

Profitable Innovation Without Patent Protection: The Case of Derivatives.

Abstract

Investment banks develop their own innovative derivatives to underwrite corporate issues but they cannot preclude other banks from imitating them. However, during the process of underwriting an innovator can learn more than its imitators about the potential clients. Moving first puts him ahead in the learning process. Thus, he develops an information advantage and he can capture rents in equilibrium despite being imitated. In this context, innovation can arise without patent protection. Consistently with this hypothesis, case studies of recent innovations in derivatives reveal that innovators keep private some details of their deals to preserve the asymmetry of information.

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Unlike many product innovations, innovative financial products have been un-patentable for many years.¹ Some research in Industrial Organization Theory shows that, for some industries, patents are the only mechanism that makes it profitable for firms to pay the research and development costs (R&D henceforth) if their invented product could otherwise be reverse-engineered, produced and marketed by competitors free-riding on the original R&D expenditure. In such types of models, the free entry drives profits to zero and potential innovators choose not to invest in R&D without legal protection against imitation.²

Nevertheless, some models of product innovation can generate equilibria with positive innovator profits even when they cannot patent their discoveries.³ One possibility is to assume that the developer has a timing leadership over its imitators. If the lead period is long enough, or if R&D costs are small enough, innovators can earn sufficiently large monopoly rents prior to imitation so as to offset the initial R&D expenditures. In essence, this effect is no different than the effect of a patent. Another possibility is to assume that clients have costs of switching from the first provider of the new service (the innovator) to the late comers (the imitators). In this case the pioneer can effectively build large market shares and earn rents.

The delayed imitation hypothesis is not consistent with the most important pieces of evidence of product innovation in finance. Tufano [30, 1989] found that periods of “monopolistic” issuing of new financial services are relatively short.⁴ This makes a strong case against the argument that only sufficiently long periods of temporary monopoly power make innovations worthwhile. In the same study, Tufano [30, 1989] also found that, for the 58 innovations he studied between 1974 and 1986, the investment banks that created them could not charge monopolistic underwriting fees before imitation occurred. Further, although data on innovation costs is not available, anecdotal evidence suggests that these are not negligible.^{5, 6}

As Bhattacharyya and Nanda [4, 2000] point out, banks and clients may develop valuable

relationships, making it costly for a firm to switch bankers. Thus, switching costs can explain why early imitation may not erode an innovator's profits and therefore the incentives to innovate. Evidence gathered in interviews of bankers by Naslund [18, 1986] suggests that switching costs might not be significant. Naslund noted that "the banks mentioned that if one came up with an idea the innovator became known as the expert and customers would turn to it even if they used another bank for other services".⁷

A clue to what are the advantages to innovators in finance might be the fact that innovative investment banks are able to capture and maintain the largest share of underwriting deals using the product they created. This is found in Tufano's sample of 58 securities where, despite being imitated early, the innovators preserve the leadership in the long run. Other evidence of innovators becoming market leaders is found by Reilly [21, 1992]: Drexel Burnham Lambert, the pioneer in underwriting junk bonds had at least 40% of the market between 1985 and 1988. Also, according to Mason et. al. [15, 1995] First Boston, the innovator of asset-backed securities, underwrote a share that almost doubled that of the second largest underwriter in this market between 1985 and 1991. More recently, Schroth [25, 2002] found that for most of the innovative equity-linked securities between 1985 and 2001 the innovators also had the lead in the corporate underwriting market. For other classes of derivatives the evidence is scarce. In fact, as Gastineau and Margolis [11, 2000] argue, some derivatives markets are not easy to define and market shares are difficult to compute or disaggregate. Nevertheless, they argue that market makers are likely to have the largest market shares, as observed in the cases mentioned.

It seems therefore that innovation in securities differs qualitatively from other kinds of product innovation. Most of the research in financial innovation has examined extensively case studies to determine why there was a demand for some new securities at the time they were introduced.⁸In other words, the focus has been, basically, on explaining what made each particular innovation attrac-

tive to investors. Not much research, though, has addressed the question of why an un-patentable innovation is worth its R&D expenditure if imitation is early and almost costless.⁹The question we try to answer here is why do investment banks find it privately profitable to be developers of marketable financial instruments.

The large variety of innovations observed in finance persuades us to seek a theory of innovation that is specific to only some kind of financial products. Our model will focus on privately negotiated financial contracts that are designed to transfer the risk of an asset from one party to another. As we will argue later, this type of contract includes a variety of private deals made between competitive investment banks and the holders of claims to assets with random payoffs. The asset holders may want to issue a new security whose payoff is backed by the cashflow of the underlying asset or may just want to swap part of the risky component of the cashflow. A particular characteristic of the market where these deals are made is that the transactions, for example, a credit swap or the purchase of a portfolio of credit card collectibles, are not observable. Confidentiality agreements in these markets are effective mechanisms that allow the banker (e.g., an innovator of a derivative) to conceal information from potential competitors.

It is clear from our motivation that the innovator must have an advantage over its imitators. In the case of financial innovations the lead-time is on average short and the development cost is substantial thus the innovator must make supra-normal profits during the imitation stage. After reviewing some case studies of innovation in credit derivatives and asset securitization we can identify a common feature: bankers choose not to disclose the history of deals they have made but rather disclose only the aggregate dollar amount of their transactions in a given period. Presumably, the knowledge of the history of their completed deals made is valuable and they do not wish to make it public. Therefore, the model we present here shows how the innovator extracts private information from early deals and uses it to compete with its imitators once they enter the market.

As William Toy, Managing Director at CDC Capital Inc. puts it, “There is at least a perception that the first mover is more familiar with the product he issues than the imitator”. [29, 2001]

In the model, the advantage enjoyed by the first-mover will be based on an information asymmetry: innovators will have had one previous period of deal making and will acquire finer information about the distribution of cash flows held by different types of clients. When imitators enter the market, this information advantage which is generated endogenously, will make the innovator the “expert” banker. The expert banker will be able to offer better deals to institutions than the competition and to realize a positive profit. In short, this paper is a particular an application of Bayesian learning to corporate finance: investment banks learn about the uncertainty in the market of corporate underwriting from past deals, so they become differentiated by the time at which they start the learning process. Thus, moving first puts them ahead in the learning curve.

In another testimony by a practitioner, we can find additional evidence that bankers learn from the deals made in the early issues of a new financial product: “Financial Innovations such as Credit Derivatives, are not like producing a new car, where you just sell it once manufactured. In every deal the Innovation changes: it is perfected to better suited the client’s needs. By the fifth or sixth deal you are able to sell a much better product,” (Tom Nobile, Managing Director, Bank of NY).[19, 2001]

To this date, we know of very few applications of Bayesian learning in corporate finance. One exception is Sharpe’s paper [26, 1990], in which he derives a dynamic theory of “customer relationships” in bank loan markets to show how the allocation of capital can be inefficiently shifted towards lower quality and inexperienced firms.¹⁰ Sharpe exploits the presumption that a bank which lends to a given firm can learn superior information about that borrower’s characteristics than other banks can. This presumption, originally made by Kane and Malkiel [12, 1965] and Fama [9, 1985] for the lending market, is consistent with the opinions we gathered in our interviews with practitioners.

