Capital Account Liberalization and Firm Innovation: Worldwide Evidence*

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ABSTRACT

This study investigates whether capital account liberalization, a leading characteristic of globalization, is associated with firms' future innovation output. Employing a novel firm-level panel dataset covering 41 countries over two decades, we show that capital account liberalization is significantly associated with higher corporate patenting activities, particularly for firms from innovation-intensive industries. Further analyses show that the effect is stronger among firms from economies in a better legal environment, signifying the important role of good institutional quality in facilitating the positive impact of liberalization. The effect is also stronger among firms with higher initial productivity, consistent with the "productivity" hypothesis, according to which bigger and more productive firms generate more innovation after liberalization. Our findings are robust to the use of various measurements, subsamples, and estimation models. This study provides global firm-level evidence of the real economic impact of financial globalization.

Keywords: capital account liberalization, innovation intensity, institutional quality, productivity

JEL Classification: F38; O31; O32

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ABSTRACT

This study investigates whether capital account liberalization, a leading characteristic of globalization, is associated with firms' future innovation output. Employing a novel firm-level panel dataset covering 41 countries over two decades, we show that capital account liberalization is significantly associated with higher corporate patenting activities, particularly for firms from innovation-intensive industries. Further analyses show that the effect is stronger among firms from economies in a better legal environment, signifying the important role of good institutional quality in facilitating the positive impact of liberalization. The effect is also stronger among firms with higher initial productivity, consistent with the "productivity" hypothesis, according to which bigger and more productive firms generate more innovation after liberalization. Our findings are robust to the use of various measurements, subsamples, and estimation models. This study provides global firm-level evidence of the real economic impact of financial globalization.

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1. Introduction

Globalization and innovation are defining themes of this historical moment. On the one hand, innovation is at the heart of sustainable long-term growth and development; on the other, despite recent setbacks, globalization has "flattened" our world by lifting barriers to cross-border trade flows (trade liberalization) and capital flows (capital account liberalization) (Friedman, 2007). But how does the advance of globalization impact firm innovation? Does globalization spur more firm innovation? A substantial body of literature, both theoretical and empirical, examines the impact of trade liberalization—one aspect of globalization—on innovation by domestic firms (see Arkolakis et al., 2018; Bustos, 2011; Coelli et al., 2020, among others). Yet, less is known about the impact of capital account liberalization, another important aspect of globalization, on firm innovation.[1] Based on a comprehensive firm-level patent and financial characteristics data set that covers more than 40 countries over two decades, this paper fills this gap by examining the impact of lifting barriers to cross-border capital flows on firm innovation.

Following a novel Internet-based matching approach in Autor et al. (2020), we construct an international, wide-ranging firm-level dataset by combining global patents and financial data. This method corrects for many false negatives that occur when matching by company name only. After matching global patents to the financial data by firm name and web URL, our comprehensive firm-level dataset includes both detailed financial information and patent data. This dataset enables us to investigate the relation between capital account liberalization and firm innovation by controlling for a group of firm-, industry-, and country-level characteristics that might contribute to firms' innovation investment and output.

[1] As pointed out by Williamson (2007, p. 407), "a key weakness of the global capital markets literature is that it rarely assesses empirically its impact on the real economy" despite substantial increase in cross-border capital mobility over the last few decades.

According to extant studies, capital account liberalization influences firm innovation through several different channels. The first channel is a reduction in the cost of capital. As the neoclassical model (Solow, 1956) predicts, a temporary decrease in the cost of capital follows advances in globalization, and firms are expected to borrow more from the international market and increase their investment during the transition period (Henry, 2003, 2007). The second channel is risk sharing (or resource reallocation). Financial integration such as equity market liberalization enables risk sharing between domestic and foreign firms through cross-border portfolio holdings (Bekaert et al., 2005; Moshirian et al., 2021). The third channel is increased competition. Reduced capital controls can spur increased competition because some originally constrained firms become able to conduct innovation projects and foreign competitors are permitted to enter the market (Aghion et al., 2005; Deng, 2009; Walz, 1997). Combined, these major channels result in a positive impact of capital account liberalization on firm innovation.

In our baseline regression, we find that the removal of capital controls is significantly and positively associated with firms' patenting activity. This result holds not only for patent counts but also for patent family size and citations, which suggests that the increase in patenting activity is not simply a "lawyer effect" (i.e., patenting more to protect intellectual property). Rather, real innovation takes place after liberalization.

Most importantly, we identify the impact of capital account liberalization on innovation, following Acharya and Subramanian (2009). Our identification comes from differential responses across firms in sectors with varying innovation intensity in the same treatment group (i.e., countries that liberalize their capital accounts). Specifically, under a generalized difference-in-differences (DiD) framework, we introduce an interaction term between the capital account liberalization

variable and a time-varying, sectoral innovation intensity variable.[2] We find that the positive effect of capital account liberalization on firm innovation is more pronounced in more innovation-intensive sectors.

In additional analyses, we find that firms from economies with better legal environments are more innovative after liberalization, emphasizing the importance of good institutional environment for innovation performance. Furthermore, we find that the effect is stronger among firms with higher initial productivity, consistent with the "productivity channel," whereby bigger, more productive firms are better positioned to take advantage of liberalization and generate more innovation afterwards.

To capture major events in the liberalization process and document the timing of the impact, we follow Larrain (2015) and identify an opening date for each country as the year a one-standard-deviation increase happened in the continuous capital account liberalization index. We trace the year-by-year effect of capital opening on firm innovation and find that the positive impact on innovation is enduring. Moreover, we find that firms spend more on research and development (R&D), generate patents with high originality and generality, and cite more foreign patents after liberalization, suggesting that capital account liberalization increases knowledge-expanding innovation. Finally, we show that our results are robust to various specifications including alternative measures, estimation models, and subsamples.

A large body of prior research focuses on the impact of liberalization on business performance, such as total factor productivity or investment (Aghion et al., 2010; Varela, 2018), but little evidence exists regarding observable firm-level innovation inputs and outputs (e.g., R&D spending and patenting activities). We provide comprehensive and consistent evidence of the

[2] This latter variable is exogenous under the assumptions in Rajan and Zingales (1998).

influence of capital account liberalization on firm innovation for a large group of countries over several decades. The scope of our analyses provides external validity to extant literature, which has largely concentrated on relatively limited policy reforms (e.g., Bustos, 2011).

Secondly, by combining our cross-country staggered capital account liberalization events with firm-level panel data, we are able to compare cross-sector variation within the group of countries that relaxed restrictions on capital accounts. Therefore, our methodology does not rely on the usual assumptions for controlling for a common trend between the treatment group (countries that liberalize their capital accounts) and the control group (countries that did not liberalize their capital accounts), as in conventional DiD estimation. Instead, our identification comes from within-country variations in innovation levels across sectors that are more (or less) dependent on new technologies. In addition, we exploit a novel, large, and inclusive firm-level patent dataset that is infrequently used in the global financial openness setting. Our study , therefore provides a deeper understanding of the economic mechanisms that help to generate industrial innovations.

This study most closely resembles Moshirian et al. (2021) but it differs in important ways. First, Moshirian et al. (2021) focused on equity market liberalization, which is only one of 10 categories of capital accounts opening. However, it is difficult to separately identify the effect of reform in one category from the effect of reform in the other categories, which could have confounding impacts on firms' innovation activity. Second, our estimation uses a firm-level panel data from multiple countries, whereas Moshirian et al. (2021) looked at aggregate industry-level innovation activity. Our cross-country firm-level sample allows us to (a) use more powerful tools to mitigate endogeneity concerns, (b) look deeper into firms' heterogeneous responses to globalization, and (c) control for firm characteristics that influence firms' innovation output. This

isolates the component of firm innovation driven by a country's removal of capital controls rather than by firm-specific or industry characteristics. As such, our paper provides the first large-scale, cross-country, firm-level evidence on the impact of capital market integration on firm-level innovation.

The paper proceeds as follows. Section 2 provides the theoretical background and develops the hypotheses. Section 3 describes the data and sample selection. Section 4 presents the main empirical results. Section 5 explores cross-sectional variations. Section 6 describes various robustness tests. Section 7 concludes.

2. Development of Hypotheses

Capital account liberalization can influence firm innovation through three possible channels. The first channel is a reduced cost of capital. Theoretically, the neoclassical model predicts that liberalization, by allowing free movement of financial resources from capital-rich economies (where expected returns are low) to capital-constrained economies (where expected returns are high), will reduce the cost of capital (Henry, 2007; Solow, 1956).[3] On a more practical level, liberalization allows investors to repatriate profits so they are willing to risk their money in these developing economies (Laban & Larrain, 1997; Levine, 1997; Desai et al., 2006). In practice, research finds that when countries liberalize their capital account, they experience increases in the gross domestic product (GDP) per worker and average investment rates of all firms, because of the reduced cost of capital (Henry, 2003, 2007). In addition, there is a natural feedback mechanism

[3] To be more specific, the theoretical model in Henry (2007) is as follows: $\Delta f_i'(k)^e = (r - r^*) + \gamma Difcov_i$, where r is the domestic interest rate and r^* is the world interest rate, and *Difcov* is the difference in covariance of individual stocks with the domestic and international equity markets. The above equation implicitly defines the size of the required increase in capital stock and therefore delivers two testable predictions: the first is that a common shock to the cost of capital should cause the average investment rate of all firms to rise (which is supported by empirical studies); the second is that, given a common shock, high *Difcov* firms should have faster capital stock growth than low *Difcov* firms immediately after liberalization (although no direct empirical evidence supports this prediction but evidence does show that firm-level stock price comoves with liberalization-induced changes in systematic risk).

in this context: firms' engagement in patenting activity can lower the cost of financing which generates further innovation (Mann, 2018).

The second channel is risk sharing (or resource allocation). Financial integration such as equity market liberalization enables risk sharing between domestic and foreign firms through cross-border portfolio holdings (Bekaert et al., 2005; Moshirian et al., 2021). Moreover, given that the fundamental purpose of financial liberalization is to allow free movement of various financial resources, liberalization permits resources to flow from places where they are abundant to where they are scarce (Henry, 2003). Reinhardt et al. (2013) show that among financially liberalized economies, capital flows from developed countries into less developed ones. If credit constraints depress investment in long-term projects (Aghion et al., 2010), then it is rational to expect that the increase in credit brought by liberalization will benefit long-term investment.[4] In addition, recent studies show that previously constrained firms react to better financing terms following the liberalization by investing more in technology, which corresponds to the resource reallocation effect (Varela, 2018; Wang, 2021).[5]

The third channel is increased competition. This competition comes from two sources. The first is from initially constrained domestic firms because reduced capital constraints enable these firms to invest in innovative projects that could not be undertaken in the absence of liberalization (Aghion et al., 2005; Varela, 2018). The second is from the entrance of foreign firms, e.g., through direct investment or merger and acquisitions (Deng, 2009; Walz, 1997). Through this pro-competitive channel, firms are likely to have higher innovation quality following liberalization.

[4] Because the log of a firm's constant elasticity of substitution (CES) production function is an increasing function of capital investment, one could reasonably argue that, all else equal, through the increased long-term investment channel, capital account openness eventually benefits innovation output.

[5] Specifically, Varela (2018) focuses on the impact of liberalization of foreign exchange in Hungary on domestic firms' R&D investment, Wang (2021) studies the impact of equity market liberalization in China on corporate innovation.

For example, research shows that the arrival of foreign entrants boosts domestic firms' innovation quality (Aghion et al., 2009; Coelli et al., 2020). However, the innovation quantity effect remains ambiguous because competition is productivity destructive and the relation between competition and firm-level innovation is an inverted-U (Bento, 2014; Hashmi, 2013).[6]

Taking the three above channels together, we expect a positive impact on firm patenting activities following capital account liberalization. Hence our main hypothesis, stated in the alternative, is as follows:

H1a: Capital account liberalization has a positive effect on firms' innovation output.

External finance is one of the most important sources of firms' R&D financing, and firms in R&D-intensive sectors are more likely to benefit from regulatory changes that bring financing and growth opportunities (Brown et al., 2013). Capital account liberalization provides opportunities that attract foreign capital to the domestic market and enable firms to directly invest in other countries as they search for new growth opportunities (Henry, 2007). Under fierce competition from both domestic and foreign entrants, firms in innovation-intensive sectors tend to respond rapidly to market liberalization (Moshirian et al., 2021). Therefore, we predict that capital account liberalization benefits firm innovation more for firms in high innovation-intensive industries. Hence our next hypothesis, stated in the alternative, is as follows:

H1b: The positive effect of capital account liberalization on firm innovation is greater for firms in more R&D-intensive sectors.

