ESSAYS ON INTERNATIONAL BUSINESS STRATEGY
OF NON-TRADITIONAL GOODS

by

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Abstract

This thesis comprises three essays on international business strategy with regards to services and technology. The first essay investigates why the average expense ratio paid by Canadian mutual fund investors is 50% higher than that paid in U.S. This discrepancy is commonly thought to exist because Canadian funds do not take advantage of economies of scale and have less competition. A monopolistic competition framework is used to develop a model for the mutual fund industry. By allowing each fund to have different attributes, the model permits funds to charge different expense ratios in equilibrium and is found to strongly fit the North American mutual fund market. Empirical analysis indicates that these two common explanations and measurable fund attributes account for 15% of the discrepancy.

The second essay analyses the U.S. mutual fund decision to enter the Canadian market through either foreign direct investment (FDI) or trade in advisement services. The total value of U.S.-controlled funds amounts to 18% of the Canadian equity fund market. This paper investigates how the fund-level and firm-level characteristics affect the channel used to enter the Canadian market. Empirical results indicate that the funds offered through FDI are not especially successful in the U.S. market but are associated with companies with large market shares, whereas the funds offered through trade in advisement services are highly successful in the U.S. market and are from companies with relatively few successful funds.

The third essay compares the motivation for acquisition between foreign and domestic acquirers of U.S. drug companies, especially with regard to technology transfer. An estimation of the acquisition decision reveals that foreign acquirers choose targets with high research intensity more as their own intensity decreases while domestic acquirers choose targets with high research intensity more as their own intensity increases. Domestic acquirers' post-acquisition innovative productivity increases mostly due to efficiency of knowledge synthesis because the targets usually have familiar product lines. Foreign acquirers' innovative productivity does not increase...
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Introduction

This thesis comprises three essays on international business strategy with regards to non-traditional goods: services and technology. The thesis focuses on two industries: the mutual fund and drug industries. A mutual fund is essentially a service provided for investors and the drug industry, especially the biotechnology segment, is highly technological. The first essay investigates why mutual funds are priced differently in Canada and the U.S., the second essay analyses the decision for U.S. mutual funds to enter the Canadian market and through which channel: FDI or trade, and the third essay determines whether there is a difference between foreign and domestic acquisition motivation in the U.S. drug industry, especially with regards to technology transfer.

The first essay investigates why the average management expense ratio (MER) paid by Canadian mutual fund investors is 50% higher than that paid in U.S. MERs are what investors pay the mutual fund company that offers the fund and this ratio reflects, to a large degree, the cost of the fund. The discrepancy in MERs is commonly thought to exist because Canadian funds do not take advantage of economies of scale and have less competition. A monopolistic competition framework is used to develop a model for the mutual fund industry. The traditional monopolistic competition model assumes products are qualitatively differentiated and are close substitutes. Mutual funds have an attractive feature: they have many observable and measurable attributes. This framework is extended to allow each fund to have different attributes and this permits funds to charge different expense ratios in equilibrium. This model is found to strongly fit the North American mutual fund market. Empirical analysis indicates that these two common explanations and measurable fund attributes account for only 15% of the discrepancy, suggesting another explanation.

The second essay analyses the U.S. mutual fund decision to enter the Canadian market. U.S. mutual funds can be offered in Canada through either foreign direct investment (FDI) or trade in advisement services. The total value of U.S.-controlled funds amounts to 18% of the
Canadian equity fund market. This paper investigates how the fund-level and firm-level characteristics affect the channel used to enter the Canadian market. This is important because Markusen (1995) asserts a number of characteristics of firms that perform FDI as stylized facts from a compilation of individual studies. These characteristics are used in the model of this paper and the estimation of the model accounts for them simultaneously while determining their individual contribution to the probability of a company performing FDI.

