# A New Decision for Hedge Fund Managers: Longer/Shorter Lockups for Lower/Higher Fees

Erik Benrud Drexel University
Beryl Chang New York University

**Abstract**

*This article develops a model in which hedge fund managers compete and differentiate themselves with incentive fees and lockup periods. The model is useful in analyzing the recent trend of hedge funds offering different tiers of fee/lockup-period combinations. It has a stable equilibrium and demonstrates how exogenous changes in market parameters affect the fees and lockup periods. For example, a decline in the number of potential investors will lower fees, lower profits, increase lockup periods, and decrease the difference in the lockup periods offered by competing funds. The model also demonstrates how offering investors varying fee/lockup-period choices may help to keep capital invested in the hedge fund market.*

*Keywords: hedge fund, lockup period, game theory*

*JEL classification: G29, L11*

**A New Decision for Hedge Fund Managers:
Longer/Shorter Lockups for Lower/Higher Fees**

There has been a great deal of controversy concerning hedge fund fees. Many experts expected an overall decline in hedge fund fees after the financial crisis of 2008. Instead of lowering fees, managers began offering investors choices between lower (higher) fees and longer (shorter) lockup periods. The purpose of this article is to develop a model describing the equilibrium of a hedge fund market in which managers offer tiers of fees and lockup periods, examine its characteristics, and explain why hedge fund managers would begin offering the different fee/lockup combinations as opposed to simply lowering fees in the wake of the 2008 financial crisis.

Despite a rapid increase in the supply of hedge funds from 1990 to 2007, managers typically offered only one fee structure where they charged a two percent management fee and a 20 percent performance fee. When faced with the decline in demand for fund shares[1] in 2008, many experts predicted that hedge fund fees would soon decline; see Phillips (2009) and *The Economist* (2009). It was not until 2011, however, when fees began "finally creeping downward, a trend long predicted that had not ever managed to arrive," and the recent decline has been modest; see Eisinger (2011).[2]

Instead of just lowering fees after the crisis, managers began offering investors choices with respect to fees and lockup periods. Practitioner journals commented on the trend, see Grene (2008) and Terzo (2008). Hu (2008) and Strasburg (2008) cite specific funds and the tiers of fee/lockup choices they offered to investors. The 2009 bfinance survey indicated that more than three out of four managers would be willing to offer discounts in return for investors agreeing to lock up their assets for three years, see Johnson (2009).

Surveys right after the crisis also indicated that investors were receptive to the idea of paying lower fees for longer lockup periods, see the Deutsche Bank 2009 survey, Phillips (2009), and Johnson (2009). More recent surveys find the same result. The Deutsche Bank 2011 survey indicated that 17 percent of those polled believed that a longer lockup period is the strongest argument for lower fees. More than half of those who responded to the Credit Suisse 2010 survey indicated that funds should lower fees for investors who agree to longer lockups.

Can a multi-tier fee/lockup-period hedge fund market have a stable equilibrium? This article answers that question by developing a model of such a market and explores its properties. Our model provides expressions for fees, lockup periods, market shares, and profits as functions of the number of potential investors, the aversion of investors to lockup periods, and the marginal cost of shortening the lockup period. The model demonstrates that when the number of potential investors increases (decreases), the lockup periods will decrease (increase) and diverge (converge). When investors become more (less) averse to longer lockups, the lockups periods will decrease (increase) and diverge (converge). When the cost of offering a given lockup period increases (decreases), the lockup periods will increase (decrease) and converge (diverge).

After a review of the literature, we develop the model in two steps. First, we introduce the assumptions in the context of a single-seller market offering investors only one choice. Then, we

[1] The outflow was in hundreds of billions, see Phillips (2009), Kouwe (2009), and Kishan (2009).

[2] The May 2011 survey conducted by the Chartered Alternative Investment Analyst Association asked which of the following would be the modal management/incentive fee structure by 2015: 0.5/5, 0.5/10, 1/10, 1/15, 1.5/15. The percentage for each response was 1%, 6%, 26%, 25%, and 42%, which indicates there is not a general expectation of a large decline in fees overall, see http://caia.org/caia-community/caia-member-poll.

expand the model to include two hedge funds that differentiate themselves with respect to fee and lockup period and examine how exogenous changes affect the fees and lockup periods. Our article concludes with a discussion of the importance of the findings and implications for future research.