The opinions we gathered apply though to more general classes of contracts between a investment banks and firms, which are the innovative contracts that we analyze in this paper. As this paper shows, the dynamics of learning may allow us to better understand the nature and the facts of product innovation in finance.

In the next section we describe briefly some case studies in the innovation of financial products in order to highlight the asymmetry between firms that is captured in our model. Then, we continue by describing the game played between the investment bank that creates a new financial product (the innovator), the banks that imitate it and their counterparts in the deal. We characterize a generic contract that can resemble a part of a credit derivative transaction (e.g. a credit risk swap) or the securitization of an asset (e.g., a mortgage or a loan) and specify the profits that accrue to each of the parties in the contract. The third section presents the general set-up in which innovators develop an information advantage over imitators by moving first in the earliest stage of the game. The learning process is formalized in the general case and then a simple case is used to solve for the equilibrium in the subsequent section. There we show that it is optimal for an investment bank to innovate in the first stage when it chooses between developing and marketing an innovation or not. The final section summarizes our results.

1 Some Cases of Product Innovation in Finance

In this paper we argue that the innovator of a financial product derives an advantage that ultimately makes it profitable to move first rather than free-ride because he positions himself ahead of his competitors in a learning curve. Below we discuss some well documented cases in the literature in which we can see that the innovators had private information about their products and were keen not to disclose more information than they were legally required. This will fix our ideas on the theory presented afterwards.

1.1 The Securitization of Charge-Card Receivables

The securitization of the American Express charge-card receivables by Lehman Brothers in 1992 is a case that matches very well the model of innovation we suggest. By February 1992, the portfolio of outstanding charge-card collectibles was not traded as a security. Mason et. al. [15, 1995] suggest that “... Lehman saw the American Express charge-card deal as an important demonstration of its structuring abilities and as a means by which it could further establish itself as an innovative and leading underwriter of asset-backed securities”.¹¹ Thus, the possibility of underwriting a large share of charge-card receivables motivated Lehman Brothers to come up with a new security, different to the existing credit-card-backed or fixed-asset-backed securities. It consisted on issuing debt collateralized by a portfolio of charge-card receivables. Interest payments to the holders of the security were financed by an additional discount on the purchase of the receivables, which was declared as the yield and used to provide a liquidity cushion against the risk of default. Note that asset-backed securities traded before the charge-card-backed products used financing charges to pay interest, but charge-cards do not collect finance charges.

In the first deal, 6’995,152 accounts were selected at random from American Express’s portfolio and bundled in a master trust. These accounts amounted to \$2.4 billion, while the total value of outstanding charge card receivables was \$6.9 billion. Later, the underwriter and the issuer could add or remove accounts from the trust. As documented by Mason et. al. [15, 1995], the securitization process allowed them to isolate accounts and have information on the trust performance on a monthly basis. For the sale prospectus though, it was not required to disclose individual account information, just aggregate statistics.

1.2 Nikkei 225 Put Warrants

The Nikkei 225 Put Warrant was a complicated transaction by which investment banks underwrote the issue of a put option on the performance of the Nikkei 225 index. Issuers were generally sovereign firms and the security was traded in the United States (American Stock Exchange). Goldman, Sachs, Inc. was the first investment banker to underwrite such issues. The first deal was completed in January of 1990.

This innovation was attractive to American investors because they were able to hold a security that would allow them to bet against the Nikkei 225 Index by buying the put option (expectations then were that the Nikkei 225 would soon revert its upward trend, and it did). Sovereign issuers could use this security as a cheaper source of finance, given the expectations in the US market about the Nikkei 225. Since the probability that the holders would exercise their option was high, Goldman, Sachs swapped the securities with the issuers and the bank hedged the risk of conversion with its investment portfolio.

Goldman pioneered this type of deal in the 1990s and was, for a decade, the only investment bank to underwrite such a deal for issuers that were not the bank itself (the investment banking departments of Salomon Inc., Bankers Trust and Paine Webber underwrote these products but the issuers were their own investment divisions). In fact, Goldman started engineering put warrants type deals but using different indexes, like France's CAC-40.

It is also worth noting that Goldman's hedging positions for each one of these deals were not disclosed (see Ryan and Granovsky [24, 2000])

1.3 Other Cases

Some anecdotal evidence also exhibits similar features as the ones described in the cases above. Thackray [27, 1985], for example, documents how Drexel, Burnham, Lambert did not disclose

its “junk-bond” prospectuses to Wall Street insiders because of fears that competitor’s imitations may challenge their lead in the market for underwriting high-yield debt. J.P. Morgan’s lead in underwriting asset-backed securities using its so called BISTRO variety of a collateralized loan obligation arguably hinges on the discretion with which it manages the pool of assets used as collateral (Roper [23, 1999]). Salomon dominated the market of ELKS (equity-linked securities), its own creation, and also managed the pool of backing assets at its discretion.

2 The Structure of the Model

In the subsections that follow we introduce the information structure and the innovation game which is general to the class of financial innovations discussed throughout the paper. There are two classes of agents in this model: investment banks and issuers. The investment banks are the innovator or the imitators of a given new security or private financial contract. The issuers are firms or institutional investors that hold an asset whose cashflow is swapped or used to back the issue of the new security.

2.1 The Innovation Game

We model financial innovation as a three stage game where the players are a finite number of investment bankers, indexed by $i = 1, 2, \dots, I$. Each stage is a time period $t = 0, 1$ and 2 .

At $t = 0$ one of the banks has to decide whether or not to invest in developing an innovation. It has to pay an R&D cost of C to develop a new type of private financial contract (e.g., a credit derivative or an asset-backed security). The probability that this innovation is successful, i.e., that it will attract issuers and induce them to sign deals with the banker is $\theta \in (0, 1)$. We assume that the probability that two bankers develop the same instrument simultaneously is zero.

At $t = 1$ only the banker that paid C , i.e., the innovator, makes underwriting deals with issuers using the innovative product. By the end of this period the new design is revealed to the investment banks that did not innovate, i.e., the imitators, who do not pay the R&D cost.

At $t = 2$ the innovator and the imitators compete to make deals with the issuers. All investment banks now engage in Bertrand Competition in underwriting fees.

2.1.1 The Issuers and their Types

While the only heterogeneity among the I investment banks is that one is an innovator and $(I - 1)$ are imitators, the issuers can be of many different types. The issuers are the potential clients of banks and they can be of a type $f \in \{1, 2, \dots, F\}$. There are a continuum of issuers for each type. The notion of an issuer type in this context, can be understood more intuitively by relating it to the case studies mentioned above. When Lehman Brothers updated the selection of accounts in the pool of American Express charge-card collectibles they used information of the credit profiles of the holders. Similarly, Salomon Brothers had to form a pool of stocks to back the repayment of the issue of equity-linked securities dubbed ELKS. The types of stocks selected would be the types we refer to here, and would be those that are particularly related to the dividend stream stipulated by the security issued. In the case of mortgage-backed securities, the types can correspond also to the risk profiles of the borrowers or the geographical distribution of the loans.¹²

We define a state of the world $z \in \{1, 2, \dots, Z\}$, which represents one of the possible contingencies of the cash flow of the assets that different issuers or institutional investors have full claim to. For each issuer type there are many identical issuers and the cash flow of anyone of type f depends on the state of the world. We assume that each issuer holds one unit of cash flow that pays X_f . Let $H_f(X|z)$ be the distribution of X_f conditional on the realized state of the world. As we will see below, from the knowledge of this distribution and the observations of X something can be learned

about the true realization of z . The true state is a random draw from of a prior distribution $G(z)$ over $\{1, 2, \dots, Z\}$. This distribution is common knowledge to all investment banks. The actual realization of z is unknown before the end of the game.

