reduction, on the one hand, can induce firms to file more patent applications; on the other hand, may also implies that firms are more likely to file patents. Thus in Table 8 Column (1), we examine the impact of TPU reduction on the likelihood of patent applications using a linear probability model. The results show that TPU reductions makes firms in the high uncertainty group more likely to invest in innovation post China's WTO accession, compared with firms in the low uncertainty group. Specifically, moving an industry from the 25th percentile of TPU reduction level to the 75th percentile increases the

[19] ASIP does not directly provide information on fixed investment. We construct firm fixed investment following Liu and Lu (2015) by using perpetual inventory method with firms' book values of fixed assets (reported in the ASIP data set) and assuming a constant depreciation rate. See details in Liu and Lu (2015).

implied likelihood of patent filings by 32.16%.

Patenters: Table 8 column (2) focuses on these firms that have filed patents during our sample period. To deal with the count data, we employ a negative binomial estimation approach.[20] The results show that TPU reduction substantially boosts patenting activities of those patenters.

[Insert Table 8 Here]

5 Conclusion

In this paper, we propose a novel channel that trade policy may affect innovation. Past literature emphasize that trade liberalization may stimulate innovation by expanding the market, intensifying competition, importing intermediate inputs that are complementary to indigenous R&D. In comparison, we argue that firms may delay or reduce their investment into innovation activities, simply because they are uncertain about trade policy. In this sense, major trade liberalization episode may to a large extent reduce market uncertainty, which translates into expected market growth and in turn leads to more innovation. To examine this link between reduction in trade policy uncertainty and firms' incentive to innovate, we adopt a DID method to empirically verify the importance of this channel. We find the effect of policy uncertainty on innovation is sizable, accounting for 6.67% increase in patent filings.

Innovations drives economic growth. As early as Schumpter, economists have emphasized the importance to pave the way for firm innovation. Our paper implies an important channel that trade liberalization may promote economic growth, by removing policy uncertainties and consequently encouraging innovation. Understanding the impact of policy uncertainty has important implications for economists and policy markers to evaluate the effectiveness of economic policies. For example, the post 2008 global financial crisis period see an insurgence of

[20] We opt for a negative binomial model instead of poisson, because the sample standard deviation is 9.6 which is much larger than the sample mean of 1.4.

trade protectionism. Many countries resort to non-tariff measures such as Anti-dumping investigations or labeling other countries as "currency manipulator",[21] such protectionism measures may not only impose higher trade costs, but also do harm to firm innovation since it creates uncertainty concerns on the market.

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Table 1: Descriptive Statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Variable definition**	**Min**	**Max**
Firm level variables						
Patent	1130432	0.10	2.49	number of total patents	0	891
Invention	1130432	0.02	1.03	number of invention patents	0	878
Utility	1130432	0.04	0.83	number of utility model patents	0	222
Design	1130432	0.04	1.57	number of design patents	0	720
lnAge	1130355	1.98	0.92	logarithm of firm age	0	4.62
lnAge2	1130355	4.77	3.91	squared logarithm of firm age	0	21.30
Exporter	1130432	0.22	0.41	firm exporting status indicator	0	1.00
lnLabor	1130432	4.71	1.07	logarithm of labor size	2.30	12.05
CapitalIntensity	1120633	3.22	1.39	logarithm of capital-labor ratio	-8.23	11.66
Foreign share	1121048	0.04	0.18	foreign share holding	0.00	7.98
TFP	1067318	2.40	1.15	TFP using Levinsohn and Petrin (2003)	-8.03	9.85
Industry level variables						
TPU1	2605	0.26	0.12	TPU1	0.00	0.62
TPU2	2605	0.49	0.19	TPU2	0.00	0.84
Skill	2585	0.30	0.10	industrial skill intensity	0.09	0.64
K/L	2585	120.15	119.68	industrial capital intensity	17.12	983.11
HHI	2605	0.04	0.07	HHI index	0.00	0.72
Lerner index	2605	1.17	1.59	Lerner index	-10.11	66.33
EG	2605	0.06	0.07	Ellison-Glaeser index	-0.11	0.50
OutputTariff	2605	0.13	0.09	output tariff	0.00	0.71
InputTariff	2605	0.10	0.05	input tariff	0.02	0.41
SOE share	2605	0.17	0.17	share of the number of SOEs	0.00	1.00
FIE share	2605	0.22	0.15	share of the number of FIEs	0.00	0.85
MFN Tariff	2588	1.03	0.03	applied tariff	1.00	1.40