## 1. Models of Quality Competition

Sutton (1997) posits that "if a profitable opportunity exists in a market, there is 'one smart agent' who will fill it," and firms have incentives to avoid "loss-making strategies." There is a lengthy literature focusing on how a monopolist must deal with the threat of entry from another firm that wishes to earn a share of the profits in that market. There is also a lot of research on how, after a second firm enters, the firms can avoid the harmful consequences of direct competition with quality differentiation. As the financial markets become more competitive, these models serve as a solid foundation for models to describe increasingly dynamic financial markets.

Prescott and Visscher (1977) and Hay (1976) pioneered the modern models of sequential entry of firms into a market. Lane (1980) extended the model to allow for endogenous prices, and this development has characterized later models including the one in our article. Other work in this area includes Shaked and Sutton (1982), Bernheim (1984), Harris (1985), Eaton and Ware (1987), Dewatripont (1987), Benoit and Krishna (1987), Vives (1988), Mclean and Riordan (1989), and Anderson, DePalma, and Thisse (2002), henceforth ADT.

ADT develops a vertical differentiation model that provides an excellent format on which to build a model of hedge fund fee/lockup-period competition. The consumer utility function of the ADT model easily adapts to a utility function of an investor who is willing to pay a higher fee for a shorter lockup period. We include an extension of the model added by Benrud (2003) where there is also a "free" product. In our model, that free choice is some long horizon where the investor can expect to earn the long-run return of the hedge fund style without active management. In essence, it is a lockup period that is so long that the hedge fund does not charge an incentive fee.[3]

There is a lengthy literature on how quality differentiation can relax price competition; see Leland (1977) and Shaked and Sutton (1982), Dixit (1980), Schwartz and Thompson (1986), Schwartz and Baumann (1987), and ADT. If firms directly compete with each other with a homogeneous product, prices fall and production costs increase to the point where the firms in the market have non-positive profits; see ADT. By vertically differentiating themselves, firms can avoid direct competition and reduce the likelihood of this outcome known as "Bertrand death"; see Bertrand (1883). Our model offers one explanation for why hedge funds fees did not decline precipitously in the face of falling demand, and the explanation is that firms reduced competitive pressures and kept investors in the market by offering choices.

As Sutton (1997) mentions, there is usually not one "true model" to describe a given market. Several models may apply, and each will have its own set of simplifying assumptions. The assumptions in our model provide a stable equilibrium where the second-order conditions are satisfied, and the model provides a framework for analyzing the effect of exogenous shifts on fees and lockup periods. The next section summarizes the assumptions of the ADT model and modifies

---

[3] Some hedge funds have been willing to offer this alternative, see Grene (2008).

that model so that its inputs correspond to parameters in a monopoly market where a hedge fund manager chooses the optimal fee and lockup period to maximize profits. It lays the groundwork for the sections that describe the duopoly characterized by vertical product differentiation and how lockup periods and fees react to changes in exogenous parameters.

## 2. A Market with One Hedge Fund and Fee/Lockup Choice

We begin by introducing the indirect utility function, denoted $V_i(\theta)$, of the consumers in the ADT model. The function includes income, price, taste, and quality, which are represented by y, $P_i$, $\theta$, and $q_i$, respectively:

$$V_i(\theta) = y - P_i + \theta q_i , \quad i = 1 \dots n . \tag{1}$$

In each period, agents purchase and consume a single unit of the good indexed i. The increase in utility from consuming the good depends on each agent's unique preference factor denoted $\theta$. The ADT model assumes that preferences follow a uniform distribution over an interval bounded by a lower and upper value of $\theta$. The quality levels have this relationship: $q_Z < q_2 < q_1$. The symbol $q_1$ represents the quality level offered by the high-quality producer, who is the monopolist in the single-seller market. In the duopoly market, the low-quality producer offers $q_2$. The symbol $q_Z$ represents the quality of a free product, which was not in the ADT model. The net benefit of consuming the product is the quantity $\theta q_i - P_i$ or simply $\theta q_Z$ if the consumer chooses the free product.

