

Financial Innovation and Real Innovation[☆]

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Abstract

We investigate whether firm's adoption of financial innovation, the use of derivative products, increases the quantity and quality of firms' real innovation, measured with patent based metrics. We employ an instrumental variables specification, using the 1987 introduction of the International Swaps and Derivatives Association (ISDA) Master Agreement and proximity to financial centers to instrument for a firm's use of derivatives. We find that the use of derivatives increases the level of real corporate innovation. The driving mechanism behind the relationship is risk management. Risk management decreases the variability of firms' cash flows, leading to more investment in R&D and more innovation.

Keywords: Innovation, Derivatives, Distance, Risk management

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1. Introduction

The last four decades have witnessed a wave of financial innovation. A considerable portion of this innovation has come from the emergence of derivatives markets. The market for over-the-counter (OTC) derivatives, for instance, has grown dramatically since the first “cross currency swap” arranged between IBM and the World Bank in 1981. Reports from the Bank for International Settlements show that the notional value of OTC derivatives contracts outstanding at the end of 2014 was US \$630 trillion, which was eight times greater than global output and 6.5 times larger than outstanding debt securities.

Many, like Merton (1992), argue that financial innovation is the engine behind real economic growth. New financial securities help firms raise capital which may not be forthcoming from traditional financing routes. Moreover, improving risk management via the use of customized derivative instruments reveals areas of firm underinvestment. Thus, to the extent that hedging can reduce cash flows variability, which disturbs both financing and investment, it can increase the value of the firm and its innovation (Froot et al. (1993)).⁴ Does financial innovation enhance real innovation?

To address this question we use financial derivatives instruments as a proxy for financial innovation and examine a period when the derivatives business was in its infancy, the mid-1980s. The International Swaps and Derivatives Association (ISDA) was formed in 1985 by ten swap dealers in order to create some common standards when trading swaps.⁵ Two years later, in 1987, ISDA introduced the Master Agreement, a standardized documentation that brought all bilaterally negotiated derivative instruments under the sheltering-umbrella terms of a central, legally enforceable relationship. The introduction of the Master Agreement

⁴Alternatively, the effect could even be reversed wherein high-value projects create demand for more efficient financial securities which then arise endogenously (Michalopoulos et al. (2015)).

⁵“ISDA played a major role in the development and maturation of the OTC derivatives markets and continues to make important contributions through coordinating efforts to mitigate the legal risks, counterparty credit risks, and operational risks that use of these instruments entails.” Alan Greenspan, Chairman (1987-2006), Federal Reserve.

led to the reduction in transaction costs, legal fees, and expected default costs associated with trading currency and interest-rate OTC derivatives contracts.⁶ We argue that this introduction was an exogenous shock to the costs of hedging using such derivatives.

Using a hand collected panel dataset of 1,877 U.S. firms from 1977 to 2001, we investigate whether firms' use of derivatives increases the quantity and quality of firms' real innovation. We estimate a difference-in-differences specification, where the first difference exploits the introduction of the 1987 ISDA Master Agreement. We then compare users versus non-users of derivatives. To address the concern that the use of derivatives might be endogenous, we use the distance of firm headquarters to the nearest financial center as an instrument for derivatives use.⁷ The treatment firms are firms located close to financial centers, the control are firms, which are far away.

The location of headquarters is relevant for our analysis because most important financial decisions, such as hedging, are finalized there (Servaes, Tamayo, and Tufano (2009)). Further, previous literature has argued that financial centers are efficient, centralized locations for lending, clearing of payments, and quick and easy access to the knowledge and services of complementary and competitive institutions (Reed (1980)). Intuitively, we expect that firms which have headquarters closer to financial centers and derivatives dealers, are more likely to use derivatives compared to firms headquartered farther away. Given that currency derivatives were relatively new financial instruments at the time, traded predominantly in OTC markets, we argue that proximity to dealers or investment banks enables access to derivatives. Following previous literature, we define financial centers as cities with the maximum number of bank branches of the world's top 300 commercial banks in 1985.⁸

⁶See Flanagan (2001) for details related to agreements for OTC derivatives and costs of drafting such agreements.

⁷Users of derivatives may have unobservable differences from non-users of derivatives. These unobservable differences may drive both their derivatives usage policy and their innovation output, thereby, leading us to the incorrect conclusion of a causal impact of derivatives usage on innovation.

⁸Choi et al. (1986) find fourteen financial centers and rank them based on the number of bank branches in 1975 and 1985. We use the list of financial centers in 1985 in our main analysis.

For the instrument to be valid, it needs to satisfy the exclusion restriction, that is, the instrument should affect innovation activity only through the derivatives usage choice. Existing research on the geography of innovation has documented that innovative firms tend to cluster in urban areas due to the availability of labor, the mobility of labor, and the presence of other small, innovative firms (Doms et al. (2010), Glaeser et al. (2010), Kerr (2010)). However, our measure of distance is only marginally correlated with distance from an urban area or a city. Our measure of distance captures the proximity to providers of derivatives (and also, providers of capital) but does not coincide with proximity to labor and other small, innovative firms. In other words, firms in large urban areas are as likely to be in the first quartile as they are to being in the fourth quartile based on our measure of distance. Finally, a possible concern with our methodology is that firms that are located far from financial centers are not an adequate control group because they are too different from firms that are located close to financial centers. While we cannot completely eliminate the endogeneity issue we argue that threats to the internal validity of the difference-in-differences estimator cannot come from either permanent differences between the treatment and control firms, or shared trends.⁹

We report three main findings. First, we find that longer distance to a financial center leads to lower currency derivatives usage. This evidence is in line with the existing literature that finds a positive relationship between distance and funding (Giroud (2012), Bernstein, Giroud, and Townsend (2016)). We investigate whether this result can be explained by the fact that larger firms are more likely to use derivatives.¹⁰ Our placebo test using size quartiles, as opposed to distance quartiles, shows no evidence in favor of the size argument.

⁹First, any permanent, i.e., time-invariant, difference between the treatment and control groups is differenced away by the inclusion of the “distance” indicator variable. Second, any common trend affecting both the treatment and control group is also differenced away by the inclusion of the “post” indicator variable (Roberts and Whited (2012)).

¹⁰A number of papers have documented a strong positive correlation between firm size and derivatives use (Nance, Smith and Smithson (1993), Geczy, Minton and Schrand (1997), Rampini, Sufi and Viswanathan (2014) among others).

Second, we show that users of currency derivatives are significantly more innovative compared to non-users in the post-1987 period. The effect is economically sizable: derivatives users have, on average, more than 20% more patents compared to non-users. The difference in innovation between users and non-users of derivatives is even higher, 49%, when we test for the quality of innovation, measured by the number of citations to granted patents. The results are robust to controlling for firm characteristics such as firm size, leverage, profitability, tangibility, industry concentration, and age. We also control for time-invariant firm-level characteristics (using firm fixed effects), and economy-wide shocks (using year fixed effects). Using IV specifications, we confirm that the use of currency derivatives leads to higher patents and citations in the following year, and two and three years after the current year.

Finally, we try to establish the channel behind the relationship. We assume that without hedging, firms face some variability in the cash flows generated by assets in place. This variability in internal cash flows results in either: a) variability in the amount of money raised externally, or b) variability in the amount of investment. If it is costly or impossible for the firm to raise external finance, the variability in cash flows will disturb both investment and financing plans in a way that is costly to the firm (Froot et al. (1993) and Lessard (1990)). Hence, if hedging reduces the variability of cash flows it can increase overall investment and this can have a positive knock-on effect on firm innovation.

To test the above channel, we first investigate whether the relationship between derivatives use and innovation is stronger for firms, which have higher variability in cash flows prior to 1987. We categorize firms into two subsamples, Low CF variability and High CF variability, based on their pre-1987 cash flows exposure to foreign currency. Consistent with our hypothesis, we find a positive and statistically significant effect of derivatives use on firm innovation only for the subsample of high cash flows variability firms.¹¹

¹¹We perform two additional tests, where we categorize firms into subsamples based on the: 1) sensitivity

We next examine whether the relationship between derivatives use and innovation is more pronounced for firms that find it more difficult to raise external finance. We classify firms into two subsample, Low cost of external capital and High cost of external capital, based on their pre-1987 loan issues and credit ratings.¹² In support of our hypothesis, we find that the positive effect of derivatives use on innovation occurred primarily among firms which find external financing more costly.

Finally, we test whether the correlation between derivatives use and innovation is stronger for financially constrained firms. We classify firms as financially constrained, or unconstrained using three alternative measures of financial constraints, the Kaplan-Zingales index, cash/assets ratio, and property, plant and equipment to assets ratio. The results provide some evidence that financially constrained firms (those more dependent on external financing) are more likely to benefit from the use of derivatives. Firms that use derivatives are able to reduce cash flow fluctuations and lower firms' financial constraints. Our results suggest that by reducing the risk of existing, traditional investment projects, firms generate more stable cash flows and divert more internal resources to innovative projects.

This paper contributes to two strands of literature. First, the paper is related to the real effects of hedging and derivatives use. A significant body of empirical literature studies how firms use derivatives. Examples include broad cross-sectional analyses (Nance, Smith and Smithson (1993), Mian (1996), Geczy, Minton, and Schrand (1997), Graham and Smith (1999), Guay (1999), Allayannis and Ofek (2001), Graham and Rogers (2002), Guay and Kothari (2003), Bartram, Brown and Fehle (2009), Bartram, Brown and Conrad (2011), Bretscher et al. (2016)), as well as specific industries such as gold mining (Tufano (1996), (1998), and Petersen and Thiagarajan (2000)) and the oil and gas industry (Haushalter

of their equity returns to foreign-exchange index prior to 1987; 2) standard deviation of their equity returns prior to 1987. We find similar results. The effect is more pronounced for the subsample of firms with higher returns variability prior to 1987.

¹²We identify firms to have a low cost of external capital if: 1) they raised a syndicated loan before 1987; 2) they had a long term credit rating prior to 1987.

(2000), Jin and Jorion (2006), Doshi et al. (2015)). A number of papers provide evidence that firms indeed use derivatives to hedge certain exposures and, thereby reduce future constraints on profitable investment opportunities. Perez-Gonzales and Yun (2013) document that energy utilities are able to use weather derivatives to reduce distortions in future investments. Campello et al. (2011) find that hedgers pay lower interest rate spreads and are less likely to face restrictions on capital expenditures. In this paper, we choose to focus on another aspect of growth which may be affected by firms' usage of derivatives. We look at manufacturing or "real" innovation carried out by firms and examine whether derivatives usage by firms affects innovative activity.

Second, our paper contributes to the literature on finance and innovation. This literature studies the effect of market characteristics including banking deregulation (Cornaggia et al. (2015), Amore, Schneider, Zaldokas (2013), and Chava et al. (2013)), bankruptcy laws (Acharya and Subramanian (2009)), labor laws (Acharya, Baghai and Subramanian (2013), and (2013)), competition (Aghion et al. (2005)), credit markets (Hsu, Tian and Xu (2014)), banking relationships (Hombert and Matray (2016)), and liquid options markets (Blanco and Wehrheim (2016)) on innovation. We add to the evidence on capital market constraints and innovation by providing evidence of a new channel behind our findings, i.e., risk management and its effect on innovation.

The rest of our paper is organized as follows. Section 2 describes some institutional details of the OTC derivatives markets and the ISDA Master Agreement. Sections 3 and 4 describe the empirical methodology and data, respectively. Section 5 examines the impact of derivatives use on innovation using a naive regression of usage on innovation. Section 6 presents the main results of the paper, examining the impact of currency derivatives on innovation, and robustness tests. Section 7 examines potential channels through which derivatives can affect firm innovation. Section 8 concludes.

2. Over-the-Counter Financial Derivatives

Derivative markets exist because of high trading (or other related) costs or trading restrictions in the market for the underlying asset. Derivatives are traded either on organized exchanges or over-the-counter. OTC derivative contracts are privately negotiated contracts between two parties. Exchange-traded contracts are standardized contracts executed over an exchange such as the Chicago Mercantile Exchange, the world's largest derivatives exchange.

The key advantage of OTC contracts is the unlimited flexibility in designing the contract. One of the main disadvantages of OTC contracts is that both the buyer and the seller must spend time and effort in identifying each other. Another disadvantage of OTC contracts is credit risk, or the possibility that the counter-party will renege on future contractual obligations. In order to deal with these disadvantages, the early derivatives trades were mostly carried out on organized exchanges.¹³ From the late 1800s to the early 1980s, the majority of derivatives trading continued to take place over such exchanges. The growth of the OTC derivatives market began in the 1980s with the formation of the International Swaps and Derivatives Association.

A notable measure is the size of the OTC derivatives market compared to the exchange-traded derivatives market. One of the earliest reports by the Bank for International Settlements shows that the notional amount of OTC contracts outstanding in June 2000, was US \$94.04 trillion. Thus, OTC contracts represented close to 87% of the gross notional amount on all derivatives contracts.

2.1. International Swaps and Derivatives Association Master Agreement

A typical OTC derivative contract starts with a telephone call between two parties (or brokers, if any are involved) in which the basic economic terms, such as delivery quality,

¹³The first derivatives exchange, the Chicago Board of Trade (CBOT), was formed in the United States in 1848. The earliest derivatives contracts on the CBOT were forward contracts on bushels of corn. Refer Whaley (2006) for a history of the development of financial derivatives markets.

quantity, location, date and price are established. Requirements for credit support, such as collateral requirements, margin and/or guarantee requirements are also established. One party prepares and issues a letter, or historically telex, to the other party which describes the economic terms of the oral agreement and asks for a confirmation in reply. The letter or telex, usually, states that the terms are intended to be binding agreements.

Although the parties intend the initial exchange of terms to constitute binding agreements, these initial agreements do not necessarily contain all the non-economic provisions that most parties require for arrangements that may last over many years in the future. Examples of non-economic provisions include representations and warranties, covenants, events of default, consent to jurisdiction and closing documents. Initial agreements also do not contain provisions for netting of swap payment obligations. These non-economic provisions were first put together into one agreement, the “Master Agreement”, in 1987 by the International Swaps and Derivatives Association (originally the International Swaps Dealers Association), which made all future transactions between two parties relatively simple.

There are a number of reasons to believe that the release of the 1987 Master Agreement came as a surprise to most, if not all, market participants. ISDA began as an informal swap documentation project undertaken by eleven financial institutions. In 1984, a meeting between these eleven institutions was organized to discuss the development of documentation standards to reduce the amount of time and effort spent by swaps dealers in renegotiating non-economic contractual terms. This initial attempt to draft a standard agreement failed.¹⁴ After the initial failure, the group focused on developing standard definitions for terms commonly used in swap agreements. When the definitions were finalized, the group of financial institutions created ISDA as an entity to release the definitions document and hold the copyright. In the early years of ISDA, membership in the organization was limited to

¹⁴See Flanagan (2001) for details of the issue related to the drafting failure. The author documents facts based on interviews with lawyers from Cravath, Swaine and Moore, who were and continue to be ISDA’s primary United States counsel.

swaps dealers only. The membership was expanded to include law firms, accounting firms and end-users of derivatives only in later years. Thus, the internal workings of ISDA was known to a handful of market participants. End-users of derivatives such as non-financial corporations were not members and would have information about legal documents only to the extent that they have existing relationships with derivatives dealers.

