LANCASTER UNIVERSITY

DOCTORAL THESIS

Three Essays in Empirical Microeconomics

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A thesis submitted in fulfillment of the requirements
for the degree of Doctor of Philosophy

in the

Department of Economics

Lancaster University Management School

May 2023

Declaration of Authorship

I, Amanda DE PIRRO, declare that this thesis titled, "Three Essays in Empirical Microeconomics" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

"It is a good morning exercise for a research scientist to discard a pet hypothesis every day before breakfast. It keeps him young. "

Konrad Lorenz

Abstract

As the world's complexity grows, economists are increasingly challenged to answer fundamental questions of individual behavior and societal phenomena. While economic theory provides the grounding intuition, the recent availability of large-scale micro-data and advanced econometric techniques allows us to exploit the linkages across disciplines to identify and explain counter-intuitive outcomes. The present work addresses an empirical investigation of the connections between three well-established areas: political economy, industrial organization, and trade policy.

In the first chapter, I investigate how political support may influence the provision of intellectual property recognition by the central government. In most countries, governments are responsible for regulating and administering the granting of intellectual property rights to firms and individuals, in order to promote and protect innovation. However, very little is known about the extent to which this decision-making process can be affected by political considerations. I address this question using newly collected historical data from the fascist period in Italy. In the analysis, I exploit the province-level variation in political activism before Mussolini's rise to power to identify the areas of greater dissent for Fascism and to estimate the subsequent response in terms of patents and trademarks released. I show that local support for Mussolini was critical to the approval of new patents, that have been disproportionately more granted to firms located in areas where the consensus for the regime was originally weaker. My findings suggest that the recognition of these rights, rather than being a reward for innovation, was manipulated by the regime for political purposes.

These findings are of particular relevance. This work is the first to provide empirical evidence that political objectives can substantially affect the provision of intellectual property rights. By showing that the allocation of these private legal rights can be subjected to distortive criteria, I uncover an alternative channel of misallocation that governments can exploit to affect the innovation process. Nevertheless, the direction of this effect is quite counter-intuitive when compared to the more popular strategy of rewarding government-supportive areas. Within my interpretation, Mussolini deliberated to allocate resources based on aggregate political preferences,

favoring more the less supportive areas in an attempt to mitigate potential sources of instability.

Whether governments provide efficient and successful incentives for innovation is also one of the broad questions behind the second chapter. In this chapter, a joint work with my supervisor, Dr. Renaud Foucart, we investigate the effects of delivering a radical innovation in a variety of a product when a market is characterized by low differentiated goods. The standard approach predicts innovation to provide a temporary competitive advantage to the innovator, which expires once innovation becomes freely available, restoring the pre-existing competition level. We show that when the above conditions apply, competition in the catch-up phase can actually become much stronger than it was in the pre-innovation one. Using a simple model of differentiated Cournot competition with endogenous choice of product variety, we find that innovation in one variety may lead to a decrease in product diversity in the catch-up phase, eventually decreasing the profit of the innovator and of all other producers. This result happens when the cost reduction delivered by the innovation is high enough for all producers to switch to the low-cost variety, but not sufficiently high to compensate for the negative effect of the increase in competition.

We provide supporting evidence for our theory by studying the case of the shrimp import competition between Asia and the US. In the late nineties, the US government financed the development of an innovative technique that allowed them to massively increase the production of their native species of shrimps. The advantage lasted very short. In order to be able to exploit the same technology, Asian countries abandoned their native shrimp cultivation to switch to the US variety. Product diversity decreased and competition became much stronger, leading the US producers to almost disappear from the market due to the Asian import penetration.

Finally, the third chapter examines the impact of China's competition shock on the use of a very popular instrument to correct trade policy infringement: the World Trade Organization (WTO) disputes. Following its accession to WTO in 2001, China has been repeatedly brought before the court due to its alleged violations of the global trade rules. I analyze the determinants of the trade disputes involving China as a respondent country in order to identify the major concerns of its complainants. I show that the peculiarities of the Chinese economic structure, and the consequent

trade distortions, have been reflected in the determinants of its complaints - which differ from the determinants of disputes addressed against other members, including other powerful economies such as the US and EU. First, I show that tensions are grounded on a bilateral basis and are significantly linked to import penetration and the relative asymmetries in the exporting activity. Second, strategic arguments significantly affect the decision to file a dispute against China, with countries more likely to act when their retaliatory power increases. Last, the inverse relationship between unilateral tariff adjustments and dispute initiation suggests that the use of multilateral solutions became secondary to the imposition of direct measures.

Acknowledgements

"You will struggle a lot, but you will survive." This is what my professors at Bocconi University told me when I was accepted for a Ph.D. in Economics. They were right. However, what they forgot to say is that it is the people surrounding you that can transform an intricate and potentially lonely journey into a marvelous adventure. My thanks go to these people.

First, I would like to give my sincere thanks to my supervisors Pavel Chakraborty and Renaud Foucart, for their guidance, generous time, and constructive criticism. It's been a great privilege to work with them, and I truly wish our professional and personal collaboration will continue throughout the years.

My thanks also go to the economics department at Lancaster University: the faculty for their friendly support and constant encouragement, but also the administrative office, for their generous help since the very first day. Above all, I would like to thank all the friends and colleagues with whom I shared discussions, lunch breaks, holidays, and (even) flats during these years.

This study owes its realisation to the financial and institutional support provided by ESRC under NWSSDTP Studentship and its host institutions. I am also grateful to Hilary Ingham, for the time we collaborated together in both teaching and research, and to Giuseppe De Feo, Anthony Priolo, and Aurelie Slechten for their useful input as examiners of my thesis.

A very special thanks go to Maurizio Zanardi. Despite he keeps saying that there is no free lunch in economics, I am quite convinced that everything he did for me during these years looks very much like that.

I cannot fail to mention Francesca, Federico, and Marielisa. Francesca sat next to me at the high school, Federico and Marielisa at the university. None of them ever left me since.

To Roberto: thank you for that first email. All the rest just belongs to you and me. Last but not least, I would like to thank my large, loud family, my siblings Gaia and Francesco for bearing my unbearable first-born character and, of course, my parents. They taught us children to navigate life with curiosity, dedication, and a great sense of humor. I am so proud of you.

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Al mio babbo

Chapter 1

With a Little Help From My Enemy: Intellectual Property Rights in Fascist Italy

Anecdotal evidence suggests that intellectual property recognition is often a politically driven mechanism. In this paper, I explore the relationship between political support and the provision of intellectual protection. I employ novel data from the fascist period in Italy to investigate how local political preferences affected the granting of intellectual property rights by the central government. To gauge exogenous variation in the support for Fascism, I exploit the spatial distribution of political activists affiliated to parties historically opposing Mussolini in the period before his rise to power. I provide robust evidence of the political manipulation in favor of firms located in geographical areas where the opposition to the regime was initially stronger. Firms located in provinces of lower consensus for Fascism were granted a disproportionately greater amount of patents and trademarks. The effect holds regardless of the local level of development and industrialization. My results indicate that the regime boosted the granting of intellectual property rights in areas that could have represented potential sources of instability. These findings suggest that authoritarian leaders may strategically manipulate the provision of intellectual protection to pursue their political objectives.

Keywords: Fascism, IP rights, political support

JEL Code: N44, O31, P16

1.1 Introduction

Recent experience of democratic and non-democratic countries suggests that the recognition of intellectual property (IP) rights is increasingly influenced by politics. Rather than being subjected to a neutral assessment, the granting of these rights is exploited by governments to pursue their programmatic objectives. For example, in the last years, the Chinese government set an ambitious state-mandated patent target to accelerate the transition from a "Made in" to a "Designed in" China, which resulted in a hyper-inflated number of low-quality patents.[1] In Russia, one of the interventions which followed the Ukraine crisis was the suspension of IP rights to companies from hostile countries.[2] Prominent examples can be also found in more democratic regimes. In the US, big tech companies have recently launched a massive lobbying action to prevent the government approval of so-called bad software/troll patents.[3]

In fact, governments are the ultimate authority to deliberate which projects deserve to be intellectually recognized (and protected), by conferring to innovators exclusive rights to market the goods and services that embody their intellectual works. There is, however, little knowledge of the government's arbitrariness that may characterize this process. Like any other resource, these assets can be subjected to strategic allocation whenever their approval is conditional on political considerations. This paper is a first attempt at investigating how governments' objectives can affect the distribution of intellectual property rights. I provide substantial evidence using as an experimental case the granting of patents and trademarks during the fascist regime in Italy in the 1920s. I show that local support for Mussolini was critical to the approval of new patents, that have been disproportionately more granted to firms located in areas where the consensus for the regime was originally weaker. My findings suggest that the recognition of these rights, rather than being a reward for innovation, was included by the regime among his political tools.

The idea of a political game behind the diffusion of patents and trademarks is

[1] US–China economic competition rests on intellectual property, East Asia Forum, 29 June 2022; China's patent targets mask weak innovation - study, Reuters, 21 August 2012; China sets new targets for high-value patents in ambitious five-year plan Mathys & Squire, 30 August 2022.

[2] What will happen to foreign intellectual property in Russia?, Lexology, 13 May 2022.

[3] Big Tech all over D.C. patent war, Politico, 27 April 2014.

motivated by a series of stylized facts. Historical documents from the Italian fascist period show that the shift to the authoritarian regime was associated with a boom in the number of new patents and trademarks released. However, there is no evidence that Fascism contributed to improving Italian technological development (Cohen, 1988; Gabbuti, 2020; Giordano & Giugliano, 2012; Ricciuti, 2014). The proliferation of IP licenses was indeed driven by a sudden increase in patents related to low-level innovations: namely, patents for industrial and commercial designs, and trademarks. This kind of intellectual property recognition became particularly valuable during the regime, which strongly promoted the development of any distinctive sign of national production. For firms at that time, obtaining tangible recognition for their products would have allowed them to access the media propaganda, as well as many other preferential conditions, hence representing an asset whose value went well beyond the actual relevance of the innovation, or the investment required for its development. On this basis, I hypothesize that the approval of "minor" patents and trademarks - whose intellectual property recognition was subjected to much less stringent criteria than proper inventions - became part of the wider system of exchanging favors aimed at reinforcing the confidence in the regime. Therefore, my objective is to investigate the linkage between the distribution of patents and trademarks and the political support for Fascism.

Carrying out this project required two main data sources: a measure of local innovation (measured by the number of patents and trademarks) and a measure of local support for the regime. To measure the concentration of patents and trademarks by province, I compile an original dataset that comprises all the certificates released between 1900 and 1945 by the Italian government. To measure local support for the regime I faced several challenges. Electoral data, the primary choice in this context, are likely to be biased. Mussolini was appointed prime minister without election in October 1922, as a representative of a right-wing coalition. The following election, held in 1924, although usually considered by historians as the last before the proper establishment of the regime, took place in an environment of strong intimidation and violence, and resulted in an overall share of more than 65% votes for the fascist party. Therefore, to gauge an exogenous variation in fascist support and overcome the fascist electoral manipulations, I define a new measure of local consensus by

geolocating all the political activists affiliated with parties opposing Mussolini in the period before his rise to power. I assume a higher incidence of activists to be indicative of lower local support for the fascist regime.

In my empirical strategy, I first substantiate my use of political activists as an exogenous measure for political support. I present robust evidence that activists capture the "real" popular opposition to the regime better than other conventional measures such as the electoral outcomes. Indeed, if on the one hand provinces with a higher incidence of activists report a lower share of votes for the fascist party, on the other hand, this correlation emerges strikingly once I account for the fascist violence perpetuated before the election. Results indicate that the fascist intimidation produced an inflated number of votes in favor of Mussolini which very likely did not mirror the real support. Secondly, I address the issue of reverse causality by investigating the link between activists and patents in the period before Fascism. I show that these individuals had no pre-existing relationship with the incidence of patents and trademarks. This condition is necessary to motivate my interpretation that the activists' incidence affects the distribution of patents because they are emblematic of the local political preferences, that are taken into account by the government when it deliberates upon the granting.

In my main results, I explore the relationship between the province-level support for the fascist regime and the subsequent response by the government in terms of patents and trademarks released. I employ different econometric techniques. I first use a reduced form cross-sectional approach. Estimates show a significantly greater number of patents granted to provinces with a higher incidence of anti-fascist activists. The effect holds regardless of the local level of development and industrialization. Moreover, I show that whilst a large portion of this effect is driven by the presence of communists and socialists, other categories of activists (anarchists and republicans) also received the same attention from the regime. Then, to estimate the causal impact of the fascist regime on the provision of intellectual protection to firms located in areas with differential levels of opposition, I employ an event-study regression. Finally, I estimate a differences-in-differences specification comparing the incidence of patents in provinces with different initial levels of opposition to fascism, relative to the period before the regime. I include year and

province fixed effects to control for common time unobservables across provinces and time-invariant characteristics between provinces. Results are consistent with the cross-sectional evidence. I estimate that a one standard deviation increase in my measure of political opposition translates in an increase of 0.10 standard deviations in the incidence of patents during the fascist regime. I interpret these results as indicative of the regime's strategy to boost the release of patents in less supportive areas.

This paper is closely related to the long-standing debate on the strategies that politicians pursue to allocate the resources they control. Politicians may reward their core supporters by favoring the interests of their constituencies (Bates, 2019; Cox & McCubbins, 1986). An alternative strategy is to allocate resources to people who did not support them in the past to win their favor in the future (Dixit & Londregan, 1996; Lindbeck & Weibull, 1993, 1987; Nichter, 2008). My results suggest that autocratic leaders place a particular emphasis on capturing the favor of their opponents, in contrast with the strategy of rewarding supporters usually prioritized by democracies. In authoritarian regimes, the distribution of favors becomes often pivotal for their survival and durability, and one of the government's key priorities is to eradicate political dissent. This is in line with the empirical evidence on Italian Fascism provided by Carillo (2022), who shows that Mussolini strategically allocated most of its propagandist infrastructures in areas where the support for the fascist party was originally weaker.

I provide a primary contribution by showing that such a strategy occurred in a context (the recognition of intellectual property rights) not previously investigated by the literature as subjected to potential manipulations. Most of the studies about how governments influence the process of technological innovation focus on financial incentives,[4] which can be exploited on a discriminatory basis to advantage politically connected firms or according to policy objectives (Akcigit et al., 2023; Guo et al., 2016; Li et al., 2018; Su et al., 2019). My findings are of particular relevance given the increasing importance of IP rights, and the authoritarian drifts that characterized several major countries in the last years. In a rising number of sectors, the

[4]Typical channels include tax incentives, government subsidies, government credits, and other financing channels

appropriation of these rights is what allows firms to obtain a competitive edge over other players. I illustrate that an authoritarian government can endogenously affect the distribution of these resources, creating room for potential misallocation. Conditioning the approval of patents on political considerations may contribute to incentivizing poor-quality innovation projects at the expense of real innovation, generating additional market distortions and limiting technological development. Hence, my results corroborate the idea of patents as a biased proxy for innovation performance (Moser, 2016) and investigate an alternative mechanism through which they can be used by governments.

Furthermore, empirical studies typically use the vote share of a party as a proxy for the number of core supporters (Cadot et al., 2006; Kauder et al., 2016; Levitt & Snyder Jr, 1995). In this paper, I construct a more accurate measure for political support that can apply to contexts where electoral manipulations are likely to be in place. Close to my strategy, Acemoglu et al. (2022) constructed an exogenous measure of support for Socialism in Italy by employing the World War I casualties. They show that municipalities with stronger support for Socialism experienced a greater local fascist activity, which led to a significantly larger vote share in favor of the fascist party in the subsequent elections. The two measures are complementary. Acemoglu et al. (2022) explain the electoral success of the fascist party on the basis of the widespread fear of Socialism. My measure captures the broader opposition to Fascism in ideological terms. By accounting for the local political activism connected to any ideology alternative to Fascism, I identify the areas that could have represented potential sources of instability for the regime regardless of the preferences expressed in the ballots. This difference explains why in my results areas with more political activists, which also comprise socialists, overall report lower shares of electoral support for Fascism.

Finally, I also contribute to the wider literature on the effects of Fascism in Italy (Cohen, 1988; Gabbuti, 2020; Giordano & Giugliano, 2012). Although extensive research has been carried out since the aftermath of World War II, empirical studies have been severely limited by the complexity of retrieving data on that period. The richness of the data assembled for this project expands the sources available and provides further stimulus to future research.

The paper is structured as follows. In Section 1.2, I provide a background on the historical roots of Fascism, while in Section 1.3 I focus on the fascist incentives towards intellectual property recognition. I then provide in Section 1.4 some stylized facts about the increase in patents and trademarks under Fascism. I specifically look at their geographical distribution and I compare it with the local political support given to the regime, which motivates my hypothesis of a connection between them. Section 1.5 presents my data and sources. In Section 1.6, I first provide evidence that my measure of support is correlated to the electoral outcomes, and I also show that this relationship has been biased by the fascist intervention. I then present my main results, exploring the relationship between political support and the incidence of patents granted under the fascist regime. Section 1.7 concludes. All the main estimates are reported in the text. Robustness checks, additional figures, and statistics are reported in Appendix A.

1.2 The rise of Fascism

Benito Mussolini began his political career as one of the young leaders of the revolutionary wing of the Socialist Party. Nevertheless, his interventionist stand towards WWI and his strong pro-war propaganda made him wildly unpopular and caused his expulsion from the Socialist Party. The Socialist Party was, together with the Catholics (Popular Party), the strongest opponent of the Italian intervention. Following the unfavourable outcome of the War, in the 1919 election the Socialist Party became the largest one in parliament, doubling its vote share to 32.3% of the votes and trebling its representation in parliament (Ufficio Centrale di Statistica, 1920), while the interventionist parties suffered a resounding defeat. The election was particularly disastrous for Mussolini, who had founded the fascist movement (Fasci di Combattimento) in March 1919 and failed to win any seat in parliament. Nevertheless, Mussolini took advantage of the historical circumstances to heavily redefine the identity of the movement as a strong enemy of the socialist instances. Indeed, after the favourable election outcome, the Socialist Party - in alliance with other revolutionary forces including communists, anarchists and republicans - called for a mass mobilization of the working class against the institutional bodies and the

bourgeoisie.

The years 1919 and 1920 (also known as *Red Biennium*) have been characterized by a rising conflict throughout the country and a widespread fear of a red revolution among industrialists and landowners. In Italy, Socialists had strong support from both factory workers and the countryside. This intensified the magnitude of the social conflict since it was not limited to the modest industrial areas of that time (concentrated in the triangle between Turin, Milan and Genoa), but it spread across the whole country, triggering a combination of industrial strikes and factories occupation in the cities, and rural strikes and land occupations in the countryside. The Italian state was unable to control this conflict and Mussolini's choice to promote his movement as a violent anti-socialist force quickly gained the favour of both the upper industrial class and the big farmers and landowners, whose support was crucial to attract the necessary resources to turn the movement into a militarized organization.

At the same time, Mussolini's ability to present himself as a modern alternative to both the working-class revolutionaries instances and the inertia of the old executive also captured the interests of the middle class (Gabbuti, 2020), which represented the most solid (and numerically influential) supporting group. In the following election, in 1921, the fascist party was included by the incumbent liberal government led by Giolitti in the national bloc and finally managed to obtain a small representation in the parliament. One year later, in October 1922, Mussolini organized the March on Rome, gathering around 25,000 supporters and demanding the king to be given the government. To avoid further social unrest, the king asked Mussolini to form a new government, which assembled a right-wing coalition formed by liberal, democratic and catholic ministers. In the following months, Mussolini promoted a new electoral law, *Legge Acerbo*, which established a strong majoritarian system. In 1924, Mussolini dissolved the Parliament and called a new election, which took place in an environment of widespread street violence, intimidation and vote rigging. In the election, the fascist list (Lista Nazionale) won more than 65% of the votes, eventually marking the shift to the autocratic fascist regime.

1.3 Fascism, innovation and IP recognition

Technological progress was among the very first programmatic points of the fascist movement. In Italy, as in other European countries, the experience of WWI generated a boost towards scientific nationalism, according to which science and technology were intended as instrumental to the development of the nation. But differently from European countries, Italy lagged far behind the average technological level of that period. The scientific community was fragmented and poorly connected to the industry, which was mainly under-developed, and concentrated in narrow areas surrounding the main cities (Maiocchi, 2003b). Few large industrialist groups dominated the scenario, heavily sustained by the state, while a multitude of small enterprises struggled to access the necessary resources for investments.

Mussolini attempted at boosting innovation by putting in place a major restructuring of the system of scientific research. In 1923, he created the National Research Council (Consiglio Nazionale delle Ricerche) to increase the performance of the Italian scientific system and its connections with industrial firms, in 1926 he established the National Statistics Institute (ISTAT) and in 1930 the National Health Institute. However, most historians agree in considering this reorganization as a missed opportunity, because it was carried out with a very limited amount of resources and more with a view to propagandist goals than to the real support of promising research projects (Nuvolari & Vasta, 2015). In fact, most of the funds were allocated according to clientelist relationships, the reform of the educational system went paradoxically all in favour of humanistic studies (causing a drop of more than 25% in the scientific faculties) and the removal of many scientists and researchers unpopular for the regime caused an additional cultural impoverishment.

Along with its (unsuccessful) interventions towards relevant technological innovation, the regime devoted consistent efforts to promoting intellectual property recognition. Less than two months after his appointment, in December 1922, Mussolini established the Intellectual Property Office (Ufficio della Proprietà Intellettuale), to create a more efficient and centralized bureaucratic system for intellectual property recognition. The office was responsible for managing all the procedures related to the granting of IP rights, previously delegated to the Ministry of Agri-

culture, Industry and Commerce.[5] At the same time, the regime launched a series of initiatives aimed at rewarding the firms' ability to create distinctive signs of Italian production. In line with the nationalist ideology - culminated in the autarky policy of the mid-Thirties - the promotion of domestic production absorbed most of the State's propaganda. Companies which could provide tangible signs of original fascist design were granted a large space on the media propaganda, but also other preferential conditions (such as tax breaks when exporting).[6] The possibility to obtain such visibility gave a new impulse: companies belonging to different sectors began investing in the design and marketing of their products, which became more and more in line with the regime aesthetics (Figure 1.1). Especially in the food and beverage sector, the fascist period represented the opportunity to jump from a local family business to a national (and in the most fortunate cases, international) dimension. This is the case of many companies that later became a symbol of Italian excellence and that registered their trademarks for the first time in the early twenties, oftentimes containing multiple references to the fascist symbology: from Barilla, to Buitoni, to Campari, to Motta, but also Lavazza, Baratti and Martini. Some companies registered an impressive number of new trademarks. Venchi, a confectionery company still existing, registered around 100 new trademarks in the period between 1926 and WWII. Likewise, Martini & Rossi, registered 89 new trademarks and Cinzano 59.

In other cases, the regime left no choice for those firms which wanted to retain their market share. This is the case of the fashion sector. Since the beginning, Fascism regarded the emergence of a "purely Italian" fashion as an important contribution to the construction of the national identity (Capalbo, 2016; Gnoli, 2017). In the following years, the regime intensified its efforts to create a fashion "Made in Italy" with the establishment of the National Body for Fashion (Ente Nazionale della Moda). It was given full powers of control over production: not only were all dress

[5]Importantly, the regime did not modify any of the definitions nor the criteria needed to obtain protection, which remained regulated by the law 12 March 1855 (Legge sulle privative industriali). Filings for patents (whether for inventions or industrial/commercial designs) as well as new trademarks certificates were now required to be submitted to the Intellectual Property Office, by means of the same local offices (Prefettura o Sottoprefettura) of the pre-regime period. The duration of patents and trademarks remained set to a maximum of 15 years.

[6]In Appendix A, Figure A.5 provides an illustrative example of these propagandist goals with an article from the main national newspaper, *Il Corriere della Sera*, dated 28 January 1926.

designers obliged to declare their activities to the body, but 25% of the creations made by the designers, who were entered into the register of Italian fashion design, had to carry an official stamp given by the body which assured it was wholly Italian. The authorities also tried to create incentives for sartorial experiments, identifying with a golden seal those laboratories capable of producing original creations and using textiles made from national raw materials (Capalbo, 2012). A number of new patents were given to those producers able to use alternative textile fibres to supply the shortage of traditional ones caused by the economic sanctions. To not undermine its reputation, Ermenegildo Zegna, a famous wool factory, created a new company, with a different name, entirely dedicated to the production of "autarchic textiles". Similarly, a number of small artisan laboratories acquired a growing reputation by means of the registration of their trademark: Gucci, the notorious bags company, registered its first trademark in 1923, Fendi in 1925, while Ferragamo, the top luxury shoes manufacturer, was launched in 1927.

FIGURE 1.1: New "fascist" trademarks and designs

(A) Campari (B) Ferragamo (C) Zegna

Last, the fascist ideology also influenced the development of specific sectors, which acquired prominence thanks to fascist propaganda, particularly the sport one. According to Elia (2017) during the fascist period in Italy have been registered over 900 patents and trademarks related to sport and sports equipment, 250 of them in the sole year 1924. Such data are even more impressive when compared to the US (the second nation for the number of patents in this field at that time), which in

contrast saw a total of only 150 new patents in the same period.

1.4 Stylized facts

In this section, my objective is to preliminary inspect a) whether the trends in the observed outcomes (i.e. the amount of IP licenses granted) are consistent with the anecdotal evidence presented in Section 1.3; and b) whether the distribution of IP grants suggests a non-neutral allocation across the Italian territory. All the statistics are based on my source of data on IP certificates, which relies on the historical files processed by the Ministry of Agriculture, Industry and Commerce (and later, from the Intellectual Property Office), in combination with the historical country series collected by the World Intellectual Property Organization (WIPO).

1.4.1 A massive rise in industrial designs and trademarks

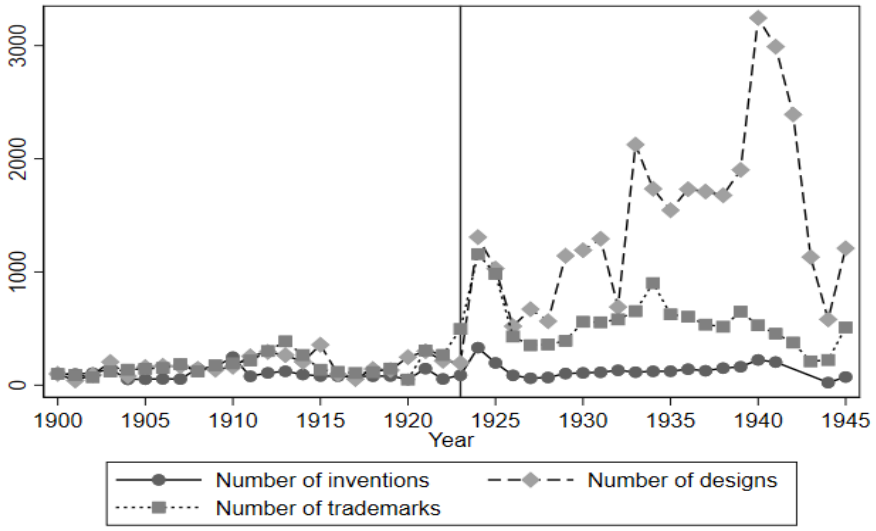
Figure 1.2 plots the annual index values of patents for inventions, designs, and trademark certificates released from 1900 to 1945 (with 1900 set as base year). The vertical reference line indicates the rise of Mussolini to power in October 1922. Data indicates that the regime substantially failed in boosting relevant technological innovation. The invention capacity, conventionally measured by the number of new invention patents released, remained in fact unchanged with respect to the previous period. This is also supported by Nuvolari and Vasta (2015), who show a decrease in the Italian innovation level during Fascism when measured by the number of patents registered abroad, and it is also in line with the lack of evidence of a positive impact of the regime on growth.[7]

While Fascism has not been associated with any improvement in the rate of radical innovation, a different story emerges when considering other measures of innovation that received special attention by the regime by virtue of their propagandist usage: namely, patents for designs and trademarks. The former can be described as a patent for incremental innovation, usually a change in the design of a product

[7]Recent studies on inter-temporal and cross-country comparisons of industrial production and labor productivity indicate, if anything, that Fascism retarded instead of promoting Italian growth. (Cohen, 1988; Gabbuti, 2020; Giordano & Giugliano, 2012).

(when labelled as commercial or ornamental) or an improvement in a productive process (industrial design). Trademarks, instead, refer to the release of a certificate that guarantees to consumers the trade source of the goods or services and summarizes the distinctive value of the item. The data series in Figure 1.2 show that Fascism is associated with a massive increase in the recognition certificates of these low-level innovations. This is consistent with the anecdotal and historical evidence on the regime's propagandist efforts in promoting intellectual protection, especially when embedding the concept of "Made in Italy", which resulted in a proliferation of patented designs and trademarks.

FIGURE 1.2: Patents for inventions, designs, and trademarks (1900-1945)

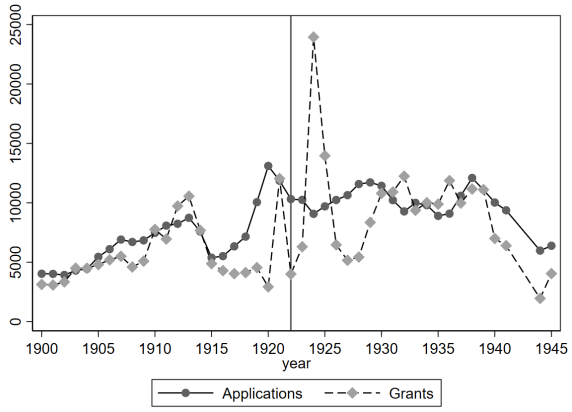


Moreover, the adoption of a separate office in charge of managing the patent system seems to have produced beneficial effects in terms of bureaucratic efficiency. From my data source on industrial designs and patents, I retrieved the information on the date of application by the author. To complete the picture, I also retrieved the number of applications and patents granted for inventions from the historical series released by WIPO, based on the documentation provided by the national offices.[8] Figure 1.3 depicts the annual applications and grants for inventions, trademarks, and designs (from the top left to bottom). In the case of trademarks and designs, I also report the average annual number of days passed between the application and

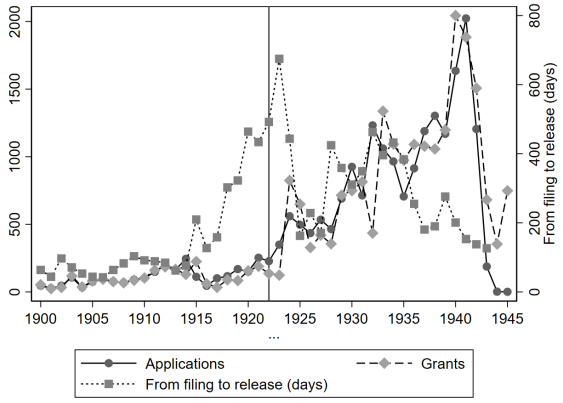
[8]In this latter case, data are aggregated at the country-year level, hence it is not possible to compute statistics on the time lag between the application dates and the release of the patents.

the patent's approval.

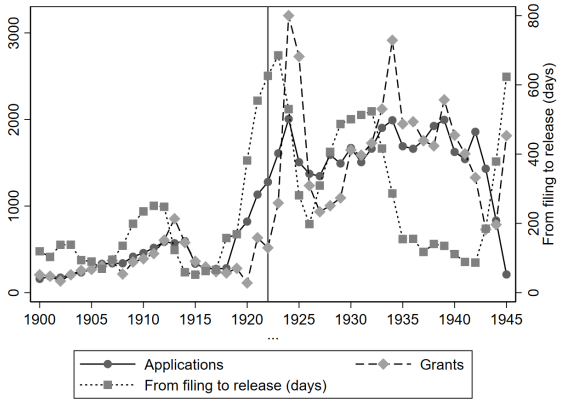
FIGURE 1.3: Annual filings and IP licences released (1900-1945)



(A) Inventions



(B) Designs



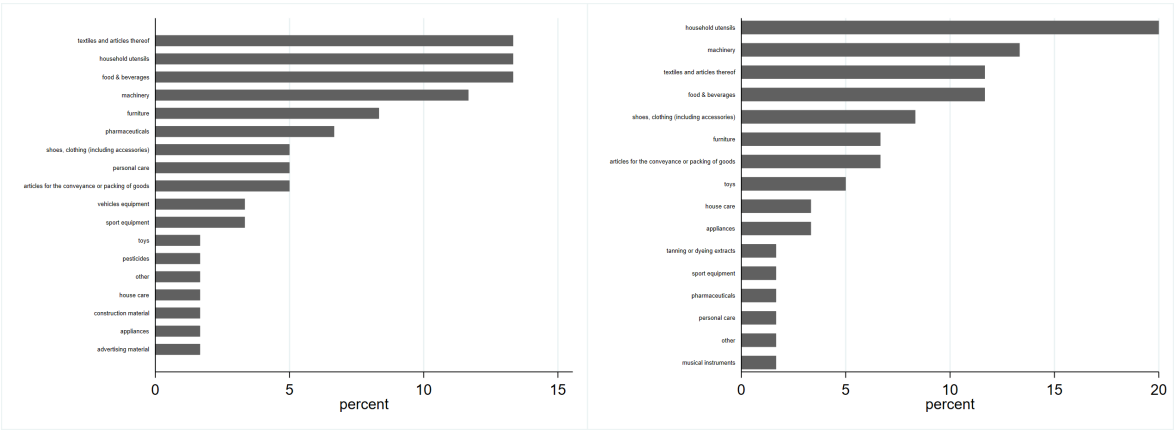
(C) Trademarks

In all three cases, data indicate that immediately after the beginning of the regime the number of patents granted outweighed the number of filings. This suggests that part of the increase in the patents approved has to be attributed to the grant of patents whose application was submitted before the regime, probably thanks to the higher bureaucratic efficiency introduced. This is also visible when observing the decrease in the average time passed between the filing of a request and its acceptance, which decreased sensibly.