The channel chosen to enter the Canadian market is, in part, solved by a bargaining game with a Canadian host for an advisement fund. The bargaining section predicts that firms that choose the advisement route tend to have one or two outstanding funds in their family, while firms that choose FDI tend to be larger and have a more equal family composition. A multinomial logit regression is used to estimate the probability of a U.S. fund being offered in Canada through either channel using characteristics of the fund itself and its associated family as regressors. The empirical results indicate that, indeed, FDI families have large market share in the U.S. market but they tend to have a smaller fraction of its U.S. operations invested in high research fundtypes than do advisement families, while funds offered through trade in advisement services are highly successful in the U.S. market and are from companies with relatively few successful funds. This suggests that advisement families are attempting to recapture high research expenditure more than FDI families.

The third essay compares the motivation for acquisition between foreign and domestic acquirers of U.S. drug companies, especially with regard to technology transfer. There were a large number of U.S. drug company take-overs in the 1990s by both foreign and domestic acquirers. This essay displays two empirical studies. The first is an estimation of the acquisition decision at the time of acquisition. This reveals that foreign acquirers choose targets with high research and development (R&D) intensity more as their own intensity decreases while domestic acquirers choose targets with high R&D intensity more as their own intensity increases. The second is an analysis of the R&D and patent intensities to determine whether innovative
efficiency of the combined companies increased or decreased post-acquisition. Domestic acquirers’ post-acquisition innovative productivity increases mostly due to efficiency of knowledge synthesis because the targets are usually have familiar product lines. Foreign acquirers’ innovative productivity does not increase after acquisition because they tend to take over firms in unfamiliar research areas that are usually highly technical and require a long-term commitment of R&D.

Despite the third essay focusing on a different industry than the first two, all three essays investigate international strategic issues. The first investigates why these goods might be priced differently in different markets, the second looks at the company and product characteristics that would influence the decision to enter a foreign market and through which channel, and the third essay compares the difference in acquisition motivation between foreign and domestic acquirers.
Chapter 1:

Expense Ratios of
North American Mutual Funds
1.1 Introduction

Investments in the Canadian mutual fund market by the end of 1998 totaled $CDN 390 billion\(^1\). It is projected that in early 2002, the amount of money Canadians will have invested in mutual funds will surpass the amount they have in guaranteed investment certificates, chequing and savings accounts combined\(^2\). The average Canadian management expense ratio (MER), the fee paid by mutual fund investors, is over 50% higher than its American counterpart. If Canadian investors paid the same average MER as U.S. investors, they would have saved almost $CDN3 billion in 1998. This paper investigates why the MERs are higher in Canada than in the U.S.

The most common explanations for the discrepancy in MERs are that Canadian funds do not take advantage of economies of scale and have fewer rival funds. The monopolistic competition structure has the advantage of accounting for these two explanations. An industry of heterogeneous but substitutable products is a hallmark of monopolistic competition and this is evidenced in the mutual fund industry by the extent to which mutual fund companies advertise the distinctions of their managers' ability, fund orientation and different fee structures. U.S. residents, by Canadian regulations, cannot purchase Canadian-owned mutual funds and U.S.-owned mutual funds cannot be sold to Canadians unless they are registered with a provincial commission. Therefore, the Canadian and U.S. mutual fund markets are essentially segregated and this allows the model developed to be applied to funds from both countries simultaneously while controlling for differences between the two markets. An estimation of the model determines the extent to which these two common explanations account for the difference in MERs and the mark-up in Canadian MERs that remains unexplained.

In traditional monopolistic competition models used in empirical studies, firms are assumed to be fully symmetric, with every firm charging the same price for its differentiated product. This paper relaxes this symmetry assumption and, in doing so, allows consumers to

\(^1\) Source: Investment Funds Institute of Canada.
choose funds according to their tastes for the differing fund characteristics and funds to charge
different prices, or MERs, in equilibrium. The MER pricing decision is a function of the fund’s
individual characteristics, the competition faced by a fund and the size of the fund, the latter two
reflecting the two common explanations for the MER discrepancy. A comparison of the actual
sizes of funds and number of funds with the predictions from the model determines the extent to
which the model fits the data. The actual values are found to be in the predicted region and
justify estimating the pricing and demand equations. The regression results show that differences
in fund sizes, intensity of competition and measurable fund attributes account for about 15% of
the Canadian MER mark-up. The Canadian MERs are even higher than the monopolistic
competition model would predict and suggest that the mark-up is due to either monopoly power
or a difference in accepted distribution practices. In addition, the exact number of Canadian
mutual funds predicted by the model can be calculated using the estimated parameters. The
model’s predicted number of funds is very close to the actual number of funds in the Canadian
market using the U.S. market size as a base and is shown to be closer than other monopolistic
competition model predictions.