2.1.2 The Contract

Here we model a private contract between a potential issuer with claims to X_f and an investment bank. In this contract the issuer agrees to sell the payment stream it owns to the investment bank in exchange for another cash flow with different characteristics. In general, these two cash flows may have different credit risk, different types of indexation (currencies, commodity prices, interest rates), and different degrees of association with other random variables.

Formally, the type f will exchange its cash flow, X_f , for a payoff stream, Y , which has a different dependence on z .¹³ For the exchange, the banker charges a transaction fee, s .¹⁴

It is important to stress the fact that the market for these private contracts differs from a generic product market in which there are many potential buyers of a product and where every seller cannot monitor each transaction made by their competitors. The market for private financial contracts described here is a market where the issuers (the bank's counterparts) are institutional investors or big corporations, so each transaction can be monitored. In effect, however, many details of such contracts are generally kept private for some time, and the very fact that they can be monitored makes it easier to detect any infringement of the confidentiality agreements on the part of the clients. Thus, the adverse effect on the reputation of the clients constitutes a strong incentive to honor the confidentiality agreement.

2.1.3 The Innovation

Investment banks pool different types of payment streams and form a portfolio which is suited to the objectives of the bank. For example, the pool may be used as collateral for the newly issued security (which is sold to outside investors), or it may be used to hedge the current positions that the bank itself has. In the case of mortgage-backed securities, the pool of outstanding mortgages was used to back the payment of interest of the different tranches of securities issued. In the case of the Nikkei 225 Put Warrants, the bankers insured the issuer of the put on the Nikkei index by swapping away from them the risk of investors exercising the put option and hedging the risk themselves in their own investment portfolio. A wide array of credit derivatives also falls in this category. Some examples are Interest Rate Swaps, Collateralized Debt Obligations, and other highly structured debt instruments in which investment banks swap with the issuers the default risk of a pool of assets.

The innovation here is essentially the development of the payment function Y that issuers would trade for their own income stream. However, an important part of doing deals using this new contract is making them with the right types of issuers, i.e., getting right the types of cash flows more suitable for the pool. More specifically, the innovation will be fully determined by Y and the tuple $\alpha \in \mathbb{R}^F$ with $\sum_f \alpha_f = 1$ of the proportions of each type of investment cash flows that form the bundle. We will call this vector α the *bundle specification*. In other words, the innovation consists of a new way to swap the cash flow of issuers, and a clever way of bundling them together.

2.1.4 Payoffs from the Deal

Issuers If a banker i purchases the cash flow X_f it gives in exchange Y . In addition, it charges a fee s^i . The payoff for a type f is then $Y - s^i - X_f$. The issuer is offered this contract by all rival

banks and chooses to make the deal that maximizes its payoff. In other words, each issuer solves

$$\text{choose } i \in \{1, \dots, I\} \text{ to maximize } Y - s^i - X_f \quad (\text{P1})$$

Note that here we take as given the fact that the deal is attractive to the issuer because the new income stream Y is more convenient than their current stream X_f : it may have a lower credit risk or be negatively correlated with some other income streams they have. A more general way to deal with this issue would be to verify that the equilibrium fees satisfy the condition $E_z u(Y - s^i) \geq E_z u(X_f)$. This is, though, not the essential discussion we pursue, so we will assume that it is a verified condition.

Investment Banks The revenue for an investment bank for one deal with a type f is:

$$X_f + s^i - Y.$$

We assume that banks are capacity-constrained and can make a (normalized) total number of deals equal to 1. Thus, on aggregate, from all the deals signed, an investment bank i would make a profit of:

$$\sum_f \alpha_f (X_f + s^i - Y) = \varphi(z) + s^i - Y, \quad (1)$$

where we have introduced the following notation:

$$\varphi(z) \equiv \sum_f \alpha_f X_f(z) \quad \forall z \in \{1, 2, \dots, Z\}.$$

Investment banks choose a bundle specification α and a fee s to maximize (1) and taking as given Y and the maximizing behavior of the issuers that they deal with. Since the fee s does not affect

the value of the bankers portfolio, $\varphi(z)$, we can break down the optimization problem in two parts.

First, banks solve the following problem:

$$\begin{aligned} &\text{choose } \boldsymbol{\alpha} = (\alpha_1, \alpha_2, \dots, \alpha_F) \text{ to maximize } E[\varphi(z)] && \text{(P2)} \\ &\text{subject to } \sum_f \alpha_f = 1, \\ &\text{and } Var[\varphi(z)] \leq V. \end{aligned}$$

Investment banks are maximizing the expected value of their portfolio subject to the constraint that they can only afford by regulation a limited volatility of returns in their portfolio.¹⁵ We assume that V is small enough so that the constraint is binding. This will imply that the problem has an interior solution: $\boldsymbol{\alpha}^* \in (0, 1)^F$. We will solve this maximization problem after we describe the learning process.

2.2 Interpretation of the Game

At the start, an investment bank has to decide whether to develop or not a financial product. This product has a development cost C , and it is designed to attract issuers that hold claims to certain types of random cash flows. Once developed, the innovator makes the first underwriting deals, being the only underwriter of the issues using such a contract. Immediately after the first contracts are signed, some information about them filters out to other investment banks that become able to imitate the product.¹⁶ The market for this type of underwriting becomes competitive then (see Figure 1 for an illustration of the game described). By the time imitation comes in, the innovator has already concluded some deals and has been able to gain some expertise. This will allow him to improve the deal and, in particular, the underlying money making scheme. This idea is summarized by the following testimony: “In Credit Derivatives, imitators can fully understand our new product

but they don't know how to make money with it," (Andrei Paracivescu, Credit Derivatives Trader, J.P. Morgan.)[20, 2001]

The result of learning-by-doing is an information advantage of the developer over the imitators. In our framework, the innovator will have learned to match more appropriately the different types of institutions' payment streams creating a better portfolio of deals, i.e., enhancing his money-making scheme. Since the innovator's benchmark contract or terms-sheet is revealed (in this model what is revealed is Y , or what to swap for X), the imitators can make their own deals, offering the same contract but they will not have the same skill and expertise as innovators in creating the portfolio of deals, i.e., to solve (P2). Again, as a Wall Street practitioner puts it, "everybody can see the laid-out contract but what I am careful not to disclose are the positions in my book. With this information you could track down the logic and see where I make money," (Andrei Paracivescu, Credit Derivatives Trader, J.P. Morgan.)[20, 2001]

This setup covers cases in which the new product or contract is standardized to all the clients. The fees of the contract are homogeneous across types and so are the terms of the exchange: X_f for Y . Thus, we can also think of contracts where the terms of the deal are contingent on the type of issuer that trades with the banker (e.g., differentiated fees or conversion ratios). Such behavior may have many interesting effects. On one hand, the innovator may discriminate clients by offering different contracts to each type to increase his profits but, on the other hand, these deals contingent on the issuer may also imply a faster disclosure of information. With standardized deals, imitators can learn only from their own deals or from the innovator's *full* record of deals (if this information were available). With differentiated deals, imitators may only need information about one or a few deals per type, e.g., how is a type f contract different from a type g contract. Incorporating this trade-off into the security design problem could be an important focus of future research. In this paper, however, we keep the contract standard, in part to be consistent with the motivating case

studies and also to keep the focus on the process of extraction of information from making deals.