The initial drafting of definitions was done by ISDA members based in New York, who continued to publish new and updated definitions until early 1987. In 1987, ISDA members based in London started working on a standard agreement. Most of the members in New York were not part of this exercise. In the spring of 1987, the Master Agreement was released. Given the recent failure to draft a common agreement and the unresolved disagreement across members in New York, the release of the Master Agreement came as a surprise to most members.

The 1987 ISDA Market Agreement changed the ease of entering into and executing OTC transactions, which brought about a surge in the market for OTC derivatives. Essentially, this agreement set up the terms (representations and warranties, obligations, definitions, events of default among others) that the parties will include in any future transactions. In addition, the ISDA Master Agreement allowed for netting payments among all transactions made under the agreement between the parties (called “cross-transaction payment netting”). This reduced transaction costs since numerous swap payments were incorporated into a single payment. Overall, the ISDA Master Agreement brought many benefits, to the parties using interest-rate and currency derivatives, including a reduction in transaction costs, lower legal fees, less legal risk, and reduced default risk.^{15,16}

¹⁵ “The transaction costs are reduced because the parties as a whole make fewer payments. The legal fees are lower because there is less drafting and consequently fewer reviews of contracts. The legal risk is less because the contract forms are carefully drafted and updated in response to litigation and regulatory developments. The default risk is reduced because of close-out netting.” Flanagan S., 2001, Harvard Negotiation Law Review.

¹⁶ Initially the 1987 ISDA Master Agreement applied to interest-rate derivatives and currency derivatives, but in 1992, the agreement was modified to account for all derivatives including those with equity, equity

3. Methodology

The main test evaluates whether an exogenous change in the market for financial innovation leads to a change in real innovation. We use the introduction of the ISDA Master Agreement in 1987 as an exogenous shock to the market for financial innovation.

The “naive” regression specification is the following:

$$y_{it} = \alpha + \beta \cdot user_{it} \cdot post_t + \beta_i \cdot user_{it} + \beta_t \cdot post_t + \beta_X \cdot X_{i,t-1} + \epsilon_{it} \quad (1)$$

where, subscript it denotes observation for firm i in year t . The independent variable, y_{it} is the measure of innovative activity for firm i . The variable, $user_{it}$ is a dummy variable that takes the value one if firm i reports using currency derivatives in year t and zero otherwise and $post_t$ is a dummy variable that takes the value one if the year of observation is after 1987 and zero otherwise. The $X_{i,t-1}$ is the vector of lagged firm characteristics. It also includes macroeconomic variables which affect average patent numbers in the country.

In terms of inference, if we are to obtain unbiased estimates of β then we must be sure that the usage of derivatives is uncorrelated with other determinants of patents and citations. However, we know that both patents count and derivatives usage is correlated with size and investment opportunities. Whenever, the decision to use derivatives is endogenous, OLS based measures of the coefficient β are biased. In this paper, we use both time-series and cross-sectional variation in derivatives usage to overcome these concerns. Because the ISDA Master Agreement was introduced in 1987, we argue that this introduction is an exogenous change in the time-series variation in the costs of hedging currency and interest-rate risks. In addition, we expect that derivatives usage will disproportionately affect firms that were “closer” to the sellers of derivatives in 1987, irrespective of innovative opportunities or innovation policy post-1987. We use physical distance of the firm’s headquarters to the

indices and commodities as underlying assets.

nearest financial center as an instrument for expected derivatives usage in the post-1987 period.

Based on existing literature, we define the list of the world’s largest financial centers in 1985. Choi et al. (1986) compile a list of fourteen cities across the world with the largest number of bank branches of the world’s largest 300 commercial banks. The authors argue that these financial centers are efficient, centralized locations for financial services providers, derivatives dealers and commercial banks included. We obtain the physical distance of the firm headquarters to the nearest financial center, which is a measure of the direct point-to-point aerial transit path, or the distance “as the crow flies”.

Formally, the first-stage of the 2SLS-IV specification is given by:

$$user_{it} = b \cdot dist_i \cdot post_t + b_t \cdot post_t + n_i + a_X \cdot X_{i,t-1} + e_{it} \quad (2)$$

where $dist_i$ measures the distance of the headquarters of firm i from the nearest financial center. This variable proxies for the potential ease of availability of derivatives to the firm after 1987. The variable, $post_t$ is an indicator variable that takes the value of one for the years after 1987, n_i are firm fixed effects and $X_{i,t-1}$ are the vector of lagged control variables.

Next, we use \widehat{user}_{it} to test for the effect of derivatives usage on patents and citations using the second stage specification:

$$y_{it} = \alpha + \beta_{user} \cdot \widehat{user}_{it} + \eta_i + \lambda_X \cdot X_{i,t-1} + \epsilon_{it} \quad (3)$$

where, y_{it} denotes the patent counts and citation counts for firm i , and \widehat{user}_{it} are the predicted values from equation (2). If the conditions for a valid instrumental variable are met, then β_{user} captures the causal effect of derivatives usage on innovation activity. We implement the instrumental variable estimator using two-stage least squares (2SLS).

For the instrument to be valid, it must strongly affect derivatives usage. In the 1980s,

and also now, currency derivatives were (are) predominantly traded over-the-counter. Even after many years of growth in the derivatives markets, the Bank for International Settlements reports that in the year 1998, exchange-traded derivatives accounted for only 0.45% of the total notional amount of currency derivatives outstanding globally.¹⁷ Given the importance of OTC derivatives markets, we argue that being located close to dealer-banks is key for firms to obtain derivatives, especially at the time of introduction of the ISDA Master Agreement. The ISDA agreement reduced expected credit risks in OTC markets. However, we argue that the search costs (the other key costs associated with OTC markets) would be lower for firms closer to dealer-banks and these firms will be more able to benefit from the ISDA Master Agreement.

Other papers have argued the importance of proximity to financiers in obtaining financing. Giroud (2012) finds that plants which are closer to headquarters have higher levels of investment. Bernstein, Giroud, and Townsend (2016) document that firms which are subject to an increase in proximity to venture capital providers, by a reduction in travel time, engage in increased innovation and are more likely to complete an IPO. We use physical distance, travel distance and travel time between firms and dealer-banks as measures of proximity. We assume that proximity to a dealer-bank is a proxy for derivatives use, therefore, banks which are close to dealers are more likely to use derivatives.

The instrument needs to not only affect the likelihood of derivatives usage, but also satisfy the exclusion restriction. The instrument should not affect innovation activity, as measured by patents, through any other channel other than the decision to use (or not) derivatives. Formally, this requires that the instrument should not be correlated to the residuals in equation (1).

¹⁷The Bank for International Settlements publishes a semi-annual report with statistics on OTC derivatives. The earliest available version is dated November 2000. The notional value of exchange-traded contracts in the report is obtained from FOW Tradedata, the Futures Industry Association, and other futures and options exchanges. The total notional amount of currency derivatives traded globally was US\$ 18,011 billion. Exchange-traded contracts amounted to US \$81 billion, around 0.45% of the total notional amount.

Existing literature has identified that there are some places which are more favorable than others for economic activities. Also, we know that urban environments with a spectrum of knowledge resources, and competence profiles of the labor supply create rich opportunities for knowledge transfer, which ultimately result in increased innovation.¹⁸ Although, location is an important determinant of innovative activity, there is heterogeneity in the extent to which firms depend on different inputs for the innovation process. In addition, inputs such as the presence of labor and mobility of labor have been found to be important determinants. Papers have documented that the higher levels of individual education (as opposed to city-level averages), higher number of small firms, and higher mobility of technical workers are positively correlated with levels of entrepreneurship and innovation (Doms et al. (2010), Glaeser et al. (2010), Kerr (2010)). Based on these findings, we argue that the distance of firm headquarters from the nearest financial center does not impact innovation, other than through the channel of derivatives usage.

4. Data Description

The data set is constructed from several data sources combining information on patent data, firms' use of financial derivatives and other firm characteristics. In this section we describe the construction of the sample and our main variables.

The patent data comes from Google patents database which holds the entire history of patents awarded by the U.S. Patent and Trademark Office (USPTO), representing a total of 7.8 million patents. We start with the patents and matched firm identifiers as made available by the authors of Kogan et al. (2015). They have matched all patents in the Google patents database to U.S. firms in the CRSP database.¹⁹ We combine this dataset with firm financial information using the CRSP-Compustat Merged database on WRDS. We focus on granted

¹⁸Backman and Loof (2015) provides a summary of the recent literature on the geography of innovation.

¹⁹We thank the authors for assembling and making the data available to us.

patents applied for in the period 1977-2002, which includes the years when the first two versions of the ISDA Master Agreements were released (1987 and 1992) and also a few years before the 1987 Master Agreement. We exclude firms with negative or zero book values and firms which are in the financial (SIC codes between 6000 and 6799) and utilities (SIC codes between 4900 and 4949) sectors. We also exclude firms for which the headquarter information is not available. The main sample includes 44,329 firm-years based on 1,877 firms that have data for all variables described below.

4.1. Construction of the Dependent Variable

In this paper, we use two types of widely accepted patent-based measures of firm innovative activity that have been shown not only to capture firms' technological contribution but also to be economically meaningful (Hall, Jaffe, and Trajtenberg 2005). The first measure of innovative output, *Pat* is a simple patent count for each firm in each year. However, patent counts do not reflect the importance, or novelty of a patent.²⁰ Therefore, our second metric of innovation, *Cit*, involves measuring the value of a patent by counting the number of citations a patent has received following its approval.

Pakes and Shankerman (1984) show that the distribution of the value of patents is extremely skewed, i.e., most of the value is concentrated in a small number of very important and highly cited patents. Hall et al. (2005) among others demonstrate that patent citations are an accurate measure of the value of innovations. Intuitively, the rationale behind using patent citations to identify important innovations is that, if firms are willing to further invest in a project that is building upon a previous patent, they have to cite that patent. This

²⁰A well-documented issue in the patent literature is that of truncation bias. The truncation bias stems from the lag in patent approval (of about two years) and the general lag in citations. Thus, towards the end of the sample, patents and citations under report the actual patenting activity since many patents, although applied for, might not have been granted, or cited. However, our sample ends in the year 2001 and the patent database extends for 9 more years, upto and including the year 2010. We believe that due to this large gap between the last date in our dataset and the last date of the patents dataset, our results are unlikely to suffer from a truncation bias.

in turn implies that the patent that is cited is technologically influential and economically significant.

4.2. Main Explanatory Variables: Financial Innovation and Distance

We hand-collect data on derivatives usage including and after the year 1987 for all U.S. firms in our database. We use data on usage of currency derivatives. We focus on currency derivatives because this category of derivatives was covered under the 1987 ISDA Master Agreement. Specifically, we use Securities and Exchange Commission (SEC) filings on EDGAR and LexisNexis Academic application, with a list of keywords to identify firms that relied on currency derivatives at least once in the 1985-2001 period.²¹ We use an indicator variable that takes the value of one if the firm is categorized as a currency derivatives user in the year.

We calculate distance of a firm’s headquarters from the nearest financial center as an instrument for derivatives use. We obtain the address of the firm’s headquarters from Compustat.²² We use the address details, including the 5-digit ZIP code, city and state of location of the headquarters to obtain the latitude and longitude corresponding to the location.

Based on the existing literature, we use the following definition of financial centers: cities with the maximum number of bank branches of the world’s top 300 commercial banks (Choi et al.(1986), Reed(1980)). Previous papers argue that these financial centers are efficient, centralized locations for lending, clearing of payments, and quick and easy access to the knowledge and services of complementary and competitive institutions (Nadler et al. (1955),

²¹We use a set of phrases to check for usage - “hedge”, “exchange contract”, “forward exchange contract”, “forward exchange agreement”, “foreign currency option”, “foreign currency swap”, “notional”. We read the relevant part of each 10-K to confirm that the firm uses currency derivatives in the fiscal year.

²²One concern is that Compustat only reports the last state of operations, and we may be unable to observe changes in headquarters that may be endogenous to changes in derivative markets. However, using data from Compact Disclosure database, Pirinsky and Wang (2006) argue that the majority of headquarter changes are driven by mergers and acquisitions. Our results are robust to excluding firm-year observations with sales or asset growth exceeding 100%, which are usually associated with mergers and other restructuring events.

Kindleberger (1974), Duffy and Giddy (1978)). Choi et al. (1986) rank the top financial centers in the world as of 1985. The largest financial centers, ranked by size (highest to lowest), are New York, Tokyo, London, Frankfurt/Hamburg, Hong Kong, Singapore, Paris, Los Angeles/ San Francisco, Milan/Rome, Toronto/Montreal, Brussels, Zurich/Geneva, Amsterdam, and Panama.

We calculate the physical distance between firm headquarters and all financial centers as the length (in kilometers) of the shortest curve between the two points along the surface of a mathematical model of the Earth. Then we obtain the minimum distance, i.e., the distance from the nearest financial center. For robustness, we also calculate the travel distance and travel time by car for all firms which are headquartered in the United States and Canada. We restrict ourselves to firms in North America, which accounts for 97% of the firms in our sample. The travel distance and time are calculated using maps obtained from OpenStreetMap and Open Source Routing Machine (OSRM).²³

4.3. Other Explanatory Variables

The data on total assets, sales, industry Standard Industrial Classification (SIC), R&D expenditures, book equity, book debt, net property plant and equipment, operating income, and firm age comes from the CRSP-Compustat Merged database. In the empirical specification, we follow Hall and Ziedonis (2001) among others, and include firm's sales to control for firm size; profitability to control for the role of internal resources in financing; book leverage, and asset tangibility to control for existing dependence and access to bank credit. Following Aghion, et al. (2005), we control for industry concentration using the Herfindahl index (HI)

²³OpenSteetMap is a project created to provide free, geographic data such as street maps. All maps and routing software are created by volunteers. The maps used in our paper is available for public download at <http://download.geofabrik.de/>. The map of North America downloaded for our paper was updated as on 3 June 2016. OSRM is a high-performance open-source C++ routing engine for shortest routes on road networks that runs with open-source maps from OpenStreetMap. The key benefit of using this method is that it is not based on APIs from third-party providers, such as Google. Therefore, the results can be replicated at any time without the risk of potential changes in APIs due to change in terms of use. The disadvantage is that the maps are not validated by a centralized authority but are maintained by volunteers.

constructed at the 4 digit SIC level. We include a variable that captures the number of years since the firm’s IPO (as reported in CRSP) to control for the firm’s age. In robustness checks, we also use the squared Herfindahl index to control for non-linear effects of industry concentration, and control for the stock of R&D as in Aghion, Van Reenen, and Zingales (2013). All the control variables are lagged by one-year to reduce simultaneity concerns. All continuous variables are winsorized at the 1st and the 99th percentiles to remove the influence of extreme outliers. We cluster our standard errors by firm.

Although the introduction of the ISDA Master Agreement is plausibly exogenous to the investment opportunities of individual firms, other concurrent events can potentially complicate inference. The introduction of the ISDA Master coincided with changes in regulation across the U.S.. While analyzing the effect of currency derivatives, we investigate and test for the implications of these concurrent events. We control for changes in banking regulation: inter-state banking regulation (Black and Strahan (2002)), intra-state banking regulation (Jayaratne and Strahan (1992)), changes in tax regulation (Atanassov and Liu (2015)), and anti takeover-regulation (Atanassov (2013)).