This paper differs from the existing literature in its attempt to explain mutual fund fees by
utilizing a monopolistic competition model. Previous work has recognized the importance of
economies of scale and other fund-specific variables in explaining mutual fund performance3.
Recently, Carhart (1997) concludes that the three fund characteristics, MERs, transaction costs,
and turnover rates, explain almost all the persistence in returns. Grinblatt and Titman (1994)
suggest that turnover rate is significantly related to the ability of the fund managers to earn
abnormal returns. There are also a number of studies that examine the determinants of mutual

2 Source: Canadian Bankers Association.

3 There is also a set of studies linking the form of fund manager compensation with fund
performance. Significant contributors include: Brown, Harlow and Starks (1996) and Berkowitz
fund fees in a purely empirical context. Trzcinka and Zweig (1990) and Malhotra and McLeod (1997) conclude that funds with 12b-1 fees have larger MERs. The latter paper also determines that economies of scale have a significant role in mutual funds fees.

This chapter proceeds as follows. Section 2 provides the background information about the U.S. and Canadian mutual fund markets with a discussion of the common explanations for the difference in MERs. Section 3 develops the consumer choice theory and the monopolistic competition model in the context of this industry and examines how closely the model fits the data. Section 4 estimates the pricing and demand equations developed in the model and uses the estimated parameters to examine the existing number of funds in Canada. Section 5 concludes the analysis and offers explanation for the unexplained Canadian mark-up.

1.2 Background Information

The data on mutual funds is obtained from Morningstar Inc. for the U.S. and PALTrak Inc. for Canada and is a cross-section at the date January 31st, 1999. These tracking services provide a large amount of fund-level data for all mutual funds offered in their respective countries, however bond and money market (maturity less than one year) mutual funds are not monitored closely by Morningstar Inc. It reports that there was $US 772 billion invested in bond and money market funds in the U.S. but the Investment Company Institute (ICI), the national association of U.S. mutual funds, claims that there was $US 2,182 billion. It is supposed that these short-term funds are not reported by the companies that own them because they are used as a temporary investment in between other investment opportunities for company’s current investors and does not necessitate exposure in the Morningstar dataset. There is an incentive to expose equity funds, on the other hand, as investors that are not current clients regularly purchase

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4 Tufano and Sevick (1997) connect board of director characteristics with fund fees and determine that smaller boards and boards with a larger fraction of independent members approve lower fees.
Chart 1.1: Distribution of MERs

It is instructive at this point to divide the funds into mutually exclusive categories according to their objective and orientation. For a detailed discussion of the fundtype
categorization, see Appendix 1.1. Dividing the funds into fundtypes is informative because there
are a number of different types of funds associated with very different attributes. For instance,
mutual funds that invest in large capitalization stocks will have significantly lower MERs than
funds that invest in emerging market equities because of smaller research expense and transaction
costs. If Canada had a relatively small proportion of funds in lower MER fundtypes, the
difference in the over-all average MER could be simply explained.

Sometimes the mean of a variable can be a misleading statistic and it is helpful to view
the distribution of that variable for the whole population. Chart 1.1 displays the distribution of
MERs for all fundtypes for both Canada and the U.S. The upper left graph demonstrates that the
mean is not a misleading indicator of the whole distribution and, as the other graphs confirm,
every fundtype has a distribution of MERs at a higher level in Canada than in the U.S. The lower
right graph is not for a fundtype but rather for a characteristic of funds. Index funds are found in
every fundtype and they mimic movements of specific stocks, industries or various other financial
indicators. They are often considered to be cheap to produce, as is evident by their lower range of
MERs.

