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Intellectual property enforcement costs and international trade

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Abstract

We study how legal institutions affect international trade. Intellectual property enforcement applies to all firms serving a market, regardless of where production occurs, implying that changes in enforcement create destination-specific litigation trade costs. We identify these effects using reforms to the UK intellectual property court system between the end of 2010 and 2013 that reduced enforcement costs while leaving the scope of intellectual property rights unchanged. Imports of litigation intensive products increased following the reforms, but this average effect masks substantial heterogeneity. Imports rose from countries with strong domestic intellectual property protection and fell from countries with weaker protection. Linking Chinese customs and patent data, we show that firms holding UK-registered patents expanded exports to the UK, while innovation abroad remained unchanged.

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Non-Technical Summary

Innovation plays an important role in economic growth, productivity and competitiveness. Intellectual property rights, such as patents, are designed to encourage innovation by allowing firms to benefit from new ideas and technologies. However, the existence of legal rights alone is not enough. Firms must also be able to enforce those rights when disputes arise. If enforcement is expensive, slow or uncertain, firms may be unable or unwilling to protect their intellectual property.

This paper examines how the cost of enforcing intellectual property rights affects international trade. We study reforms to the UK intellectual property court system introduced between 2010 and 2013 that reduced the cost and complexity of resolving intellectual property disputes and made the enforcement process faster and more predictable. Importantly, the reforms did not change the scope of intellectual property rights which allows us to isolate the economic effects of enforcement rather than changes in intellectual property law itself.

The premise for this study is that intellectual property enforcement affects all firms selling into a market, whether based domestically or abroad. A company exporting to the UK operates under the same legal environment as a UK-based producer. When it becomes easier and cheaper to defend intellectual property rights, firms that own valuable intellectual assets may find the market more attractive. At the same time, firms whose products risk infringing existing intellectual property may face higher risks and costs.

Using detailed data on UK imports, we find that imports increased in product categories where intellectual property disputes are more common. The increase occurred after the reforms were introduced and is not observed beforehand. Among other major European countries that did not introduce comparable changes over the period, we find no similar pattern. This suggests that the changes in UK trade patterns were linked to the reforms in the UK court system.

Looking beyond overall import growth reveals important differences across countries. Imports increased most strongly from countries with relatively strong intellectual property systems. In contrast, imports of the same products fell from countries with weaker levels of intellectual property protection. These findings suggest that the reforms changed which firms were most successful in serving the UK market. Firms that owned intellectual property appear to have benefited from lower enforcement costs and stronger protection, while firms facing a greater risk of infringement became less competitive.

To explore this mechanism further, we combined Chinese customs data with information on patent ownership. This allows us to identify firms that held patents and, more specifically, firms that had patents registered in the UK. We find that Chinese firms with UK-registered patents expanded the range of products they exported to the UK following the reforms. The evidence suggests that lower enforcement costs improved market access for firms whose intellectual property was protected in the UK.

We also examined whether the reforms encouraged additional innovation. Stronger enforcement could increase the rewards from innovation and encourage firms to invest more in research and development. However, we find no evidence that Chinese firms increased their patenting activity as a result of the UK reforms. Given the relatively small size of the UK market in the global economy, this result is perhaps unsurprising.

There is some evidence, however, that innovation-related activity increased within the UK. Industries more affected by the reforms increased their spending on research and development, and UK exports also rose. This suggests that stronger enforcement has a greater effect on firms whose activities are more closely tied to the domestic market.

Overall, the reforms produced only modest changes in total trade volumes. Their main effect was to change the composition of trade by altering which firms could compete successfully in the UK market. Lower enforcement costs improved market access for firms holding intellectual property rights, while making conditions less favourable for firms whose products faced a greater risk of infringement disputes. The results suggest that reforms to intellectual property enforcement can have important effects on the mix of exporters serving a market even when their impact on aggregate trade flows appears relatively small.

IP Enforcement Costs and International Trade*

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Abstract

We study how legal institutions affect international trade. Intellectual property enforcement applies to all firms serving a market, regardless of where production occurs, implying that changes in enforcement create destination-specific litigation trade costs. We identify these effects using reforms to the UK intellectual property court system between the end of 2010 and 2013 that reduced enforcement costs while leaving the scope of intellectual property rights unchanged. Imports of litigation-intensive products increased following the reforms, but this average effect masks substantial heterogeneity. Imports rose from countries with strong domestic intellectual property protection and fell from countries with weaker protection. Linking Chinese customs and patent data, we show that firms holding UK-registered patents expanded exports to the UK, while innovation abroad remained unchanged.

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1 Introduction

Firms selling into foreign markets face not only tariffs, transport costs and product regulations, but also the legal environment of the destination market (Anderson and Van Wincoop, 2004). While a large literature shows that intellectual property protection affects trade (Maskus, 2015), much less is known about how the ability to enforce those rights affects market access. This gap matters because enforcement operates through a specific channel, shaping firms' decisions to litigate or infringe.

For firms that own intellectual assets, the decision to seek legal redress depends on whether its discounted expected future private value exceeds the costs incurred in hiring legal services, together with the expected legal and revenue costs should the judgment go against them (Lanjouw, 1994; Lanjouw and Schankerman, 2001). If these costs, or uncertainty over them, are high relative to the private value, then IP owners will choose not to defend their IP even when firms with IP-infringing products are present in the market. Similarly, the decision to infringe depends on the probability of detection and litigation, as well as the severity of penalties. When the expected costs exceed the benefits, infringement remains low, even if the actual IP court activity is limited (Choi, 1998). A reduction in enforcement costs strengthens IP protection both by lowering the cost of legal action for IP owners and by increasing the expected penalties faced by potential infringers (Lanjouw and Lerner, 2000).

These enforcement costs have direct implications for international trade. IP enforcement is determined by the courts of a given jurisdiction and applies regardless of the location of production.[1] Firms that sell into a market face its enforcement environment irrespective of whether they produce domestically or export from elsewhere (Mai and Stoyanov, 2019; De Rassenfosse and Raiteri, 2022). This implies that enforcement acts as a destination-specific trade cost, which we label a litigation trade cost, that differs across firms depending on their standing as IP owners or potential infringers.[2] Lowering enforcement costs in a country reduces the expected litigation costs for firms whose products are protected by IP, while increasing the expected costs for firms whose prod-

[1] An example case between Manvers Engineering from the UK and Lubtech Industries from Germany that occurred in the UK in 2013 helps illustrate this point. In this case the claimants argued that their UK patent was being infringed by the German-based defendant who was importing a similar product into the UK. The case was lost by the plaintiff and the German company was allowed to restart its exports to the UK. Further details of the case are available at the National Archive of judgments and decisions on IP cases.

[2] Throughout the paper we use the term *litigation trade cost* to refer to the expected cost that a given trade flow bears on account of IP litigation risk in the destination market — the product of the probability that a shipment triggers a dispute and the expected cost of that dispute, net of any expected gain from prevailing in it.

ucts risk infringement, altering the composition of exporters that can profitably serve that market.

The aggregate trade response depends on where IP-owning and potentially infringing firms are located, and on how enforcement costs translate into market access across domestic and foreign IP-owning versus potentially infringing firms. As a consequence, the overall effect on trade volumes is theoretically ambiguous. For IP-owning firms, lower per-case litigation costs can be offset if the reform also encourages more disputes - for instance through stronger strategic motives to litigate (Choi, 1998; Crampes and Langinier, 2002; Gallini, 2002; Bessen and Meurer, 2006), or through uncertain patent boundaries that raise the risk of accidental infringement and discourage sales even by firms with no intention to infringe (Bessen and Meurer, 2013). For firms at risk of infringement, the effect is unambiguously negative, as enforcement becomes more credible. Total trade volumes should therefore mask much greater churn in who exports than any level effect would suggest.

In this paper we show that a reduction in IP enforcement costs acts as a destination-specific trade cost, raising market access for firms that own intellectual property and lowering it for firms whose exports risk infringement, and reshaping the composition of who trades as a result. We study this through its effects on which products and countries drive UK imports, which firms gain market access, and whether it also alters innovation incentives. We exploit a sequence of reforms to the UK IP court system between the end of 2010 and 2013 that, crucially, did not alter the scope or definition of IP rights, allowing us to isolate the economic effects of enforcement from those of IP ownership. This contrasts with much of the existing literature, which typically studies reforms that simultaneously affect both the granting and enforcement of rights, examines settings starting from a much lower institutional base, or relies on proxy measures of enforcement costs (Maskus, 2015; Palangkaraya et al., 2017).[3]

Using a combination of HS6 product-country data on UK imports, micro data on firm-product-destination data and innovation data we explore this question from a number of perspectives and identification approaches. We begin by studying which (HS6) products were affected. For this question our empirical strategy uses a difference-in-differences design combining the timing of the UK reforms with predetermined variation across products in their exposure to litigation from Mezzanotti (2021). This product exposure variable measures the global ranking of technologies where IP disputes are more likely. High values capture environments in which infringement is more prevalent, but also

[3] The use of a narrow set of IP policy changes is more common within the innovation literature. For examples see the discussion in Williams (2017).

where disputes are more likely to be formalized through litigation, whether because of stronger incentives to enforce IP or more strategic use of the legal system. Motivation for this choice of exposure variable comes from Helmers et al. (2015) and Helmers et al. (2016), who provide quantitative and qualitative evidence that the UK reforms encouraged firms to use the legal system to protect their IP more frequently.[4]

Our product-level findings suggest that the improvement in IP protection had a small positive effect on UK import flows, indicating that the UK's total litigation trade costs fell over the reform period. Imports of litigation intensive products increased in the post-reform period compared to products with a lower litigation intensity. This result corroborates the importance of domestic IP institutions for international trade and highlights the importance of enforcement within this. Of importance, and supporting a causal interpretation of these results, we find no evidence of a difference in the trends between more and less litigation intensive imports prior to the UK court reforms. These results are robust to a number of considerations that include the effects of other UK policy changes that might have affected international trade over this period, such as those around capital incentives and skill-intensity. We also provide falsification tests using data on imports into other European countries that did not undergo similar IP reforms. Here we find no evidence that the imports of litigation intensive products into Belgium, France, Germany, Italy, Netherlands, Spain and Switzerland responded in the time period after the change in UK IP court access.

Having established which products were most affected, we next ask which countries benefited from the reduction in enforcement costs in the destination market. Changes in IP enforcement are expected to have larger effects on the composition of trade than on aggregate trade volumes and this is what we find. The aggregate import response reflects the net effect of improved market access for IP-owning firms and the increased costs faced by firms whose exports risked infringing existing IP rights. To identify which countries gained and lost from these reforms, we exploit cross-country differences in domestic IP protection, where we follow previous evidence on the effects of the TRIPS summarized by Maskus (2015), and use the GP index (Ginarte and Park, 1997).

Under the assumption that production by IP-owning firms is greater in countries with stronger domestic IP protection, and that IP-infringing firms represent a greater share of exporters in countries with lower GP scores, we find significant country-heterogeneity that was masked in the product level estimates. For countries with high levels of do-

[4] The reform acted on costs and not on the gains from winning a case. We describe the reforms in more detail, along with a UK Intellectual Property Office (UKIPO) funded report by (Helmers et al., 2015) and developed further in Helmers et al. (2016) on the volume and type of cases presented to IP courts. This UK-IPO report did not explore any wider economic effects, including any effects on international trade.

mestic IP protection there is evidence of a strong positive effect on imports to the UK for litigation exposed products. This is consistent with the idea that the UK reform lowered litigation trade costs for existing IP owners with foreign production to export to the UK. In contrast, for countries with low levels of IP protection in their domestic market, and therefore potentially greater numbers of IP-infringing exporters, imports into the UK of litigation intensive products in fact fell. This suggests that litigation trade costs rose for these firms. When focusing on low litigation intensive product categories we again find that imports to the UK only rose for countries with the highest IP protection.

Having established which products and which countries were most affected by the reform to enforcement costs elsewhere, we next ask which firms drove these changes. To provide direct evidence on the likely beneficiaries of a reduction in IP enforcement costs, patent owners, we focus on China and combine firm-product-destination export data with firm-level patent information. This allows us to distinguish Chinese owned exporters according to whether they owned patents prior to the UK reforms and, for a small subset of firms, whether they held patents registered in the UK itself. We note that this reflects the full population of such firms rather than a data-driven sample restriction, since both the patent and trade records are drawn from comprehensive administrative sources. Identification exploits within-firm variation in exports across European destinations, comparing exports to the UK with exports by the same firm to other European markets before and after the reforms while controlling for firm-product-country fixed effects.