5. Derivatives Usage and Real Innovation

5.1. Descriptive Statistics

Table 1 reports the summary statistics of the variables used in the analysis. Following the literature, our main proxy for innovative activity is the number of patents and citations. The average patent counts for a firm in the sample is 18 patents, with a median of 1 patent. Similarly, the average number of citations for a firm in the sample is 158 citations, with a median of 5 citations. The average (median) firm in the sample has total assets of \$2.111 (\$0.185) million. The average (median) revenue is \$2.171 (\$0.250) million. The mean (median) profitability of firms in the sample is 0.140 (0.144). Mean (median) tangibility ratio is 0.321 (0.291). The average (median) Herfindahl index is around 0.415 (0.357). On average, firms in the sample have been in the CRSP-Compustat database for 24 years.

We use an indicator variable to classify firms as currency derivatives users whenever the SEC filings describe such contracts in the post-1987 period. Table 1 reports information for the post-1987 sample for 12,194 firm-year observations. Currency derivatives are used by 22% of the sample firms. Although our derivatives usage statistics appear to be very low, they compare well with numbers from the literature (Chernenko and Faulkender (2011)).

Table 2, shows the variables we use to capture the proximity of firms in our sample to financial centers in the world. These include: (1) distance (the physical distance between the headquarters of the firm and the nearest financial center), (2) travel distance (the travel distance by car, in 1,000 kilometers, between the firm's headquarters and the nearest financial center using road networks), and (3) travel time (the time, in hours, it takes to travel by car between the firm's headquarters and the nearest financial center).

Table 2, Panel A provides evidence that distances vary substantially. The averages of the distance and travel distance are 667 km and 821 km. Yet the 10th and the 90th percentiles are 28 km and 1,636 km for distance and 47 km and 2,033 km for travel distance. The average travel time between the headquarters of the firm and the nearest financial center is 9 hours. The 10th and the 90th percentiles are 0.65 hours and 21.59 hours, respectively. The correlation coefficients between the variables, distance, travel distance and travel time are high. The correlation between distance and travel distance is 0.9969, between distance and travel time is 0.9968, and between travel distance and travel time is 0.9995. This correlation may be one of the reasons explaining why our results are similar when we use distance or travel distance. Since we are interested in the distance rankings, our main results are based on the distance variable.

In Table 2, Panel B we sort firms into four groups based on the distance from a financial center and present firm and derivatives usage characteristics. Firms in group 1 (4) exhibit the lowest (highest) distance to a financial center. The results reveal that firms which are closest to a financial center are significantly larger compared to firms which are located the farthest. The average revenue differences between groups 1 and 4 is \$0.57 million, significant

at the 1% level. Distant firms are smaller, and their innovation measures are smaller as well. This is consistent with the fact that larger firms may have greater resources available to invest in innovative activities. The difference in natural logarithm of $(1 + \text{Pat})$ between firms in groups 1 and 4 is 0.36, significant at the 1% level. In the case of citations, the difference between firms in groups 1 and 4 is 0.42, also significant at the 1% level. In addition, profitability and tangibility are also changing with distance. The difference in profitability between groups 1 and 4 is -0.008, while the difference in tangibility is -0.075. Both are statistically significant at the 1% level. The net debt/assets ratio, and book leverage are increasing with distance. The difference in net debt/assets ratio between groups 1 and 4 is -0.038, while the difference in book leverage is -0.015. Both are statistically significant at the 1% level. Firms closer to financial centers are more likely to use currency derivatives post-1987. The fraction of currency derivatives users is 0.056, 0.054, 0.058, and 0.047 for firms in groups 1-4 respectively. These results agree with the existing literature on risk management, which reports that smaller size firms hedge less despite facing significant financing frictions and high probabilities of distress.²⁴

Although the summary statistics indicate that proximity to financial centers may enable firms to innovate more, and at the same time maintain less leverage ratios, there may be confounding issues that potentially account for these correlations. In the following sections, we investigate the impact of financial derivatives usage on patents and citations using instrumental variable specifications.

5.2. Multivariate Analysis

We start by estimating the dynamic effects around the event year, 1987. In Figure 1, we re-estimate equation (1), where the variable, *Post*, is replaced by dummy variables for

²⁴A number of papers find a robust positive relationship between firm size and derivatives use: Nance, Smith and Smithson (1993), Geczy, Minton and Schrand (1997), Carter, Rogers and Simkins (2006b) among others. Refer to Rampini, Sufi and Viswanathan (2014) for a review of the literature on hedging and firm size.

each year.²⁵ The figure shows estimations from the year 1985 onwards because there are no declared users of derivatives before the year 1985. Reassuringly, the chart suggests the absence of a trend before 1987. In particular, the level of patents granted to derivatives users is no more than the level of patents granted to non-users. The chart also suggests a lag between the 1987 ISDA Market Agreement introduction and a significant increase in patenting activity by derivatives users. The first year in which the coefficient is significantly different is 1990, three years after the shock. In Figure 2, we estimate a similar model but replace the dependent variable with $\text{Ln}(1 + \text{Cit})$. This figure also suggests the absence of a trend before 1987, i.e., the level of citations received by derivatives users is no more than the level of citations received by non-users.

We then turn to formal, statistical tests of the effect of the 1987 ISDA Master Agreement on the level of innovation. The results are reported in Table 4. Columns (1), (3), and (5) report the estimates of our “naive” regression, where the dependent variables, $\text{Ln}(1 + \text{Pat})_{t+k}$, show patents measured, one, two, and three years after the current year, respectively. We find that users of currency derivatives are more likely to obtain patents as compared to non-users after 1987. The tests include firm fixed effects and controls for $\text{Ln}(\text{Sales})$, Book leverage, Profitability, Tangibility, the Herfindahl Index, Age and for serial correlation by clustering the standard errors at the firm level. Consistent with the literature, we find that larger firms have more patents, while book leverage is negatively correlated with patents. We find that the Herfindahl Index has a significant negative impact on patent counts. Firm age is also negatively related to innovation which implies that older firms are less likely to innovate. The signs of the coefficients for profitability and tangibility also agree with the existing literature. Further, in unreported tests, we obtain similar results if we include year fixed effects (while dropping the variable, Post), positive and significant at the 1% level

²⁵We omit all control variables to alleviate concerns of endogeneity, while standard errors are clustered at the firm level.

coefficient of interest. These results confirm that users of currency derivatives are more likely to apply for (and successfully obtain) patents post-1987 as compared to non-users of currency derivatives.

In Table 5, we use citation counts as the dependent variable. Looking at citations gives us an idea of the quality of innovation. Column (1) shows that users of currency derivatives have more citations as compared to non-users after 1987. The coefficient of interest is positive and significant at the 1% level. The results in columns (3) and (5), show that derivatives users have also more citations two and three years after the current year as compared to non-users. These results suggest that users of currency derivatives are more innovative in the post-1987 period as compared to non-users. A likely hypothesis supporting our results is: derivatives users were able to smooth their cash flows and allocate more resources to more innovative projects as compared to non-users. Derivatives users were, thus, more able to invest in risky technologies. However, we know that both the usage of derivatives and innovative activity are endogenous decisions of the firm. In other words, a firm which uses derivatives may have different innovation opportunities post-1987 when compared to a non-user. These opportunities may drive both, the decision to use derivatives and the decision to invest in “patent-able” technologies. To delineate the causal impact of derivatives usage on patenting activity, we use an instrumental variable.

6. Innovation Activity

6.1. Instrumental Variable Specifications

Table 3, shows the results of the first stage of the 2SLS-IV estimation. The dependent variable, *Currency derivatives*, is an indicator variable that takes the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. In column (1) we use distance quartiles as a measure of proximity, where firms are sorted into quartiles based on the physical distance between firm headquarters and the nearest financial center.

The variable *Distance quartile 1* denotes the quartile of firms with the smallest average pre-1987 distance. The results show that quartile 1 and quartile 2 firms are 6.7% and 5% more likely to use currency derivatives after 1987 as compared to quartile 4 firms and all firms before 1987. These differences are significant at the 5% and 10% level, respectively. This result suggests that firms with a greater distance between firm headquarters and the nearest financial center, are less likely to use derivatives after 1987. In other words, being physically close to dealer-banks at a financial center increases the likelihood that the firm will have access to derivatives, more specifically, currency derivatives. The high F-statistic suggests the instrument is not weak.

In Table 4, columns (2), (4), and (6) we present the main result of derivatives usage on innovative activity. These columns present 2SLS-IV estimates of the effect of currency derivatives on firm innovation corresponding to the first-stage specifications from column (1), Table 3. These fixed effects specifications show a positive and significant effect of derivatives usage on patents in the first, second, and third year after the current year. The coefficient estimates, 0.451, 0.477, and 0.517, are smallest for the first year after the current year and increase monotonically. They are all statistically significant at the 1% level. Overall, they support the hypothesis that derivatives use results in positive, statistically large effects on innovation.

In Table 5, columns (2), (4), and (6) we present the main result of derivatives usage on quality of innovation. These columns present 2SLS-IV estimates of the effect of currency derivatives on firm innovation corresponding to the first-stage specifications from column (1), Table 3. Table 5, column (2) shows a positive and significant effect of derivatives usage on citations in the first year after the current year. The coefficient is significant at the 1% level. Columns (4), and (6) show that the effect of currency derivatives usage is also positive and significant in the second and third year after the current year. The coefficient estimates 0.966, and 0.995, are statistically significant at the 1% level. These results support the hypothesis that derivatives use results also in higher quality of innovation.

The theoretical literature on derivatives usage documents that hedging using derivatives can reduce the likelihood of negative cash flow outcomes and the probability of bankruptcy (Froot, Scharfstein and Stein (1993)). Recent empirical papers have documented the positive impact of derivatives usage. Perez-Gonzales and Yun (2013) find that firms which are most exposed to weather shocks are most likely to increase firm value when they use weather derivatives. They also find that the more-exposed firms reduce distortions in investment and increase capital expenditure compared to a group of control firms. Campello et al. (2011) also find that derivatives usage can increase firm value through the channel of reduced interest rates and increase in debt capacity. Our main results are in line with existing literature. By reducing cash flow volatility, derivatives usage can, potentially, lead to more allocation of resources to innovative projects. As a result, firms may be more likely to invest in profitable, yet risky ventures such as investments in innovation.

6.2. Robustness Tests

In this section, we present a series of robustness and falsification tests. First we include additional control variables in our main specification. Second, we use alternative definitions of proximity as instruments for derivatives usage, and alternative measures of innovation. Finally, we address issues of endogeneity and do further miscellaneous robustness checks.

6.2.1. Additional Control Variables

We include additional control variables which have been identified by the literature as important determinants of innovation outcomes. Aghion, Van Reenen, and Zingales (2013) argue that not including the stock of R&D implies that the coefficient of the variable of interest on the right-hand side will reflect both the increase in R&D expenditures and the productivity of R&D. The R&D stock is calculated following the 15% depreciation rate used in the literature (Hall, Jaffe, and Trajtenberg (2005)). We have treated missing R&D

expenditures as zero.²⁶ We include the square of the Herfindahl Index to account for non-linear effects of industry competition on innovation. Aghion et al. (2005) argue that firms at low levels of competition may increase innovation to “escape” competition and increase incremental profits from innovation. Whereas, firms in very competitive industries, may reduce innovation because they lag behind the leaders in innovation and cannot obtain incremental profits. We also include the capital-to-labor ratio, following the literature on the production function of patents (Hall and Ziedonis (2001), and Aghion et al., (2013)).

Other state-level changes in regulation have also been documented as determinants of innovative activity. The literature on credit constraints and innovation documents that changes in banking regulation has had a significant impact on the level of patents and citations in the U.S. economy (Amore, Schneider, and Zaldokas (2013), Cornaggia et al. (2015), Chava et al. (2013)). We include state-year fixed effects which account for changes in inter-state, and intra-state banking deregulation in the U.S. and the implementation of the Interstate Banking and Branching Efficiency Act (IBBEA). Changes in tax legislation and state-level anti-takeover legislation also increase the patenting activity of firms (Atanassov and Liu (2015), Atanassov (2013)). We include these legislation changes in our specifications.

Table 6 shows the results from the second stage of the 2SLS-IV estimation, where the first stage has been estimated using the specification in Table 3, column (1). Columns (1) and (2) show the impact of currency derivatives use on the number of patents one year after the current year. The coefficients are positive and significant at the 1% level. Columns (3), (4) and (5), (6) show the impact of currency derivatives use on the level of patents in the second and third year after the current year, respectively. The coefficients in all columns are positive and significant at the 1% level. These results support the main result of the paper - increased derivatives use results in higher innovation outcomes.

²⁶Our results also hold if we use interpolations to replace missing values of R&D (Amore, Schneider, and Zaldokas (2013)).

6.2.2. *Alternative Definitions of Proximity*

Table 7, shows the results from the second stage of the 2SLS-IV estimation using alternative measures of distance between firm headquarters and the nearest financial center. The instrumental variables are based on physical distance, *Distance* (column (1)); travel distance, by car, *Travel dist quartiles* (column (2)), and *Travel dist* (column (3)); and travel time by car, *Time quartiles* (column (4)), and *Time* (column (5)). The corresponding estimates from the first stage estimation are reported in Table 3, columns (2)–(6). The results confirm that firms which are farther away from financial centers are less likely to use currency derivatives in the post-1987 period. For instance, in Table 3, column (2), the coefficient of distance is negative and significant at the 5% level. Moreover, the corresponding 2SLS-IV estimate of the effect of currency derivatives on firm innovation, reported in Table 7, columns (1), confirms that the results continue to hold. Overall, they support the hypothesis that the use of derivatives results in positive, statistically significant effects on innovation.

We find similar results when we use proxy for distance using travel distance by car and travel time by car, instead of physical distance. The results in Table 3 indicate that firms headquartered farther from financial centers are less likely to use derivatives after 1987. Being physically close to dealer-banks at a financial center increases the likelihood that the firm will have access to derivatives, more specifically, currency derivatives. The higher use of currency derivatives leads to positive and statistically significant outcome on firm-level innovation, reported in Table 7.

6.2.3. *Alternative Measure of Innovation*

To confirm that firms that use derivatives not only innovate more (where innovation output is measured using number of patents and number of citations) but also invest more in innovation, we replace the dependent variable in our main specifications with the stock of R&D. The results are reported in Table 8. The dependent variable in columns (1) and (2), $R\&Dstock/Assets_{t+1}$ measures the R&D expenditures in the first year after the current year.

The dependent variables in columns (3)–(4) and columns (5)–(6) measure R&D expenditures two and three years after the current year, respectively. The results, consistent with our previous findings, suggest that users of currency derivatives have higher output of innovation because they are also more likely to invest more in R&D in the three years after 1987, as compared to non-users. Further, in alternative specifications we replace the dependent variable with the number of patents scaled by firms’ R&D expenditures. Consistent with the previous findings, our unreported results show that firms that use derivatives are more efficient in producing innovation after 1987, compared to firms that don’t use derivatives.