At the same time, Figure 1.3 indicates that also the number of filings contemporary rose significantly and remained persistently high in the following years. This is true in the case of designs and trademarks, whilst the number of filings for invention patents remained, once again, substantially unchanged. In other words, the increase in the grants cannot be attributed to a matter of higher bureaucratic effi-

ciency.[9] Equally important, data are not suggestive that the rise in IP requests was the result of specific industrial policies. Figure 1.4 compares the industry composition of the patents and trademarks released before and after the fascist regime.[10] There is no evidence of a significant change in the share of the different sectors, nor an increase in industries traditionally regarded as highly innovative. Rather, the growth in the number of patents and trademarks affected all the sectors, suggesting that within each of them, many more companies attempted to get their brands and products intellectually recognized.

FIGURE 1.4: Shares of IP licences by industry



(A) Designs and trademarks (1900-1922) (B) Designs and trademarks (1923-1945)

To further corroborate my interpretation of the effects of the fascist regime on the amount of IP rights granted, I employed the historical country data series made available by the World Intellectual Property Office (WIPO) to obtain a comparison of the Italian performance in terms of IP rights vis a vis other countries.[11] I make

[9] To this point, it is important to notice that no changes have been made to the filing forms to be compiled for the request, nor to the channels to apply (the local Prefettura or Sotto-Prefettura). In essence, the bureaucratic burden for firms did not decrease compared to before. Regarding the monetary costs, before Mussolini to keep the patent or trademark validity the owner was subjected to the payment of an annual fee of 40 Lire in the first three years after the approval, 60 Lire from the third to the sixth year, 90 Lire from the sixth to the ninth, 115 Lire from the ninth to the twelfth and 140 in the last three years. With the amendments made in 1922, the costs for the application and maintenance of the patent were changed to Lire 100 for the sole application and then an annual fee of Lire 50 for all subsequent years if the application was approved.

[10] The figure is based on samples of 100 patents and trademarks randomly extracted before and after 1922.

[11] One potential concern relates to whether these patents are harmonized in their definition. Specifically, the WIPO provides a comprehensive dataset on industrial designs, which in the case of Italy comprise both industrial and utility designs (indeed, the annual number corresponds to the annual

use of a simple difference-in-differences (DiD) model. In this setting, the treated country, Italy, is compared to other Western democracies which were not affected by the same regime change in 1922. The sample includes five countries (Italy, France, the United States, Germany, and the United Kingdom) and 21 years, from 1910 to 1930. Specifically, I estimate the following linear model:

$$y_{it} = a_i + a_t + \beta \text{After}_t \times \text{Italy}_i + \epsilon_{it} \tag{1.1}$$

where the dependent variable y_{it} is the number of patents and trademarks released by country i in year t, expressed in logs. Country and year fixed effects are included. In this specification, the coefficients on the individual variables $After_t$ and $Italy_i$ are absorbed by country and year fixed effects. The coefficient of interest, β reports the differential effect of the years after 1922, which indicates the beginning of the fascist regime, for the treated country, i.e. Italy. Time-varying controls at the country level include population and GDP growth. Results are reported in Table 1.1.

Estimates confirm that the rise in IP rights granted was a peculiar outcome of the fascist regime. In Column (1) the β coefficient is highly significant when considering as a dependent variable the sum of patents (either for inventions and designs) and trademarks. In Columns (2) to (4), the dependent variables are the number of patents for inventions, designs, and trademarks separately. Splitting the sample indicates that the effect is driven by both designs and trademarks, while no significant change is found when considering only the patents for invention (Column 2). To corroborate these results, in Tables A.4-A.7 I repeat this exercise by estimating the interaction effect for all five countries. All of them display largely non-significant, or negative, coefficients. In Table A.8, I compare all countries with Italy as reference category.

Finally, in Columns (5) to (7) I perform a different exercise by employing a triple interaction, comparing the production of different types of patents in Italy with the same type of patents in the non treated countries, in the period after Mussolini. While the performance of designs and trademarks in significantly greater than in

number from the National Archives data). However, some countries grant patents for utility designs, but not for industrial ones. This is the case of the United States.

other countries, the production of patents for inventions is instead significantly lower. Overall, results suggest that the regime fostered the production and intellectual recognition of low-level innovations when compared to other countries, and also confirm the lack of impact of Fascism on radical country-level innovation.

TABLE 1.1: The pattern of innovation in Western countries

	(1) Total	(2) Inventions	(3) Designs	(4) Trademarks	(5) Inventions	(6) Designs	(7) Trademarks
$Italy_i \times After_t$	0.354***	-0.029	1.060**	0.809***			
	(0.076)	(0.042)	(0.232)	(0.037)			
$Italy_i \times After_t \times Inventions_v$					-1.078***		
					(0.202)		
$Italy_i \times After_t \times Models_v$						0.717***	
						(0.126)	
$Italy_i \times After_t \times Trademarks_v$							0.380**
							(0.095)
Controls	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes
Observations	79	80	79	64	223	223	223
R-squared	0.966	0.961	0.932	0.961	0.768	0.765	0.669

Columns show coefficients of a linear model. Robust standard errors in parentheses. The sample includes five countries (Italy, Germany, United Kingdom, France and United States) and twenty years (1910-1930). The years of the WWI have been excluded from the sample. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

1.4.2 The distribution of IP grants across the Italian territory

As in many other bureaucratic instances, Mussolini put in place a patent system that was highly unified and dependent on the central government. Previous literature already discussed the regime manipulations of public funds, including those devoted to technological development, as subjected to political favoritism (Maiocchi, 2003a). My main hypothesis is that like any other resource, the granting of patents and trademarks - which became particularly valuable by virtue of the strong nationalist propaganda - could have been subjected to a similar rationale. Given the value that intellectual property recognition rights assumed for firms, the government had an incentive to use them in a strategic manner. The regime may have indeed manipulated the allocation of these goods, by either rewarding the most supportive areas or by favoring the swing/opposing constituencies. The second strategy is particularly attractive in the case of autocracies. Authoritarian leaders often exploit the allocation of public goods to expand their popular support. Previous literature

widely documented this choice in the case of infrastructure building.[12] Recent evidence on Italian Fascism is provided by Carillo (2022), who shows that Mussolini strategically allocated most of its propagandist infrastructures (i.e. the foundation of new towns) in areas where the support for the Party was originally weaker. More broadly, opposition from outside the ruling coalition poses a huge challenge for the autocratic leader, who attempts to prevent it by introducing in those areas a mutual exchange of favors.[13]

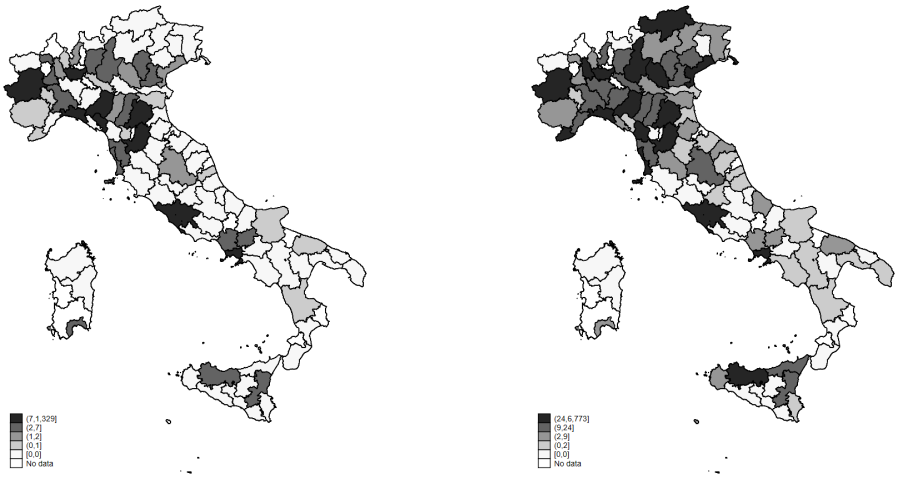
Therefore, I explored the geographical distribution of patents across the Italian territory. If the fascist regime neutrally managed the IP grants, their allocation should be independent of political considerations, meaning that we should not observe a correlation with political support. Very plausibly, we would expect a greater incidence of grants in those areas with higher pre-existing levels. In Figure 1.5, I map the spatial distribution of patents and trademarks released at the province level and I compare it with the spatial distribution in the support for Fascism. Panel A and B show the distribution of patents and trademarks in the years immediately before (1919-1922) and after Mussolini (1923-1929), measured as the sum of patents and trademarks released in each Italian province in the two periods. The period before (Panel A) reports an impressive between-province variation in the patents and trademarks released. Out of 3,300 patents and trademarks, almost 90% (2,894) had been released to companies or individuals based in Milan, Turin, or Rome. Three-fourths of the provinces had less than 7 patents or trademarks released in four years, a value which is virtually very close to no innovation at all. In the years after Mussolini's rise to power, the map changes significantly. Among the provinces with almost null values before, some of them show a consistent incidence of patents and trademarks. This is particularly visible for the North-East and the Centre but is also true in regions like Sicily. At the same time, other provinces with previous similar values do not seem to have shared the same positive change and remained com-

[12] Examples include the Autobahn in Nazi Germany (Voigtländer & Voth, 2014), roads in Kenya (Burgess et al., 2015), the infrastructures for the 1980 Olympic games in the USSR (García & Magnúsdóttir, 2019), as well as the New Towns founded by the Swedish Crown (Cermeno & Enflo, 2019) and more recently in China.

[13] At the opposite of the spectrum there is the resort to violent repression. However, the final outcome suffers from a higher uncertainty. Repression, if on the one hand reduces the probability of protests (Lyall, 2009; Weyland, 2009), on the other hand, can further undermine the support for the government (Findley & Young, 2007; Francisco, 2005; Hess & Martin, 2006).

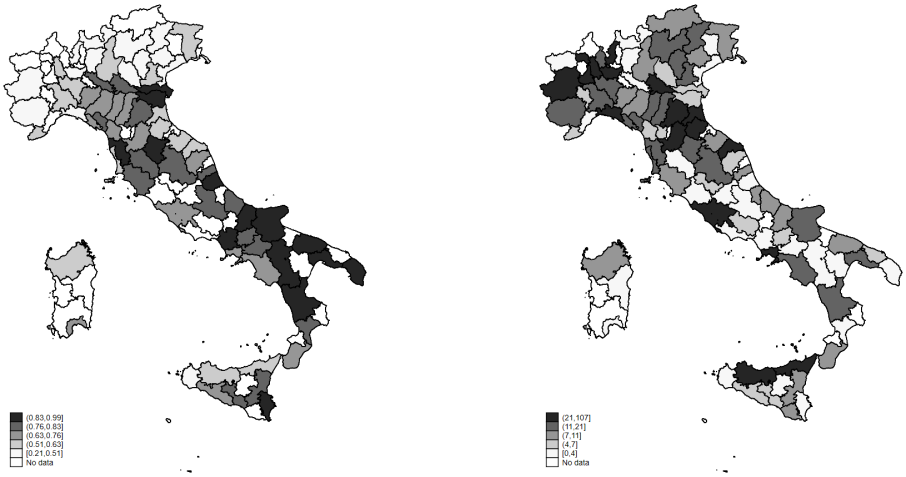
pletely unaffected.

FIGURE 1.5: Spatial distribution of patents and support for Fascism



(A) Patents and trademarks released in 1919-1922

(B) Patents and trademarks released in 1923-1929



(C) Vote share collected by the fascist party

(D) Political activists recorded in 1919-1920

This variation across provinces becomes even more captivating when compared to the variation in the support for the fascist regime. In Panel C, I consider the share of votes in favor of the fascist party in the 1924 election. Data suggest an inverse relationship between the number of patents and trademarks released and the electoral support received at the province level. In Panel D, I use an alternative strategy to measure the support for fascism, which will become my main proxy in the empirical section. Given that Mussolini defined the identity of the fascist movement as an alternative force to the revolutionary instances that arose during the *Red Biennium*, I use the number of political activists recorded by the Italian police during those

years. These activists are affiliated for the large majority (65%) to the Socialist and Communist parties and, to a lesser extent, to Anarchists and Republicans. None of these movements ever supported the fascist regime, and they later become the main source of the Italian Resistance. In other words, I assume the presence of these activists to be a measure of the future local opposition to the regime.

First, there is a clear correlation between activists and election outcomes. Provinces with higher numbers of activists detected in 1919-1920 reported lower shares of votes for the fascist party. Moreover, the use of activists to measure support results in a more accurate picture when compared to the spatial distribution of patents and trademarks. A higher incidence of activists seems to be correlated with a greater number of patents and trademarks granted. Overall, these stylized facts strengthen the idea that the granting of patents and trademarks was (at least in part) conducted on a strategic basis by the government. Areas with weaker support received a major stimulus, suggesting that companies located in those provinces received preferential treatment from the regime.

1.5 Data

My dataset covers 93 provinces according to the Italian administrative divisions in 1970. I employ this province's administration level as my main data sources on political support and innovation are classified on this basis. Not less importantly, it also allows obtaining a greater variation compared to the number of provinces existing during the fascist regime (72 in 1924). However, when the structure of data requires it, for instance when I employ the province electoral results, data have been mapped to the provinces in 1924.

My main data of interest comes from the Italian Central State Archives, which in recent years has launched a project aimed at digitising the historical files contained in their physical archives and originally registered at several Italian bureaucratic offices of the pre-republican period. Examples of the original papers are contained in Appendix A (Figures A.6, A.7, and A.8).

Patents and Trademarks To measure innovation, I rely on the documentation submitted to the Ministry of Industry, Commerce and Craftsmanship, and later, to the Intellectual Property Office. At present (January 2023), the Italian Central State Archive has released the historical documentation on patents for designs - whether industrial or ornamental - (99,069 files) and trademark certificates (165,670 files) from 1865 to 1965. Patents for designs contain the name of the owner (whether an individual or a company); the date of application; the date of registration; the city, province, and state of residence of the owner/company, the typology (whether commercial or industrial) and a short description of the item at issue. Trademark certificates contain the name of the owner (whether an individual or a company); the date of application; the date of registration; the city, province, and state of residence of the owner/company; and the city, province, and state where the trademark has been registered. Data have been aggregated at the province level based on the company/owner's residence location. I used the registration date to identify the year the certificates were released.

Political support To measure the local support given to the regime, I resort to the political activists recorded by the Public Security Office of the Italian Kingdom (Casellario Politico Centrale, CPC). The office had been established in 1894 with the aim of providing a biographic record of those individuals affiliated with the major subversive parties and was part of those measures undertaken to limit the influence of the first nationwide working-class movements. In the aftermath of WWI, a large majority of recorded people were affiliated with the communist and socialist parties, and to a lesser extent, anarchist and republican. With the advent of Fascism, the CPC activity and its power were expanded, and it became one of the major instruments to monitor and suppress political dissent.

The registry contains 152,589 individual files between 1894 and 1945. Each file provides information on the residence, political affiliation, occupation, and sanctions (a simple report to authorities, a monetary penalty, or more serious measures such as prison or confinement) corresponding to each individual. In addition, they also provide the date their file was first created and the date it was dismissed. As for the data on patents and trademarks, I aggregate these data at the province level

based on the individuals' residence reported. I drop individuals with multiple residences across Italy since it is not possible to identify the location at the time of the first inquiry. Given that I assume that the Italian government could only investigate people when they reside in the Italian territory, I include individuals born abroad as long as they had an Italian residence. Seemingly, I include individuals born in Italy but living abroad, by using as place of residence the location where they were born. In the latter case, I assume that they migrated abroad following the investigations.

Finally, to measure the electoral share given to the fascist party in 1924, I aggregate the municipality-level data provided by Acemoglu et al. (2022) who reconstructed local support based on local archives and local newspapers and by partially using data from Corbetta and Piretti (2009).

Fascist activity Measures of fascist activity are also retrieved by Acemoglu et al. (2022). Using these data, I create a province-level measure of fascist violence in 1920–22, which records the number of violent episodes per 1,000 inhabitants for the period 1920–22. An alternative measure focuses on killings only. I also compute the number of local branches of the fascist party per province in September 1921, and the number of municipalities in a province with at least a large donor to the fascist party in 1919–25 (i.e. a donor whose financial contribution was officially recorded by the party in this period).

Fascist propaganda I obtain an estimated measure of the regime's presence at the local level using the photographic archive of fascist activities collected by the official media of the regime. Through the photo descriptions, I geolocalize all major activities and events attended by Mussolini during the twenty years of government (openings of new establishments, cultural events, public speeches), excluding its governmental duties held in Rome. I additionally consider also the location of the so-called "fascist towns", i.e. those built by the regime on the Italian peninsula mainly as a result of its land reclamation policy.

Additional data I use data on province population from ISTAT. From Acemoglu et al. (2022), I use province-level controls for the number of industrial firms, the

share of industrial workers, the number of industrial strikes, the number of agrarian strikes, the share of landowner elites, the share of bourgeoisie, and the level of male literacy. Given that the Acemoglu et al. (2022) dataset is at the municipality level, I either aggregate the data at the province level (e.g. in the case of the number of strikes per municipality) or I compute the average across municipalities (e.g. for the province literacy level) or compute a weighted average (in the case of variables such as the rate of industrial workers and firms).[14] Data on other countries' innovation rates have been retrieved from the World Intellectual Property Organization (WIPO) historical datasets. WIPO collects data before 1980 on inventions, trademarks, and industrial designs as provided by the national offices of its members. A full list of the variables, and their description, is contained in Appendix A. Summary statistics are also included.

1.6 Empirical analysis

In this section, I explore the relationship between the province-level support (opposition) to the fascist regime and the subsequent response by the government in terms of patents and trademarks granted. Preliminary evidence from the maps in Section 1.4 suggests that IP grants had been strategically allocated in less supportive areas. In my econometric strategy, I proxy the support to the regime by using the political activists recorded by the Italian police in 1919-1920 (Red Biennium) and affiliated to parties historically against Mussolini. By doing this, I assume the higher incidence of these individuals to be indicative of a greater opposition to the fascist regime.

1.6.1 Political activists: identifying assumptions

Before presenting my main results, in this section I substantiate the use of political activists as an exogenous measure for political support. I first present robust evidence that activists capture the "real" opposition to the regime better than other conventional measures such as the electoral outcomes, by showing that those results

[14] Their original variable was the number of industrial workers/firms over the municipality's male population. Given that I missed the municipality male population data, I first weighted the municipality-level variable for the share of the province population of that municipality and then I computed the sum.

have been biased by the fascist activity. Then, I address the issue of reverse causality by investigating the link between activists and patents in the period before Fascism. I show that these individuals are unrelated to any prior level of technological performance. This condition is necessary to motivate my interpretation that the activists' incidence affects the distribution of patents because they are emblematic of the local political preferences, that are taken into account by the government when it deliberates upon the grants.

Political activists and electoral support for the fascist party

I document the relationship between political activists recorded during the Red Biennium and the electoral support given to the fascist party in the 1924 election. This relationship, which is interesting in itself, is important to motivate the resort to an alternative measure to map the consensus (opposition) towards the regime, which in my case is expressed by the number of political activists. In fact, given that the large majority of activists were affiliated with the socialist and communist parties, if the election outcomes well represented the local political preferences, we would expect a negative and strong correlation between the number of activists recorded in a province and its subsequent support for Fascism.

However, a major issue in this context relates to the reliability of electoral data. Mussolini won the election with an overall share of more than 65%, hence by virtually winning in every province. This greatly reduces the variation across provinces when measuring the political support given to the regime. Moreover, the election (which followed a new majoritarian rule introduced by Mussolini himself) took place in a climate of widespread intimidation and violence, as explained in Section 1.2. Thus, the support pictured by the final results is unlikely to be fully representative of real political sentiments. My estimating equation can be summarized as:

$$Vote\,share_p = \alpha_1 + \beta_1 Political\,activists_p + \gamma X_p + z_r + \epsilon_p \tag{1.2}$$

where $Vote\,share_p$ is the share of votes collected by the fascist party in the 1924 election in province p. $Political\,activists_p$ is the number of political activists recorded in the years 1919-1920 in province p (per 1000 inhabitants). X_p refers to a set of co-

variates at the province-level. In all the specifications I include region-fixed effects (z_r). Given the different scale of the dependent and independent variables, in these regressions I report standardized coefficients (computed after standardizing both left-hand-side and right-hand-side variables).

Results are reported in Table 1.2. Column (1) displays a negative correlation, meaning that provinces with a higher presence of political activists affiliated with other parties reported lower shares of votes in favor of the fascist party. Nevertheless, the significance of the coefficient is quite low. To investigate whether provinces with the most activists had been prevented by the fascist intimidation from revealing their preferences in the election I use the data from Acemoglu et al. (2022). In Column (2) I add as control variables the number of violent episodes per 1000 inhabitants, while in Column (3) I include the number of killings per 1000 inhabitants in 1920-1922. Both the rate of fascist violence and fascist killings positively correlate with the vote share collected by the fascist party at the province level, indicating that the fascist intimidation proved to be quite effective in influencing voting behavior. Moreover, the inclusion of these controls significantly increases both the size and significance of the activists' coefficient.[15]

In Column (4), I introduce the dummy variable $RedProvince_p$ to indicate those provinces with the highest number of parliamentary seats assigned to the socialist and communist parties in the previous election (1921). These same provinces, which had the highest drop in votes for the socialist and communist parties, were responsible for the debacle of the red forces, which were able to secure in 1924 only 65 seats, against the 138 secured in 1921. Indeed, traditionally strongly aligned red provinces paradoxically reported the highest growth in electoral support for Mussolini. According to Acemoglu et al. (2022), areas characterized by strong support for Socialism and Communism experienced a powerful fascist response in terms of violence and activity. Such a response, if on the one hand prevented socialists and communists from freely expressing their preferences, on the other hand, induced a consolidation of the right-wing and center-right vote in the face of the perceived red scare.

[15] When including the violence controls, the number of observations drops from 68 to 58. To make sure that the bigger and more significant effect in column (2) is the result of adding violence and is not due to sample selection I run the same specification in (1) with the 58 observations in (2). The coefficient size is the same as with the full sample.

TABLE 1.2: Political activists and electoral support for the fascist regime

	(1)	(2)	(3)	(4)	(5)
	Dep. variable: Vote Share				
Activists_p	-0.219*	-0.504***	-0.468**	-0.296**	-0.532***
	(0.120)	(0.138)	(0.179)	(0.139)	(0.119)
Violence_p		0.365***			1.476*
		(0.099)			(0.809)
Killings_p			0.307**		
			(0.129)		
Red province_p				-0.058	0.221
				(0.117)	(0.170)
$\text{Activists}_p \times \text{Red province}_p$				0.273**	0.031
				(0.120)	(0.248)
$\text{Activists}_p \times \text{Violence}_p$					-1.084
					(0.770)
$\text{Violence}_p \times \text{Red province}_p$					-0.447**
					(0.200)
$\text{Activists}_p \times \text{Red province}_p \times \text{Violence}_p$					0.421*
					(0.238)
Demographic control	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes
Observations	68	58	58	68	58
R-squared	0.609	0.684	0.663	0.653	0.787

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable *Vote Share* is the share of votes collected by the fascist party (Lista Nazionale) in province p in the 1924 election. Demographic control includes the log of total province population. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

Thus, in Column (4) I interact the dummy $RedProvince_p$ with $Activists_p$, whilst in Column (5) I employ the triple interaction $Activists_p \times RedProvince_p \times Violence_p$.

Estimates are aligned with the results by Acemoglu et al. (2022): when interacted with the incidence of activists, results indicate a strong positive effect on electoral outcomes from red provinces with a high incidence of activists. Moreover, the effect increases when accounting for the rate of fascist violence reported in those areas. I interpret these results as indicative of the fact that fascists have prioritized in their violence those provinces which were traditionally aligned with red parties, and particularly those with the highest presence of opponent activists. Altogether, results show that severe endogeneity concerns arise when using electoral outcomes to measure fascist support. The spatial distribution of activists identifies more accurately the areas of greater dissent.

Activists and prior levels of designs and trademarks

I claim that the political activists recorded in the period before Mussolini's rise to power represent a valid exogenous measure of the support for the regime. I substantiate my claim through three main facts. First, those activists were mainly affiliated with the socialist, communist, and anarchist parties, and to a lesser extent, the republican party, none of which had ever historically supported the regime.[16] Second, by using the activists recorded in the period before Mussolini's rise to power, I avoid any constraint on their political expression caused by the fascist activity - as it happened with the election. The third condition requires to be proven empirically. Indeed, in order to be defined as exogenous, my measure of support has to be unrelated to any prior level of local innovation, i.e. political activists should not be correlated to the pre-existing incidence of patents and trademarks released.

This concern relates specifically to activists affiliated with the communist party, historically tied to more industrialized areas, that are also likely to have higher patents and trademarks level. This is not true for other political beliefs, including socialists, that in Italy were highly spread in rural areas (so-called "Proletariato agricolo", rural proletariat, Crainz (1992)). To document the relationship between political activists and the incidence of patents, I first consider the correlation between activists and innovation in the period before Fascism. Then, I estimate the differential effect of activists on patents in the period before and after Mussolini. Results are reported in Table 1.3. The dependent variable is the number of patents in year t released in province p, measured per thousand inhabitants. My variable of interest is the number of activists recorded by the police in year t in province p, measured per 1000 inhabitants. I define a dummy $Mussolini_t$, equal to 1 for the years following Mussolini's first rise to power in 1922, and a dummy $Election_t$, equal to 1 for the years following the election in 1924. I include year and province fixed effects.

In Column (1) I restrict the sample to the years before Mussolini (1900-1922), while in Column (2) I consider the government immediately before Mussolini. Estimates do not show any significance between the incidence of political activists and the incidence of patents and trademarks released. In Columns (3) to (8), the sample

[16]Only a few of the activists recorded in 1919-1920 were affiliated to the fascist movement, and have been dropped by the sample.

covers the ten years before and after Mussolini's appointment (1910-1932) 1910-1930 and distinguishes between the total trademarks and patents altogether ($Total_{pt}$) and the two types of licenses separately ($Designs_{pt}$ and $Trademarks_{pt}$).

Both the interaction terms $Mussolini_t \times Activists_{pt}$ and $Election_t \times Activists_{pt}$ report positive and significant coefficients. The results are fairly clear: the incidence of activists has a significant correlation with the incidence of patents only in the period after the beginning of the fascist regime. This pattern increases my confidence that political activists, despite their potentially higher presence in industrialized areas, were unlikely to have produced an effect on the innovation on their own, when considering the between-provinces variation. Moreover, estimates suggest that areas with higher opposition performed consistently better in terms of patenting levels once the fascist regime was established.

TABLE 1.3: Political activists and IP rights

	(1) Before 1922	(2) 1919-1922	(3) 1910-1930	(4) 1910-1930	(5) 1910-1930	(6) 1910-1930	(7) 1910-1930	(8) 1910-1930
		Total		Designs	Trademarks	Total	Designs	Trademarks
$Activists_{pt}$	0.003	0.005	-0.025*	-0.005	-0.021*	-0.022**	-0.005	-0.017*
	(0.010)	(0.053)	(0.014)	(0.003)	(0.012)	(0.011)	(0.003)	(0.009)
$Mussolini_t \times Activists_{pt}$			0.033**	0.006*	0.027**			
			(0.015)	(0.003)	(0.013)			
$Election_t \times Activists_{pt}$						0.030**	0.007*	0.023**
						(0.012)	(0.004)	(0.009)
Demographic control	yes	yes	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,869	267	1,909	1,909	1,909	1,909	1,909	1,909
R-squared	0.800	0.779	0.633	0.467	0.632	0.671	0.442	0.672

Columns show coefficients of a linear model. Robust standard errors in parentheses, adjusted for clustering at province level. The dependent variable *Total*, *Designs* and *Trademarks* is the incidence of total IP licenses, designs patents and trademarks in province p at time t respectively. Demographic control includes the log of total province population. Panel estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

1.6.2 Main results: the effect of local opposition to the Regime on the granting of patents and trademarks

I now provide evidence of the effect of local opposition to fascism, measured through the number of rival activists in a province, and the granting of patents and trademarks. I employ the following reduced form, cross-sectional specification:

$$y_p = \alpha_1 + \beta \text{Activist}_p + \gamma \text{X}_p + z_r + \epsilon_p \tag{1.3}$$

where y_p is the sum of the patents for designs and trademarks certificates released in the first five years of Mussolini's government (1923-1929) in province p (per 1000 inhabitants) and $Activists_p$ is the number of activists recorded in the years 1919-1920 in province p (per 1000 inhabitants). X_p controls for the province size in terms of population, as well as other province-level characteristics, and z_r are region-fixed effects. The coefficient of interest, β, indicates the effect of political opposition at the time Mussolini came to power on the distribution of patents and trademarks in the following years. More activists mean weaker consensus for the regime. Hence, a positive coefficient would suggest that the government favored the release of patents in less supportive areas. Estimates are reported in Table 1.4.

TABLE 1.4: Effect of political support on IP rights granted

	(1)	(2)	(3)	(4)	(5)
	Dep. variable: Total				
Activists$_p$	4.328**	5.547**	2.390*	2.771*	5.262**
	(1.833)	(2.143)	(1.287)	(1.420)	(2.235)
Main city$_p$			-0.504		
			(0.478)		
Main city$_p$ × Activist$_p$			33.890*		
			(17.441)		
Region capital$_p$				0.132	
				(0.269)	
Region capital$_p$ × Activist$_p$				9.687	
				(9.184)	
Red province$_p$					0.132
					(0.379)
Red province$_p$ × Activist$_p$					1.290
					(7.136)
Least red province$_p$					-0.239
					(0.377)
Least red province$_p$ × Activist$_p$					13.901
					(15.242)
Demographic control	yes	yes	yes	yes	yes
Region FE	no	yes	yes	yes	yes
Observations	93	91	91	91	91
R-squared	0.233	0.407	0.692	0.490	0.417

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable *Total* is the sum of the patents for designs and trademarks certificates released in 1923-1929 in province p (per 1000 inhabitants). Demographic control includes the log of total province population. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

In all five columns, there is a sizeable effect of local opposition on the incidence

of patents and trademarks. One standard deviation increase in my measure of political opposition is associated with an increase of 0.22-0.48 standard deviations in the outcome variable.[17] In Columns (3) and (4) I included city dummies for the ten most populous cities[18] ($Main\ City_p$) and a dummy variable $Region\ Capital_p$, to control for those provinces which contain the capital of the region. The effect increases sensibly in the case of the most populous cities, where it is likely to be biased by their intrinsically higher level of industrial firms. Conversely, there is no significant within-region difference between the main province and the others (Column (4)). In the last column, I consider again the difference between historically red and non-red provinces. Estimates do not suggest a differential effect of the incidence of activists in the two categories of provinces. Finally, Tables A.9 and A.10 in Appendix A replicate the same estimates above using as a dependent variable either the number of patents for designs (Table A.9) or the number of trademarks certificates (Table A.10). Results are largely consistent, showing positive coefficients in all the different specifications, with a greater coefficient size in the case of trademarks.

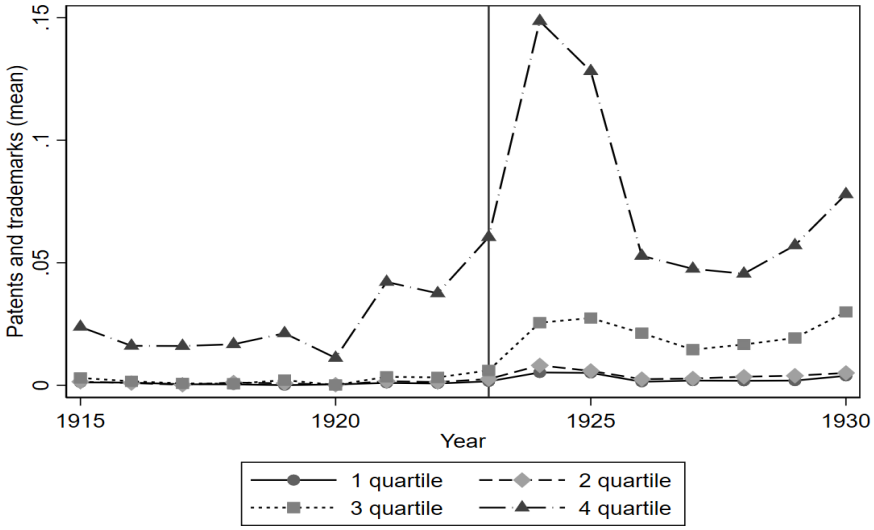
Differences-in-Differences estimations

The model in Eq.1.3 captures the cross-sectional correlation among provinces with different numbers of activists. However, this model does not allow to control for time-invariant unobservables at the province level, which could potentially correlate positively with the number of patents and the number of activists. Figure 1.6 plots the average number of patents and trademarks obtained annually (per 1000 population) by provinces with different levels of fascist support, as measured by the incidence of activists during the Red Biennium (per 1000 population). The figure suggests that the beginning of the fascist regime coincides with a sharp increase in the number of patents and trademarks registered by provinces with the greatest activists' incidence (those belonging to the 3rd and 4th quartiles), while provinces falling in the lowest ranks do not significantly change their pattern.