We find that Chinese firms holding UK-registered patents expanded the range of products they exported to the UK following the reforms, indicating a positive extensive-margin response among firms whose intellectual property was directly protected in the destination market. This effect is fully explained by those firms that registered their patents in the UK in the post-reform time period rather than those with pre-reform registered patent. This evidence suggests that firms responded to lower enforcement costs by jointly increasing UK market participation and the registration of IP rights in the UK. There was also no effect among Chinese patent owning firms more generally, indicating that registration of patent ownership and exports were jointly determined. There was no evidence of a similar effect on the intensive margin of trade. Taken together, these results provide direct evidence that lower enforcement costs reshaped market access in favour of firms with established intellectual property rights.

Finally, the international trade response to a change in IP enforcement costs can also depend whether the reforms alter the expected returns to innovation and we complete the analysis by focusing on this channel. Protecting innovation through the threat and

use of enforcement channels is one of the key costs of the innovation process (Bessen and Meurer, 2013; Lanjouw and Schankerman, 2001). To combat infringement, IP holders need to spend resources monitoring, and then use legal services to deal with cases of imitation. A decrease in enforcement costs could lower these costs and raise the returns to future innovations, encouraging greater investment in R&D. It might alternatively reduce innovation if it raises total litigation costs by increasing the volume of litigation that occurs. The link from innovation to trade features in the theoretical model of IP protection and exporting found in Lai et al. (2020) and (Melitz and Redding, 2021), while De Rassenfosse and Raiteri (2022) provide evidence of a link from IP enforcement costs to exports.[5] To test if the increased protection also affected international trade indirectly through this innovation channel we use micro data on patent applications in China. Using firms that export to the UK (as well as other countries) at the start of the period, we find no effect of the reforms on patenting, even for firms producing litigation intensive products.

Given the relative size of the UK market versus other international markets, the absence of an innovation response in China is consistent with the idea that the change in UK enforcement costs did little to alter global research incentives (Williams, 2016). Following the logic of this argument, such effects are likely to be stronger for UK innovators, as the reforms and the resulting increased protection apply to a larger share of their innovations. Switching to industry-level data on UK innovation we find preliminary support for this idea. UK R&D investments increased in response to the reduction in IP enforcement costs, while patents fell, and when using the HS6 product level trade data we also show that exports from the UK rose. This divergence between R&D and patenting is consistent with evidence from Lerner (2009). Taken together, the innovation effect of this change in IP enforcement therefore appears to be weak for firms based outside of the UK, changing UK imports by very little, but stronger for UK firms, increasing UK exports.

Contributions. Relative to this literature, the paper makes three contributions. First, where existing studies typically infer enforcement effects from reforms that also alter the scope or granting of IP rights, our setting holds rights fixed and varies only their cost of enforcement — allowing us to attribute the trade response specifically to the enforcement margin, rather than to a bundle of institutional changes. Second, we move beyond the aggregate trade volumes studied elsewhere to show *who* trades: linking trade and firm-level patent ownership lets us show that enforcement reforms reallocate mar-

[5] An indirect effect on innovation might occur through changes in competition (Aghion et al., 2005).

ket access toward IP owners. Third, by comparing the innovation response of firms in the reforming country (the UK) to that of firms in a major trading partner (China), we provide suggestive new evidence on how the innovation effects of IP enforcement scale with a firm's exposure to the reforming market, complementing existing single-country evidence on this channel.

Related Literature. We locate these contributions within four strands of literature: the effects of IP protection on trade and innovation in developing countries, the more recent effort to disentangle specific components of IP systems from one another, the literature on how patent systems shape innovation and R&D, and the broader literature on institutions and non-tariff barriers to trade.

There exists a large literature on the effects of enhanced IP protection on a range of economic outcomes in developing countries. Using the introduction of TRIPS from the mid-1990's onward, the broad consensus that has emerged from this literature has been that TRIPS adoption was largely successful in encouraging greater flows of international technology transfer from R&D intensive countries to developing countries, which in turn increased exports, but with little or no effect on domestic innovation (Co, 2004; Falvey et al., 2009; McCalman, 2005; Ivus, 2010; Foster, 2014; Cockburn et al., 2016; Palangkaraya et al., 2017; Maskus, 2015).[6]

As highlighted by Palangkaraya et al. (2017), the breadth of TRIPS provisions limits the insights this literature is able to provide as to which aspects of IP protection are important for international trade.[7] The TRIPS reforms introduced and extended many provisions for granting IP ownership, while also deepening and extending the powers of enforcement institutions. The first attempts to unpick the trade effects of different elements of the IP system were made in Palangkaraya et al. (2017) and Lai et al. (2020), who study both the granting of IP rights and their enforcement, and more recently in De Rassenfosse and Raiteri (2022) which studies the effect of granting IP ownership. A related set of papers studies how destination-country IP protection affects trade outcomes without separating enforcement from other components of the system. Lin and Lincoln (2017) find that IP protection in the destination market encourages exports from US firms across a broader range of goods, while De Rassenfosse et al. (2022) extend this to quantity and price effects for French exporters. Among these, the paper closest to

[6] A theoretical literature has developed alongside its empirical counterpart and used North-South models of international trade, either product life-cycle or quality ladders, to study the effects of greater IP protection by Southern-imitator countries. Examples here include Maskus and Penubarti (1995).

[7] They also argue that these policy variables might be capturing development-related issues.

ours is Palangkaraya et al. (2017), who measure the effects of enforcement and threat of patent litigation using a variable capturing the win percentage of IP owners in court and number of local-owned patents in the export market respectively and De Rassenfosse and Raiteri (2022) who study the granting of IP rights.

The main contribution we make relative to this literature and the Palangkaraya et al. (2017) paper specifically, comes from isolating the effects of IP enforcement costs on international trade from other features of the wider IPR system. We observe the international trade and innovation responses that can be attributed to a policy focused on IP enforcement, the imposition of which was orthogonal to other confounding factors, in particular other omitted institutional characteristics of a country that matter for international trade. Our claim of robust identification rests on four features of the empirical strategy. First, the reform itself changed only the cost of enforcing IP rights while leaving their scope and definition unchanged. This lets us attribute the trade response to the enforcement margin specifically rather than to a bundle of institutional changes, as is typically the case in the TRIPS-based literature. Second, it exploits a policy setting and an outcome (imports) that isolate changes in IP enforcement costs from production decisions, using variation in exposure to the reform based on litigation intensity across products that is pre-determined, fixed over time, and measured in a different country (the US). This is supported by the absence of a differential pre-trend between high- and low-litigation products before the reform, and by falsification tests showing no comparable response in imports into other European countries that did not undergo similar reforms over the same period. Third, we combine this product-level exposure with pre-determined cross-country variation in domestic IP protection to separate countries where exporters are more likely to be IP owners from those where infringement is more likely, conditional on country and product fixed effects. Fourth, when testing the mechanisms we use micro data that exploits within-firm variation across destinations, comparing the export response of existing patent owners in the UK market against their exports to other European markets, before and after the reform, again in a country different from the one where the change in IP protection occurred.

A second important contribution we make comes from the use of detailed micro data linking patents and customs data for China in order to provide direct evidence on the mechanism through which the change in IP enforcement costs impacted the exports to the UK by patent owners located abroad. While this type of data has been used previously, see for example (De Rassenfosse and Raiteri, 2022), we are not aware of any papers that study that directly links the effects of a change in IP enforcement costs in a different country on international trade. The benefit of using these within this study is the ability

to provide for the first time detailed evidence on the mechanisms through which international trade responds to IP enforcement costs. These include how these costs improve the market access for foreign IP owners and how these are separate this from trade effects brought about by an increase in innovation. This indicates a conceptual contribution that IP enforcement matters for who exports not just how much they export. These results also suggest a previously hidden benefit of TRIPS. Countries where innovation is rising in response to the introduction of TRIPS can also benefit from further improvements in IP protections offered in high-income countries. Our results identify the reverse channel. Stronger enforcement in high-income destination markets raises market access for developing-country exporters that already hold IP, independent of any change in their domestic innovation incentives. Countries with rising patenting under TRIPS stand to gain further from enforcement improvements in the markets they export to.

Our inclusion of the innovation effects of IP reforms means that this paper relates to the innovation literature on the innovation and patent response to various aspects of IP systems. This is not the primary focus of this paper, and our contribution to this literature is more modest and we largely support results found previously. We also note that our focus on a specific policy change within the broader IP system means we share elements of the research design with that literature. Early work in this area found limited effects of changes to patent systems on innovation, see for example Sakakibara and Branstetter (1999), Qian (2007) and Lanjouw and Lerner (1996), while more recent work has begun to find stronger effect on domestic innovation, such as Mezzanotti (2021). Williams (2017) argues that the limited innovation effects were a function of the relative small change that the IP reforms being studied had on the global returns to innovation. The reduction in IP litigation risk in the US studied by Mezzanotti (2021) would have had stronger effects on these global returns. Our finding of a limited effect on Chinese patents and a stronger effect on UK industry R&D expenditures and patents can be viewed as consistent with this idea. This literature has also shown that changes to the innovation system can generate opposite effects on R&D and patents (Lerner, 2009), a pattern we return to later in the paper. Williams (2017) argues that the innovation effects of IP systems are dependent on how much information is disclosed by the patent system, the extent stronger patent protection is effective in inducing additional research investments and whether patents on existing technologies affect subsequent research investments.

The UK IP court reforms represent an improvement in institutional quality. The link between institutions and economic growth is well established. Besley and Ghatak (2010) review this literature, emphasizing that the presence of weak IP rights can keep

investment at an inefficiently low level, creating unproductive expenses for defending property and leading to the inefficient allocation of resources. The evidence that this impacts international trade is more limited however. Two notable exceptions are Anderson and Marcouiller (2002) who show that corruption and non-optimal contract enforcement reduce international trade, and Nunn (2007) who shows that contract enforcement is a more important determinant of international trade than human or physical capital, because it supports trade in goods that require relationship-specific investments, which themselves depend on contracts.

Finally, our paper contributes to the literature studying non-conventional barriers to trade. This includes any non-tariff related factor that can shape trade; not only IPR but also rules of origin (Conconi et al., 2018), policy uncertainty (Steinberg, 2019), political economy considerations (Maggi and Ossa, 2021) and even financial constraints (Manova, 2013). Evidence from Fink and Braga (1999) suggests that the effect of market power dominates the effect of market expansion in high-technology products.

Outline. The remainder of this paper is organized as follows. Section 2 discusses the background of the IP reform. In Section 3 we present the data sources and the construction of variables. Section 4.1 presents the empirical findings on production, Section 4.2 the results for countries, Section 4.3 the results for firms, and Section 4.4 focuses on the innovation responses. Finally Section 5 concludes.

2 Background to the Reform

The unique nature of knowledge and ideas has created the need for a system of ownership rights designed specifically for this class of assets. Being intangible, these assets are hard to restrict from use or imitation, which often undermines the originators' ability to capture an adequate return on their investment. To support investment and reward innovation, therefore, granting IPR and establishing mechanisms to ensure their enforcement are key components of an effective IP system. Despite its economic importance, enforcement is often a complex environment that firms have difficulty navigating. The use of the legal system to protect IP requires knowledge and resources that IP owners often lack and can entail costs they cannot absorb. In the UK, the Jackson Review of the Civil Litigation Costs and the final report published in 2009 by the Intellectual Property Court Users Committee highlighted concerns that high litigation costs were preventing

firms from accessing IP courts.[8] The reports put forward an extensive list of proposals aiming at making court proceedings more cost-effective.

Following the publication of the Jackson Review, the UK IP court system was reformed over the period October 2010 to October 2013, streamlining court procedures and speeding up the resolution of claims (Helmers et al., 2015, 2016). This had the effect of reducing the time and monetary costs of protecting IP, but also the uncertainty over the costs in the event that these actions lead to losses. Part of the reforms involved renaming the Patents County Court (PCC) the Intellectual Property Enterprise Court (IPEC). Essentially, this marked the establishment of a new type of court, and hence the change in the name reflected the wider scope of work that it was intended to undertake. The creation of the IPEC improved access for businesses via the Small Claims Track for claims below £10,000 and the Multi Track for claims below £500,000.[9] IPEC would adjudicate over less complex claims,[10] with limits on the size of both recoverable costs and damages, and offering a speedier resolution system.[11] The new legal system for IP infringement claims is set out in Figure 1, while Figure 2 provides a timeline of the reforms.