6.2.4. *Additional Endogeneity Tests*

Although the introduction of the ISDA Master Agreement was arguably exogenous to individual firms, in Table 9 we examine the robustness of our results by running one key placebo test. We examine the size issue: do larger size firms locate closer to financial centers and have larger number of patents compared to smaller firms?

We create size quartiles based on the average pre-1987 (from 1977 to 1987) revenues of each firm in our sample. The variable *Size quartile 1* denotes the quartile of firms with the smallest average pre-1987 revenues. All other variables are defined as before. Column (1) reports that quartile 1 firms do not show any difference in patents post-1987 as compared to firms in quartiles 2 and 3. In columns (2) and (3), we focus on patents two and three years after the current year, respectively. In both cases, there is no differential impact on quartile 1 firms’ patenting activity compared to quartile 2 and 3 firms post-1987. The coefficient for the variable, *Post* is positive and significant in all the three specifications. These results suggest that, on an average, firms patent more after 1987 as compared to before 1987. However, there is no differential impact of the 1987 ISDA Master Agreement on firms in different size quartiles. This evidence is against the argument that firm size is the causal mechanism behind our main results. Although it is very difficult to address all endogeneity concerns, these results help to alleviate such concerns to a reasonable extent.

6.2.5. Miscellaneous Robustness Checks

This section presents some additional robustness checks. The results are tabulated in the Internet Appendix section of the paper.

Entry and exit of firms. An alternative explanation for our results is that the introduction of the ISDA Master agreement led to an increase in innovation for all firms, but more firms were incorporated close to financial centers after the introduction. In that case, our results could be driven by survivorship bias. To purge the sample of entry and exit effects, we restrict the sample to only those firms that are present during the entire period from 1977 to 1997, which is the period ten years before the introduction of the ISDA agreement until ten years after the introduction of the ISDA agreement. The results are reported in Table I.1. They remain robust although the sample size is reduced by more than 80%.

Technological class fixed-effects. In addition to using firm fixed-effects we control for the existence of any systematic differences across patents' technological fields by rescaling our dependent variables, number of patents and number of citations. Following Hall and Ziedonis (2001), we remove all field effects, by dividing the number of patents and citations by the corresponding field mean. The results are reported in Table I.2. While they are weaker, the results are overall consistent with our main findings.

Universal Banking. A second concern with our instrumental variables specification is that the ISDA Master Agreement was launched in the same year in which the Glass-Steagall Act was partially repealed. Large commercial banks located in New York City were able to offer underwriting services, traditionally, offered by investment banks. As a result, firms located close to investment banks would obtain more banking services from their existing relationship banks, which could, potentially, lead to more funds for innovative activities.

To address this concern, we eliminate firms located in New York state and check whether other firms substantiate our main result. Table I.3 shows the results of the first-stage of the IV regression excluding one state at a time. The coefficient to the variable of interest,

*Distance*Post*, is provided in the table. Eliminating firms headquartered in New York state, we continue to obtain similar results as the main result in our paper. Firms closer to financial centers have a higher likelihood of derivatives use. The results also indicate that no one state entirely drives the main result of the paper.

7. Channel

The evidence presented so far demonstrates that firms closer to financial centers use currency derivatives more frequently. The greater derivatives usage leads to larger number of patents and citations. In this section, we focus on possible mechanism behind these results.

7.1. Risk Management

We investigate whether the reduction in cash flows' variability is the mechanism through which risk management increases firm innovation. We examine whether firms that are more likely to face higher volatility in cash flows in the absence of a suitable hedging instrument, firms with higher exposure to foreign exchange shocks before 1987, benefit more from the lower costs of currency derivatives. In our first test, we estimate the sensitivity of cash flow/assets to changes in an index of foreign currencies using the following specification.

$$\frac{CF_{it}}{A_{it}} = \alpha_i + \beta_i^{FX} \cdot FX_t + \lambda_i \cdot \ln(A_{it}) + \epsilon_t \quad (4)$$

where, CF_{it} is the free cash flow to firm i in year t , A_{it} is the total assets of firm i in year t , and FX_t is the average level of a trade-weighted basket of foreign currencies in year t . In equation (4), we also control for the level of assets (Perez-Gonzalez, and Yun (2013)).

We measure free cash flow as operating income before depreciation minus investment. It is important to subtract investment to obtain a measure of free cash flow because we want to estimate the hedging demand of the firm after operational hedges (Chernenko and Faulkender (2011)). For example, consider a firm whose operating cash flows and investment opportuni-

ties are both positively related with foreign currency changes. This firm is naturally hedged against currency fluctuations and therefore, has less hedging demand for currency derivatives. On the other hand, consider a firm whose operating cash flows are positively correlated and investment opportunities are negatively correlated with foreign exchange changes. For this firm, free cash flows are positively correlated with currency fluctuations and therefore, this firm has higher hedging demand. The difference between these firms arises from the correlation between investment opportunities and currency fluctuations. For this reason we estimate the currency sensitivity of post-investment cash flows.

The estimated coefficient, β_i^{FX} captures the sensitivity of cash flows to currency fluctuations, “CF variability”. Firms can potentially gain from using derivatives irrespective of the sign of these betas. Some firms may benefit if the value of a U.S. dollar reduces vis-a-vis other currencies, while other firms may be negatively affected in the same scenario. As a result, the absolute value of these betas is informative about firms’ hedging opportunities as a function of each variable. We categorize firms as “Low CF variability” if the coefficient, β_i^{FX} is in the first quartile and “High CF variability” if it is in the fourth quartile. Table 10, columns (1) and (2) show the results. The derivatives-innovation relationship is positive and significant for firms with high ex-ante exposures to currency fluctuations. In other words, firms with higher hedging demand prior to 1987 benefited more from the reduction in hedging costs, and were able to obtain more innovation through patents. In contrast, firms with the lowest ex-ante exposure to currency fluctuations do not exhibit significant derivatives-innovation relationship. These firms were not affected by the introduction of the ISDA Master Agreement because they had no need to use these derivatives.

In our second test, we calculate currency exposure using the equity returns of firms. We estimate the betas of firm equity returns to returns on the market and a foreign-exchange

index using the following specification.

$$R_{it} = \alpha_i + \beta_i^C \cdot R_{FX,t} + \beta_i^M \cdot R_{M,t} + \epsilon_t \quad (5)$$

Based on Jorion (1990), we use a trade-weighted basket of foreign currencies of the main trading partner countries of the U.S.. We use the value-weighted CRSP index to calculate market returns. The regression uses monthly data and calculates the returns over a five-year period ending in the 1987 financial year. Based on the coefficient, β_i^C we categorise firms as “Low FX beta” if the absolute value of the coefficient is in the first quartile and “High FX beta” if it is in the fourth quartile. Table 10, columns (3) and (4) show the results. The derivatives-innovation relationship is positive and significant for firms with high betas. For firms with the lowest betas, there is no impact of derivatives usage on innovation.

In the third test, we use a more noisy measure of risk to categorize firms, the standard deviation of equity returns. We calculate the standard deviation of monthly equity returns for each firm for five years before 1987. We categorize firms as “Low SD of returns” if the standard deviation is in the first quartile and “High SD of returns” if it is in the fourth quartile. Table 10, columns (5) and (6) show that firms with more volatile returns patent more, with the use of derivatives, compared to firms with less volatile returns.

Looking further at the impact of derivatives use, we check whether firm’s exposure reduces with derivatives usage. We calculate the beta of equity returns to foreign exchange index returns or FX beta, or β_i^C , as shown in equation (5) for each firm-year using a rolling five-year window. Table 11 reports the results, where FX beta is the dependent variable. In columns (1) and (2) we focus on the subsets of firms categorized as “Low CF variability” and “High CF variability”. If firms with high CF variability were using derivatives for hedging, we should observe a reduction in the FX betas. The results point in the same direction. Firms with high CF variability see no change in the FX betas whereas firms with low CF variability see an increase in their FX betas. In a relative sense, the FX betas of high CF variability

firms increases less with derivatives use. We find similar results in columns (3) and (4), where we focus on the subset of firms categorized as “Low FX beta” and “High FX beta”. Overall, our results provide support for the risk management channel.

7.2. Access to Capital

If it is difficult or impossible for a firm to raise external finance, the variability in cash flows will effect both investment and financing plans in a way that is costly to the firm (Froot et al. (1993)). We examine whether firms with a limited access to external capital prior to 1987, are more likely to benefit from the lower costs of hedging after the ISDA Agreement introduction. An alternative hypothesis is that firms with a better access to capital innovate more because of external financing and not because of risk management.

We capture firm access to external capital using three alternative measures. First, we use the syndicated loans information from the LPC Dealscan database. We classify a firm as one “With loan pre-1987” if the firm had raised a syndicated loan before and including the year 1987. If the firm had not raised a syndicated loan on or before the year 1987, we categorize it as one “Without loan pre-1987”. Table 12, columns (1) and (2) report the results. Firms with limited access to external capital increase patenting more compared to firms with access to capital. Given that the LPC Dealscan reporting is low in the years before and including 1987, we also run the same test with a marginally different definition of access to capital. We categorize firms as those with access to capital if they have raised syndicated loans on or before one to five years from the year of the ISDA Master Agreement. In columns (3) and (4), we report results for firms “With loan pre-1992” (“Without loan pre-1992”) if they raised (did not raise) syndicated loans on or before 1992. The results suggest that firms with a limited access to external capital show a greater increase in innovation.²⁷

In a final test, we use the presence of a credit rating as another proxy for access to capital.

²⁷In unreported tests, we obtain similar results if we define firms with access to capital as those which raised syndicated loans on or before one to four years after 1987.

We categorize a firm as “With credit rating” if the firm has a long-term credit rating before or on 1987. Columns (5) and (6) show the results. Firms without credit ratings increase their innovation more as compared to firms with credit ratings. These results do not support the access to capital channel, and provide additional evidence for the risk management channel.

7.3. Financial Constraints

We also test whether the reduction in financial constraints is the mechanism behind the derivatives-innovation relationship. The argument is that derivatives may reduce volatility of expected future cash flows and reduce financial constraints of firms, thus enabling investment in more risky, innovative projects (Geczy et al. (1997)). To test this hypothesis, we first calculate the average industry-level (as measured by the 3-digit SIC industry code) measure of financial constraints, the Kaplan-Zingales Index. To calculate the index, we follow Lamont, Polk and Saa-Requejo (2001) who use the original coefficient estimates of Kaplan and Zingales (1997). In Table 13, columns (1) and (2) we report the results. We find some evidence that firms in constrained industries have a greater increase in patents as compared to firms in less-constrained industries.

Our second test investigates whether firms with lower cash show a greater increase in patents. Empirical papers in the innovation literature have highlighted the importance of financial constraints on innovation. Rampini, Sufi, and Viswanathan (2014) argue that derivatives use and financing, draw on the same source of collateral with a firm. Due to the requirement of posting cash and high-grade securities as collateral for OTC transactions, we use the availability of cash pre-1987 as a measure of firm-level constraints. We sort firms based on average pre-1987 cash/assets ratio. Firms in the first quartile are categorized as “Low cash” firms and those in the fourth quartile are categorized as “High cash” firms. Columns (3) and (4) show that low cash firms have a higher increase in patents when compared to high cash firms. However, it is unlikely that the difference in coefficients is statistically significant from zero.

In our final test, we investigate whether firms with less tangible assets have a greater increase in innovation compared to firms with more tangible assets. Firms with less tangible assets are less able to collateralize their assets and, therefore, are more likely to face constraints in raising debt capital, before the spread of derivatives in 1987. We sort firms based on their average pre-1987 ratio of property, plant and equipment to assets. We categorize firms as “Low tangibility” if the ratio is in the first quartile and as “High tangibility” if the ratio is in the fourth quartile. Columns (5) and (6) show that firms with less tangible assets have a greater increase in innovation compared to firms with high tangibility of assets. These results provide evidence in favor of the financial constraints channel.

8. Concluding Remarks

Understanding the determinants of innovation is important because innovations establish companies’ comparative advantages (Porter (1992)) and are important drivers of growth (Solow (1957)). A recent literature examines the effect of capital market conditions on the level of innovation. Our paper focuses on the usage of derivatives and its impact on real innovation.

Derivatives are powerful tools for shifting risks. However, the lack of data on derivatives usage by firms has hindered empirical research in identifying the impact of derivatives. In this paper, we address this issue by exploiting, an arguably exogenous change in the market for OTC derivatives which led to a reduction in the costs of derivatives use. Using this natural experiment and data from U.S. firms, we find evidence consistent with the idea that derivatives use leads to an increase in innovation. We find that the use of derivatives is more effective at increasing innovation in firms which are more likely to benefit from risk management. Firms which have higher cash flows volatility are more likely to obtain derivatives, reduce overall risk, and invest in innovation.

- [1] Acharya, V., R., Baghai, and K., Subramanian, 2013, “Labor Laws and Innovation”, *Journal of Law and Economics* 56, 997-1037.
- [2] Acharya, V., R., Baghai, and K., Subramanian, 2013, “Wrongful Discharge Laws and Innovation”, *Review of Financial Studies* 27, 301-346.
- [3] Acharya, V., K., Subramanian, 2009, “Bankruptcy Codes and Innovation”, *Review of Financial Studies* 22, 4949-4988.
- [4] Aghion, P., N., Bloom, R., Blundell, R., Griffith, and P., Howitt, 2005, “Competition and Innovation: An Inverted U Relationship”, *The Quarterly Journal of Economics* 120, 701-728.
- [5] Aghion, P., J., Van Reenen, and L., Zingales, 2013, “Innovation and Institutional Ownership”, *American Economic Review* 103, 277-304.
- [6] Allayannis, G., E., Ofek, 2001, “Exchange Rate Exposure, Hedging and the Use of Foreign Currency Derivatives”, *Journal of International Money and Finance* 20, 273-296.
- [7] Amore, M., D., C., Schneider, and A., Zaldokas, 2013, “Credit Supply and Corporate Innovation”, *Journal of Financial Economics* 109, 835-855.
- [8] Atanassov, J., 2013, “Do Hostile Takeovers Stifle Innovation? Evidence from Anti-takeover Legislation and Corporate Patenting”, *Journal of Finance* 68, 1097-1131.
- [9] Atanassov, J., X., Liu, 2015, “Corporate Income Taxes, Financial Constraints, and Innovation”, Working paper.
- [10] Atanassov, J., V., Nanda, and A., Seru, 2007, “Finance and Innovation: The Case of Publicly Traded Firms”, Working paper.
- [11] Backman, M., H., Loof, 2015, “The Geography of Innovation and Entrepreneurship”, *The Annals of Regional Science* 55, 1-6.
- [12] Bartram, S., G., Brown, and F., Fehle, 2009, “International Evidence on Financial Derivatives Usage”, *Financial Management* 38, 185-206.