For the hedge fund market, our version of the utility function for investors is:

$$V_i(\lambda) = R - M - F_i - \lambda L_i \qquad i = 1 \dots n \tag{2}$$

where:

- R: the expected long-run annual risk-adjusted return for the hedge fund's asset class and investment style,
- M: a fixed annual management fee that does not vary with the other inputs,
- $F_i$: the incentive fee paid by the investor in fund "i,"
- $\lambda$: the lockup-period aversion of the investor, which is unique to each investor,
- $L_i$: the lockup period of fund "i."

In essence, the quality level is $-L_i$, and lowering the value of $L_i$ corresponds to increasing $q_i$ in the ADT model. We assume that the funds do not compete with management fees, that is, there is a fixed management fee "M" that does not vary in either the monopoly or duopoly model. It is the only cost to an investor who chooses a holding period greater than or equal to $L_Z$.

$L_Z$ represents a period over which a given class of assets is assumed to achieve its long-run, risk-adjusted annual return within an acceptable degree of error. When investing in equities, for example, a 10-year horizon may be long enough to assume that an investor will earn the long-run, annualized equity risk premium on a passively-managed, diversified portfolio of equity investments.

Therefore, a hedge fund with a strategy that uses equity investments could not demand an incentive fee for a fund with a 10-year lockup period. By using various strategies such as hedging with derivatives, however, the manager can offer the long-run return over a horizon shorter than 10 years, and that shorter horizon is the lockup period. The manager charges the incentive fee, $F_i>0$ for this service. It is reasonable to assume that varying the length of the lockup period would affect the cost, and a theoretical model by Panageas and Westerfield (2009) demonstrates how manager behavior can change based on the length of the investment horizon.

In a single hedge fund market, the potential investors have the choice between

i) holding a portfolio for period $L_Z$, or longer, and paying only M, or

ii) paying $F_1$ and M and then getting a shorter lockup period, $L_1$.

Both alternatives offer the same expected risk-adjusted return and have the same management fee. Thus, R and M will not appear in subsequent analysis in this article just as the term for income, denoted y, disappears from the analysis in ADT. Allowing R and M to vary will be a topic for future research.

If R and M are constant, then potential investors characterized by $\lambda>F_1/(L_Z-L_1)= \lambda^*$ will choose the hedge fund offering the lockup period $L_1$ over the choice of holding their investments for $L_Z$ or longer. In other words, investors with a higher value of $\lambda$ are willing to pay $F_1$. As assumed in many models of this type, for example, ADT and Benrud (2002), the values of $\lambda$ follow a uniform distribution. Each value of $\lambda$ identifies the corresponding investor. The lower bound of $\lambda$ is zero, and the upper bound is $\Lambda$. Letting N represent the number of potential investors and $\phi'(\lambda)$ represent the density function, we can write $\phi'(\lambda)=N/\Lambda$ when $0<\lambda<\Lambda$; otherwise, $\phi'(\lambda)=0$.

With these assumptions, the profit function of the fund becomes: $\pi_1= (N/\Lambda)(\Lambda- \lambda^*)F_1-$ cost. Substituting $\lambda^*$ into the profit function and optimizing with respect to price gives this expression for the optimal fee: $F_1^*= \Lambda(L_Z-L_1)/2$. Using the assumed distribution of $\lambda$ gives the following expression: $\lambda^* = [\Lambda(L_Z -L_1)/2]/(L_Z-L_1) = \Lambda/2$, i.e., half of the potential investors take positions in the hedge fund with lockup period $L_1$. This is a standard result in a monopoly market where the firm has zero per-unit costs of production. It does not change as a result of variations in the cost function or other exogenous parameters; however, the actual number of investors will change if N changes. Determining the equilibrium values for $L_1$ and $F_1^*$ requires a specific cost function. We assume a quadratic cost function, which incorporates the principle of increasing costs for shortening the lockup period:

$$C(L_1) = C(L_1|L_Z) = \xi(L_Z - L_1)^2 . \qquad (3)$$

The scale factor $\xi$ represents the effect on costs caused by changes in technology and market conditions. The value for $\xi$ would decline as technology improves, for example, and it would increase if markets become more volatile.