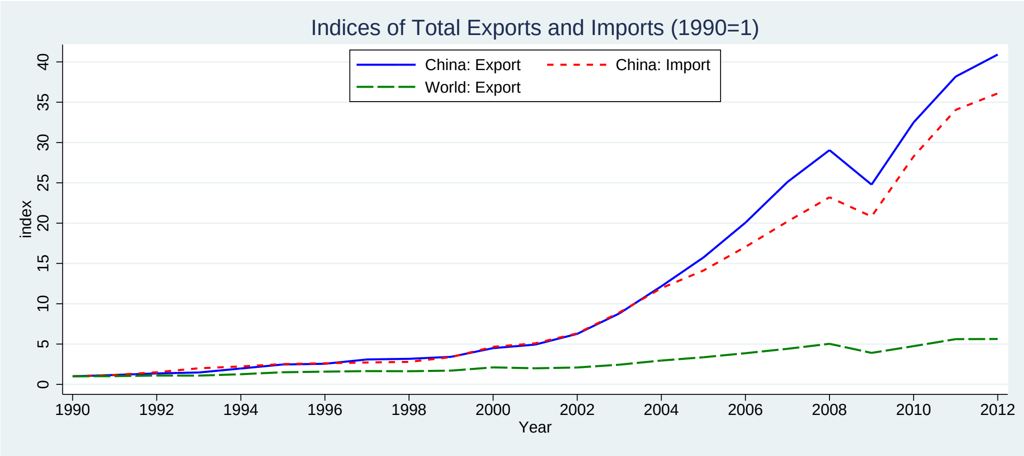

Figure 1: Remarkable Export Growth: 1990-2012

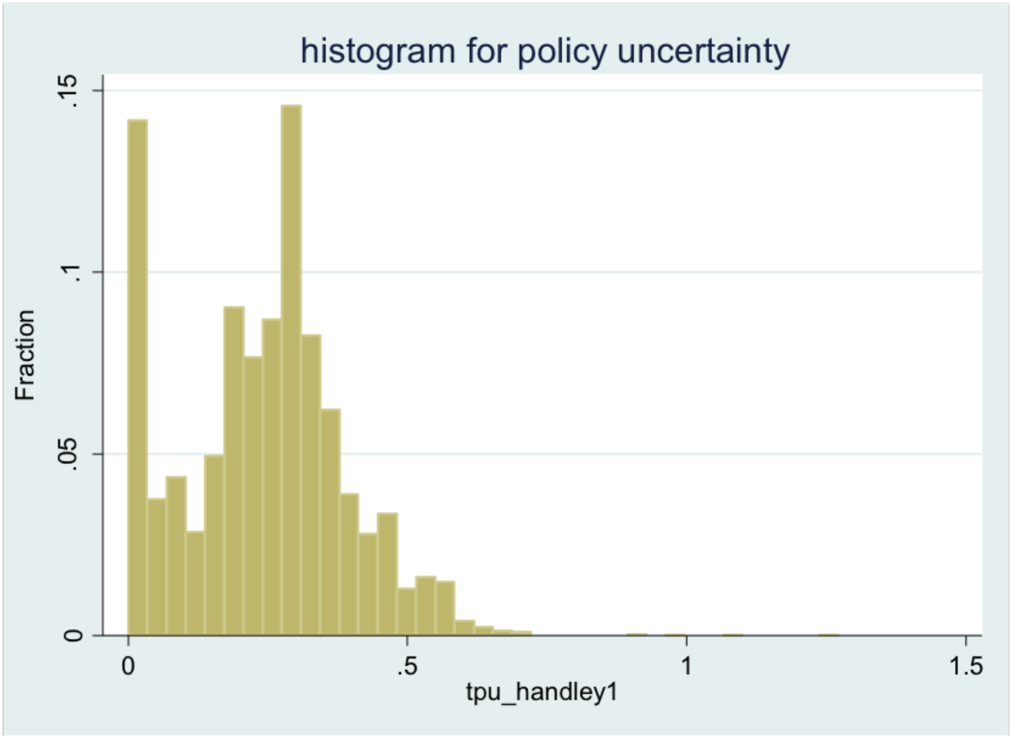

Figure 2: TPU Measure Across Products

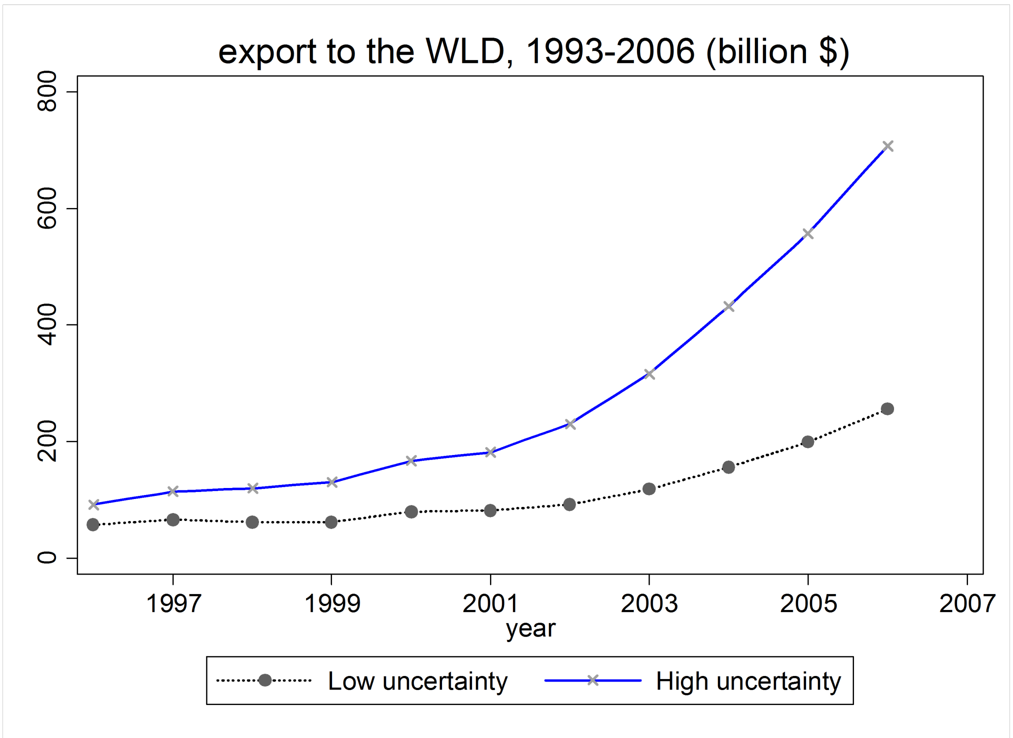

Figure 3: Export Growth by Exposure to TPU: 1996-2016

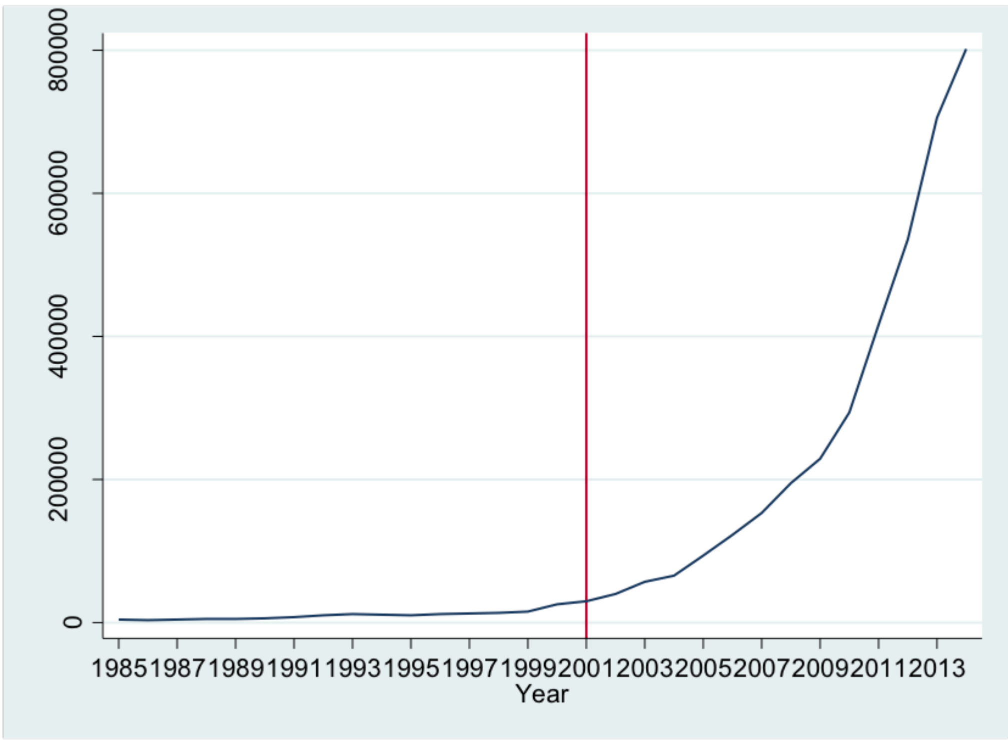

Figure 4: Growth of Patent Applications in China

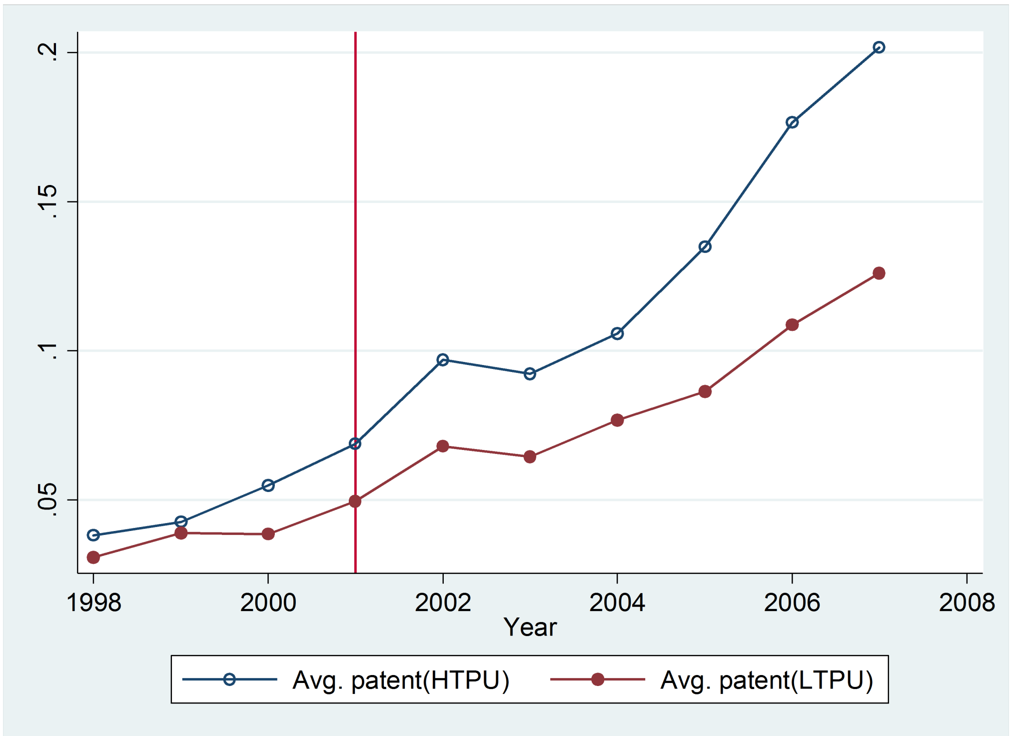

Figure 5: Patent Applications by High- and Low-TPU industries

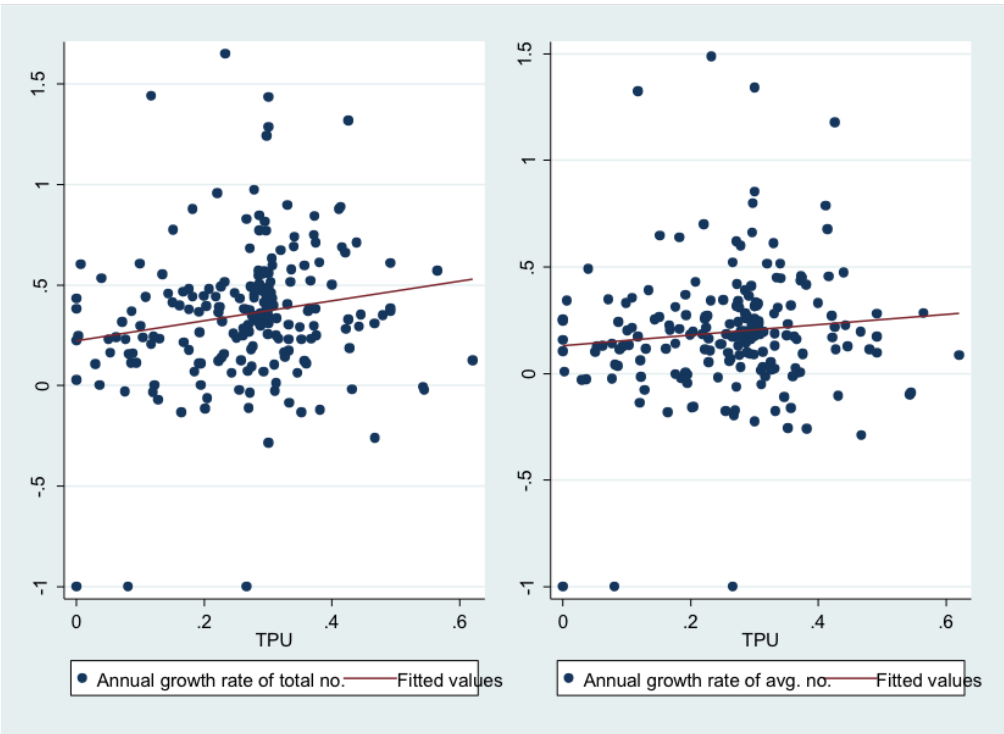

Figure 6: Correlation between Patent Filings Growth and TPU across Sectors

Table 2: Trade Policy Uncertainty and Innovation: Benchmark Results

VARIABLES	(1) lnPatent	(2) lnPatent	(3) lnPatent	(4) lnPatent	(5) lnPatent	(6) lnPatent
TPU1*Post	0.0263***	0.0251***	0.0349***			
	(0.0059)	(0.0059)	(0.0075)			
TPU2*Post				0.0197***	0.0188***	0.0255***
				(0.0034)	(0.0034)	(0.0043)
S/L*Post			0.0193***			0.0191***
			(0.0031)			(0.0031)
K/L*Post			0.0006			0.0011
			(0.0011)			(0.0011)
lnAge		-0.0027	-0.0024		-0.0026	-0.0024
		(0.0018)	(0.0018)		(0.0018)	(0.0018)
lnAge2		0.0001	0.0000		0.0000	0.0000
		(0.0005)	(0.0005)		(0.0005)	(0.0005)
Exporter		0.0075***	0.0076***		0.0075***	0.0076***
		(0.0015)	(0.0015)		(0.0015)	(0.0015)
lnLabor		0.0147***	0.0148***		0.0147***	0.0148***
		(0.0009)	(0.0009)		(0.0009)	(0.0009)