- [13] _____, and J., Conrad, 2011, “The Effect of Derivatives on Firm Risk and Value”, *Journal of Financial and Quantitative Analysis* 46, 967-999.
- [14] Bernstein, S., X., Giroud, and R., R., Townsend, 2016, “The Impact of Venture Capital Monitoring”, *Journal of Finance* 71, 1591-1622.
- [15] Black, S., and P., Strahan, 2002, “Entrepreneurship and Bank Credit Availability”, *Journal of Finance* 57, 2807-2833.
- [16] Blanco, I., and D., Wehrheim, 2002, “The Bright Side of Financial Derivatives: Options Trading and Financial Innovation”, *Journal of Financial Economics* forthcoming.
- [17] Bretscher, L., L., Schmid, and A., Vedoli, 2016, “Interest Rate Management in Uncertain Times”, Working paper.
- [18] Campello, M., C., Lin, Y., Ma, and H., Zou, 2011, “The Real and Financial Implications of Corporate Hedging”, *The Journal of Finance* 66, 161-1647.
- [19] Carter, D., D., Rogers, B., Simkins, 2006b, “Does Hedging Affect Firm Value? Evidence from the US Airline Industry”, *Financial Management* 35, 53-86.
- [20] Chava, S., A., Purnanandam, 2007, “Determinants of the Floating-to-Fixed Rate Debt Structure of Firms”, *Journal of Financial Economics* 85, 755-786.
- [21] Chava, S., A., A., Oettl, K., Subramanian, V., Subramanian, 2013, “Banking Deregulation and Innovation”, *Journal of Financial Economics* 109, 759-744.
- [22] Chen, H., P., Gompers, A., Kovner, and J., Lerner, 2010, “Buy Local? The Geography of Successful and Unsuccessful Venture Capital Expansion”, *Journal of Urban Economics* 67, 90-102.
- [23] Chernenko, S., M., Faulkender, 2011, “The Two Sides of Derivative Usage: Hedging and Speculating with Interest Rates”, *Journal of Financial and Quantitative Analysis* 46, 1727-1754.
- [24] Choi, S-R., A., E., Tschoegl, C-M., Yu, 1986, “Banks and the World’s Major Financial Centers, 1970-1980”, *Weltwirtschaftliches Archiv* 122, 48-64.

- [25] Cornaggia, J., Y., Mao, X., Tian, and B., Wolfe, 2015, “Does Banking Competition Affect Innovation?”, *Journal of Financial Economics* 115, 189-209.
- [26] Doms, M., E., Lewis, and A., Robb, 2010, “Local Labor Market Endowments, New Business Characteristics, and Performance”, *Journal of Urban Economics* 67, 61-77.
- [27] Doshi, H., P., Kumar, and V., Yerramilli, 2016, “Uncertainty, Capital Investment and Risk Management”, Working paper.
- [28] Duffy, G., I., Giddy, 1978, “The international Money Market”, *Prentice Hall, New Jersey*.
- [29] Flanagan, S., 2001, “The Rise of a Trade Association : Group Interactions within the International Swaps and Derivatives Association”, *Harvard Negotiation Law Review*.
- [30] Froot, K., D., Scharfstein, J., Stein, 1993, “Risk Management: Coordinating Corporate Investment and Financing Policies”, *The Journal of Finance* 48, 1629-1658.
- [31] Geczy, C., B., Minton, and C., Schrand, 1997, “Why Firms Use Currency Derivatives”, *The Journal of Finance* 52, 1323-1354.
- [32] Giroud, X., 2012, “Proximity and Investment: Evidence from Plant-Level Data”, *The Quarterly Journal of Economics* 128, 861-915.
- [33] Glaeser, E., W., Kerr, and E., Ponzetto, 2010, “Clusters of Entrepreneurship”, *Journal of Urban Economics* 67, 150-168.
- [34] Graham, J., C., Smith, 1999, “Tax Incentives to Hedge”, *The Journal of Finance* 54, 2241-2262.
- [35] Graham, J., D., Rogers, 2002, “Do Firms Hedge in Response to Tax Incentives?”, *The Journal of Finance* 57, 815-839.
- [36] Guay, W., 1999, “The Impact of Derivatives on Firm Risk: An Empirical Examination of New Derivative Users”, *Journal of Accounting and Economics* 26, 319-351.
- [37] Guay, W., S., Kothari, 2003, “How Much Do Firms Hedge with Derivatives?”, *Journal of Financial Economics* 70, 423-461.

- [38] Hall, B., A., Jaffe, and M., Trajtenberg, 2005, “Market Value and Patent Citations”, *RAND Journal of Economics* 36, 16-38.
- [39] Hall, B., R., Ziedonis, 2001, “The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995”, *RAND Journal of Economics* 32, 101-128.
- [40] Haushalter, G., D., 2000, “Financing Policy, Basis Risk and Corporate Hedging: Evidence from the Oil and Gas Producers”, *Journal of Financial Economics* 55, 107-152.
- [41] Hombert, J., and A., Matray, “The Real Effects of Lending Relationships on Innovative Firms and Inventor Mobility”, *Review of Financial Studies* forthcoming.
- [42] Hsu, P., X., Tian, Y., Xu, 2014, “Financial Development and Innovation: Cross-Country Evidence”, *The Journal of Finance* 112, 116-135.
- [43] Jayaratne, J., P., Strahan, 1992, “The Finance-Growth Nexus: Evidence from Bank Branch Deregulation”, *The Quarterly Journal of Economics* 111, 639-670.
- [44] Jin, Y., P., Jorion, 2006, “Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers”, *The Journal of Finance* 61, 813-919.
- [45] Jorion, P., 1990, “The Exchange Rate Exposure of U.S. Multinationals”, *The Journal of Business* 63, 331-345.
- [46] Kaplan, S., N., L. Zingales, 1997, “Do Investment-Cash Flow Sensitivities provide Useful Measures of Financing Constraints?”, *The Quarterly Journal of Economics* 112, 169-215.
- [47] Kerr, W., 2010, “Breakthrough Inventions and Migrating Clusters of Innovation”, *Journal of Urban Economics* 67, 46-60.
- [48] Kindleberger, C., 1974, “The Formation of Financial Centers: A Study in Comparative Economic History”, *Princeton Studies in International Finance* 36.
- [49] Kogan, L., D., Papanikolaou, A., Seru, and N., Stoffman, 2015, “Technological Innovation, Resource Allocation and Growth”, *Quarterly Journal of Economics*, Forthcoming.

- [50] Kortum, S., Lerner, J., 2000, “Assessing the Contribution of Venture Capital”, *RAND Journal of Economics* 31, 674-692.
- [51] Lamont, O., Polk, C., and J., Saa-Requejo, 2001, “Financial Constraints and Stock Returns”, *Review of Financial Studies* 14, 529-554.
- [52] Lerner, J., M., Sorensen, and P., Stromberg, 2011, “Private Equity and Long-Run Investment: The Case of Innovation ”, *The Journal of Finance* 66, 445-477.
- [53] Lessard, D., 1990, “Global competition and corporate finance in the 1990s”, *Continental Bank Journal of Applied Corporate Finance* 1, 59-72.
- [54] Merton, R., C., 1992, “Financial Innovation and Economic Performance”, *Journal of Applied Corporate Finance* 4, 12-22.
- [55] Mian, S., 1996, “Evidence on Corporate Hedging Policy”, *Journal of Financial and Quantitative Analysis* 31(3), 419-439.
- [56] Michalopoulos, S., L., Laeven and R., Levine, 2015, “Financial Innovation and Endogenous Growth”, *Journal of Financial Intermediation* 24, 1-24.
- [57] Nadler, M., S., Heller, S., Shipman, 1955, “The Money Market and its Institutions”, Ronald Press Company, New York.
- [58] Nance, D., C., W., Smith Jr., and C., Smithson, 1993, “On the Determinants of Corporate Hedging”, *The Journal of Finance* 48, 267-284.
- [59] OpenStreetMap contributors, North America Map <http://download.geofabrik.de/north-america.html>, Retrieved 3 June 2016.
- [60] Pakes, A., M., Shankerman, 1984, “The Rate of Obsolescence of Patents, Research Gestation Lags, and the Private Rate of Return to Research Resources”, in Zvi Griliches, ed., *R&D, Patents and Productivity*, University of Chicago Press, 98-112.
- [61] Perez-Gonzales, F., H., Yun, 2013, “Risk Management and Firm Value: The Effect of Weather Derivatives”, *The Journal of Finance* 68, 2143-76.
- [62] Petersen, M., R., Thiagarajan, 2000, “Risk Measurement and Hedging: With and Without Derivatives”, *Financial Management* 5-30.

- [63] Pirinsky, C., Q., Wang, 2006, “Does Corporate Headquarters Location Matter for Stock Returns”, *Journal of Finance* 61, 1991-2005.
- [64] Porter, M., 1992, “Capital Disadvantage: America’s Failing Capital Investment System”, *Harvard Business Review* 70, 65-82.
- [65] Rampini, A., A., Sufi, and S., Viswanathan, 2014, “Dynamic Risk Management”, *Journal of Financial Economics* 111, 271-296.
- [66] Reed, H., C., 1980, “The Ascent of Tokyo as an International Financial Center”, *Journal of International Business Studies* 11, 19-35.
- [67] Roberts, M., R., Whited, T., M., 2012, “Endogeneity in Empirical Corporate Finance”, Working paper.
- [68] Servaes, H., Tamayo, A., and Tufano, P., 2009, “The Theory and Practice of Corporate Risk Management”, *Journal of Applied Corporate Finance* 21, 60-78.
- [69] Solow, R., 1957, “Technical Change and the Aggregate Production Function”, *Review of Economics and Statistics* 39, 312-20.
- [70] Whaley, R., 2006, “Derivatives: Markets, Valuation and Risk Management”, Wiley Finance Series.
- [71] Tufano, P., 1996, “Who Manages Risk? An Empirical Examination of Risk Management Practices in the Gold Mining Industry”, *The Journal of Finance* 51, 1097-1137.
- [72] ———, 1998, “Agency Costs of Corporate Risk Management”, *Financial Management* 27, 67-77.

Figure 1: Effect of the ISDA Master Agreement on Innovation

The figure shows the evolution of innovation around the year of introduction of the ISDA Master Agreement. The specification is the same as equation (1) with $\ln(1 + Pat)$ as the dependent variable, the variable, $Post$ has been replaced by a collection of year fixed effects and there are no controls. The solid dot plots the point estimates and the dashed line plots the 95% confidence interval. Standard errors are clustered at the firm level.

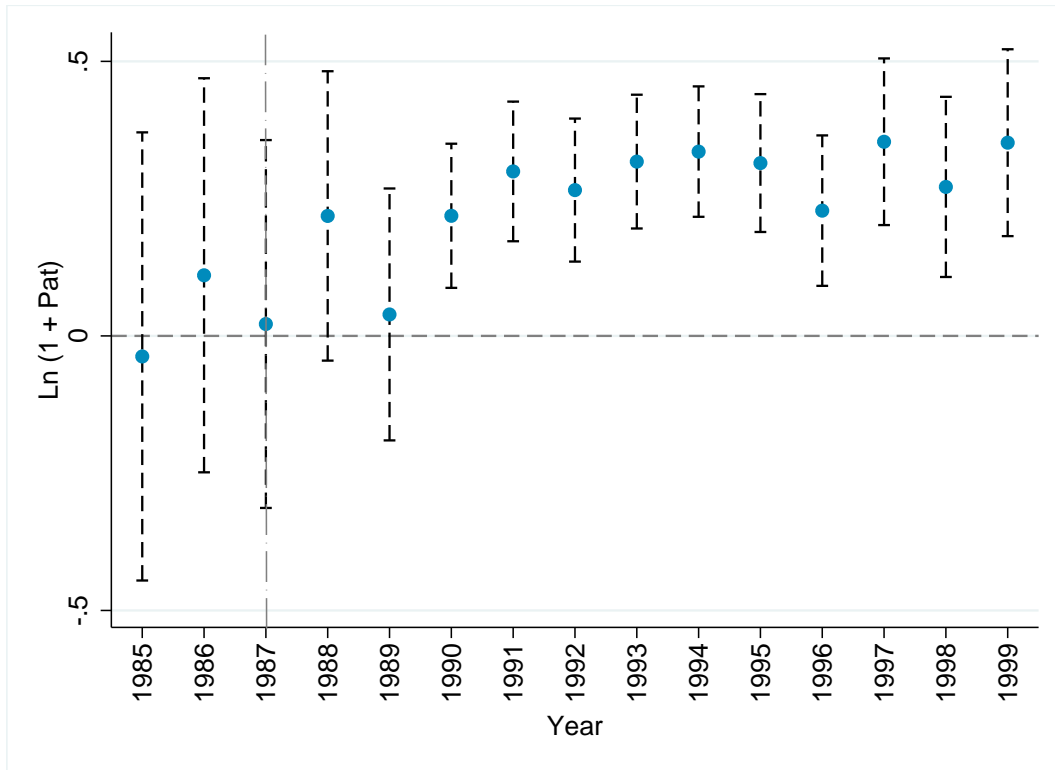


Figure 2: Effect of the ISDA Master Agreement on Innovation Quality

The figure shows the evolution of innovation quality around the year of introduction of the ISDA Master Agreement. The specification is the similar to equation (1) except that the dependent variable is $\ln(1 + Cit)$, the variable, $Post$ has been replaced by a collection of year fixed effects and there are no controls. The solid dot plots the point estimates and the dashed line plots the 95% confidence interval. Standard errors are clustered at the firm level.

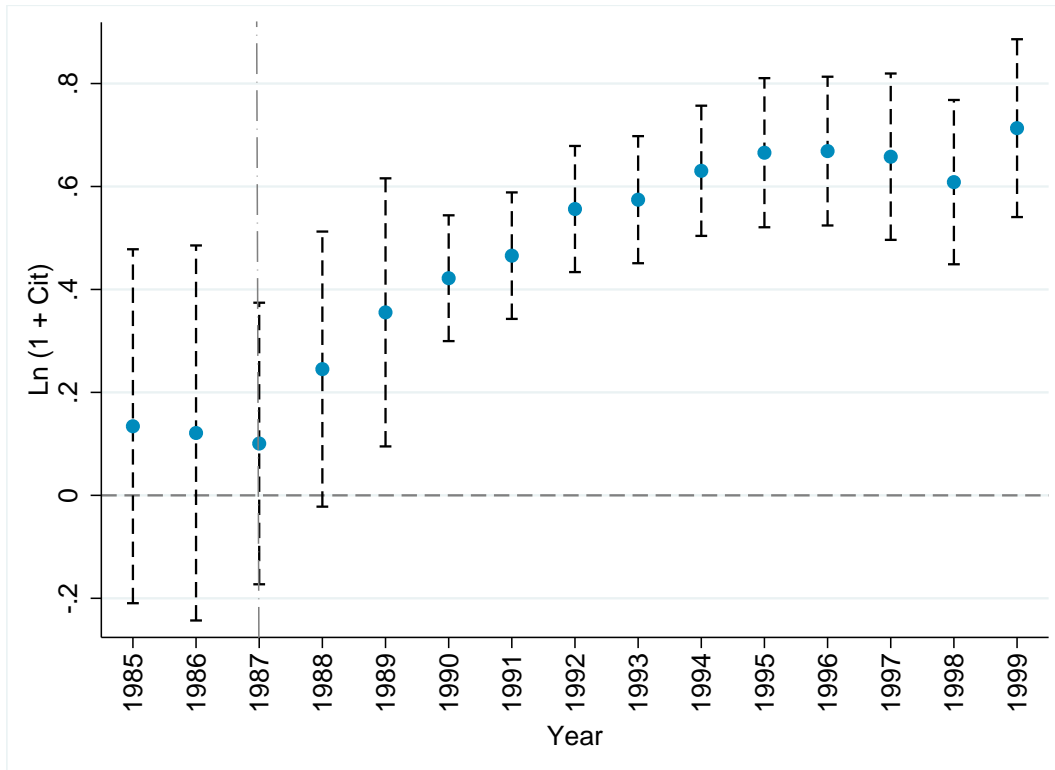


Table 1. Summary Statistics

This table reports summary statistics for key variables used in the analysis. *Assets* and *Sales* of the firm are in US\$ thousands. *R&D/Assets* is research and development expenses of firm to total assets. *Book leverage* is the total debt of the firm to total assets. *Profitability* is defined as ratio of the earnings before interest, tax, depreciation and amortization (EBITDA) to total assets. *Tangibility* is defined as the ratio of net property, plant and equipment to total assets. *Herfindahl* is equal to the sum of the squared share of the firm in total industry sales in a given 4-digit SIC industry in a given year. *Age* is the number of years that the firm has been on the CRSP-Compustat Merged database. *Patents* is the number of patents applied for (and granted) by the firm. *Citations* is the number of citations to the patents owned by the firm. *Currency derivatives* is a dummy variable that takes the value of one if the firm uses currency derivatives in the year. The table reports currency derivatives usage including and after 1987.