Substituting expression (3) and the measures $\lambda^*=F_1/(L_Z-L_1)$ and $F_1^*= \Lambda(L_Z-L_1)/2$ into the profit function gives:

$$\pi_1 = (N\Lambda/4)(L_Z - L_1) - \xi(L_Z - L_1)^2 \ . \quad (4)$$

The first-order condition[4] determines the optimal value for $L_1$. The monopolist finds it optimal to require the following lockup period:

$$L_1 = L_Z - 0.125N\Lambda/\xi \ . \quad (5)$$

As the expression indicates, the fund finds it profitable to accommodate an increase in the number of potential investors, i.e., an increase in N, by lowering the lockup period. Equation (5) also indicates that there is an inverse relationship between lockup-period aversion, $\Lambda$, and the lockup period offered. Since $dL_1/d\xi = 0.125N\Lambda/\xi^2 > 0$, the fund will offer a longer lockup period if the costs increase. Factors that could increase $\xi$ include a more volatile market or a decrease in the liquidity of the fund's assets. Each of these would make it more costly for the hedge funds to engage in the strategies to provide the target return for a given lockup period.

Solving for the fee, gives the following expression:

$$F_1 = 0.0625N\Lambda/\xi, \quad (6)$$

where $\Lambda$ and N have positive impacts, and $\xi$ has a negative impact. It is interesting to note that the increase in $\xi$ lowers the fee, but this is because the increase in costs causes the hedge fund manager to increase the lockup period.

The profit of the monopoly hedge fund is:

$$\pi_1 = 0.015625(N\Lambda)^2/\xi, \quad (7)$$

where increases in $\Lambda$ and N have positive impacts, and an increase in $\xi$ has a negative impact.

These results hold when $\lambda$ follows a distribution other than the uniform distribution. An expression for a cumulative distribution function, denoted $\phi(\lambda)$, can help create a more general expression for profit:

$$\pi = NF_1\{ 1-\phi[F_1/(L_1 - L_Z)] \} - \xi (L_1 - L_Z)^2 \ .$$

Given $\lambda^*$, the optimal fee is $F_1^* = [1-\phi(\lambda^*)]/[(L_1 - L_Z) - \phi'(\lambda^*)]$. Substituting $F_1^*$ into $\lambda^*=F_1/(L_1 - L_Z)$ gives the following expression: $\lambda^*=[1 - \phi(\lambda^*)]/\phi'(\lambda^*)$, and $\lambda^*$ is a constant nominal value for many distributions. Unique solutions exist for $\lambda^*$ and the second-order conditions are satisfied when $\phi(\lambda)$ represents a uniform, normal or exponential distribution.

Future research will investigate how changing assumptions such as the distribution of tastes will affect the results. We proceed by expanding the model to include a second hedge fund with a longer lockup period and lower fee. The next section also compares the characteristics of the equilibrium

---

[4]The first derivative is $d\pi_1/dL_1 = -(\Lambda^2/4) + 2\xi(L_Z - L_1)$. The second-order condition is satisfied: $d^2\pi_1/d(L_1)^2 = -2\xi$ .

fees, lockup periods, profits, and number of investors to those of the monopolist hedge fund with one fee/lockup structure.

## 3. A Market with Two Hedge Funds and Fee/Lockup Structures

To describe the interaction of the long lockup and short lockup hedge funds, we use the widely used assumption that the firms can adjust prices more easily than qualities; therefore, the funds engage in a quality-then-price two-stage game. Representative work in this area includes ADT, Jehiel (1992), Tirole (1988), and Wauthy (1996). The model we develop has a stable equilibrium that determines the market shares, fees, lockup periods, and profits of the funds in terms of the exogenous parameters defined in the previous section.[5]

In the first stage of the game, the competitors recognize how their respective choices of $L_i$ determine market shares, and they offer distinct lockup period and fee combinations as characterized by $L_1 < L_2$ and $F_1 > F_2$. Henceforth, the terms "Fund 1" and "Fund 2" refer to the short and long lockup-period hedge funds, respectively. Recalling expression (2), the condition that leads an investor to choose the short lockup period is $-F_2 - \lambda L_2 < -F_1 - \lambda L_1$. The preference factors for the marginal buyers are:

$$\lambda_1^* = (F_1 - F_2)/(L_2 - L_1) \tag{8.a}$$

$$\lambda_2^* = F_2/(L_Z - L_2)\ . \tag{8.b}$$

The term $(N/\Lambda)(\Lambda - \lambda_1^*)$ indicates the number of investors who choose Fund 1 with the shorter lockup period. The corresponding measure for Fund 2 is $(N/\Lambda)(\lambda_1^* - \lambda_2^*)$. In equilibrium, the fees are,