Studies also document that the impact of capital account liberalization depends on a given country's legal environment, which in turn affects the composition of foreign portfolios (Benhabib

[6] Stokey (1995) argues that one of the most important potential sources of excessive R&D in a competitive economy is diminishing returns in innovation technology. Therefore, under intensive competition, it is increasingly difficult for a firm to patent more because of increasingly scarce resources within the industry (Cornaggia et al., 2015).

& Spiegel, 2000; Mendoza et al., 2009). Lane (2013) found that financial globalization amplified the crisis for some countries but provided a buffer against the crisis for others. As such, Lane (2013) concluded that financial openness can positively affect risk sharing and efficient capital allocation if institutional support exists. Moreover, as documented in Desai et al. (2004), multinational firms are financed with less external debt in countries with underdeveloped capital markets or weaker creditor protection because of higher local borrowing costs. Overall, external shocks to capital flows will have a larger impact on innovation in countries with better legal environments (i.e., ones that encourage firm innovation activities). This leads to our second alternative hypothesis:

H2: The positive effect of capital account liberalization on firm innovation is greater for firms that located in countries with better legal protection.

According to Melitz (2003), firms with better initial productivity better prepared to take advantage of financial globalization. With better productive ability, these firms can benefit from liberalization by expanding their domestic and overseas businesses in response to lower capital barriers. Other firms are less likely to improve their operations during periods of liberalization. According to Aghion et al. (2005), firms with lower productivity are less motivated to innovate when they are faced with tighter competition within the industry. Therefore, our third alternative hypothesis is as follows:

H3: The positive effect of capital account liberalization on firm innovation is greater for firms with high initial productivity.

3. Data

We measure a firm's innovation output using patent data obtained from European Patent Office World Patent Statistical Database (hereafter, EPO PATSTAT).[7] This database contains

[7] We retrieved data from the online Autumn 2016 version of EPO PATSTAT. See Online Appendix A for a detailed description of the database.

information on patent assignees, patent family links, and patent citations, which facilitates the computation of different measures of innovation (see Section 3.1, below, for a discussion of these measures). We collect firm-level financial data from Capital IQ Global and North America. One of the biggest obstacles faced by cross-country innovation studies is matching across different data sources because there are no common IDs. We address this challenge by employing the refined matching procedure proposed by Autor et al. (2020). Specifically, we match patent data from EPO PATSTAT to financial data from Capital IQ by both firm name and firm web URLs.[8]

We then calculate sectoral indexes from publicly listed firms in the United States (US). Lastly, we match several country-level measures that are used as control variables and partition measures from World Bank World Development Indicators (WDI), Global Financial Development database (GFD), UNCTAD World Investment Report, and several other data sources. We exclude firms from financial sectors (SIC 2-digit: 60-69) and restrict our study to firms that have the necessary data to compute the firm-level control variables.[9] Our final sample relies on the joint availability of innovation measures, financial variables, and the capital account liberalization index, It consists of 170,375 firm-year observations representing 17,331 nonfinancial firms from 41 countries from 1995 through 2013.

3.1 Firm-Level Innovation Variables

Following Balsmeier et al. (2017) and Bena et al. (2017), we use patent counts to measure firm innovation quantity. PAT_{it} represents the count of patent applications made by firm i in year t. Fortunately, EPO PATSTAT organizes patents in "patent families," wherein each unique patent corresponds to a unique family identifier. Hence, in our estimation, each patent represents a unique

[8] See Online Appendix B for a detailed description of the matching process. Also see the matching results for IBM in Online Table OA2 as an example.
[9] This data step is common in the literature. See Brown et al. (2013) and Bereskin et al. (2018), for example.

invention. To measure patent quality, we follow Harhoff et al. (2003) and use two measures that are positively correlated with the value of patent rights: patent "family size" and patent citations. Patent "family size" is computed as the number of jurisdictions in which patent protection was sought for the same invention.[10] Patent citation is the total number of forward citations received by patent applications filed by the firm.

Similar to Balsmeier et al. (2017), Bena et al. (2017), and Luong et al. (2017), we address several concerns related to the innovation measures calculated using data from PATSTAT. First, we avoid truncation problems by using published patents and we calculate citations over the full post-publication sample period. Second, we avoid the double-counting problem by retrieving patents with a unique family ID. Third, we address the right skewness of patent count and citation distributions by winsorizing these variables at 1% and then using the natural logarithm of 1 plus the actual values to avoid losing firm-year observations with 0 patents or citations.

3.2 Capital Account Liberalization

We use an integrated capital account restrictions index – *KA*. This index constructed by Fernández et al. (2016) based on the information from International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions. This is a *de jure* indicator of capital account restrictions in that it is based on officially designated policy reforms so it is less susceptible to reverse causality issues common in panel regressions (Collins, 2007).[11] The index measures a country's degree of financial openness based upon binary dummy variables that classify restrictions on cross-border financial transactions for 10 asset categories: equities, bonds,

[10] Empirical work documents that the number of countries in which a patent is filed correlates to other indicators of patent value. See, e.g., Grupp (1996) and Guellec and van Pottelsberghe (2004).

[11] Measuring the degree of a country's capital account liberalization with the rest of the world is challenging due to the gradual progress of liberalization itself. Although alternative *de jure* or *de facto* measures are proposed in other studies, the dataset we use has detailed information about restrictions on capital inflows and outflows and covers a decent number of countries. See Fernández et al. (2016) for more details about the methodology and measurements.

collective investments (also referred to as funds), derivatives, financial credits, commercial credits, real estate, direct investments, money market instruments, and guarantees, sureties, and financial backup facilities. We rescale the variable by using one minus the original index so that a value of 0 indicates full capital controls and a value of 1 indicates no restrictions on the overall capital account.[12] This index is available for an unbalanced panel of 100 economies from 1995 through 2013.

3.3 Control Variables

Following prior literature, we control for observable firm-level variables that are commonly found to effect innovation. Specifically, we control for firm age (*ln(AGE)*), firm size (*ln(SALE)*), capital expenditures (*CAPEX*), R&D expense (*R&D*), total property, plant, and equipment (*PPE*), book leverage (*LEV*), asset growth (*GROWTH*), return on assets (*ROA*), growth opportunities (*TOBINS_Q*), and financial constraints (*WW*). We also control for industry concentration (*HHI* and HHI^2) to alleviate the concern that product market competition might have a nonlinear effect on firm innovation.

To control for the impact of lifting trade barriers upon innovation, our regression includes a measure of a country's trade openness (*TradeOpen*). We further control for country time-varying factors such as the country's economic growth (*GDPGrowth*), government expenditures (*GovExpense*), and financial development (*CreditGDP*). Finally, we add country and industry (firm) fixed effects. Detailed variable definitions are provided in Online Table OA1.

3.4 Descriptive Statistics

[12] Measurements of capital account liberalization vary slightly under each rule (Quinn et al., 2011). As a robustness check, we also use *de jure* KAOPEN index from Chinn and Ito (2008) as well as the *de facto* foreign ownership restrictions index from Edison and Warnock (2003) as alternative measures of capital account openness; the overall results are not substantially different from our main results.

Panel A of Table 1 shows the means of innovation and capital account liberalization data by country. In total, the sample covers 41 different jurisdictions, with the United States having the largest number of firms (5,382), followed by Japan (2,698), China (1,737), and the United Kingdom (977). Only two economies, Peru and Portugal, provide fewer than 20 sample firms. Firms in Japan have the largest number of patents per year (47), followed by firms in Ireland (46), Switzerland (42), and the Netherlands (35). The pattern is mostly similar for patent family size and citations. On average, a firm in a high-income economy has more patents and citations than a firm in an emerging economy. Regarding capital account liberalization, high-income economies have higher values on average. As shown in Panel B, firms in the sample register more patents over time, from an average of 11 patents per firm in 1995 to an average of 24 patents per firm in 2013. Year and technology class adjusted citations (*CITEPAT*) also exhibit a slight increase over the sample period.[13]

< Table 1 is about here >

Table 2 presents the sample means and medians of the innovation measures, capital account liberalization indexes, and firm- and country-level characteristics. On average, each firm files 20 patents each year and receives 31 citations (adjusted) after publication of the application. The mean of the capital account liberalization index (*KA*) is 0.773, suggesting that, on average, countries in the sample have a high degree of openness in capital accounts. Regarding the firm-level variables, the mean and median of firm size (*ln(SALE)*) are 5.414 and 5.487, respectively, average R&D spending (*R&D*) is about 5.8% of total assets, the mean value of asset growth (*GROWTH*) is 19.6%,

[13] There is a substantial decrease in the average raw patent citations per firm over the sample period (from 148 citations per firm in 1995 to just 21 citations per firm in 2013, untabulated). This is consistent with citations taking time to be realized. Moreover, raw citations of patents are more likely for certain technology classes than for others. Therefore, we follow Hall et al. (2001) and adjust the raw citations using time-technology class fixed effects. The results are qualitatively unchanged if we use raw citations in our estimation instead.

the average profitability measured by return on assets (*ROA*) is about 5.8%, and the average Tobin's Q ratio (*TOBINS_Q*) is 1.907.

< Table 2 is about here >

4. Capital Account Liberalization and Firm Innovation

4.1 Baseline Regression Results

To assess the impact of capital account liberalization on firm innovation, we estimate various forms of the following ordinary least squares (OLS) model at the firm level:

$$INNOVATION_{i,\mathrm{j},\mathrm{c},t} = \alpha + \beta_1 KA_{c,t-1} + \rho \mathrm{X}_{i,j,c,t-1} + \vartheta \mathrm{C}_{c,t-1} + \vartheta_c + \varphi_j + \gamma_t + \varepsilon_{i,j,c,t} \quad (1)$$

where i, j, c, and t refer to firm, industry, country, and year, respectively. $INNOVATION_{i,j,c,t}$ captures firm innovation output in year *t* for firm *i* from country *c* in industry *j*.[14] $KA_{c,t-1}$ is a continuous variable that captures the degree of capital account liberalization for country c in year t-1. α is a constant, β_1 captures the effect of the capital account liberalization on firms' innovation outcomes. $\mathrm{X}_{i,j,c,t-1}$ is a group of firm-level control variables measures in year t-1 and $\mathrm{C}_{c,t-1}$ is a group of country-level control variables in year t-1. ϑ_c, φ_j, γ_t capture country-, industry-, and time-fixed effects, respectively. In all regressions, we report robust standard errors that are clustered by country and year.

Table 3 presents the results from the baseline regression. Columns 1 through 3 report the results using three measures of innovation. The regression of firm innovation on *KA* in Column (1) yields a positive coefficient of 0.54, which is statistically significant at the 1% level. This positive

[14] We use three measures of firm innovation outcomes: patent quantity is measured as the natural logarithm of 1 plus the patent count (*ln(PATENT)*); patent quality is measured as the natural logarithm of 1 plus the patent family size (*ln(FAMPAT)*) and the natural logarithm of 1 plus the number of patent citations (*ln(CITEPAT)*). We lag all explanatory variables by 1 year following Balsmeier et al. (2017) and Luong et al. (2017). Our results do not change substantially if we use patent output measures 2 or 3 years ahead (untabulated).

association is consistent with H1a. The magnitude of impact is economically meaningful. Quantitatively, a 0.1 unit increase in the capital account openness index *KA*, from its mean of 0.77 to 0.87, is associated with a 5.4% increase in the number of patents registered by domestic firms, from the mean of 20 to 21 patents per year. We also present results for the impact of capital account liberalization on patent quality, as proxied by patent family size and patent citations, in Columns (2) and (3). As reported, the estimated coefficients on *KA* are all positive and statistically significant at the 1% level using either of the patent quality measures.[15]

< Table 3 is about here >

For firm-level control variables, the estimated coefficients on firm size are positive and significant, suggesting that larger firms tend to innovate more and receive more patent citations. Firms that spend more on R&D also tend to innovate more. In addition, firms that have higher leverage are associated with lower innovation output, whereas firms that have a higher return on assets are associated with less innovation. Financially constrained firms are associated with less innovation output. All of these results are generally consistent with previous studies (e.g., Bena et al., 2017; Luong et al., 2017).

For country-level control variables, the coefficient on *GDPGrowth* is negative and significant, consistent with the observation that high-income countries (with low GDP growth) exhibit a higher level of innovation output. Government expenditure is negatively related to firm innovation. Financial development is positively associated with innovation. However, there is no clear relation between trade openness and innovation because the coefficients on trade openness are insignificant. Overall, our results support H1a – that there is indeed a real impact on firm innovation from the removal of capital controls.