Table 1.2 displays the different fundtypes along with their descriptive statistics. In every
fundtype, the U.S. MER is smaller than the Canadian MER and the U.S. mean fund size is larger.
There is a large variation of mean fund size differences ranging from about twice as large
(Balanced funds) to five and a half times larger (Blend funds). The proportion of a country’s
assets in a given fundtype allows us to determine the predominance of certain types of equity
funds found in the country. For instance, it is clear that Canada has a higher proportion of foreign
oriented funds (24% compared to 15% in the U.S.). This is expected, given the general outward-
orientation of the Canadian market. The U.S. has a higher proportion of Growth funds and
Canada has relatively more Balanced funds.

The mean market share of funds in each category is the inverse of the number of funds.
This accounts for the difference in fundtype size while it proxies the degree of competition.
a) There are a larger number of index funds in the U.S. that traditionally have much lower MERs that push down the mean MER.

There is a larger number of index funds in the U.S. (163 in U.S. compared to 60 in Canada) but the ratio of index funds is not substantially different than the ratio of the total number of funds. However, index funds comprise 1.51% of the Canadian Market and 7.04% of the U.S. market. This difference may not be enough to affect the average MERs but they will be controlled for in the regression analysis.

b) Higher marketing costs in Canada caused by typical load structure.

The majority of mutual funds are sold with either a front or rear load. A front load requires that the consumer pay a commission directly to the broker when the fund is purchased. Rear loads (or deferred loads) are paid to the company when the consumer withdraws her investment. They usually decline over time so that long term investors are not subject to this fee. The company pays a commission to the investment advisor when a rear-loaded fund is sold and part of the MER is used to fund the initial commission. In fact, Dellva and Olson (1998) conclude that funds sold with front-end loads generally have lower expenses and this is reflected in a lower expense ratio. If there is a higher proportion of rear-load funds in Canada, then this would at least partially explain the difference in MERs. It is difficult to determine this, as mutual funds which are sold with an option of front or rear loads do not have to disclose what proportion was sold with each. However, anecdotal evidence indicates that rear loaded funds are outselling front loaded funds in Canada by a factor of four to one.

c) Higher costs in Canada due to higher trailer fees.

Trailer fees are the part of the MER that is paid by the company to the investment advisor for continued customer service. All funds, whether they are sold with a rear, front or without a load, pay trailer fees if sold by a third party. In the U.S. this is the 12b-1 fee and is named for the SEC rule that created and permits it. Trailer fees on load funds typically are 25 to 50 basis points
but the average is, again, difficult to compare the average between Canada and the U.S. because the Canadian information is not readily available. Canadian trailer fees are required to be disclosed on prospectuses, thanks to recent efforts by Glorianne Stromberg (1998), however the coverage by tracking agencies are not comprehensive. Furthermore, the amount of a fund that had been sold with a certain trailer fee and load combination is not available. Therefore, even if the trailer fee/load structures were available, to determine the average trailer fee in Canada, we would still have to know how much was sold with a given fee/load. The average trailer fee in Canada is believed to be about twice as much as that in the U.S.\(^7\)

The reason for the difference between the size of trailer fees in Canada and the 12b-1 fees in the U.S. is assumed to be institutional. For example, one possible reason for the difference is that U.S. mutual funds are sold through independent advisors more than they are in Canada. Independent advisors do not directly benefit from a trailer fee and would not have the incentive to suggest a client to purchase shares in a mutual fund because it has a particular trailer fee or load structure. This may lead to a lower average 12b-1 fee in the U.S.

d) The larger average fund size in the U.S. leads to efficiencies of scale.

There are two reasons to believe that economies of scale play a role in mutual funds. One is that fixed costs or initial cost outlays can be easier recaptured with larger outputs. The other involves an efficiency argument with respect to research and trading costs in the larger scale. As with many industries, larger funds simply get better at what they do and it appears that larger mutual funds can perform large block trading at lower prices.

e) The average size of families of funds in Canada is smaller than in the U.S. not allowing Canada to take advantage of economies of scope.

If a mutual fund company offers various different funds, they are often grouped together as a “family” and, objectively, a family tries to offer many different types of funds to their customers.