[17] One additional unit in my measure of political support is associated with 2.7-5.5 more units in the incidence of patents measured in the first five years of Mussolini's government. On average, this translates into a positive effect ranging between 1.3 and 3%.

[18] At that time, these were Bari, Bologna, Catania, Firenze, Genova, Milano, Napoli, Palermo, Roma, and Torino.

FIGURE 1.6: Annual average of design patents and trademarks released (per 1000 population), by province level of activists (per 1000 population)



To better evaluate the regime-induced response in terms of patents of firms located in provinces with differential opposition rates, and exclude that the difference was driven by pre-existing own province characteristics, I set up an event-study analysis. Holding fixed the activist incidence in 1919-1920, I compare the over-the-years production of patents and trademarks of provinces with different opposition levels. I employ the conventional event-study framework:

$$y_{pt} = a_p + a_t + \sum_{x=t_0-7, \neq t_0}^{t_0+8} \beta_x \times \text{Activists}_p + \epsilon_{pt} \tag{1.4}$$

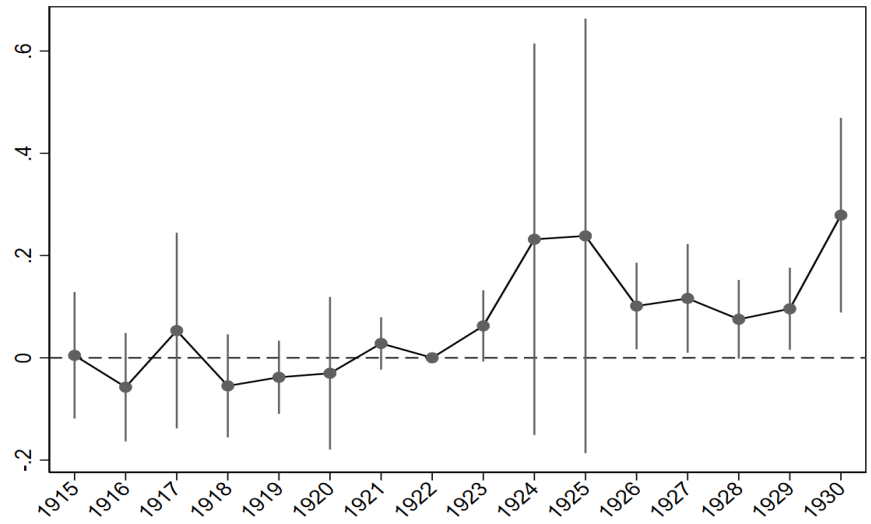
where y_{pt} is the number of patents per 1000 inhabitants in province p and year t. $Activists_p$ is the province number of activists per 1000 inhabitants recorded in 1919-1920. Coefficients β_x are time dummies. I omit the baseline period 1922 (i.e. the last year before Mussolini's rise to power) such that the time dummies should be interpreted as the change in outcomes relative to that omitted period. I saturate the model by including year fixed effects, a_t, and a set of province fixed effects, a_p, differencing out the time-invariant unobservables at the province level.

Figures 1.7 plots the estimated coefficients. I consider the years from 1915 to 1930. Reassuringly, the coefficients in the pre-periods are not statistically significant, implying that provinces with different opposition rates had similar trends in terms

of their pre-regime patents and trademarks measures. Consistent with Figure 1.6, we see a persistent increase in patents and trademarks for firms located in areas of greater opposition after the beginning of the fascist regime.

Given that the years 1915-1918 also corresponds to the WWI, in Appendix A I first restrict the analysis to the three years before and after Mussolini's appointment (1920-1925), as well as to the ten years before and after (1912-1932).

FIGURE 1.7: Event study, IP certificates released in provinces with different activists' rates



Notes: Estimated impact of the fascist regime on designs and trademarks production rates for provinces with differential activists' rates. Province and year fixed effects are taken into account, and the base year is the year 1922. The bars indicate confidence intervals at the 95% confidence level. Standard errors clustered at the province level.

Next, I estimate a differences-in-differences specification according to the following linear model:

$$y_{pt} = a_p + a_t + \beta \text{After}_t \times \text{Activists}_p + \epsilon_{pt} \tag{1.5}$$

In this specification, the coefficient of interest, β, gauges the differential effect of the fascist regime on patents and trademarks granted to provinces with different levels of activists. More activists indicate areas with lower support for the regime. A positive coefficient estimate would support the hypothesis that, other conditions equal, the regime prioritized and favored areas of lower consensus, that could have represented potential sources of political instability. Table 1.5 reports the DiD estimates.

Results show a positive and statistically significant effect of the fascist regime on the number of patents granted to those areas with a greater number of political activists. Results are robust across the model's specifications. In Columns (1) to (3) I use the year 1922 to define the period before and after Mussolini. In Columns (4) to (6), I use instead the year 1924, which is conventionally indicated by historians as the beginning of the dictatorship. Results are similar in magnitude to those when considering Mussolini's 1922 appointment as prime minister, as reported in Columns (1) to (3). A one standard deviation increase in my measure of political opposition translates in an increase of 0.10 standard deviations in the incidence of patents during the fascist regime. More intuitively, a one unit increase in Activists_p displays a 0.15 more units in patents in the period after the rise of Mussolini. On average, this corresponds to a 0.9% higher growth rate in the number of patents and trademarks obtained at the province level. From Column (4), the effect displays a greater statistical significance, suggesting that political considerations became predominant once the 1924 election legitimized the fascist regime. This is not surprising: if the granting of patents and trademarks was subjected to the government's manipulations, I would expect a greater effect after the removal of the democratic and parliamentarian constraints, which were wiped out only after the 1924 election.

TABLE 1.5: Effect of political support on IP rights granted

	(1) Total	(2) Designs	(3) Trademarks	(4) Total	(5) Designs	(6) Trademarks
$\text{Mussolini}_t \times \text{Activists}_p$	0.147*	0.035**	0.113			
	(0.086)	(0.015)	(0.075)			
$\text{Election}_t \times \text{Activists}_p$				0.147**	0.042***	0.106*
				(0.068)	(0.015)	(0.057)
Demographic controls	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	1,824	1,824	1,824	1,824	1,824	1,824
R-squared	0.653	0.489	0.649	0.684	0.460	0.683

Columns show coefficients of a linear model. Robust standard errors in parentheses, adjusted for clustering at the province level. The dependent variable *Total*, *Designs* and *Trademarks* is the incidence of total IP licenses, design patents and trademarks in province p at time t respectively. Panel estimates. All the specifications include year and province fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

In addition to this baseline scenario, in Appendix A I consider alternative specifications. In Table A.11 I report the estimates by computing the mean values of the

dependent and independent variables in the period before and after Mussolini's appointment. In Table A.12, I exclude from the sample the years of the WWI. In Table A.13, I perform other sample restrictions and I also log-transformed both my dependent and independent variables, which allows to reduce the skewness of the data distribution. In Table A.14 I perform further sample restrictions, based on the distribution of patents and activists across provinces. To account for the possibility that the effect is driven by provinces with very high levels of both innovation and activists and reduce the between-provinces, pre-existing differences in the number of patents produced, I also dropped from the samples provinces that fall in the highest ranks of the distribution in the two variables. Having excluded this group of observations returns a much more comparable sample of observations (Appendix A, Figure A.2).

IV estimations

To probe further the interpretation of my findings, I consider an Instrumental Variable approach. I instrument the electoral (province-level) support to the fascist party with the incidence of activists detected in 1919-1920 in the province. I employ the same cross-sectional form as in Eq.1.3. This test has to be intended as a second-order validation of the results in Section 1.6.2. The motivation is twofold. First, within this setting, I estimate the effect of electoral support on the following IP rights allocation. This takes a slightly different interpretation from the effect estimated by the reduced form specification, where the activists measure the intensity of local "ideological" opposition and hostile political activity. Second, employing an IV approach further reduces the sample, as it requires geolocating the observations according to the province denomination in 1924 (for which election data are available), and therefore decreases the variation observed in the data.

Despite these caveats, the IV approach can be very useful. I am interested in detecting the behavior of Mussolini toward his opponents with respect to the rewards he provided for innovation activity. One fundamental issue arises when determining if a lower vote share in this context is indicative of lower support. Indeed, we don't know whether the areas that collected the highest shares were effectively the

ones with the highest popular consensus. As previously explained, a higher vote share was also recorded in areas that were generally less supportive but a) were influenced to vote in his favor because of the fascist activity or b) fascist opponents registered a low turnout, with the effect of increasing the vote share in favor of the fascist party. Hence, regressing the IP licenses on the votes share collected, and assuming a negative correlation, does not necessarily implies that Mussolini rewarded less the areas that were more in his favor.[19] By using the variation in the activists' incidence that negatively correlates with the votes received by the fascist party, I can detect the effect of lower electoral support. Importantly, from the tests performed in Section 1.6.1, a higher activist incidence pre-Mussolini does not cause a greater amount of patents in the period after, as we saw that there is no significant correlation between innovation levels and political activism. The only way in which higher activism could increase patents is if the government decides to grant patents according to the level of opposition it faces.

In Table 1.6 I first report the OLS reduced form estimates by employing the 1924 spatial division to calculate the incidence of patents and activists, to verify that previous results were not driven by the differences in the provinces denomination between 1924 and 1970. Despite the lower sample, estimates are largely consistent with Table 1.4. Then, I estimate the effect of lower electoral support on the subsequent amount of patents and trademarks granted. Column (5) reports the coefficient of the sole vote share. The effect is negative, although not significant, with a weak first stage. In Columns (6) to (8), I condition the correlation between the vote share and the activists' incidence on the value of other covariates, particularly those - such as the fascist violence - that were responsible for contaminating the relationship. The validity of the instruments increases above the rule of thumb F-statistic of 10. All the coefficients are negative and significant. According to estimates, a one-unit decrease in the explanatory variable increases the dependent variable by about 1.8-2.8 units, which corresponds to a 1-1.5% increase on average.

[19] This relationship, when estimated via OLS, displays a negative, but marginally insignificant, coefficient (p-value at 14%).

TABLE 1.6: Effect of electoral support on IP rights granted

Dep. variable: Total	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS				IV			
Activists$_p$	3.154**	3.842*	2.785*	2.714*				
	(1.432)	(2.133)	(1.562)	(1.388)				
Vote share					-5.315	-2.818*	-1.768*	-1.819*
					(3.424)	(1.619)	(1.009)	(1.063)
Violence$_p$		-0.201	-0.090	-0.062		0.648**	0.483**	0.535*
		(0.331)	(0.247)	(0.248)		(0.253)	(0.184)	(0.277)
Red province$_p$			0.466	0.376			0.630*	0.570*
			(0.294)	(0.276)			(0.322)	(0.286)
Demographic control	yes	yes	yes	yes	yes	yes	yes	yes
Additional controls	no	no	no	yes	no	no	no	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
First-Stage					-0.593*	-1.364***	-1.575***	-1.492***
					(0.325)	(0.374)	(0.368)	(0.353)
Kleibergen-Paap Wald Fstat					3.34	13.32	18.26	17.89
Observations	68	58	58	58	68	58	58	58
R-squared	0.341	0.372	0.430	0.583	-0.870	0.060	0.328	0.442

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable *Total* is the sum of the patents for designs and trademarks certificates released in 1923-1929 in province p (per 1000 inhabitants). Demographic control includes the log of total province population. Additional controls include the large donors to the fascist party, the number of industrial strikes, the share of industrial workers and the level of literacy. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

1.6.3 Robustness checks

Further robustness checks for the results are provided in this section. All the corresponding tables are reported in the Appendix A.

Does activists' incidence variation coincide with other relevant changes?

My main hypothesis is that in an autocratic regime such as Italian Fascism, the granting of intellectual property recognition is driven by the political support received, that in my setting is proxied by the political activists affiliated with opponent parties. I show a clear relationship between the spatial distribution of patents and trademarks and the incidence of political activists, which are intended to exogenously identify the support for the regime. However, political activists can also be a measure for something else, which intrinsically correlates with the levels of innovation: the level of industrialization, the presence of a rich entrepreneurship class or even being a source of innovation by themselves, if they possess particularly high levels of education. If this is the case, we may observe a spurious (rather than causal) correlation between political support (activists) and the incidence of

patents and trademarks.

To corroborate my results, I included in my baseline regression some selected predictors that are likely to influence the level of innovation and also explain the spatial distribution of activists. From Acemoglu et al. (2022), I retrieved province-level controls for the share of industrial workers, the number of industrial strikes and the level of male literacy. The share of industrial workers allows to control for the level of industrialization and the presence of industrial firms in a province. Instead, including the number of industrial strikes takes into account the fact that social disorders usually take place where labour unions are more active. Indeed, one of the very first interventions of the regime was the dismantling of labour unions, which could have sensibly reduced business uncertainty and favoured innovation investments. The data cover 64 provinces (out of the 69 existing in 1919 and the 72 existing in 1924) and thus results in a smaller sample, which is further reduced to 58 observations by the inclusion of region-fixed effects.

Estimates are reported in Table A.15. Column (1) displays my baseline specification as in Eq.1.3. Columns (2) to (6) reports the estimates by including the additional regressors separately, whilst in Columns (7) to (8) I add the full set. Estimates show a low significant correlation that does not affect the coefficient on activists and disappears when controlling for the regional variation and when considering the full set of predictors altogether. Overall, results indicate that the variation in the patents incidence is not explained by province characteristics usually associated with higher innovation levels, supporting my interpretation of a discretionary granting strategy addressed by the fascist government.

Potential bias: sample selection

The effect of activists on patents could be exclusively driven by some specific categories of activists in 1919-1920, which correlated with industrial productivity and possibly with the future incidence of patents. First, if the firms' concentration played a role in the number of activists I would reasonably expect its effect to be driven by those living in urban areas. Second, some activists are more likely to be employed in industrial sectors and to be distributed in specific locations (such as the "indus-

try triangle" in the North of Italy). This is again the case of communists. In that case, this category of individuals may suffer from a selection bias. In Table A.16, I conducted a series of additional tests to address these concerns.

In Column (1), I add to my baseline regression the share of activists living in the province's main urban centre ($Urban\ share_p$). The coefficient is negative and significant. This suggests that the provinces with a higher incidence of patents during the fascist regime were those with a higher share of activists in the peripheral areas during the Red Biennium. More activists in the urban centres mean actually fewer patents released by the fascist government. In Column (2) I tested only the incidence of communists, while in Column (3) I eliminate these activists from my computations for the total activists recorded in a province. Estimates show that the spatial variation in activism affiliated with the communist party explains a large portion of the patents' distribution. Nevertheless, excluding this category from the sample (Column (3)) does not produce significant changes in the overall effect, which is still positive and significant, nor does the exclusion of both communists and socialists in Column (4). Although reduced in size, the effect is still positive and significant also for other categories of activists historically not employed in the industry.

To corroborate the results obtained so far, in Table A.17 I address an alternative strategy. Assuming local political preferences to be time-invariant (at least in the short-medium run), I use different periods to map the future opposition to the regime. By doing so, I still follow the assumption that political activists are a proxy for future opposition to the regime, however, I attenuate the effect on patents that may arise by the fact that many activists in 1919-1920 were prosecuted in industrial areas due to the high number of industrial strikes in that period. This is also visible by looking at the composition of these activists: while during the Red Biennium a majoritarian share was affiliated to the Communist and Socialist Party, in 1915-16 and 1913-1914 a large majority was instead recorded as Anarchists and Republicans (see Figure A.1 in Appendix A). Particularly the anarchists, while sharing with communists and socialists the aim for social revolution, found their consensus in the lowest and most marginalized segments of the population, and rarely meet the preferences of the large industrial workforce.[20]

[20]Due to their preference for autonomous and violent actions and their rejection of official chan-

Hence, in Columns (1), (2) and (3) I first assess the relationship between the vote share in favour of the fascist party and the activists in the years 1913-1914, 1915-1916 and 1917-1918 respectively. Estimates are consistent with the results in Table 1.2. A higher incidence of activists affiliated with revolutionary forces negatively correlates to the future electoral support of the fascist regime, suggesting a persistence over time of local political preferences. Column (1) displays a very high significance. This is explained by the historical events. In 1914, under the initiative of the anarchists, an anti-militarist convention took place in Ancona. The government violently intervened, provoking the killing of several activists. This fact triggered a wave of popular outrage and a series of insurrections spread across the country in the following months. In that instance, anarchists received strong support from republicans and socialists, including the most revolutionary wing led by Mussolini himself. Very likely, the spatial distribution of activists during this period revealed quite accurately the local political beliefs. Finally, in the last three columns, I estimate the effect on the future release of patents. Also in this case, the estimates are positive and significant, and the size of the coefficient increases the closer the time is to the Red Biennium.

State propaganda and the granting of patents

Political support could be significantly correlated to another factor that is likely to have impacted the request for patents by firms: the fascist propaganda. Different levels of exposure to the nationalistic propaganda on productivity and technology could have differently stimulated firms to achieve the fascist standards, with the consequence that some of them became more sensitive to apply and being granted new patents. If this is the case, omitting a measure for the local level propaganda may produce biases in the estimated effect of political support on the regime's concession of intellectual property rights.

I obtain an estimated measure of the regime's presence at the local level using the photographic archive of fascist activities collected by the official media of the regime. Through the photo descriptions, I geolocalize all major activities and events

nels, they were generally ostracized by the red forces, which expelled them from their trade unions in 1912 and rejected any official political coalition.

attended by Mussolini during the twenty years of government (openings of new establishments, cultural events, public speeches), excluding his governmental duties held in Rome. I additionally consider also the location of the so-called "fascist towns", i.e. those built by the regime on the Italian peninsula mainly as a result of its land reclamation policy. A higher regime presence, measured as a higher number of events organized and attended by Mussolini, would entail a higher exposure to fascist propaganda. Similarly, provinces where the regime sponsored the foundation of new towns are assumed to have been more influenced by the fascist ideology.

With regards to the propaganda events, the best approach would be to use only those events organized in the first years of the regime, as it is very unlikely that the political circumstances at the beginning of the regime could have affected the location of such events in the far future. Nevertheless, reducing the sample to the first five years, as I did in my main specifications, does not allow us to collect a meaningful data sample since the variation across provinces is drastically low.[21] Therefore, I consider the number of events attended by Mussolini from 1927 until the beginning of WWII. In this case, my dependent variable also changes to the sum of the patents for designs and trademarks certificates granted in province p (per 1000 inhabitants) in the same period.

In Table A.18 I first consider the relationship between the support for Fascism at the time of Mussolini's rise to power and the intensity of the regime's presence in the area during his dictatorship (Column (1)). Estimates report no evidence that propaganda spread more intensively in areas of less support in the early twenties, indicating that Mussolini's decision to visit some locations rather than others was not driven by the local sentiment towards the regime at its beginning. Nevertheless, propaganda seems to have a role in influencing the distribution of patents and trademarks. In Column (2) I report the effect of political support on the total patents and trademarks granted during the whole regime to provinces. When considering the total stock of patents and trademarks, one additional unit in my measure of activists' incidence results in around 25 more units in the incidence of patents obtained during the regime. In Column (3), I tested the relationship between the distribution of

[21] These data are available only from 1927. Moreover, only seven provinces have been visited by Mussolini in 1927-1929.

patents and the intensity of local fascist presence, by using the variables *Propaganda Episodes*$_p$ and *Fascist town*$_p$. Estimates suggest a greater number of patents granted to provinces that hosted a higher number of propaganda events, while provinces encompassing new fascist towns report lower levels of patents granted, which is in line with the fact that new towns had been built in historically distressed and underdeveloped agrarian areas. Importantly, despite their significance, the inclusion of these regressors does not change my qualitative results: political support persists in being a highly significant predictor of the future level of patents and trademarks granted.

1.7 Conclusion

Intellectual property rights are a powerful tool to protect technology innovations and gain competitive advantage. This paper investigates how a government influences the recognition of intellectual property rights by strategically granting them based on local political support. I provide substantial evidence using as an experimental case the granting of new designs and trademarks during the fascist regime in Italy. I show a substantial variation in the incidence of these low-innovation patents across the Italian territory and I argued that their approval has been manipulated by the regime for political purposes.

I document a strong association between the spatial distribution of new designs and trademarks and the incidence of political activists affiliated with anti-fascist movements in the period before the rise of Mussolini to power. I further argued that this relationship is not explained by any pre-existing level of innovation, rather, the incidence of activists well captures the future local support for the regime. I interpret my results by regarding patents and trademarks as an asset that could be granted by the government according to political objectives. The fact that the granting of these IP rights has been significantly higher in areas of weaker popular support is suggestive of a government strategy to exploit the distribution of these rights to expand its consensus. Within this interpretation, Mussolini deliberated to allocate resources based on the aggregate political preferences, thereby favoring more the less supportive areas in the attempt to mitigate potential sources of instability.

A potential caveat relates to the complexity of assessing the outcome of this strategy in terms of subsequent support for the regime. Indeed, due to the data limitations, it is not possible to measure whether the popular consensus has effectively increased as a result of the fascist IP policies, nor if the political preferences of the IP rights owners significantly changed afterward. Moreover, it is also true that a higher local opposition at the province level does not automatically imply a higher aversion from the companies that applied for IP protection. An alternative explanation for the differential amount of IP rights obtained by more averse provinces is that firms located in those areas received preferential treatment by the regime as an extra reward for their support.

Despite these caveats, my analysis pins down a key lesson about the process of IP recognition: that it can be heavily affected by the government's intervention. Whenever a leader has the power to influence the decisions about IP rights, they can exploit their recognition to pursue their objectives. If so, the ability to generate endogenous, and biased, innovation measures can be used to mask weak innovation, as it recently happened with the hyper-inflated number of low-quality patents in China. Reconnecting to the Italian experience, it is not a case that despite the proliferation of these innovation measures, Italy did not display any significant growth during Fascism. Therefore, it is important to account for this issue when evaluating the innovation performance. In parallel, potential misallocation can be mitigated through the design of an IP system that guarantees the deputy authority the highest independence from the government.

Chapter 2

Of Shrimp and Men: Innovation, Competition and Product Diversity

We build a model showing how a cost-reducing innovation can hurt the profit of the innovator by decreasing product diversity and strengthening competition. An innovation increasing social welfare may never be delivered by the private sector, regardless of how much of its R&D is subsidized. The only way is for the government to fully provide it. We illustrate this result using data from the shrimp industry. In the late 1990s, a US governmental program designed a new breed reducing the production cost of a variety of shrimp. This innovation gave a temporary boost to the profit of American producers. Over time, other countries abandoned their native production to adopt the new breed. In this catch-up phase, US producers not only lost their cost advantage, but also the market power derived from product differentiation.

Keywords: innovation, appropriability, product differentiation
JEL Code: D43, F61, L1, L81, O3, Q22

2.1 Introduction

Western manufacturing companies typically see R&D investment as a way to gain protection against international competition (Hombert & Matray, 2018). Delivering a radical innovation provides a temporary competitive advantage to the innovator, until the laggard eventually catches up (Aghion et al., 2005; Griffith & Van Reenen, 2021). Competition then goes back to its initial level, until the next breakthrough.

In this paper, we show how a cost-reducing innovation can generate an increase in competition, leading to a trade-off between higher market power in the short run and lower market power in the long run. Using a simple model of differentiated Cournot competition with endogenous choice of product variety, we find that innovation in one variety may lead to a decrease in product diversity in the catch-up phase, eventually decreasing the profit of the innovator and of all other producers. This result happens when the cost reduction delivered from an innovation is high enough to wipe out the incentives to offer differentiated products but not sufficient to compensate the negative effect of the increase in competition. In that scenario, there is no amount of R&D subsidy that aligns private interest and social welfare: the only way is for the government to provide the innovation itself.

Our result is thus in contrast with recent views of industrial policy – defined as providing sector-specific investment subsidies – as a way to foster growth by supporting national producers (Criscuolo et al., 2019; Liu, 2019). In our model, it may be in the interest of the government to directly provide R&D because it improves consumer welfare, at the cost of decreasing producer surplus.

An illustrative example of a "cursed" innovation (for producers) which stemmed as a result of a government's intervention is the US development of pathogen-free shrimp. Shrimp is the most important internationally traded fishery commodity in terms of value, worth more than $20 billion a year in 2020.[1] In the mid Eighties the US government launched a publicly funded research program that identified as main constraints on the industry performance the spread of disease across cultivation. Having prioritized the prevention and treatment of these diseases, in the early nineties they developed a bio-technology to produce virus resistant shrimp

[1] FAO Globefish trade statistics, April 2020.

seed. The technology was specifically tailored to the most commonly cultivated US shrimp species, and not transferable to the one cultivated by Asian competitors, which gave the US a strong advantage in the following years.

Nevertheless, technology spillovers quickly made the innovation available to competitors which decided to switch from their native production to the US one. In this catch-up phase, US producers not only lost their cost advantage, but also the market power derived from product differentiation. At present, the US variety of shrimp accounts for more than 75% of the world production, but they are largely produced in Asia. The US shrimp industry almost disappeared, accounting for less than 10% of the domestic consumption and less than 1% of total world production.

Our paper relates to the literature on innovation, spillovers and absorptive capacity. The existence of a catch-up phase in innovation is based on the fact that innovation shares some of the characteristics of a public good (Arrow, 1962, p.619), so that innovators often fail to capture the economic returns on their R&D investment (Levin et al., 1987; Teece, 2018, 1986).[2]

In our model, firms do not only under provide innovation, but they may actively oppose it by fear of future competition. This result is reminiscent of Cunningham et al., 2021's result of "killer acquisition" where dominant firms acquire startups to destroy a potentially superior technology. It also relates to the "Cournot cost paradox" (Seade, 1985) that a common decrease in firms unit costs may lead to a lower equilibrium profit for some degrees of convexity of the inverse demand function, so that R&D races are a form of prisoner's dilemma (Amir et al., 2017). Our model with linear demand however does not satisfy the conditions for the existence of such a cost paradox.

The link between product differentiation and innovation has been studied among others by Vives, 2008 and Narajabad and Watson, 2011, who finds that higher product substitutability increases the incentives to innovate. The key differences with our approach is that product diversity is endogenous, and we condition the ability

[2]Spillovers are however not automatic: they are the result of an investment in absorptive capacity by those who benefit from it, be it through an independent investment in R&D or through the adoption of technological standards (Cohen & Levinthal, 1989; Foucart & Li, 2021; Keller, 2004). The study of technological spillovers has also led to a stream of research on whether R&D investments are complements or substitutes and the implication of these results on growth models (Aghion & Jaravel, 2015; Cassiman & Veugelers, 2002).

of a firm to adopt an innovation in the catch-up phase to the adoption of a similar variety.

Finally, albeit the research fields are seemingly unrelated, the logic of our main theoretical argument is mathematically very close to the "Braess Paradox" (Braess, 1968; Braess et al., 2005) on the congestion of road networks. In some cases, adding an express road to a network subject to congestion leads commuters to use less diversified paths, so that everyone goes slower. In our setting, by decreasing the production cost of one variety of shrimp, everyone makes lower profit because everyone switch to producing that variety. The idea that a laggard chooses to use the same technology as an innovator who would have preferred to be left alone using it is also related to the "pesky little brother" situation in standard adoption described by Besen and Farrell, 1994.

The paper is structured as follows. In Section 2.2, we present the theoretical model. Section 2.3 shows that data on the evolution of the shrimp market is consistent with our theoretical predictions. We conclude in Section 2.4.

2.2 Theory

In this section, we provide a simple model of a market in which two representative firms compete on quantity and choose their product variety. One of the two firms is in position to invest in a cost-reducing innovation in one variety. A successful innovation is protected for one period, and becomes available to both firms in the next one. We start by comparing the equilibrium outcome with and without innovation. We then move to the question of optimal investment in innovation from the point of view of the firm and of a social planner.

To keep our setup as simple as possible, we focus on the case of symmetric demand and cost functions. As our main result is a proof of existence of a certain type of equilibrium, we would indeed gain nothing by looking at the more realistic case in which the cost is asymmetric for a given level of technology.

2.2.1 Setup

Two representative firms, Home (h) and Foreign (f) compete in quantities for the production of a good. There are two varieties of this good on the market, that we denote by (v) and (m), corresponding to the US breed (also known as *Vannamei*) and Asian breed (*Monodon*) in our shrimp example. Each of the firms can produce only one variety. As producers decide their quantities but are price takers on world markets, and as the two varieties are not identical, we model the market as a differentiated Cournot competition (Singh & Vives, 1984).

Inverse demand for firm $i \in \{h, f\}$ is given by $\mathrm{p}_i^k = A - q_i^k - g(k,l)q_j^l$,

- with $k, l \in \{v, m\}$ the chosen variety of each firm, and q_i^k and q_j^l the respective quantities, $j \neq i$;
- For $k \neq l$, $g = \gamma \in (0,1)$, the two firms produce different varieties and γ characterizes the level of substitution between both varieties ;
- For $k = l$, $g = 1$, the two firms produce the same variety and the game is a standard Cournot with homogeneous goods and linear demand.

Our focus is on the impact of innovation on competition and product diversity. Following Aghion et al., 2005, we assume that when a firm benefits from an innovation, it gets a competitive advantage for one period. We model this advantage by a technology allowing to reduce its production cost. Then, the laggard eventually catches up on the innovation and benefits from the same technology. Our focus is on the case where innovation is possible on a single variety only, v.

The game consists of three stages. In the first stage, the firm h chooses her investment in innovation. In the second stage, h has a cost advantage in the production of variety v if the innovation was successful. In the third stage, both f and h benefit from the innovation if it was successful.

There are thus three possible cost-configurations:

1. **Pre-Innovation**: both firms produce at constant marginal cost $c_i^k = c > 0$ for all $k \in \{v, m\}$;

2. **Innovation:** firm h can produce variety v at marginal cost $c_h^v = 0$, while the production cost for the other variety and the other firm remain $c_f^v = c_h^m = c_f^m = c$;

3. **Catch-up:** both firms produce variety v at marginal cost $c_i^v = 0$ for all $i \in \{h, f\}$, while the production cost for the other variety m remains $c_h^m = c_f^m = c$.

Our parameter c is therefore a measure of how important the innovation is. A high c means that the innovation offers a significant reduction in the production costs, while a low value of c means the innovation is not substantial.

We start by looking at the competitive outcomes in the different cost configurations. We then solve the first stage of innovation by backward induction, given expectations of the payoffs in the later stages. We also look at the optimal government subsidy for innovation in the first stage.

A key assumption for our results is that only one firm is in position to innovate, in only one variety. Allowing for f to also invest in $R\&D$ would increase the respective incentives to invest, as the two firms may be stuck in an equilibrium reminiscent of the prisoners' dilemma documented in Amir et al., 2017: despite not benefiting any firm, both invest in the innovation because they expect the other one to do so. Our curse of innovation therefore relies on the existence of a firm with larger pockets, or of a country with a technological advantage. Allowing for innovation in both varieties would mean that diversity is possible in the catch up phase. Our assumption that innovation is only possible in one variety thus corresponds to the idea that as technology evolves markets move towards more standardization.

2.2.2 Competitive outcomes

We now look at the competitive outcomes in the three possible cost configurations of the game.

Pre-innovation

We start by considering the case without innovation. As the demand and costs are symmetric, we only need to solve for two cases: both firms producing the same va-

riety, and both producing a different variety. We denote by π^i the equilibrium profit of firm i, for a given choice and a given marginal cost of both firms in the chosen market (both in the form *home,foreign*). We provide the detailed computations and collect the proofs of the different Lemmas and Propositions in Appendix B. We report in Table 2.1 the equilibrium profit of both firms conditional on their choice of variety. As $\gamma \in (0, 1)$, the following result immediately follows:

Lemma 1 *The Pre-innovation case has two Nash equilibria in pure strategy, in which both firms choose different varieties.*

The formal proof is in Appendix B. In either of the Nash equilibria in pure strategy, there is product diversity and both firms make a profit $\frac{(A-c)^2}{(2+\gamma)^2}$. There is also a mixed strategy Nash equilibrium, but it is not stable in the sense that any small perturbation in the beliefs make the best responses converge towards one of the two pure strategy Nash Equilibria. The same holds for all the mixed strategy equilibria identified in the next subsections.

TABLE 2.1: Equilibrium payoffs in the pre-innovation case

		Foreign	
		v	m
Home	v	$\frac{(A-c)^2}{9}, \frac{(A-c)^2}{9}$	$\frac{(A-c)^2}{(2+\gamma)^2}, \frac{(A-c)^2}{(2+\gamma)^2}$
	m	$\frac{(A-c)^2}{(2+\gamma)^2}, \frac{(A-c)^2}{(2+\gamma)^2}$	$\frac{(A-c)^2}{9}, \frac{(A-c)^2}{9}$

Innovation

We now look at the case where firm h benefits from a cost-reducing innovation in variety v, so that its marginal cost for that variety is equal to 0, while it remains $c > 0$ for variety m. Firm f however keeps the same marginal cost as before, $c > 0$. We report in Table 2.2 the Cournot equilibrium profits for each choice of variety, given the cost structure.

TABLE 2.2: Equilibrium payoffs in the innovation case

		Foreign: v	Foreign: m
Home	v	$\frac{(A+c)^2}{9}, \frac{(A-2c)^2}{9}$	$\frac{(A(2-\gamma)+\gamma c)^2}{(4-\gamma^2)^2}, \frac{(A(2-\gamma)-2c)^2}{(4-\gamma^2)^2}$
	m	$\frac{(A-c)^2}{(2+\gamma)^2}, \frac{(A-c)^2}{(2+\gamma)^2}$	$\frac{(A-c)^2}{9}, \frac{(A-c)^2}{9}$

Depending on the value of c, the games displays either two equilibria in pure strategy, or a unique one.