[15] In Online Table OA4, we show that our inferences are robust when we use citations per patent, patent generality and originality, and the number of cited foreign patents as the alternative dependent variables.

4.2 Identification: Innovation Intensity

Prior empirical studies document that firms in innovation-intensive sectors are more likely to be influenced by macroeconomic changes in external capital because external equity and debt are major sources for financing innovation (Acharya & Subramanian, 2009; Moshirian et al., 2021). To examine whether the positive effect of capital account liberalization on firm innovation differs in sectors with different levels of innovation intensity, we add an interaction between the innovation intensity measure and capital account liberalization.

Table 4 presents the results. Columns 1 through 3 report the results with only one interaction term $KA_{c,t-1} * Intensity_{j,t-1}$ in the regression. To rule out possible confounding effects, we add interactions with other country-level control variables in Columns 4 through 6. Consistent with our conjecture, the coefficient estimates on the interaction of capital account liberalization and R&D intensity are all positive and statistically significant in all columns. This suggests that when a country liberalizes its capital accounts, firms in more innovation-intensive sectors tend to have higher patent counts and bigger patent family size and receive more patent citations, supporting in H1b.[16]

< Table 4 is about here >

Overall, industry-level innovation intensity plays a role in explaining how capital account liberalization influences firm innovation. According to Acharya and Subramanian (2009), the country-level analysis looks at the aggregate effect, whereas the sectoral analysis identifies the underlying mechanism. Consequently, this evidence reveals that innovation-intensive sectors respond more to capital account liberalizations in terms of firm innovation output.

5. Additional Analyses

[16] These results are obtained after controlling for time-varying firm-, industry- and country-factors as in Table 3, although not reported for simplicity.

In this section, we explore how capital account liberalization promotes firm innovation by testing possible underlying economic mechanisms: legal protection and productivity.

5.1 Legal Enforcement

Prior literature indicates that institutional environments are important for innovation (Guellec & Van Pottelsberghe, 2004; Levine et al., 2017). To investigate whether the impact of capital account liberalization on firms' innovation varies in the quality of institutional environments, we consider two commonly used measures of a country's legal environment that are closely related to patenting activity. Taken from Park (2008), the patent protection index (*IPR Protection*) measures the extent to which intellectual property rights are protected in a country. Higher values indicate patent laws with stronger intellectual property rights. The rule of law indicator (*Rule of Law*) captures "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann et al., 2011, p. 223).

We introduce three-way interactions among *KA*, patent intensity, and legal protection proxies in the regression. The estimation results are shown in Table 5. Across all specifications, the coefficient estimates on the triple interactions are positive and significant. This indicates that capital account liberalization benefits firms' innovation output especially for firms from countries with higher property rights protection or countries with better rule of law.

< Table 5 is about here >

5.2 Initial Productivity

We next explore whether the impact of capital account liberalization on firm innovation is

more positive for firms that are already more productive prior to liberalization.[17] In Table 6, we examine the impact of capital account liberalization on firm patenting when we separate firms into subsamples based on their initial productivity. We use two indicators of initial firm performance: firm size, proxied by the natural logarithm of total sales (*ln(sale)*),[18] and firm profitability, proxied by return on assets (*ROA*). We then introduce three-way interactions among liberalization, patent intensity, and initial productivity in the regression. All regression results convey that firms from innovation-intensive sectors with a higher initial firm size (Columns 1 to 3) and higher initial profitability (Columns 4 and 5) experience a larger increase in patenting activities for a comparable increase in exposure to capital account liberalization, relative to their less productive counterparts.

< Table 6 is about here >

Find more positive innovation shocks from capital account liberalization for more productive firms is broadly consistent with extant studies (e.g., Aghion et al., 2005; Autor et al., 2020; Melitz, 2003). In a recent study using data from French firms, Aghion et al. (2018) showed that, in terms of manufacturing firms' patenting activity, more productive corporations respond more positively to export-demand shocks. This outcome is consistent with our findings that firms with higher initial productivity seem to be more responsive to capital shocks and are more likely to take advantage of the innovation opportunities brought about by liberalization.

6. Robustness Check

6.1 Event Study

As we mentioned previously, our continuous measure of capital account liberalization

[17] According to the theoretical model in Melitz (2003), more productive firms are better prepared to exploit resources brought by globalization but this is not necessarily true for their less productive counterparts.

[18] Because data on firm employment for listed firms in many countries is generally lacking, it is not possible to calculate labor productivity and total factor productivity for our broad sample but the literature has established that large firms are more productive (Melitz, 2003) so we use initial firm size as an indicator of firm productivity.

index does not provide a timeline of the impact on innovation. Therefore, we replace the continuous *KA* index with an alternative measure, *POST*, in the baseline regression. This captures large jumps and major events in the liberalization process. Following Larrain (2015), we identify the opening date as the year in which a one-standard-deviation increase happened in the continuous *KA* index (presented in Panel A of Table 7). The *POST* dummy equals one if an observation is at or after the liberalization year, and zero otherwise. The mean of *POST* dummy is 0.804, indicating that about 20% of the sample observation is in the pre-opening period.[19] The results in Panel B reveal that the effect of liberalization on patent counts and citations is positive and significant at the 10% level. For example, patent counts increase about 6.1% after the capital account opening year. We also observe positive and significant coefficients on the *POST* x *Intensity* interaction.

< Table 7 is about here >

Next, we trace the year-by-year dynamics of the impact of capital account liberalization on firm innovation. We follow Larrain (2015) and include a series of dummy variables in Equation (1), such that each dummy variable captures the pre- and post-year effect of opening on innovation in a different year:

$$INNOVATION_{i,j,c,t} = \alpha + \beta_1 {D_{c,t-1}}^{-4} + \beta_2 {D_{c,t-1}}^{-3} + \cdots + \beta_9 {D_{c,t-1}}^{+5} + \vartheta C_{c,t-1} + \vartheta_c + \varphi_j + \gamma_t + \varepsilon_{i,j,c,t} \quad (2)$$

where ${D_{c,t-1}}^{-k}$ equals one if an observation is at the kth year before opening and ${D_{c,t-1}}^{k}$ takes the value of one if an observation is at the kth year after opening, zero otherwise. D^{-4} equals to one for all the observations that are 4 or more years before opening, and D^{+5} takes the value of one for

[19] We only include countries that have experienced a one-standard-deviation increase in the *KA* index in the sample and we retain no more than 5 years of firm-level data in the pre-opening period to avoid other potential concurrent regulatory changes. Therefore, sample size for *POST* is only about half of that in the primary sample with available continuous *KA* index.

all years that are 5 or more years after the opening year. The opening year serves as the benchmark year and is thus omitted from the regression.

Figure 1 plots the coefficient estimates and the corresponding 95% confidence intervals, adjusted for country and year clustering, for: (a) patent counts and (b) patent citations. The coefficients on all pre-event dummies are not significant but the coefficients on the post-opening dummies become significant and positive 2 years after opening. In addition, the effect lasts for at least 5 years. Overall, these results trace the dynamic effect of opening over the years.

<Figure 1 is about here>

6.2 Decomposing the Capital Account Liberalization Index

Because firms generate new patents in different ways (e.g., internal resource allocation, external knowledge spillover, etc.), capital inflows and outflows could have different effects on firm innovation. We therefore decompose the capital account liberalization index into inflows and outflows as well as sub-indices. For brevity, we report the findings in Online Table OA3. We observe significant coefficients on both *Capital Inflow* and *Capital Outflow*, as well as on their interactions with *Intensity*. This suggest that both capital inflows and outflows give rise to firm innovation. However, the coefficients on *Capital Inflow* are generally larger than those on *Capital Outflow* (e.g., 0.532 vs. 0.365 when regressing on patent counts), indicating that the positive impact of capital inflows on innovation is greater than the positive impact of capital outflows. In fact, if we introduce these two indices at one time into the regression, we observe that our baseline results are mainly driven by liberalization of capital inflows. This supports prior literature that finds that by allowing free movement of capital and repatriation of profits, capital flows contribute to domestic long run economic growth (Albuquerque, 2003; Igan et al., 2020; Levine, 1997; Zeev, 2017).

Moving to the asset subcategories, we find some evidence that liberalization of money market, collective investments (funds), derivatives, and commercial and financial credits inflows have a positive impact on innovation. This finding is consistent with evidence of the increasing importance of fund investment, derivatives, and credits investment in alleviating financing frictions in international capital markets (Bena et al., 2017; Caballero et al., 2019; Coppola et al., 2021). We do not detect a significant, positive impact of equity inflow or other asset categories on innovation.[20] However, we do observe positive and significant coefficients when we interact innovation intensity with all asset sub-categories, suggesting that compared to other sectors, firms from innovation-intensive industries respond more to these investments. In general, these findings are consistent with our cross-sectional results because investments in funds, credits, and money markets are normally made by sophisticated foreign investors who are likely to be very selective about the investment environment (Benhabib & Spiegel, 2000; Mendoza et al., 2009), have a high demand for good corporate governance (Bae & Goyal, 2010; Luong et al., 2017), and prefer large firms with stable productivity (Dahlquist & Robertsson, 2001).

6.3 Other robustness tests

We conduct a series of robustness checks which show that our findings are robust to various specifications. For brevity, we present the results in Online Table OA4. We first attempt to address the omitted correlated variables issue by controlling for possible confounding factors: the level of economic development (Luong et al., 2017), stock market development (Hsu et al., 2014), change in creditor rights protection (Acharya & Subramanian, 2009), stock market liberalization (Bekaert et al., 2005), inflows and outflows of foreign direct investment (Walz, 1997), the patent rights

[20] One reason could be that we are using a very different sample from that of Moshirian et al. (2021) and our measure of equity inflow differs. However, if we restrict our sample to economies that have changes in equity controls, we obtain positive coefficients on equity liberalization (untabulated).

protection index (Aghion et al., 2015), and insider trading law enforcement (Levine et al., 2017). Our main inferences are robust to controlling for these variables.[21] We then show that our baseline regression results are robust to different combinations of firm, country-year, and industry-year fixed effects. The robust estimates help to alleviate the concern that firm-specific, country-level, or industry-level time-varying characteristics are driving our results.

We also find that our inferences are robust when we use (a) several alternative innovation measures, including patent generality, originality, citations per patent, cited foreign patents, and R&D spending; (b) two alternative measures of capital account liberalization to estimate the baseline regression – *KAOPEN*, the financial openness index from Chinn and Ito (2008), and *Investability*, liberalization of foreign ownership restrictions from Edison and Warnock (2003); and (c) two alternative measures of innovation intensity from Levine et al. (2017) – *R&D Intensity*, the average two-digit SIC industry level of annual growth in R&D expenses of US publicly listed firms, and *Innovate Propensity*, the innovation propensity measured as the two-digit SIC industry-level average number of patents filed by US publicly listed firms. Taken together, our main conclusion that capital account liberalization promotes firm innovation is robust to various estimation models, alternative measures, and specifications.

6.4 Subsample analyses

We further look at subsets of countries with particular capital market constraints to refine our analyses and generate additional results. For brevity, we report the estimated results in Online

[21] Once again, the estimated coefficients on stock market liberalization are inconsistent with Moshirian et al. (2021). This may be because their sample is limited to only 20 economies that have experienced liberalization, whereas our sample covers both open and non-liberalized economies. In addition, the equity liberalization date is concentrated around the 1990s, which is the start of our sample period so we have few pre-liberalization observations in the estimation. Finally, the KA index incorporates liberalization of equity accounts as one of its asset subcategories and including both indicators in one regression may reduce the explanatory power of equity liberalization. Nevertheless, as mentioned above, if we restrict our sample to economies that have changes in the equity controls index, we obtain positive coefficients on equity liberalization.

Table OA5. In these subsample analyses, we find that the coefficients on capital account liberalization are slightly larger for firms from emerging markets compared to those from developed economies, but the differences are not statistically significant. We also observe that the effect of liberalization on innovation is statistically significant for firms from Europe (including countries from the former Soviet Union) and East Asia Pacific, but not significant in America (North and Latin America) or other regions. These results suggest that capital account liberalization benefits innovation in relatively less economically developed but rapidly growing markets. We also show that the main effects remain robust when we exclude specific countries including the United States, China, and countries that do not experience variations in liberalization, suggesting that our findings are not driven by these countries or country groups.