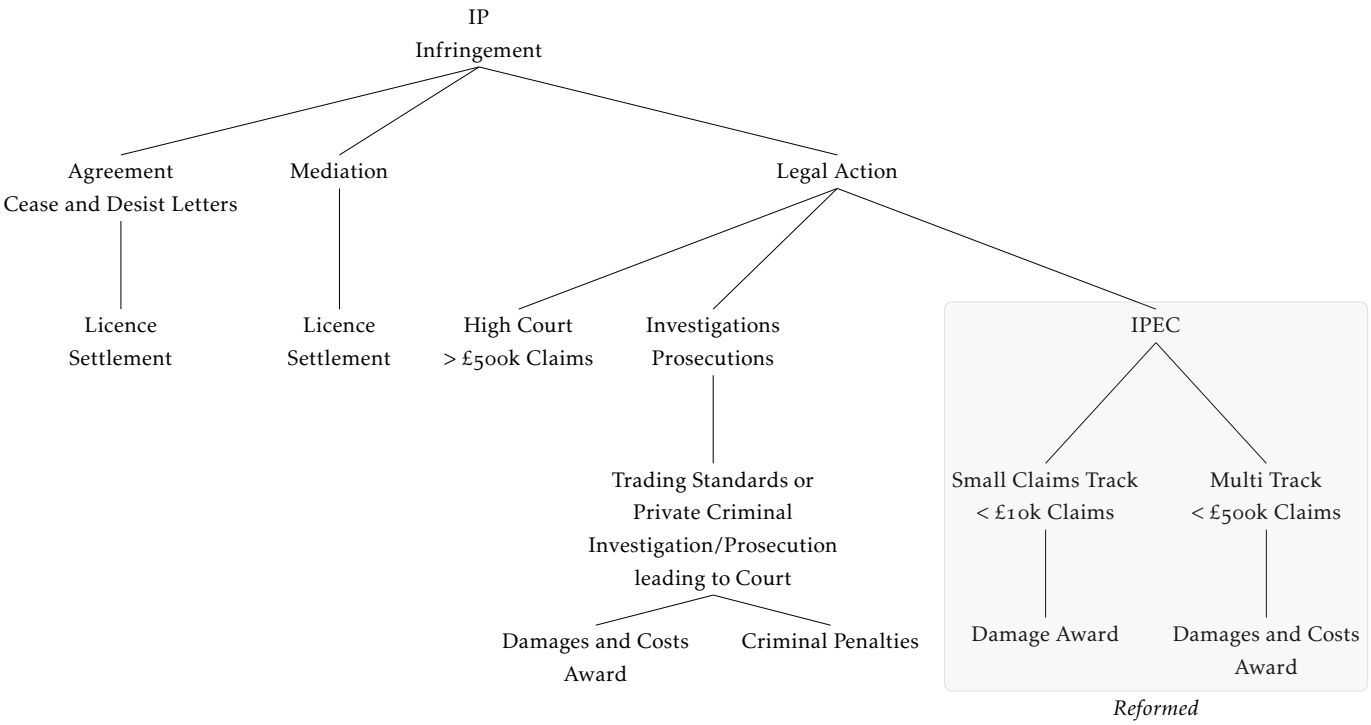
[8] Quantifying the costs of IP protection is subject to a number of difficulties, but estimates reported in Weatherall and Webster (2014) estimate that the costs of initial proceedings in the UK (in 2000) were three times those for Germany and France. They argue that this difference accounted for the reduced volume of IP litigation in the UK compared to these other jurisdictions.

[9] Claims above £500,000 are dealt with by The High Court.

[10] A small claims track was introduced in October 2012. This track could hear claims regarding the infringement of copyright, trade marks and passing off, databases, breach of confidence, and unregistered design matters – but not cases concerning patents, registered designs and plant variety rights.

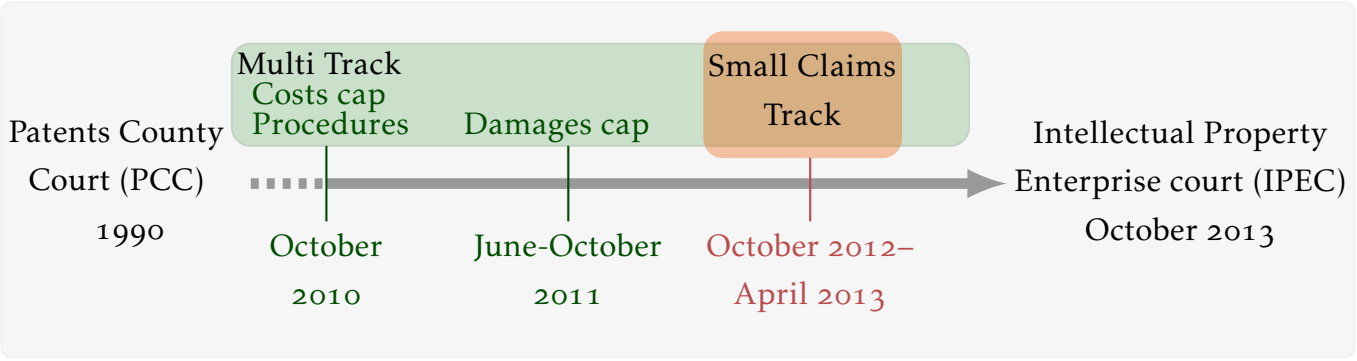
[11] The most important aspect of these were the introduction of an active case management system, early identification of the issues by the judge, and a limit on the time to be taken at trial.

Figure 1:
Justice Flowchart for IP Infringement in the UK



Notes: This tree diagram, adapted from the UK Government's guidance on IP crime and enforcement for businesses, outlines the main pathways available to IP holders to defend their rights against infringement. It distinguishes between informal resolution (agreement or mediation), legal action through the High Court or criminal prosecution, and the reformed Intellectual Property Enterprise Court (IPEC). The gray box in the diagram highlights the Intellectual Property Enterprise Court (IPEC), which is the part of the system that has been reformed. IPEC offers two tracks: the Small Claims Track for claims under £10,000, and the Multi Track for claims under £500,000. These tracks aim to improve access to justice for lower-value IP disputes by offering a more streamlined and cost-effective process. Our empirical analysis leverages the reform of this part of the IP court system.

Figure 2:
Timeline of IP Court Reforms



Legal Framework: 2010-2013 IP Reforms

Notes: This timeline outlines key changes to the UK IP legal framework from 1990 to 2013. The Patents County Court was established in 1990. A cap on legal costs for multi-track cases was introduced in October 2010, followed by a cap on damages between June and October 2011. The Small Claims Track, introduced in October 2012 and followed by further reforms through 2013, aimed to improve access for lower-value cases. In October 2013, the court was renamed the Intellectual Property Enterprise Court to reflect its broader role and the substantial reforms introduced over the preceding three years.

An analysis of the initial effect of the reforms on litigation behaviour was conducted by Helmers et al. (2015) and extended in Helmers et al. (2016).[12] The qualitative data from various legal experts reported in Helmers et al. (2015) suggest that the reforms had the effect of encouraging firms to protect their IP using the legal system, with an increase in both court and pre-court settlements. The reduction in legal costs that occurred as a result of the reforms gave confidence to both sides, claimant or defendant, as to what their exposure might be in the event of a loss, while those around case management meant both parties went to trial with a clear picture of the issues at stake and with greater confidence in the time it would take to reach a decision. Helmers et al. (2016) argue that the most important feature of the reforms was the cost cap, which brought the UK IP system closer to that of the US, where there is a tradition that parties pay their own costs. The quantitative assessment of case filings found in Helmers et al. (2015) and extended in Helmers et al. (2016), which covers the period from 2007 to 2013, showed that there was a large increase in cases (litigation) across all forms of IP, with stronger effects on the number of patent and copyright cases.

[12] This also included the background to the reform and a detailed description of the reform itself.

WTO rules require that the IPEC court provide equal access to both domestic and foreign owned firms, regardless of whether they are located in the UK or serve the UK market via exports (imports from the UK perspective). Neither Helmers et al. (2015) nor Helmers et al. (2016) discuss this point. The case filings from UK IP courts in the BAILII database of UK case law provide evidence in support of the idea that foreign owned firms began using the UK IP courts more frequently.[13] Focusing on the cases from the Patents County Court and its renaming as the Intellectual Property Enterprise Court, we search for cases that include foreign owned firms. While recognizing that an overwhelming majority of the cases do not reach court but are settled prior to this point (Weatherall and Webster, 2014), the number of cases involving foreign firms in the BAILII data rose from 0 (out of 3 cases) in 2008, to 2 (out of 9 cases) at the start of the reform period in October 2010, to 13 (out of 45) in 2013 and 9 (out of 22) in 2016.[14] The share of cases in which foreign-owned firms appeared therefore rose from 0% to 22%, to 29% to 41% across these years.[15] Of the cases involving foreign-owned firms, they appeared as claimants in about half of the cases and as defendants in the other half (55%:45%). While not definitive, this evidence illustrates the international dimension of these reforms, which streamlined access for domestic and foreign firms. The bigger rise in cases involving foreign firms could also reflect a greater reduction in enforcement costs for these firms, possibly due to the additional expenses they face for their legal representation in a foreign country and their challenges of navigating foreign court procedures.

3 Data and Variables

In the empirical analysis, we use a variety of data including data on imports into the UK, a measure of litigation exposure across products, as well as micro-level data for China. In this section, we introduce the sources of the data used and discuss their key features along with the approach used to construct the main variables.

International Trade Data. We use data on quantities and values of imports at the HS 6-digit product-level data from the BACI database. It covers 200 countries and 5,000

[13] https://www.bailii.org/databases.html

[14] This increase is smaller than the rise in IPEC cases reported in Helmers et al. (2016), who use hand-collected data. They show that the number of IPEC cases rose from 50 in 2008, to 103 in 2010, and 207 in 2013. The number of IP cases heard at the High Court cases rose from 64 to 274 to 208 across these same years.

[15] We identify the ownership of firms by matching the case files to data from Companies House, which provides a registry of firms operating in the UK.

products over a period of 20 years.[16] The BACI database is widely used in the literature and of high quality. Specifically, BACI builds on United Nations' COMTRADE database, making several improvements. The most important one is that it reconciles information reported by both trade partners ensuring data consistency. In the empirical analysis, we focus on the period from 2005 to 2020, study quantities and values, and we also construct unit values as a proxy for prices, which we compute as the ratio of value to quantity. In the baseline estimations we aggregate the data to the HS-6 product level in order to focus in on the cross-product variation in litigation intensity. This has the further effect of reducing the number of zeroes in the data and so we take the natural log of these product level imports to estimate elasticities. We exploit the country dimension of the data later in the analysis.

Chinese Micro Data. To provide direct evidence of the link between the UK court reforms and trade we also use micro level trade and patent data on China. The idea of using IP reforms in one country to study the response in a different country can be found in Lerner (2009), who uses Austrian IP reforms to study patenting in the UK. Chinese firm-level export data is provided by Chinese Customs Trade Statistics. This Customs dataset is the primary transaction-level data in China which includes firm names, import and export values, product codes (at HS 6-digit level), origin and destination countries for the years 2000-2016, of which we use data from 2007 onward.[17] This information enables us to identify Chinese firms' exports to the UK and other countries. We study both the intensive and extensive margins of exports. For the extensive margin, we assume that firms can potentially export any product within their product scope to any destination market. Accordingly, we construct the sample by considering all firm-product-destination combinations, where the set of potential products is defined as those exported by a firm at least once during the period 2007-2016. For each firm, we then combine this product set with all destination countries and assign zero export values to observations with no realized exports in a given year.

Firm-level patent data is collected from China National Intellectual Property Administration (CNIPA). The CNIPA data provides detailed information on Chinese patent filings from 1985 to 2016, including the year the patent application is made, the name and address of the applicant, and the application number. We merge Chinese Customs and patent datasets using the name of firm to identify the patent holdings of Chinese

[16] We use the 2023 version of the data – HS02 (2002-2021).

[17] The original data is at the HS 8-digit level and we aggregate to the HS 6-digit product-level to match the litigation exposure variable.

exporters. We measure prior IP ownership by whether the firms owned patents or not prior to the reform (by 2006). To investigate the effect on innovation, we measure firm innovation using counts of patent applications.