$$F_1^* = 2\Lambda(L_2 - L_1)(L_Z - L_1)/(3L_Z + L_2 - 4L_1) \tag{9.a}$$

$$F_2^* = \Lambda(L_Z - L_1)(L_Z - L_2)/(3L_Z + L_2 - 4L_1)\ . \tag{9.b}$$

For ease of notation, we write[6] $F_1^*=2\Lambda\delta_{1,2}\delta_{1,Z}/(3\delta_{1,Z}+\delta_{1,2})$ and $F_2^*=\Lambda\delta_{2,Z}\delta_{1,Z}/(3\delta_{1,Z}+\delta_{1,2})$. The profit functions in the first stage of the game are:

$$\pi_1 = 4N\Lambda\delta_{1,2}\delta_{1,Z}^2/(3\delta_{1,Z} + \delta_{1,2})^2 - \xi(\delta_{1,Z})^2 \tag{10.a}$$

$$\pi_2 = N\Lambda\delta_{2,Z}\delta_{1,2}\delta_{1,Z}/(3\delta_{1,Z} + \delta_{1,2})^2 - \xi(\delta_{2,Z})^2\ . \tag{10.b}$$

The first-order conditions for funds 1 and 2, respectively, are,[7]

---

[5] The competitive positions of the funds are stable, but exactly which firm takes each position is not certain. Recalling Sutton (1997), and assuming that "loss-making strategies will be avoided," it follows that the second firm would not challenge the incumbent, shorter lockup-period hedge fund. The second firm avoids a losing outcome by entering as the longer lockup-period hedge fund.

[6] The implied transformations are $\delta_{1,Z}=L_Z-L_1$, $\delta_{2,Z}=L_Z-L_2$, and $\delta_{1,2}=L_2-L_1$.

[7] The first-order conditions yield reaction functions in the plane defined by $L_1$ and $L_2$. The first-order conditions give $L_1 = 5.25123L_2 - 4.25123L_Z$; therefore, when an equilibrium combination of $L_1$ and $L_2$ exists, it is unique. The second-order conditions are satisfied:

$$d^2\pi_1/dL_1^2 = -8N\Lambda(\delta_{2,Z} + 5\delta_{1,Z})\delta_{2,Z}^2/(3\delta_{1,Z} + \delta_{1,2})^4 < 0$$

$$\xi = 2N\Lambda L_Z( 2\delta_{2,Z}^2 - 3\delta_{2,Z}\delta_{1,Z} - 4\delta_{1,Z}^2)/(\delta_{1,Z}(3\delta_{1,Z} + \delta_{1,2})^3) \qquad (11.a)$$

$$\xi = N\Lambda\delta_{1,Z}^2 (4\delta_{1,Z} - 7\delta_{2,Z})/(2\delta_{2,Z}(3\delta_{1,Z} + \delta_{1,2})^3) \ . \qquad (11.b)$$

Equating the two expressions for $\xi$ gives a third-degree polynomial in a variable defined as $\delta_{1,Z}/\delta_{2,Z}$.

Only a single real root exists: $\delta_{1,Z}/\delta_{2,Z} = 5.25123$. The solutions for the lockup periods are,

$$L_1 = L_Z - 0.12665N\Lambda/\xi \qquad (12.a)$$

$$L_2 = L_Z - 0.02412N\Lambda/\xi \ . \qquad (12.b)$$

Substituting these values into 9.a and 9.b yields expressions for fees in terms of exogenous variables,

$$F_1 = 0.05383N\Lambda^2/\xi \qquad (13.a)$$

$$F_2 = 0.00513N\Lambda^2/\xi. \qquad (13.b)$$

Profits per period are,

$$\pi_1=0.0122193(N\Lambda)^2/\xi \qquad (14.a)$$

$$\pi_2=0.0005075(N\Lambda)^2/\xi \ . \qquad (14.a)$$

Congruous with the conclusions of Lehmann-Grube (1997), Fund 1 clearly has a superior position. We observe the reaction to competition by comparing expression (5) with (12.a), expression (6) with (13.a), and expression (7) with (14.a). The competition forces Fund 1 to shorten its lockup period by about one percent and to lower its fee by about 14 percent. Fund 1's profit falls to about 75 percent of that earned in the monopoly market.