	N	Mean	Std. Dev.	Min	p10	Median	p90	Max
Assets	44,329	2,111	9,500	0	15	185	3,891	304,012
Sales	44,329	2,171	8,144	0	19	250	4,341	195,805
R&D/Assets	44,329	0.025	0.036	0.000	0.000	0.009	0.075	0.165
Book leverage	44,329	0.238	0.163	0.000	0.030	0.222	0.455	0.717
Profitability	44,329	0.140	0.095	-0.180	0.031	0.144	0.248	0.391
Tangibility	44,329	0.321	0.173	0.029	0.125	0.291	0.583	0.807
Herfindahl	44,329	0.415	0.235	0.076	0.166	0.357	0.794	1.000
Age	44,329	24	16	0	7	19	53	72
Patents	44,329	18	91	0	0	1	28	3,639
Citations	44,329	158	894	0	0	5	217	46,914
Currency derivatives	12,194	0.222	0.416	0	0	0	1	1

Table 2. Measures of Distance from Financial Centers

This table reports measures of distance between firm headquarters and financial centers. Panel A presents summary statistics. *Distance* is measured as the physical distance, in thousands of kilometers, between the firm headquarters and the nearest financial center (as in Choi et al. (1986)) along the surface of a mathematical model of the Earth. *Travel distance* is measured as the distance on road networks, measured in thousands of kilometers. *Travel time*, measured in hours, is the time taken to travel by road between firm headquarters and the nearest financial center. Panel B reports firm characteristics for firms in different quartiles based on the Distance. Group 1 (2, 3, and 4) represent the first (second, third, and fourth) quartile firms.

Panel A: Measures of distance to financial centers

	N	Mean	Std. Dev.	Min	p10	Median	p90	Max
Distance	1,877	0.667	0.610	0	0.028	0.477	1.636	2.577
Travel distance	1,820	0.821	0.717	0	0.047	0.610	2.033	2.509
Travel time	1,820	9.005	7.712	0.01	0.651	6.752	21.591	27.509

Panel B: Distance groupings, firm characteristics, and derivatives usage

	Group 1	Group 2	Group 3	Group 4	Diff 1 vs. 4	Diff 1&2 vs. 3&4
Sales	1,974.224 (67.965)	1,398.549 (65.292)	1,316.221 (39.684)	1,404.644 (57.041)	569.580*** (89.247)	328.990*** (58.740)
Assets	2,145.916 (99.453)	1,325.212 (85.915)	1,216.326 (44.075)	1,299.032 (49.056)	846.883*** (112.920)	481.883*** (74.297)
Ln(1+Pat)	1.295 (0.016)	1.378 (0.014)	1.300 (0.013)	0.937 (0.013)	0.359*** (0.020)	0.214*** (0.014)
Ln(1+Cit)	2.055 (0.021)	2.270 (0.019)	2.091 (0.018)	1.638 (0.018)	0.417*** (0.028)	0.292*** (0.019)
Profitability	0.141 (0.001)	0.151 (0.001)	0.161 (0.001)	0.149 (0.001)	-0.008*** (0.001)	-0.009*** (0.001)
Tangibility	0.294 (0.002)	0.308 (0.001)	0.337 (0.001)	0.369 (0.002)	-0.075*** (0.002)	-0.052*** (0.002)
Book leverage	0.237 (0.001)	0.217 (0.001)	0.217 (0.001)	0.251 (0.002)	-0.015*** (0.002)	-0.007*** (0.001)
Cash/Assets	0.109 (0.001)	0.096 (0.001)	0.093 (0.001)	0.085 (0.001)	0.023*** (0.001)	0.014*** (0.001)
Net debt/Assets	0.132 (0.002)	0.123 (0.002)	0.127 (0.002)	0.170 (0.002)	-0.038*** (0.003)	-0.020*** (0.002)
Currency derivatives	0.056 (0.002)	0.054 (0.002)	0.058 (0.002)	0.047 (0.002)	0.009*** (0.003)	0.003 (0.002)

Table 3. First Stage

This table reports the first-stage estimates of the effect of distance from financial centers on currency derivatives use. The dependent variable is *Currency derivatives*, a dummy variable taking the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. The instrumental variables are physical distance between firm headquarters and the nearest financial center, *Distance quartiles* (columns (1) and (2)); travel distance, by car, *Travel dist quartiles* (columns (3) and (4)); travel time by car, *Time quartiles* (columns (5) and (6)). The variable, *Post* takes the value one for years after 1987 and zero otherwise. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	Currency derivatives					
	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	OLS (6)
Distance quartile 1 * Post	0.067** (0.030)					
Distance quartile 2 * Post	0.050* (0.029)					
Distance quartile 3 * Post	0.068** (0.029)					
Distance * Post		-0.032** (0.015)				
Travel dist quartile 1 * Post			0.051* (0.031)			
Travel dist quartile 2 * Post			0.057* (0.030)			
Travel dist quartile 3 * Post			0.062** (0.029)			
Travel dist * Post				-0.030** (0.015)		
Time quartile 1 * Post					0.047 (0.031)	
Time quartile 2 * Post					0.058* (0.030)	
Time quartile 3 * Post					0.055* (0.030)	
Time * Post						-0.002* (0.001)
Post	0.149*** (0.019)	0.215*** (0.014)	0.144*** (0.019)	0.209*** (0.016)	0.147*** (0.019)	0.188*** (0.016)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
F-statistic	62.48	69.52	42.38	46.53	38.84	46.52
Observations	44,329	44,329	43,349	43,349	43,349	43,349

Table 4. Impact of Financial Innovation on Number of Patents

This table reports the effect of currency derivatives on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t+k$, $k=1, 2$, and 3 denoting one, two and three years after the current time period, t . Columns (1), (3), and (5) report estimates of an Ordinary Least Squares (OLS) model, where *Currency derivatives* is a dummy variable taking the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. Columns (2), (4), and (6) report estimates of the second stage of a Two-stage Least Squares Instrumental Variable (2SLS-IV) model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. The instrumental variable is based on the distance of the firm headquarters from the nearest financial center, *Distance quartiles*. The variable, *Post* takes the value one for years after 1987 and zero otherwise. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$		$Ln(1 + Pat)_{t+2}$		$Ln(1 + Pat)_{t+3}$	
	OLS	2SLS-IV	OLS	2SLS-IV	OLS	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Currency derivatives * Post	0.224*** (0.046)		0.212*** (0.047)		0.212*** (0.049)	
$\widehat{Currency\ derivatives}$		0.451*** (0.150)		0.477*** (0.155)		0.517*** (0.158)
Post	0.036 (0.028)		0.042 (0.028)		0.051* (0.029)	
Ln(Sales)	0.258*** (0.020)	0.254*** (0.020)	0.247*** (0.021)	0.242*** (0.021)	0.234*** (0.021)	0.228*** (0.021)
Book leverage	-0.123* (0.063)	-0.140** (0.067)	-0.149** (0.064)	-0.168** (0.068)	-0.145** (0.065)	-0.167** (0.069)
Profitability	-0.258*** (0.085)	-0.276*** (0.088)	-0.218** (0.087)	-0.239*** (0.089)	-0.226** (0.90)	-0.251*** (0.092)
Tangibility	0.287*** (0.093)	0.315*** (0.098)	0.270*** (0.094)	0.302*** (0.099)	0.292*** (0.096)	0.326*** (0.100)
Herfindahl	-0.183** (0.084)	-0.191** (0.085)	-0.157* (0.082)	-0.166** (0.083)	-0.130 (0.082)	-0.138* (0.083)
Age	-0.015*** (0.002)	-0.016*** (0.003)	-0.015*** (0.003)	-0.016*** (0.003)	-0.015*** (0.003)	-0.016*** (0.003)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	44,329	44,329	43,208	43,208	42,007	42,007
R-squared	0.854	0.854	0.858	0.857	0.861	0.860

Table 5. Impact of Financial Innovation on Number of Citations

This table reports the effect of currency derivatives on citations. The dependent variable is the natural logarithm of $(1 + Cit)_{t+k}$, where Cit is the patent count in year $t + k$, $k=1, 2$, and 3 denoting one, two and three years after the current time period, t . Columns (1), (3), and (5) report estimates of an OLS model, where $Currency\ derivatives$ is a dummy variable taking the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. Columns (2), (4), and (6) report estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. The instrumental variables are based on the distance of the firm headquarters from the nearest financial center, $Distance\ quartiles$. The variable, $Post$ takes the value one for years after 1987 and zero otherwise. All specifications include firm fixed effects, and controls for $Ln(Sales)$, $Book\ leverage$, $Profitability$, $Tangibility$, $Herfindahl$, and Age . The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Cit)_{t+1}$		$Ln(1 + Cit)_{t+2}$		$Ln(1 + Cit)_{t+3}$	
	OLS	2SLS-IV	OLS	2SLS-IV	OLS	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Currency derivatives * Post	0.513*** (0.046)		0.495*** (0.047)		0.474*** (0.047)	
$\widehat{Currency\ derivatives}$		0.981*** (0.174)		0.966*** (0.175)		0.995*** (0.178)
Post	0.085** (0.034)		0.087** (0.034)		0.098*** (0.035)	
Ln(Sales)	0.324*** (0.024)	0.315*** (0.024)	0.329*** (0.024)	0.319*** (0.024)	0.328*** (0.024)	0.317*** (0.024)
Book leverage	-0.203** (0.081)	-0.239*** (0.087)	-0.190** (0.082)	-0.225** (0.088)	-0.169** (0.082)	-0.209** (0.088)
Profitability	-0.451*** (0.113)	-0.489*** (0.119)	-0.478*** (0.114)	-0.516*** (0.119)	-0.486*** (0.114)	-0.532*** (0.119)
Tangibility	0.084 (0.125)	0.138 (0.132)	0.072 (0.123)	0.122 (0.131)	0.109 (0.124)	0.161 (0.131)
Herfindahl	0.239** (0.097)	0.232** (0.099)	0.206** (0.098)	0.200** (0.100)	0.174* (0.098)	0.170* (0.100)
Age	0.039*** (0.003)	0.038*** (0.003)	0.038*** (0.003)	0.037*** (0.003)	0.038*** (0.003)	0.038*** (0.003)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	44,329	44,329	43,208	43,208	42,007	42,007
R-squared	0.901	0.899	0.906	0.904	0.909	0.908

Table 6. Robustness Check: Additional Control Variables

This table reports the effect of currency derivatives on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t + k$, $k=1, 2$, and 3 denoting one, two and three years after the current time period, t . The table reports estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. The instrumental variables are based on the distance of firm headquarters from the nearest financial center, *Distance quartiles*. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *R&D/Assets (R&D stock/Assets)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, *Herfindahl²*, *Age*, *Ln(K/L)*, *Inter-state deregulation*, *Intra-state deregulation*, *State corporate tax changes*, and *Anti-takeover provisions*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

	$Ln(1 + Pat)_{t+1}$		$Ln(1 + Pat)_{t+2}$		$Ln(1 + Pat)_{t+3}$	
	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Currency derivatives	0.921*** (0.143)	0.815*** (0.139)	0.839*** (0.145)	0.742*** (0.142)	0.697*** (0.146)	0.639*** (0.143)
Ln(Sales)	0.225*** (0.023)	0.223*** (0.026)	0.219*** (0.024)	0.208*** (0.027)	0.209*** (0.025)	0.191*** (0.028)
R&D/Assets	2.636*** (0.472)		2.532*** (0.479)		2.525*** (0.501)	
R&D stock/Assets		0.692*** (0.194)		0.599*** (0.196)		0.573*** (0.200)
Book leverage	-0.255*** (0.066)	-0.231*** (0.072)	-0.258*** (0.067)	-0.230*** (0.073)	-0.214*** (0.068)	-0.199*** (0.075)
Profitability	-0.248*** (0.084)	-0.221** (0.098)	-0.171** (0.087)	-0.147 (0.101)	-0.142 (0.089)	-0.115 (0.104)
Tangibility	0.034 (0.125)	-0.009 (0.141)	-0.003 (0.127)	-0.034 (0.141)	-0.009 (0.127)	-0.013 (0.143)
Herfindahl	0.019 (0.276)	0.181 (0.310)	0.073 (0.285)	0.188 (0.320)	0.154 (0.295)	0.296 (0.334)
Herfindahl ²	0.038 (0.228)	-0.069 (0.259)	-0.008 (0.234)	-0.073 (0.266)	-0.083 (0.243)	-0.154 (0.277)
Age	-0.030*** (0.003)	-0.029*** (0.003)	-0.029*** (0.003)	-0.027*** (0.004)	-0.026*** (0.003)	-0.024*** (0.004)
Ln(K/L)	0.046** (0.023)	0.038 (0.026)	0.046* (0.024)	0.037 (0.026)	0.048** (0.024)	0.040 (0.027)
Inter-state deregulation	0.033 (0.023)	0.044* (0.023)	0.041* (0.023)	0.050** (0.023)	0.050** (0.024)	0.055** (0.024)
Intra-state deregulation	-0.035 (0.024)	-0.043* (0.026)	-0.037 (0.025)	-0.042 (0.027)	-0.037 (0.026)	-0.036 (0.028)
State corporate tax changes	-0.112 (0.084)	-0.092 (0.090)	-0.135 (0.090)	-0.121 (0.097)	-0.153 (0.096)	-0.155 (0.104)

(Continue)

Table 6. – Continued

	$Ln(1 + Pat)_{t+1}$		$Ln(1 + Pat)_{t+2}$		$Ln(1 + Pat)_{t+3}$	
	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Anti-takeover provisions	0.005 (0.074)	-0.021 (0.076)	-0.0382 (0.081)	-0.045 (0.082)	-0.051 (0.083)	-0.075 (0.093)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	30,374	26,287	29,680	25,626	28,888	24,886
R-squared	0.873	0.884	0.873	0.885	0.874	0.886