Additional Data. The litigation exposure variable is sourced from Mezzanotti (2021). This measure of litigation exposure is a count of the number of patent litigation cases that occur in the US within a USPTO technology class, normalized by the total number of litigated patents and weighted by the share of granted patents with applications prior to 2006 in a given technology class. Lanjouw and Schankerman (2001) provides evidence supporting the idea that reputation building plays a role in the decision to litigate. Firms litigate against both existing infringement, as well as potential infringement in order to build a reputation that they will actively act to defend their IP in the event of an infringement. The measure of litigation exposure we use therefore captures the degree of willingness by existing IP owners to defend their innovations. It is constructed at the United States Patent Classification (USPC) level and we crosswalk it to HS6 product codes using a bridge file we source from Zola's website.[18]

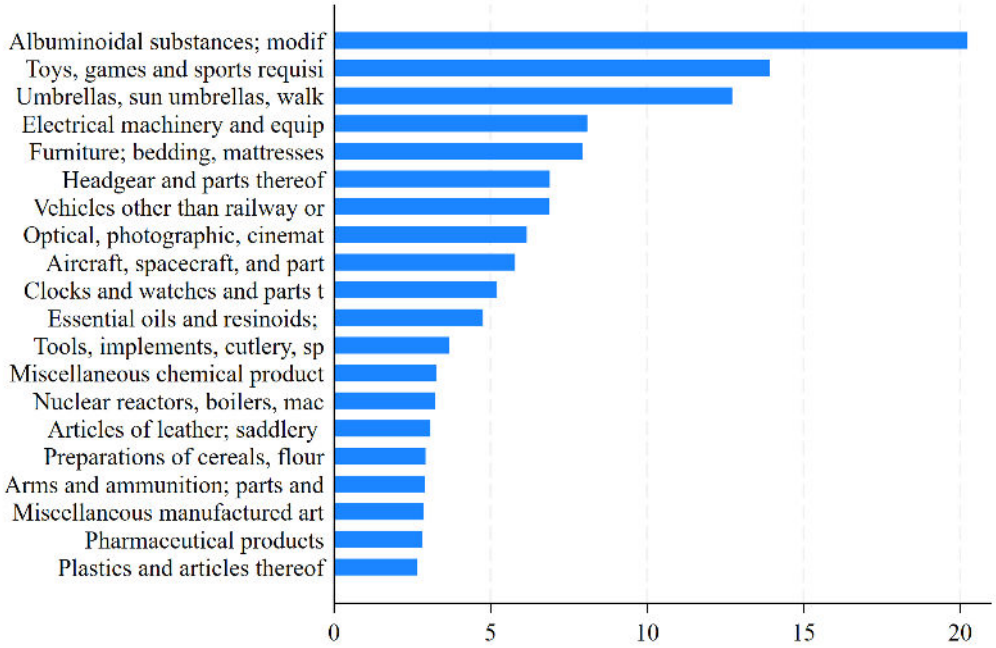
We measure litigation exposure across technology classes using the average litigation intensity of the period 1980-2006, which covers years prior to our reform period. We do not allow cross-time changes in this variable because, as Helmers et al. (2015) show, the reform also had the effect of increasing both the number of court cases as well as pre-court settlements.[19]

Identification of the effects of IP enforcement costs when using this measure is that this time invariant US measure of litigation captures relevant variant in the exposure to the UK reforms. To support this claim we first note the persistence of litigation cases over time. Past litigation exposure is therefore a good predictor of future litigation. The motivation to use US data has two parts. Firstly, as discussed in Weatherall and Webster (2014) the US has lower costs of litigation and therefore greater volumes of IP cases compared to the UK. Secondly, Helmers et al. (2016) argues that an important element of the reform was to move away from the UK tradition that the winner can recover their costs from the loser, to the system typically found in the US, where each party pays their own costs. US IP litigation intensity therefore captures the exposure to these UK reforms.

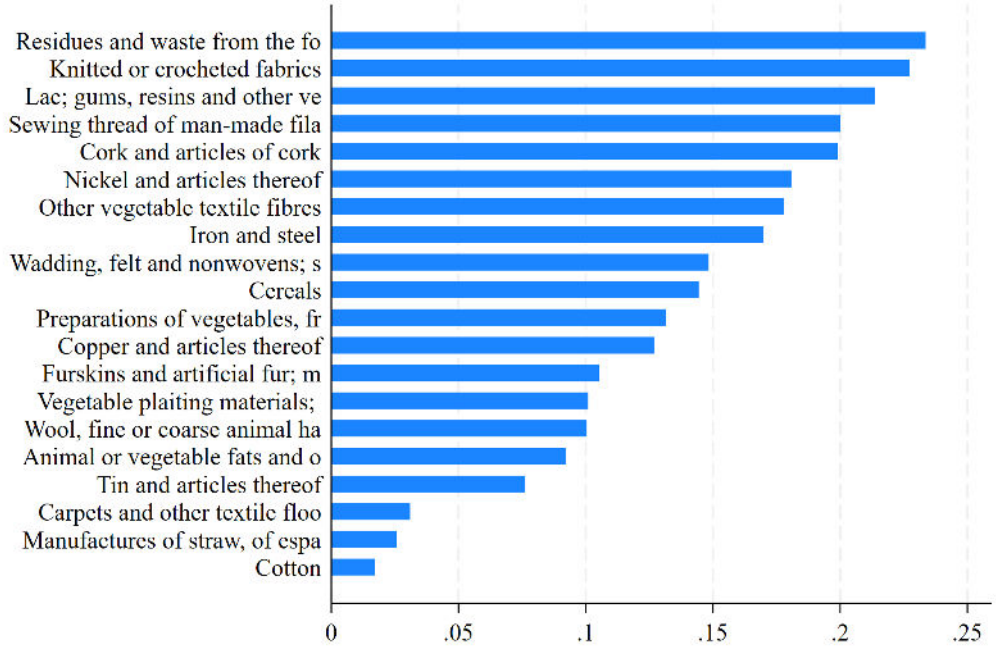
[18] https://sites.google.com/site/nikolaszolas/PatentCrosswalk. Further details on the construction of this bridge file can be found in Goldschlag et al. (2019).

[19] Fournier and Zuehlke (1989) and Lanjouw and Lerner (1996) analysis highlight the importance of considering these effects.

Figure 3:
Ranking Sectors by Litigation Risk



(A) Top 20 HS2 Products



(B) Bottom 20 HS2 Products

Notes: This figure shows the twenty HS2 product categories with the highest and lowest litigation intensity, aggregated from HS6-level data. *Panel (A)* shows categories with higher intensity; *Panel (B)* shows those with lower intensity. The variation reflects sectoral differences in litigation exposure, plausibly driven by differences in product characteristics and the frequency of legal disputes, which may in part reflect the expected net of costs returns to defending innovation.

A visual summary of the 20 most and least litigation exposed products is shown in Figure 3a. Among the most litigation exposed products in the data are products such as those in machinery and equipment, transportation and pharmaceuticals. The products with the lowest levels of litigation exposure include products in textiles, apparel and food and agricultural manufacturing.

To explore the heterogeneity of the effects across countries associated with the system of IP protection in the country of origin of the UK imports, we use the Ginarte and Park index. This index measures the presence, enforcement, and quality of IP rights across 121 countries. We fix this variable across time as the value for each country in 2006. Our empirical analysis groups countries into three equally sized groups according to their Ginarte and Park index. These are identified by the low, medium, and high IP indicator variables in Table 4.

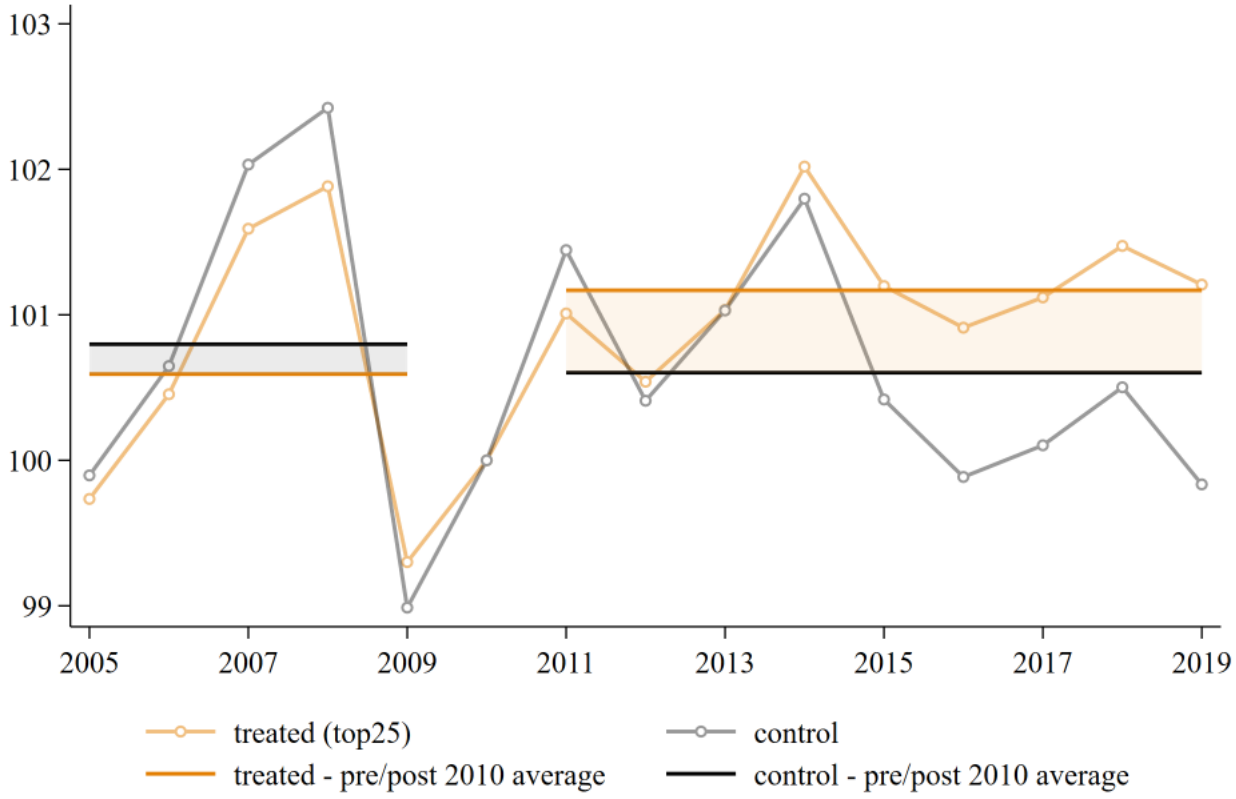
Finally, we describe the source of the measures of industry innovation. Research and Development (R&D) expenditure data and patent data are sourced from the EUKLEMS & INTANProd database (Bontadini et al., 2023) and the INPACT-S database (LaBelle et al., 2023), respectively. Specifically, we use sectoral (NACE rev.2) real gross fixed capital formation values of R&D expenditures by year. The patent data are described in LaBelle et al. (2023) and are available at the 2-digit sectoral level (ISIC rev3) by year. Patent counts are available by the applicant's country and by the country where the application was filed. The citation counts include measures of both the industry and country of the inventor of those citing, and cited by, each patent.

4 Empirical Analysis

4.1 Which Products?

Within this paper we examine how a set of reforms that lowered the costs of IP enforcement impacted at the product, country and firm level. We begin by focusing on products. To provide initial evidence on this question in Figure 4 we plot the product level data on UK imports over time separating products by whether they are in the top quartile of litigation exposure or not. Indexing these to be equal to 100 for both groups in 2010, the trend in these import flows is very similar in the pre-reform period. These import flows then diverge at the end of the reform period in 2013, with imports increasing for those that are most litigation intensive.

Figure 4: Import Values
Comparing Litigation Intensive and Less Intensive Product Groups



Notes: This figure shows the evolution of log import values over time for HS6 products in the top quartile of litigation intensity (treated group) and the remaining products (control group). To compare changes over time, both series are set to 100 in 2010. The figure includes horizontal lines indicating the average pre- and post-2010 values for each group, with the treated group in orange and the control group in black. The shaded area between the lines shows the difference in average values between the treated and control groups before and after the reforms.

To test this more formally in the baseline regressions we employ a difference-in-differences empirical strategy at the product level that leverages the panel dimension of our trade data and the variation of exposure to IP litigation across products. The exclusion restriction is that, conditional on product fixed effects and global litigation intensity measured prior to the reform, no other UK-specific shock differentially affected imports of high- and low-litigation-intensity products over the reform period. This as-

sumption implies that imports of litigation-intensive products should not display similar post-reform changes in countries that did not alter their IP enforcement regime, which we later verify using data for other European destinations.