The adjustments increase Fund 1's market share to 52.5 percent. Fund 2 serves 26.25 percent of all potential investors. The potential investors in the remaining 21.25 percent of the market choose to hold their investments for a period of $L_Z$, or longer, and do not incur an incentive fee. These market shares are constant if both funds remain in the market and if $\xi$ is the same for both funds.

This section has summarized the basic vertical differentiation model in a duopoly market for hedge funds competing with lockup periods. Under the standard assumptions of established models of this type, there is a unique set of equilibrium fees and lockup periods. The equilibrium choices of the firms are functions of the number of potential investors, the lockup

---

$d^2\pi_2/dL_2^2 = -2N\Lambda(7\delta_{2,Z} + 8\delta_{1,Z})\delta_{1,Z}^2/(3\delta_{1,Z} + \delta_{1,2})^4 < 0.$

aversion of the investors, and the cost to the funds for offering a given lockup period. The next section examines how changes in exogenous parameters affect that equilibrium.

## 4. How Exogenous Shifts Affect Lockup Periods and Fees

Our model provides a framework for predicting how hedge funds will change fees and lockup periods in response to changes in the number of investors, the level of lockup aversion, and the cost to the fund for offering a given lockup period. The comparative statics indicate whether the value of each choice variable of each fund will increase or decrease. The comparative statics also indicate the changes in the relative distance between the values, e.g., the dispersion of choices.

Lockup periods increase from a decrease in the number of potential investors, a decrease in the aversion to lockup periods, and an increase in the cost of lowering lockup periods. In general, Fund 1's lockup period is more sensitive to changes in exogenous variables. In the case of the number of potential investors, we find,

$$|dL_1/dN| = |-0.12665\Lambda/\xi| \quad > \quad |dL_2/dN| = |-0.02414\Lambda/\xi| \,. \qquad (15)$$

Since $L_2 - L_1 = 0.10253N\Lambda/\xi$, we can predict whether the lockup periods will become more or less dispersed in response to changes in N, $\Lambda$, and $\xi$. For example, an increase (decrease) in N and/or $\Lambda$ will increase (decrease) the difference in the lockup periods offered. The solutions for the fees in expressions (13.a) and (13.b) and the profits in expression (14.a) and (14.b) allow for comparative statics such as those in (15). In response to an increase (decrease) in N, fees and profits increase (decrease) for both firms, and the variables diverge (converge) in each case.

Given how the term $\Lambda$ appears in the expressions for lockup periods, fees, and profits, changes in the aversion to lockup periods will affect the equilibrium choice variables and profits in the same way as an increase or decrease in N affects those variables. One important implication of the model is that given a fixed number of potential investors, if the investors begin preferring shorter lockup periods, then each hedge fund will respond by offering a shorter lockup period with a higher fee.

An increase (decrease) in $\xi$ will increase (decrease) both lockup periods, and the lockup periods of the funds will converge (diverge):

$$dL_1/d\xi = 0.12665N\Lambda/\xi^2 \quad > \quad dL_2/d\xi = 0.02412N\Lambda/\xi^2 \qquad (16)$$

and $d(L_2 - L_1)/d\xi = -0.10253N\Lambda/\xi^2$. The increase (decrease) in the cost factor will have the same effect on profits, with respect to sign and dispersion, as it does on the fees.

## 5. Discussion

This article introduces a methodology for analyzing the ways that hedge funds have begun to differentiate themselves and compete with respect to lockup periods and fees. We build upon established models from the industrial organizations literature and use many of the same assumptions. We demonstrate that the market equilibrium is stable and how exogenous market parameters determine the fees, lockup periods, and profits in a duopoly market.

It is true that the some of the model's results may depend on assumptions such as a uniform distribution of preferences and both funds offering the same return; however, these are standard assumptions in the literature. Survey data may eventually provide enough information to estimate the true distribution of lockup aversion factors.[8]

Since investors have heterogeneous preferences, offering more choices can keep capital from flowing out of the market. The results show how only 50 percent of investors purchase shares in the single-choice monopoly market, but 78.75 percent purchase shares in the duopoly market. To illustrate the importance of offering choices, let us assume the number of potential investors is initially 15,000 in the single hedge-fund market. Then, exogenous changes reduce the number of potential investors to 10,000.[9] With only one fee/lockup-period choice, the number of potential investors who purchase shares will decline from the initial 7,500 to 5,000. By offering two choices, when there are 10,000 potential investors, 5,250 will invest in the short lockup hedge fund and 2,625 will invest in the long lockup hedge fund. Therefore, the total number of actual investors will be 7,875. This demonstrates how the offering of different tiers of fee/lockup period combinations is a rational reaction by hedge fund managers in the face of an outflow of funds.