Lemma 2 *The innovation case has either one or two Nash equilibria in pure strategy. For $c \leq \frac{A(1-\gamma)}{\gamma+5} = \tilde{c}$, the two equilibria are similar to the pre-innovation case, both firms choose different varieties. For $c > \tilde{c}$, in the unique equilibrium the firm benefiting from the innovation h produces the variety v in which it has a cost advantage, the other firm f produces the other variety m.*

The formal proof is in Appendix B. If the cost-advantage from the innovation is small, no firm has a dominant strategy, and it is a best response for both firms to choose a different variety than the other. As the cost-reducing innovation is available to firm h only, and only for variety v, the game is however not symmetric. Firm h has a higher profit when it produces v and f produces m than in the other equilibrium. In our simultaneous setting, whether firms coordinate on this equilibrium is however a matter of beliefs.[3] When c is sufficiently high, it becomes a dominant strategy for firm h to produce the variety v on which it has a cost advantage. In that case, the best response of firm f is to produce the other variety so that the equilibrium is unique.

Catch-up

Finally, we look at the case in which both firms have access to the new technology and can produce at low cost the variety v (but not m). In the case without differentiation, the standard Cournot result holds, with $c = 0$ when both firms produce

[3] An alternative would be to consider variety adoption as sequential and let the innovator move first, in which case the unique sequential equilibrium of the innovation subgame involves the innovator h producing the low-cost variety v.

variety v. In the case with differentiation, the firm producing the low cost variety v is always advantaged.

We report in Table 2.3 the Cournot equilibrium profits for each choice of variety, given the cost structure.

TABLE 2.3: Equilibrium payoffs in the catch-up case

		Foreign: v	Foreign: m
Home	v	$\frac{A^2}{9}, \frac{A^2}{9}$	$\frac{(A(2-\gamma)+\gamma c)^2}{(4-\gamma^2)^2}, \frac{(A(2-\gamma)-2c)^2}{(4-\gamma^2)^2}$
	m	$\frac{(A(2-\gamma)-2c)^2}{(4-\gamma^2)^2}, \frac{(A(2-\gamma)+\gamma c)^2}{(4-\gamma^2)^2}$	$\frac{(A-c)^2}{9}, \frac{(A-c)^2}{9}$

Depending on the value of c, the games displays either two equilibria in pure strategy, or a unique one.

Lemma 3 *The catch-up case has either one or two Nash equilibria in pure strategy. For $c \leq \frac{1}{6}A(2-\gamma)(1-\gamma) = \bar{c}$, the two equilibria are similar to the pre-innovation case, both firms choose different varieties. For $c > \bar{c}$, in the unique equilibrium both firms produce variety v.*

The formal proof is in Appendix B. In this catch-up case, the game is symmetric among players, but not among varieties. When the benefit from the innovation c is sufficiently low, it remains beneficial for both firms to produce different varieties. While it is a best-response for each firm to produce a different variety than the other, the payoffs are not identical, as the profit of the firm producing variety v is higher. For higher values of the benefit from the innovation c, producing v becomes a dominant strategy for both firms. In that case, both firms produce the cheaper variety in equilibrium. The catch-up case, due to the asymmetric production costs between the two varieties, is the only configuration in which the market may not display product diversity in equilibrium.

2.2.3 Equilibrium investment and optimal subsidy

In this subsection, we look at what the equilibria in the three possible subgames imply in terms of equilibrium investment in innovation.

In the first stage, firm h maximizes her expected profit by backward induction, given the equilibrium outcomes in the different possible sub-games. Assume that to deliver an innovation with probability θ, firm h has to spend in R&D an amount equal to $\eta R(\theta)$, with R, the total cost of delivering the innovation, continuous, increasing and convex, $R(0) = 0$, $\lim_{\theta \to 1} \frac{\partial R}{\partial \theta} = \infty$, $\lim_{\theta \to 0} \frac{\partial R}{\partial \theta} = 0$, η the share of the cost paid by the firm and $1 - \eta$ the level of R&D subsidies.

A successful innovation gives a cost-advantage in one period, before a second period catch-up. The second period is discounted by a factor $\delta > 0$. We do not make any further assumption on δ as the second period may correspond to a longer amount of time as the first so that even an impatient firm could have $\delta > 1$. Denote the equilibrium profit of firm h in the pre-innovation case by π^{pi}, in the innovation case by π^{i}, and in the catch-up case by π^{cu}. The optimal investment in $R\&D$ of firm h therefore maximizes $\arg\max_{\theta} \left(\theta\pi^{i} + (1-\theta)\pi^{pi}\right) + \delta\left(\theta\pi^{cu} + (1-\theta)\pi^{pi}\right) - \eta R(\theta)$, so that if the solution is interior, θ^* solves $\mathrm{R}'(\theta^*) = \frac{(\pi^{i} - \pi^{pi}) + \delta(\pi^{cu} - \pi^{pi})}{\eta}$, while $\theta^* = 0$ for $\frac{(\pi^{i} - \pi^{pi}) + \delta(\pi^{cu} - \pi^{pi})}{\eta} < 0$.

We now move to the problem of a social planner choosing η to incentivize innovation. Assume that the social planner maximizes a function of firm profit and consumer welfare à la Baron and Myerson, 1982, with a unit weight on consumer welfare, a weight $\alpha \in (0,1)$ on firms profits, and a shadow cost of providing public funds $\lambda > 1$. Looking at equation equ:invest, it is easy to see that, when $(\pi^{i} - \pi^{pi}) > \delta(\pi^{pi} - \pi^{cu})$, the government can reach any θ^* by changing the amount of subsidies η. Whenever $(\pi^{i} - \pi^{pi}) \leq \delta(\pi^{pi} - \pi^{cu})$ however, the equilibrium investment $\theta^* = 0$ is independent of η: there is no level of subsidy such that the firm wants to invest a strictly positive amount of money in R&D. The only option is to provide the innovation fully publicly. We show below that there exists values of the parameters such that investing in innovation is socially beneficial but $\theta^* = 0$ for all values of η.

Let us first look at what firm h gains and loses in terms of equilibrium profit when benefiting from a cost-reducing innovation on variety v. We use the results of Lemmas 1, 2 and 3 and further assume that if firm h delivers a successful innovation, beliefs are such that the innovator actually specializes in her innovation whenever the subgame displays multiple equilibria.[4]

[4]One could argue that the presence of an innovation helps making the equilibrium in which it is

The following Proposition summarizes the different cases. In all configurations, $\pi^i - \pi^{pi} > 0$. Hence, a necessary condition for $\theta^* = 0$ is $\pi^{pi} - \pi^{cu} > 0$, corresponding to our third "curse of innovation" case below.

Proposition 1 *1. For $c < \tilde{c}$, innovation benefits firm h in the innovation and in the catch-up case, and there is always product diversity ;*

2. For $c \in (\tilde{c}, \bar{c})$, innovation benefits firm h in the innovation and in the catch-up case, and there is always product diversity;

3. For $c \in (\bar{c}, c^*)$, innovation benefits firm h in the innovation case, as in the unique equilibrium she produces v and there is diversity. In the catch-up case there is no diversity, and both firms make lower profit than in the pre-innovation case ;

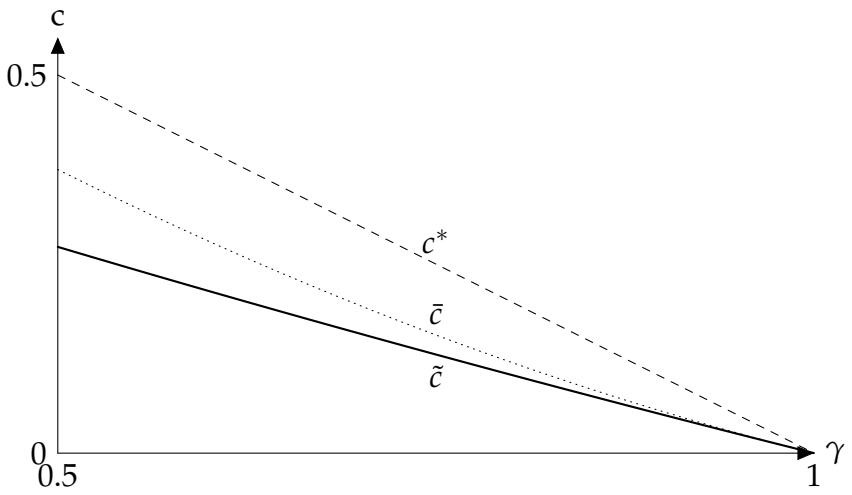
4. for $c > c^*$, innovation benefits firm h in the innovation case, as in the unique equilibrium she produces v and there is diversity. In the catch-up case there is no diversity, but both firms nonetheless make higher profit than pre-innovation thanks to a sufficiently high reduction in their costs.

The formal proof is in Appendix B. We provide an illustration with arbitrary parameter values in Figure 2.1 and show formally in the Appendix that $\tilde{c} < \bar{c} < c^*$. In the first two cases, innovation is unambiguously positive for the firm benefiting from it: firm h obtains a cost advantage and product diversity remains the same. In the fourth case, innovation is also positive: despite the fact that a decrease in product diversity increases the intensity of competition, the cost advantage is so high that it compensates for the loss.

In the third case however, innovation gives a short-term advantage in the innovation case, at the cost of a lower profit in the catch-up case than pre-innovation. This configuration, that we describe as an "innovation curse" for both firms, is however always beneficial to consumers. Intuitively, the reason why the market power of firms is higher when products are differentiated stems from consumer preference for diversity. Whether consumers benefit from the innovation in the catch-up case depends on whether the gains from the lower prices are higher than the losses from

used focal (Schelling, 1980). This assumption is however not necessary for the case $c \in (\bar{c}, c^*)$ that constitutes the main focus of this paper.

FIGURE 2.1: Critical values of c, for $A = 3$.



the lower product diversity. This trade-off touches the eternal question of what the optimal level of product diversity is in the presence of product differentiation (see for instance Anderson and Renault, 1999; Dhingra and Morrow, 2019; Dixit and Stiglitz, 1977; Wolinsky, 1986). In our linear Cournot model, when the cost benefit from the innovation is sufficiently high to ensure there is no diversity in the catch up case ($c > \bar{c}$), consumer surplus is always higher with lower cost and no diversity than in the pre-innovation case.[5]

Using Proposition 1, and our condition $\frac{(\pi^i - \pi^{pi}) + \delta(\pi^{cu} - \pi^{pi})}{\eta} \leq 0$ for the innovation stage to have a corner solution we know that for values of $c \notin (\bar{c}, c^*)$, the equilibrium investment θ^* is always positive. This is however not true for $c \in (\bar{c}, c^*)$.

Corollary 1 *For any $c \in (\bar{c}, c^*)$, there exists values of α, δ, λ, such that a strictly positive investment in innovation is socially optimal, but firm h delivers $\theta^* = 0$ for all levels of the subsidy $1 - \eta$.*

We have already established that for $c \in (\bar{c}, c^*)$, the equilibrium investment has a corner solution $\theta^* = 0$ when δ is sufficiently large for firm h to value the long term losses from competition more than the short term gains from innovation.[6] We also know that for these parameter values innovation increases consumer surplus.

[5]Consumer surplus with diversity in the pre-innovation case is equal to $CS = \frac{(2A-c)^2}{18}$ while without diversity in the catch-up case it is equal to $CS' = \frac{(A-c)^2(1+\gamma)}{(2+\gamma)^2}$. Computing $CS' - CS$ and replacing c by $\bar{c}$ we find $\frac{A^2(1-\gamma)^2(\gamma(\gamma((\gamma-18)\gamma+22)+144)+112)}{648(\gamma+2)^2}$, higher than zero for $\gamma \in (0, 1)$.

[6]Using the solutions from the different sub-games in the case where $c \in (\bar{c}, c^*)$, θ has an interior

Hence, there always exists a value of the shadow cost of public funds λ and weight on producer surplus α such that the social planner would prefer $\theta > 0$, but there is no value of the R&D subsidy $1 - \eta$ that makes it possible. In that case, the only way to get investment in innovation is for it to come entirely from the government.

2.3 Evidence

The US shrimp industry experience constitutes an illustration of the principle that R&D outcomes are always meant to be (in the long run) non-rivalrous and non-excludable. What makes this case particularly useful to look at is the fact that the innovation happened on a single variety, so that the catch up led to a decrease in product diversity and an dramatic increase in competition.

In this Section, we first give some background on the innovation provided by the US government. We then provide evidence of an initial stage of product diversity and gain for the innovator, followed by a catch up phase without product diversity.

2.3.1 Background

Large-scale commercial farming began developing in the 1970s in the Eastern and Western Hemispheres based on local shrimp species. In Asia, the dominant species of choice was the Monodon shrimp, native to tropical, coastal regions of the Indo-Pacific basin. In the West, the principal farmed species was the Vannamei, a shrimp which is native to the tropical Pacific coast of Latin America. Both Asia and the West, however, had failed to set up a large-scale intensive shrimp aquaculture. Independently from the species cultured, all attempts were affected by the same common problem: the periodical outbreak of diseases. Shrimp are highly susceptible to pathogens and the rudimentary solutions available at that time were ineffective in preventing the spread of viruses across farms, that were more disrupting the more intensive the production was. With the high incidence of diseases, and the subsequent losses, shrimp aquaculture suffered from high volatility and uncertainty in

solution whenever $\delta \leq \frac{9\left(\frac{1}{9}(\gamma+2)^2(A-c)^2-\frac{(A(\gamma-2)-c\gamma)^2}{(\gamma^2-4)^2}\right)}{A^2-(\gamma+2)^2(A-c)^2}$.

the final volumes and profits, causing a drop in investments.

In order to promote the development of a domestic shrimp farming industry in the United States, in 1984 the U.S. Department of Agriculture launched a research program, the United States Marine Shrimp Farming Program (USMSFP), publicly funded and made up of several institutions.[7] Established with the general aim of increasing local production of marine shrimp while decreasing the reliance on importation, the program rapidly evolved into an effort to discover a method to prevent the emergence of pathogens. In the late eighties, researchers were able to develop Specific Pathogen Free (SPF) stocks of Vannamei, and massively supplied them to US hatcheries.[8] In 1992, virtually all shrimp ponds in the U.S. were stocked with SPF postlarvae. As a result of this innovation, total production of the U.S. industry doubled, contributing to a sensible increase in profitability (Wyban, 2009).

The supremacy of the bio-security methods developed in the US only became clear with the insurgence of a new disease, the Taura Syndrome (TS) in 1995-1997. Under the pressure of a new mass mortality, the same technology was quickly refined and readopted to cover a broader spectrum of viruses. By 1999, the first stocks of Taura syndrome resistant shrimp (called TVR for Taura Virus Resistant) were supplied to the U.S. industry. For the next four years, use of TVR (and SPF) stocks by the U.S. industry resulted in continuous improvement of 34% higher production per year (see Figure **??**).

"In general, publicly supported research programs have not done a good job in the commercial development of the technology generated by these programs. Too often we fall back to a development mode and end up giving away technology to our competitors." In a letter dated August 1992, this is what Dr Broussard, the principal scientist at USMSFP, wrote to Mr Rowland, Chairman of the executive committee. In the same letter, however, Dr Broussard also assures that the technology needed to produce the SPF seed was "highly sophisticated and is not easily transferred, copied, or adopted." Nevertheless, in about two-three years Asian countries

[7] These include the University of Southern Mississippi, the Oceanic Institute, the Tufts University, the South Carolina Department of Natural resources, the Texas AgriLife Research, the University of Arizona and the Nicholls State University. Support was also given by the Office des International Epizootics (OIE) of Paris, France.

[8] Table B.1 in Appendix B provides a comparison of the production parameters between SPF and non-SPF stocks.

began producing massive quantities of SPF shrimp, which almost entirely replaced their domestic production of Monodon thanks to the increasing availability of the SPF/TVR broodstock exported by the US.

In fact, in the first stages of the catch-up Asian countries did not import the innovation - the new selective production method developed by US - but rather the product of that innovation, the SPF/TVR broodstock. In practical terms, all they had to do was to re-adopt their ponds to guarantee the growth of such breeding. It certainly required an investment by farmers to grant the post-larvae isolation, but the costs were plausibly lower (also in terms of safety) than producing the broodstock by themselves - a process that started in more recent years, thanks to the experience accumulated and under the pressure to reduce their dependence from US breeding companies. The reason why the US government and producers did not protect their innovation is that, while the original research leading to the innovation was publicly funded, the actual SPF brood-stock were privately owned and free to trade. In the case of the shrimp industry, conflicting interests with the broodstok industry fostered the innovation's diffusion, resulting in a very short catch up period. This is a standard example of Arrow (1962)'s statement on innovation being non-appropriable: the market opportunity represented by Asian countries was simply too attractive to the US broodstock industry for spillovers not to happen.

2.3.2 Innovation

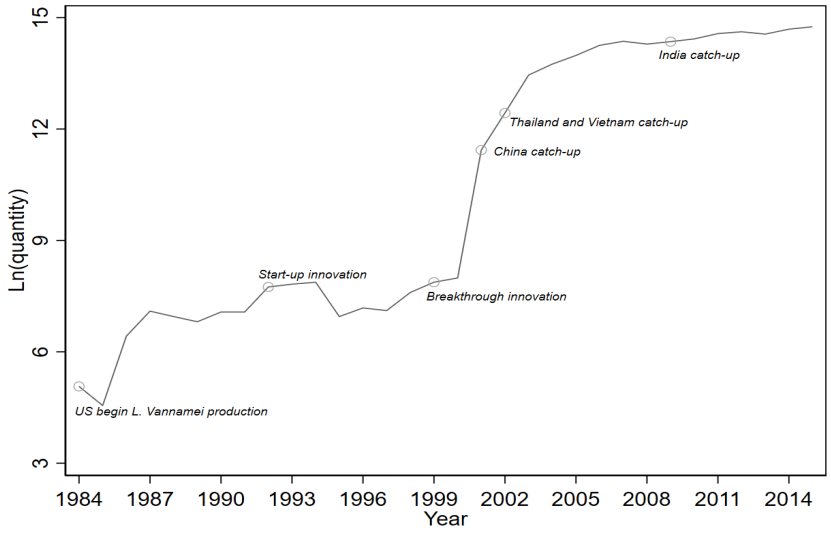
We retrieved data on shrimp production from the Food and Agriculture Organization (FAO) database. The organization collects data on the annual production (in volumes and value) of fishery commodities, as well as imports and exports (including re-exports) of fishery commodities by country. Specifically, the data on domestic production in terms of volumes are available from 1980, while production values are available from 1984.[9] Data can be desegregated up to the species level. Based on

[9]For clarity purposes, FAO country-level data do not specify the production's destination (i.e. whether it is for domestic or foreign consumption) It is not possible to retrieve this information by looking at country-level exports as they rely on a different commodity classification, not distinguishing by species. Moreover, while quantity data are largely available, most of the corresponding data in terms of production values (in US dollars) are missing, with the exception of the most recent years. Finally, with regards to Vannamei shrimp, data for Asian countries are generally available one-two years after the formal date of production's beginning reported by the literature, in line with the time

the scope of this study, we focused the attention on the aquaculture/fisheries sector, thereby not considering wild-caught shrimp.

Figure 2.2 looks at the total production of Vannamei shrimp by the five major producers (US, China, India, Thailand and Vietnam), that overall account for 80% of world production. We denote with dots the different stages of innovation. In 1984, the US started to produce white legs Vannamei shrimp. In 1992, the first SPF shrimp were developed (start-up era). 1999 is the breakthrough second generation of SPF shrimp giving US producers a major cost advantage. Following this cost-reducing innovation, the quantity of Vannamei shrimp increases massively. The years 2001, 2002 and 2009 correspond to the sequential adoption of the new breed by major Asian producers. We observe that during those latter years the produced quantity continued to increase, but at a much slower pace.

FIGURE 2.2: The three phases of innovation



Our first goal is to assess whether innovation produced significant gains for the innovator in the short term period, i.e. before the catch-up phase. Given that we rely on the assumption that innovation could only be applied to a specific product variety, comparing more varieties within the innovating country seems the most convenient approach.

We make use of a simple Diff-in-Diffs setting where the treated variety (the Vannamei species) is compared to the other species cultivated at that time, in the three

required for cultivation trials.

years before and after the introduction of the SPF technology. Although the innovation did not originate from the industry, endogeneity concerns may arise if the government's choice of investing in a specific variety technology was driven by differential trends in the previous period production, or by a different market power of the industries affected. Thus, we consider only the start-up period of the innovation (in 1992, when the SPF innovation was developed).[10]

Our econometric specification follows the standard form:

$$y_{it} = a_i + a_t + \beta \text{Post}_t \times \text{Vannamei}_i + \epsilon_{it} \tag{2.1}$$

where the dependent variable is either the quantity or the production share (the share of the variety over the total shrimp produced) of variety i in time t. The dummy *Post* indicates the period after 1992, while the dummy *Vannamei* indicates the treated variety. Given that our outcome variables includes zero production values, we employ a Poisson-Pseudo Maximum Likelihood and include year and variety fixed effects. Standard errors are clustered at the variety level. Estimates are reported in Columns 1 and 2 of Table 2.4. Results confirm the findings of our model of innovation granting a competitive advantage in the short term period. Innovation generates a net and significant increase in volumes and production share of the Vannamei variety. Following the standard interpretation this corresponds to an increase of (exp(0.76)-1)$\times$100 = 113% with respect to the control group.

To further test the robustness of our results, in Columns 3 and 4 of Table 2.4 we exploit the comparison with Brazil, one of the few countries that at the time were producing Vannamei as major native species. This country is conveniently close to the US, meaning that they shared a similar production in terms of native species, but has not being reported for using SPF shrimp until 2006.[11] We employ a triple difference and compare the Vannamei variety in the United States with Vannamei

[10] Using the second innovation wave, i.e. the breakthrough innovation in 1997, would be misleading as it clearly developed under the pressure of the new virus discovered and the mass mortality that produced in the already innovated variety in the two years before. In Appendix B, Figure B.1 and Figure B.2, we test for the parallel trend assumption in the 4 years before the innovation. The test does not outline significant differences between the production trends before the innovation, except for one year (1989) which is statistically (negatively) significant. Conversely, it shows a clear jump in production for the treated variety in the period after

[11] Field performance of imported SPF shrimp in Brazil, Global Seafood Allience, May 2008.

TABLE 2.4: Effect of innovation on quantity produced

	(1) Quantity	(2) Production share	(3) Quantity	(4) Production Share
Post×Vannamei	0.765***	0.776***	0.373***	0.363***
	(0.106)	(0.104)	(0.036)	(0.040)
US×Vannamei			0.928	0.896
			(0.717)	(0.718)
Post×US			0.055	0.007
			(0.113)	(0.113)
Post×Vannamei×US			0.392***	0.413***
			(0.113)	(0.113)
Variety FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Country FE	no	no	yes	yes
Observations	91	91	119	119

Columns show coefficients using Poisson QMLE. Standard errors are clustered at the variety level. All the specifications include year and variety fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

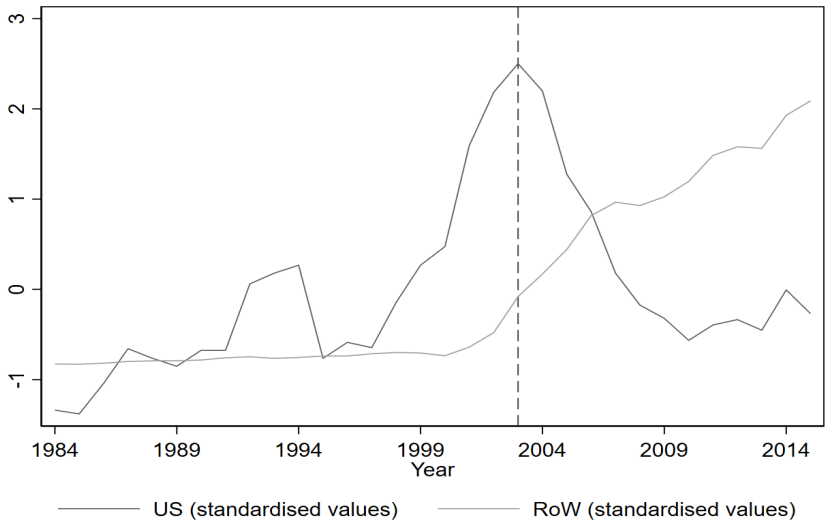
variety in Brazil. While both countries show a positive increase in the Vannamei variety in the period after 1992, the coefficient on the triple interaction term confirm a positive differential change for the United States.

2.3.3 Catch up

In Figure 2.3, we distinguish the total production of Vannamei in the US from the rest of the world. The vertical dashed line (2003) marks the year in which all the Asian major competitors (with the exception of India) had terminated the production trials and began operating in the global market. The increase in the US production of Vannamei starts with the SPF innovation, and the decrease in the production starts when the production in the rest of the world increases, in particular following the adoption of Vannamei by Thailand and China.

We provide additional Figures in Appendix B, documenting the evolution in the choice of product variety. We report FAO estimates of the impact of the innovation on production costs in different countries in Table B.3. With the exception of China, whose costs were much lower even in the pre-innovation period, all other countries experienced a consistent reduction in costs by an average 30%. Table B.2 shows in

FIGURE 2.3: US and total world Vannamei production (1984-2015)



detail the differential production parameters for Thailand. In Figure B.3, we plot the total country production of shrimp (any species) in the major Asian producers. For each country, the dashed vertical line corresponds to the year of adoption of SPF Vannamei. Data suggests a net acceleration in the rate of production following the adoption of Vannamei in China, Thailand and India, while it didn't affect Vietnam's trend. In Figure B.4 we compare the production share of Vannamei against the major native species in the main Asian countries following the adoption of the SPF breed. In all countries, there is a clear evidence of a decrease in the native species production in favor of the US imported one. Finally, in Figure B.5 we report the price level trend of the US shrimp. The increase in competition following the Asian catch up is associated with a drastic reduction in price. Descriptive statistics are all strongly consistent with the theoretical prediction that a sufficiently important innovation, $c > \bar{c}$ leads to a decrease in product diversity in the catch-up phase.

The limited availability of data at the variety level for the Asian shrimp producers does not allow to set up a a similar experiment as in Eq.2.1.[12] Thus, in Table 2.5 we simply estimate the correlation between the post-innovation period and the total (country-level) shrimp production, and the share of the previously leading native variety production over the total production.[13]

[12]For all the Asian countries the beginning of Vannamei production coincides with the innovation adoption, therefore we do not have any pre-treatment data for this product variety.

[13]Identified by calculating the average yearly production for each variety in the five years before

TABLE 2.5: Post innovation and country-level indicators

	(1) Total	(2) Native prod. share	(3) Total	(4) Native prod. share
$Post_t$	0.674***	-0.486**	0.636***	-0.581**
	(0.164)	(0.192)	(0.158)	(0.257)
Observations	44	44	44	44
R-squared			0.274	0.104

Columns 1 and 2 show coefficients using Poisson QMLE. Columns 3 and 4 show coefficients using OLS. In the OLS specification the dependent variable is expressed in log. Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

Estimates show that the period after the introduction of SPF Vannamei is associated with a significant increase in production, and a corresponding decrease in the share of native variety produced, in line with the predictions of our model for $c > \bar{c}$. The adoption of the US variety boosted the production capacity of Asian countries, and as the native species production decrease, the product diversity decreased.

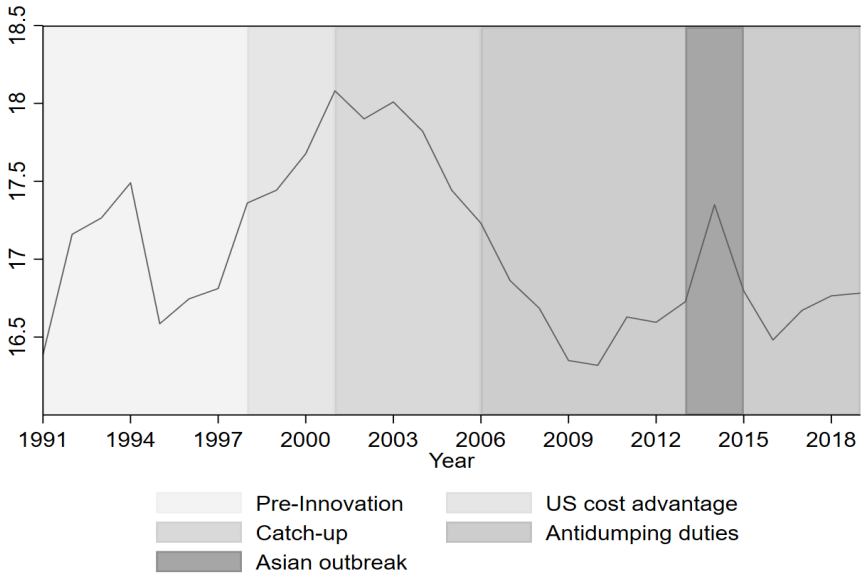
The question of whether the innovation was sufficiently important to avoid a decrease in the US firms' profit (whether or not $c > c^*$) in the catch up phase is however more complicated to assess. We plot on Figure 2.4 the aggregate estimated profit of the US industry (in natural logarithm) between 1991 and 2019. We computed quantity data from the FAO, the price data from the FED global shrimp prices time series (wholesale price in New York, $ per kilo), and the average production cost from Briggs et al., 2004. Estimates are adjusted for inflation.

The increase in profits from 1991 corresponds to the first stage of the innovation, and the years 1995-97 correspond to the outbreak of Taura syndrome. Then, 1999 is the year of the major breakthrough that gave US producers a cost advantage. It is clear that this innovation coincides with the beginning of a new increase in profits, and that the years when Asian countries switched to Vannamei corresponds to a turning point in which profits start to fall. Then, profits decrease to a level much lower than the one of 1998-99. The trend up to 2010 is consistent with the theoretical result that $c < c^*$ and that profit decreased below their pre-innovation level.

The story however does not stop there. In early 2000s, the decline in US market share and the dramatic rise in importations caused a 40% drop in employment

the innovation adoption.

FIGURE 2.4: Aggregate US industry profit (1991-2019)



in US shrimping factories (Beaulieu, 2005). In an attempt to save their dying industry, the Southern Shrimp Alliance (SSA), a group of eight south-eastern states consisting of forty-two shrimp processors successfully petitioned the US government to impose anti-dumping duties on imports from Thailand, China, Vietnam, India, Ecuador, and Brazil. The first duties were imposed in 2005, with a calculated margin ranging from 2% (in the case of Ecuador exporters) up to 112% (in the case of China exporters).[14] The antidumping duties imposition represents a prominent case for the scope and length of these measures and it gave rise to one of the longest disputes before the World Trade Organization. Countries affected by antidumping duties repeatedly questioned the methodology used by US investigation authorities to calculate dumping margins (which are regularly updated and reviewed). Along the years, only Ecuador and Brazil (two countries that have always produced the Vannamei variety) obtained a significant lift of these measures, therefore comparing pre-innovation and catch-up profits after 2006 would be a misleading exercise.

Finally, in 2014, a new major disease, the Early Mortality Syndrome (EMS) wiped out Chinese and Thai production of shrimp by more than 50%, leading to price

[14]Source: United States Department of Commerce, International Trade Administration (ITC), Enforcement and Compliance, Antidumping and Countervailing Case Information report. Table B.4 in the Appendix provides details on the calculated margins during the first round of investigations in 2005.

increases of more than 40% for a kg of Vannamei shrimp.[15] The disease only affected South-East Asia, and never reached the US, leading to a new phase of profit increase for US producers, not caused by any product innovation.

2.4 Conclusion

This paper is a first attempt at looking at the link between innovation and the endogenous level of product diversity. Our results suggest that innovation may constraint firms active in a previously diversified market to sell more homogeneous products, and that such an incentive may lead to more intense competition in the catch-up phase than pre-innovation.

Our predictions found consistency in the case of the shrimp industry competition between US and Asia. Descriptive statistics indicates that when US innovation became freely available, the Asian countries switched to the new variety, and the level of product differentiation decreased. Similarly, the profit level variation in the US industry is consistent with the curse of innovation we identify in our theoretical setting. The main policy implication is that, for innovation that increase consumer welfare but decrease product diversity, it may not be enough for government to subsidize R&D, the only possibility being to directly provide the innovation.

An important limitation of our work is that our setting and data do not allow us to study the link between product diversity and the more general question of the dynamic of innovation. Our static results suggest that the "curse of innovation" case, by decreasing the profit in the catch-up phase, may actually make the subsequent innovation more attractive, not less. It would also increase the advantage from staying one step ahead of the competitors in a model similar to Aghion et al. (2005).

While the empirical focus of this paper is on the shrimp industry, the theoretical results refer to any innovation that would make a variety cheaper to produce. This applies more generally to the agricultural sector, where an innovation often consists in developing a more resistant or cheaper to produce variety. It also correspond more broadly to technological innovations in which the adoption of a superior, com-

[15] Globefish, FAO, March 2014.

mon standard, constraints product diversity.

Chapter 3

New Trade Disputes: When the WTO "met" China

This paper investigates the determinants of the WTO trade disputes against China. Using a new dataset that covers the totality of the disputes between 1995 and 2018, I provide evidence of a strong "China effect" on disputes initiation: following its entry into WTO, the probability to target China has been more than three times higher than the average. The use of a large-scale set of hypotheses allows us to identify the determinants of this positive effect and indicates that China induced a significant change in dispute predictors of its plaintiffs. First, I show that tensions are grounded on a bilateral basis and are significantly linked to import penetration and the relative asymmetries in the exporting activity. Second, strategic arguments significantly affect the decision to file a dispute against China, with countries more likely to act when their retaliatory power increases. Finally, China is also responsible for reversing some empirical regularities concerning the regime similarity of the countries involved in these conflicts.