Specifically, we estimate the following specification:

$$Y_{pt} = \alpha_t + \alpha_p + L_p \times Post\_Reform_t + \varepsilon_{pt} \tag{1}$$

Within the regression Y is the natural log of imports: value, quantities, or prices of (HS6) product p at time (year) t. As the reforms began at the end of 2010, $Post\_Reform$ is a binary indicator for whether year t is 2011 or later. Lp is the continuous measure of US IP litigation intensity, constructed at the technology class level, mapped to products p, and fixed at pre-reform period values. We account for shocks experienced similarly across products using the year fixed effect α_t, while α_p is a product-level fixed effect that accounts for time-invariant systematic differences in the determinants of trade across products. While in this specification the exposure of the products to the IP reforms is based on a continuous measure of IP litigation, in later regressions we also separate this variable into quartiles to create dummy variable versions in order to explore non-linearities in the effects of the reforms and to explore pre-trends. We aggregate across countries in the baseline estimations, and we use the country level information available in the data in order to explore heterogeneity in the effects of the reforms towards the end of the paper.

In Table 1 we report the effects of a change in IP enforcement costs on the price (column 1), quantity (column 2) and value (column 3) of UK imports. We anticipate that litigation-intensive products experienced the greatest change in IP enforcement costs, as they incurred the highest costs under the pre-reform IP system. In contrast, products that rely little on the IP court system (minimal involvement in IP litigation) faced minimal costs, and were unlikely to be significantly affected by the reform, making them an appropriate counterfactual group. The change in litigation trade costs is measured by differences in HS6 product level exposure to IP litigation, interacted with a time dummy that turns one (i.e. equals 1, and 0 otherwise) in the post-IP reform period. This dummy, therefore, captures the policy shift introduced by the IP reforms.

Table 1:
Estimates of the Effect on UK Product Imports

	Price	Quantity	Value				
			Continuous	P25 Base	Binary	Binary	≤2019
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Lp \times Post\_Reform$	0.061*	0.156***	0.224***				
	(0.037)	(0.054)	(0.048)				
$Lp\_Q4 \times Post\_Reform$				0.144***		0.091***	0.071***
				(0.015)		(0.011)	(0.011)
$Lp\_Q3 \times Post\_Reform$				0.101***			
				(0.016)			
$Lp\_Q2 \times Post\_Reform$				0.060***			
				(0.016)			
$Lp\_topP50 \times Post\_Reform$					0.093***		
					(0.011)		
Observations	63,107	63,107	63,141	63,141	63,141	63,141	55,754
Year FE	✓	✓	✓	✓	✓	✓	✓
Product FE	✓	✓	✓	✓	✓	✓	✓

Notes: This table studies the impact of the UK IP courts reforms on three outcomes: the price of imports (*column 1*), defined as value over quantity; the quantity of imports (*column 2*); and the value of imports (*columns 3 to 7*). All dependent variables are in log form and measured at the HS6 product level. The variable *Lp* captures the frequency of patent litigation at the HS6 level and measures product-level exposure to the UK IP court reforms. *Columns 1 to 3* use a continuous measure of litigation. For the value of imports (*columns 4 to 7*), we study non-linear effects by splitting the litigation variable into quartiles. In particular, *Column 4* compares the impact on products with higher litigation exposure relative to the baseline (bottom quartile in *column 4*). In *columns 5 and 6*, the litigation exposure is defined using binary indicators: above versus below the median (*column 5*), and above versus below the top quartile threshold (*column 6*). *Column 7* builds on column 6 but restricts the post-reform period to 2011–2019 to exclude the COVID-19 years (2020-2021). $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. Each specification includes year and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

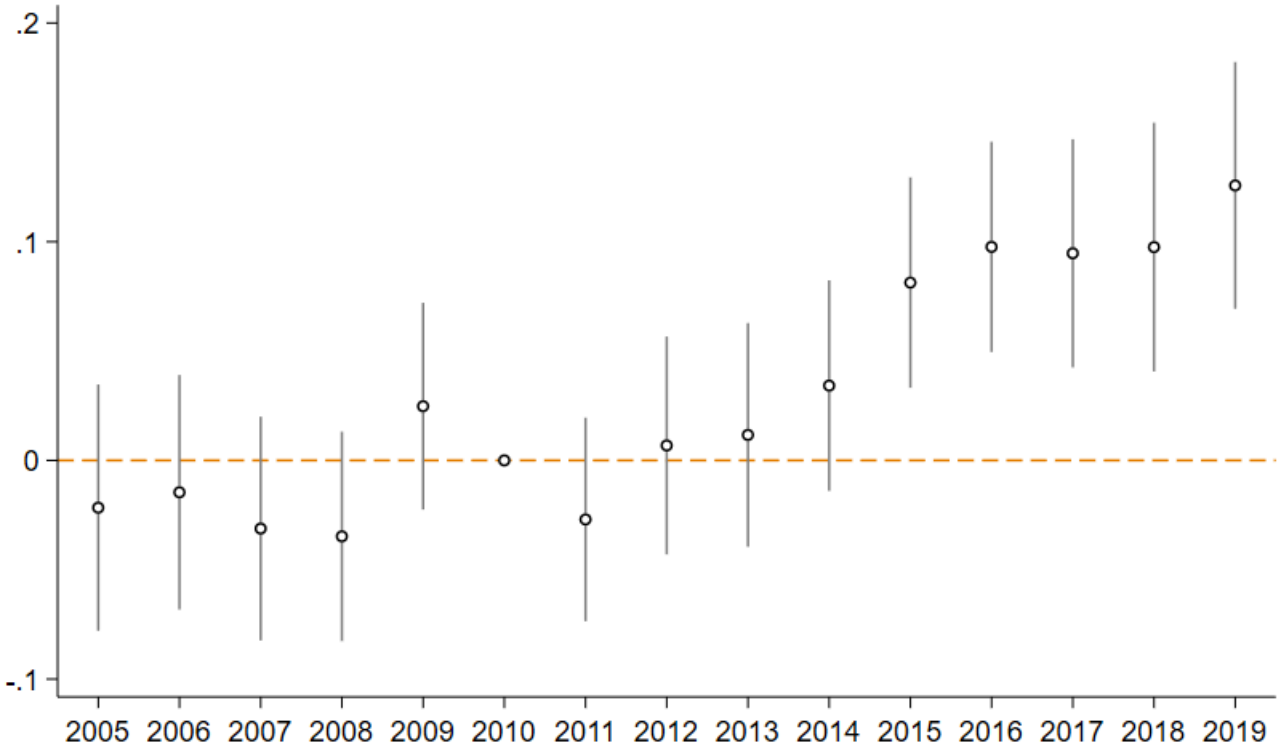
The results in these columns suggest that the effect of the UK IP reforms had a statistically significant positive effect on the price, quantity and value of UK imports for products exposed to litigation. This is consistent with the idea that these reforms lowered litigation trade costs. These aggregate effects are also modest in size. For a standard deviation increase in the intensity of litigation between products, import prices increased by 0.4%, quantities increased by 1.5%. This increase in price and quantity led the value of imports to rise by 2.0%. Interestingly, much of this change is due to an increase in the quantity of trade. With the data that we have available we are unable to determine whether the increase in prices reflects greater market power for importers or an increase in quality.

In column 4 we explore non-linearities in this relationship by separating products according to quartiles of their litigation exposure and using those below the 25th percentile of exposure as the reference category. The results here suggest that compared to the products where IP litigation occurs less often, and therefore less exposed to the reform, imports of products with a greater litigation intensity rose after the reforms. These effects are strongest for products with a litigation exposure in the top quartile, at about 0.14% compared to 0.10% for products between the 75th and 50th percentiles of litigation exposure, and 0.06% for products between the 50th and 25th percentiles. In the final two columns of the table we create dummies measuring products above and below the median (column 5) and the top quartile of litigation intensity (column 6). Again, across all the specifications, we continue to find evidence which suggests that compared to products that were less exposed to the reform, UK imports increased. Finally, in this table, as the data period used thus far includes the COVID-19 period in 2020-2021, in column 7 we show the robustness of these results when we include data for the years up to and including 2019. The results are similar to before and we continue to find that the UK market became more attractive for importers in particular for those products where IP litigation is frequent.

The internal validity of the difference-in-differences design rests on the assumption that, in the absence of the change in IP enforcement costs in the UK, treated and control products would have followed parallel trends. This allows us to attribute any change in trends following the policy shift to the reduction in enforcement costs brought about by the reform. We provide evidence for how imports of litigation exposed products evolve over time by identifying the exposed products as those in the top quartile of the litigation intensity measure and then interacting their imports with a set of year dummies. The results from this event-study regression are reported in Figure 5, which shows the coefficients for the year-treatment dummies and their associated confidence intervals

(measured relative to 2010). [20] It is clear from Figure 5 that in the years prior to the IP reforms, the imports of low- and high-litigation products into the UK exhibited similar trends. The value of imports of products that were more exposed to litigation then rose steadily as the court reform period ended in 2013 and became statistically significant from 2015 onward. In the remaining post-reform years, the effect on import values are positive and significant at standard statistical significance levels, consistent with the results in Table 1.

Figure 5: Event Study Plots
Imports of Litigation Intensive and Less Intensive Product



Notes: This figure shows the estimated effects over time, with 2010 as the base year. The period is divided into a pre-reform period (2005–2009) and a post-reform period (2011–2019). For each year, we report an estimate of the effect of the IP court reforms on log imports at the HS6 product level, along with its confidence interval. The dashed horizontal line marks the reference point for no effect.

We use Table 2 to explore the robustness of the results to the inclusion of additional

[20] The reforms began in October of that year.

controls. In the specifications reported in columns 1 to 4 we explore whether the results are in fact driven by other domestic UK policy changes, such as those around capital investment and education that may also affect international trade, while in column 4 we control for other policies related to international trade directly by including a measure of (lagged) exports in the same product category. We measure capital intensity and skill intensity at the HS6 digit product level for the US in 2005 using data from Nunn and Trefler (2013). Each specification includes interactions between these variables and year dummies, allowing us to control for domestic or policy changes that occurred in any year and may have differentially affected products with characteristics captured by these variables. We measure capital both as flexible capital, measured by the importance of machinery, and by the amount of fixed capital, measured by building capital. As argued in Nunn and Trefler (2013), buildings, as opposed to other capital assets, tend to maintain their value (i.e. they face lower depreciation rates), and it is easier to re-purpose and resell them (greater liquidity). Using this measure, we also absorb variation across products in liquidity constraints that could affect decisions around importing, exporting, IP protection, or investment.

Specifically, we augment the baseline specification by sequentially introducing three interaction terms. In column 1 we add the interaction of the measure of machinery intensity of the industry with a full set of year dummies; in column 2 we also add the skill-year dummies; and in column 3 we also add fixed capital intensity-year dummies. The addition of these measures does not effect the main results of the paper. The effect of the UK IP reforms was to raise imports of products more exposed to litigation. The inclusion of these controls has the effect of reducing the estimated effect of the reforms from 0.146 when we include flexible capital-year dummies, to 0.113 when we include these alongside the skill-year and fixed capital-year dummies. In column 4 we attempt to control for the possible confounding effects of other international trade policies by including a measure of lagged exports. The outcome from this additional empirical exercise continues to suggest that the effect of the IP reforms had a positive effect on imports into the UK.[21]

[21] These results are also unchanged if we replace the lag of exports with the contemporaneous value.

Table 2:
Addressing Confounding Effects

	Import Value			
	(1)	(2)	(3)	(4)
$Lp \times Post\_Reform$	0.146***	0.115***	0.113**	0.106**
	(0.049)	(0.049)	(0.049)	(0.048)
Observations	50,817	50,817	50,817	37,094
Year FE	✓	✓	✓	✓
Product FE	✓	✓	✓	✓
Further Controls:				
Machinery x Year	✓	✓	✓	
Skills x Year		✓	✓	
Buildings x Year			✓	
Lagged Exports				✓

Notes: This table studies the robustness of the main results. To do so, it includes control variables that may capture alternative channels through which imports could be affected. Each column builds on the specification reported in column (3) of Table 1, augmenting it with an additional control variables: the value of machinery in Column (1), the number of workers in Column (2), the value of buildings in Column (3), and the total exports in Column (4). The variable Lp captures the frequency of patent litigation at the HS6 level and measures product-level exposure to UK IP court reforms. $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. All specifications include year and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

We conclude this section with the results of a falsification test using trade data for other European countries. In column 1 of Table 3 we explore whether imports of litigation intensive products changed post-reform for France, Germany, and Italy, the three largest non-UK European countries, and the ones closest to the UK in GDP terms. In column 2 we add to this group of countries imports into the Netherlands, column 3 further adds Belgium, column 4 further adds Spain, and column 5 further adds Switzerland. The anticipation throughout this analysis is that these countries did not implement a similar type of reform during the same period as the UK, reforms that lowered the costs of IP enforcement. Therefore, there should be no change in the imports of litigation-intensive products relative to less intensive products over the post-reform period. Indeed, this is

what we find. Imports in countries outside the UK do not differ with the degree of US litigation intensity when comparing the periods before and after the reforms. Again, this corroborates and reinforces the causal interpretation of the baseline results that changes in UK imports over this time period were affected by changes in IP enforcement within the UK, rather than by other similar policies introduced at the same time that also affected other countries.