We next present results based on subsamples comprised of either pure domestic firms or firms with foreign exposure. Desai et al. (2008) showed that multinational affiliates tend to have a superior ability to overcome financial constraints compared to local firms. This finding implies that capital controls—especially on inflows—could be less important for multinational firms that have been exposed to foreign investment shocks prior to liberalization (Luo, 2003). Consequently, we predict that firms less exposed to foreign investment shocks tend to benefit more from the liberalization of capital account inflows. Consistent with our conjecture, for pure domestic firms, the coefficient estimates on the liberalization of capital inflows are positive and significant, and are stronger than those on outflows, whereas the results are insignificant for firms that have either cross-listed abroad or have foreign segments.[22]

[22] We define a firm as having foreign exposure if is cross-listed in at least one foreign equity market or has foreign sales revenue. Firms' cross-listing status data are obtained from Capital IQ global security database; market segment revenue data come from the S&P Capital IQ platform.

Lastly, we conduct a subsample analysis focusing on firms with high innovation efficiency in highly innovative sectors. This test helps us to verify one assumption in the hypothesis. As argued, liberalization brings new financing opportunities to innovative firms. However, patenting activity creates better access to financing at the firm level, such that financing availability feeds further innovation. Thus, we expect that highly innovative firms patent and finance more after liberalization. We observe significant and positive coefficients on the interaction between *KA* and high innovation efficiency, whereas the coefficients on *KA* alone are significantly negative. This outcome suggests that firms with high innovation efficiency from innovative sectors contribute to our main finding.

7. Concluding Remarks

This paper empirically investigates the impact of capital account liberalization on firm innovation. We construct a novel international firm-patent panel data and find that capital account liberalization is associated with higher patenting activity. More importantly, by employing a generalized DiD estimation framework and exploiting within-country variation in innovation intensity at the industry level, we show that the effects are more pronounced for firms in more innovation-intensive sectors. Furthermore, in more innovation-intensive industries, firms with better legal protections and greater productivity respond more to the opening up of capital accounts by filing more patents. The observed innovation effect is not merely a "lawyer effect," because the impact exists for various patent quality measures as well. Our results are robust to a battery of tests, including alternative measures of capital account liberalization, the inclusion of firm-level and country-level characteristics, and other specifications of the estimation model. Overall, our paper provides robust firm-level evidence of the real economic effect of capital account liberalization globally.

These findings have meaningful implications for corporate investment and policy reform. As Henry (2007) pointed out, financial globalization leads to only transitory growth in a country's economy, even in the fundamental neoclassical model setting. In contrast to most empirical studies, this paper sheds light on the temporary effects of macro-level financial reforms that are ultimately reflected in the behavior of micro-level entities. Overall, financial integration can serve as a driving force that gives rise to domestic firms' innovation growth, at least temporarily.

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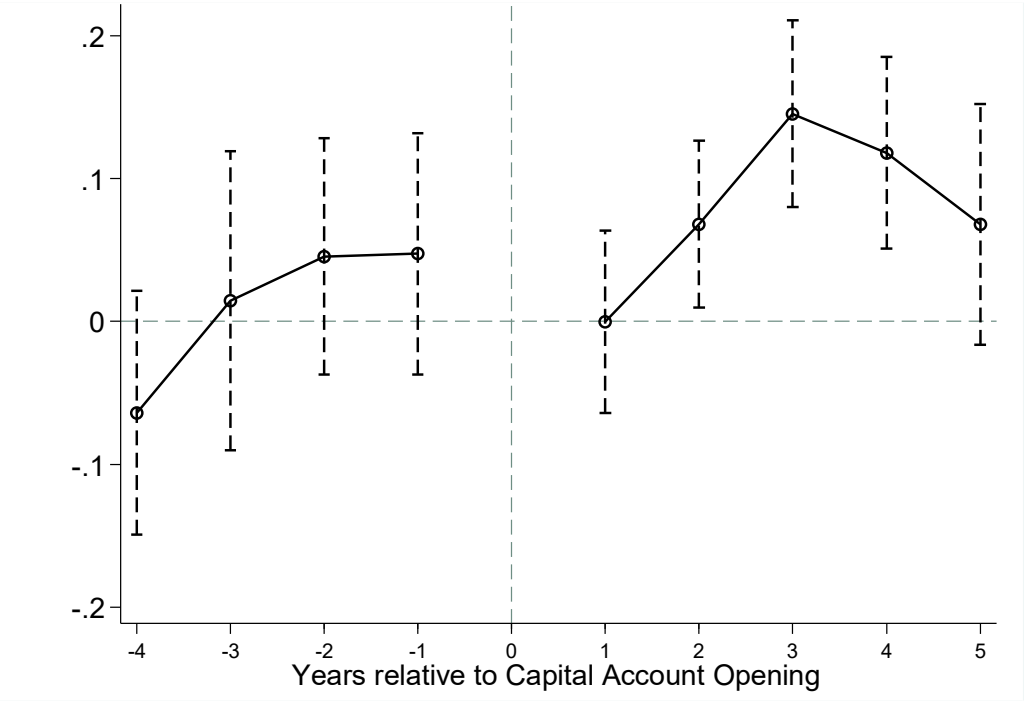
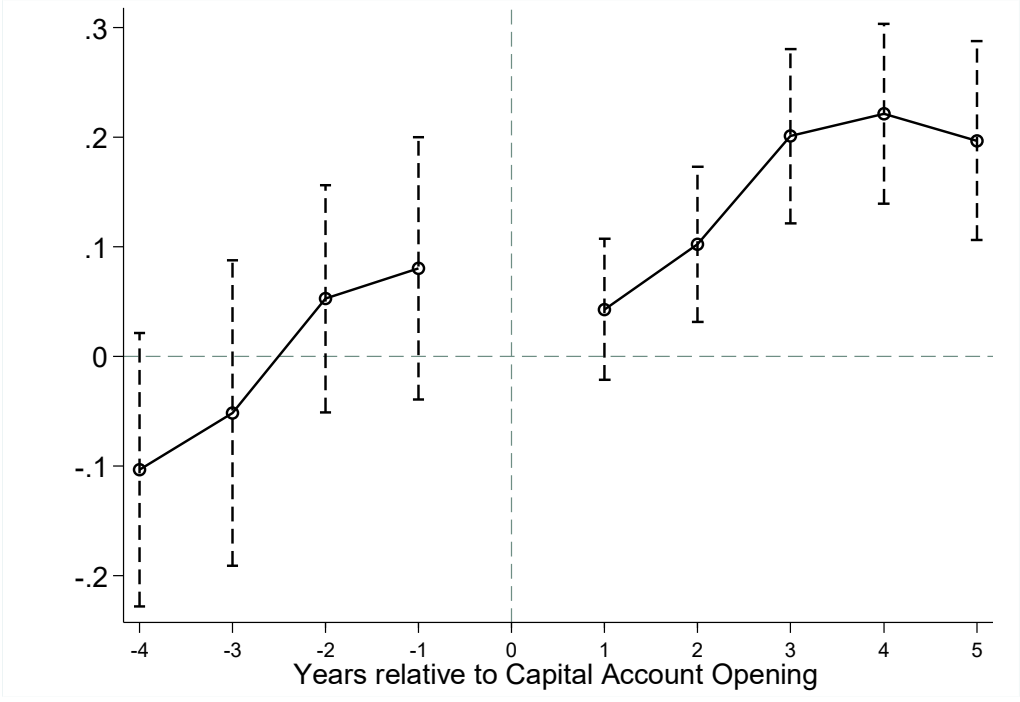
Tables and Figures



(a) Patent Counts



(b) Patent Citations

Figure 1 Dynamics effect of capital account opening on firm innovation.

This figure plots the dynamic effect of capital account opening on firm-level patent counts and citations. To obtain a precise opening date, we follow Larrain (2015) and define the opening year as the year in which the Fernández et al. (2016) KA index of a country increases by more than one standard deviation. The identified event year is used as the benchmark year and is thus excluded from the model.

Table 1 Sample Composition

This table reports the sample composition of the major data sample used in the empirical analysis. Panel A reports the means of innovation and capital account liberalization indexes by country. *Income Group* indicates the income level of the countries, as defined in the World Bank database. *No. of Firms* is the number of unique firms in each sample country. *No. of Firm-Years* is the number of firm-year observations in each sample country. *PATENT* is the total number of patent applications (unique family ID) filed by each firm each year. *FAMPAT* is the total family size of the patent applications by each firm each year. *CITEPAT* is the total number of citations received by each firm for patents applied in each year. *KA* is 1 minus the overall capital account restrictions index from Fernández et al. (2016). *KAOPEN* is the capital account openness index from Chinn and Ito (2008). *Investability* is the de facto foreign ownership restrictions measure from Edison and Warnock (2003). We multiply the original value with minus one to be consistent with two other measures. Panel B shows the sample distribution by year.

Panel A. Sample composition by economy

Economy	Income Group	No. of Firms	No. of Firm-Years	Innovation			Capital Account Liberalization		
				PATENT	FAMPAT	CITEPAT	KA	KAOPEN	Investability
Argentina	Middle	22	203	0.635	1.892	0.265	0.363	0.311	-0.132
Australia	High	648	5,851	2.842	15.861	2.236	0.710	0.726	.
Austria	High	51	385	10.834	49.239	8.368	0.788	1.000	.
Belgium	High	57	508	18.033	107.711	19.009	0.922	0.996	.
Brazil	Middle	139	992	3.266	9.984	1.128	0.472	0.461	-0.149
Canada	High	585	4,339	4.522	29.992	5.871	0.949	1.000	.
Chile	High	28	337	0.460	1.332	0.113	0.630	0.735	-0.132
China	Middle	1,737	13,378	15.031	23.221	13.570	0.014	0.165	0.310
Denmark	High	84	939	31.093	193.534	29.287	0.941	1.000	.
Finland	High	79	1,050	21.838	92.230	64.098	0.904	1.000	.
France	High	324	3,167	21.248	93.331	22.826	0.946	1.000	.
Germany	High	461	4,765	29.110	108.813	39.291	0.853	1.000	.
Greece	High	45	402	1.085	4.453	1.049	0.946	0.994	-0.006
Hong Kong	High	295	3,292	8.243	15.055	5.832	0.983	1.000	.
India	Middle	741	5,722	9.441	42.826	7.429	0.050	0.165	-0.379
Indonesia	Middle	31	428	0.801	4.126	0.591	0.376	0.668	-0.233
Ireland	High	50	346	46.043	210.249	69.391	0.950	1.000	.
Israel	High	197	1,522	9.912	43.251	9.862	0.918	0.880	-0.008
Italy	High	145	1,318	5.551	30.017	5.029	0.970	1.000	.
Japan	High	2,698	31,439	47.009	124.771	66.583	1.000	0.997	.
Korea, Rep.	High	789	5,785	24.876	56.459	18.219	0.742	0.502	-0.201
Malaysia	Middle	179	2,116	0.662	2.552	0.512	0.199	0.380	-0.158
Mexico	Middle	37	451	16.239	67.248	23.633	0.437	0.672	-0.317
Netherlands	High	107	1,079	35.140	151.893	45.946	1.000	1.000	.
Norway	High	80	508	4.624	26.506	4.271	0.963	0.972	.

Pakistan	Middle	46	462	26.658	105.541	25.238	0.291	0.159	-0.710
Peru	Middle	15	171	1.912	6.684	1.320	0.984	1.000	-0.012
Philippines	Middle	38	459	0.795	4.142	0.838	0.144	0.363	-0.391
Poland	High	129	862	2.123	12.833	1.738	0.347	0.442	-0.023
Portugal	High	15	146	0.205	0.295	0.060	0.832	0.999	-0.028
Russia	High	25	199	0.704	1.864	0.345	0.461	0.470	-0.291
Singapore	High	301	3,348	4.755	16.904	7.959	0.855	0.988	.
South Africa	Middle	146	1,524	3.494	16.630	2.865	0.384	0.168	0.011
Spain	High	83	615	4.057	28.462	1.994	0.984	0.999	.
Sri Lanka	Middle	31	288	0.462	0.774	0.247	0.000	0.420	-0.910
Sweden	High	218	2,172	11.655	56.011	12.173	0.947	0.999	.
Switzerland	High	153	1,998	42.274	191.098	138.783	0.893	1.000	.
Thailand	Middle	100	1,156	1.300	2.833	0.626	0.238	0.304	-0.432
Turkey	Middle	63	508	8.608	26.819	6.297	0.553	0.330	-0.040
United Kingdom	High	977	10,085	7.744	36.875	8.566	0.998	1.000	.
United States	High	5,382	56,060	16.900	76.746	35.982	0.864	1.000	.
Total/Mean	-	17,331	170,375	20.446	70.473	31.789	0.773	0.842	-0.051

Panel B. Sample distribution by year

Year	No. of Firms	*PATENT*	*FAMPAT*	*CITEPAT*	*KA*	Year	No. of Firms	*PATENT*	*FAMPAT*	*CITEPAT*	*KA*
1995	4,004	10.836	49.936	25.223	0.872	2005	10,396	20.397	72.897	31.363	0.781
1996	4,599	12.461	55.418	29.804	0.858	2006	10,699	20.403	73.384	31.306	0.776
1997	5,139	13.004	58.144	29.748	0.841	2007	10,963	20.453	71.802	32.069	0.761
1998	5,347	12.374	55.637	28.952	0.833	2008	10,953	20.6	70.832	32.017	0.747
1999	7,194	21.223	72.692	32.028	0.866	2009	10,595	20.883	70.428	31.602	0.724
2000	8,327	22.813	79.349	33.721	0.874	2010	10,827	21.207	69.357	31.463	0.703
2001	9,075	21.914	76.449	31.783	0.831	2011	10,941	22.424	70.856	33.053	0.691
2002	9,428	20.494	70.341	30.154	0.819	2012	11,287	23.394	71.129	34.462	0.681
2003	9,643	20.833	75.493	30.072	0.805	2013	10,993	24.341	70.389	35.231	0.685
2004	9,965	20.681	73.477	32.088	0.793						

Table 2 Descriptive Statistics

This table reports the summary statistics of main variables used in the empirical analysis. *N* is the total number of firm-year observations. *Mean* is the average value of each variable. *Median* is the median value of each variable. *SD* is the standard deviation of each variable. *P25* is the lower quartile of each variable. *P25* is the upper quartile of each variable. The sample period is from 1995 to 2013. Following the literature, all firm-level continuous variables are winsorized at 1% tails.