Keywords: trade disputes, China, WTO
JEL Code: F13, F14, F51, F53

3.1 Introduction

The Dispute Settlement (DS) System of the World Trade Organization (WTO) had certainly better days. In the latest years, the juridical institution for the resolution of trade grievances has found itself in the middle of a tumultuous battle between the US and the organization. Its failure to safeguard the US position against "the world's richest countries which claim to be developing countries to avoid WTO rules"[1] has been exploited to justify the blockage of new adjudicators appointment - which resulted in a long-lasting stalling of the activity of the arbitration system - as well as a rapid escalation of unilateral measures. Yet, the DS System for a long time has been considered a crucial instrument to address alleged violations of the WTO agreements, including against its most controversial member: China. In December 2019[2], China recorded 67 disputes, 44 as a respondent country: the third most targeted country after US and EU. The severity of the action against China is unprecedented in the secular use of trade disputes, whose outcomes very likely played a major role in increasing the frustration for a system that made the use of disputes "too risky and potentially unwinnable" (Bown, 2019).

In this paper, I investigate the determinants of the disputes filed against China, as compared to both the general WTO membership and the other major trade partners. I hypothesize that China's entry to the WTO induced a change in the main determinants of trade disputes. China's accession forced the Organization to confront itself with a new economic model, very often in contradiction with the liberal order promoted by the WTO. It is plausible that the determinants of disputes against this country have been adjusted to its specific characteristics, significantly differing from those usually applied to the wider membership.

To carry out my analysis, I construct a new dataset that classifies the total amount of disputes filed under the WTO system from its establishment in 1995 to 2018. This dataset represents a sensible extension of a previous dataset compiled by Bown and Reynolds (2014) for the years 1995-2010.

[1] From the official account of US President Donald Trump on Twitter, 26th July 2019.

[2] On December 10th, 2019, the number of judges fall below the minimum threshold of three appointments to rule out the final verdicts. Since December 2020, all seven seats on the appellate body have been vacant.

I first explore the effects of China's accession to the WTO in 2001 on the probability of generating trade disputes. Following its accession, the probability to address a dispute against China was more than three times higher than the average. Moreover, in contrast with a general reduction in the use of trade disputes, the activity against this country has been characterized by a significantly increasing trend. In order to explain this positive "China effect" and identify the determinants of disputes against China, the analysis considers a mixed set of explanatory variables. In line with previous findings (Busch, 2000; Davis & Bermeo, 2009; Horn et al., 1999; Reinhardt, 2001; Sattler & Bernauer, 2011) governments' decision to file a dispute is assumed the result of both economic and political incentives, which affect the probability and incidence of trade litigation. Thus, I combine economic and trade-related arguments with institutional and power-related variables to reconcile and evaluate the specific channels which may impact countries' propensity to file disputes.

The empirical approach that I adopt emphasizes the strong strategic and political component of trade (Baldwin, 1989; Gould & Woodbridge, 1998; Grossman & Helpman, 1995; Helpman, 1995). From a theoretical perspective, this is part of the well-established trend in trade policy theory which promoted the grounding of trade-related decisions, including those of government, in a rational optimizing behavior and advocated a greater realism in describing government objectives and the strategic and economic environment (Goldberg & Maggi, 1999; Grossman & Helpman, 1994; Pack, 1994; Rodrik, 1995; Trefler, 1993). Within this context, the use of political economy indicators is of particular importance to understand how China's accession has shaped the interplay of powers at the WTO.

To preview my main results, I find that the incidence of disputes against China is only partially explained by traditional economic and political predictors, strengthening the importance of introducing variables that can capture omitted China's characteristics. I show that tensions are grounded on a bilateral basis and are significantly linked to import penetration and the relative asymmetries in the exporting activity. Moreover, strategic arguments significantly affect the decision to file a dispute against China, with countries more likely to act when their retaliatory power increases. Finally, China is also responsible for reversing some empirical regularities assessed by previous literature. This is especially true when considering

the institutional characteristics of the countries. The use of the DS mechanism was found to be significantly higher in the case of democratic countries, as well as when the countries involved share similar regimes - a relationship that was broken down by China's entry to the WTO. In line with intuition, these predictors are not relevant in explaining the activity against the average WTO membership. Finally, given that isolating China with respect to all other countries may not necessarily capture country-specific issues, but also those common to large trading blocks, I focus on the comparison with the two other major outliers in terms of disputes received, the US and European Union. When compared to the United States and European Union, estimates show that disputes' determinants can significantly differ even amongst major powers, and that China and United States share the greatest similarities.

This paper is strictly related to the literature on the political economy of trade disputes. An extensive number of empirical studies has investigated the determinants of trade conflicts initiation, testing the validity and significance of numerous hypotheses (see for instance Bagwell and Staiger, 1999; Bown, 2004; Busch, 2000; Guzman, 2003; Horn et al., 1999; Jackson, 1997; Maggi, 1999; Reinhardt, 2001; Rosendorff and Smith, 2018). Crucially, these hypotheses have been generally tested in the broader WTO membership, without accounting for potential heterogeneity. This is the first attempt to explicitly isolate China from the rest of the WTO membership when evaluating complainants' motives. In this sense, this work gives a different perspective on the most sensitive issues of China's trade partners.

This paper is also related to the literature on the economic and political implications of China's trade integration after its accession to WTO. Previous studies greatly emphasized the effects of China's trade shock on local labor markets (Acemoglu et al., 2016; Autor et al., 2013; Balsvik et al., 2015; Dauth et al., 2014; Pierce & Schott, 2016) and domestic industrial environment (Autor et al., 2016; Bloom et al., 2016; Iacovone et al., 2013; Medina, 2017; Xu & Gong, 2017). In parallel, a growing literature shows that economic effects have spurred also the political dimension, fuelling the support for nationalism and political polarization (Colantone & Stanig, 2016; Dorn et al., 2016; Margalit, 2012; Mayda & Rodrik, 2005; Scheve & Slaughter, 2007). In these regards, this work addresses the question of how China's entry impacted the use of multilateral institutions and clarifies the importance of the DS system in the

years following China's accession. Indeed, the high incidence of disputes against China suggests that for a long time, countries have attempted to solve trade issues via traditional channels, or through a combination of both multilateral and unilateral instruments.

Finally, the insights of this study contribute to understanding the debate on the institutional crisis faced by the WTO, which culminated in the American veto on the appointment of the judges of the Appellate Body.[3] In fact, the propensity to file disputes is considered a signal of a positive belief in the organization and trust in the policy effectiveness of this instrument. The decrease in the number of disputes filed against China, when related to the current scenario, makes it hard to believe that it was motivated on the basis of more cooperative behavior. Rather, a plausible argument is that the unsatisfactory outcomes of the disputes and the excessive rigidities of the legal framework (Wu, 2016) may have exacerbated the membership discontent, contributing to the rejection of multilateral solutions and the revamp of protectionist, unilateral measures.

The remainder of the paper is organized as follows. Section 3.2 discusses the related literature and provides an overview of the main dispute determinants. Section 3.3 introduces the data sources. Section 3.4 discusses the key stylized facts. Section 3.5 explains the empirical strategy and the benchmark results. Section 3.6 concludes. All the main estimates are reported in the text. Robustness checks, additional figures, and statistics are reported in Appendix C.

3.2 Determinants of WTO disputes

Scholars have traditionally focused on bilateral trade relationships to explain the variation in the pattern of dispute initiation across countries. Early findings (Allee, 2004; Guzman & Simmons, 2005; Horn et al., 1999) can be summarized in a "gravity law" of trade disputes. A country pair is more likely to get involved in a dispute when countries' trade intensity is higher in absolute and relative terms, and the larger their economic size is.

[3]The Appellate Body represents the last stage of the Dispute Settlement Mechanism. Since July 2017, the US refused to appoint new judges. On the 10th December 2019, the term of two of the last three judges ended, rendering the AB ineffective.

The following analyses of bilateral trade relationships substantially confirmed and refined these results. Among others, the extensive work of Bown (Bown, 2004, 2005a, 2005b) demonstrated that a dispute's probability is significantly linked to the level of trade dependency, trade openness, value of exports, level of employment in each sector, tariff and non-tariff barriers imposed. Disputes-promoting effects are found to be mitigated when preferential trade agreements (Reinhardt, 2001) and facilitation trade agreements (Li & Qiu, 2015) are in place. More recently, Yildirim et al. (2018) focused on the degree of vertical integration of the industries at stake, while Kuenzel (2017) investigated the link between tariff overhangs and disputes incidence, showing that when applied tariff rates are close to their bindings countries are more likely to resort to disputes.

A growing strand of the literature also focused on what extent plaintiffs' decisions are based on retaliatory or strategic motives. Economic theory suggests that if a plaintiff desires compensation (or inducing the counterpart to comply), it must have the capacity to make its own bilateral retaliatory threats to obtain it.[4] The capacity to retaliate through trade policy is determined by the extent a retaliating country accounts for its trading partner exports.

In the context of specific disputes, having a strong retaliatory power may discourage "weak" countries to initiate a dispute. Discrimination against small and least developed countries due to differences in retaliatory capacity is often referred to as the *standard power argument* (Sattler & Bernauer, 2011). Normally, countries refrain from targeting members from which they suffer from a strong trade dependency, fearing their reaction in the form of trade restrictions (Bown, 2004). In a companion paper, Bown (2005a) also showed that a high share of the respondent's exports going to a certain country makes it more likely that this country will be a complainant. A possible interpretation here is that "power" matters in the decision to complain since such a high share makes the enforcement possibilities stronger. However, Horn and Mavroidis (2006) noticed that interpreting power as

[4] As the main regulatory entity, the WTO ensures that negotiations deliver a set of mutual trade concessions based on the principle of reciprocity. The notion of reciprocity also serves to rebalance and restore trade distortions originated by countries' misconduct, under the form of retaliation. The latter might be explicitly authorized by the DSB at the end of a dispute, or it might be the result of a unilateral country decision.

a reason for discrimination against developing economies may be misleading. Indeed, a similarly strong relationship also holds for large exporters, where the role of power should be plausibly lower. Thus, they suggest that either even relatively small power differences can be determinant or the relationship captures something else associated with "power". On top of this, countries are often found to initiate disputes in retaliation for previously being the target of complaints, a situation that may lead to an escalation of cases between specific members. Empirical studies have demonstrated that tit-for-tat action is a significant determinant of these proceedings (see for instance Reinhardt, 2000; Rosendorff and Smith, 2018). Importantly, most of the disputes concern not only the same players but also, very often, the same sectors and issues.

Finally, there is a well-established relationship between institutional characteristics and propensity to trade. In the late Nineties, Morrow et al. (1998) showed that the similarity of political interest between states and the lower political risks of democratic regimes increase the activity in foreign commerce. Conversely, political instability and uncertainty shrink the terms of trade, increase frictions between countries and reduce the probability of peacefully solved trade-related issues.

However, larger trade volumes also increase the chance to incur violations, either as the infringing party or the detecting one. The democratic peace postulate, which predicts that democratic states are much less likely to fight one another than other pairs of states, does not apply to trade conflicts. Several studies provided empirical support that democratic regimes are associated with a greater disputes initiation and also a greater probability to be targeted (Allee, 2004; Busch, 2000; Davis & Bermeo, 2009; Reinhardt, 2000; Rosendorff & Smith, 2018). Reinhardt (2000) suggested that democracies are more likely to incur violations - and therefore, being targeted - because their governments are more susceptible to domestic pressure for protection. A companion paper (Reinhardt, 2001), also showed that if initial consultations do not provide a satisfactory outcome, democracies are also less likely to solve disputes cooperatively.

At the same time, the higher number of disputes filed by highly democratic countries is generally interpreted as an index of a greater government's efficiency in monitoring and defending their economic interests (Bouet, Antoine and Metivier,

Jeanne, 2017; Reinhardt, 2000). Betz (2018) proposed a further refinement in the term democracy, by differentiating among democratic countries using the plurality rule. He estimated that pluralistic systems are associated with a three times increase in the GATT/WTO disputes. A first possible channel is domestic groups' willingness to invest more in the monitoring of international law. A second channel is that pluralistic governments are more susceptible to domestic pressure for protection, and will, as a result, be more prone to implement illegal measures, or not to implement agreed-upon liberalization, and thus be the targets of litigation.

All the findings above have been crucial to defining the empirical strategy. First, to avoid bias due to the omission of relevant variables, I include indicators of each dimension: economic, strategic, and institutional. Second, I privilege the use of bilateral indicators and measures of reciprocal bilateral advantage, not only for trade-related variables - as it is common - but also for power-related and institutional characteristics. The implicit assumption is that the propensity to file a dispute is not only affected by the individual characteristics of the complainant, nor by its characteristics relative to the respondent, but also by potential asymmetries amongst them. This approach serves the double purpose of better evaluating the effect of China on usual conflict interactions and also provides a meaningful extension to previous findings.

Finally, I consider significant variables tested and discussed in studies specifically applied to WTO disputes. Indeed, although also the General Agreement on Tariffs and Trade (GATT) envisaged a formal resolution of potential disputes, the legislative differences with the current system make hard any comparison. Moreover, such differences very likely affected the determinants of the disputes themselves, which may significantly differ between the two systems. Including the GATT disputes (thus adding data from 1945) would confound the general results and would unnecessarily make it more intricate to estimate the effects of a late accession country like China.

3.3 Data

My dataset covers all the 74 countries which actively engaged in the Dispute Settlement mechanism between 1995 and 2018.[5] Countries that participated as third parties (observers) to the disputes are not considered. Every (potential) complainant $country_i$ is paired with every (potential) respondent $country_j$, for the years they have been both members of the organization.[6] In line with the literature, the European Union is treated as a single actor because its members generally pursue a common trade policy in the WTO context. Thus, I include single EU countries only when explicitly reported in the dispute proceedings.[7] However, not all the countries participated in disputes in both roles. Given my interest in identifying complainants' motives, I drop the countries with only disputes as respondents from the sample of countries i, which is reduced to 51 potential complainants. Hence, the total number of country pairs amounts to 3,723 units.

Trade disputes Dispute records are publicly available on the WTO institutional website in the form of reports periodically updated based on the juridical stage reached. I manually classified disputes' information by integrating a previous dataset compiled by Bown and Reynolds (2014) for the years 1995-2010.[8] Specifically, I codified information on the timing and composition of disputes and violated policies for the disputes between 2011 and 2018. My final dataset includes all the disputes filed over the period 1995 to 2018, based on the date of consultations, the first stage of the WTO dispute process. Disputes involving multiple countries have been separated into sub-units by means of all the possible (complainant-defendant) combinations, for a total of 615 complaints. This approach follows the common practice in the existing literature (Busch, 2000; Horn et al., 1999; Reinhardt, 2001). The reason is that

[5] In Appendix C, Tables C.1 and C.2 report the full list of countries.

[6] For instance, in 1999 China is not among the potential respondents of the US since China accessed the organization only in 2001 (and of course, it cannot be either among the potential complainants).

[7] For instance, the dispute DS452 *European Union and certain Member States — Certain Measures Affecting the Renewable Energy Generation Sector* launched by China against EU, Italy, and Greece has been reported in the dataset in three distinct dyads - China-EU, China-Italy, and China-Greece. Consequently, I extracted data on China, European Union, Greece, and Italy.

[8] The dataset identifies the violated policies, the timing of implementation of corrective measures, the products/sectors involved, and the corresponding value, volume, and calculated unit values of imports from all trading partners directly impacted by the respondent's policy change.

the consultation request may be advanced by multiple members, although disputes can be settled (or escalated) only bilaterally.[9]

Bilateral Trade Country-level trade flows have been retrieved from the World Integrated Trade Solutions (WITS) dataset. Bilateral trade (sum of total imports and exports between country i and country j, expressed in natural logarithm -) is used to investigate how bilateral trade relations affect the probability to file a dispute. Single trade flows, i.e. $Exports_{ijt}$ and $Imports_{ijt}$, have also been tested separately. According to the literature, country pairs with larger trade flows should experience more disputes. However, one could hypothesize that a strong interconnection between two economies may discourage a country to target the other, especially in the presence of a long-term market relationship. In that case, countries may prefer to settle eventual issues informally, outside the DS court. Bilateral trade balance (net exports of country i from country j as % of country i GDP), is included to account for the country i position vis a vis the specific partner. Trade deficits are generally associated with decreased competitiveness and should cause domestic pressures for protection and dispute initiation. Country i imports from country j over total country i imports are used as an indicator of import dependency.

Strategic components Previous findings suggest that countries are more likely to file disputes when their retaliatory capacity increases and that they are less likely to be targeted by partners with significantly lower power. Therefore, I compute a measure of retaliatory capacity, defined as the share of country j exports to the country i over country j total exports. This indicator is used for both complainants and respondents. Additionally, I exploit the difference between the two indexes to construct an indicator of retaliatory distance, to account for the role of relative power disparity. Even countries with very high retaliatory power may be hesitant to file a dispute if the partner retains a similar or greater power. The escalatory nature of trade disputes has been accounted for by using a variable *Tit-for-Tat* equal to 1 if the country i received at least one complaint from country j in the previous year. This variable measures the possibility for a dispute to be the reaction to a dispute filed by

[9] For a comparison, WTO official statistics - which account for the request of consultation - report 586 cases in the same period.

the partner in the previous period. I also exploit the dataset constructed by Kuenzel (2017) on tariff overhangs to further investigate the link with trade liberalization. Specifically, I employ the time-varying overhangs - the complainant/defendant's difference between the average bound tariff and the average applied MFN tariff - and the overhang shares, the complainant/defendant share of active 6-digit HS import sectors from country d with a zero or negative tariff overhang.[10]

Institutional indicators I employ the Polity IV dataset for information on countries' institutional quality. The polity score measures the annual level of democracy in each country - with a higher score indicating a higher level of democratization - and varies over a range of -10 and +10. I create a measure of regime distance by computing the difference (in absolute values) between the polity score of the complainant and that of the respondent. A value of 0 indicates the minimum difference, i.e. the countries have the same level of institutional quality. This variable represents a further extension to previous literature, which documented a higher probability for democratic countries to participate in trade conflicts (as both complainants and respondents), in contrast with the empirical regularity which sees democracies less inclined to get involved in military conflicts. By accounting for the similarities in their regimes, the aim is to test whether it is the element "democracy" at the pair level which affect the disputes' initiation or whether it is rather the similarity (in both senses: democratic or not) to prevent/incentivize countries to file a dispute against their peers.

Additional data Other economic controls include the percentage of trade (sum of total imports and exports) over GDP - as a proxy for the openness of the economies; while GDP growth and the unemployment rate are used as macroeconomic indicators.

[10] According to Kuenzel (2017), these variables are lagged one year to control for information delays. These variables have not been included in the main specifications due to the lack of data for the years after 2014. Moreover, in his analysis Kuenzel (2017) only considers country pairs with positive trade flows in both directions, thereby causing an additional substantial drop in my observations.

3.4 Stylized facts

Out of 163 WTO members, only 74 have been actively involved in the Dispute Settlement proceedings. The first 10 countries for the number of disputes account for 71% of the disputes received and 69% of the disputes filed. Most powerful countries, mainly developed countries and large developing economies, dominate the use of the mechanism while the remaining countries made a very sporadic appearance.[11] Overall, the frequency of litigation has been characterized by a decreasing trend over time. Figure 3.1 plots the number of annual disputes between 1995 and 2018. The vertical line indicates the accession of China to WTO.[12] In the first years (1995-2000), the frequency of litigation was extremely high. Annual cases significantly declined from 2001-2010, showing a slight increase only from 2015. This contraction has involved both developing and developed countries, which followed a similar trend over time.

3.4.1 The aggressiveness against China

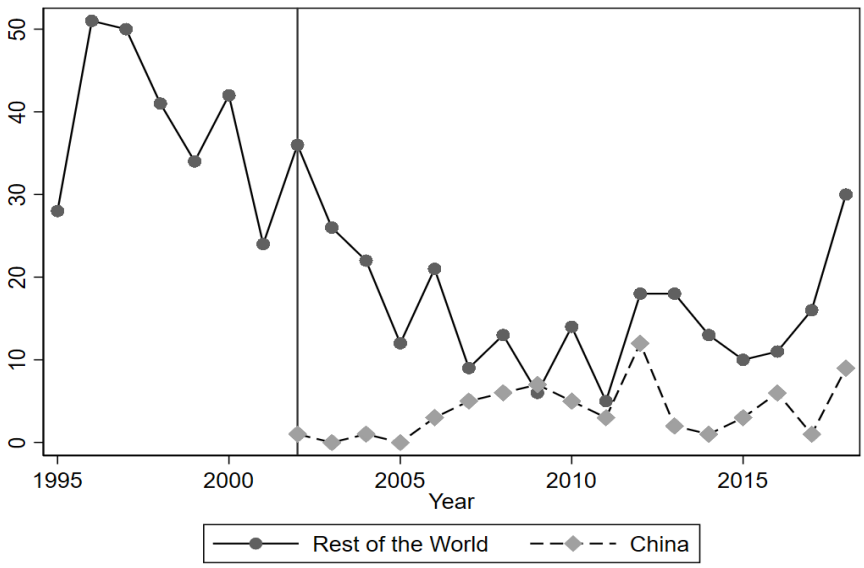
Despite the overall decrease in the activity of the Dispute Settlement Body, from 2002 the number of cases involving China progressively rises, absorbing a substantial proportion of the total disputes. Between 2004 and 2012, China passes from 4% to an average of 30%. In 2008, for instance, the disputes involving China were more than the total of disputes involving the rest of the countries. Arguably, the impressive growth and trade expansion undertaken by China after joining the WTO induced its trade partners to address their efforts against this new major player. In this sense, disputes against China very well reflected the rise in international tensions.

From 2012 the number of cases involving China adjusted to lower levels, while total disputes remained stable. In 2018 the WTO recorded 39 disputes, more than doubled compared to previous years and the highest number since 2000. However, only four of these disputes have been addressed against China (10%), and only 9 filed by it.[13] Although this may still appear a considerable share, it is a very different

[11] In Appendix C, Tables C.1 and C.2 report the full list of respondent and complainant countries.
[12] China officially joined the WTO on the 11th December 2001.
[13] Descriptive statistics on China's annual shares are reported in Appendix C, Table C.3.

figure with respect to previous years. On the one hand, the turmoil in global trade caused by the US-China war may have been reflected in a generally revamped use of the DS mechanism. On the other hand, over the years this instrument seems to have lost much of its appeal- especially if compared to the proliferation of unilateral sanctions.

FIGURE 3.1: Annual number of disputes (1995-2018)



For a better cross-country comparison, Table 3.1 lists the countries with more than 5 disputes as respondents and the corresponding disputes as complainants. In the fourth column, the index $Intensity_i$ measures the count of disputes over the years of participation in WTO. Clearly, Table 3.1 shows a predominance of developed and large developing countries, but also includes some very small economies (e.g. Chile, Dominican Republic, Peru), among the most targeted countries. Interestingly, some of the biggest traders such as Germany or the United Kingdom do not show up in the ranking or have a relatively low participation, as in the case of Japan. To some extent, this is reasonable: these advanced economies, even though they trade more, are probably more likely to respect their WTO commitments and have better trade relationships, which may allow them to escape potential conflicts. When it comes to developing countries, two things must be taken into account. First, their degree of liberalization is relatively lower than large traders and they generally rely on several preferential conditions because of their status. These conditions

are often abused and hard to remove, increasing the likelihood of their plaintiffs of resorting to the WTO. Second, their trade relationships are less well established, and they generally possess much fewer chances to solve issues outside the court.

TABLE 3.1: Frequency of countries targeted (countries with more than 5 disputes in 1995-2018)

	As respondent			As complainant		
Country	Count	Percent	Intensity	Count	Percent	Intensity
USA	164	26.67	6.83	131	21.30	5.45
European Union	96	15.61	4	99	16.10	4.13
China	43	6.99	2.53	22	3.58	1.29
India	25	4.07	1.04	25	4.07	1.29
Canada	23	3.74	0.96	39	6.34	1.63
Argentina	22	3.58	0.92	22	3.58	0.92
Rep. of Korea	18	2.93	0.75	20	3.25	0.83
Australia	16	2.60	0.67	8	1.30	0.33
Brazil	16	2.60	0.67	33	5.37	1.38
Japan	15	2.44	0.63	25	4.07	1.04
Mexico	15	2.44	0.63	25	4.07	1.04
Indonesia	14	2.28	0.58	11	1.79	0.45
Chile	13	2.11	0.54	10	1.63	0.42
Turkey	11	1.79	0.49	5	0.81	0.20
Russian Federation	9	1.46	1.28	7	1.14	1
Dominican Rep.	7	1.14	0.29	1	0.16	0.04
Hungary	7	1.14	0.29	5	0.81	0.20
Peru	6	0.98	0.25	3	0.49	0.12
Philippines	6	0.98	0.25	5	0.81	0.21

China is the only late accession country among the first ten members for the number of disputes received, the third after US and EU. The intensity of the activity against China is high, more than twice as the second largest developing economy (India), and concentrated among few complainants. The US is the most aggressive plaintiff (23 complaints), followed by the EU (9). The remaining disputes were filed by Mexico (4), Canada (3), Japan (2), Brazil (1), and Guatemala (1). Considering also its respondents, China interacted with a total of 11 WTO members. In contrast, the US has received and filed disputes with more than 25 different countries, and India participated in disputes with 15 countries. Moreover, Table 3.1 shows that most of the countries exhibit a higher rate of participation as plaintiffs, or a fairly balanced participation in both roles. Only in the case of China the size of its activity as respondent is not reflected in the disputes initiated. The pace at which China

climbed the ranking is strongly due to the number of disputes received, while its activity as a complainant remained rather low.

3.4.2 Non-standard motives

One may argue that WTO members have naturally oriented their efforts against China because this country represented a "perfect combination" of all the motives usually associated with dispute initiation. There is a main objection to this argument. China's economic model was, and still is, a unique paradigm in the WTO universe. WTO provisions were poorly adequate to address, and contain, the contradictions of its economic structure. Wu (2016) argued that the issue did not lie in the WTO's neglect of alternative economic regimes, but rather in the fundamental differences between China and *any* of these regimes.[14] These contradictions had been only partially recognized in the safeguard clauses contained in the Protocol of Accession.[15] The massive - and oftentimes, distorted - resort to policies of administered protection (i.e. anti-dumping) reveals to what extent countries were substantially unprepared to face some issues strictly related to the peculiarity of the Chinese economy: the persistence of non-trade barriers and subsidized sectors, the inadequate protection for intellectual property rights and the uneven playing field in reciprocal access to markets.

In such a context, it is reasonable to assume that standard predictors may not be sufficient to explain the aggressiveness against China. A preliminary inspection of the correlation between the number of disputes and the greatest predictor of disputes, the intensity of trade (Horn et al., 1999), points in this direction. Figure 3.2 shows the correlation between the average annual trade (sum of imports and exports) and the number of disputes accumulated in the time intervals considered.

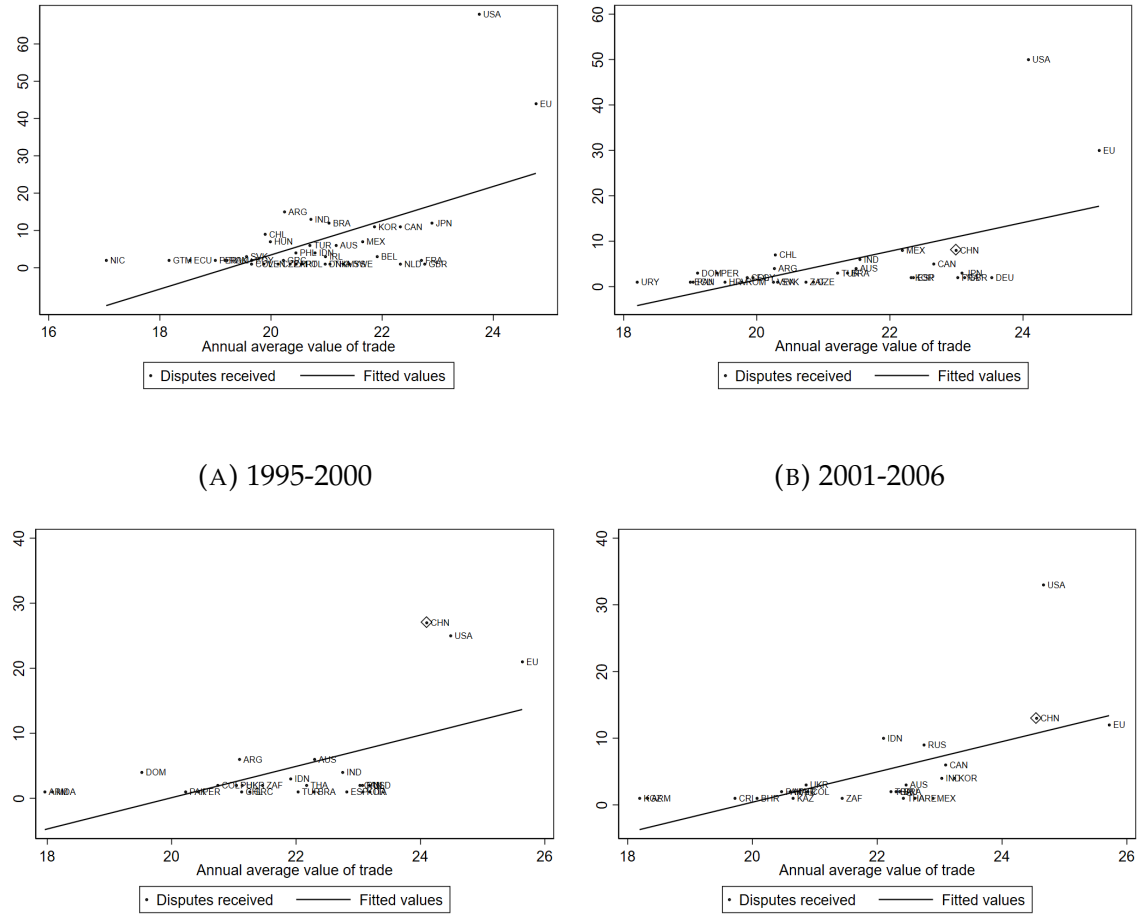
In the case of China (and US and EU), volumes of trade are associated with a number of disputes which is disproportionate to both the increment in trade and the other countries, particularly major traders such as Japan, Canada, and Germany.

[14] Similarly, many commentators have outlined the excessive rigidity in assimilating China to other state capitalist models (such as Russia's or Brazil's) at the time of entry negotiations.

[15] These include the status of non-market economy for price comparability purposes, the introduction of a special Transitional Product-Specific Safeguard Mechanism and the exploitation on a discriminatory basis of the already existing WTO Agreement on Safeguards.

The discrepancy between the three top players and the other countries supports the hypothesis of more sophisticated determinants to explain the frequency of interaction. Moreover, the similarity in terms of dispute incidence between China and the US and EU can be hardly re-conduct to any common economic and political characteristics. US and EU greatly differ from China in terms of liberalization of their economies, market status, balance of trade, and, not less importantly, political regime and institutional characteristics. These "within" differences may relate to both the exceptional rapidity at which China climbed the rank - becoming the biggest outlier in 2007-2012 - and the sudden drop in the use of trade disputes against it in the latest years (differently from the US and, to a lesser extent, the EU, which maintained a more stable position along the whole period).

FIGURE 3.2: Average trade and number of disputes, by country and intervals



(A) 1995-2000

(B) 2001-2006

(C) 2007-2012

(D) 2013-2018

3.4.3 Challenged measures

The issues at stake represent another element of differentiation. Table 3.2 provides information on the measures of the disputes involving China as respondent part.[16]

TABLE 3.2: Targeted measures, disputes against China

Measures	Freq.	Percent	Cum.
Anti-dumping and countervailing duties	8	18.6	18.6
Export restrictions	8	18.6	37.21
Subsidies	8	18.6	55.81
Market access	4	9.3	65.12
Export subsidies	2	4.65	69.77
Import measures and regime	2	4.65	74.42
Import restrictions (ban, licensing)	2	4.65	79.07
Intellectual property rights	2	4.65	83.72
Discriminatory measures, practices, regulations	1	2.33	86.05
Domestic support	1	2.33	88.37
Import duties	1	2.33	90.7
Internal taxation	1	2.33	93.02
Safeguard measures	1	2.33	95.35
Tariffs-related	1	2.33	97.67
Technology transfer	1	2.33	100
Total	43	100	

At the general level, a predominantly large share of complaints relates to the imposition of anti-dumping measures (22.6%). Import restrictions are ranked the second place, although with a significantly reduced share (13.6%). In the case of China, anti-dumping measures represent the 18.6%, on par with export restrictions. The Chinese government has indeed imposed a long series of control (quotas and duties) on export production which have been systematically challenged by its complainants. The interested sectors are mainly raw materials[17] and rare-earths - that are crucial components in the steel, aluminium, and chemical sectors, where China has been instead accused of mass subsidization. In these regards, the fact that industry and export subsidies cumulatively account for the largest share (23%) of Chinese disputes, mirrors the conflicting relationship between the Chinese economic model

[16]Statistics on the total amount of disputes are available in Appendix C, Table C.4.