Capital Intensity		0.0032***	0.0031***		0.0032***	0.0031***
		(0.0004)	(0.0004)		(0.0004)	(0.0004)
Foreign Share		0.0005	0.0007		0.0005	0.0007
		(0.0041)	(0.0041)		(0.0041)	(0.0041)
Constant	0.0065***	-0.0709***	-0.0710***	0.0065***	-0.0708***	-0.0710***
	(0.0012)	(0.0054)	(0.0055)	(0.0012)	(0.0054)	(0.0055)
Observations	1,130,432	1,120,551	1,118,817	1,130,432	1,120,551	1,118,817
R-squared	0.5189	0.5205	0.5207	0.5189	0.5205	0.5207

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: TPU and Innovation: Other Determinants of Innovation

VARIABLES	(1) lnPatent	(2) lnPatent	(3) lnPatent	(4) lnPatent	(5) lnPatent	(6) lnPatent	(7) lnPatent
TPU1*Post	0.0353***	0.0333***	0.0354***	0.0328***	0.0371***	0.0349***	0.0367***
	(0.0076)	(0.0075)	(0.0075)	(0.0075)	(0.0078)	(0.0076)	(0.0078)
S/L*Post	0.0194***	0.0188***	0.0192***	0.0188***	0.0178***	0.0183***	0.0159***
	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
K/L*Post	0.0002	0.0004	0.0007	0.0007	0.0005	0.0006	0.0005
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
HHI	-0.0101**						-0.0088**
	(0.0040)						(0.0040)
HHI^2	-0.0010***						-0.0008**
	(0.0004)						(0.0004)
EG	0.0081	0.0127					-0.0134
	(0.0158)	(0.0155)					(0.0161)
LI		0.0067**					
		(0.0030)					
LI^2		-0.0040**					
		(0.0019)					
Import Tariff			0.0197*				0.0072