3 The Innovator’s Learning Process

In this section we explain the mechanism through which this learning-by-doing occurs, and illustrate what is the private signal that allows the innovator to have asymmetric information which is advantageous over its imitators.

3.1 The General Set-up

To fix ideas, let $F = Z$ so that there are as many types of issuers as states of the world. Issuers of any type can have either a high cash flow, H , or a low one, L ($H > L$). “Good” states for different types will be those states where the probability of having a high cash flow is greater than having a low one; “bad” states will be those in which the latter is not true. We assume that for each type there is only one good state and that this state is only good for that type of firm. Without loss of generality, let the good state for any arbitrary type f be such that $z = f$. Thus, we can summarize $H_f(X|z)$ by:

$$\Pr(X_f = H|z = f) = 1 - \varepsilon, \tag{2}$$

$$\Pr(X_f = H|z \neq f) = \gamma, \forall f, z.$$

where ε and γ are small enough (all we need is for them to be smaller than $\frac{1}{2}$). Figure 2 illustrates these conditional distributions, for the case of Type 1 issuers.

Consider the case of an investment bank that has no information about the true state of the world. The bank knows the prior probability distribution $G(z)$ over the states that, to keep things simple, we assume to be the uniform. An innovator holds claims to a pool of assets of different

types and he observes the realization of each type's payoffs. Thus, effectively he gets a private signal in the first stage. This signal, $\tilde{\mathbf{X}}$, gives him a more accurate knowledge of the realized state of the world. It is an F -dimensional vector of the cash flows of assets of each type. Formally, $\tilde{\mathbf{X}} \in \{H, L\}^F$. Conditional on this signal, and the distributions given by (2), the innovator updates his prior beliefs about the actual realization of the state of the world. Notice that the signal can be mapped in two subsets of types: one containing those types that had high cash flows (the “high types”) and the other containing those that did not (the “low types”).

3.2 Bayesian Updating

For a uniform prior we have that $\forall z, G(z) = \frac{1}{Z}$. The generic signal will be a sequence of H and L .

Now, we can define the sets

$$\mathcal{H} = \{f | X_f = H\} \text{ and } \mathcal{L} = \{f | X_f = L\},$$

and let $\#\mathcal{H} = h$ and $\#\mathcal{L} = l$, so that $h + l = Z$.

Then for any state $f \in \mathcal{H}$, the posterior probability that this state was realized would be given by:

$$\begin{aligned} \Pr(z = f | \tilde{\mathbf{X}}, f \in \mathcal{H}) &= \\ &= \frac{(1 - \varepsilon) \gamma^{h-1} (1 - \gamma)^l}{h \left[(1 - \varepsilon) \gamma^{h-1} (1 - \gamma)^l \right] + l \left[\varepsilon (1 - \gamma)^{l-1} \gamma^h \right]} \\ &= \frac{1}{h + l \left[\frac{\varepsilon \gamma}{1 - \varepsilon} \frac{1 - \gamma}{1 - \gamma} \right]} = \frac{\lambda}{Z + h[\lambda - 1]}, \end{aligned}$$

where $\lambda \equiv \left[\frac{1-\varepsilon}{\varepsilon} \frac{1-\gamma}{\gamma} \right] > 1$ for ε and γ small enough. For states $f \in \mathcal{L}$,

$$\begin{aligned} \Pr(z = f | \tilde{\mathbf{X}}, f \in \mathcal{L},) &= \\ &= \frac{\varepsilon (1-\gamma)^{l-1} \gamma^h}{h \left[(1-\varepsilon) \gamma^{h-1} (1-\gamma)^l \right] + l \left[\varepsilon (1-\gamma)^{l-1} \gamma^h \right]} = \\ &= \frac{1}{h \left[\frac{1-\varepsilon}{\varepsilon} \frac{1-\gamma}{\gamma} \right] + l} = \frac{1}{Z + h[\lambda - 1]}. \end{aligned}$$

Then, for most signals, i.e., for $h = 1, 2, \dots, Z-1$, there will be updating, i.e.:

$$\Pr(z = f | \tilde{\mathbf{X}}, f \in \mathcal{H}) > \frac{1}{Z} > \Pr(z = f | \tilde{\mathbf{X}}, f \in \mathcal{L}).$$

Notice that the difference between the probabilities above is $\frac{\lambda-1}{Z+h[\lambda-1]}$, which is decreasing in the observed number h of high types. Intuitively, the set of states of the world is partitioned in one with those more likely states and another with the less likely. The smaller h , the smaller the set of more likely states and the larger its complement. Thus, each state within the smaller set has more probability of being the realized one.

Note that the signals (H, H, \dots, H) and (L, L, \dots, L) don't allow any updating of the prior distribution $G(z)$. The probability that the innovator gets a signal which allows updating, and in consequence, the probability of having superior information for the next issues of the new instrument is:

$$\xi = 1 - (1-\varepsilon)\gamma^{Z-1} - \varepsilon(1-\gamma)^{Z-1}. \quad (3)$$

3.3 Portfolio Choice for Innovators at $t = 2$

Given that investment banks solve the problem (P2), this implies that:

Lemma 1 *The Lagrangian for (P2), Λ , is symmetric with respect all α_f such that $f \in \mathcal{H}$ and all*

α_g such that $g \in \mathcal{L}$:

$$\begin{aligned}\Lambda(\dots, \alpha_i, \dots, \alpha_j, \dots) &= \Lambda(\dots, \alpha_j, \dots, \alpha_i, \dots) \quad \forall i, j \in \mathcal{H}, \\ \Lambda(\dots, \alpha_g, \dots, \alpha_h, \dots) &= \Lambda(\dots, \alpha_h, \dots, \alpha_g, \dots) \quad \forall g, h \in \mathcal{L}.\end{aligned}$$

Proof. See appendix. ■

This will imply that the solution arising from the first-order condition is also symmetric across types with the same realized cash flow in $t = 1$:

$$\begin{aligned}\alpha_i &= \alpha^H \quad \forall i \in \mathcal{H}, \\ \alpha_i &= \alpha^L \quad \forall i \in \mathcal{L}.\end{aligned}\tag{4}$$

With updated beliefs on the states of the world, an informed banker will now form bundles that put more weight on the high types. That is, $\alpha^H > \alpha^L$.

3.4 Portfolio Choice of Uninformed Bankers

Imitators, or innovators at $t = 1$, know only a prior distribution of the true state of the world. That is, they have not had the chance to observe a signal $\tilde{\mathbf{X}}$ and update their beliefs. Given this information, and given the symmetry of (P2), an uninformed banker can only form bundles with all the types of firms weighted symmetrically. That is, $\alpha_f = \frac{1}{F}$ for any type f .