Variable	N	Mean	Median	SD	P25	P75
PATENT	170375	20.446	1.000	75.010	0.000	6.000
FAMPAT	170375	70.473	1.000	258.177	0.000	15.000
CITEPAT	170375	31.789	0.000	257.090	0.000	4.463
ln(PATENT)	170375	1.181	0.693	1.570	0.000	1.946
ln(FAMPAT)	170375	1.578	0.693	2.027	0.000	2.773
ln(CITEPAT)	170375	0.921	0.000	1.576	0.000	1.477
KA	170375	0.773	0.870	0.315	0.850	1.000
POST	82724	0.804	1.000	0.397	1.000	1.000
Firm Characteristics						
ln(AGE)	170375	2.407	2.485	0.716	1.946	2.890
CAPEX	170375	0.065	0.038	0.093	0.017	0.077
ln(SALE)	170375	5.414	5.487	2.372	4.104	6.923
R&D	170375	0.043	0.000	0.105	0.000	0.030
PPE	170375	0.615	0.527	0.454	0.268	0.867
LEV	170375	0.151	0.080	0.207	0.002	0.222
GROWTH	170375	0.196	0.067	0.684	-0.043	0.207
ROA	170375	0.058	0.099	0.311	0.041	0.164
TOBINS_Q	170375	1.907	0.971	4.340	0.631	1.721
HHI	170375	0.374	0.275	0.288	0.146	0.519
HHI^2	170375	0.223	0.076	0.307	0.021	0.269
WW	170375	-0.278	-0.288	0.119	-0.356	-0.209
Country Characteristics						
GDPGrowth	170375	3.110	2.788	3.177	1.551	4.447
TradeOpen	170375	0.574	0.337	0.695	0.245	0.592
GovExpense	170375	0.163	0.159	0.034	0.141	0.184
CreditGDP	170375	0.872	0.916	0.398	0.499	1.086

Table 3 Baseline Regressions

This table reports the overall impacts of capital account liberalization on firm innovation. The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). The higher the index, the more open a country's capital account is. Columns 1 to 3 show the pooled ordinary least squares (OLS) (country, industry, and year FE) regression results on total number of patents *ln(PATENT)*, patent family size *ln(FAMPAT)*, and patent citations *ln(CITEPAT)*. Following the prior literature, all explanatory variables are lagged by 1 year. For brevity, all variables are defined in the Online Table OA1. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*
KA	0.540***	0.745***	0.466***
	(0.118)	(0.146)	(0.122)
Firm-level controls			
ln(AGE)	-0.017	-0.034**	0.011
	(0.013)	(0.015)	(0.013)
CAPEX	0.485***	0.579***	0.504***
	(0.045)	(0.058)	(0.048)
ln(SALE)	0.162***	0.178***	0.163***
	(0.012)	(0.015)	(0.012)
R&D	2.285***	3.423***	2.300***
	(0.143)	(0.190)	(0.138)
PPE	-0.033	-0.071**	-0.054**
	(0.024)	(0.032)	(0.024)
LEV	-0.217***	-0.234***	-0.206***
	(0.023)	(0.027)	(0.021)
GROWTH	-0.035***	-0.047***	-0.036***
	(0.011)	(0.014)	(0.011)
ROA	-0.249***	-0.267***	-0.209***
	(0.029)	(0.037)	(0.028)
TOBINS_Q	0.022***	0.027***	0.024***
	(0.001)	(0.002)	(0.002)
HHI	0.756***	0.923***	0.726***
	(0.054)	(0.071)	(0.055)
HHI^2	-0.694***	-0.853***	-0.673***
	(0.053)	(0.064)	(0.051)
WW	-3.136***	-4.413***	-3.068***
	(0.130)	(0.191)	(0.154)
Country-level controls			
GDPGrowth	-0.018***	-0.022***	-0.024***
	(0.005)	(0.006)	(0.006)
TradeOpen	-0.027	-0.028	-0.096
	(0.058)	(0.067)	(0.064)
GovExpense	-9.606***	-10.199***	-10.813***
	(1.524)	(1.698)	(1.589)
CreditGDP	0.110***	0.050	0.138***
	(0.030)	(0.035)	(0.031)
Country FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	170,375	170,375	170,375
Adj. R2	0.310	0.298	0.283

Table 4 Identification: Capital Account Liberalization, R&D Intensity, and Firm Innovation

This table presents results from generalized difference-in-differences regressions on how capital account liberalization has a disproportionate impact on innovation in firms in R&D-intensive sectors. The dependent variables are the three measures of patent quantity (*ln(PATENT)*) and patent quality (*ln(FAMPAT)*, *ln(CITEPAT)*). The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). *POST* is a dummy variable that captures the big jump in the *KA* index, and is defined as equal to one after the year in which the change in *KA* is greater than one standard deviation of the index over the sample period, and zero otherwise, following Larrain (2015). We use a sectoral, patent-based innovation propensity measure of *Intensity* based on the industry median number of patents filed by US publicly listed firms in year t-1, following Acharya and Subramanian (2009). All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here, for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
KA × *Intensity*	0.119***	0.145***	0.164***	0.129***	0.159***	0.200***
	(0.027)	(0.030)	(0.028)	(0.029)	(0.036)	(0.034)
GDPGrowth × *Intensity*				-0.003	-0.004	-0.004
				(0.002)	(0.003)	(0.003)
TradeOpen × *Intensity*				-0.116***	-0.135***	-0.119***
				(0.011)	(0.013)	(0.011)
GovExpense × *Intensity*				-0.748***	-0.745**	-1.066***
				(0.287)	(0.346)	(0.324)
CreditGDP × *Intensity*				0.101***	0.096***	0.048**
				(0.019)	(0.022)	(0.022)
KA	0.348***	0.515***	0.210	0.340***	0.504***	0.164
	(0.123)	(0.151)	(0.128)	(0.118)	(0.147)	(0.127)
Intensity	-0.092***	-0.104***	-0.125***	0.029	0.033	0.080
	(0.021)	(0.025)	(0.022)	(0.044)	(0.055)	(0.050)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	165,764	165,764	165,764	165,764	165,764	165,764
Adj. R2	0.311	0.299	0.285	0.312	0.300	0.286

Table 5 Capital Account Liberalization and Firm Innovation: Legal Protection

This table presents the impact of exposure to capital account liberalization on firm innovation conditional on the quality of intellectual property–related legal enforcement. The dependent variables are the three measures of patent quantity (*ln(PATENT)*) and patent quality (*ln(FAMPAT)*, *ln(CITEPAT)*). The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). We use two measurements of legal protection. The patent protection index (*IPR Protection*) measures the extent to which intellectual property rights are protected in the country and is from Park (2008). Higher values indicate patent laws with stronger protection for intellectual property rights. The rule of law indicator (*Rule of Law)* captures "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann et al., 2011, p. 223). All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here, for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Rule of Law			*IPR Protection*		
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
KA × *Intensity* × *Protection*	0.239***	0.275***	0.222***	0.122**	0.153***	0.158***
	(0.041)	(0.050)	(0.047)	(0.047)	(0.057)	(0.052)
KA × *Protection*	-0.973***	-1.018***	-0.912***	-0.670***	-0.733***	-0.617***
	(0.207)	(0.253)	(0.218)	(0.147)	(0.168)	(0.151)
Protection × *Intensity*	-0.201***	-0.210***	-0.128***	0.133***	0.164***	0.156***
	(0.031)	(0.036)	(0.037)	(0.032)	(0.037)	(0.035)
Protection	0.931***	1.041***	0.659***	0.139	0.126	0.043
	(0.175)	(0.204)	(0.190)	(0.100)	(0.114)	(0.094)
KA × *Intensity*	0.110**	0.090	0.039	-0.567***	-0.712***	-0.713***
	(0.050)	(0.057)	(0.051)	(0.193)	(0.236)	(0.212)
KA	0.915***	1.142***	0.932***	3.346***	3.832***	3.073***
	(0.258)	(0.316)	(0.283)	(0.605)	(0.696)	(0.629)
Intensity	-0.119***	-0.123***	-0.126***	-0.577***	-0.698***	-0.689***
	(0.019)	(0.023)	(0.020)	(0.122)	(0.145)	(0.137)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	141,355	141,355	141,355	165,764	165,764	165,764
Adj. R2	0.312	0.301	0.286	0.313	0.300	0.287

Table 6 Capital Account Liberalization on Innovation: Heterogeneity by Initial Conditions

This table presents the impact of exposure to capital account liberalization on firm innovation conditional on firms' initial productivity. The dependent variables are the three measures of patent quantity (*ln(PATENT)*) and patent quality (*ln(FAMPAT)*, *ln(CITEPAT)*). The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). We use a sectoral, patent-based innovation propensity measure of *Intensity* based on the industry median number of patents filed by US publicly listed firms in year t-1, following Acharya and Subramanian (2009). We use two indicators of firm performance: firm size, measured by the natural logarithm of total sales (*ln(sale)*), and firm profitability, measured by return on assets (*ROA*). We generate *Productivity* dummies based on whether they fall above the sample mean among firms in the same industry from the same country for two indicators of firm performance in the initial time period. All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here, for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Initial Size: *ln(sale)*			Initial Profitability: *ROA*		
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
KA × *Intensity* × *Productivity*	0.354***	0.485***	0.569***	0.133**	0.157**	0.191***
	(0.048)	(0.059)	(0.051)	(0.053)	(0.062)	(0.051)
KA × *Productivity*	-0.608***	-0.707***	-0.700***	-0.545***	-0.697***	-0.478***
	(0.042)	(0.052)	(0.045)	(0.114)	(0.130)	(0.088)
Productivity × *Intensity*	-0.021	-0.056	-0.135***	0.037	0.062	0.013
	(0.036)	(0.045)	(0.037)	(0.043)	(0.052)	(0.041)
Productivity	0.156***	0.165***	0.159***	0.256**	0.336***	0.169**
	(0.013)	(0.015)	(0.013)	(0.100)	(0.113)	(0.074)
KA × *Intensity*	-0.166**	-0.269***	-0.241***	-0.004	-0.027	0.006
	(0.065)	(0.080)	(0.066)	(0.053)	(0.062)	(0.048)
KA	0.819***	1.164***	0.799***	0.665***	0.965***	0.548***
	(0.139)	(0.174)	(0.136)	(0.132)	(0.161)	(0.117)
Intensity	0.006	0.059	0.035	-0.033	-0.024	-0.048
	(0.046)	(0.060)	(0.050)	(0.042)	(0.051)	(0.039)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	122,292	122,292	122,292	122,292	122,292	122,292
Adj. R2	0.321	0.302	0.298	0.320	0.301	0.295