			(0.0101)				(0.0118)
Input Tariff				0.0690**			0.0756**
				(0.0272)			(0.0314)
SOE share					-0.0352***		-0.0380***
					(0.0096)		(0.0099)
FIE share					0.0452***		0.0442***
					(0.0112)		(0.0113)
MFN Tariff						-0.0532***	-0.0914***
						(0.0163)	(0.0175)
lnAge	-0.0024	-0.0023	-0.0023	-0.0024	-0.0021	-0.0020	-0.0016
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0017)
$lnAge^2$	0.0000	-0.0000	0.0000	0.0000	0.0001	-0.0000	-0.0000
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Exporter	0.0076***	0.0078***	0.0076***	0.0076***	0.0076***	0.0073***	0.0073***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
lnLabor	0.0148***	0.0147***	0.0148***	0.0148***	0.0150***	0.0147***	0.0149***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Capital Intensity	0.0031***	0.0031***	0.0031***	0.0031***	0.0031***	0.0031***	0.0031***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Foreign share	0.0007	0.0006	0.0007	0.0007	0.0006	0.0002	0.0002
	(0.0041)	(0.0041)	(0.0041)	(0.0041)	(0.0041)	(0.0041)	(0.0041)
Constant	-0.0954***	-0.0720***	-0.0749***	-0.0807***	-0.0699***	-0.0153	-0.0072
	(0.0116)	(0.0055)	(0.0057)	(0.0066)	(0.0068)	(0.0178)	(0.0201)
Observations	1,118,817	1,116,916	1,118,817	1,118,817	1,118,817	1,116,172	1,116,172
R-squared	0.5207	0.5218	0.5207	0.5207	0.5207	0.5208	0.5209