It is possible that the mutual fund industry has positive economies of scope because of knowledge spillovers. A mutual fund company may become more efficient at researching one type of fund given that they are knowledgeable in other fund types. There are 578 fund families in the U.S. compared with 183 in Canada or a U.S. to Canada ratio of 3.15 which is lower than the ratio of the number of funds (3.95). There is an average of 16 funds in every American fund family while in Canada there are 10 members. The absolute size of fund families in Canada is smaller than the U.S. and does not take advantage of economies of scope. Not only are there relatively more mutual funds in Canada operating at a relatively higher cost but there are relatively more fund families in Canada spread out over a smaller base leading to higher average costs and diseconomies of scope.

There are various U.S. mutual fund companies that have Canadian affiliates or distribute their funds through Canadian banks or investment houses. Some of the funds they offer in Canada identify the same fund manager(s), investment objective, assets invested in and sometimes even the same name as funds they offer in the U.S. There might be some additional costs for the funds offered in Canada, such as higher advertisement costs for entering into a new market and some investment decisions may not apply to the Canadian fund due to its smaller relative size or different regulations. However, one would believe that the investment decisions and their costs for these funds are similar. As of January 1999, there are 124 such funds with identifiable equivalents in the U.S. Table 1.3 displays the 40 funds that are owned by U.S. companies as opposed to those that are Canadian-owned but U.S-managed (see Ruckman, 1999).
consideration, only 2 funds have lower Canadian MERs when the trailer fees are netted out. For example, the Templeton Emerging Markets fund in Canada charges a MER of 3.33% and gives its investment advisors a trailer fee of 0.5%. By contrast, the Templeton Developing Markets Fund in the U.S. has the same fund manager and invests in very similar securities but only charges a MER of 1.96% and gives its investment advisors a trailer fee of 0.27%. If the Canadian and U.S. industries were equally competitive, one would expect the MERs less the trailer fees to be almost the same.

It has been established that mutual funds in Canada have higher MERs. This begs the question: why, then, do Canadians buy Canadian-owned mutual funds, at all? The answer to this involves a discussion of legalities. Each province has a securities commission that oversees securities including mutual funds. To sell mutual funds in any province, a fund must be registered with the commission in that province. The IFIC has regulations that prohibit U.S. residents from purchasing Canadian mutual funds. These regulations suggest that the Canadian and American mutual fund markets are segregated. That is, only Canadians can buy Canadian-owned mutual funds and U.S.-owned mutual funds can only be sold to Canadians if they have an affiliate registered in a Canadian province.

There are, however, three ways Canadian consumers can bypass the law to buy U.S.-owned mutual funds. First, there is nothing to prevent a Canadian from going directly to a U.S. fund to make a purchase. This is commonly referred to as an unsolicited sale. Each fund organization then decides to accept or reject such a request. U.S. mutual fund companies that have a Canadian affiliate reject these requests but other U.S. firms without affiliates are recently joining suit. A possible reason for this trend is an increasing concern over antagonizing Canadian authorities, especially if they are considering entering the Canadian market in the future. Second,

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8 The two Merrill Lynch funds have lower Canadian fees once trailer fees are deducted. These funds are very new to the Canadian market and it is supposed that they may be priced low to induce initial demand.
a consumer can set up an account with an American broker who then buys the U.S.-owned fund. Third, it is possible to buy funds through the Internet even though each province’s securities commission requires that foreign companies that sell securities to people even through the Internet must be registered with the commission in that province. Clearly, each of these loopholes is difficult to monitor. That said, Canadian investors who buy shares in U.S.-owned funds are individuals who have deliberately sought them out and have gone to considerable trouble to find an outlet (Quirin, 1969).

Precise data is not available on how much Canadians own of U.S.-based mutual funds, however the Investment Company Institute, a U.S. organization, reports the total sales of U.S.-based funds to Canadians. Their report may not include all U.S. funds. Nonetheless, in 1990, Canadians purchased $28US million in U.S. funds comprising 0.02% of the U.S. market and, converting to Canadian dollars, amounts to 0.13% of the Canadian market. These fractions have been steadily declining since the 1960s. Because these figures are miniscule, their effects will be ignored and the two markets will be regarded as segregated.

There is another institutional reason why the markets are virtually segregated. Canadian investors must not invest more than 20% (at the time this Chapter was written, it is now 30%) of their investment income into non-Canadian based investments to claim retirement savings plan (RSP) tax benefits. The majority of mutual fund investments are made by personal investors, however, a significant portion is made for pension funds. Pension funds face the same institutional regulations regarding RSP-eligibility as personal investors.