The confidentiality agreements guarantee that imitating banks are prevented from gathering crucial information, such as the bundle specification, from the innovator's clients. In reality, it is observed that bankers make sure that their bundle specification is not disclosed early enough. For example, in the American Express Charge-Card securitization case, only the aggregate value of the accounts pooled was publicly reported, and not the active management of the portfolio.

Similarly, as we mentioned before, Drexel, Brunham, Lambert were careful to keep private the order-flow of their “junk-bond” deals. In more recent cases, it has been well documented that due to discretionary management of the pools backing collateralized loan obligations it is impossible to observe the positions and to be rated by Standard & Poor (See Roper [23, 1999]).

Perhaps this fact is best summarized by a recent statement in the Recommendations for Disclosure of Trading and Derivatives Activities of Banks and Securities Firms, by the Basle Committee on Banking Supervision, on February 1999: “institutions should disclose information produced by their internal risk measurement and management systems on their risk exposures and their actual performance in managing these exposures. Linking public disclosure to internal risk management processes helps ensure that disclosure keeps pace with innovations in risk measurement and management techniques.” [2, 1999].

3.5 A Simple Case of Learning: Two types, Two states

The discussion above argues that first-movers are able to assign higher probability of occurrence to those states that are good for the institutions that had high cash flows at the first stage of the game (and lower probability to the other states). Next, we develop the model for a simpler case where firms can be of one of two types only.

In the first stage, the first-mover develops the bundle with equal weights for each type, i.e., $\alpha_1 = \alpha_2 = \frac{1}{2}$. Imitators in the second stage have the same information as innovators had in the previous period. Thus, they can only form the $(\frac{1}{2}, \frac{1}{2})$ bundle.

Signals are drawn out of the set $\{(H, H), (H, L), (L, H), (L, L)\}$ conditional on the realized state of the world. Notice that, in this symmetric case, the signals $(H, H), (L, L)$ do not allow any updating. From (3), this probability equals $\varepsilon + \gamma - 2\varepsilon\gamma$.

If the first mover observes any of the two signals that allow him to update his prior beliefs $G(z)$

then he will form a bundle in the second stage with larger weight on high types. Let this weight be α^H . Then, it is clear that $\alpha^H > \frac{1}{2} > \alpha^L = 1 - \alpha^H$.

An event in this world is characterized by the triple (z, X_1, X_2) . Four of the eight possible events involve non-informative signals and in two of them the realized state is not the most likely one, given the signal. In the latter cases, the future cash flows of the firm with more weight in the bundle would be low with a large probability.

Based on this information structure we compute the expected payoffs of imitators' and innovators' portfolios using the Lemma below.

Lemma 2 *In the case where Innovators can update their beliefs on the realization of the state of the world, i.e., when the signal is informative, we have:*

$$\begin{aligned}
E(\varphi^{In}) &= \left\{ \alpha^H \frac{(1-\gamma)(1-\varepsilon)}{(1-\gamma)(1-\varepsilon) + \gamma\varepsilon} + \alpha^L \frac{\gamma\varepsilon}{(1-\gamma)(1-\varepsilon) + \gamma\varepsilon} \right\} [(1-\varepsilon)H + \varepsilon L] + \\
&\quad \left\{ \alpha^H \frac{\gamma\varepsilon}{(1-\gamma)(1-\varepsilon) + \gamma\varepsilon} + \alpha^L \frac{(1-\gamma)(1-\varepsilon)}{(1-\gamma)(1-\varepsilon) + \gamma\varepsilon} \right\} [\gamma H + (1-\gamma)L], \tag{5}
\end{aligned}$$

$$E(\varphi^{Im}) = \frac{1}{2} [(1-\varepsilon)H + \varepsilon L] + \frac{1}{2} [\gamma H + (1-\gamma)L]. \tag{6}$$

Proof. See appendix. ■

Lemma 3 *In the case where Innovators receive uninformative signals, the portfolio of innovators is equal to the imitators' and so are their corresponding expected cash flow, which equal:*

$$E(\varphi^{In}) = E(\varphi^{Im}) = \frac{1}{2} [(1-\varepsilon)H + \varepsilon L] + \frac{1}{2} [\gamma H + (1-\gamma)L]. \tag{7}$$

Proof. See appendix. ■

Our goal now is to show that, when learning occurs, the innovator will have a better portfolio

of deals than the imitator. The reason for this is straightforward: the innovator's bundle has more units of cash flows of institutions of the high types and these are ex-ante more likely to have high returns in $t = 2$.

Proposition 1 *Whenever Innovators get an informative signal, $E(\varphi^{In}) > E(\varphi^{Im})$.*

Proof. See appendix. ■

Note that even though in some nodes of the last stage innovators will be no different than imitators, the probability of reaching these nodes is small. The event that there is no learning from the innovator becomes less likely as the number of types increases: the number of uninformative signals is always only two, while the total number of possible signals is 2^F . This is seen formally in equation (3), as $\frac{\partial \xi}{\partial F} > 0$. This is intuitive: the more deals across different types an innovator makes, the more likely it is he will learn to improve his portfolio and the higher the profit margin he will have with respect to imitators, as we will see below.

3.6 Issuers's Choice

All issuers that sign this underwriting contract are willing to swap X for the new payment stream Y . Since all investment bankers offer the same cash flow in exchange, Y , it is clear from (P1) that the issuers will be attracted to the banker that charges the lowest underwriting fee, s . That is, they choose $i \in \{1, 2, \dots, I\}$ to minimize s^i .

4 The Equilibrium

4.1 Bertrand Competition

We assume that investment banks will compete à la Bertrand in fees by undercutting each other. The undercutting process will reach a halt when imitators make zero profits. As a result, the

equilibrium fee will be given by the imitators' zero profit condition:

$$s^* = Y - E(\varphi^{\text{Im}}). \quad (8)$$

This will be the equilibrium underwriting fee charged to issuers. Indeed, for that fee, the innovator makes the profit :

$$E(\varphi^{\text{In}}) - Y + s^* = E(\varphi^{\text{In}}) - E(\varphi^{\text{Im}}). \quad (9)$$

If the profits in (9) are positive, the pioneer will be able to marginally lower his fee further to attract more institutions, as we will show later.

Proposition 2 *At $t = 2$, imitators make zero profit in equilibrium and the innovator makes profit $E(\varphi^{\text{In}}) - E(\varphi^{\text{Im}})$.*

Note that the higher the wedge between the expected returns of the portfolio of innovator over the imitators', the larger the developer's profits. The innovator's profits are determined by the extent of the learning-by-doing in the first stage, that is, by how much he learned how to improve the money-making scheme in the second round of underwriting with respect to the first. Of course, in the unlikely event that there is no learning (no improving of the portfolio of deals), competition by imitators will drive innovator's second stage profits to zero.

4.2 Market Shares

If there is learning the developer's profit will be positive and it will allow him to undercut the fee s^* further by, say, an epsilon, and swap as many units of Y for X until his capacity constraint is reached. This will leave imitators to share the rest of the underwriting market. If we assume that issuers represent the short side of this market, the underwriting contracts will be rationed across imitators. Even though all investment banks have the same capacity, the equilibrium market shares

of innovator and imitators are not the same. Since the innovator has the information advantage, he chooses a lower fee that allows him to underwrite deals at full capacity.