Table 7. Robustness Check: Alternative Definitions of Proximity

This table reports the effect of currency derivatives on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+1}$, where Pat is the patent count in year $t + 1$. The table reports estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in Table 3. The instrumental variables are based on the distance of firm headquarters to the nearest financial center $Distance$ (column (1)); travel distance, by car, $Travel\ dist\ quartiles$ (column (2)), and $Travel\ dist$ (column (3)); and travel time by car, $Time\ quartiles$ (column (4)), and $Time$ (column (5)). All specifications include firm fixed effects, and controls for $Ln(Sales)$, $Book\ leverage$, $Profitability$, $Tangibility$, $Herfindahl$, and Age . The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$				
	2SLS-IV (1)	2SLS-IV (2)	2SLS-IV (3)	2SLS-IV (4)	2SLS-IV (5)
Currency $\widehat{derivatives}$	0.457*** (0.150)	0.419*** (0.162)	0.396** (0.158)	0.407*** (0.156)	0.890*** (0.145)
Ln(Sales)	0.252*** (0.020)	0.329*** (0.024)	0.319*** (0.024)	0.328*** (0.024)	0.317*** (0.024)
Book leverage	-0.162** (0.066)	-0.190** (0.082)	-0.225** (0.088)	-0.169** (0.082)	-0.209** (0.088)
Profitability	-0.271*** (0.088)	-0.478*** (0.114)	-0.516*** (0.119)	-0.486*** (0.114)	-0.532*** (0.119)
Tangibility	0.284*** (0.105)	0.072 (0.123)	0.122 (0.131)	0.109 (0.124)	0.161 (0.131)
Herfindahl	-0.187** (0.085)	0.206** (0.098)	0.200** (0.100)	0.174* (0.098)	0.170* (0.100)
Age	-0.016*** (0.003)	0.038*** (0.003)	0.037*** (0.003)	0.038*** (0.003)	0.038*** (0.003)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No
Observations	43,329	43,349	43,349	43,349	43,349
R-squared	0.854	0.855	0.857	0.854	0.855

Table 8. Robustness Check: Alternative Measure of Innovation

This table reports the effect of currency derivatives on innovation. The dependent variable is $(R\&Dstock/Assets)_{t+k}$, where R&D expenses are scaled by total assets in year $t + k$, $k=1, 2$, and 3 denoting one, two and three years after the current time period, t . Columns (1), (3), and (5) report estimates of an OLS model, where *Currency derivatives* is a dummy variable taking the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. Columns (2), (4), and (6) report estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. The instrumental variables are based on the distance of the firm headquarters from the nearest financial center, *Distance quartiles*. The variable *Post* takes the value one for years after 1987 and zero otherwise. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$(R\&Dstock/Assets)_{t+1}$		$(R\&Dstock/Assets)_{t+2}$		$(R\&Dstock/Assets)_{t+3}$	
	OLS	2SLS-IV	OLS	2SLS-IV	OLS	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Currency derivatives * Post	0.017*** (0.004)		0.015*** (0.004)		0.014*** (0.004)	
$\widehat{Currency\ derivatives}$		0.154** (0.073)		0.163** (0.071)		0.178*** (0.070)
Post	-0.049*** (0.012)		-0.101*** (0.010)		-0.099*** (0.011)	
Ln(Sales)	0.008*** (0.002)	0.006*** (0.002)	0.012*** (0.002)	0.009*** (0.002)	0.014*** (0.002)	0.011*** (0.002)
Book leverage	-0.022*** (0.007)	-0.032*** (0.009)	-0.024*** (0.007)	-0.034*** (0.009)	-0.026*** (0.007)	-0.038*** (0.008)
Profitability	-0.114*** (0.012)	-0.125*** (0.013)	-0.100*** (0.012)	-0.112*** (0.012)	-0.083*** (0.011)	-0.096*** (0.012)
Tangibility	0.011 (0.011)	0.027** (0.014)	0.009 (0.011)	0.026** (0.013)	0.006 (0.011)	0.025* (0.013)
Herfindahl	-0.040*** (0.009)	-0.042*** (0.009)	-0.038*** (0.009)	-0.040*** (0.009)	-0.035*** (0.009)	-0.037*** (0.009)
Age	0.002*** (0.000)	0.001*** (0.000)	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37,618	37,618	38,303	38,303	38,949	38,949
R-squared	0.816	0.816	0.815	0.815	0.813	0.813

Table 9. Placebo Test: Size Quartile Effect on Patents

This table reports the effect of firm size on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+k}$, where Pat is the patent count in year $t + k$, $k=1, 2$, and 3 denoting one, two and three years after the current time period, t . The variable *Size quartile* is a measure of pre-1987 average firm size. The variable *Post* takes the value one for years after 1987 and zero otherwise. All specifications include firm fixed effects, and controls for $Ln(Sales)$, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$	$Ln(1 + Pat)_{t+2}$	$Ln(1 + Pat)_{t+3}$
	OLS	OLS	OLS
	(1)	(2)	(3)
Size quartile 1 * Post	-0.032 (0.062)	-0.004 (0.064)	0.034 (0.066)
Size quartile 2 * Post	0.011 (0.068)	0.034 (0.069)	0.057 (0.071)
Size quartile 3 * Post	0.018 (0.074)	0.032 (0.076)	0.053 (0.077)
Post	0.160*** (0.056)	0.145** (0.058)	0.128** (0.060)
Ln(Sales)	0.282*** (0.021)	0.268*** (0.021)	0.255*** (0.022)
Book leverage	-0.133** (0.060)	-0.163*** (0.061)	-0.139** (0.063)
Profitability	-0.390*** (0.087)	-0.400*** (0.090)	-0.378*** (0.093)
Tangibility	0.472*** (0.092)	0.515*** (0.093)	0.586*** (0.095)
Herfindahl	-0.254*** (0.077)	-0.260*** (0.077)	-0.245*** (0.077)
Age	-0.025*** (0.002)	-0.026*** (0.002)	-0.026*** (0.002)
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	No	No	No
Observations	44,329	43,208	42,007
R-squared	0.852	0.857	0.856

Table 10. Risk Management and Innovation Output

This table reports the effect of currency derivatives on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+1}$, where Pat is the patent count in year $t + 1$. The table reports estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. Columns (1) and (2) report results separately for firms with low and high CF variability. Low (High) CF variability firms are defined as firms that are in the first (fourth) quartile when sorted based on beta of cash flows to foreign currency shocks pre-1987. Columns (3) and (4) report results separately for firms with low and high FX beta. Low (High) FX beta firms are defined as firms that are in the first (fourth) quartile when sorted based on beta of equity returns to foreign-exchange index returns pre-1987. Columns (5) and (6) report results separately for firms with low and high standard deviation of returns. Low (High) SD of returns firms are defined as firms that are in the first (fourth) quartile when sorted based on standard deviation of equity returns five years before 1987. All specifications include firm fixed effects, and controls for $Ln(Sales)$, $Book\ leverage$, $Profitability$, $Tangibility$, $Herfindahl$, and Age . The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$					
	Low	High	Low	High	Low SD	High SD
	CF variability	CF variability	FX beta	FX beta	of returns	of returns
	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Currency derivatives	0.445 (0.286)	0.962*** (0.327)	0.272 (0.299)	0.724** (0.307)	0.605* (0.337)	0.697*** (0.264)
Ln(Sales)	0.263*** (0.046)	0.186*** (0.034)	0.264*** (0.042)	0.289*** (0.039)	0.412*** (0.051)	0.137*** (0.027)
Book leverage	-0.085 (0.136)	-0.199* (0.121)	-0.297** (0.137)	-0.234* (0.133)	0.094 (0.220)	-0.351*** (0.079)
Profitability	-0.217 (0.235)	0.0261 (0.133)	-0.144 (0.148)	-0.422* (0.221)	0.033 (0.350)	-0.176** (0.082)
Tangibility	0.205 (0.224)	0.441*** (0.164)	0.267 (0.183)	0.300 (0.210)	0.677** (0.292)	0.397*** (0.134)
Herfindahl	-0.337** (0.162)	-0.253 (0.189)	-0.267 (0.170)	0.031 (0.176)	-0.136 (0.224)	-0.034 (0.153)
Age	-0.013*** (0.005)	-0.013** (0.006)	-0.014*** (0.005)	-0.021*** (0.005)	-0.024*** (0.006)	-0.017*** (0.004)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	11,169	9,969	10,558	11,062	11,167	10,197
R-squared	0.876	0.806	0.846	0.862	0.870	0.659

Table 11. Additional Results on Risk Management

This table reports the effect of currency derivatives on FX beta (beta of equity returns to foreign-exchange index returns). The dependent variable is $FXbeta_{t+1}$. The table reports estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. Columns (1) and (2) report results separately for firms with low and high CF variability. Low (High) CF variability firms are defined as firms that are in the first (fourth) quartile when sorted based on beta of cash flows to foreign currency shocks before 1987. Columns (3) and (4) report results separately for firms with low and high FX beta. Low (High) FX beta firms are defined as firms that are in the first (fourth) quartile when sorted based on beta of equity returns to foreign-exchange index before 1987. All specifications include firm fixed effects, and controls for $Ln(Sales)$, $Book\ leverage$, $Profitability$, $Tangibility$, $Herfindahl$, and Age . The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$FXbeta_{t+1}$			
	Low	High	Low	High
	CF variability	CF variability	FX beta	FX beta
	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV
	(1)	(2)	(3)	(4)
$\widehat{Currency\ derivatives}$	0.738*** (0.224)	2.888 (1.789)	1.220*** (0.246)	1.902 (1.190)
Ln(Sales)	-0.149*** (0.047)	-0.247*** (0.063)	-0.049 (0.046)	-0.235*** (0.070)
Book leverage	0.214 (0.148)	1.616 (1.156)	-0.138 (0.287)	1.307 (1.144)
Profitability	0.631** (0.309)	1.353*** (0.376)	0.147 (0.262)	1.059*** (0.350)
Tangibility	-0.191 (0.278)	0.019 (0.761)	-0.081 (0.154)	0.733 (0.674)
Herfindahl	-0.020 (0.181)	-0.472 (0.291)	-0.017 (0.258)	-0.304 (0.215)
Age	-0.003 (0.005)	-0.018 (0.022)	0.004 (0.004)	-0.015 (0.016)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No
Observations	6,515	5,327	5,677	6,363
R-squared	0.285	0.157	0.277	0.144

Table 12. Access to Credit and Innovation Output

This table reports the effect of currency derivatives on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+1}$, where Pat is the patent count in year $t + 1$. The table reports estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. Columns (1) and (2) report results separately for firms with and without a syndicated loan before 1987. With (Without) a syndicated loan firms pre-1987 are defined as firms which had (had not) raised a syndicated loan before and including 1987. Columns (3) and (4) report results separately for firms with and without a syndicated loan before 1992. With (Without) a syndicated loan firms pre-1992 are defined as firms which had (had not) raised a syndicated loan on or before 1992. Columns (5) and (6) report results separately for firms with and without a credit rating. With (Without) a credit rating firms are defined as firms which have (do not have) an S&P long-term issuer credit rating before 1987. All specifications include firm fixed effects, and controls for $Ln(Sales)$, $Book\ leverage$, $Profitability$, $Tangibility$, $Herfindahl$, and Age . The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$					
	With loan pre-1987	Without loan pre-1987	With loan pre-1992	Without loan pre-1992	With credit rating	Without credit rating
	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV	2SLS-IV
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{Currency\ derivatives}$	-0.586 (0.559)	0.560*** (0.155)	0.118 (0.252)	0.720*** (0.187)	0.169 (0.260)	0.782*** (0.168)
$Ln(Sales)$	0.299*** (0.076)	0.252*** (0.021)	0.266*** (0.033)	0.249*** (0.024)	0.314*** (0.034)	0.195*** (0.022)
Book leverage	0.238 (0.256)	-0.173** (0.070)	-0.095 (0.116)	-0.150* (0.081)	-0.068 (0.133)	-0.200*** (0.066)
Profitability	-0.464 (0.520)	-0.261*** (0.088)	-0.416*** (0.160)	-0.190* (0.105)	-0.393* (0.226)	-0.203*** (0.079)
Tangibility	-0.488 (0.417)	0.390*** (0.099)	0.019 (0.166)	0.509*** (0.120)	0.280 (0.184)	0.358*** (0.095)
Herfindahl	-0.804*** (0.301)	-0.135 (0.089)	-0.270** (0.129)	-0.137 (0.113)	-0.366** (0.158)	-0.032 (0.074)
Age	-0.005 (0.011)	-0.017*** (0.003)	-0.016*** (0.004)	-0.016*** (0.003)	-0.016*** (0.005)	-0.018*** (0.003)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	3,245	40,493	14,904	28,920	17,717	26,113
R-squared	0.874	0.850	0.862	0.847	0.864	0.760

Table 13. Financial Constraints and Innovation Output

This table reports the effect of currency derivatives on patents. The dependent variable is the natural logarithm of $(1 + Pat)_{t+1}$, where Pat is the patent count in year $t + 1$. The table reports estimates of the second stage of a 2SLS-IV model, where $\widehat{Currency\ derivatives}$ is the predicted variable from the first stage, reported in column (1) of Table 3. Columns (1) and (2) report results separately for financially constrained and unconstrained firms. Constrained (unconstrained) firms are defined as firms that are in the fourth (first) quartile when sorted using the average industry-level Kaplan-Zingales Index before 1987. Columns (3) and (4) report results separately for firms that have low and high cash levels. Low (high) cash firms are defined as firms that have cash/assets ratio in the first (fourth) quartile when sorted based on average cash/assets ratio before 1987. Columns (5) and (6) report results separately for firms that have low and high asset tangibility. Low (high) tangibility firms are defined as firms in the first (fourth) quartile of firms when sorted based on average property, plant and equipment/assets before 1987. All specifications include firm fixed effects, and controls for $Ln(Sales)$, $Book\ leverage$, $Profitability$, $Tangibility$, $Herfindahl$, and Age . The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$					
	Constrained (High KZ index)	Unconstrained (Low KZ index)	Low cash	High cash	Low tangibility	High tangibility
	2SLS-IV (1)	2SLS-IV (2)	2SLS-IV (3)	2SLS-IV (4)	2SLS-IV (5)	2SLS-IV (6)
Currency $\widehat{derivatives}$	19.07*** (4.546)	14.72*** (3.233)	0.670*** (0.189)	0.561*** (0.190)	0.672*** (0.168)	0.630*** (0.221)
Ln(Sales)	-0.109 (0.147)	-0.099 (0.086)	0.219*** (0.047)	0.247*** (0.043)	0.121*** (0.044)	0.238*** (0.052)
Book leverage	-1.454*** (0.296)	-1.194*** (0.260)	-0.210* (0.115)	-0.326** (0.145)	-0.170* (0.089)	-0.180 (0.143)
Profitability	-1.800*** (0.339)	-1.379*** (0.263)	-0.147 (0.144)	-0.086 (0.161)	-0.036 (0.123)	-0.331 (0.214)
Tangibility	2.510*** (0.452)	1.962*** (0.461)	0.196 (0.246)	-0.016 (0.170)	0.081 (0.211)	-0.020 (0.203)
Herfindahl	0.229 (0.353)	0.145 (0.163)	-0.033 (0.174)	-0.061 (0.159)	-0.026 (0.153)	-0.055 (0.175)
Age	-0.024*** (0.006)	-0.010* (0.006)	-0.025*** (0.006)	-0.008 (0.005)	-0.015*** (0.005)	-0.023*** (0.006)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	No	No
Observations	3,904	4,050	10,791	10,779	10,662	11,012
R-squared	0.975	0.913	0.808	0.891	0.794	0.874

Table A.1. Variable Definitions

This table provides a summary of all explanatory variables used in the analysis.