[17]Bauxite, coking coal, fluorspar, magnesium, manganese, silicon metal, silicon carbide, yellow phosphorus, and zinc.

and the WTO market-oriented and rules-based multilateral trading system. At the general level, these measures, as well as market access issues, represent a minority share of the rest of the countries, whose market status supposedly prevents them from applying such protectionist policies.

3.5 Empirical analysis

This section presents and discusses the main results of the empirical analysis. I define my main outcome variable $Dispute_{ijt}$ as a dichotomous variable which takes the value of 1 if the country i filed at least one dispute against country j in a given year, and 0 otherwise. In this context, the choice of a binary variable rather than a count variable represents a fair approximation. Indeed, the variation in the count of disputes is minimal. For most of the countries in the sample, the probability to file more than a dispute a year against the same country is essentially null.[18] Therefore, I employ the following linear probability model:

$$Dispute_{ijt} = \alpha_i + +\gamma_j + \delta_t + \beta_1 China_j + \beta_2 X_{it} + \beta_3 X_{jt} + \beta_4 X_{ijt} + e_{ijt} \tag{3.1}$$

where the variable of interest is a dummy $China_j$, which takes the value of 1 when China is the respondent party, and 0 otherwise. This variable estimates the probability of filing a dispute against China compared to the average potential respondent. The terms X_{it} and X_{jt} are vectors of individual characteristics of the countries and X_{ijt} is a matrix of pair-level characteristics. In order to account for possible serial correlation, standard errors have been clustered at the country-pair level. Unobserved heterogeneity at the year and individual countr(ies) level has been accounted for by including time and countries fixed effects. Therefore, the dummy $China_j$ coincides with the respondent-specific unobserved effect. The reference category for respondents is Chile, while for complainants is Japan (i.e. the countries which are the closest to the average).

[18] Only in 53 cases countries reported two disputes filed against the same country in one year, and only in 26 the count has been higher than two disputes per year. For an average country, the probability to receive a dispute in a given year is lower than 1%. Table C.6 in Appendix C reports the sample variation in the count of disputes.

The importance of the individual effects estimation supports the choice of a linear rather than a non-linear probability model. Estimating a fixed effects model for non-linear regressions leads to the incidental parameters problem,[19] and consequently to biased marginal effect estimates of covariates (Greene, 2002, 2007). Moreover, differently from the linear model, estimates of individual effects are not consistent, thus the interpretation of these effects is no possible[20]. In this context, potential outbound predictions represent a less severe problem when compared to the impossibility to obtain an estimate for the China effect.

The analysis develops in three stages. In Section 3.5.1 I first estimate China's effect on the propensity to file a dispute. The primary interest is to verify whether China is significantly associated to a higher probability to be targeted with respect to other countries.

Then, in Section 3.5.2, I explore which determinants explain the probability to file a dispute against this specific country, as compared to other WTO respondents. In order to identify which determinants explain the augmented probability to file a dispute against China, I exploit the main specification as in Eq. 3.1. By including the control variables, I can determine which elements contribute to triggering a dispute at the general membership level. More importantly, it allows to detect which ones are specifically related to China, if they also contribute to explaining the specific China individual effect. Indeed, if the data contain the key factors that explain the aggressiveness against China, then adding them as regressors will yield small and statistically insignificant country fixed effect for China.

Section 3.5.3 reports my main results. Once selected the relevant variables, I follow a more traditional gravity equation approach adding a China interaction term to capture which mechanisms are more responsible for disputes involving China. The purpose is to investigate whether their marginal effect is consistent with the general

[19] Assume that a panel data has N individuals over T time periods. If T is fixed, as N grows large the covariate estimates (β) become biased. This occurs because the number of "nuisance parameters" grows quickly as N increases, and is more severe when the number of repeated measurements per individual is small.

[20] In some papers on trade disputes, a more refined alternative is the use of corrected logistic models (see for instance the Relogit command developed by King and Zeng, 2001, and the Firth logit, developed by Coveney and based on Firth, 1993). However, while these methods sensibly alleviate small-sample bias due to the large number of zeros, there is no evidence that potential estimates for person-level heterogeneity be consistent.

effect in terms of magnitude and direction. Given that isolating China with respect to all other countries may not necessarily capture country-specific issues, but also those common to large trading blocks, I focus on the comparison with the two other major outliers in terms of disputes received, the US and European Union.

3.5.1 The probability to target China

To preliminary investigate the probability to launch a dispute against China, I reduced Eq. 3.1 to a very parsimonious form where the only covariate is the dummy $China_j$. Estimates are reported in Table 3.3. The expected probability to file a dispute for the country i increases by 3% when China is the potential respondent (i.e. the probability for China to be targeted is more than three times higher than the average, which is less than 1%). The significance of China's coefficient acquires a greater importance if compared with other respondents' dummies. 14 countries have a positive coefficient, which is significant only in the case of US and EU (with a coefficient of respectively 0.091 and 0.059)[21]. Thus, China's estimated country fixed effect ranks third, the only country which joined the organization at a later stage among those with a positive coefficient. All the remainder are negative, 22 of them significant, meaning that most of the countries face a negative probability to be targeted, in line with the anecdotal evidence presented in the descriptive statistics.

To explore potential changes in the probability to file disputes over the years and specifically after China's accession, I make use of linear and China-specific time trends. Introducing a linear time trend in Column (4) indicates that countries' propensity to file disputes has decreased over time. To investigate possible differences in the use of the DS mechanism after China accession, I introduced a dummy variable $Post_t$, equal to one from 2001 onward and zero otherwise, which I interacted with the linear time trend. The purpose is to clarify whether China's entry not only triggered an escalation of cases against it but is also associated with a change in the use of the mechanism. A negative and significant coefficient in the interaction term would support this intuition, meaning that a negative trend started in coincidence with China's accession.[22] A complementary hypothesis is the exis-

[21] There results are available on request.

[22] Note that it doesn't indicate that a negative trend has been caused by China. The variables $China_j$

tence of a separate trend for China, as opposed to other respondents, in the period after 2001. Therefore, in Column (6) the dummy $China_j$ is interacted with the linear time trend.[23]

TABLE 3.3: The probability to file a dispute against China

Dep. variable: Dispute	(1)	(2)	(3)	(4)	(5)	(6)
				1995-2018	1995-2007	1995-2012
$China_j$	0.0283*	0.0278*	0.0283*	-0.0084	-0.1310**	-0.0964**
	(0.0166)	(0.0166)	(0.0166)	(0.0122)	(0.0587)	(0.0421)
Trend		-0.0004***	-0.0004	-0.0004	-0.0004	-0.0004
		(0.0001)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
$Post_t$			-0.0066*	-0.0060	0.0017	-0.0031
			(0.0038)	(0.0038)	(0.0050)	(0.0041)
$Post_t \times$ Trend			0.0002	0.0002	-0.0003	0.0000
			(0.0005)	(0.0005)	(0.0005)	(0.0005)
$China_j \times$ Trend				0.0019*	0.0097**	0.0075**
				(0.0011)	(0.0047)	(0.0035)
Complainants FE	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes
Year FE	yes	no	no	no	no	no
Observations	79,822	79,822	79,822	79,822	39,714	57,586
R-squared	0.0538	0.0529	0.0532	0.0534	0.0736	0.0627

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant and respondent fixed effects. Columns 1 to 4 report the estimates for the years 1995-2018. Column 5 and 6 reduce the sample to 2007 and 2012 respectively. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

The dummy $Post_t$ indicates that the period after 2001 is associated with a decrease in the probability to file a dispute. However, there is no evidence that the year 2001 represents the beginning of a decreasing overall trend, as the interaction $Post_t \times Trend$ in Column (5) is not significant. The year of China's accession did not coincide with the beginning of a progressive reduction in total disputes filed. In Column (6), the coefficient of the specific China trend is positive and significant (at 10% level), suggesting that the period after China's accession is characterized by an increasing trend in the probability to file a dispute against this country.

and $Post_t$ are collinear and cannot be interacted. Indeed, the variable China is missing for the years before 2001, when China was not part of the organization (i.e. when $Post_t$ is 1, $China_j$ can be either 1 or 0, but when $China_j$ is 1, $Post_t$ can only be 1). This is the reason why a difference-in-differences design cannot be considered in this framework.

[23]Note that the interaction between $China_j$ and $Trend$ is possible only for the post-2000 period. Normally we would also have a term $China_j$*$Post_t$*$Trend$, which in this case is omitted (see the footnote above).

Given the disproportionate length of China's post-accession period compared to the six years before, the period after 2000 has been first reduced to the years until 2007 and then until 2012 (Columns (7) and (8)). This refinement helps to clarify the "aggressiveness" of the action against China over the years. In Column (7), the coefficient on the specific China trend is greater in magnitude and significance with respect to the total sample in Column (6). When the post-accession period is extended to 2012, the coefficient, although still larger than in the full sample, is reduced by about 20%. Given that the coefficient in Column (6)is the average of the full period until 2018, this suggests that the probability to target China has slowed down over time.

3.5.2 The determinants of disputes against China

In order to investigate the determinants of the "China" effect, I now exploit a set of control variables according to Eq. 3.1. Importantly, the inclusion of control variables greatly reduces the sample size. Particularly problematic are data on bilateral trade flows. Within this context, missing trade flows mainly relates to small and least-developed economies, especially in the first decade (1995-2005). Such countries record a very low number of disputes, two third of them belongs to the group of 15 respondents with 0 disputes received and one dispute filed in the whole period. This deletion leads to an increase in the share of positive events with respect to the sample population.[24]

In Table 3.4, additional controls are aggregated by type and tested separately. In Column (1) I consider basic economic indicators for the size and openness of the economy. Column (2) reports the estimates for regime similarity and the dummy $Tit\text{-}for\text{-}Tat_{ijt}$, while in Column (3) I account for the specific complainant-respondent trade relationship and the more strategic component connected to the disparity in the capacity of effective retaliation. Columns (4) and (5) employ the full set of covariates. To allow for a comparison, Table 3.4 reports also the estimates of the individual unobserved effects of US and EU.

[24]To tackle this issue I performed several tests on single coefficients and repeated the analysis by fixing the subsample of non-missing observations to ensure that the change in the significance of some regressors was not the result of the decline in sample size. Results are, nonetheless, highly consistent.

Traditional economic determinants in Column (1), leave China's coefficient substantially unaffected. Likewise, the variables $Tit\text{-}for\text{-}Tat_{ijt}$ and $Regime\ distance_{ijt}$ (Column 2), although significant, do not even partially explain the aggressiveness against China. This is a first difference if compared to the two other outliers in the sample. Indeed, EU and US fixed effects, while statistically significant, are greatly reduced by the inclusion of political variables. At the general level, a greater openness of the potential respondent decreases the probability to launch a dispute against it. A country targeted by its partner in the year before has a 90% greater probability to file a dispute back in the current period. Moreover, country pairs with similar levels of institutional development tend to fight more intensively.

Including the set of variables in Column (3) suggests that the determinants of disputes against China are grounded on the trade imbalances between China and the potential plaintiffs, as the coefficient on the China individual effect becomes insignificant. A similar effect is not found in the case of EU and US fixed effects, which are only minimally affected by the use of these variables. On average, a 10% increase in trade flows increases the probability of a dispute by around 1%. This effect is weakly significant. Previous studies have found export volumes and export varieties as a main predictor of disputes (Horn et al., 1999). Nevertheless, when considering bilateral flows, higher volumes do not only increase the probability to incur violations (especially at the extensive margin), but also indicate a greater liberalization between two economies. The inverse relationship between trade liberalization and dispute probability is also suggested by the coefficient of $Openness_{jt}$.

The positive coefficient of $Balance_{ijt}$ indicates that improvements in the complainant's trade balance augment the probability of a dispute. In other words, countries target less the partners with whom they retain a larger trade deficit, thereby supporting the interpretation that a greater exporting activity increases the probability to incur violations by trade partners, and subsequently challenging them. It must be noticed that this positive coefficient greatly contrasts with China's bilateral position, which retains a persistent trade surplus with all major economies. Nevertheless, for these users (e.g. US, EU, Canada), China represents the major (if not the only) source of deficit[25] and indeed the inclusion of this control, when taken

[25]The range of variation when considering the total sample is [-0.91, +0.29], with a mean of -0.0009.

singularly, does not affect China.

TABLE 3.4: Determinants of trade disputes

	(1)	(2)	(3)	(4)	(5)
	Dep. variable: Dispute				
China_j	0.0279*	0.0251**	0.0263	0.0254	0.0231*
	(0.0164)	(0.0123)	(0.0204)	(0.0202)	(0.0137)
GDP growth_{it}	0.0086			0.0080	0.0071
	(0.0112)			(0.0217)	(0.0215)
GDP growth_{jt}	-0.0050			-0.0056	-0.0209
	(0.0100)			(0.0174)	(0.0184)
Openness_{it}	0.0001			0.0020	-0.0014
	(0.0011)			(0.0018)	(0.0025)
Openness_{jt}	-0.0034**			-0.0044**	-0.0091***
	(0.0013)			(0.0020)	(0.0027)
$\text{Regime distance}_{ijt}$		-0.0002**			-0.0003**
		(0.0001)			(0.0002)
Tit-for-Tat_{ijt}		0.9339***			0.9244***
		(0.0096)			(0.0110)
$\text{Bilateral trade}_{ijt}$			0.0010*	0.0011*	0.0011**
			(0.0006)	(0.0006)	(0.0005)
Dependency_{ijt}			0.1390	0.1394	0.1022
			(0.0947)	(0.0914)	(0.0623)
$\text{Retaliatory distance}_{ijt}$			0.0199	0.0201	0.0071
			(0.0301)	(0.0304)	(0.0199)
Balance_{ijt}			0.3076**	0.2979**	0.4869***
			(0.1407)	(0.1341)	(0.1329)
US_j	0.0825***	0.0667***	0.0802***	0.0708***	0.0402***
	(0.0198)	(0.0147)	(0.0241)	(0.0233)	(0.0147)
EU_j	0.0612***	0.0391***	0.0503***	0.0505***	0.0235**
	(0.0141)	(0.0086)	(0.0189)	(0.0186)	(0.0118)
Complainants FE	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
Observations	73,866	68,260	47,483	46,907	43,155
R-squared	0.0527	0.2182	0.0687	0.0667	0.2486

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

When China is the specific partner, the range is [-0.91, +0.1], with a mean of -0.034.

3.5.3 Main results: China's differential effects

So far, results indicate that the forces behind China's targeting may be driven by specific variables: bilateral trade flows, import dependency, retaliatory distance, and trade balance. In Table 3.5, these key characteristics are interacted with the dummy *China* to investigate the differential effect of these variables when China is the potential respondent. Nevertheless, China is not the only country to have been involved in a disproportionate number of trade disputes. The United States and European Union have been equally, if not more, targeted. Therefore, I also interact the same variables with the dummies *United States* and *European Union*, equal to 1 if the respondent j are the United States or European Union respectively. The aim is to investigate whether these three members share common dispute determinants, or whether they significantly differ amongst them.

From a preliminary inspection, Table 3.5 suggest that the marginal effects estimates can significantly differ amongst the three countries. Moreover, China's disputes determinants are more aligned with the United States disputes than the European Union ones. In Column (1), the effect of an increase in bilateral trade flows when China or the United States are the potential respondent is notably increased in magnitude, while it has no additional effect for the EU. A 10% increase in trade volumes increases the dispute probability by more than 19% in the case of China, and 33% in the case of the United States. In Columns (2) and (3) I distinguish between export and import flows. Whilst greater exports or imports do not affect the probability to initiate a dispute against the EU, they are nonetheles significant for China and the US. The effect is notably increased in magnitude in the case of imports, and the difference between exports and imports effects is larger for China. A 10% increase in imports determines a 23% increase in dispute probability.[26] These estimates help to refine the effect of the total bilateral trade flows. What really seems to affect the propensity to file a complaint against China is the disparity between the relative export flows.

In Column (4) an increase in bilateral trade has a very large effect on the propensity to file disputes against the United States and the European Union, while it has

[26] More than 20 times larger than the average effect.

no additional marginal effect in the case of China. This indicates that the strategy of filing more disputes when the trade balance improves is a peculiar characteristic of US and EU plaintiffs.

Column (5) shows that strategic arguments such as a greater retaliatory capacity matter in the case of China and European Union, but not against the United States. Especially in the case of China, the larger the difference between the Chinese export's share to a country and the correspondent country's export share to China is, the higher the probability that China's partner will complain. This is in line with the evidence presented by Bown (2004, 2005a), who demonstrated that developing countries have changed their pattern of initiation to take better advantage of the instances where they have the leverage to threaten. When it comes to filing a dispute against China, a similar behavior also applied to the most advanced economies. These findings help to clarify the interpretation of the power argument. The lack of evidence at the general level in Table 3.4, compared to previous papers, may be a consequence of a change in countries' relationships. It is plausible that these relationships were much more disproportionate in the past, resembling that of China and its trade partners today, thus making countries more sensible to file disputes according to their retaliation capacity. This is in line with the common interpretation that "power" affects the decision to complain as higher market shares make the enforcement possibilities stronger. However, it is also possible that this variable captures also some other effect. Higher export shares do not only indicate a greater retaliatory power of the complainant but they also signal a higher competitive power of the respondent. In this sense, countries are also more likely to file a dispute in an attempt to protect their domestic production, by either reducing their weight on foreign exports or increasing the importance of the foreign market for their export production.

In Column (6) a lower import dependency decreases only the probability to target the European Union. Finally, Column (7) shows that China is more likely to be targeted by countries with very high levels of democratic institutions, while United States and European Union do not report significant differences according to the istitutional framework of their plaintiffs.

TABLE 3.5: China's differential effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. variable: Dispute						
$\text{China}_j \times \text{Bilateral trade}_{ijt}$	0.0197**						
	(0.0088)						
$\text{US}_j \times \text{Bilateral trade}_{ijt}$	0.0335***						
	(0.0061)						
$\text{EU}_j \times \text{Bilateral trade}_{ijt}$	0.0071						
	(0.0053)						
$\text{China}_j \times \text{Exports}_{it}$		0.0085*					
		(0.0049)					
$\text{US}_j \times \text{Exports}_{it}$		0.0295***					
		(0.0055)					
$\text{EU}_j \times \text{Exports}_{it}$		0.0065					
		(0.0049)					
$\text{China}_j \times \text{Imports}_{it}$			0.0233**				
			(0.0095)				
$\text{US}_j \times \text{Imports}_{it}$			0.0328***				
			(0.0060)				
$\text{EU}_j \times \text{Imports}_{it}$			0.0071				
			(0.0052)				
$\text{China}_j \times \text{Trade balance}_{ijt}$				0.0452			
				(0.2181)			
$\text{US}_j \times \text{Trade balance}_{ijt}$				0.9853***			
				(0.2688)			
$\text{EU}_j \times \text{Trade balance}_{ijt}$				0.5121***			
				(0.1699)			
$\text{China}_j \times \text{Ret. distance}_{ijt}$					0.6210***		
					(0.1858)		
$\text{US}_j \times \text{Ret. distance}_{ijt}$					0.0675		
					(0.0523)		
$\text{EU}_j \times \text{Ret. distance}_{ijt}$					0.1793***		
					(0.0537)		
$\text{China}_j \times \text{Dependency}_{ijt}$						0.0232	
						(0.2071)	
$\text{US}_j \times \text{Dependency}_{ijt}$						0.0293	
						(0.1167)	
$\text{EU}_j \times \text{Dependency}_{ijt}$						-0.1436**	
						(0.0670)	
$\text{China}_j \times \text{Regime distance}_{ijt}$							0.0038**
							(0.0018)
$\text{US}_j \times \text{Regime distance}_{ijt}$							-0.0003
							(0.0020)
$\text{EU}_j \times \text{Regime distance}_{ijt}$							-0.0027
							(0.0020)
Complainant FE	yes	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Observations	43,155	43,155	43,155	43,155	43,155	43,155	43,155
R-squared	0.2570	0.2554	0.2572	0.2505	0.2536	0.2492	0.2492

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

3.5.4 Robustness

Further robustness checks for the results in this section are provided in Appendix C. Briefly, in Table C.7 I show that the results are robust to control for several sample restrictions. In Column (1), respondents with zero disputes received (a large part of which had been already dropped due to the lack of data on bilateral flows) are excluded. Column (2) drops the EU and US from the samples of both complainant and respondent countries, thereby excluding the biggest positive complainant outliers. In Columns (3) to (5), I restrict the complainants' sample to countries with more than 5 disputes, to developed and developing countries. Finally, in Column (6) I drop the years 2008, 2009, and 2010, to control for the influence of the global crisis, while in Column (7) I introduce both the GDP growth rates and the unemployment rates - as macroeconomic indicators - lagged one year to limit potential endogeneity concerns. The estimates are highly consistent in magnitude and significance with the results in the main specifications.

The only significant difference relates to the coefficient on the bilateral balance of trade. According to theory, larger trade deficits should call for more protectionist measures against the counterpart, which arguably include also a higher number of trade disputes. Nevertheless, results so far suggested rather an unexpected opposite effect. In Column (2), the exclusion of the US and EU from the sample yields a non-significant effect on the probability to file a dispute, suggesting that the average positive effect is driven by US and EU plaintiffs, which are more likely to file disputes when their deficit with these biggest economies decreases. In the first stance, this is related to the increase in exports which, especially at the extensive margin, increases the probability to incur violations. Moreover, filing disputes when they retain a better position vis a vis the US and EU may also be a strategic choice. For potential complainants - most of them developing economies - the expected payoff to file a dispute against a powerful respondent such as the US is very low if compared to the potential damages of a retaliatory reaction. There is always the threat that the US and EU will retaliate by restricting their imports, either by imposing barriers or switching to another supplier, thereby reducing even more the exports of the complainant. In that case, complainants do not have the capacity to retaliate

further since their imports have generally a low weight on the US export production. China's plaintiffs, however, may adopt a different strategy. Even in the event China will retaliate, they have the power to retaliate back and a potential winning has a very high payoff, which is particularly appealing when they retain a more disadvantaged position.

Finally, Tables C.8, C.9 and C.10 in Appendix C, reports the interaction effects considering the three countries separately.

3.5.5 Disputes and trade liberalization

In this section, I investigate more carefully the link between trade liberalization and trade disputes. According to Kuenzel (2017) disputes appears more frequently during tariff reduction periods. This higher participation is motivated on the basis of a less flexible trade policy that a country may rely on when facing unexpected productivity shocks. Lower tariffs indeed decrease the margin between the applied tariff and the tariff MFN bound, i.e. the tariff overhang, thus constraining countries' capacity to unilaterally adjust their trade policies and increasing the likelihood to resort to the Dispute Settlement mechanism.

To check the validity of this channel, Kuenzel (2017) made use of a newly constructed dataset.[27] The dataset covers the years 1995-2014 and considers only country pairs with positive trade flows in both directions, causing a significant drop in my observations.[28] In Table C.11, I first verify whether the effect of *Overhang* and *Overhang share* is still significant and consistent when considering my set of independent variables[29]. According to previous findings, tighter overhangs would have a positive effect on disputes, as well as larger shares of bilateral import sectors featuring zero or negative tariff overhangs. Then, I interact these variables with the dummy *China* to verify the presence of a differential effect in the case of this coun-

[27]The dataset is publicly available on the website of the *European Economic Review*, https://www.journals.elsevier.com/european-economic-review.

[28]Kuenzel (2017) employs a different outcome variable, equal to 1 if the country pair is observed to have a dispute in a given year.

[29]The independent variables are very similar in between the two studies. Kuenzel (2017) adds some measures of preferential treatment, legal capacity, and the extensive margin of the defendant's exports to the complainant. He does not consider, instead, import dependency, bilateral trade balance, retaliation asymmetries, and tit-for-tat.

try.

In Column (1) I include the average tariff overhang and the share of zero/negative sectors in bilateral trade by considering basic economic indicators (bilateral trade, GDP growth rates, and shares of trade over GDP). All the coefficients have the expected signs. The coefficients on the complainant's and defendant's average tariff overhangs are negative (but significant only in the case of complainants), indicating that lower overhangs increase the probability to file disputes, while the overhang shares retain a positive sign, which is significant only in the case of the respondent.

In Column (2), I consider the entire set of my dependent variables. The inclusion of other covariates absorbs the effect of the trade liberalization indicators. In the last four columns, I consider the relationship between trade liberalization and dispute probability when China is the potential respondent. In contrast with the main effect, higher overhangs on the part of China significantly increase its probability to be targeted. In these regards, it shall be noticed that from 2001 China's liberalization happened mainly through a consistent reduction of the tariffs imposed, rather than a generalized decrease in the tariff bounds. In fact, greater liberalization, even though advocated by WTO members, produced larger gains for China and an adverse effect on its main partners, thereby increasing disputes.

Consistently with previous findings, a larger share of imports from China with zero or negative overhangs augment the probability for the complainant country to resort to the WTO. Following Kuenzel's interpretation, additional productivity shocks cannot be absorbed because of the substantial rigidity in trade policies, therefore countries with tight tariff overhangs are also more likely to gain from dispute filings. In the context of this paper, these findings clarify the use of the Dispute Settlement System against China. The resort to trade disputes appears to be a secondary policy option, with respect to the possibility of unilaterally "punishing" China by raising their tariff rates.

3.6 Conclusion

This paper investigates the determinants of the WTO trade disputes against China. Using a new dataset that covers the totality of the WTO complaints between 1995

and 2018, I show that China's accession in 2001 allowed countries to massively exploit disputes, which have been persistently and increasingly addressed against China in the following years. My analysis allows to identify which channels explain the propensity to file disputes against China by reconciling trade arguments with strategic and political motives. I show that the peculiarities of the Chinese economic structure, and the consequent trade distortions, have been reflected in the determinants of its complaints. Significant differences have been found with respect to both the general membership. Moreover, the comparison with the US and EU indicates tha peculiar elements of differentiation also exist among the most powerful economies.

In the case of China, the incidence of disputes strongly depends on the asymmetries in the bilateral trade relationship of the countries involved. The dramatic China trade expansion was not counterbalanced by a similar expansion of its trade partners into the Chinese market, whose access is still severely hampered, resulting in large trade deficits. This has given new rise to the importance of the strategic dimension, also for members whose economic power generally prevented them from applying such rationale. Other than the role of import penetration, the probability to file disputes against China increase when the complainants' capacity to retaliate increase relative to the Chinese one, as countries reacted by increasing disputes when they hold a larger share of Chinese exports. Moreover, trade asymmetries dominate the effect of other traditionally important predictors, including institutional characteristics. Especially in the case of the regimes quality, China reversed the empirical regularity which predict the similarity of democratic regimes to enhance these types of conflicts.

Finally, the use of variables that represent both the degree of liberalization and the constraint on trade policy adjustments helps to clarify the use of trade disputes. The inverse relationship between the tariff overhangs and the initiation of the dispute suggests that the use of the multilateral system is secondary to the imposition of direct measures. This shouldn't be surprising. The Dispute Settlement System has been heavily criticized for its inability to promptly solve issues which, in the case of China, are of primary concern: among others, the distortion arising from its state-controlled economy and the heavy subsidization of crucial sectors. The

costs associated with disputes in terms of time and uncertainty explain the choice of unilateral measures, when available. However, recent developments in the international scenario suggest that the resort to trade disputes may be not anymore perceived as a valid substitute. The risk, in this case, is that countries will put in place an escalation of measures that fall well beyond the necessary respect for the multilateral principles they agreed upon at the time of their entry into the Organization.

Appendix A

Appendix Chapter 1

A.1 Variables description

Variable	Description
	Panel A: Measures of political support
Activists	The total number of political activists recorded by the Public Security Office in a province during the Red Biennium (1919-1920) (per 1000 inhabitants)
Communists	The number of communist activists recorded by the Public Security Office in a province during the Red Biennium (1919-1920) (per 1000 inhabitants)
Socialists	The number of socialist activists recorded by the Public Security Office in a province during the Red Biennium (1919-1920) (per 1000 inhabitants)
Republicans	The number of republican activists recorded by the Public Security Office in a province during the Red Biennium (1919-1920) (per 1000 inhabitants)
Anarchists	The number of anarchist activists recorded by the Public Security Office in a province during the Red Biennium (1919-1920) (per 1000 inhabitants)
Other	The number of individual recorded by the Public Security Office in a province during the Red Biennium (1919-1920) not reporting any specific political affiliation at the time of the arrest and later labelled as “antifascist" (per 1000 inhabitants)
Vote Share	Share of votes to the fascist Party (Lista Nazionale) over the total province votes
	Panel B: Incidence of patents and trademarks

(Continued)

Variable Label	Description
Total	The total number of design patents and trademarks certificates released to a province in 1923-1929 (per 1000 inhabitants)
Designs	Number of design patents certificates released to a province in 1923-1929 (per 1000 inhabitants)
Trademarks	Number of trademarks certificates released to a province in 1923-1929 (per 1000 inhabitants)
	Panel C: Measures of fascist activity
fascist violence	number of fascist violent episodes per 1,000 inhabitants for the period 1920–22
fascist killings	number of fascist killings per 1,000 inhabitants for the period 1920–22
fascist party branches	number of branches of the fascist Party in a province in September 1921 (per 1000 inhabitants)
Propaganda Episodes	number of propaganda events attended by Mussolini in a province in 1927–39
Donors	number of municipalities in a province with at least a large donor to the fascist party in 1919–25
	Panel C: Time dummies
Mussolini	1 for the years after 1922 (March on Rome)
Election	1 for the years after 1924 (election)
	Panel C: Other controls
Population	Province population as recorded by the 1921 Census (expressed in logs)
Main city	1 for the ten most populous cities at the time
Region capital	1 if the province contains the region capital
Red province	1 for the 10 provinces with the highest number of parliamentary seats assigned to the Socialist and Communist parties in 1921 election
Least red province	1 for the 10 provinces with the lowest number of parliamentary seats assigned to the Socialist and Communist parties in the 1921 election

A.2 Descriptive statistics

TABLE A.1: Summary statistics: cross-sectional (1)

	count	mean	sd	min	max
Vote Share$_p$	72	0.678	0.173	0.275	0.986
Activists$_p$	72	0.045	0.066	0.000	0.454
Socialist$_p$	72	0.020	0.041	0.000	0.340
Communists$_p$	72	0.006	0.009	0.000	0.070
Anarchists$_p$	72	0.014	0.021	0.000	0.140
Republicans$_p$	72	0.004	0.009	0.000	0.057
Other$_p$	72	0.001	0.001	0.000	0.006
LnPopulation$_p$	72	12.971	0.764	9.565	14.939
N	72				

Use of the province denomination in 1924 to map the province number of activists. This mapping has been used for the estimates in Tables 1.2 in order to match the province electoral results.

TABLE A.2: Summary statistics: cross-sectional (2)

	count	mean	sd	min	max
Activists$_p$	93	0.041	0.059	0.000	0.454
Socialists$_p$	93	0.018	0.037	0.000	0.340
Communists$_p$	93	0.006	0.009	0.000	0.070
Other$_p$	93	0.001	0.002	0.000	0.010
Anarchists$_p$	93	0.013	0.019	0.000	0.140
Republicans$_p$	93	0.004	0.008	0.000	0.057
Total$_p$	93	0.185	0.687	0.000	4.428
Designs$_p$	93	0.027	0.131	0.000	0.924
Trademarks$_p$	93	0.158	0.600	0.000	4.427
LnPopulation$_p$	93	12.752	0.720	9.565	14.939
N	93				

Use of the largest province denomination to map the province number of activists and patents. This mapping has been used for the estimates in Tables 1.4, A.9 and A.10.