As in standard Bertrand competition, in this model each imitator's share of the new product's market is really undetermined because they make zero profits. Since the imitators are identical we can assume that the contracts that remain to be underwritten after the innovator has taken his share are equally rationed among them, following the general convention for Bertrand allocations. This will leave the innovator being the market leader, i.e., having the biggest market share.

Notice that it is not important that the innovator has a larger market share. Just because he is better informed about the state of the world, he is the only bank that can work at full capacity for any size of the market of potential issuers, and he is the only banker making profits with free-entry. Here we illustrate that this model can have as a prediction the market-shares leadership fact by assuming that imitators ration the proportion not underwritten by the innovator.

4.3 Optimality of Innovating

The final step is to find the optimal choice of the potential innovator and the equilibrium allocations resulting from this choice. At $t = 0$ this bank must decide whether or not to pay the development cost C . The potential developer will have to take into account that the innovation is risky: if he develops and pays C , there is a probability θ that the new product attracts institutions, but with probability $1 - \theta$ the innovation will not be marketable, and the developer will make a loss.

If the innovative product proves to be successful, the developer will have to face competition from imitators. Imitators will enter the market after they see the first innovative deals. The developer's profits from these first deals, i.e., in the learning stage, are zero. This is because in this stage the newly established innovator has the same information and expertise as an imitator in the next stage. So, since the time lapse between the introduction of a new financial product and the

appearance of imitations is typically very short, an innovator in the first stage effectively competes in fees with the imitators. With no time discounting, if an innovator charges a higher underwriting fee institutions will prefer to wait for the next period and make a more convenient deal with an imitator.¹⁷ As a consequence, for the investment in the development of a new product to be worthwhile, the developer will have to make positive profits in the last stage, when competition from imitators drives profit margins down.¹⁸ The developer will have on his side additional expertise and information over his competitors. In our model, this will happen if and only if some learning occurs in the first stage, that is, with probability ξ . With probability $1 - \xi$, the innovator will have no comparative advantage with respect to his imitators and will make zero profit.

To summarize, at $t = 0$, the expected profits for a bank that decides to invest to develop the innovation are:

$$\theta[\xi(E(\varphi^{In}) - E(\varphi^{Im})) + (1 - \xi)(0)] + (1 - \theta)(0) - C.$$

That is, at the start of the game, a potential developer will pay the development cost C if and only if:

$$\theta\xi[E(\varphi^{In}) - E(\varphi^{Im})] \geq C. \tag{10}$$

Note that ξ increases in F . That is, the more deals a pioneer is able to make prior to imitation, the higher the likelihood that he will gain expertise over his competitors from his first issues and that he will perfect the way to make money using this new way financial product. This constitutes his first-mover advantage.

Despite the absence of patents and the possibility of cost-less and early imitation, investment in R&D is still profitable for the investment banks. The monopolistic advantage derived from the first stage learning guarantees positive profits for innovators in the second period. Imitation may look attractive because it is cost-less but, for this same reason, has the disadvantage of being undertaken

by almost all other banks: competition is fierce and generates low (zero in our model) profits.

5 Concluding Remarks

The empirical evidence (such as Tufano [30, 1989]) shows that financial innovation is a permanent phenomenon even in the absence of patents and that innovators dominate the markets where their innovations are used or traded. In this paper we argue that an innovator of financial products (such as asset-backed securities, swaps or credit derivatives) may not need to foreclose imitation by legal means, i.e., with patents, to derive profits from the innovation. Recent case studies revised here or described elsewhere show that, for many types of new financial products, there is a substantial value in the information the innovator acquires through the deals it makes. To help explain these studies, we model an innovator as a first-mover in a game where every deal made for a given innovation improves the knowledge about the characteristics of the client. This learning feature may explain why for instance imitators never caught up with Goldman Sachs in the market for underwriting issues of Nikkei Put Warrants or why JP Morgan dominated the underwriting of collateralized loans. In both cases the innovator had acquired superior expertise on the configuration of a pool of assets underlying the payoff promised by the issued securities.

The present work also contributes to the ongoing discussion triggered by the *State Street Case* resolution, in which the US Supreme Court decided to uphold a patent for a financial business method in 1999. The immediate effect of this decision should be to encourage firms in the financial industry to acquire new patents or enforce old ones. It is not clear, though, what other incentives this decision may introduce. We argue here that patents are not necessary for some innovations to occur. What makes these innovations profitable is that the innovator exploits an information advantage during the *competitive/imitation* stage. Thus, the supra-normal profits that can recoup the initial R&D expenditure are realized during this imitation stage, not during the period of

temporary monopoly in which the innovator moves alone while imitators unravel the design of the new product. Therefore, for many innovations, a patent would just distort the allocation of the surplus created, most likely in favor of the innovative banker. Moreover, in a dynamic context a patent may reduce the incentives to develop future innovations. Van Horne [32, 1985] pointed out that the life cycle of financial innovation usually involves the gradual erosion of the innovator's profits and that the benefits to innovation are increasingly realized by the end users of the products. In the search for new profit opportunities in the absence of patents, incentives for the creation or perfection of financial products arise. In this sense, an interesting avenue of research is to study the market shares and profits of innovators and imitators à la Tufano but across time, that is, focusing on the time evolution of an innovation and its subsequent generations. One step in this direction was taken by Schroth [25, 2002] who observes that equity-linked innovations are followed by improved versions, or “next generation” innovations.

The State Street Case will provide a natural experiment to address these issues rigorously. An assessment of its overall impact on the quantity, variety and profitability of financial innovations as well as on the welfare issues such as the surplus sharing among innovators imitators and final buyers remains to be documented.

Figure 1

In this figure we illustrate the timing of the innovation game. There are three periods. In period 0 a given investment bank chooses to become an innovator or not. If it wants to innovate it must pay an R&D cost, C . In period 1, it is only the innovator that makes underwriting deals using the new financial product. Given his information about the quality of the potential clients, it chooses the composition of the pool of clients to deal with, α , and the underwriting fees. At the end of this period, he extracts a private signal. Imitators do not make any underwriting deals, but they discover the design of the product, as they observe what the innovator swaps with firms: a cashflow Y for the cashflow held by firms, X . In period 2, the innovator and its imitators compete for market share using the same financial product, and choosing the pool specification and the fees.

Figure 2

This diagram illustrates the probability distribution function of the cash flow that an issuer of type 1 has claims to. z is the underlying random variable that introduces uncertainty in the cash flow, and there are Z possible states of nature. Only one state is the “good state” for each type and the rest of states are bad states for it. In this diagram, state $z = 1$ is the good state for the issuer of type 1. Note that $H > L$, while ε and γ are smaller than $\frac{1}{2}$.