Table 3:
Falsification Analysis

	EU3	EU3 +Netherlands	EU3+Netherlands+ Belgium	EU3+Netherlands+ Belgium+Spain	EU3+Netherlands +Belgium+Spain +Switzerland
	(1)	(2)	(3)	(4)	(5)
$Lp \times Post\_Reform$	0.060	0.021	0.017	-0.001	0.028
	(0.040)	(0.039)	(0.039)	(0.040)	(0.041)
Observations	37,307	37,315	37,317	37,321	37,322
Year FE	✓	✓	✓	✓	✓
Product FE	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓

Notes: This table studies the internal validity of the main results by studying imports in other European countries instead of the UK. The outcome variable is imports in Germany, France, and Italy (EU3) in Column (1). Column (2) includes the Netherlands; Column (3) further includes Belgium; Column (4) further includes Spain; and Column (5) further includes Switzerland. All specifications include the controls used in Column (3) of Table 3. The variable Lp captures the frequency of patent litigation at the HS6 level and measures product-level exposure to UK IP court reforms. $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. All specifications include year and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

4.2 Which Countries?

The product-level results establish that the UK IP court reforms had their largest effects on litigation-intensive products. These estimates, however, describe the average response across all source countries and therefore mask potentially important differences in how exporters were affected. If lower enforcement costs improve market access for firms that own intellectual property while raising expected costs for firms whose exports risk infringement, then the aggregate trade response should conceal substantial

reallocation across exporting countries. We explore this possibility by exploiting cross-country differences in the strength of domestic IP protection and asking which countries gained and lost market access following the reforms.

For this exercise, we use the IP protection index constructed by Ginarte and Park (1997) (GP index). Using this data, we separate countries according to the values of this index for 2006 into three groups, where the 33rd and 66th percentile values of the distribution are used as thresholds to determine the group into which countries are categorized. We label these groups IP˙Low, IP˙Med and IP˙High in the table. We then interact the three country IP protection groups with a dummy for the litigation exposure of products above and below the median value (labeled Lp˙Low and Lp˙High), which gives six country-product groups. More formally we estimate the following specification:

$$Y_{pjt} = \alpha_t + \alpha_p + \alpha_j + \sum_{l \in \{Low,High\}} \sum_{g \in \{Low,Med,High\}} \beta_{lg} \left(L_p^l \times IP_j^g \times Post\_Reform_t \right) + \varepsilon_{pjt} \quad (2)$$

where we use j to denote import origin countries. We use countries in the low-litigation-low-IP protection group as the reference category in the regressions. In these regressions the identifying assumption is that, conditional on country and product fixed effects, the only channel through which domestic IP protection (as measured by the GP index) interacts with litigation intensity to affect UK-bound imports after the change in UK enforcement costs.

The results presented in Table 4 reveal clear heterogeneity. The results in column 1 suggest noticeable heterogeneity in the effect of the UK court reforms according to the degree of IP protection in the market of origin. Imports to the UK rose for litigation intensive products from those countries with the highest levels of domestic IP protection (labeled $Lp_{High} \times IP_{High}$). These are the countries where a higher number of IP owners and IP producers was expected and therefore where litigation trade costs were expected to fall. In contrast, for countries with low levels of IP protection in their domestic market, and therefore possibly greater numbers of IP-infringing firms, imports of litigation intensive products fell relative to the comparison group (labeled $Lp_{High} \times IP_{Low}$). These results confirm expectations that the reforms had the effect of changing litigation trade costs, deterring infringing imports and improving sales by IP owners at the same time.

Table 4:
Product and Country Changes

	Value	Quantity	Price
	(1)	(2)	(3)
$Lp\_Low \times IP\_Med \times Post\_Reform$	-0.020	-0.014	-0.028
	(0.041)	(0.045)	(0.021)
$Lp\_Low \times IP\_High \times Post\_Reform$	0.154***	0.305***	-0.186***
	(0.037)	(0.040)	(0.018)
$Lp\_High \times IP\_Low \times Post\_Reform$	-0.152***	-0.128***	-0.024
	(0.038)	(0.041)	(0.018)
$Lp\_High \times IP\_Med \times Post\_Reform$	0.177***	0.207***	-0.062***
	(0.042)	(0.046)	(0.021)
$Lp\_High \times IP\_High \times Post\_Reform$	0.231***	0.398***	-0.201***
	(0.039)	(0.042)	(0.019)
Observations	152,731	152,148	152,148
Year FE	✓	✓	✓
Product FE	✓	✓	✓
Country FE	✓	✓	✓
Controls	✓	✓	✓

Notes: This table studies how the impact of the UK IP courts reform on import outcomes varies by country of origin. The outcomes are the value of imports (*column 1*), the quantity of imports (*column 2*), and the price of imports (*column 3*), defined as value over quantity. All specifications include the same control variables as those used in Table 4. The *Lp* variable is a binary indicator equal to one if litigation exposure is above the median, and zero otherwise. $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. Each specification includes year, country and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

There is further country heterogeneity in the effects of the IP enforcement reforms across countries for the low litigation product categories (Lp_{Low}). Relative to the same products imported to the UK from countries with low levels of IP protection, there was no change in imports for countries with mid-level (IP_{Med}) IP protection and imports rose from the high-GP group of countries (IP_{High}). Again, for low-litigation products, it would appear that imports increased more for countries where IP ownership is more

likely, compared to those where infringement tends to be more prevalent. Finally, for the same level of IP protection in the origin market, we note that litigation intensive products responded more strongly than less litigation intensive products.

We extend the insights above by considering the effects on prices and quantities. For quantities the effects on imports are the same as those found for values, although with stronger positive effects on imports from the highest-GP group of countries. For prices, there are the opposites of those found for values and quantities. For products exposed to high litigation (Lp_{High}), prices were lower for countries with high and medium levels of domestic IP protection. The effect on the IP_{Low} group is similarly negative but not close to statistical significance. Prices of imports were also significantly lower for products with low-litigation exposure and had high domestic IP protection ($Lp_{Low} \times IP_{High}$). Interpreting these changes in prices as changes in quality (Baldwin and Harrigan, 2011; Manova and Zhang, 2012), these results are consistent with the interpretation that the UK court reforms extended IP protection to better cover those with lower value IP products, specifically those involved in cases below £500,000.

These results also have a distributional dimension. Countries with the weakest domestic IP protection, a group that overlaps with the low- and middle-income countries central to the TRIPS literature, saw imports of litigation-intensive products into the UK fall after the reform. Enforcement improvements in a destination market can raise market access for IP-owning exporters and reduce it for exporters from the same countries whose goods risk infringing IP in the destination market.

4.3 Which Firms?

The country-level results suggest that the reduction in UK enforcement costs affected different groups of exporters in different ways. Imports increased from countries with stronger domestic IP protection and fell from countries with weaker IP protection, consistent with the idea that firms owning intellectual property benefited from the reforms while firms exposed to infringement risks became less competitive in the UK market. We next examine the effect on patent owners directly by asking which firms drove these trade responses.

To do so, we focus on a single country, China, and combine detailed firm-product-destination export data with firm-level patent information.[22] While the choice of China

[22] A further benefit of using micro data is the ability to account for time invariant firm characteristics that determine export decisions in the empirical model. Micro data on international trade by firms has tended to suggest the importance of firm characteristics in determining participation in international trade (Melitz, 2003; Bernard and Jensen, 2004; Greenaway and Kneller, 2007).

is partly determined by data availability, it also represents an interesting setting given the substantial strengthening of IP rights and rapid growth in patenting that occurred during the 2000s.

The merged data allow us to distinguish firms according to whether they owned patents or not prior to the UK reforms (by 2006) and combining the data with Patstat, to identify from this set of patent owners those Chinese firms that held UK-registered patents versus all patent owners broadly. Only 72 out of 38,281 Chinese firms held UK-registered patents. This count reflects the true population of such firms rather than incomplete coverage, since CNIPA records the universe of Chinese patent applications and Chinese Customs records the universe of export transactions over this period. We explain how we use this information further below.

Alongside patent ownership, identification relies on within-firm variation in exports across European destinations. Drawing on the evidence from Table 3, we compare exports to the UK with exports by the same firm to France, Germany and Italy before and after the reforms. In the regression we also control for firm-product-country fixed effects, thereby removing the influence of time-invariant firm-product-country characteristics and allowing us to isolate the effects of changes in the UK enforcement environment on firms with different levels of intellectual property ownership and exposure to the UK market prior to the reform.[23] The first three columns of Table 5 focus on the extensive margin of trade and the final three columns on the intensive margin. For the extensive margin we assume that firms can potentially export any (HS6) product within their product scope to any destination market (UK, France, Germany and Italy). Specifically, we estimate the following specification:

$$\begin{aligned} Y_{fpct} =& \alpha_{fpc} + \alpha_t + \beta_1(Patent_f \times PostReform_t) + \beta_2(UK_c \times PostReform_t) \\ &+ \beta_3(Patent_f \times UK_c \times PostReform_t) + \varepsilon_{fpct} \end{aligned} \tag{3}$$

where f, p, c and t index firm, product, destination country and year, respectively. Our focus is on the triple interaction term.

Across the table we compare results based on different samples of firms and that change the definition of patent ownership. In columns (1), (2), (4) and (5) we restrict the sample to include observations on exports by Chinese firms that held UK-registered patents, where this registration could occur any point up to 2019. These firms can and do own patents that are not registered in the UK and we exploit this difference in the

[23] We have tested the robustness of these results of adding exports to Belgium, Netherlands, Spain and Switzerland to the control group. The results do not change.

regressions. In columns (1) and (4) we define the patent variable to equal one if the patent was UK-registered prior to 2006, while in columns (2) and (5) we define patent variable as equal to one if the patent is UK-registered at any point in the sample period. Columns (2) and (5) therefore allow for firms to register patents in the period after the UK IP reforms, thereby capturing the increase in the incentive to register patents in the UK as a consequence of the lowering of enforcement costs there. Finally, for comparison with these firms with UK-registered patents in columns (3) and (6) we include Chinese firms that own patent at any point up to 2019. [24]

Table 5:
Effect on Chinese Exports (2007-2016)

	Export Dummy			ln Export Value		
	(1)	(2)	(3)	(4)	(5)	(6)
$UKPatent \times Post\_Reform$	0.0172			0.2013		
	(0.0185)			(0.2665)		
$Patent \times Post\_Reform$		-0.0221	-0.0031***		0.2507	-0.1447***
		(0.0196)	(0.0012)		(0.3570)	(0.0498)
$UK \times Post\_Reform$	0.0106	-0.0268*	0.0015**	0.2725	0.6545*	0.0579
	(0.0110)	(0.0136)	(0.0008)	(0.2775)	(0.3880)	(0.0446)
$UKPatent \times UK \times Post\_Reform$	-0.0099			0.0277		
	(0.0123)			(0.4627)		
$Patent \times UK \times Post\_Reform$		0.0351**	0.0007		-0.3852	0.1141*
		(0.0152)	(0.0014)		(0.4829)	(0.0604)
Observations	187,328	187,328	15,171,796	4,081	4,081	401,348
Firm-Product-Country FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓

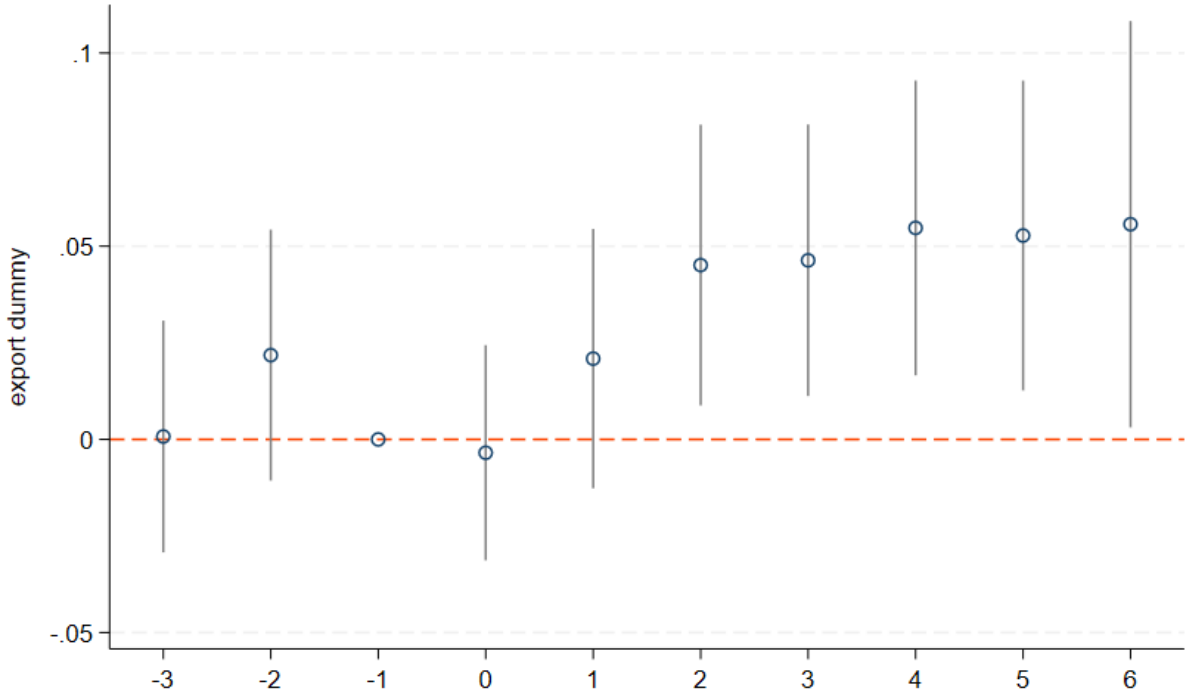
Notes: This table studies the impact of the UK reform on exports at both the extensive and intensive margins, using Chinese exports to the UK, France, Germany, and Italy. The dependent variable in columns (1) to (3) is a dummy variable indicating firm–country–product–year level export participation, while in columns (4) to (6) it is the logarithm of firm-country-year level export values at the HS6 product level. Among the independent variables, *Patent* is a dummy equal to 1 if a firm patented in any year prior to or during 2006. *UKPatent* is a dummy equal to 1 if a firm had a UK-registered patent in any year prior to or during 2006. *UK* equals 1 if the destination of the firm-country-product export is the UK. Columns (3) and (6) include Chinese firms with patents (those that are UK and non-UK registered), while in other columns, the sample is restricted to Chinese firms with UK-registered patents only. Standard errors in parentheses are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

[24] To isolate the role of ownership we choose not to add the litigation variable to these regressions. This decision is further justified given the small number of firms with UK-registered patents. These interaction terms are not statistically significant when included.

We focus first on the extensive margin of trade. The evidence from columns (1) and (2) of Table 5 suggests an interesting effect on UK exports between owners of pre-2006 UK-registered patents and firms that register UK patents at any point up to 2019. In column (1) the triple interaction term is not statistically significant whereas in column (2) the effect is positive and significant. This suggests that the UK IP reforms increased the number of products sold to the UK relative to other countries for Chinese firms that registered UK patents after 2006. The results in the next section of the paper suggest that there is no innovation response among Chinese firms. It would appear therefore that increased exports to the UK and registration of existing patents in the UK co-occur. We interpret this as evidence of complementary adjustment in patent registration and exporting rather than a pure causal effect of registration itself. The results in column (3) where we expand the sample to include Chinese firms with non-UK registered patents shows that this is not a common effect across all patent owners. In this regression the estimated coefficient is much smaller in magnitude and far from standard significance levels.

To assess the robustness of the results in Table 5, we employ an event-study specification to examine the dynamic effects of the UK IP reform for the specification in column (2). As shown in Figure 6, none of the coefficients for the pre-reform periods are statistically significant, indicating no systematic differences in export trends between the treatment and control groups prior to the reform. These results provide strong support for the parallel trends assumption. From Figure 6, the estimated coefficients become positive and statistically significant after the reform, suggesting that the positive effect of the UK IP reform is concentrated among Chinese firms that registered patents in the UK.

Figure 6:
Event-study Estimates



Notes: The figure presents the estimated dynamic effects of the UK IP reform on Chinese firms' exports based on the event-study specification, with 2009 as the reference year. It reports the results for the extensive margin of trade using a sample of Chinese firms with UK-registered patents. Firm-product-country and year fixed effects are included, and standard errors are clustered at the firm level.

The final three columns of the table explore the effect for the same firms as the first three columns but focus on the firm-intensive margin of trade. In columns (4) and (5) of Table 5 we find much weak evidence of a trade response, largely explained by the loss of observations and the increase in the standard errors. Focusing on firms with UK-registered patents, there is no significant effect on the intensive margin of trade in either of these regressions. In column (6), where we expand the sample to include Chinese firms who own patents more broadly, there is evidence that for patent owners the IP court reforms had a weakly significant effect on the intensive margin of exports to the UK. The estimated coefficient for the patent-owning firms is 0.11 and significant at the 10% level.

4.4 Did Innovation Respond?

We finish this section by exploring the innovation effects of the enforcement cost reforms. As described in the introduction, the change in IP enforcement costs could indirectly affect international trade by encouraging greater investment in innovation.

We report in Table 6 the effect on patenting in China using firm level patent data. Again, the results are introduced in stages to build intuition. In column 1 we focus exclusively on firms that export only to the UK, on the basis that these firms were most exposed to the court reforms. In this regression, we explore whether innovation rose by more among products with higher IP litigation intensity, on the premise that these products were more exposed to the reform, given that US data show they are frequently subject to IP litigation. In column 2 we extend the sample to add firms that export to any of the UK, France, Germany or Italy while in column 3 we add firms that export to any of these four countries or to any of Belgium, Netherlands, Spain and Switzerland. In these regressions we use the log of exports to the UK market at the start of the time period to capture firms more exposed to the IP reforms, while in columns 4 and 5 we additionally add an interaction with the litigation intensity measure.

Across all the specifications in the table, we find no evidence that Chinese patents increased as a consequence of the UK IP reforms. This result holds if we rely on firms that export to the UK only (column 1), such that the identifying variation comes from the litigation intensity of products, or when we use whether the firm had prior-exports to the UK or not to define treatment status (columns 2 and 3), or use both these dimensions (columns 4 and 5).[25] In all specifications there is no evidence that innovation in China responded to the UK reforms.

The absence of innovation response plausibly arises from the fact that the UK accounts for only a small share of global GDP (about 2.24% in 2024), such that the UK reforms did little to raise the global returns to innovation. This makes it likely that changes to the returns to innovation were greatest for UK firms compared to non-UK firms such as those in China. To provide initial evidence for the plausibility of this argument we estimate the UK export and innovation responses to the IP reforms using product-level data on exports and on industry-level data on R&D and patenting. These regressions assume that no other contemporaneous UK policy change differentially affected R&D investment or patenting in industries more exposed to litigation-intensive products. Data access limitations mean we are not able to strengthen this assumption

[25] The results in columns 2 to 5 remain robust when using the share of UK exports in total firm exports as an alternative measure of export exposure to the UK market.

Table 6:
The Effect on Chinese Patents (2007-2016)

	UK	UK+EU3	UK+EU7	UK+EU3	UK+EU7
	(1)	(2)	(3)	(4)	(5)
$Lp \times Post\_Reform$	0.1165			0.0793	0.0512
	(0.0730)			(0.0637)	(0.0656)
$UK \times Post\_Reform$		-0.0008	-0.0096	-0.0055	-0.013
		(0.0205)	(0.0193)	(0.0216)	(0.0207)
$UK \times Lp \times Post\_Reform$				0.0391	0.0675
				(0.0451)	(0.0424)
Observations	103,556	460,462	699,656	401,348	608,651
Firm-Product FE	✓				
Firm-Product-Country FE		✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓

Notes: This table studies the impact of the UK reform on patents of Chinese firms. Column 1 looks at firms that export to the UK only. Columns 2 and 4 expand the analysis to include exports to France, Germany, and Italy, while columns 3 and 5 further include Belgium, the Netherlands, Spain and Switzerland. The dependent variable is the logarithm of the number of patents at the firm-year level. Product-level litigation (Lp) and post-reform indicator ($Post\_Reform$) are defined as in Table 3. The UK dummy (UK) is defined as in Table 6. Standard errors in parentheses are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

and provide this evidence at a more granular level. These results should therefore be viewed as suggestive of a UK innovation response.

Consistent with the evidence for a link between exports and innovation found in the literature (Melitz and Redding, 2021), column 1 of Table 7 shows that UK exports rose in the post-reform period. In columns 2 and 3 we then seek to understand whether the reductions in enforcement cost also increased the returns to innovation.[26] Supportive of this interpretation, column 2 shows that R&D expenditures rose in UK industries more exposed to the reform, but the effect on patents in columns 3 was negative.[27] The oppo-

[26] The rise in UK exports raises the possibility that the import effects found in the baseline estimations are explained by international supply chain effects. Exporting firms use more intermediate inputs some of which are produced abroad and so imports rise. We use Table A3 to explore this possibility. We use UK input output tables to construct a measure of litigation exposure of a product to other upstream and downstream products, using input-output coefficients as weights. We find that these supply chain effects play some, albeit small, role in explaining the change in UK imports, but that the principle effects are from the direct litigation exposure of the industry. As an alternative approach we excluded intermediate input product categories by using product codes with the terms, parts, spare parts etc. Again the results are unchanged by excluding these products.

[27] In Table A2 we separate this overall effect on UK patents into whether the patent applicant is from

Table 7:
UK Exports and UK Innovation

	UK exports (1)	UK R&D (2)	UK patents (3)	EU3 R&D (4)	EU3 patents (5)
$Lp \times Post\_Reform$	0.227***	0.507**	-0.357**	0.104	-0.086
	(0.052)	(0.207)	(0.150)	(0.106)	(0.069)
Observations	46,161	285	465	285	465
Product FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓

Notes: This table studies the impact of the UK IP courts reform on three outcomes: UK exports (*column 1*), research and development (R&D in *columns 2 and 4*), and patenting (total number of patents in *columns 3 and 5*). All dependent variables are in log form. The *Lp* variable captures the frequency of patent litigation and is defined at the HS6 product level in *column 1*, and at the sector level (NACE Rev. 2) in *columns 2 to 5*. *Columns 4 and 5* are a falsification analysis, studying the impact of the reforms on R&D and patenting in Germany, France and Italy. Each specification includes year and industry fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

site effects on innovation and patenting matches previous evidence from Lerner (2009) as well as discussion of the complicated effects of IP reforms on innovation and patenting in Williams (2016) and Williams (2017). Finally, and in contrast to the results for UK, as shown in column 4 and column 5, the effect on R&D investments and patenting among other major European countries over the same period did not change significantly.[28] Again, we note this is consistent with the idea that we capture only the effects of the UK IP reforms on innovation, and leave confirmation of this with more comprehensive micro data for the UK to future research.

5 Conclusions

Institutional reforms can play a key role in improving economic performance, including through their effects on international trade. The creation of frameworks for IPR in developing countries is one such example. The literature has established clear evidence that the effects of the adoption of TRIPS encouraged greater flows of international technology

the UK (column 1) or is a non-UK applicant (column 2). The results show that the negative effect is explained by a drop in applications from UK innovators.

[28] In column 3 of Table A2 we explore whether UK firms also patented less in other countries. We find evidence in support of this.

transfer from R&D intensive countries, which in turn increased exports.

As discussed above, the breadth of the TRIPS provisions has left the literature with limited understanding of which aspects of IP frameworks matter for trade. In this paper, we provide insight into the effect of a change in the costs of IP enforcement in a country where IP protection is already strong, the UK. Between the end of 2010 and 2013, reforms were implemented in the UK that addressed the difficulty of using IP courts by lowering costs and simplifying the process of accessing them.

Focusing on products our main finding is that a lowering of the costs of IP enforcement led to an increase in imports into the UK of products with higher likelihood of litigation. This suggests that products more exposed to the reform were now better able to defend their IP rights, thereby enhancing their competitiveness in the UK market. It also suggests that the TRIPS reforms affected international trade by altering litigation trade costs. Digging into the mechanisms that might generate these findings, we find that the reform had different effects on imports by IP-owners compared to other firms. Imports to the UK rose by more from countries where IP-ownership is more likely and fell from countries where imitation is more likely. The Chinese micro evidence helps explain this further. Chinese firms became incentivised to export to the UK and register patents there. Given the link between innovation and product quality, this would suggest a benefit to the UK. We also search for evidence that IP enforcement costs might affect trade indirectly by increasing the amount of innovation that took place. We find that this indirect effect was present, but affected UK innovation only. We find no evidence of an effect on innovation by Chinese firms or when using industry data for other European countries, suggesting that market size is a key determinant of innovation (Schmookler, 1962). Taken together, the results show that lower enforcement costs expand UK market access for foreign IP owners, with no corresponding innovation response.