Variable name	Variable description
Firm characteristics and innovation measures:	
$Assets_{it}$	Total assets of firm i in year t (in US\$ thousands).
$Sales_{it}$	Sales by firm i in year t (in US\$ thousands).
$R\&D/Assets_{it}$	Research and development expenses of firm i in year t divided by its Assets in year t .
$R\&D\ stock/Assets_{it}$	Research and development expenses stock (computed following the conventional 15% depreciation rate used in the related literature (Hall, Jaffe, and Trajtenberg, 2005)) of firm i in year t divided by its Assets in year t .
$Book\ leverage_{it}$	Total debt of firm i in year t divided by its Assets in year t .
$Net\ debt/Assets_{it}$	Total debt minus cash and short term investments of firm i in year t divided by its Assets in year t .
$Cash/Assets_{it}$	Cash of firm i in year t divided by its Assets in year t .
$Profitability_{it}$	Earnings before interest, tax, depreciation and amortization (EBITDA) of firm i in year t divided by its Assets in year t .
$Tangibility_{it}$	Net property, plant and equipment of firm i in year t divided by its Assets in year t .
$Herfindahl_{it}$ ($Herfindahl^2_{it}$)	Equal to the sum of the squared share of firm i in total industry sales at the 4 digit SIC industry code in year t . (Equal to $Herfindahl_{it}$ squared.)
Age_{it}	Age of firm i in year t based on the years from a firm's IPO (from CRSP).
K/L_{it}	Capital of firm i , represented by property, plants, and equipment (PPE), in year t divided by its labor in year t , measured by the number of employees.
Pat_{it}	Count of the number of granted patents in year t by firm i .
Cit_{it}	Count of the number of citations to granted patents received by firm i from the grant year to year t .
$Currency\ derivatives_{it}$	A dummy variable that takes on a value of one if firm i reports using currency derivatives in year t , and zero otherwise.
$FX\ beta_{it}$	Beta of equity returns to foreign-exchange index returns calculated by running a regression of monthly equity returns for firm i on CRSP value-weighted market index returns and returns on a trade-weighted basket of foreign currencies for a five-year rolling window before and including year t .
Measures of distance to financial centers:	
$Distance_i$	Equal to the physical distance between firm i headquarters and the nearest financial center, calculated as the shortest distance between the two points along the surface of a mathematical model of the Earth.
$Travel\ distance_i$	Equal to the travel distance (by car, using road networks, in 1000 kilometers) between firm i headquarters and the nearest financial center.
$Travel\ time_i$	Equal to the travel time, in hours (the time it takes to travel by car), between firm i headquarters and the nearest financial center.
$Distance\ quartile\ 1_i$ (2_i , 3_i)	A dummy variable that takes on a value of one if the firm is in the first (second, third) quartile based on physical distance between headquarters and financial centers.
$Travel\ dist\ quartile\ 1_i$ (2_i , 3_i)	A dummy variable that takes on a value of one if the firm is in the first (second, third) quartile based on travel distance between headquarters and financial centers (the least distance to financial centers).

Table A.1. – Continued

Variable name	Variable description
Time quartile 1 _{<i>i</i>} (2 _{<i>i</i>} , 3 _{<i>i</i>})	A dummy variable that takes on a value of one if the firm is in the first (second, third) quartile based on time distance between headquarters and financial centers (the least distance to financial centers).
Size quartile 1 _{<i>i</i>} (2 _{<i>i</i>} , 3 _{<i>i</i>})	A dummy variable that takes on a value of one if the firm is in the first (second, third) quartile based on size, measure by average pre-1987 (from 1977 to 1987) revenues.
Additional control variables:	
Post _{<i>t</i>}	A dummy variable that takes on a value of one for each year <i>t</i> after 1987, and zero otherwise.
Inter-state deregulation _{<i>it</i>}	A dummy variable that takes on a value of one if inter-state banking deregulation has been implemented before or in the year <i>t</i> in the state in which firm <i>i</i> 's headquarters are located.
Intra-state deregulation _{<i>it</i>}	A dummy variable that takes on a value of one if intra-state banking deregulation has been implemented before or in the year <i>t</i> in the state in which firm <i>i</i> 's headquarters are located.
State corporate tax changes _{<i>it</i>}	A dummy variable that takes on a value of one if year <i>t</i> represents a year with a significant tax change in the state in which firm <i>i</i> 's headquarters are located.
Anti-takeover provisions _{<i>it</i>}	A dummy variable that takes on a value of one if an anti-takeover legislation has been implemented before or in the year <i>t</i> in the state in which firm <i>i</i> 's headquarters are located.
Low (High) CF variability _{<i>it</i>}	A dummy variable that takes on a value of one if the firm is in the first (fourth) quartile when sorted based on beta of cash flows to foreign currency shocks pre-1987.
Low (High) FX beta _{<i>it</i>}	A dummy variable that takes on a value of one if the firm is in the first (fourth) quartile when sorted based on beta of equity returns to foreign-exchange index returns pre-1987.
Low (High) SD of returns _{<i>it</i>}	A dummy variable that takes on a value of one if the firm is in the first (fourth) quartile when sorted based on standard deviation of equity returns five years before 1987.
With loan (Without loan) pre-1987 _{<i>it</i>}	A dummy variable that takes on a value of one if the firm had (had not) raised a syndicated loan before and including 1987.
With loan (Without loan) pre-1992 _{<i>it</i>}	A dummy variable that takes on a value of one if the firm had (had not) raised a syndicated loan before and including 1992.
With (Without) credit rating _{<i>it</i>}	A dummy variable that takes on a value of one if the firm has (does not have) an S&P long-term issuer credit rating pre-1987.
Constrained (Unconstrained) _{<i>it</i>}	A dummy variable that takes on a value of one if the firm is in the fourth (first) quartile when sorted using the average industry-level Kaplan-Zingales Index before 1987.
Low (High) cash _{<i>it</i>}	A dummy variable that takes on a value of one if the firm has cash/assets ratio in the first (fourth) quartile when sorted based on average cash/assets ratio pre-1987.
Low (High) tangibility _{<i>it</i>}	A dummy variable that takes on a value of one if the firm is in the first (fourth) quartile when sorted based on pre-1987 average property, plant and equipment/assets.

Internet Appendix

Table I.1. Impact of Financial Innovation on Innovation: Balanced Panel

This table reports the effect of currency derivatives on innovation. The dependent variable is the natural logarithm of $(1 + Pat^C)_{t+k} ((1 + Cit^C)_{t+k})$ in the first (last) three columns. The table reports estimates of an OLS model, where *Currency derivatives* is a dummy variable taking the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. The variable *Post* takes the value one for years after 1987 and zero otherwise. The sample is restricted to only those firms that are present during the entire period from 1977 to 1997. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	$Ln(1 + Pat)_{t+1}$	$Ln(1 + Pat)_{t+2}$	$Ln(1 + Pat)_{t+3}$	$Ln(1 + Cit)_{t+1}$	$Ln(1 + Cit)_{t+2}$	$Ln(1 + Cit)_{t+3}$
	OLS	OLS	OLS	OLS	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Currency derivatives * Post	0.242*** (0.057)	0.239*** (0.058)	0.231*** (0.060)	0.359*** (0.055)	0.359*** (0.057)	0.359*** (0.058)
Post	0.091*** (0.031)	0.068** (0.032)	0.037 (0.032)	0.002 (0.027)	0.009 (0.028)	0.013 (0.030)
Ln(Sales)	0.290*** (0.056)	0.283*** (0.057)	0.275*** (0.057)	0.260*** (0.046)	0.273*** (0.048)	0.275*** (0.049)
Book leverage	-0.131 (0.146)	-0.124 (0.146)	-0.102 (0.142)	-0.103 (0.146)	-0.131 (0.148)	-0.099 (0.147)
Profitability	-0.224 (0.187)	-0.271 (0.190)	-0.186 (0.195)	-0.568*** (0.232)	-0.538*** (0.226)	-0.430* (0.228)
Tangibility	-0.019 (0.209)	-0.068 (0.204)	0.016 (0.200)	0.016 (0.218)	-0.031 (0.228)	-0.024 (0.235)
Herfindahl	0.003 (0.164)	-0.020 (0.164)	-0.077 (0.170)	-0.232 (0.197)	-0.249 (0.194)	0.259 (0.191)
Age	-0.017*** (0.005)	-0.015*** (0.006)	-0.011* (0.006)	0.053*** (0.005)	0.053*** (0.005)	0.055*** (0.005)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	8,452	8,452	8,452	8,452	8,452	8,452
R-squared	0.914	0.913	0.912	0.952	0.952	0.952

Table I.2. Impact of Financial Innovation on Innovation: Alternative Measures of Innovation

This table reports the effect of currency derivatives on innovation. The dependent variable is the natural logarithm of $(1 + Pat^C)_{t+k} ((1 + Cit^C)_{t+k})$ in the first (last) three columns. The table reports estimates of an OLS model, where *Currency derivatives* is a dummy variable taking the value of one if the firm uses currency derivatives (as per its SEC filings) in the year and zero otherwise. The variable *Post* takes the value one for years after 1987 and zero otherwise. To control for the technological field-fixed effects, the number of patents and citations are divide by the corresponding field mean. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	OLS (6)
	$Ln(1 + Pat^C)_{t+1}$	$Ln(1 + Pat^C)_{t+2}$	$Ln(1 + Pat^C)_{t+3}$	$Ln(1 + Cit^C)_{t+1}$	$Ln(1 + Cit^C)_{t+2}$	$Ln(1 + Cit^C)_{t+3}$
Currency derivatives * Post	0.262*** (0.055)	0.256*** (0.058)	0.260*** (0.061)	0.175** (0.080)	0.078 (0.081)	-0.036 (0.082)
Post	0.005 (0.022)	0.018 (0.023)	0.023 (0.024)	-0.144*** (0.042)	-0.172*** (0.043)	-0.204*** (0.044)
Ln(Sales)	0.183*** (0.019)	0.181*** (0.020)	0.178*** (0.021)	0.393*** (0.032)	0.379*** (0.033)	0.365*** (0.033)
Book leverage	-0.099* (0.056)	-0.109* (0.057)	-0.102* (0.059)	-0.226** (0.102)	-0.255*** (0.104)	-0.204** (0.105)
Profitability	-0.135* (0.076)	-0.106 (0.080)	-0.140 (0.084)	-0.336*** (0.137)	-0.337*** (0.141)	-0.381*** (0.147)
Tangibility	0.090 (0.088)	0.090 (0.092)	0.090 (0.097)	0.212 (0.154)	0.235 (0.159)	0.246 (0.161)
Herfindahl	-0.327 (0.238)	-0.299 (0.247)	-0.205 (0.257)	-1.296*** (0.420)	-1.263*** (0.431)	-1.066*** (0.449)
Age	-0.008*** (0.002)	-0.009*** (0.002)	-0.010*** (0.002)	-0.004 (0.004)	-0.005 (0.004)	-0.006 (0.004)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	No	No
Observations	44,329	43,208	42,007	44,329	43,208	42,007
R-squared	0.801	0.802	0.804	0.754	0.755	0.758

Table I.3. Additional Robustness Tests: Excluding States

This table reports the first-stage estimates of the effect of distance from financial centers on currency derivatives use. The instrumental variable is physical distance between firm headquarters and the nearest financial center, *Distance*. The variable, *Post* takes the value one for years after 1987 and zero otherwise. Unreported coefficients are available upon request. Each row excludes firms which are headquartered in one state. All specifications include firm fixed effects, and controls for *Ln(Sales)*, *Book leverage*, *Profitability*, *Tangibility*, *Herfindahl*, and *Age*. The standard errors, reported in parentheses, are heteroskedasticity consistent and clustered by firm. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	Currency derivatives		
	Interaction term coefficient	Standard error	Observations
	<i>Distance</i> * <i>Post</i>		
Excluding New York	-0.040**	(0.016)	39,751
Excluding Alabama	-0.032**	(0.015)	44,196
Excluding Arkansas	-0.032**	(0.015)	44,173
Excluding Arizona	-0.032**	(0.015)	43,880
Excluding California	-0.033**	(0.015)	40,531
Excluding Colorado	-0.031**	(0.015)	43,732
Excluding Connecticut	-0.031**	(0.015)	42,293
Excluding District of Columbia	-0.033**	(0.015)	44,272
Excluding Delaware	-0.031**	(0.015)	44,060
Excluding Florida	-0.026*	(0.015)	43,204
Excluding Georgia	-0.030**	(0.015)	43,415
Excluding Idaho	-0.032**	(0.015)	44,176
Excluding Illinois	-0.034**	(0.015)	40,658
Excluding Indiana	-0.032**	(0.015)	43,718
Excluding Kansas	-0.032**	(0.015)	44,059
Excluding Kentucky	-0.032**	(0.015)	44,071
Excluding Louisiana	-0.031**	(0.015)	44,226
Excluding Massachusetts	-0.031**	(0.015)	42,524
Excluding Maryland	-0.033**	(0.015)	43,822
Excluding Maine	-0.032**	(0.015)	44,257
Excluding Michigan	-0.033**	(0.015)	42,060
Excluding Minnesota	-0.035**	(0.015)	43,072
Excluding Missouri	-0.033**	(0.015)	43,286
Excluding Mississippi	-0.032**	(0.015)	44,299
Excluding Montana	-0.032**	(0.015)	44,318
Excluding North Carolina	-0.032**	(0.015)	43,173
Excluding Nebraska	-0.032**	(0.015)	44,224
Excluding New Hampshire	-0.032**	(0.015)	44,091
Excluding New Jersey	-0.032**	(0.015)	41,931
Excluding Ohio	-0.033**	(0.015)	41,754
Excluding Oklahoma	-0.032**	(0.015)	44,065
Excluding Oregon	-0.032**	(0.015)	44,131

Table I.3 – Continued

Currency derivatives			
	Interaction term coefficient	Standard error	Observations
	<i>Distance * Post</i>		
Excluding Pennsylvania	-0.033**	(0.015)	44,076
Excluding Rhode Island	-0.032**	(0.015)	44,115
Excluding South Carolina	-0.031**	(0.015)	44,105
Excluding South Dakota	-0.032**	(0.015)	44,040
Excluding Tennessee	-0.032**	(0.015)	44,279
Excluding Texas	-0.034**	(0.015)	43,890
Excluding Utah	-0.036**	(0.015)	41,005
Excluding Virginia	-0.032**	(0.018)	44,148
Excluding Washington	-0.034**	(0.015)	43,077
Excluding Wisconsin	-0.031**	(0.015)	43,928