To sum up, the mutual fund industry has many heterogeneous but substitutable goods, each with fund-specific attributes. This affords each fund some market power and this is shown in funds charging different MERs. The funds may be subject to economies of scale and the prices charged may also depend on the degree of competition. The following section will link these assumptions with a monopolistic competition framework to model the mutual fund industry.
Then, using the fact that the Canadian and American markets are virtually segregated, the attributes of the two markets can be compared to test how closely the model fits the data.

1.3 Monopolistic Competition Model

The basic monopolistic competition framework has a large number of firms producing and selling goods that are close substitutes, allowing each firm a degree of monopoly over the sale of its own product. The other basic premise of the model is that each firm faces a demand curve that has that firm selling less the greater are the number of firms in the market and selling more the higher are the prices charged by its rivals. The average cost curve depends on the size of the market and the number of firms in the industry. The more firms there are in the industry, the higher is average cost. Even though there is free entry in the market, there can be a short-run equilibrium involving profits. The long-run equilibrium, however, has each firm earning zero economic profits, charging a price equal to average cost and, compared to perfect competition, operating at excess capacity.

A large amount of empirical work based on monopolistic competition models assumes that products differ in a qualitative manner. Fortunately, mutual funds have many observable and measurable characteristics. The incorporation of these attributes into the model causes fund demand to depend not only on market size and number of rivals but also on these fund-specific characteristics. In addition, most empirical monopolistic competition models impose symmetry on firms for simplicity but, in this paper, the inclusion of fund-specific attributes permits funds to charge different prices and earn non-zero profits in equilibrium. At the time of entry, it is assumed that the response of the market to the particular characteristics of the fund is not known and, hence, funds in each category face the same expected return prior to entry. It follows that at the free entry equilibrium, expected profits are driven to zero. The description of the model begins with consumer behaviour.
Consumer's problem:

A consumer's mutual fund investment decision usually follows a two-stage process. In the first stage, the investor decides what proportion of her income available for mutual fund investment to optimally allocate in the various fundtypes (i.e.: 20% in growth funds, 30% in value funds and 50% in balanced funds). In the second stage, one fund in each fundtype is chosen over the others based on its MER and its individual attributes and the consumer beliefs about the value of the fund's attributes in predicting future returns. This two-stage decision process is very common in the personal investment literature (see, among many others, Gadsden, 1998).

A consumer's mutual fund utility is increasing in fund returns, decreasing in variance of returns and is subject to constant relative risk aversion. This implies that the proportions invested in the different fundtypes are invariant to different levels of initial wealth. When a consumer is deciding what proportion of her available mutual fund income to efficiently allocate to the different fundtypes, she observes the average expected return and expected risk (variance of returns) for each fundtype. It is assumed that risk varies between fundtypes but, because funds are consistently and exclusively identified to fundtypes, funds within a given fundtype have the same risk.

The return that consumers receive from their mutual fund investment is always net of MER. Fundtype $f$'s average expected net return ($\mu_f$) is the fundtype average expected return ($r_f$) less the fundtype average MER ($P$).

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9 The allocation of investment income to alternatives (stocks, bonds, bond funds, gambling, etc.) is done in stage 1 simultaneously as she allots income to mutual fund categories. We only model the within fundtype choice for mutual funds and assume the other investment choices are solved implicitly.

10 This assumption is primarily made because of the limited time series (3 years) with which to calculate fund-level variances. I have experimented with adding the variance of 3-year fund-level returns as an exogenous variable in the demand equation. It had a positive, but not statistically
\[ \mu_f = r_f - \bar{P} \]

Consumer \( k \) views fund \( i \) in fundtype \( f \) as having an expected net return (\( \mu_{ik} \)) equal to fundtype \( f \)'s average expected net return plus a variable that reflects the fund’s observable characteristics (\( a_{ik} \)). These observable characteristics are valued as predictors of future returns and each consumer has different beliefs about the value of each characteristic.