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: TPU and Innovation: Validity Tests

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	lnPatent	lnPatent	lnPatent	lnpatent	lnPatent	lnpatent
	Expectation		Pre-WTO	Trend	Flexible	Two-Period
TPU*post	0.0357***	0.0409***		0.0351***		0.0262**
	(0.0077)	(0.0085)		(0.0081)		(0.0112)
TPU*YR2000	-0.0071	-0.0021				
	(0.0057)	(0.0062)				
TPU*YR2001		0.0163**				
		(0.0074)				
annual TPU			-0.0156			
			(0.0232)			
TPU*1999					-0.0135*	
					(0.0071)	
TPU*2000					-0.0105	
					(0.0075)	
TPU*2001					0.0082	
					(0.0080)	
TPU*2002					0.0147*	
					(0.0089)	
TPU*2003					0.0241***	
					(0.0089)	
TPU*2004					0.0337***	
					(0.0101)	
TPU*2005					0.0477***	
					(0.0107)	
TPU*2006					0.0733***	
					(0.0114)	
TPU*2007					0.0752***	
					(0.0116)	
HHI	-0.0088**	-0.0087**	-0.0024	-0.0070	-0.0121***	-0.0055
	(0.0040)	(0.0040)	(0.0065)	(0.0043)	(0.0041)	(0.0080)
HHI2	-0.0008**	-0.0008**	-0.0001	-0.0006	-0.0012***	-0.0005
	(0.0004)	(0.0004)	(0.0007)	(0.0004)	(0.0004)	(0.0008)
EG	-0.0134	-0.0140	-0.0094	-0.0142	-0.0123	0.0060
	(0.0161)	(0.0161)	(0.0305)	(0.0165)	(0.0161)	(0.0280)
Output Tariff	0.0074	0.0069	0.0173	0.0028	0.0112	0.0086
	(0.0118)	(0.0118)	(0.0199)	(0.0123)	(0.0119)	(0.0190)
Input Tariff	0.0739**	0.0786**	-0.0477	0.1017***	0.0668**	-0.0095
	(0.0316)	(0.0318)	(0.0444)	(0.0356)	(0.0320)	(0.0542)
SOE Share	-0.0381***	-0.0388***	-0.0203	-0.0391***	-0.0459***	-0.0579***
	(0.0099)	(0.0100)	(0.0162)	(0.0102)	(0.0102)	(0.0157)
FIE Share	0.0445***	0.0431***	0.0226	0.0582***	0.0419***	0.0118
	(0.0113)	(0.0114)	(0.0203)	(0.0122)	(0.0115)	(0.0206)
MFN Tariff	-0.0906***	-0.0940***	-0.0634*	-0.0936***	-0.0867***	-0.0685
	(0.0175)	(0.0177)	(0.0381)	(0.0184)	(0.0179)	(0.0422)
lnage	-0.0017	-0.0016	0.0103***	-0.0016	-0.0013	0.0053
	(0.0017)	(0.0017)	(0.0034)	(0.0017)	(0.0017)	(0.0052)
lnage2	-0.0000	-0.0000	-0.0025***	-0.0000	-0.0001	-0.0010
	(0.0005)	(0.0005)	(0.0009)	(0.0005)	(0.0005)	(0.0014)
Exporter	0.0073***	0.0073***	0.0085***	0.0073***	0.0074***	0.0111**
	(0.0015)	(0.0015)	(0.0026)	(0.0015)	(0.0015)	(0.0056)
lnLabor	0.0149***	0.0149***	0.0054***	0.0149***	0.0149***	0.0194***
	(0.0009)	(0.0009)	(0.0012)	(0.0009)	(0.0009)	(0.0028)
Capital Intensity	0.0031***	0.0031***	0.0009	0.0031***	0.0031***	0.0057***
	(0.0004)	(0.0004)	(0.0006)	(0.0004)	(0.0004)	(0.0015)
Foreign share	0.0002	0.0002	0.0014	0.0002	0.0003	0.0032
	(0.0041)	(0.0041)	(0.0086)	(0.0041)	(0.0041)	(0.0143)
S/L*post	0.0158***	0.0159***		0.0162***	0.0161***	0.0125***
	(0.0031)	(0.0031)		(0.0032)	(0.0031)	(0.0044)
K/L*post	0.0005	0.0004		0.0003	0.0000	0.0003
	(0.0011)	(0.0011)		(0.0012)	(0.0011)	(0.0017)
Constant	-0.0077	-0.0042	0.0398	-0.0167	-0.0150	-0.0339
	(0.0201)	(0.0203)	(0.0411)	(0.0214)	(0.0205)	(0.0451)
Observations	1,116,172	1,116,172	302,414	1,116,172	1,116,172	457,501
R-squared	0.5209	0.5209	0.6014	0.5209	0.5210	0.8330

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: TPU and Innovation: Robustness