The empirical design used in the paper applies most cleanly where enforcement can be separated from the scope of rights, a condition the UK reform satisfies and most developing-country TRIPS reforms do not. A small number of developing countries have introduced specialized IP courts of a similar kind, including China from 2014. These settings offer a route to testing the same mechanism where the trade and development stakes are largest.

Finally, by leveraging the UK's IP court reforms that reduced IP enforcement costs, we have studied their effects on international trade, making contributions to a better understanding of the IP enforcement channel and the mechanisms through which it affects trade. Moving forward, continued attention to IP enforcement and its implications for international trade is required. Our evidence suggests that efforts to strengthen IP rights

are likely to be more effective if they are accompanied by measures to enhance their enforcement, and additional policies that involve further streamlining court procedures, reducing litigation costs, and enhancing legal certainty for IP owners.

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Appendix

Table A1:
Summary Statistics

Main Variables	Obs.	Mean	Std. Dev.	P5	Median	P95
Exposure: Litigation Intensity	63,107	0.023	0.088	0.000	0.001	0.106
Outcomes: Imports						
Value (log)	63,107	9.786	2.091	6.303	9.853	12.943
Price (log)	63,107	2.079	1.848	-0.717	2.032	5.110
Quantity (log)	63,107	7.707	2.659	3.289	7.830	11.763
For the Chinese sample (UK + EU7)						
Export Value (log)	437,281	9.978	2.984	4.615	10.191	14.501
Number of Patents (log)	437,281	2.222	1.239	0.693	2.079	4.454

Notes: This table reports summary statistics for the main variables used in the analysis. It includes litigation intensity, which measures exposure to the IP court reforms, and imports, the main outcome variable, broken down into value, price, and quantity. For Chinese firms, it also includes exports to the United Kingdom and seven European Union countries, as well as the number of patents.

Table A2:
International Patenting

	UK patents by UK applicants	UK patents by foreign applicants	Foreign patents by UK applicants
	(1)	(2)	(3)
$Lp \times Post\_Reform$	-0.524***	-0.283	-0.256*
	(0.128)	(0.197)	(0.150)
Observations	465	465	465
Year FE	✓	✓	✓
Product FE	✓	✓	✓

Notes: This table studies the effect of intellectual (IP) property court reforms in the United Kingdom on patenting activity, measured as the log number of patents. The analysis distinguishes between UK patents filed by UK applicants, UK patents filed by foreign applicants, and foreign patents filed by UK applicants. $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. Each specification includes year and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table A3: Effects through Upstream or Downstream Imports

	Imports
	(1)
$Lp \times Post\_Reform$	0.138***
	(0.049)
$Lp^{UP} \times Post\_Reform$	0.002***
	(0.001)
$Lp^{DOWN} \times Post\_Reform$	-0.003***
	(0.000)
Observations	50,565
Controls	✓
Year FE	✓
Industry FE	✓

Notes: This table reports result on the effects of indirect exposure to the IP court reforms. $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. To measure between industry effects, we source input-output matrices from the national statistical authorities (ONS). The I-O industries are first cross-walked to NACE Rev. 1.1 to NACE Rev. 2 to HS6 codes, Then we use them to construct product-level indirect measures of exposure through upstream and downstream links to other industries that they themselves are exposed to the reforms. Specifically, we constructed $pt^{Up}_{p,t=2005} = \sum_{j \neq i} \lambda_{pj} \cdot Lpj_{,t=2005}$ and $Lp^{Down}_{p,t=2005} = \sum_{j \neq i} \sigma_{pj} \cdot Lpj_{,t=2005}$. These indirect exposure measures are made up of two components: λ_{pj} and σ_{pj} measure the share of value in product p that comes or goes to an upstream or downstream product j, respectively, and Lp is an indicator variable that identifies whether the j-product is high litigation exposure. In the empirical analysis, we include these variables in our main specification interacted with the $POST\_Reform$ indicator to understand whether the effect we estimate is a result of these between industry links. Each specification includes year and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table A4: Chinese Patent

	UK+EU3	UK+EU7
	(1)	(2)
$Lp \times Post\_Reform$	0.0696	0.0696
	(0.0452)	(0.0452)
$UK \times Post\_Reform$	-0.0212	-0.0212
	(0.0139)	(0.0139)
$UK \times Lp \times Post\_Reform$	0.0489	0.0489
	(0.0793)	(0.0793)
Observations	335,216	381,814
Year FE	✓	✓
Firm-Product-Country FE	✓	✓

Notes: This table studies the impact of the UK IP courts' reform on patents of Chinese firms. *Column 1* looks at firms that export to the UK, France, Germany, and Italy. *Column 2* expand the analysis to include exports to Belgium, the Netherlands, Spain and Switzerland. The dependent variable is the logarithm of the number of patents at the firm-year level. Product-level litigation (Lp) and post-reform indicator ($Post\_Reform$) are defined as in Table 3. The UK dummy (UK) is defined as in Table 6. Standard errors in parentheses are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table A5:
Alternative Intellectual Property Intensity Variables

	US R&D	Global R&D	Patents	Patents, Trademarks, & Copyrights
	(1)	(2)	(3)	(4)
$Lp \times Post\_Reform$	0.173***	0.192***	0.173***	0.134***
	(0.050)	(0.049)	(0.050)	(0.049)
$R\&D\_US\_inv \times Post\_Reform$	0.011***			
	(0.001)			
$R\&D\_Global\_inv \times Post\_Reform$		0.017***		
		(0.002)		
$Patents\_Intenisty \times Post\_Reform$			0.012***	
			(0.002)	
$IP\_Intenisty \times Post\_Reform$				0.001
				(0.001)
Observations	46,161	50,860	37,896	49,048
Year FE	✓	✓	✓	✓
Product FE	✓	✓	✓	✓

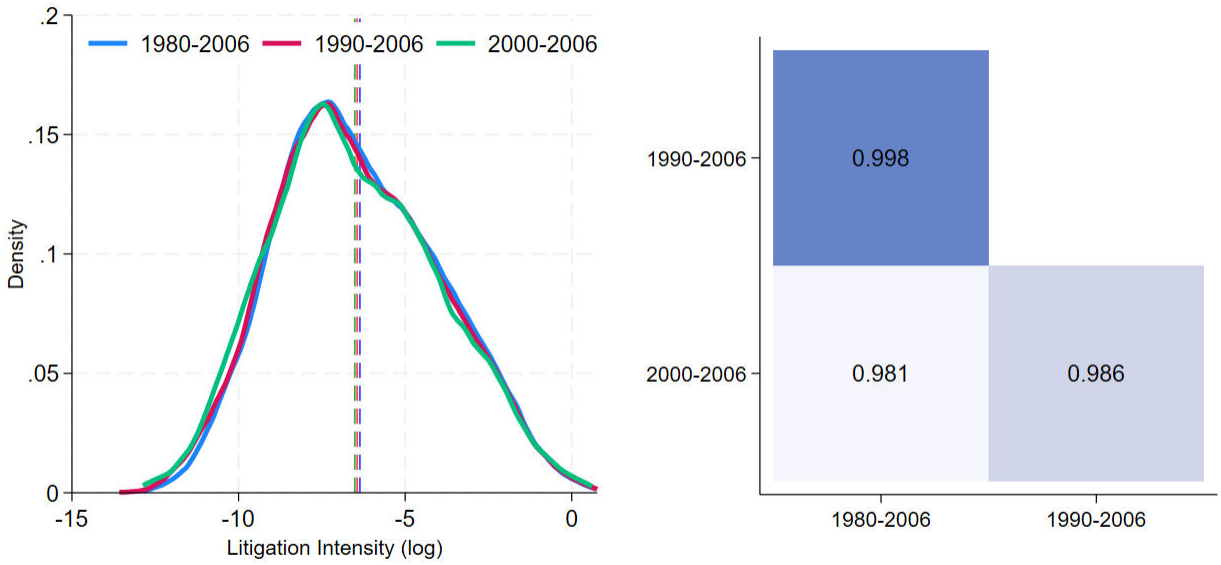
Notes: This table studies the robustness of the main findings to including other IP-related variables. *Column (1)* augments the main specification with US *R&D*, *Column (2)* with Global *R&D*, *column (3)* with Patent intensity, and *column (4)* with the average intensity across patents, trademarks, and copyrights. All the IP variables are inverted so that higher values reflect lower levels of *R&D* or IP intensity, and hence greater exposure to the reforms. This focuses the analysis on low-value innovations, which the policy plausibly supported by improving access to IP courts. The dependent variable is log imports at the HS6 product level. $Post\_Reform$ equals 1 from 2011 onwards and 0 before. All specifications include year and product fixed effects. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table A6:
Litigation Intensity Across Alternative Time Periods

	1990-2006	2000-2006
	(1)	(2)
$Lp_{1990-2006} \times Post\_Reform$	0.149***	
	(0.047)	
$Lp_{2000-2006} \times Post\_Reform$		0.114**
		(0.049)
Observations	55,754	55,754
Year FE	✓	✓
Product FE	✓	✓

Notes: This table studies the robustness of the main findings to alternative definitions of the litigation intensity variable. Compared to the main results, the specifications reported in columns (1) and (2) use a litigation intensity which is defined over a narrower time window. The *column (1)* specification uses a litigation intensity variable defined over 1990–2006; the *column (2)* specification uses the same variable defined over 2000–2006. The remainder of the analysis in the paper uses a litigation intensity variable defined over 1980–2006. The dependent variable is log imports at the HS6 product level. $Post\_Reform$ equals 1 for years when the policy is active (2011 onwards) and 0 otherwise. Each specification includes year and product fixed effects. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

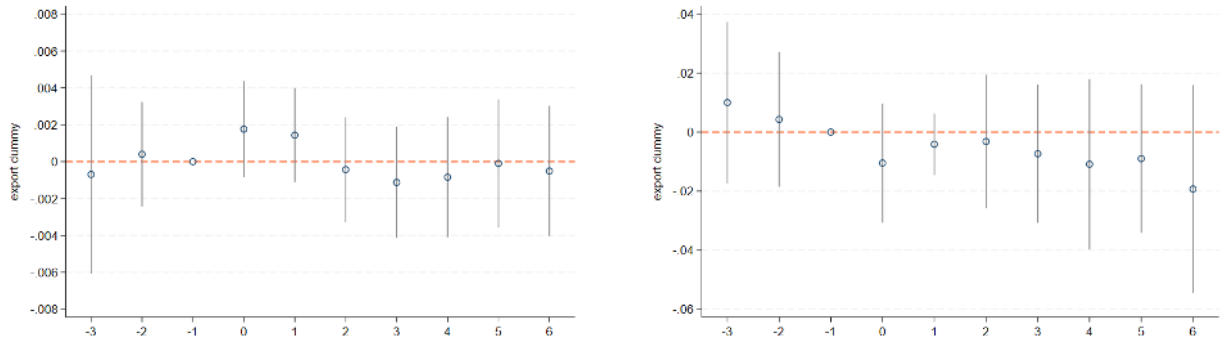
Figure I: Litigation Intensity by Period



Panel A Panel B

Notes: This graph shows how the log of litigation varies across HS6 product codes for three overlapping time periods: 1980-2006, 1990-2006, and 2000-2006. *Panel A* presents kernel density plots, allowing comparison of both average values, marked by vertical lines, and the full distribution across products in each period. *Panel B* is a heatmap showing the correlation coefficients between periods. The strength of the correlation is shown by the intensity of the blue colour. A darker blue indicates a stronger correlation. For reference, the main analysis in the paper uses a litigation intensity variable defined over 1980–2006.

Figure II:
Event-study Estimates



(A) Firms with Patents

(B) Firms with UK-registered Patents

Notes: The figure presents the estimated dynamic effects of the UK IP reform on Chinese firms' exports from the event-study specification, with 2009 as the reference year. Panel IIa shows the result for the extensive margin of trade using the sample of Chinese firms with patents, while Panel IIb shows the result using the sample of Chinese firms with UK-registered patents only. All regressions control for firm-product-country and year fixed effects, and standard errors are clustered at the firm level.