Appendix

Proof to Lemma 1. We omit a proof, since we believe it is verified only by inspection. ■

Proof to Lemmas 2 and 3. In any state, one of the two firms in the bundle will have high cash flows with a probability $1 - \varepsilon$ and the other with probability γ . When innovators receive an informative signal and form up the bundle with larger weight for the good type, the true state could be indeed the one suggested by the high signal, in which case the expected payoffs of the bundle would be

$$\alpha^H[(1 - \varepsilon)H + \varepsilon L] + \alpha^L[\gamma H + (1 - \gamma)L]. \quad (11)$$

In case the true state is not the most likely one, given the signal, the expected payoff of the same bundle would be

$$\alpha^L[(1 - \varepsilon)H + \varepsilon L] + \alpha^H[\gamma H + (1 - \gamma)L]. \quad (12)$$

Now then, the probability of receiving a “correct ” informative signal, i.e., the one where the good type has a payoff of H , is $\frac{(1-\varepsilon)(1-\gamma)}{(1-\varepsilon)(1-\gamma)+\varepsilon\gamma}$ while the probability of getting incorrect signals is $\frac{\varepsilon\gamma}{(1-\varepsilon)(1-\gamma)+\varepsilon\gamma}$.

The expected payoff to the innovators’ bundle at any node of the game where the signal was informative is then nothing but the weighted average of equations (11) and (12):

$$\begin{aligned} E(\varphi^{In}) &= \frac{(1 - \varepsilon)(1 - \gamma)}{(1 - \varepsilon)(1 - \gamma) + \varepsilon\gamma} \{ \alpha^H[(1 - \varepsilon)H + \varepsilon L] + \alpha^L[\gamma H + (1 - \gamma)L] + \\ &\quad \frac{\varepsilon\gamma}{(1 - \varepsilon)(1 - \gamma) + \varepsilon\gamma} \{ \alpha^L[(1 - \varepsilon)H + \varepsilon L] + \alpha^H[\gamma H + (1 - \gamma)L] \} \\ &= \{ \alpha^H \frac{(1 - \varepsilon)(1 - \gamma)}{(1 - \varepsilon)(1 - \gamma) + \varepsilon\gamma} + \alpha^L \frac{\varepsilon\gamma}{(1 - \varepsilon)(1 - \gamma) + \varepsilon\gamma} \} [(1 - \varepsilon)H + \varepsilon L] + \\ &\quad \{ \alpha^L \frac{(1 - \varepsilon)(1 - \gamma)}{(1 - \varepsilon)(1 - \gamma) + \varepsilon\gamma} + \alpha^H \frac{\varepsilon\gamma}{(1 - \varepsilon)(1 - \gamma) + \varepsilon\gamma} \} [\gamma H + (1 - \gamma)L]. \end{aligned}$$

For any uninformative signal, innovators choose equal weights for each type of institution. Thus,

in any event the expected payoff of the portfolio is:

$$E(\varphi^{In}) = \frac{1}{2}[(1 - \varepsilon)H + \varepsilon L] + \frac{1}{2}[\gamma H + (1 - \gamma)L]. \quad (13)$$

Imitators behave just like innovators who have received signals that allow no updating. They assign equal weights to each type in the bundle, thus the expected payoff of their portfolio is given by:

$$\begin{aligned} E[\varphi^{Im}] &= E[\varphi|z = 1] \Pr[z = 1] + E[\varphi|z = 2] \Pr[z = 2] \\ E[\varphi|z = 1] &= E[\varphi|z = 2] = \frac{1}{2}[(1 - \varepsilon)H + \varepsilon L] + \frac{1}{2}[\gamma H + (1 - \gamma)L], \end{aligned} \quad (14)$$

which yields:

$$\begin{aligned} E[\varphi^{Im}] &= E[\varphi|z = 1] (\Pr[z = 1] + \Pr[z = 2]) = \\ &= \frac{1}{2}[(1 - \varepsilon)H + \varepsilon L] + \frac{1}{2}[\gamma H + (1 - \gamma)L]. \end{aligned}$$

It is important to notice that this last result does not depend on the probability distribution. Imitators believe that $\Pr[z = 1] = \Pr[z = 2] = \frac{1}{2}$, the common prior. Once Innovators have updated their beliefs they will in general find new *different* values for this probabilities. Therefore, it could be argued that imitators are “wrong”, i.e., less accurate than the one made by innovators that have learned more about the state of the world. However, given the symmetry of this setup this is not an issue here: $E[\varphi^{Im}]$ does not depend on the probability distribution. Probabilities add up to one and cancel out, since they multiply a common symmetric factor.

By assumption, $H > L$, $0 < \varepsilon, \gamma < \frac{1}{2}$ and $\alpha^H > \frac{1}{2}$. Now,

$$\begin{aligned}
E(\varphi^{In} - \varphi^{Im}) &= \left\{ \alpha^H \frac{(1-\varepsilon)(1-\gamma)}{(1-\varepsilon)(1-\gamma) + \varepsilon\gamma} + \alpha^L \frac{\varepsilon\gamma}{(1-\varepsilon)(1-\gamma) + \varepsilon\gamma} - \frac{1}{2} \right\} [(1-\varepsilon)H + \varepsilon L] + \\
&\quad \left\{ \alpha^L \frac{\varepsilon\gamma}{(1-\varepsilon)(1-\gamma) + \varepsilon\gamma} + \alpha^H \frac{(1-\varepsilon)(1-\gamma)}{(1-\varepsilon)(1-\gamma) + \varepsilon\gamma} - \frac{1}{2} \right\} [\gamma H + (1-\gamma)L].
\end{aligned}$$

Substituting for $\alpha^L = 1 - \alpha^H$,

$$\begin{aligned}
E(\varphi^{In} - \varphi^{Im}) &= \left(\alpha^H - \frac{1}{2} \right) [(1-\varepsilon)H + \varepsilon L] - \\
&\quad \left(\alpha^H - \frac{1}{2} \right) [\gamma H + (1-\gamma)L] \\
&= \left(\alpha^H - \frac{1}{2} \right) (1-\gamma-\varepsilon)(H-L),
\end{aligned}$$

which is clearly positive by the assumptions above. ■

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Footnotes

1. Only recently, in January of 1999, a patent for a “financial method or formula” was upheld by the United States Supreme Court. The State Street Bank of Boston filed a lawsuit against a patent for a valuation algorithm by the Signature Financial Group of Massachusetts, arguing that the business method exemption provision in the patent law made this particular patent unlawful. The Supreme Court upheld the patent however, setting an important precedent that may make most innovations in finance patentable. As Lerner [14, 2000] argues, the number of patent filings and awards may increase sharply now that the *State Street Case* has been settled.
2. See Tirole [28, 1988, Ch. 10] for a description of the reasons why imitation of discoveries provides incentives for maintaining low levels of R&D.
3. Benoît [3, 1985] and Reinganum [22, 1983] provide some notable examples.
4. For all the 58 innovations he studied, the median number of underwriting deals completed by the innovating bank prior to entry by rival banks was of only one.
5. The relevant innovation cost is not only R&D, but all the sunk payments required to discover and introduce an innovation. Mansfield [16, 1971] disaggregates them in R&D, the building of production facilities, and marketing. In the IO literature, these costs are usually referred to as R&D. In this paper we follow the IO convention and use the term R&D to refer to total innovation costs.
6. Investment bankers interviewed by Tufano [30, 1989] reportedly spent between \$50,000 and \$5 million to develop each new security. In a study by Nashund [18, 1986], marketing costs for innovations by 20 financial institutions range between \$1 million and \$3 million.