VARIABLES	(1) lnPatent	(2) lnPatent	(3) lnPatent	(4) lnPatent	(5) lnPatent	(6) lnPatent	(7) lnPatent
	Multiproduct	Incumbent	Industry-level	SOE	POE	FIE	Processing
TPU*Post	0.0306***	0.0385***	0.0510**	0.0664***	0.0239***	0.0339	-0.0373
	(0.0081)	(0.0081)	(0.0209)	(0.0219)	(0.0085)	(0.0264)	(0.0278)
S/L*Post	0.0156***	0.0181***	0.0293***	0.0111	0.0126***	0.0188*	0.0333**
	(0.0031)	(0.0031)	(0.0084)	(0.0086)	(0.0033)	(0.0103)	(0.0130)
K/L*Post	-0.0007	0.0000	-0.0017	0.0055	-0.0007	0.0026	0.0040
	(0.0012)	(0.0011)	(0.0036)	(0.0034)	(0.0013)	(0.0039)	(0.0052)
HHI	-0.0070*	-0.0073	-0.0101	0.0010	-0.0095**	-0.0080	-0.0067
	(0.0040)	(0.0048)	(0.0120)	(0.0102)	(0.0044)	(0.0133)	(0.0207)
HHI squared	-0.0007*	-0.0007	-0.0016	0.0004	-0.0009**	-0.0010	-0.0009
	(0.0004)	(0.0005)	(0.0013)	(0.0010)	(0.0004)	(0.0012)	(0.0019)
EG	-0.0164	-0.0145	-0.0447	-0.0315	-0.0112	-0.0159	-0.0015
	(0.0170)	(0.0191)	(0.0601)	(0.0678)	(0.0183)	(0.0408)	(0.0634)
OutputTariff	0.0136	0.0077	0.0096	0.0224	0.0141	-0.0356	-0.1351*
	(0.0125)	(0.0142)	(0.0566)	(0.0253)	(0.0143)	(0.0448)	(0.0715)
InputTariff	0.0421	0.0914**	0.2121*	-0.0029	0.0772**	0.1284	0.2607
	(0.0340)	(0.0358)	(0.1243)	(0.0699)	(0.0373)	(0.1179)	(0.1934)
SOE share	-0.0282***	-0.0400***	-0.0894***	0.0022	-0.0334***	-0.0724**	-0.1353***
	(0.0101)	(0.0108)	(0.0262)	(0.0198)	(0.0125)	(0.0340)	(0.0442)
FIE share	0.0410***	0.0494***	0.0180	0.0522	0.0418***	0.0368	0.0318
	(0.0114)	(0.0134)	(0.0446)	(0.0359)	(0.0130)	(0.0325)	(0.0369)
MFN Tariff	-0.0998***	-0.1016***	-0.3191	-0.0614	-0.0878***	-0.0784	0.1927**
	(0.0187)	(0.0232)	(0.2409)	(0.0450)	(0.0200)	(0.0598)	(0.0854)
lnAge	-0.0012	0.0041	0.0913***	-0.0048	-0.0008	0.0002	-0.0125
	(0.0018)	(0.0028)	(0.0342)	(0.0071)	(0.0019)	(0.0071)	(0.0104)
lnAge2	-0.0002	-0.0014*	-0.0170**	0.0003	-0.0002	0.0002	-0.0013
	(0.0005)	(0.0007)	(0.0082)	(0.0018)	(0.0006)	(0.0034)	(0.0035)
Exporter	0.0068***	0.0102***	0.0108	0.0173**	0.0061***	0.0081**	0.0081**
	(0.0015)	(0.0022)	(0.0347)	(0.0068)	(0.0017)	(0.0033)	(0.0039)
lnLabor	0.0151***	0.0188***	0.0262*	0.0128***	0.0138***	0.0229***	0.0301***
	(0.0009)	(0.0013)	(0.0154)	(0.0023)	(0.0010)	(0.0030)	(0.0047)
CapitalIntensity	0.0031***	0.0042***	0.0107	0.0036***	0.0028***	0.0056***	0.0101***
	(0.0004)	(0.0006)	(0.0087)	(0.0012)	(0.0004)	(0.0018)	(0.0031)
Foreign share	0.0012	-0.0005	-0.0259	-0.0816	0.0011	0.0010	-0.0051
	(0.0044)	(0.0062)	(0.0842)	(0.0758)	(0.0120)	(0.0043)	(0.0047)
Constant	0.0076	-0.0158	0.0685	-0.0070	-0.0094	-0.0560	-0.3580***
	(0.0215)	(0.0260)	(0.2207)	(0.0525)	(0.0230)	(0.0678)	(0.0963)
Observations	1,042,636	443,357	2,569	114,338	848,059	153,775	97,581
R-squared	0.5208	0.4251	0.6304	0.4970	0.5326	0.5610	0.5581

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: TPU and Innovation:Heterogenous Effects