Our model can help predict managers' reactions to exogenous shifts. If an aging population or increasing nervousness leads to a higher general level of lockup aversion, for example, then hedge fund managers will accommodate this change of preferences with shorter and more dispersed lockup choices and higher fees. As another example, regulatory changes could affect the population of potential hedge fund investors, e.g., lower N by placing more stringent restrictions on who can invest in hedge funds. The result of the more severe restrictions would be an increase in lockup periods and an increase in their dispersion.

There is certainly much to do. In addition to exploring the true distribution of investor preferences, there is the issue of whether an investor's preference is dependent on other market factors and the investor's wealth. Other issues include allowing the funds to choose different management fees and allowing the expected return to be stochastic. Although game-theory models can become very complex, continued work in this field will allow researchers and practitioners to better understand the evolving market for financial services such as hedge funds.

## References

Anderson, Simon P., Andre de Palma, Jacques-Francois Thisse, 1992. *Discrete Choice Theory of Product Differentiation* (Cambridge: MIT Press).

Aragon, George, 2007. Share Restriction and Asset Pricing: Evidence from the Hedge Fund

[8] The 2010 Deutsche Bank survey asked respondents to indicate their longest acceptable lockup period. The percentages of responses that indicated one year, two years, three-four years, and five-seven years were 35 percent, 43 percent, 19 percent, and three percent respectively.
[9] Since hedge fund investors must have certain qualifications, for example, level of wealth, we could assume that 5,000 of the investors experience an exogenous loss of wealth that makes them ineligible to invest in hedge funds.

Industry, *Journal of Financial Economics* 83, 33-58.

Bei, Hu, 2008. Hedge Funds Lower Fees, Lengthen Lockups on New Funds, *The Financial Express*, Available at http://www.financialexpress.com/news/hedge-funds-lower-fees-lengthen-lockups-on-new-funds/394401/1.

Benrud, Erik, 2003. Competition Between Low and High Quality Products in the Financial Services Market, *Journal of Financial Services Research* 23, 133-147.

Benoit, Jean-Pierre, Vijay Krishna, 2008. Dynamic Duopoly: Prices and Quantities, *Review of Economic Studies* 54, 23-35.

Bernheim, B. Douglas, 1984. Strategic Deterrence of Sequential Entry into an Industry, *The Rand Journal of Economics* 15, 1-11.

Bertrand, Joseph, 1883. Review of 'Theorie mathematique de la richesse sociale' and 'Recherchesur les principes mathematiques de la theorie des richesses', *Journal des Savants*, 499-508.

Credit Suisse, 2010. *The Credit Suisse 2010 Global Survey of Hedge Fund Investor Appetite and Activity* (Credit Suisse Capital Services).

Daniel, Naveen , Narayan Naik, and Vikas Agarwal, 2009. Role of Managerial Incentives and Discretion in Hedge Fund Performance, *Journal of Finance* 64, 2221-2256.

Deutsche Bank, 2009. *2009 Alternative Investment Survey – A Closer Look at the Hedge fund Industry* (Deutch Bank Hedge Fund Capital Group).

Deutch Bank, 2011. *2011 Alternative Investment Survey – A Closer Look at the Hedge fund Industry* (Deutch Bank Hedge Fund Capital Group).

Dewatripont, Mathias, 1987. The Role of Indifference in Sequential Models of Spatial Competition: an Example, *Economics Letters* 23, 323-328.

Dixit, Avinash K, 1980. The Role of Investment in Entry Deterrence, *Economic Journal* 90, 95-106.

Eaton, B. Curtis, R. Ware, 1987. A Theory of Market Structure with Sequential Entry, *The Rand Journal of Economics* 18, 1-16.

Eisinger, Jesse, February 17, 2011. *New York Times* available at http://query.nytimes.com/gst/fullpage.html?res=9807E0DF113DF934A25751C0A9679D8B63.

Foster, Dean P., H. P. Young, 2007. The Hedge Fund Game: Incentives, Excess Returns, and Performance Mimics (University of Oxford Department of Economics Discussion Paper Series, Issn 1471-0498, No. 378).