7. Krigman, Shaw and Womack [13, 2000] mention other reasons why firms switch underwriters, the most important being the tendency to gradually select more reputed bankers to benefit from the higher quality of their research analysts.
8. Miller [17, 1986], for example, argues that what spurred the latest innovation “wave” were loopholes in tax codes that provided incentives to design securities that circumvented regulation. Finnerty [10, 1992] describes different ways in which new securities add value and relates them to corporate financial innovations since the 70s. A broader survey of the history financial innovation is provided by Tufano [31, 1995].
9. In a general setting, Boldrin and Levine [6, 2002] show how the natural monopoly position of the innovator as a provider of the original prototype can make the innovative process worthwhile despite imitation. In the case of financial innovation, Black and Silber [5, 1986] present a model in which the innovator is a futures exchange that develops an advantage for creating a new contract by providing liquidity for investors earlier than the competing exchanges in order to attract future trades.
10. Another contribution of learning to corporate finance is the one by Douglas Diamond [8, 1991].
11. By that time, a large share of Credit-Card receivables had already been securitized by Citibank and First Boston and were publicly traded.
12. Coincidentally, Fannie Mae, the largest issuer of mortgage-backed securities and collateralized mortgage obligations started reporting publicly the disaggregation of the pool of securitized mortgages in its 2001 Information Statement. The first mortgage-backed securities were introduced in the early 1980s.

13. In general, Y can be made contingent on many observable random variables. Credit derivatives will often provide insurance to financial institutions by swapping their uncertain cash flow for one which is tied to a more popular and less volatile index, e.g., tied to LIBOR. Y can also be a payment in cash if the banker is just buying outstanding loans to pool them.
14. This fee would be equivalent to the underwriting spread.
15. This volatility restrictions are common practice in portfolio management. For example the "Basle 2" agreement fixes upper bound on value at risk. Besides, this constraint also allows to solve the indeterminacy on the weights α of all the H types and all the L types. Alternatively, a problem in which bankers have mean-variance utility would produce the same result.
16. Although these kinds of private contracts are strictly confidential, information is leaked in various ways: the client may go to other investment banks to seek a better fee, or people that develop these products may be hired away to competing banks.
17. Indeed, when offered an innovative deal by its developer at a given price, institutions often search around to see if other bankers can offer them a cheaper deal. As we mentioned, this is one channel through which some strictly confidential information about the innovation is transmitted to potential imitators. In reality, as we mentioned, what is rather disclosed is the new swap technology, Y .
18. This result is consistent with the evidence that Tufano [30, 1989] found: when they are the sole underwriters, innovators do not charge fees larger than when they compete with imitators.

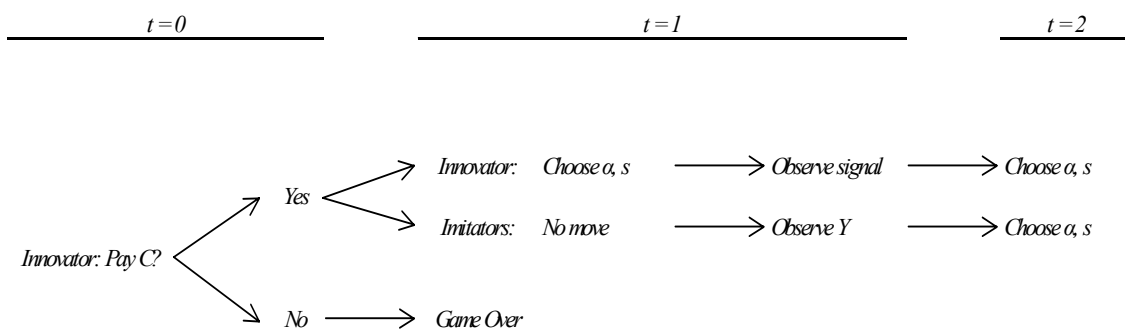


Figure 1: An illustration of the timing of the innovation game.

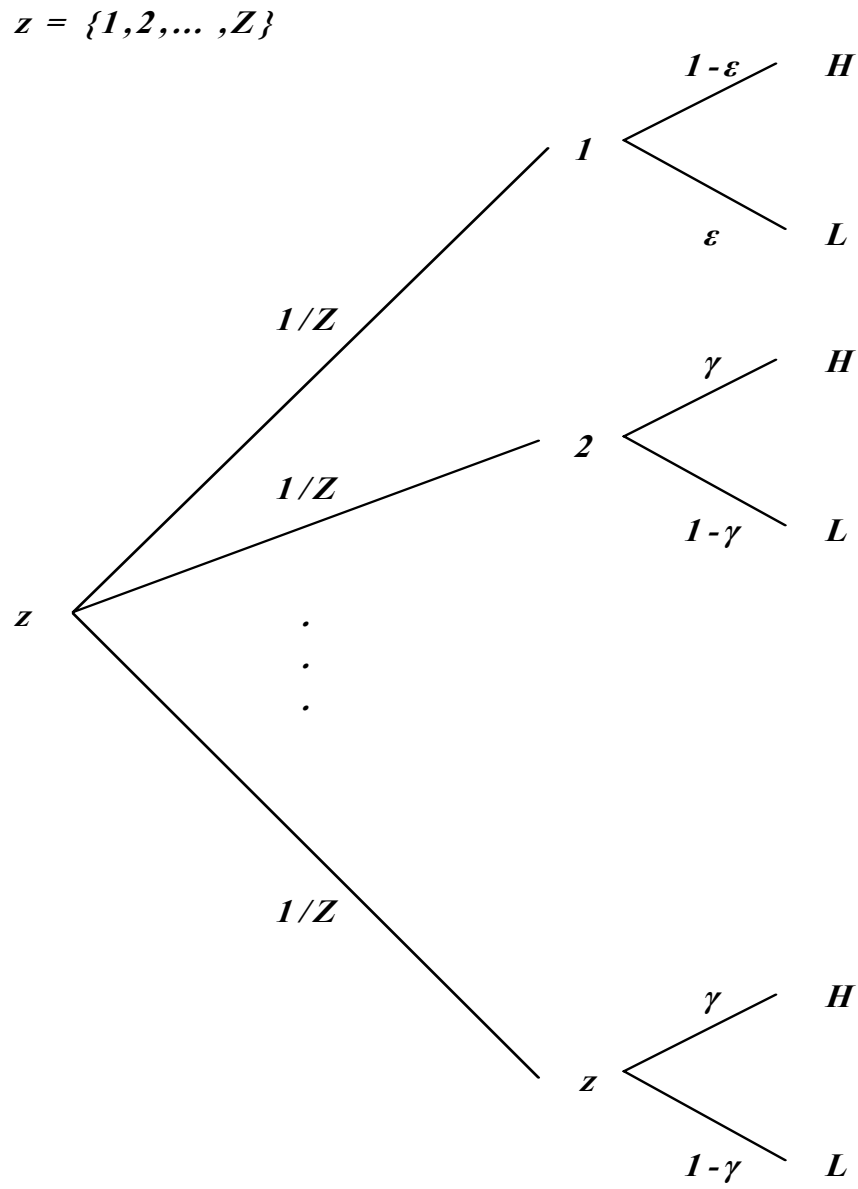


Figure 2: An illustration of the probability distribution function of the cash flow of a type 1 issuer.