VARIABLES	(1) lnPatent	(2) lnPatent	(3) lnInvention	(4) lnUtility	(5) lnDesign	(6) lnPatent	(7) lnPatent
	bottom	frontier	Invention	Utility	Design	Exporters	Export to US
TPU*Post	0.0075	0.0765***	0.0208***	0.0091**	0.0125**	0.0083	0.0192**
	(0.0105)	(0.0176)	(0.0035)	(0.0042)	(0.0058)	(0.0079)	(0.0076)
TPU*Post*Exporter						0.0580***	
						(0.0082)	
TPU*Post*USExporter							0.1363***
							(0.0206)
S/L*Post	0.0026	0.0248***	0.0111***	0.0081***	0.0008	0.0166***	0.0160***
	(0.0033)	(0.0078)	(0.0015)	(0.0020)	(0.0020)	(0.0031)	(0.0031)
K/L*Post	-0.0013	0.0041	0.0017***	-0.0021***	0.0004	0.0011	0.0005
	(0.0014)	(0.0027)	(0.0006)	(0.0007)	(0.0007)	(0.0011)	(0.0011)
HHI	-0.0054	-0.0142*	-0.0054***	-0.0047*	-0.0049*	-0.0098**	-0.0082**
	(0.0044)	(0.0077)	(0.0020)	(0.0028)	(0.0026)	(0.0040)	(0.0040)
HHI squared	-0.0005	-0.0013*	-0.0005**	-0.0005*	-0.0005**	-0.0009**	-0.0008**
	(0.0004)	(0.0007)	(0.0002)	(0.0003)	(0.0002)	(0.0004)	(0.0004)
EG	0.0204	-0.0358	-0.0063	-0.0060	-0.0082	-0.0139	-0.0155
	(0.0234)	(0.0299)	(0.0068)	(0.0107)	(0.0111)	(0.0161)	(0.0161)
OutputTariff	0.0167	0.0209	0.0037	-0.0045	0.0028	0.0074	0.0078
	(0.0177)	(0.0232)	(0.0040)	(0.0075)	(0.0088)	(0.0118)	(0.0118)
InputTariff	-0.0321	0.0517	0.0387***	0.0571***	-0.0077	0.0802**	0.0761**
	(0.0529)	(0.0667)	(0.0121)	(0.0199)	(0.0223)	(0.0315)	(0.0314)
SOE share	0.0004	-0.0791***	-0.0271***	-0.0268***	0.0011	-0.0407***	-0.0395***
	(0.0140)	(0.0220)	(0.0047)	(0.0068)	(0.0060)	(0.0099)	(0.0099)
FIE share	0.0173	0.0742***	0.0165***	0.0333***	0.0115	0.0459***	0.0442***
	(0.0173)	(0.0211)	(0.0050)	(0.0075)	(0.0075)	(0.0113)	(0.0112)
MFN Tariff	-0.0420	-0.1144***	-0.0227***	-0.0459***	-0.0396***	-0.0908***	-0.0907***
	(0.0321)	(0.0310)	(0.0084)	(0.0095)	(0.0135)	(0.0175)	(0.0175)
lnAge	0.0043	-0.0055**	-0.0031***	-0.0024**	0.0014	-0.0016	-0.0017
	(0.0041)	(0.0026)	(0.0008)	(0.0012)	(0.0011)	(0.0017)	(0.0017)
lnAge2	-0.0011	0.0004	0.0007***	0.0003	-0.0005	-0.0000	-0.0000
	(0.0010)	(0.0009)	(0.0002)	(0.0004)	(0.0003)	(0.0005)	(0.0005)
Exporter	0.0046	0.0081***	0.0025***	0.0042***	0.0020**	0.0071***	0.0067***
	(0.0031)	(0.0021)	(0.0007)	(0.0009)	(0.0010)	(0.0015)	(0.0015)
lnLabor	0.0044***	0.0158***	0.0050***	0.0074***	0.0059***	0.0147***	0.0144***
	(0.0013)	(0.0014)	(0.0004)	(0.0006)	(0.0006)	(0.0009)	(0.0009)
Capital Intensity	0.0019**	0.0033***	0.0012***	0.0014***	0.0012***	0.0031***	0.0030***
	(0.0008)	(0.0006)	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Foreign share	0.0089	-0.0028	0.0006	0.0003	0.0003	0.0001	-0.0001
	(0.0094)	(0.0055)	(0.0016)	(0.0023)	(0.0032)	(0.0041)	(0.0041)
Constant	0.0056	-0.0161	-0.0187**	-0.0033	0.0015	-0.0083	-0.0028
	(0.0322)	(0.0367)	(0.0095)	(0.0118)	(0.0149)	(0.0201)	(0.0201)
Observations	92,552	691,286	1,116,172	1,116,172	1,116,172	1,116,172	1,116,172
R-squared	0.4203	0.5585	0.4768	0.5051	0.4755	0.5210	0.5212

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Market Expansion or Technology Investment