TABLE A.3: Summary statistics: panel data. Data covers 93 provinces and 22 years (1910-1930), as used in my main panel data specifications.

	count	mean	sd	min	max
Activists_{pt}	1824	0.042	0.059	0.000	0.454
Total_{pt}	1824	0.018	0.082	0.000	1.390
Designs_{pt}	1824	0.003	0.020	0.000	0.382
Trademarks_{pt}	1824	0.015	0.071	0.000	1.390
Mussolini_{t}	1824	0.510	0.500	0.000	1.000
Election_{t}	1824	0.459	0.498	0.000	1.000
LnPopulation_{pt}	1824	12.780	0.634	9.565	15.003
N	1824				

A.3 Additional Tables

TABLE A.4: The pattern of innovation in Western countries

	(1) Total	(2) Inventions	(3) Designs	(4) Trademarks
$\text{Germany}_i \times \text{After}_t$	0.068	0.167**	0.125	-0.370
	(0.135)	(0.040)	(0.405)	(0.367)
LnPopulation_{it}	2.352	-0.332	8.297	5.617**
	(1.144)	(0.752)	(5.137)	(1.593)
lnGDP_{it}	0.482	0.280	0.268	-1.658
	(0.846)	(0.266)	(2.380)	(1.434)
Observations	79	80	79	64
R-squared	0.963	0.961	0.923	0.947

Columns show coefficients of a linear model. Robust standard errors in parentheses. The sample includes five countries (Italy, Germany, United Kingdom, France and United States) and twenty years (1910-1930). The years of the WWI have been excluded from the sample. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.5: The pattern of innovation in Western countries

	(1) Total	(2) Inventions	(3) Designs	(4) Trademarks
$\text{France}_i \times \text{After}_t$	-0.296**	0.012	-0.798*	-0.337
	(0.106)	(0.135)	(0.361)	(0.244)
LnPopulation_{it}	1.078	-0.382	4.925	4.580**
	(0.859)	(1.199)	(4.557)	(0.913)
lnGDP_{it}	1.068	0.197	1.848	-0.846
	(0.676)	(0.419)	(2.043)	(0.794)
Observations	79	80	79	64
R-squared	0.964	0.961	0.926	0.945

Columns show coefficients of a linear model. Robust standard errors in parentheses. The sample includes five countries (Italy, Germany, United Kingdom, France and United States) and twenty years (1910-1930). The years of the WWI have been excluded from the sample. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.6: The pattern of innovation in Western countries

	(1) Total	(2) Inventions	(3) Designs	(4) Trademarks
United States$_i \times$After$_t$	-0.543**	-0.061	-1.552**	-0.473
	(0.138)	(0.158)	(0.416)	(0.479)
LnPopulation$_{it}$	4.608***	-0.174	14.811**	7.981*
	(0.621)	(1.290)	(4.703)	(2.890)
lnGDP$_{it}$	0.253	0.200	-0.382	-1.546
	(0.704)	(0.194)	(2.176)	(1.270)
Observations	79	80	79	64
R-squared	0.966	0.961	0.933	0.947

Columns show coefficients of a linear model. Robust standard errors in parentheses. The sample includes five countries (Italy, Germany, United Kingdom, France and United States) and twenty years (1910-1930). The years of the WWI have been excluded from the sample. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.7: The pattern of innovation in Western countries

	(1) Total	(2) Inventions	(3) Designs
United Kingdom$_i \times$After$_t$	0.074	-0.125	0.191
	(0.150)	(0.069)	(0.355)
LnPopulation$_{it}$	2.334	-0.544	8.300
	(1.195)	(0.770)	(5.146)
lnGDP$_{it}$	0.537	0.145	0.413
	(0.886)	(0.232)	(2.404)
Observations	79	80	79
R-squared	0.963	0.961	0.923

Columns show coefficients of a linear model. Robust standard errors in parentheses. The sample includes five countries (Italy, Germany, United Kingdom, France and United States) and twenty years (1910-1930). The years of the WWI have been excluded from the sample. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.8: The pattern of innovation in Western countries

	(1) Total	(2) Inventions	(3) Designs	(4) Trademarks
$\text{Germany}_i \times \text{After}_t$	-0.179***	0.160*	-0.607**	-0.832***
	(0.036)	(0.065)	(0.197)	(0.090)
$\text{France}_i \times \text{After}_t$	-0.446***	0.052	-1.287**	-0.863***
	(0.070)	(0.111)	(0.393)	(0.144)
$\text{United States}_i \times \text{After}_t$	-0.616***	-0.024	-1.783***	-0.747**
	(0.100)	(0.134)	(0.123)	(0.200)
$\text{United Kingdom}_i \times \text{After}_t$	-0.136	-0.048	-0.448***	
	(0.064)	(0.091)	(0.093)	
LnPopulation_{it}	2.838**	-0.084	9.673*	4.723
	(0.790)	(1.737)	(4.228)	(2.186)
lnGDP_{it}	0.992	0.149	1.688	-0.716
	(0.529)	(0.411)	(1.993)	(0.740)
Observations	79	80	79	64
R-squared	0.968	0.962	0.939	0.961

Columns show coefficients of a linear model. Robust standard errors in parentheses. The sample includes five countries (Italy, Germany, United Kingdom, France and United States) and twenty years (1910-1930). The years of the WWI have been excluded from the sample. In all the specifications, Italy is the omitted baseline category. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.9: Effect of political support on patents for designs

	(1)	(2)	(3)	(4)	(5)
	Dep. variable: Designs				
Activists_p	0.749**	0.759**	0.188	0.330	0.661**
	(0.328)	(0.346)	(0.287)	(0.271)	(0.305)
Main city_p			0.041		
			(0.095)		
$\text{Main city}_p \times \text{Activist}_p$			3.520		
			(2.874)		
Region capital_p				0.054	
				(0.043)	
$\text{Region capital}_p \times \text{Activist}_p$				1.022	
				(1.264)	
Red province_p					0.074
					(0.085)
$\text{Red province}_p \times \text{Activist}_p$					0.388
					(1.602)
$\text{Least red province}_p$					-0.032
					(0.043)
$\text{Least red province}_p \times \text{Activist}_p$					1.820
					(1.951)
Demographic control	yes	yes	yes	yes	yes
Region FE	no	yes	yes	yes	yes
Observations	93	91	91	91	91
R-squared	0.173	0.252	0.413	0.304	0.296

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $Designs_p$ is sum of the patents for designs granted in 1923-1929 in province p (per 1000 inhabitants). Demographic control includes the log of total province population. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.10: Effect of political support on trademarks licences

	(1)	(2)	(3)	(4)	(5)
	Dep. variable: Trademarks				
Activists_p	3.579**	4.788**	2.202*	2.441*	4.601**
	(1.673)	(2.071)	(1.222)	(1.386)	(2.217)
Main city_p			-0.545		
			(0.465)		
$\text{Main city}_p \times \text{Activist}_p$			30.371*		
			(16.260)		
Region capital_p				0.077	
				(0.239)	
$\text{Region capital}_p \times \text{Activist}_p$				8.665	
				(8.188)	
Red province_p					0.057
					(0.309)
$\text{Red province}_p \times \text{Activist}_p$					0.903
					(5.625)
$\text{Least red province}_p$					-0.208
					(0.334)
$\text{Least red province}_p \times \text{Activist}_p$					12.081
					(13.547)
Demographic control	yes	yes	yes	yes	yes
Region FE	no	yes	yes	yes	yes
Observations	93	91	91	91	91
R-squared	0.214	0.413	0.693	0.493	0.419

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $\textit{Trademarks}_p$ is the sum of the trademarks certificates granted in 1923-1929 in province p (per 1000 inhabitants). Demographic control includes the log of total province population. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.11: Effect of political support on IP rights granted

	(1) Total	(2) Total	(3) Designs	(4) Designs	(5) Trademarks	(6) Trademarks
$\text{Mussolini}_t \times \text{Activists}_p$	0.372**		0.071*		0.301**	
	(0.171)		(0.039)		(0.142)	
$\text{Election}_t \times \text{Activists}_p$		0.322**		0.069*		0.253**
		(0.137)		(0.035)		(0.112)
Demographic controls	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	186	186	186	186	186	186
R-squared	0.815	0.826	0.695	0.679	0.836	0.849

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $Total_{pt}$ is the average of the patents for designs and trademarks certificates granted in province p before and after the Fascist regime (per 1000 inhabitants). Panel estimates. All the specifications include year and province fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.12: Effect of political support on IP rights granted

	(1) Total	(2) Designs	(3) Trademarks	(4) Total	(5) Designs	(6) Trademarks
Mussolini$_t$ × Activists$_p$	0.136*	0.035**	0.101			
	(0.079)	(0.014)	(0.069)			
Election$_t$ × Activists$_p$				0.141**	0.043***	0.097**
				(0.058)	(0.015)	(0.049)
Demographic controls	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	1,379	1,379	1,379	1,379	1,379	1,379
R-squared	0.728	0.583	0.715	0.752	0.542	0.743

Columns show coefficients of a linear model. Robust standard errors in parentheses, adjusted for clustering at the province level. The dependent variable *Total*, *Designs* and *Trademarks* is the incidence of total IP licenses, design patents and trademarks in province p at time t respectively. Panel estimates, 1912-1932 (excluding the WWI). All the specifications include year and province fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.13: Effect of political support on IP rights granted

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. variable: Total					
$\text{Mussolini}_t \times \text{Activists}_p$	0.330*	0.163*	0.182**	0.151**	0.225*	0.213**
	(0.194)	(0.093)	(0.081)	(0.069)	(0.129)	(0.098)
Demographic control	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	554	1,646	1,824	1,379	554	1,646
R-squared	0.650	0.626	0.697	0.718	0.743	0.686

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $Total_{pt}$ is the sum of the patents for designs and trademarks certificates granted in province p at time t (per 1000 inhabitants). Demographic control includes the log of total province population. Panel estimates. All the specifications include year and province fixed effects. Column 1 restricts the sample years to 1921-1926. Column 2 considers the years 1914-1932. Columns 3 to 6 report the coefficients of the log-transformed specification. Column 3 reports the full sample (1912-1932). Column 4 drops the years of WWI. Column 5 restricts the sample years to 1921-1926. Column 6 considers the years 1914-1932. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.14: Effect of political support on IP rights granted

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. variable: Total					
$\text{Mussolini}_t \times \text{Activists}_p$	0.175***	0.203***	0.136*	0.182***	0.147**	0.166**
	(0.065)	(0.073)	(0.076)	(0.060)	(0.073)	(0.065)
Demographic control	yes	yes	yes	yes	yes	yes
Province FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	1,644	1,464	1,644	1,464	1,764	1,584
R-squared	0.711	0.593	0.517	0.459	0.697	0.571

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $Total_{pt}$ is the sum of the patents for designs and trademarks certificates granted in province p at time t (per 1000 inhabitants), expressed in logs. Demographic control includes the log of total province population. Panel estimates. All the specifications include year and province fixed effects. Column 1 eliminates the top 10 percentile in innovation level. Column 2 eliminates the top 9 percentile in innovation level. Column 3 eliminates the top 10 percentile in activists level. Column 4 eliminates the top 9 percentile in activists level. Column 5 eliminates the top 10 percentile in both innovation and activists level. Column 6 eliminates the top 9 percentile in both innovation and activists level. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.15: Relevant province characteristics and IP rights granted

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Dep. variable: Total									
Activists$_p$	4.328**	5.547**	5.202**	4.323*	4.763**	3.287**	5.374**	4.221**	4.651**	3.666**
	(1.833)	(2.143)	(2.417)	(2.248)	(2.173)	(1.345)	(2.293)	(1.913)	(2.157)	(1.731)
Industrial strikes$_p$			0.126*	-0.017					0.028	-0.066
			(0.074)	(0.095)					(0.108)	(0.132)
Industrial workers$_p$					2.940*	2.939			2.767	3.509
					(1.621)	(2.080)			(2.031)	(2.457)
Literacy$_p$							0.859*	0.021	0.040	-0.995
							(0.501)	(0.515)	(0.433)	(0.800)
Demographic control	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	93	91	64	58	64	58	64	58	64	58
R-squared	0.233	0.407	0.304	0.385	0.361	0.453	0.314	0.385	0.362	0.467

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $Total_{pt}$ is sum of the patents for designs and trademarks certificates granted in province p at time t (per 1000 inhabitants). Demographic control includes the log of total province population. Cross-sectional estimates. All the specifications include year and province fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.16: Activists characteristics and IP rights granted

	(1)	(2)	(3)	(4)
	Dep. variable: Total			
Activists$_p$	4.721**			
	(1.936)			
Urban share$_p$	-0.684**			
	(0.285)			
Communist$_p$		23.811**		
		(10.636)		
Activists (except communists)$_p$			5.292**	
			(2.147)	
Activists (except communists and socialists)$_p$				11.436**
				(5.721)
Demographic control	yes	yes	yes	yes
Region FE	yes	yes	yes	yes
Observations	89	91	91	91
R-squared	0.454	0.347	0.386	0.362

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable *Total* is sum of the patents for designs and trademarks certificates released in 1923-1929 in province p (per 1000 inhabitants). Demographic control includes the log of total province population. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.17: Alternative activists' samples

	(1)	(2)	(3)	(4)	(5)	(6)
	Vote Share			Total		
$Activists_{13-14}$	-0.212***			1.128*		
	(0.064)			(0.605)		
$Activists_{15-16}$		-0.218*			1.306*	
		(0.113)			(0.760)	
$Activists_{17-18}$			-0.801*			4.907*
			(0.437)			(2.763)
Demographic control	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes
Observations	68	68	68	91	91	91
R-squared	0.626	0.612	0.621	0.334	0.322	0.349

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable $Vote\ share_p$ is the share of votes received by the Lista Nazionale in the 1924 elections. $Total_p$ is the sum of the patents for designs granted in 1923-1929 in province p (per 1000 inhabitants). Demographic control includes the log of total province population. Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE A.18: Local fascist propaganda and IP rights granted

	(1)	(2)	(3)	(4)
	Propaganda Episodes	Total		
Activists$_p$	33.571	16.167***		9.689***
	(20.875)	(4.604)		(3.177)
Propaganda Episodes$_p$			0.222***	0.189***
			(0.057)	(0.055)
Fascist town$_p$			-0.643**	-0.528*
			(0.294)	(0.274)
Demographic control	yes	yes	yes	yes
Region FE	yes	yes	yes	yes
Observations	91	91	91	91
R-squared	0.435	0.409	0.560	0.613

Columns show coefficients of a linear model. Robust standard errors in parentheses. The dependent variable *Propaganda Episodes*$_p$ is the number of events attended by Mussolini in province p during his government. *Total*$_p$ is the sum of the patents for designs granted in 1923-1939 in province p (per 1000 inhabitants). Cross-sectional estimates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

A.4 Additional Figures

FIGURE A.1: Activists recorded in Italy, by political affiliation (1900-1945)

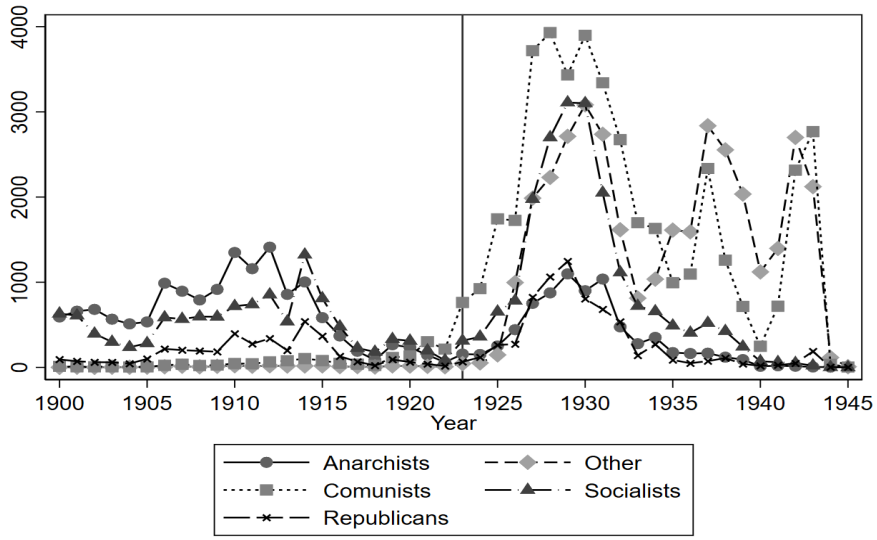


FIGURE A.2: Annual average of design patents and trademarks released, by province level of activists

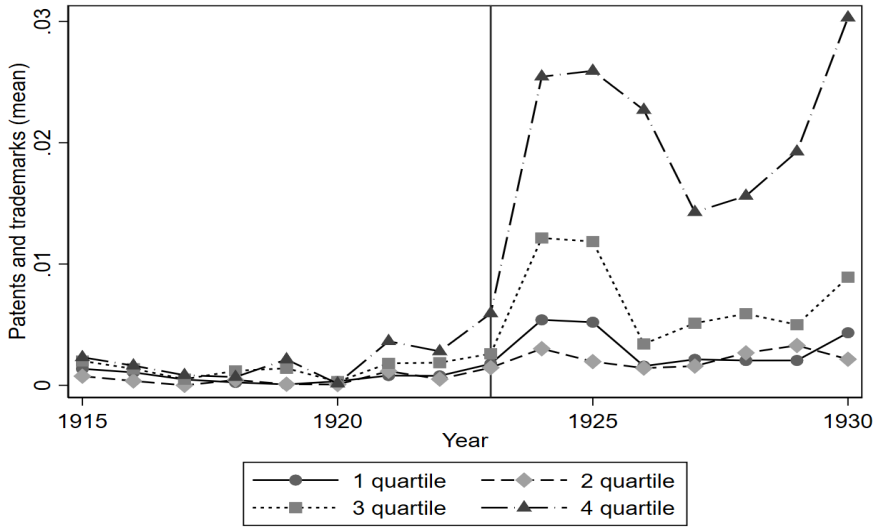
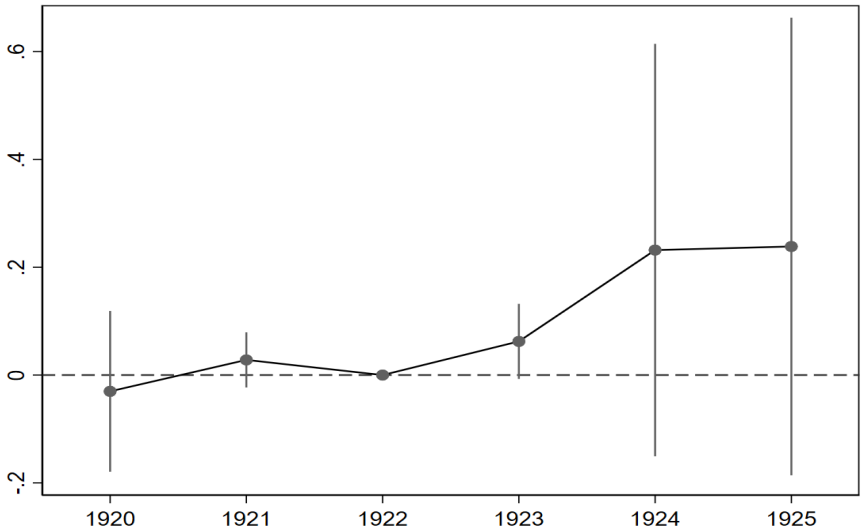
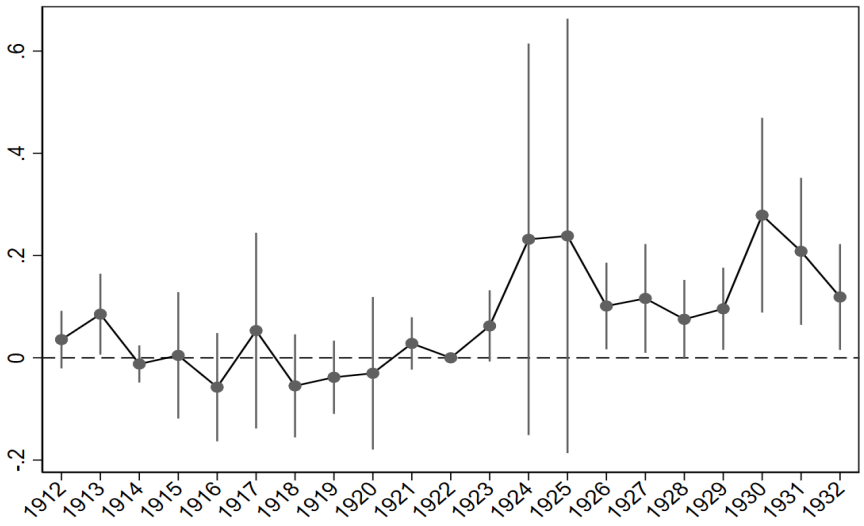


FIGURE A.3: Event study, IP certificates released in provinces with different activists' rates



Notes: Estimated impact of the fascist regime on designs and trademarks production rates for provinces with differential activists' rates. Province and year fixed effects are taken into account, and the base year is the year 1922. The bars indicate confidence intervals at the 95% confidence level. Standard errors clustered at the province level.

FIGURE A.4: Event study, IP certificates released in provinces with different activists' rates



Notes: Estimated impact of the fascist regime on designs and trademarks production rates for provinces with differential activists' rates. Province and year fixed effects are taken into account, and the base year is the year 1922. The bars indicate confidence intervals at the 95% confidence level. Standard errors clustered at the province level.

FIGURE A.5: Corriere della Sera, 28 January 1926

Il programma dell'on. Belluzzo
per l'incremento delle piccole industrie

Roma, 28 gennaio, notte.

Nel programma che il ministro dell'Economia nazionale on. Belluzzo si propone di svolgere per l'incremento delle piccole industrie, è posta in prima linea, — scrive l'Agenzia *La Corrispondenza*, — la questione dell'esportazione sui mercati stranieri dei prodotti fabbricati dalle piccole industrie e dall'artigianato. Si ha in proposito ragione di ritenere che in questo senso sono stati presi accordi tra gli organi competenti, per assicurare a questi nostri prodotti sui mercati stranieri quella situazione di giusto riconoscimento dei pregi dei nostri articoli.

Al riguardo si può assicurare che da vari mesi si trova sui mercati nordamericani un delegato delle piccole industrie, il quale ha già potuto effettuare proficue intese con alcuni gruppi finanziari e ha già stabilito notevoli rapporti tra quei mercati d'esportazione e le nostre ditte.

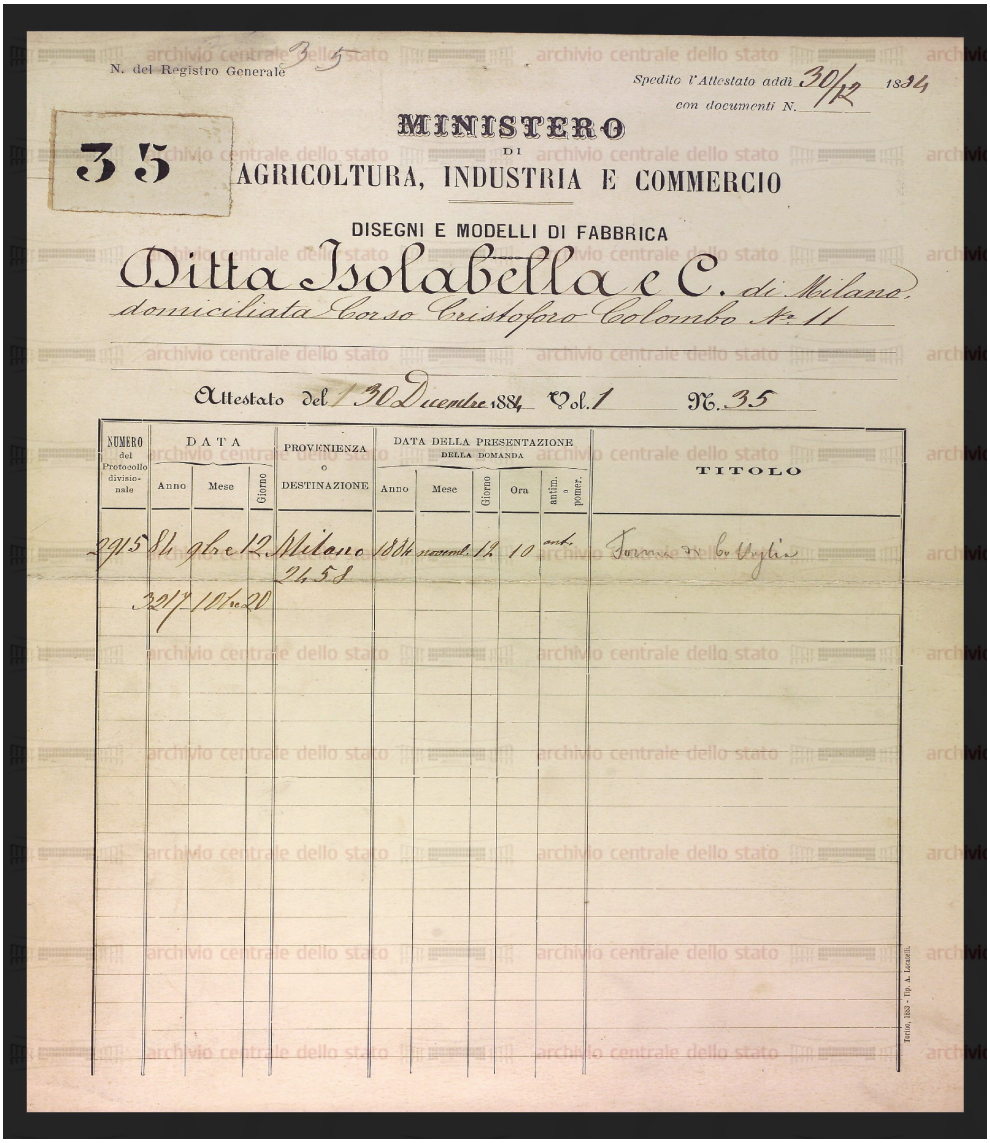
Tali accordi preludono all'istituzione di una vera e propria *Corporation*, con capitali italiani e americani, destinata a piazzare nel Nord America i prodotti delle piccole industrie e del nostro artigianato. Con lo stesso sistema si procederà gradualmente negli altri Stati, non solo d'America ma anche del continente europeo.

Si sta inoltre studiando la questione dell'istituzione di un marchio destinato a proteggere il prodotto nazionale sui mercati stranieri, per evitare le contraffazioni e permettere che all'estero siano esportati solamente articoli degni del nome italiano. Sembra che, al riguardo, si sia scartata l'ipotesi di istituire appositi uffici, in quanto la creazione di nuovi organi avrebbe avuto come conseguenza un inutile dispendio, e si è adottata in linea di massima l'idea di investire alcuni organi provinciali esistenti, della facoltà di apporre ai prodotti destinati all'esportazione il marchio di fabbrica.

Con la realizzazione di questo vasto programma, oltre ad assicurare alle nostre aziende una notevole sfera di influenza, si provvede a dare il giusto posto ai prodotti italiani.

The article explicitly mentions the government's aim of: 1) establishing a "national trademark" to ensure the export of manufactures "worthy" of the Italian identity 2) conferring to local (provincial) offices the power to granting trademarks to exporting firms 3) fighting counterfeit Italian products.

FIGURE A.6: Registration certificate for an industrial design, original manuscript



N. del Registro Generale 35

Spedito l'Attestato addì 30/12 1884
con documenti N.

35

MINISTERO
DI
AGRICOLTURA, INDUSTRIA E COMMERCIO

DISEGNI E MODELLI DI FABBRICA

Ditta Isolabella e C. di Milano,
domiciliata Corso Cristoforo Colombo N. 11

Attestato del 30 Dicembre 1884 Vol. 1 N. 35

NUMERO del Protocollo divisionale	DATA Anno	DATA Mese	DATA Giorno	PROVENIENZA o DESTINAZIONE	DATA DELLA PRESENTAZIONE DELLA DOMANDA Anno	Mese	Giorno	Ora	antim. o pomer.	TITOLO
2915	84	9bre	12	Milano 2458	1884	novemb.	12	10	ant.	Fornace [illegible]
3217	10bre	20								

FIGURE A.7: Registration certificate for a trademark, original manuscript

Registro Generale Vol. 1° N° 24

Registro Attestati Vol. 1° N° 23

REGNO D' ITALIA

MINISTERO DI AGRICOLTURA, INDUSTRIA E COMMERCIO

Il Direttore Capo di Divisione sottoscritto dichiara e certifica che nel giorno Nove del mese di Settembre 1869 alle ore 10 antimeridiane il Signor Loforte Giovanni rappresentante la Ditta Giovanni Loforte e figli Napoli ha presentato alla Prefettura di Napoli la domanda e i documenti prescritti dalla legge del 30 Agosto 1868 N. 4577 per ottenere il presente

Attestato di Trascrizione

per l'assunzione di un marchio per distinguere i prodotti della sua fabbrica (guanti) ed i cui tratti caratteristici sono i seguenti: Striscia di carta porcellanata con bordo d'oro in tre fili di cui quello di mezzo più grosso e portante nel centro impressa in caratteri d'oro la parola Louis con ai lati due stellette e due guanti, quest'ultimi sormontati dalle parole - Coupe Jouvin e Coupe Alexandre. il tutto ugualmente in oro. Superiormente ed inferiormente alla parola Louis trovansi impressi in rilievo il diritto ed il rovescio di quattro medaglie conseguite in diverse Esposizioni.

Il presente Attestato non guarentisce l'importanza o l'autorità del marchio o segno distintivo, o la bontà o la provenienza dei prodotti o l'esistenza delle altre condizioni richieste perchè l'Attestato sia valido ed efficace.

Firenze addì 7 Ottobre 1869

IL DIRETTORE
Capo della 4ª Divisione assente
Il Capo Sezione

FIGURE A.8: Political activist file, original biographic record

Appendix B

Appendix Chapter 2

B.1 Detailed resolution of the theoretical model

B.1.1 Pre-innovation phase, Proof of Lemma 1

The profit of firm $i \in \{h, f\}$, with $i \neq j$ is given by

$$\pi_i = (A - q_i - \gamma q_j - c)q_i \tag{B.1}$$

Differentiating with respect to q_i, the first order condition yields

$$q_i^* = \frac{1}{2}(A - c - \gamma q_j^*) \tag{B.2}$$

As the game is symmetric, we can replace q_j^* by q_i^* and find

$$q_i^* = q_j^* = \frac{A - c}{2 + \gamma} \tag{B.3}$$

Unsing the result in B.3 and replacing in the profit function B.1 yields the differentiated Cournot equilibrium profit,

$$\pi_i^* = \pi_j^* = \frac{(A - c)^2}{(2 + \gamma)^2} \tag{B.4}$$

Replacing $\gamma = 1$ yields the non-differentiated Cournot equilibrium profit,

$$\pi_i^* = \pi_j^* = \frac{1}{9}(A - c)^2 \tag{B.5}$$

Given the above profits, it follows directly that the best response of a firm to a pure strategy of the other is to choose the other variety. There is also an equilibrium in mixed strategy, such that both firms choose each variety with equal probability. For any probability σ that firm i chooses variety k, the best response of firm $j \neq i$ is to choose variety $l \neq k$ with certainty when $\sigma > 1/2$, and to choose variety k with certainty when $\sigma < 1/2$. As the firms are symmetric, it implies that any small perturbation in σ around an exact value of $1/2$ leads to an equilibrium in pure strategy.

B.1.2 Innovation phase: proof of Lemma 2

The respective profit functions become

$$\pi_h = (A - q_h - \gamma q_f)q_h \tag{B.6}$$

$$\pi_f = (A - q_f - \gamma q_h - c)q_f \tag{B.7}$$

Differentiating with respect to q_i, the first order conditions yield

$$q_h^* = \frac{1}{2}(A - \gamma q_f^*) \tag{B.8}$$

$$q_f^* = \frac{1}{2}(A - \gamma q_h^* - c) \tag{B.9}$$

Solving the system of equations we find

$$q_h^* = \frac{A(2-\gamma) + \gamma c}{4 - \gamma^2} \tag{B.10}$$

$$q_f^* = \frac{A(2-\gamma) + c}{4 - \gamma^2} \tag{B.11}$$

Using the result in B.10 and B.11 and replacing in the profit functions B.6 and B.7 yields the differentiated Cournot equilibrium profit,

$$\pi_h^* = \frac{(A(2-\gamma) + \gamma c)^2}{(4 - \gamma^2)^2} \tag{B.12}$$

$$\pi_f^* = \frac{(A(2-\gamma)-2c)^2}{(4-\gamma^2)^2} \tag{B.13}$$

Replacing $\gamma = 1$ yields the non-differentiated Cournot equilibrium profit,

$$\pi_h^* = \frac{(A+c)^2}{9} \tag{B.14}$$

$$\pi_f^* = \frac{(A-2c)^2}{9} \tag{B.15}$$

For the same reasons as in the case without innovation, both firms producing variety m is never a Nash equilibrium. Similarly, Home producing v and Foreign producing m is always a Nash equilibrium, as $\frac{(A(2-\gamma)-2c)^2}{(4-\gamma^2)^2} > \frac{(A-2c)^2}{9}$ for all $\gamma < 1$. Simplifying, $\frac{(A(2-\gamma)-2c)}{(4-\gamma^2)} - \frac{(A-2c)}{3} = \frac{(1-\gamma)(A(2-\gamma)+2c(\gamma+1))}{3(4-\gamma^2)}$, with $(1-\gamma) > 0$, $A(2-\gamma)+2c(\gamma+1) > 0$ and the denominator always strictly positive for $\gamma < 1$.

There are either one or two Nash equilibria in pure strategy. Both firms producing v is never a Nash equilibrium (as it would be a best response for Foreign to produce m at the same marginal cost with less competition). However, if the benefits from innovation is sufficiently low, the equilibrium in which Home produces m and Foreign produces v (and no one makes use of the innovation) may continue to exist. The condition for this second equilibrium to exist is $c \leq \frac{A(\gamma-1)}{\gamma+5} = \tilde{c}$. We show in B.1.4 that this last possibility is however not relevant to the case in which innovation increases future competition.

B.1.3 Catch-up phase: proof of Lemma 3

The values in Table 2.3 combine the standard Cournot result of Lemma 1, using $c = 0$ for variety v, with the asymmetric payoffs in Lemma 2 for the case when one firm produces variety v and the other m. The case were both firms producing variety m is the standard Cournot outcome with marginal cost c, and it is straightforward to see it never constitutes a Nash equilibrium.

There is either a single Nash equilibrium without diversity in which both firms produce variety v, or two equilibria in pure strategy with diversity. The equilibrium is unique without diversity if and only if a firm prefers to produce the low cost variety v without product diversity than producing the high cost one m with diversity,

$\frac{A^2}{9} > \frac{(2c-A(2-\gamma))^2}{(4-\gamma^2)^2}$. Choosing v is then a dominant strategy for both players. This is equivalent to a condition on the cost reducing innovation being sufficiently large, $c > \frac{1}{6}A(2-\gamma)(1-\gamma) = \bar{c}$. Note that the condition is easier to satisfy when the substitutability between the two varieties γ is high, as the benefit from producing variety m then decreases.