Table 7 Capital Account Liberalization on Innovation: Event Study

This table presents results from generalized difference-in-differences regressions on how large capital account liberalization events impact innovation, and how the impact disproportionally differs across sectors. The dependent variables are the three measures of patent quantity (*ln(PATENT)*) and patent quality (*ln(FAMPAT)*, *ln(CITEPAT)*). The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). *POST* is a dummy variable that captures a big jump in the *KA* index, and is defined equal to one after the year in which the change in *KA* is greater than one standard deviation of the index over the sample period, and zero otherwise, following Larrain (2015). Panel A shows the sample distribution. *Lib Year* is the year in which the change in *KA* is greater than one standard deviation of the index over the sample period. Panel B shows the estimation results. We use a sectoral, patent-based innovation propensity measure of *Intensity* constructed based on the industry median number of patents filed by US publicly listed firms in year t-1, following Acharya and Subramanian (2009). All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Sample distribution

Economy	*Lib Year*	Economy	*Lib Year*
Argentina	2006	Korea	2005
Australia	2011	Mexico	1996
Austria	2010	Norway	2003
Brazil	2002	Pakistan	2004
Canada	1997	Peru	2011
Chile	2001	Philippines	2006
China	2013	Poland	2002
Denmark	2002	Portugal	2006
Finland	2011	Russia	2009
France	2002	Singapore	2001
Germany	1998	South Africa	2008
Hong Kong	2010	Spain	2008
India	1997	Sweden	2013
Indonesia	2008	Thailand	2013
Israel	1998	Turkey	2003
Japan	1999	Mean	2002

Panel B. Estimation results

	(1) *ln(PATENT)*	(2) *ln(FAMPAT)*	(3) *ln(CITEPAT)*	(7) *ln(PATENT)*	(8) *ln(FAMPAT)*	(9) *ln(CITEPAT)*
POST × Intensity				0.046*	0.040	0.041*
				(0.027)	(0.030)	(0.025)
POST	0.061*	0.060	0.120***	-0.004	0.008	0.065
	(0.033)	(0.045)	(0.044)	(0.057)	(0.070)	(0.062)
Intensity				0.074	0.078	0.038
				(0.060)	(0.072)	(0.058)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	82,724	82,724	82,724	80,563	80,563	80,563
Adj. R2	0.340	0.326	0.312	0.342	0.327	0.315

Capital Account Liberalization and Firm Innovation: Worldwide Evidence

Online Appendix

A. PATSTAT Database

We use patent data from PATSTAT to measure firms' innovation output. To construct our data set, we deal with a set of issues as follows:

Identifying unique firms/business applicants. As described in section III, we observe the exact names of each patent applicant in the Person Table. However, the names appeared in patent documents are not always the same due to misspelling or variations in naming conventions among different patent authorities. Fortunately, EUROSTAT in collaboration with ECOOM (K.U.Leuven) and Sogeti provide harmonized names in the ECOOM-EUROSTAT-EPO PATSTAT Person Augmented Table (EEE-PPAT), and some of these information has been included in PATSTAT database since October 2011. In order to obtain detailed applicants information, we also requested for a copy of the EEE-PPAT Table[1]. We use "HRM_L2_ID" from this Table as the unique id that identifies each unique applicant in our sample and we use "HRM_L2" as the standard applicant names for further process.

Patent families. In practice, firms might file the same patent application for a few times or in multiple countries, depending on where they want to seek the intellectual property protection. Consequently, simply counting the number of patent filings might repeatedly count the same patent that is actually not a new invention. Therefore, we count the total number of family-level patents as well as citations for each firm. Fortunately, PATSTAT organizes patent in "patent families", where each unique patent corresponds to a unique family id. A patent family specifies and clusters

[1] For detailed information see https://www.ecoom.be/en/EEE-PPAT.

all succeeding patent applications attributing to the same original (priority) filing. Hence in our sample, each patent represents a unique invention, that is, applications are identified with family id so that the same patent will not be repeatedly counted if it is filed in subsequent years or in multiple countries. Throughout our analysis we use "DOCDB_FAMILY_ID" as the unique identification for a group of same inventions.

Assigning patents and citations to firms. We use patent counts to measure firms' innovation quantity, and patent citations to measure the innovation quality. We retrieve citations of each patent that in the Table TLS212_CITATION for the application corresponds to an APPLN_ID in the baseline Table TLS201_APPLN. If an application has "APPLN_SEQ_NR" greater than 0 in the Table TLS207_PERS_APPLN, and it has a unique "DOCDB_FAMILY_ID" in the baseline Table TLS201_APPLN, then we attribute this application to its corresponding applicant in the Table TLS206_PERSON.

Identify home country of firms. We adopt the similar strategy documented in Coelli et al. (2017) to find firms' home country based on the "PERSON_CTRY_CODE" in the EEE-PPAT Table. An applicant's country code is assigned with its most frequent use of home country code (non-missing), and is marked with blank if all of its records have home country code missing.

B. Matching PATSTAT with Capital IQ Global

We are not the first trying to match PATSTAT with Capital IQ Global on firm names. This effort has already been done in e.g., Torrisi et al. (2016). The matching details in this paper, however, are unclear to us. As Thoma and Torrisi (2007) described in their attempt to match PATSTAT with another financial database – Amadeus, there are lot of matching and consolidation problems related to such an attempt. Firstly, the variation in spelling or spelling errors is the mostly common problem that researchers might be faced with. Secondly, as different databases have

different naming conventions, even the identification with rule-based or dictionary-based approach could not fully tackle with such a mismatch problem. In addition, firms' financial data is often reported at a consolidated level, while the patent data is often at the subsidiary level. Without dataset containing information on ownership structure, there will be problematic in matching firm subsidiaries in one list to ultimate owners in another list.

Firstly, following Autor et al. (2020), we clean the firm names by removing punctuation and accents, and standardized the commonly used words such as LTD, Corp, Corporation in all firm names in both the patent and financial data. In our approach, applicant or firm names in both datasets are standardized first as suggested in Thoma et al. (2010). First, we prepare clean master file and base file with information of firm name, id and home country. We then transform all the names into upper case to simplify the matching. We delete string variables inside the parentheses which is typically the location of the subsidiary. We also delete other characters so that we am having only alphabetical letters and numbers in the name strings. Company type abbreviations such as LTD and PLC are erased from the name string to avoid mismatch caused by different naming conventions in two databases. If the firm name starts with "CO LTD (OF)" or "DE SA" OR "CO KG", then we delete these name strings and otherwise we delete what's following them. Finally, we clear all the redundant blanks within the name strings. We then perform an initial matching by these standardized names. This gives us only about 59,000 lines of matched firms from these two datasets, and it is possible that more than one patent assignee is matched to a Capital IQ firm, and vice versa.

Next, we search Bing.com for the names of each patent assignee (2,513,630) and each Capital IQ Global and North America firm (standardized format, 57,172). Our program retrieves the URLs of the top five search results, which serves as the input of the next step of the algorithm.

Based on the URLs, we consider a patent assignee and a Capital IQ firm to be a match if: a) the top search results for the patent assignee contain the company website listed in Capital IQ or b) the top five search results for the patent assignee and the Capital IQ firm share at least two URLs in common. This gives us about 280,000 lines of matched firms in these two datasets. Notice here it is possible that more than one patent assignee is matched to a Capital IQ firm, or one patent assignee is matched to multiple Capital IQ firms, which is considered to be reasonable that a firm could have multiple subsidiaries and a subsidiary can simultaneously belong to multiple parent companies though the latter is relatively rarer.

The combination of names matching, and web matching gives a total of more than 324,000 lines of matched firms in these two datasets (20,791 lines of duplicated results are excluded), see IBM in Appendix Table OA1 as an example of the matching result.

Online Reference

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Table OA1. Variables Definition

Variables	Definition	Main Source
Innovation Indicators		
Ln(PATENT)	The natural logarithm of 1 plus the total number of patents (with a distinct family ID) filed each firm in each year.	PATSTAT 2016 Autumn
ln(FAMPAT)	The natural logarithm of 1 plus the total amount of patent family size filed by each firm in each year.	As above
ln(CITEPAT)	The natural logarithm of 1 plus the total number of citations made to each firm's patents in each year. Following Hall, Jaffe, and Trajtenberg (2001), we adjust the raw values by the technology class and year fixed effects to alleviate the impact of time trend and technology class heterogeneity.	As above
Generality	Patent generality score, constructed as one minus the Herfindahl concentration index of technological classes (three-digit IPC class) for all the citations it receives, following Hall, Jaffe, and Trajtenberg (2001). The higher the score, the wider range of impact on future patents for various technological classes.	As above
Originality	Patent originality score, constructed as one minus the Herfindahl concentration index of technological classes (three-digit IPC class) for all previous patents that it cites, following Hall, Jaffe, and Trajtenberg (2001). A higher score indicating the patent is inspired by a wider range of prior patents from various technological classes.	As above
Citations Per Patent	The total number of citations received by a firm's patents filed in year t divided by the total number of patents filed by the firm in year t.	As above
Cited Foreign	The total number of a firm's patents' (filed in year t) backward citations to foreign patents.	As above
IE: Patents/R&D Capital	Innovation efficiency measured by patent counts scaled by R&D Capital, where R&D capital is calculated as the sum of previous five years' R&D expenses, assuming a 20% annual depreciation rate.	PATSTAT 2016 Autumn & Capital IQ Global
IE: Citations/R&D Capital	Innovation efficiency measured by patent citations scaled by R&D Capital, where R&D capital is calculated as the sum of previous five years' R&D expenses, assuming a 20% annual depreciation rate.	As above
Capital Account Liberalization Indicators		
KA	The overall capital account restrictions index from Fernández et al. (2016) ranging from 0 (fully open) to 1 (fully restricted). We take 1 minus the original value as our major index to indicate the level of capital account liberalization.	Fernández, Klein, Rebucci, Schindler, and Uribe (2016)
POST	A dummy variable which captures big jump in the *KA* index, and is defined equal to one after the year in which the change in *KA* is greater than one standard deviation of the index over the sample period, and zero otherwise, following Larrain (2014).	As above
KAOPEN	The Chinn and Ito (2008) financial openness index ranging from -1.856 (fully restricted) to 2.456 (fully open).	Chinn and Ito (2008)
Investability	The foreign ownership restrictions index from Edison and Warnock (2003) ranging from 0 (fully open) to 1 (fully restricted). We use minus one multiply the original index to make it consistent with two other variables.	Edison and Warnock (2003)
Firm Characteristics		
ln(AGE)	The natural logarithm of the number of years a firm has been listed in Capital IQ Global.	Capital IQ Global

CAPEX	Capital expenditure scaled by beginning year of total assets.	As above
Ln(SALE)	Natural logarithm of net sales.	As above
R&D	Research and Development expenditure, scaled by beginning year of total assets.	As above
PPE	Total property, plant and equipment, scaled by beginning year of total assets.	As above
LEV	Book value of total debt (long-term debt plus debt in current liabilities) divided by beginning year of total assets.	As above
GROWTH	Asset growth rate, annual percentage change of total assets, measured at the fiscal year end.	As above
ROA	Return on assets, defined as operating income before depreciation divided by begging year of total assets.	As above
TOBINS_Q	Growth opportunities, measured as the sum of market value of equity and book value of debt, divided by fiscal year-end total assets.	As above
WW	$= -0.091 * \mathrm{CF}_{it} - 0.062 * \mathrm{DIVPOS}_{it} + 0.021 * \mathrm{TLTD}_{it} - 0.044 * \mathrm{LNTA}_{it} + 0.102 * \mathrm{ISG}_{it} - 0.035 * \mathrm{SG}_{it}$, where CF is cash flow from operations divided by total assets, DIVPOS is an indicator take the value of one if the firms pays cash dividends; TLTD is long term debt divided by total assets; LNTA is natural logarithm of total assets, ISG is the firm's three-digit SIC industry sales growth, SG is firm sales growth.	As above
Industry Characteristics		
HHI	Herfindahl index of 4-digit SIC industry to which the firm belongs, measured at the fiscal year end.	Capital IQ Global
HHI^2	The squared value of HHI.	As above
Intensity	Time-varying sectoral patent-based innovation propensity measure, calculated as the industry median number of patents filed by US publicly listed firms in year t-1, following Acharya and Subramanian (2009).	Capital IQ North America
R&D Intensity	Intensity the industry median ratio of R&D expenditures to total sales following Li (2011), using all U.S. public firms from 1980 to 1989.	Levine, Lin, and Wei (2017)
Patent Intensity	Investment intensity, the share of capital expenditure in net property, plant, and equipment for the median publicly traded firm in each industry in the United States from 1980 to 1989 following Rajan and Zingales (1998).	As above
Country Characteristics		
GDPGrowth	Annual GDP Growth rate.	World Bank WDI
TradeOpen	Trade openness measured as the sum of imports and exports of goods and services divided by GDP.	As above
GovExpense	General government final consumption expenditure (% of GDP).	As above
CreditGDP	Financial Development measured as Private credit by deposit money banks to GDP (%).	World Bank GFD database
InsiderTrade	An indicator variable, which takes the value of one if the insider trading law exist and has been enforced in the country, and zero otherwise.	Denis and Xu (2013)
Ln(GDP)	The natural logarithm of real GDP per capita (current US$).	World Economic Outlook 2016
IPR Protection	Patent protection index, originally from Park (2008), defined similarly following Luong et al. (2017).	Park (2008)
Creditor Rights	A time-varying measure of bankruptcy code, based on scores ranging from 0 to 4, with higher scores repress enting more superior creditor rights in bankruptcy or reorganization. The index is only available up to 2003, we	Djankov, McLiesh, and Shleifer (2007)