VARIABLES	(1) lnPatent	(2) lnPatent	(3) lnPatent	(4) ln(R&D)	(5) ln(Fixed Investment)	(6) ln(Imported Inputs)
TPU*Post	0.0360***	0.0380***	0.0371***	0.0560	0.2160***	0.2735***
	(0.0078)	(0.0078)	(0.0083)	(0.0577)	(0.0553)	(0.0671)
lnExports	0.0066***					
	(0.0009)					
lnIndExports		0.0019***				
		(0.0007)				
IndExports growth*Post			0.0028***			
			(0.0006)			
Skill*Post	0.0159***	0.0162***	0.0157***	0.0645***	0.0100	0.1504***
	(0.0031)	(0.0031)	(0.0032)	(0.0225)	(0.0189)	(0.0263)
K/L*Post	0.0006	0.0006	0.0011	0.0001	0.0085	0.0165
	(0.0011)	(0.0011)	(0.0012)	(0.0094)	(0.0092)	(0.0110)
HHI	-0.0089**	-0.0083**	-0.0077*	0.0076	0.0509*	-0.0187
	(0.0040)	(0.0042)	(0.0044)	(0.0361)	(0.0278)	(0.0359)
HHI^2	-0.0008**	-0.0009**	-0.0007*	0.0004	0.0080***	-0.0035
	(0.0004)	(0.0004)	(0.0004)	(0.0035)	(0.0028)	(0.0035)
EG	-0.0131	-0.0151	-0.0188	-0.0973	0.3379***	-0.0255
	(0.0161)	(0.0163)	(0.0172)	(0.1555)	(0.1063)	(0.1446)
Import Tariff	0.0070	0.0090	0.0088	-0.0736	-0.0001	-0.2790***
	(0.0118)	(0.0118)	(0.0123)	(0.1036)	(0.0950)	(0.1003)
Input Tariff	0.0733**	0.0769**	0.0861**	0.1426	0.0007	0.7171**
	(0.0314)	(0.0315)	(0.0357)	(0.3072)	(0.2510)	(0.2986)
SOE share	-0.0387***	-0.0354***	-0.0453***	-0.4989***	0.3025***	-0.0359
	(0.0099)	(0.0101)	(0.0104)	(0.0968)	(0.0627)	(0.0843)
FIE share	0.0443***	0.0425***	0.0478***	0.2239**	-0.0699	-0.0176
	(0.0112)	(0.0113)	(0.0122)	(0.0982)	(0.0720)	(0.0967)
MFN Tariff	-0.0899***	-0.0935***	-0.1144***	-0.1045	-0.1422	1.1559***
	(0.0175)	(0.0175)	(0.0215)	(0.1783)	(0.1672)	(0.1843)
lnAge	-0.0020	-0.0016	-0.0012	-0.0062	-0.4184***	0.2144***
	(0.0018)	(0.0018)	(0.0018)	(0.0177)	(0.0206)	(0.0168)
$lnAge^2$	0.0001	-0.0000	-0.0001	0.0045	0.0765***	-0.0472***
	(0.0005)	(0.0005)	(0.0005)	(0.0052)	(0.0050)	(0.0045)
Exporter	-0.0477***	0.0072***	0.0068***	0.1376***	0.0890***	0.0544***
	(0.0072)	(0.0015)	(0.0015)	(0.0125)	(0.0088)	(0.0143)
lnLabor	0.0140***	0.0148***	0.0147***	0.2423***	0.8175***	0.1081***
	(0.0009)	(0.0009)	(0.0009)	(0.0088)	(0.0073)	(0.0076)
Capital Intensity	0.0030***	0.0031***	0.0031***	0.0585***	0.2895***	0.0402***
	(0.0004)	(0.0004)	(0.0004)	(0.0042)	(0.0043)	(0.0034)
Foreign share	0.0000	0.0002	-0.0005	-0.0114	-0.0094	0.0464
	(0.0041)	(0.0041)	(0.0042)	(0.0308)	(0.0243)	(0.0570)
Constant	-0.0037	-0.0284	0.0202	-0.5666***	2.1928***	-2.0912***
	(0.0201)	(0.0218)	(0.0245)	(0.2129)	(0.1885)	(0.2162)
Observations	1,116,169	1,115,351	1,077,287	740,476	1,072,004	1,116,172
R-squared	0.5211	0.5210	0.5191	0.7162	0.7163	0.6456

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Decision to Patenting

VARIABLES	(1) Patent Decision	(2) Patent Number	(3) Patent Decision	(4) Patent Number
TPU*Post	0.0220***	0.7560***	0.0362***	0.9403***
	(0.0050)	(0.1395)	(0.0069)	(0.1680)
lnPatentstock,			-0.0996***	
			(0.0061)	
S/L*Post	0.0106***	0.2826***	0.0166***	0.2730***
	(0.0020)	(0.0429)	(0.0028)	(0.0516)
K/L*Post	0.0006	0.0106	0.0001	0.0270
	(0.0008)	(0.0233)	(0.0011)	(0.0279)
HHI	-0.0037	-0.2332***	-0.0059	-0.2189**
	(0.0026)	(0.0712)	(0.0037)	(0.0862)
HHI^2	-0.0003	-0.0307***	-0.0005	-0.0331***
	(0.0002)	(0.0074)	(0.0003)	(0.0090)
EG	-0.0068	0.0992	-0.0132	0.3202
	(0.0108)	(0.2244)	(0.0156)	(0.2739)
Import Tariff	0.0104	0.4819**	-0.0013	0.6372***
	(0.0073)	(0.1895)	(0.0102)	(0.2286)
InputTariff	0.0378*	-2.0817***	0.0711**	-2.1287***
	(0.0213)	(0.4187)	(0.0299)	(0.5134)
SOE share	-0.0212***	-0.1730	-0.0290***	-0.2546*
	(0.0064)	(0.1214)	(0.0091)	(0.1488)
FIE share	0.0231***	0.3342***	0.0398***	0.3728**
	(0.0075)	(0.1260)	(0.0109)	(0.1549)
MFN Tariff	-0.0525***	-3.9531***	-0.0516***	-3.8746***
	(0.0121)	(0.4705)	(0.0164)	(0.5557)
lnAge	0.0004	0.1838***	-0.0018	0.1572**
	(0.0012)	(0.0455)	(0.0027)	(0.0748)
lnAge2	-0.0004	-0.0454***	-0.0000	-0.0346**
	(0.0004)	(0.0098)	(0.0007)	(0.0151)
Exporter	0.0047***	0.0645***	0.0059***	0.0390
	(0.0010)	(0.0226)	(0.0014)	(0.0267)
lnLabor	0.0099***	0.2175***	0.0133***	0.2325***
	(0.0006)	(0.0110)	(0.0009)	(0.0135)
CapitalIntensity	0.0020***	0.0577***	0.0028***	0.0677***
	(0.0003)	(0.0088)	(0.0004)	(0.0106)
Foreign share	-0.0012	-0.0561	0.0007	0.0318
	(0.0024)	(0.0534)	(0.0033)	(0.0641)
Lambda				-4.5727***
				(0.2052)
Constant	-0.0046	0.1493	0.0157	5.0336***
	(0.0139)	(0.5200)	(0.0202)	(0.6445)
Observations	1,116,172	72,542	742,959	51,362
R-squared	0.4717	0.5058		
Number of firmid		13,215	742,959	51,362

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1