Grene, Sophia, 2008. Funds Slash Fees to Pull in Cash, *Financial Times Weekly Review of the Hedge Fund Management Industry*. Available at http://media.ft.com/cms/17427d0c-bd8a-11dd-bba1-0000779fd18c.pdf.

Harris, Christopher J., 1985. Existence and Characterization of Perfect Equilibrium in Games of Perfect Information, *Econometrica* 53, 613-616.

Hay, Donald A., 1976. Sequential Entry and Entry-Deterring Strategies in Spatial Competition, *Oxford Economic Papers* 28, 240-257.

Holt, Christopher, 2008. Hedge Fund Fees: The Shape of Things to Come, *Seeking Alpha*. Available at http://seekingalpha.com/article/109727-hedge-fund-fees-the-shape-of-things-to-come.

Jehiel, Philippe, 1992. Product Differentiation and Price Collusion, *International Journal of Industrial Organization* 10, 633-641.

Johnson, Steve, 2009. Hedge Fund Managers Resigned to Falling Fees, *Financial Times*. Available at http://www.ft.com/cms/s/0/26a7a8fe-de90-11dd-9464-000077b07658.html.

Kishan, Saijel, 2009. Hedge-Fund Investors Remove Record $152 Billion (Bloomberg News). Available at: http://www.bloomberg.com/apps/news?pid=20601087&refer=home&sid=aL3fOSkanqs8

Kouwe, Zachery, 2009. Hedge Fund Withdrawals Keep Rising, *The New York Times*. Available at http://dealbook.blogs.nytimes.com/2009/04/21/hedge-fund-withdrawals-keep-rising.

Lane, W., 1980. Product Differentiation in a Market with Sequential Entry, *Bell Journal of Economics* 11, 237-260.

Lehmann-Grube, Ulrich, 1997. Strategic Choice of Quality When Quality is Costly: the Persistence of the High-Quality Advantage, *RAND Journal of Economics* 28, 372-384.

Leland, Hayne E., 1977. Quality Choice and Competition, *American Economic Review*. 67, 127-138.

Mclean, Richard P., M. H. Riordan, 1989. Industry Structure with Sequential Technological Choice. *Journal of Economic Theory* 47, 1-21.

Panageas, Stavros, M. M. Westerfield, 2009. High-Water Marks: High Risk Appetites? Convex Compensation, Long Horizons, and Portfolio Choice, *Journal of Finance* 64, 1-36.

Phillips, Maha K., 2009. Cross Roads, *CFA Institute Magazine* 20, 32-34.

Prescott, Edward C., M. Visscher, 1977. Sequential Location Among Firms With Foresight, *Bell Journal of Economics*. 8, 378-393.

Schwartz, M. and M. Baumann, 1988. Entry-Deterrence Externalities and Relative Firm Size. *International Journal of Industrial Organization* 6, 181-197.

Schwartz, M., E. A. Thompson, 1986. Divisionalization and Entry Deterrence, *Quarterly Journal of Economics* 101, 307-321.

Shaked, Avner, J. Sutton, 1982. Relaxing Price Competition Through Product Differentiation, *Review of Economic Studies* 49, 3-14.

Strasburg, Jenny, 2008. Hedge Funds' Capital Idea: Fee Cuts, *The Wall Street Journal*. Available at http://www.efinancialnews.com/story/2008-09-09/hedge-funds-capital-idea-fee-cuts.

Sutton, John, 1997. One Smart Agent, *RAND Journal of Economics* 28, 605-628.

Terzo, Gerelyn, 2008. A Changing World For Hedge Funds, *Investment Dealer's Digest*. Available at http://media.web.britannica.com/ebsco/pdf/726/35686726.pdf.

*The Economist*, January 29, 2009. One-and-Ten, *The Economist* 390, 82. Available at http://www.economist.com/research/Backgrounders/displaystory.cfm?story_id=13036802.

Tirole, J., 1988. *The Theory of Industrial Organization* (Cambridge: MIT Press).

Vives, Xavier, 1988. Sequential Entry, Industry Structure and Welfare. *European Economic Review* 32, 1671-1687.

Wauthy, Xavier Y., 1996 Quality Choice in Models of Vertical Differentiation, *The Journal of Industrial Economics* 44, 345-353.