	extend the sample up to 2013 by replacing missing values with most recent available scores.	
Stock MCAP/GDP	A measure of stock market development, measured as the total stock market capitalization as a percentage of GDP.	World Bank WDI
Equity Liberalization	An indicator variable, which takes the value of one if an economy's stock market is open to foreign investors, and zero otherwise.	Bekaert, Harvey, and Lundblad (2005)
FDI Inflow	Global foreign direct investment (FDI) inflows as a percentage of GDP.	UNCTAD World Investment Report 2020
FDI Outflow	Global foreign direct investment (FDI) outflows as a percentage of GDP.	As above
Rule of Law	The time-varying rule of law indicator which captures "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence".	Kaufmann, Kraay, and Mastruzzi (2011)
Sub-indices of Capital Account Liberalization		
Capital Inflow	Overall inflow index (all asset categories, average bonds restrictions is only available from 1997 onwards), we take 1 minus the original value such that a higher value indicates higher level of capital account inflow liberalization.	Fernández, Klein, Rebucci, Schindler, and Uribe (2016)
Capital Outflow	Overall outflow restrictions index (all asset categories, average bonds restrictions is only available from 1997 onwards), we take 1 minus the original value such that a higher value indicates higher level of capital account outflow liberalization.	As above
Equity inflow	Equity inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of the equity account inflow liberalization.	As above
Bond inflow	Bonds (bonds with maturity of greater than 1 year) inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of bonds account inflow liberalization.	As above
Money market inflow	Money market (bonds with maturity of 1 year or less) inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of money market inflow liberalization.	As above
Collective investments inflow	Collective investments (funds) inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of collective investments liberalization.	As above
Derivatives inflow	Derivatives inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of derivatives inflow liberalization.	As above
Commercial credits inflow	Commercial credits inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of commercial credits inflow liberalization.	As above
Financial credits inflow	Financial credits inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of financial credits inflow liberalization.	As above
Direct investment inflow	Direct investment inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of direct investment inflow liberalization.	As above

Real estate inflow	Real estate inflow (real estate purchase locally by nonresidents) restrictions index, we take 1 minus the original value such that a higher value indicates higher level of real estate inflow liberalization.	As above
Direct investment inflow	Direct investment inflow restrictions index, we take 1 minus the original value such that a higher value indicates higher level of direct investment liberalization.	As above

Table OA2. Patents matched to IBM by Name Matching and Web URL Matching

This table comprises all the patent assignees with at least two published patents (by family ID) during 1980-2010 which have been matched to the US publicly listed company "IBM" by either name matching or web match algorithm. The listed assignee harmonized names have been subject to minimal cleaning, including standardizing cases, and removing of accents. No. of Patents is the total number of patents counted by unique family ID. No. of Applications ID is the total number of patents counted by unique application ID. No. of Citations is the total number of citations received (counted by unique family ID). Matching flag is a flag marking the matching source: 1 means the assignee is matched by web searching result with web URL in Capital IQ; 2 means the assignee is matched by web searching results both in PATSTAT and firms in Capital IQ; 3 means the assignee is matched by firm name.

Patent Assignee Harmonized Name in PATSTAT	Person Country Code	No. of Patents (family)	No. of applications	No. of Citations	Matching flag	Name Matching	Web Matching
IBM CORP	US	105791	283992	2127270	1		x
INTERNATIONAL BUSINESS MACHINES CORPORATION	-	1877	7097	23192	3	x	x
IBM	-	680	2260	5470	1		x
IBM DEUTSCHLAND GMBH	DE	475	2636	6325	1		x
IBM CORP IBM	US	267	838	7128	1		x
COMPAGNIE IBM FRANCE	-	76	491	1516	1		x
THINKING MACHINES CORP	-	71	184	3211	-		x
IBM CORP ARMONK NY	US	38	202	633	1		x
INTERNATIONAL BUSINESS MACHINES CORPORATION.	-	28	106	327	3	x	
GREAT LOTUS CORP	TW	27	30	49	1		x
IBM FR	FR	24	140	497	1		x
IBM CO	US	22	62	402	1		x
LOTUS DEV CORP	US	20	43	1336	1		x
ISSC TECH CORP	TW	18	41	59	1		x
IBM CORPROATION	US	17	55	240	1		x
GLI GLOBAL LIGHT IND GMBH	DE	14	61	103	1		x
TRACE STORAGE TECH CORP	TW	14	14	83	1		x
ENCENTUATE PTE LTD	SG	13	57	260	1		x
ERIC TECH CORP	CA	12	103	149	1		x
INTERNATIONAL BUSINESS MACHINES CORP	-	12	43	19	3	x	x
IBM DEUTSCHLAND	-	11	60	256	1		x
INTERNATIONAL MOBILE MACHINES CORPORATION	-	11	16	-	1		x
UNITED IND CORP	-	8	9	152	-		x
S&S TECH CORP	TW	7	13	18	1		x
INTERNATIONAL BUSINESS MACHINES CORP., ARMONK, N.Y., US	-	6	27	81	3	x	
CONNEXION TECH CORP	TW	5	5	2	1		x

EUROPEAN SIGN SYSTEMS ESS GMBH	DE	5	25	60	1	x
INT BUSINESS MACINES CORP	-	5	5	32	-	x
ITM INDUSTRIAL TECH & MACHINES AG	CH	5	16	45	1	x
MICROMUSE LTD	GB	5	24	202	1	x
IBM CORP.	-	4	10	45	1	x
INTEL MOBILE COMM TECH GMBH	DE	4	8	15	1	x
MICROMUSE INC	US	4	13	327	1	x
UNITED DEVELOP INTERNATIONAL CORP.	TW	4	4	-	1	x
ADVANCED MACHINES CORP AG	LI	3	30	12	1	x
HUMANO WATER CORP	CA	3	18	15	1	x
IBM FRANCE	-	3	27	81	1	x
INT BSUINESS MACHINES CORP	US	3	3	29	1	x
THINKING MACHINES CORPORATION	-	3	31	407	1	x
ADVANCES MACHINES CORP AG	LI	2	20	8	1	x
BLUE LION MOBILE GMBH	DE	2	4	2	1	x
COGNITIVE CODE CORP	US	2	10	18	1	x
DOUBLE MICROELECTRONICS CORPORATION OF SHANGHAI	-	2	2	4	1	x
GCD HARD & SOFTWARE GMBH	DE	2	3	5	1	x
IBM CANADA LTD	US	2	12	8	1	x
IBM CORP INC	US	2	4	45	1	x
IBM CORPORATAION	US	2	5	25	1	x
IBM CORPORATIION	US	2	13	39	1	x
IBM CORPORATIOIN	-	2	6	43	-	x
IBM UNITED STATES	US	2	4	24	1	x
IIBM CORP	US	2	2	44	1	x
SHANGHAI DOUBLE MICROELECTRONICS CORPORATION	-	2	2	2	1	x
SMITH RPM CORP	US	2	5	30	1	x
TECHLINE SERVICES & ENG SA	CH	2	12	6	1	x
WESTFORD TECH CORP	US	2	10	11	1	x

Table OA3. Sub-Categories of Capital Account Liberalization

This table presents the impacts of exposure to capital account liberalization on firms' innovation when we decompose the indicator of capital account liberalization into inflows and outflows. The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). The dependent variables are the three measures of patent quantity (*ln(PATENT)*) and patent quality (*ln(FAMPAT)*, *ln(CITEPAT)*). We use sectoral patent-based innovation propensity measure of *Intensity* constructed based on the industry median number of patents filed by US publicly listed firms in year t-1 following Acharya and Subramanian (2009). Panel A presents the results when we decompose the *KA* index into liberalization of capital inflows and outflows. Panel B shows the results when we delve deeper into sub-categories of the capital inflow index, including liberalization on inflows of equity, bond, money market, collective investments, derivatives, commercial credits, financial credits, direct investments, and real estate. All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Capital Inflow and Outflows

(1)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Capital Inflow	0.532***	0.350***	0.725***	0.507***	0.462***	0.211
	(0.128)	(0.133)	(0.159)	(0.165)	(0.137)	(0.145)
Capital Inflow ×		0.112***		0.139***		0.166***
Intensity		(0.028)		(0.032)		(0.030)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.285

(2)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Capital Outflow	0.365***	0.176*	0.508***	0.282**	0.313***	0.068
	(0.097)	(0.101)	(0.119)	(0.124)	(0.092)	(0.097)
Capital Outflow ×		0.117***		0.141***		0.154***
Intensity		(0.024)		(0.027)		(0.025)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.299	0.283	0.285

Panel B. Sub-indices of Capital Inflows

(1)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Equity inflow	-0.063	-0.219***	-0.082	-0.278***	-0.015	-0.254***
	(0.072)	(0.080)	(0.092)	(0.102)	(0.074)	(0.085)
Equity inflow ×		0.101***		0.127***		0.158***
Intensity		(0.023)		(0.026)		(0.025)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.285

(2)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Bond inflow	0.065	-0.081	0.076	-0.114	0.093	-0.136
	(0.087)	(0.097)	(0.103)	(0.114)	(0.088)	(0.098)
Bond inflow ×		0.090***		0.117***		0.145***
Intensity		(0.024)		(0.028)		(0.027)
N	161,772	157,525	161,772	157,525	161,772	157,525
Adj. R2	0.311	0.311	0.300	0.300	0.285	0.286

(3)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Money market	0.248***	0.103	0.314***	0.130	0.208***	-0.019
inflow	(0.072)	(0.083)	(0.092)	(0.103)	(0.076)	(0.089)
		0.091***		0.117***		0.146***

Money market inflow × Intensity		(0.024)		(0.028)		(0.027)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.285

(4)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Collective investments inflow	0.281***	0.162**	0.370***	0.212**	0.206***	0.001
	(0.057)	(0.071)	(0.069)	(0.084)	(0.059)	(0.078)
Collective investments inflow × Intensity		0.070***		0.094***		0.130***
		(0.025)		(0.029)		(0.029)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.284

(5)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Derivatives inflow	0.164***	0.010	0.241***	0.039	0.121**	-0.112
	(0.046)	(0.061)	(0.055)	(0.072)	(0.050)	(0.068)
Derivatives inflow × Intensity		0.095***		0.126***		0.147***
		(0.023)		(0.027)		(0.026)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.284

(6)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Commercial credits inflow	0.287***	0.178***	0.381***	0.239***	0.263***	0.064
	(0.065)	(0.062)	(0.074)	(0.071)	(0.077)	(0.075)
Commercial credits inflow × Intensity		0.063***		0.082***		0.118***
		(0.022)		(0.025)		(0.025)
N	170,374	165,763	170,374	165,763	170,374	165,763
Adj. R2	0.310	0.311	0.299	0.299	0.284	0.285

(7)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Financial credits inflow	0.209***	0.084	0.278***	0.122**	0.156***	-0.034
	(0.041)	(0.051)	(0.050)	(0.062)	(0.042)	(0.054)
Financial credits inflow × Intensity		0.074***		0.093***		0.117***
		(0.018)		(0.021)		(0.020)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.284

(8)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Direct investment inflow	-0.017	-0.155***	0.001	-0.160**	-0.025	-0.237***
	(0.047)	(0.053)	(0.062)	(0.069)	(0.043)	(0.048)
Direct investment inflow × Intensity		0.085***		0.100***		0.128***
		(0.017)		(0.019)		(0.018)
N	170,375	165,764	170,375	165,764	170,375	165,764
Adj. R2	0.310	0.311	0.298	0.298	0.283	0.285

(9)	*ln(PATENT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
Real estate inflow	0.010	-0.089	0.000	-0.085	-0.000	-0.036
	(0.051)	(0.061)	(0.067)	(0.076)	(0.055)	(0.066)
Real estate inflow × Intensity		0.053***		0.045**		0.017
		(0.018)		(0.020)		(0.021)
N	170,374	165,763	170,374	165,763	170,374	165,763
Adj. R2	0.310	0.310	0.298	0.298	0.283	0.284