B.1.4 Proof of Proposition 1

Denote by c^* the level of initial cost such that a innovation that leads to lower product diversity still offers a higher producer surplus than product differentiation without innovation. The gain from the innovation is the lower cost. The loss from the innovation is the increased competition. The latter dominates if and only if $\frac{(A-c)^2}{(2+\gamma)^2} > \frac{A^2}{9}$. This expression simplifies to $c < \frac{1}{3}A(1-\gamma) = c^*$. The key result is that $c^* - \bar{c} = \frac{1}{6}A(1-\gamma)\gamma > 0$: there always exists a value of $c \in (\bar{c}, c^*)$ such that both firms choose to produce v after the technological catch up, and such that in that equilibrium the profit of both firms in the catch up stage is lower than it was before the innovation. It is also possible to show that $\bar{c} > \tilde{c}$. This implies that in the case where innovation decreases diversity in the catch up stage, the innovator is actually guaranteed to temporarily benefit from its innovation as there is a unique equilibrium when home has a cost advantage in v.

As we have established that $\tilde{c} < \bar{c} < c^*$, we can characterize the different possibilities.

1. By Lemma 2 and 3, we know that for $c < \tilde{c}$, the equilibrium is such that both firms produce a different variety both in the innovation and in the catch-up phase. As long as firm h specializes in variety v (our focality argument), it follows directly that the profit is higher with a lower cost.

2. By Lemma 2 and 3, we know that for $c \in (\tilde{c}, \bar{c})$, the equilibrium is such that both firms produce a different variety both in the innovation and in the catch-up phase. The difference with case 1 is that there is no need to make an assumption that firm coordinate towards h producing v in the innovation phase, as this is the unique equilibrium. We however need the focality argument for the catch-up phase that firm h continues to produce v.

3. By Lemma 2 and 3, we know that for $c \in (\bar{c}, c^*)$, the equilibrium is such that both firms produce a different variety both in the innovation phase (with h producing v) and both firms produce v in the catch-up phase. By definition of c^*, for $c < c^*$ the profit in the catch-up phase is lower than in the pre-innovation phase.

4. By Lemma 2 and 3, we know that for $c > c^* > \bar{c}$, the equilibrium is such that both firms produce a different variety both in the innovation phase (with h producing v) and both firms produce v in the catch-up phase. By definition of c^*, for $c \geq c^*$ the profit in the catch-up phase is higher than in the pre-innovation phase.

B.2 Additional Tables

TABLE B.1: Comparison of High Health vs. non-high health shrimp in a commercial intensive system in Hawaii, 1991

	Non-High Health	High Health
Stocking Density (#/m2)	97	90
Duration (days)	101	104
Survival (%)	86	90
Mean Weight (g)	8.5	11.8
CV (%)	38	9
FCR	3.34:1	2.1:1
Total Crop (kg)	1,424	1,937
Crop Value	$12,507	$20,326
Crop less feed costs	$7,228	$15,852

Source: Wyban, 2009

TABLE B.2: Comparison of production between Monodon and Vannamei in Thailand

Parameter	Monodon	SPF Vannamei	Perc. change
Density (PL/m2)	40-50	120-200	300%
Crop duration (days)	110-140	105-120	27%
Harvest size (g) (#/kg)	22-28 (40/kg)	21-25 (42/kg)	5%
Yield MT/ha/crop	8	24	300%
Crop value ($/ha)	$45,000	$96,000	220%
Crop costs ($/ha)	$32,000	$60,000	187%
Production profit ($/ha)	$13,000	$36,000	280%

Source: Wyban, 2009

TABLE B.3: Average production costs estimates, by country

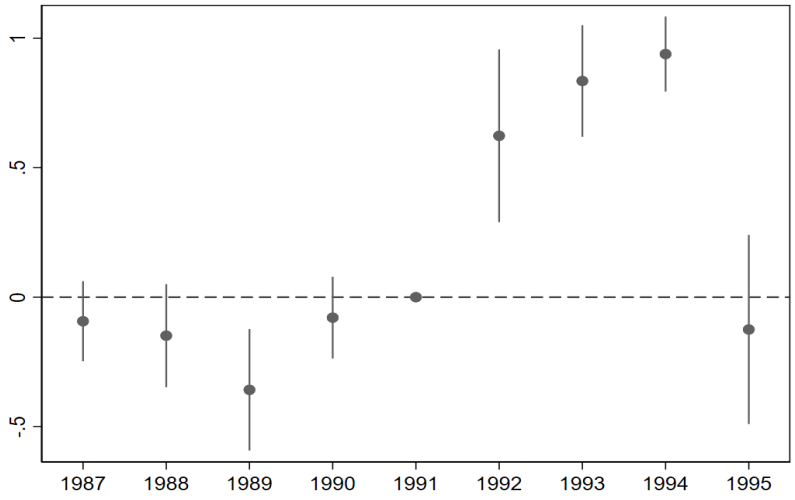
Country	Pre-innovation costs (US$/kg)	Post-innovation costs (US$/kg)	Perc. change	Source
United States	3.7	2.30	-37	Authors' own calculations based on Wyban, 2009
China	2.00	2.00	-0	FAO
Thailand	3.1	2.14	-30	FAO
Philippines	3.40	1.89	-44	FAO
Taiwan	3.50	1.95	-44	FAO
Malaysia	4.27	2.63	-38	FAO
India	3.50	3.35	-4	FAO
Sri Lanka	4.13	-	-	FAO

TABLE B.4: US Imported Shrimp Antidumping Duty Investigations, 2005

Country	Product	Initiation	Final	Duty order	Min	Max
Brazil	Frozen Warmwater Shrimp	27-Jan-04	23-Dec-04	1-Feb-05	4.97%	67.80%
Ecuador	Frozen Warmwater Shrimp	27-Jan-04	23-Dec-04	1-Feb-05	2.48%	4.42%
India	Frozen Warmwater Shrimp	27-Jan-04	23-Dec-04	1-Feb-05	4.94%	15.36%
Thailand	Frozen Warmwater Shrimp	27-Jan-04	23-Dec-04	1-Feb-05	5.29%	6.82%
China	Frozen Warmwater Shrimp	27-Jan-04	8-Dec-04	1-Feb-05	27.89%	112.81%
Vietnam	Frozen Warmwater Shrimp	27-Jan-04	8-Dec-04	1-Feb-05	4.30%	25.76%

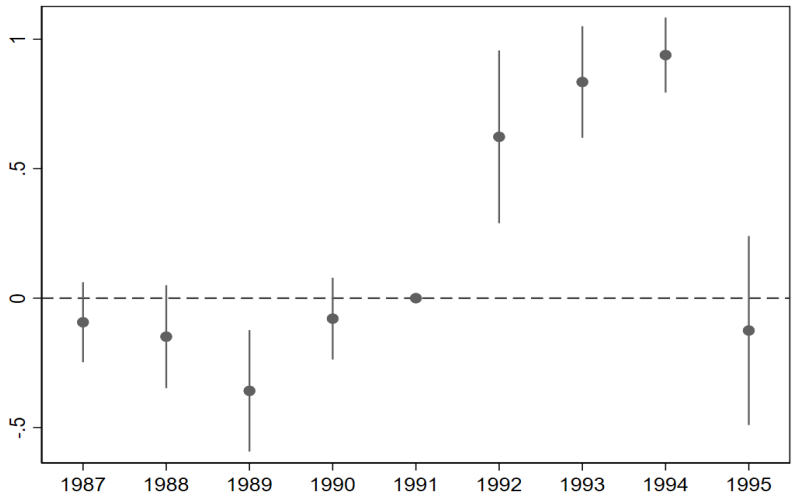
B.3 Additional Figures

FIGURE B.1: Event study, differential quantity produced of product variety affected vs unaffected



Notes: Estimated impact of innovation adoption on differential production rates for the treated variety vs other varieties produced. Variety and year fixed effects are taken into account, and the base year is the year before innovation. The bars indicate confidence intervals at the 95% confidence level. Standard errors clustered at the variety level.

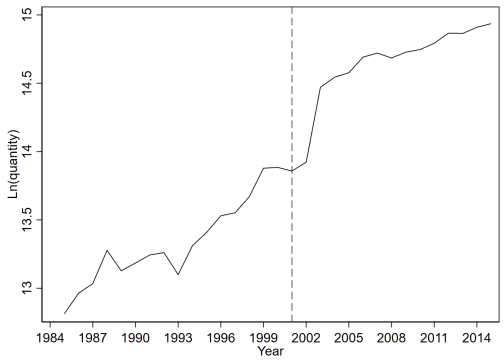
FIGURE B.2: Event study, differential production share of product variety affected vs unaffected



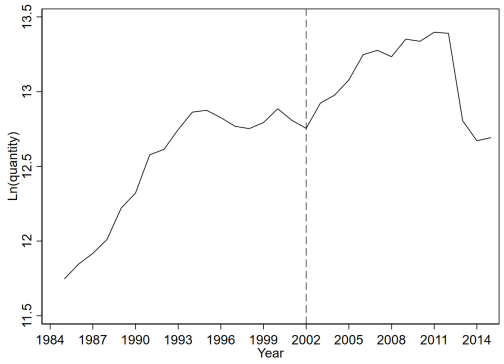
Notes: Estimated impact of innovation adoption on differential production shares for the treated variety vs other varieties produced. Variety and year fixed effects are taken into account, and the base year is the year before innovation. The bars indicate confidence intervals at the 95% confidence level. Standard errors clustered at the variety level.

FIGURE B.3: Production trends (in tons) by country, 1980-2015

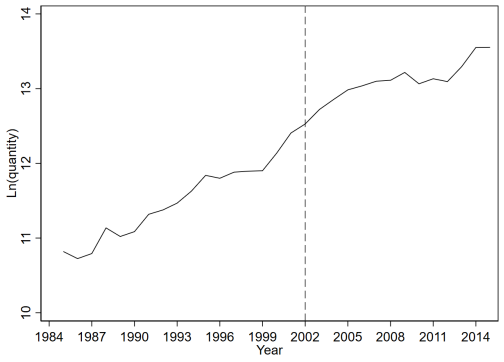
(A) China



(B) Thailand



(C) Vietnam



(D) India

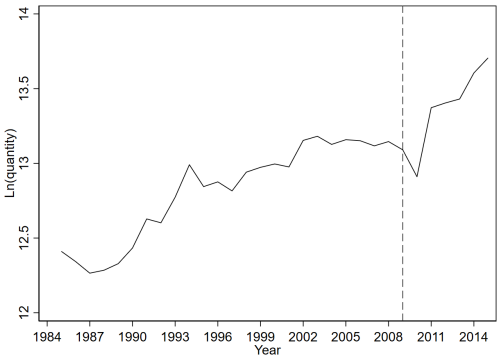
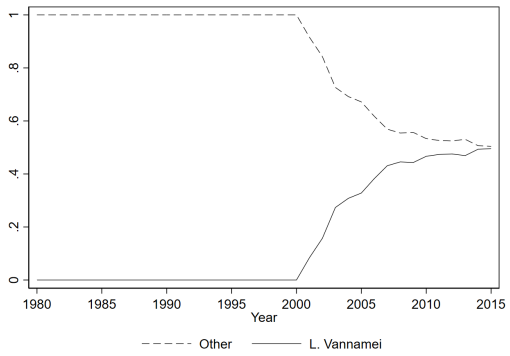
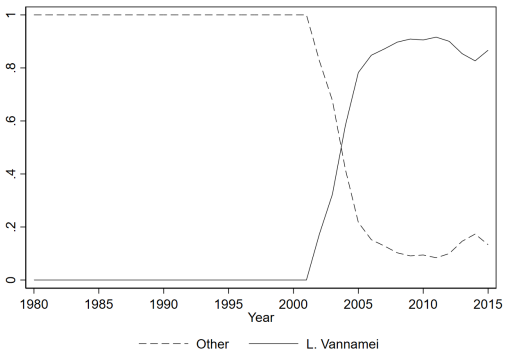


FIGURE B.4: Switch in production: native main species vs SPF/TVR L. Vannamei

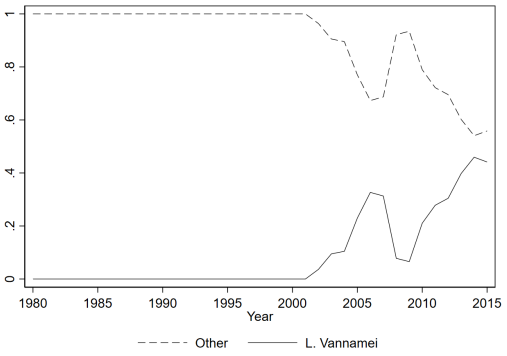
(A) China



(B) Thailand



(C) Vietnam



(D) India

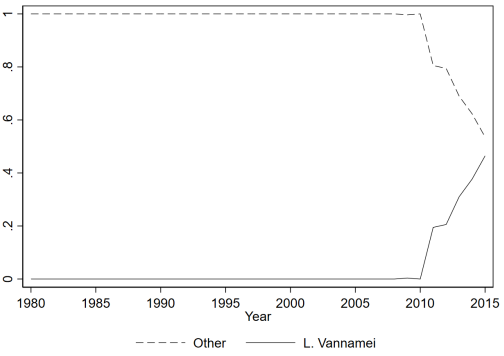
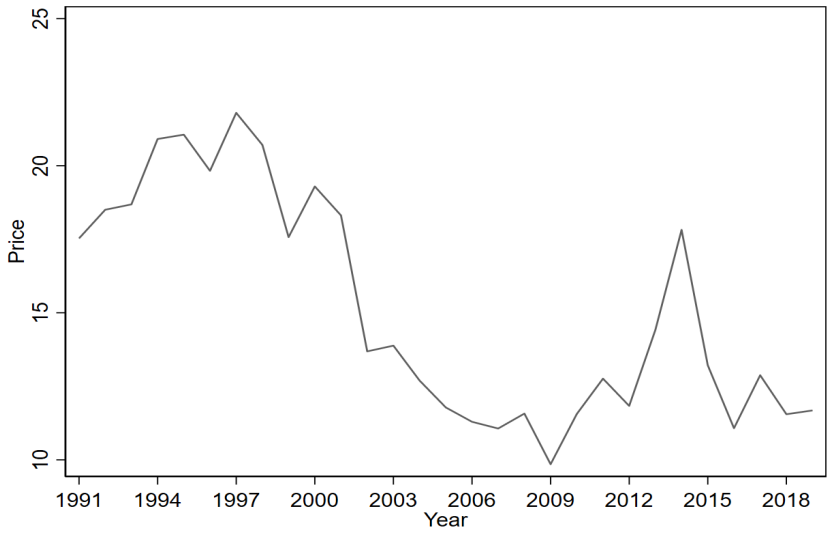


FIGURE B.5: US shrimp price (1991-2019)



Appendix C

Appendix Chapter 3

C.1 The Dispute Settlement Procedure: process

The resolution procedure is activated when a member complains to the WTO that it found another member acting inconsistently to the treaty's obligations. The complainant party must be a member that has suffered some economic harm from the misbehavior of the other and complaints can only be brought to the Dispute Settlement Body (DSB) - the General Council, in another guise - after the parties have tried to settle the issue by consultations among themselves. Most of the issues generally stop at this stage. Nevertheless, when members fail in reaching a mutually agreed solution, the DSB creates a panel of experts that has up to 6 months to analyze the case, issue a decision, and draw a final report containing recommendations to be submitted to the interested parties. The latter have the right to appeal any aspects of the legal contents to a separate Appellate body, and then to the general WTO membership.

The Appellate Body represents the highest stage of resolution and can eventually uphold, modify or reverse the legal findings and conclusions of a panel. It is composed of seven judges with a four-year mandate, which are supposed to be unaffiliated with any government and to be broadly representative of the membership of the WTO. Differently from the panel, judges can only be elected by consensus of all WTO members.

Once a recommendation becomes binding and if immediate compliance is not practicable, a "reasonable period of time" can be designated, at the end of which the respondent must demonstrate that it has implemented the required changes so that

the trade measures at issue in the dispute are now WTO-consistent[1]. If corrections are considered null or not satisfactory, the DSB may authorize the winning party to retaliate to obtain compensation. Retaliation informally indicates the DSB's authorization to suspend WTO obligations in relation to another member, by essentially imposing trade sanctions.

[1] According to DSU Articles 21.4, this reasonable period of time for implementation shall not exceed 15 months beyond the adoption of the dispute panel or Appellate Body report.

C.2 Variables description

Variable	Description
	Panel A: Bilateral trade measures
Bilateral trade	Sum of imports and exports, expressed in natural logarithm
Exports	Log of exports
Imports	Log of imports
Balance	Net exports of country *i* from country *j* as % of GDP
Dependency	Country *i* imports from country *j* over total country *i* imports
	Panel B: Strategic components
Retaliatory capacity	Country *i*'s exports to *j* over country *i*'s total exports (x100)
Retaliatory distance	Difference between two countries retaliatory capacities
Tit-for-Tat	Equal to 1 if country *j* filed a dispute against country *i* in the previous year
Retaliatory distance	Difference between two countries retaliatory capacities
Overhang	Difference between the average bound tariff and the average applied MFN tariff
Overhang share	Share of active 6-digit HS import sectors from country d with a zero or negative tariff overhang
	Panel C: Political indicators
Polity	Polity score
Regime distance	Difference between the polity scores of the two countries (in absolute value)
	Panel C: Dummy variables
China	1 if the potential respondent is China
Post	1 for the years after China's accession to WTO (2001)
	Panel C: Other controls
Openness	Percentage of trade over total GDP
GDP growth	Annual GDP growth (in percentage)
Unemployment rate	Share of unemployed population over total labor force

C.3 Descriptive statistics

TABLE C.1: Complainant countries

Country	N. of disputes	Percent
United States	131	21.30
European Union	99	16.10
Canada	39	6.34
Brazil	33	5.37
Mexico	25	4.07
India	25	4.07
Japan	25	4.07
Argentina	22	3.58
China	22	3.58
Rep. of Korea	20	3.25
Thailand	14	2.28
Indonesia	11	1.79
Chile	10	1.63
Guatemala	9	1.46
Ukraine	9	1.46
New Zealand	9	1.46
Honduras	8	1.30
Australia	8	1.30
Panama	7	1.14
Russian Federation	7	1.14
Taiwan, Province of China	6	0.98
Norway	5	0.81
Costa Rica	5	0.81
Switzerland	5	0.81
Philippines	5	0.81
Turkey	5	0.81

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Table C.1 – continued from previous page

Country	N. of disputes	Percent
Viet Nam	5	0.81
Hungary	5	0.81
Colombia	5	0.81
Pakistan	5	0.81
Qatar	4	0.65
Poland	3	0.49
Peru	3	0.49
Ecuador	3	0.49
Venezuela	2	0.33
United Arab Emirates	1	0.16
Moldova	1	0.16
Dominican Rep.	1	0.16
Sri Lanka	1	0.16
Bangladesh	1	0.16
Czech Republic	1	0.16
Denmark	1	0.16
Singapore	1	0.16
El Salvador	1	0.16
Tunisia	1	0.16
Antigua and Barbuda	1	0.16
China, Hong Kong SAR	1	0.16
Cuba	1	0.16
Uruguay	1	0.16
Malaysia	1	0.16
Nicaragua	1	0.16

TABLE C.2: Respondent countries

Country	N. of disputes	Percent
United States	164	26.67
European Union	96	15.61
China	43	6.99
India	25	4.07
Canada	23	3.74
Argentina	22	3.58
Rep. of Korea	18	2.93
Australia	16	2.60
Brazil	16	2.60
Mexico	15	2.44
Japan	15	2.44
Indonesia	14	2.28
Chile	13	2.11
Turkey	11	1.79
Russian Federation	9	1.46
Dominican Rep.	7	1.14
Hungary	7	1.14
Peru	6	0.98
Philippines	6	0.98
South Africa	5	0.81
Colombia	5	0.81
France	4	0.65
Pakistan	4	0.65
Ukraine	4	0.65
Thailand	4	0.65
Egypt	4	0.65
United Kingdom	3	0.49
Ireland	3	0.49
Greece	3	0.49
Belgium	3	0.49
Netherlands	3	0.49
Spain	3	0.49
Ecuador	3	0.49
Slovakia	3	0.49
Germany	2	0.33

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Table C.2 – continued from previous page

Country	N. of disputes	Percent
Nicaragua	2	0.33
Venezuela	2	0.33
Armenia	2	0.33
Morocco	2	0.33
Saudi Arabia	2	0.33
Trinidad and Tobago	2	0.33
Guatemala	2	0.33
Romania	2	0.33
Czech Republic	2	0.33
Portugal	1	0.16
Kyrgyzstan	1	0.16
Denmark	1	0.16
Malaysia	1	0.16
Bahrain	1	0.16
Uruguay	1	0.16
Panama	1	0.16
Croatia	1	0.16
Kazakhstan	1	0.16
Moldova	1	0.16
Costa Rica	1	0.16
Poland	1	0.16
United Arab Emirates	1	0.16
Italy	1	0.16
Sweden	1	0.16

TABLE C.3: China's annual shares over total disputes

Year	Count	China (total)	China (as respondent)
1995	28	-	-
1996	51	-	-
1997	50	-	-
1998	41	-	-
1999	34	-	-
2000	42	-	-
2001	24	0	0
2002	37	2.7	0
2003	26	0	0
2004	23	4.3	4.3
2005	12	0	0
2006	24	12.5	12.5
2007	14	35.7	28.6
2008	19	31.6	26.3
2009	13	53.8	30.8
2010	19	26.3	21.1
2011	8	37.5	25
2012	30	40	23.3
2013	20	10	5
2014	14	7.1	7.1
2015	13	23.1	15.4
2016	17	35.3	23.5
2017	17	5.9	5.9
2018	39	23.1	10.3
Total	615		

TABLE C.4: Targeted measures, 1995-2018

Measures	Freq.	Percent	Cum.
Anti-dumping and countervailing duties	139	22.6	22.6
Import restrictions (ban, licensing)	81	13.17	35.77
Safeguard measures	44	7.15	42.93
Import measures and regime	43	6.99	49.92
Subsidies	41	6.67	56.59
Domestic legislation	29	4.72	61.3
Intellectual property rights	28	4.55	65.85
Technical regulation	26	4.23	70.08
Tariffs-related	24	3.9	73.98
Discriminatory measures, practices, regulations	23	3.74	77.72
Export subsidies	23	3.74	81.46
Import duties	18	2.93	84.39
Customs-related	16	2.6	86.99
Export restrictions	16	2.6	89.59
Internal taxation	16	2.6	92.2
Local content requirements, trade balancing requirements	15	2.44	94.63
Zeroing, pricing and other methodologies	10	1.63	96.26
Market access	6	0.98	97.24
Preferential treatment scheme and GSP	5	0.81	98.05
Rules of origin	3	0.49	98.54
Copyright	2	0.33	98.86
Domestic support	2	0.33	99.19
Export credit	1	0.16	99.35
Procurement practices	1	0.16	99.51
Regulations on services	1	0.16	99.67
Sanitary and phytosanitary measures	1	0.16	99.84
Technology transfer	1	0.16	100
Total	615	100	

TABLE C.5: Summary statistics

	count	mean	sd	min	max
Dispute_{ijt}	79,822	0.006	0.079	0	1
China_{j}	79,822	0.011	0.104	0	1
$\text{Bilateral trade}_{ijt}$	60,908	19.295	2.948	4.89	27.391
$\text{Retaliatory capacity}_{ijt}$	60,758	0.019	0.081	0	2.098
$\text{Retaliatory capacity}_{jit}$	59,184	0.017	0.064	0	2.098
$\text{Retaliatory distance}_{ijt}$	48,041	0	0.09	-2.093	2.093
Dependency_{ijt}	62,111	0.014	0.045	0	0.717
Balance_{ijt}	60,908	-0.001	0.017	-0.92	0.296
Openness_{it}	77,295	0.855	0.683	0.156	4.426
Openness_{jt}	76,867	0.861	0.614	0.156	4.426
Tit-for-Tat_{ijt}	76,099	0.001	0.034	0	1
Polity index_{it}	74,890	6.295	5.226	-10	10
Polity index_{jt}	76,408	6.281	5.63	-10	10
$\text{Regime distance}_{ijt}$	71,620	5.114	5.795	0	20
GDP growth_{it}	77,879	0.038	0.035	-0.148	0.262
GDP growth_{jt}	78,480	0.035	0.035	-0.148	0.262
$\text{Unemployment rate}_{it}$	76,975	0.058	0.034	0.001	0.205
$\text{Unemployment rate}_{jt}$	77,855	0.07	0.049	0.001	0.335
Overhang_{it-1}	39,403	0.165	0.193	-0.098	1.51
Overhang_{jt-1}	31,450	0.16	0.187	-0.227	1.51
$\text{Overhang share}_{it-1}$	18,699	0.305	0.344	0	1
$\text{Overhang share}_{jt-1}$	18,699	0.305	0.336	0	1
N	79,822				

TABLE C.6: Summary statistics: variation in the count of disputes

Dispute count	Freq.	Percent	Cum.
0	79,323	99.37	99.37
1	420	0.53	99.90
2	53	0	99.97
3	19	0	99.99
4	4	0	100.00
5	2	0	100.00
6	1	0	100.00
Total	79,822	100.00	

C.4 Additional Tables

TABLE C.7: Determinants of trade disputes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. variable: Dispute						
China_j	0.0228*	-0.0006	0.0516	0.0595	0.0033	0.0231*	0.0220
	(0.0135)	(0.0090)	(0.0322)	(0.0393)	(0.0102)	(0.0137)	(0.0137)
GDP growth_{it}	0.0064	-0.0039	-0.0243	0.1565**	-0.0151	0.0071	
	(0.0251)	(0.0175)	(0.0424)	(0.0643)	(0.0234)	(0.0215)	
GDP growth_{jt}	-0.0246	-0.0229	-0.0529	0.0097	-0.0322*	-0.0209	
	(0.0204)	(0.0157)	(0.0362)	(0.0416)	(0.0188)	(0.0184)	
Openness_{it}	-0.0018	-0.0030	0.0058	0.0199**	-0.0028	-0.0014	-0.0014
	(0.0030)	(0.0019)	(0.0098)	(0.0092)	(0.0026)	(0.0025)	(0.0025)
Openess_{jt}	-0.0106***	-0.0077***	-0.0131***	-0.0188***	-0.0050**	-0.0091***	-0.0092***
	(0.0035)	(0.0023)	(0.0049)	(0.0068)	(0.0023)	(0.0027)	(0.0027)
Tit-for-Tat_{ijt}	0.9185***	0.9792***	0.8759***	0.8941***	0.9395***	0.9244***	0.9244***
	(0.0116)	(0.0065)	(0.0154)	(0.0198)	(0.0118)	(0.0110)	(0.0110)
$\text{Regime distance}_{ijt}$	-0.0004**	-0.0002*	-0.0005*	0.0002	-0.0003**	-0.0003**	-0.0003**
	(0.0002)	(0.0001)	(0.0002)	(0.0005)	(0.0001)	(0.0002)	(0.0002)
$\text{Bilateral trade}_{ijt}$	0.0016***	0.0014***	0.0023***	0.0000	0.0014***	0.0011**	0.0011**
	(0.0005)	(0.0004)	(0.0009)	(0.0012)	(0.0004)	(0.0005)	(0.0005)
Dependency_{ijt}	0.1126*	0.0700	0.1590*	0.2367**	0.0861	0.1022	0.1023
	(0.0640)	(0.0440)	(0.0923)	(0.1181)	(0.0530)	(0.0623)	(0.0623)
$\text{Retaliatory distance}_{ijt}$	0.0185	0.0134	-0.0182	-0.0098	0.0586*	0.0071	0.0072
	(0.0229)	(0.0300)	(0.0209)	(0.0199)	(0.0329)	(0.0199)	(0.0199)
Balance_{ijt}	0.5245***	0.0122	0.9727***	0.6414**	0.3651***	0.4869***	0.4862***
	(0.1384)	(0.0747)	(0.2915)	(0.2906)	(0.1063)	(0.1329)	(0.1328)
GDP growth_{it-1}							0.0049
							(0.0174)
GDP growth_{jt-1}							-0.0094
							(0.0159)
$\text{Unemployment rate}_{it-1}$							0.0192
							(0.0263)
$\text{Unemployment rate}_{jt-1}$							-0.0096
							(0.0189)
Complainant FE	yes	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Observations	36,638	39,382	19,738	12,945	30,210	43,155	43,155
R-squared	0.2504	0.0593	0.2894	0.3155	0.1886	0.2486	0.2486

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. In Column (1), respondents with zero disputes received are excluded. Column (2) drops the EU and US from the samples of both complainant and respondent countries. In Columns (3) to (5), the complainants sample is restricted to countries with more than 5 disputes, to developed and developing countries. Column (6) excludes the years 2008, 2009 and 2010, while Column (7) controls for both the GDP growth rates and the unemployment rates. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE C.8: China's differential effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. variable: Dispute						
$\text{China}_j \times \text{Bilateral trade}_{ijt}$	0.0175**						
	(0.0087)						
$\text{China}_j \times \text{Exports}_{it}$		0.0072					
		(0.0051)					
$\text{China}_j \times \text{Imports}_{it}$			0.0218**				
			(0.0099)				
$\text{China}_j \times \text{Trade balance}_{ijt}$				-0.4422*			
				(0.2308)			
$\text{China}_j \times \text{Ret. distance}_{ijt}$					0.5745***		
					(0.1897)		
$\text{China}_j \times \text{Dependency}_{ijt}$						0.0616	
						(0.2055)	
$\text{China}_j \times \text{Regime distance}_{ijt}$							0.0038**
							(0.0018)
Joint Effect	0.0285**	0.0078	0.0228**	0.0888	0.5768***	0.1611	0.0033*
Complainant FE	yes	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Observations	43,155	43,155	43,155	43,155	43,155	43,155	43,155
R-squared	0.2506	0.2436	0.2457	0.2488	0.2522	0.2486	0.2489

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE C.9: United States' differential effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. variable: Dispute						
United States$_j$ × Bilateral trade$_{ijt}$	0.0315***						
	(0.0060)						
United States$_j$ × Exports$_{it}$		0.0279***					
		(0.0056)					
United States$_j$ × Imports$_{it}$			0.0306***				
			(0.0061)				
United States$_j$ × Trade balance$_{ijt}$				0.7615***			
				(0.2714)			
United States$_j$ × Ret. distance$_{ijt}$					-0.0122		
					(0.0568)		
United States$_j$ × Dependency$_{ijt}$						0.1035	
						(0.1140)	
United States$_j$ × Regime distance$_{ijt}$							-0.0003
							(0.0020)
Joint Effect	0.0328***	0.0287***	0.0314***	1.0097***	-0.0010	0.1726	-0.0006
Complainant FE	yes	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Observations	43,155	43,155	43,155	43,155	43,155	43,155	43,155
R-squared	0.2542	0.2485	0.2480	0.2500	0.2486	0.2488	0.2486

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE C.10: European Union's differential effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. variable: Dispute						
European Union$_j$ × Bilateral trade$_{ijt}$	0.0033						
	(0.0055)						
European Union$_j$ × Exports$_{it}$		0.0030					
		(0.0054)					
European Union$_j$ × Imports$_{it}$			0.0035				
			(0.0057)				
European Union$_j$ × Trade balance$_{ijt}$				0.0954			
				(0.1966)			
European Union$_j$ × Ret. distance$_{ijt}$					0.1255**		
					(0.0541)		
European Union$_j$ × Dependency$_{ijt}$						-0.1601**	
						(0.0780)	
European Union$_j$ × Regime distance$_{ijt}$							-0.0027
							(0.0020)
Joint Effect	0.0044	0.0037	0.0045	0.5543***	0.1254**	-0.0042	0.0030
Complainant FE	yes	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Observations	43,155	43,155	43,155	43,155	43,155	43,155	43,155
R-squared	0.2487	0.2430	0.2430	0.2486	0.2494	0.2492	0.2489

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

TABLE C.11: Disputes and trade liberalization

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. variable: Dispute					
China_j	0.0335	0.0159	0.0430	0.0210	-0.0449**	0.0909
	(0.0360)	(0.0255)	(0.0374)	(0.0269)	(0.0227)	(0.1675)
Overhang_{it-1}	-0.0395*	-0.0271	-0.0236	-0.0270	-0.0246	-0.0271
	(0.0240)	(0.0218)	(0.0220)	(0.0219)	(0.0218)	(0.0218)
Overhang_{jt-1}	-0.0164	-0.0404	-0.0408	-0.0508*	-0.0396	-0.0417
	(0.0283)	(0.0262)	(0.0262)	(0.0262)	(0.0263)	(0.0264)
$\text{Overhang share}_{it-1}$	0.0064	-0.0037	-0.0032	-0.0038	-0.0050	-0.0037
	(0.0085)	(0.0087)	(0.0087)	(0.0087)	(0.0085)	(0.0087)
$\text{Overhang share}_{jt-1}$	0.0145**	0.0117	0.0114	0.0125	0.0092	0.0121
	(0.0069)	(0.0093)	(0.0092)	(0.0093)	(0.0091)	(0.0092)
$\text{China}_j \times \text{Overhang}_{it-1}$			-0.1442			
			(0.1040)			
$\text{China}_j \times \text{Overhang}_{jt-1}$				1.4323***		
				(0.5137)		
$\text{China}_j \times \text{Overhang share}_{it-1}$					0.2596***	
					(0.0864)	
$\text{China}_j \times \text{Overhang share}_{jt-1}$						-0.0833
						(0.1896)
Complainants FE	yes	yes	yes	yes	yes	yes
Respondent FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	15,709	11,949	11,949	11,949	11,949	11,949
R-squared	0.1023	0.3232	0.3242	0.3239	0.3295	0.3233

Columns show coefficients of a linear model. Robust standard errors in parentheses, clustered at the country pair level. The dependent variable $Dispute_{ijt}$ takes the value of 1 if the country i filed at least one dispute against country j in a year t, and zero otherwise. Panel estimates. All the specifications include complainant, respondent and year fixed effects. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

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