Table OA4. Robustness Tests

Note: This table reports the robustness tests of capital account liberalization on firm innovation. Panel A shows the robustness of our baseline results as well as identification tests to additional control variables. Specifically, we control for the level of GDP per capita (*Ln(GDPPC)*), creditor rights protection (*Creditor Rights*), stock market development (*Sock MCAP/GDP*), equity market liberalization (*Equity Liberalization*), intellectual property rights protection (*IPR Protection*), inflows and outflows of foreign direct investment (*FDI Inflow & FDI Outflow*), and insider trading law enforcement (*InsiderTrade*). Panel B presents the baseline estimation results using alternative fixed effects. Panel C presents the impacts of exposure to capital account liberalization on firms' innovation using alternative measures of innovation quality. The main independent variable is the capital account liberalization (*KA*) index from Fernández et al. (2016). The dependent variables are the following innovation indicators: *Generality*, *Originality*, *Citations Per Patent,* and Backward citations to foreign patents (*Cited Foreign*). We also show the effect of liberalization on R&D spending (logarithm value). Panel D shows the baseline regressions using two alternative indices of capital account liberalization: *KAOPEN* from Chinn and Ito (2008), and a de facto financial openness measure *Investability* from Edison and Warnock (2003). Panel E shows the robustness of our identification regression using two alternative measures of innovation intensity. We obtain two related measures directly from Levine, Lin, and Wei (2017): *R&D Intensity* is the averaged SIC 2-digit industry level of annual growth in R&D expenses of US publicly listed firms; *Innovate Propensity* is the innovation propensity measured as the SIC 2-digit industry level averaged number of patents filed by US publicly listed firms. All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Additional control variables

	(1) *ln(PATENT)*	(2) *ln(FAMPAT)*	(3) *ln(CITEPAT)*	(4) *ln(PATENT)*	(5) *ln(FAMPAT)*	(6) *ln(CITEPAT)*
KA × Intensity				0.066***	0.077***	0.111***
				(0.025)	(0.027)	(0.023)
KA	0.356***	0.540***	0.317***	0.159	0.309**	-0.021
	(0.098)	(0.123)	(0.110)	(0.117)	(0.142)	(0.127)
Ln(GDPPC)	0.360***	0.403***	0.388***	0.438***	0.509***	0.510***
	(0.094)	(0.106)	(0.108)	(0.094)	(0.108)	(0.107)
Stock MCAP/GDP	0.015	0.014	0.012	0.025	0.029	0.010
	(0.012)	(0.015)	(0.013)	(0.018)	(0.023)	(0.019)
⊿Creditor Rights	-0.110*	-0.086	-0.065	-0.013	-0.074	-0.068
	(0.064)	(0.072)	(0.071)	(0.111)	(0.141)	(0.126)
Equity Liberalization	-0.430***	-0.427***	-0.526***	-0.325**	-0.333**	-0.447***
	(0.116)	(0.134)	(0.107)	(0.136)	(0.156)	(0.132)
IPR Protection	0.121	0.123	0.084	-0.056	-0.108	-0.158
	(0.110)	(0.126)	(0.098)	(0.109)	(0.127)	(0.100)
FDI Inflow	-0.293	-0.466	-0.039	2.572***	2.925***	2.496***
	(0.311)	(0.381)	(0.315)	(0.561)	(0.702)	(0.587)
FDI Outflow	0.386	0.687**	0.204	-1.300*	-1.410	-1.017
	(0.261)	(0.338)	(0.312)	(0.731)	(0.942)	(0.735)

InsiderTrade	-0.811*	-1.674***	1.694***	-0.816*	-1.645***	1.794***
	(0.471)	(0.573)	(0.122)	(0.489)	(0.594)	(0.130)
Ln(GDPPC) × Intensity				-0.046***	-0.058***	-0.060***
				(0.014)	(0.017)	(0.014)
Stock MCAP/GDP × Intensity				-0.002	-0.005	0.003
				(0.009)	(0.011)	(0.009)
⊿Creditor Rights × Intensity				-0.067*	-0.049	-0.012
				(0.039)	(0.041)	(0.034)
Equity Liberalization × Intensity				-0.051	-0.001	-0.011
				(0.053)	(0.070)	(0.063)
IPR Protection × Intensity				0.119***	0.148***	0.148***
				(0.028)	(0.034)	(0.028)
FDI Inflow × Intensity				-1.714***	-2.084***	-1.631***
				(0.330)	(0.396)	(0.354)
FDI Outflow × Intensity				1.020**	1.353**	0.927**
				(0.453)	(0.579)	(0.465)
InsiderTrade × Intensity				0.015	-0.006	-0.045**
				(0.018)	(0.020)	(0.019)
Intensity				-0.006	-0.014	-0.074***
				(0.031)	(0.035)	(0.027)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	143,521	143,521	143,521	139,649	139,649	139,649
Adj. R2	0.320	0.308	0.294	0.322	0.309	0.296

Panel B. Alternative fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
KA	0.583***	0.778***	0.599***						
	(0.120)	(0.154)	(0.125)						
KA × Intensity				0.054***	0.049**	0.079***	0.171***	0.195***	0.239***
				(0.020)	(0.023)	(0.024)	(0.032)	(0.041)	(0.038)
Intensity				-0.041**	-0.034*	-0.056***			
				(0.017)	(0.019)	(0.021)			
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Firm FE	Yes	Yes	Yes	Yes	Yes	Yes			
Year FE	Yes	Yes	Yes						
Country-Year FE				Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE							Yes	Yes	Yes
N	170,375	170,375	170,375	165,719	165,719	165,719	165,748	165,748	165,748
Adj. R2	0.824	0.784	0.802	0.830	0.788	0.808	0.316	0.303	0.290

Panel C. Alternative measures of innovation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Generality	*Originality*	*Citations Per Patent*	*Cited Foreign*	*R&D Spending*	*Generality*	*Originality*	*Citations Per Patent*	*Cited Foreign*	*R&D Spending*
KA × Intensity						0.116***	0.154***	0.043***	0.136***	0.149***
						(0.018)	(0.021)	(0.008)	(0.021)	(0.041)
KA	0.170***	0.402***	0.277***	0.191***	0.453*	-0.009	0.164**	0.205***	-0.016	0.194
	(0.051)	(0.073)	(0.066)	(0.064)	(0.256)	(0.061)	(0.078)	(0.067)	(0.072)	(0.271)
Intensity						-0.067***	-0.118***	-0.046***	-0.081***	-0.157***
						(0.014)	(0.017)	(0.009)	(0.019)	(0.037)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	170,375	170,375	69,238	170,375	76,819	165,764	165,764	68,110	165,764	76,108
Adj. R2	0.290	0.303	0.216	0.211	0.714	0.292	0.304	0.218	0.212	0.714

Panel D. Alternative measures of capital account liberalization

	(1)	(2)	(3)	(4)	(5)	(6)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
KAOPEN	0.185*	0.289**	0.058			
	(0.112)	(0.138)	(0.115)			
Investability				0.187**	0.205**	0.194**
				(0.081)	(0.102)	(0.076)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	162,634	162,634	162,634	13,550	13,550	13,550
Adj. R2	0.310	0.298	0.284	0.187	0.189	0.163

Panel E. Alternative measures of innovation intensity

	(1) *ln(PATENT)*	(2) *ln(FAMPAT)*	(3) *ln(CITEPAT)*	(4) *ln(PATENT)*	(5) *ln(FAMPAT)*	(6) *ln(CITEPAT)*
*KA*R&D Intensity*	1.240***	1.805***	1.504***			
	(0.118)	(0.157)	(0.118)			
*KA*Innovate Propensity*				0.311***	0.443***	0.387***
				(0.051)	(0.052)	(0.050)
KA	0.381***	0.496***	0.254**	0.441***	0.589***	0.322**
	(0.118)	(0.144)	(0.120)	(0.123)	(0.151)	(0.127)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	149,723	149,723	149,723	149,695	149,695	149,695
Adj. R2	0.322	0.310	0.297	0.322	0.310	0.297

Table OA5. Subsample Analyses

Note: This table reports several subsample analyses of capital account liberalization on firm innovation. Panel A depicts the estimation results based on subsamples by developed vs. emerging markets. Panel B presents the results when dividing the sample based on World Bank region classifications: Europe, East Asia-Pacific, America, and other regions. Panel C reports the main results on the sample excluding some specific countries: removal of countries with no change in *KA* index, excluding United States, and excluding China. Panel D shows our main results using the subsample of pure domestic firms (firms that have never being cross-listed in any foreign markets). Panel E shows the estimation results for a subsample of firms with high Innovation Efficiency (IE) in highly innovative sectors. All explanatory variables are lagged by 1 year. Time-varying firm-level and country-level control variables, as reported in Table 3, are included in the regression but not reported here for brevity. Standard errors in parentheses are robust to heterogeneity and clustered by country and year. ***, **, and * indicates significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Subsample by developed vs. emerging markets

	(1)	(2)	(3)	(4)	(5)	(6)
	Developed	Emerging	Developed	Emerging	Developed	Emerging
	ln(PATENT)	*ln(PATENT)*	*ln(FAMPAT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(CITEPAT)*
KA	0.397***	0.689***	0.598***	0.733***	0.366***	0.576***
	(0.080)	(0.210)	(0.102)	(0.252)	(0.080)	(0.207)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	142,517	27,858	142,517	27,858	142,517	27,858
Adj. R2	0.325	0.254	0.310	0.214	0.298	0.210
Test of Difference	$\beta^{(1)} = \beta^{(2)}$		$\beta^{(3)} = \beta^{(4)}$		$\beta^{(5)} = \beta^{(6)}$	
p-value	0.1922		0.6212		0.3436	

Panel B. Subsample by different regions

	Europe		East Asia Pacific		America		Other Regions	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(PATENT)	*ln(CITEPAT)*	*ln(PATENT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(CITEPAT)*
KA	0.278***	0.158	0.958***	1.049***	-0.075	-0.043	0.176	0.090
	(0.103)	(0.108)	(0.188)	(0.189)	(0.127)	(0.145)	(0.176)	(0.186)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	29,813	29,813	67,252	67,252	62,553	62,553	10,757	10,757

Adj. R2	0.323	0.303	0.361	0.336	0.292	0.270	0.198	0.182

Panel C. Removal of specific countries in the sample

	Removal of countries with no change in KA index			United States excluded			China excluded		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
KA	0.559***	0.762***	0.484***	0.571***	0.784***	0.495***	0.329***	0.496***	0.262***
	(0.120)	(0.147)	(0.124)	(0.113)	(0.139)	(0.119)	(0.072)	(0.093)	(0.073)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	166,990	166,990	166,990	114,315	114,315	114,315	156,997	156,997	156,997
Adj. R2	0.311	0.299	0.284	0.326	0.315	0.295	0.319	0.306	0.293

Panel D. Subsample: Pure domestic firms vs. firms with foreign exposure

	Pure Domestic Firms			*Firms with Foreign Exposure*		
	(1)	(2)	(3)	(4)	(5)	(6)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*
Capital Inflow	0.276**	0.386**	0.253**	-0.104	-0.030	-0.030
	(0.123)	(0.151)	(0.111)	(0.140)	(0.177)	(0.142)
Capital Outflow	0.043	0.094	-0.043	0.104	0.208	0.110
	(0.110)	(0.135)	(0.087)	(0.128)	(0.167)	(0.121)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	86,948	86,948	86,948	83,200	83,200	83,200
Adj. R2	0.234	0.224	0.209	0.364	0.352	0.340

Panel E. Subsample: Firms with high Innovation Efficiency (IE) in highly innovative sectors

	IE: *Patents/R&D Capital*			IE: *Citations/R&D Capital*		
	(1)	(2)	(3)	(4)	(5)	(6)
	ln(PATENT)	*ln(FAMPAT)*	*ln(CITEPAT)*	*ln(PATENT)*	*ln(FAMPAT)*	*ln(CITEPAT)*

KA × High IE	0.714***	0.721***	0.726***	0.518***	0.456***	0.552***
	(0.138)	(0.115)	(0.134)	(0.128)	(0.091)	(0.102)
High IE	1.009***	1.426***	1.016***	1.317***	1.855***	1.405***
	(0.104)	(0.094)	(0.108)	(0.099)	(0.074)	(0.085)
KA	-0.652***	-0.535***	-0.678***	-0.355***	-0.155	-0.388***
	(0.147)	(0.196)	(0.174)	(0.133)	(0.179)	(0.136)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	73,303	73,303	73,303	73,305	73,305	73,305
Adj. R2	0.553	0.526	0.521	0.577	0.554	0.567