\[ \mu_{ik} = \mu_f + a_{ik}, \]

where \( a_{ik} = A_i - b(P_i - \bar{P}) + \varepsilon_{ik}. \)

The variable \( A_i \) reflects fund \( i \)'s attributes and it has an expected value of zero within its fundtype,

\[ E(A_i) = \frac{1}{n_f} \sum_{i=1}^{n_f} A_i = 0. \]

The term \( \varepsilon_{ik} \) reflects consumer \( k \)'s beliefs about the value of the different fund attributes and it has an expected value of zero across all \( m \) consumers,

\[ E(\varepsilon_{ik}) = \frac{1}{m} \sum_{k=1}^{m} \varepsilon_{ik} = 0. \]

The five fund attributes are the age of the fund, whether it has a load, the difference of the fund’s past return from the fundtype’s mean past return, if it is an index fund and the number of associated family members. There may be other fund attributes that consumers value but these are observable and measurable and will be used in the empirical section to follow. In addition, consumers have different beliefs about the ranking of the fund characteristics in terms of their significant estimated coefficients. This is probably attributable to the imprecision of the 3-year measure.

\(^{11}\) This expression for \( a_{ik} \) was derived from the longer

\[ a_{ik} = -(P_i - \bar{P}) + A_i + (1 - b)(P_i - \bar{P}) + \varepsilon_{ik}. \]  

The first term on the right-hand side is a correction for the fund MER from the fundtype average MER. It is hypothesized that \( b \) is positive reflecting that consumers value an MER below average fundtype MER. The second and third terms recognize that fund observable attributes and its MER may give information about future returns. For example, an increase in MER implies an increase in research costs and, possibly, higher future fund return.
ability to predict future net returns. For instance, some consumers rank the difference of a fund’s past return from its fundtype’s mean past return as the highest of the five attributes to indicate future returns. Other consumers may believe that the age of a fund correlates with higher future returns because of greater experience and rank this attribute among the highest of the five. Some consumers believe many family members is a good indicator of future returns because of economies of scope.

Consumer $k$'s expected utility of her total returns on mutual fund investment ($R_k$) is

$$EU(R_k) = \ln \left\{ \sum_{f} \sum_{i=1}^{n_f} \mu_{ik} I_{ik} t_{fk} - \frac{1}{2} \sum_{f} \sum_{g} t_{fk} t_{gk} C_{fg} \right\},$$

Where $I_{ik}$ = an indicator function that equals 1 if fund $i$ chosen by consumer $k$, 0 otherwise,

$t_{fk}$ = the fraction of mutual fund investment income allocated to fundtype $f$ (non-negative)

by consumer $k$,

$C_{fg}$ = the co-variance of fundtype $f$ and $g$'s average expected net returns.

The indicator function reflects that consumer utility depends only on the funds chosen for investment. The fractions of mutual fund investment income, $t_{fk}$, weight the utility from each fund chosen by the proportion of income allocated to its fundtype.

The expected utility function is additively separable and builds upon Hey (p.49, 1979) and Borch (p.50, 1968). Their investigation is a one-stage decision of the optimal fraction of income to allocate to individual stocks. The expected utility above adds to their work by changing the optimal fraction of mutual fund investment income from an allocation across stocks to an allocation across fundtypes and allowing for different attributes of the funds within their fundtypes in the second-stage choice of which funds to buy. It is necessary to incorporate fund-specific characteristics because the first stage of the decision process observes only average fundtype expected risk and returns and does not reflect that consumers expect the fund they invest in will have a return different from the average fundtype return.
Implicitly maximizing expected utility with respect to $t^*_k$'s subject to $\sum_j t^*_k = 1$ for consumer $k$ yields a set of optimally chosen fractions of mutual fund investment income: $\{ t^*_k \}^{12}$.

Given this optimally chosen set, the consumer chooses one fund from each category in the second stage. In reality, a consumer usually allocates her money among a few types of equity funds, but chooses more than just one fund in each of those categories. The theory accommodates a consumer choosing to buy two (or more) funds in a given fundtype by viewing the funds as being bought by two (or more) consumers with identical tastes. There are five observable fund attributes which consumers value for predicting future returns. It is possible, using linear combinations of fund attributes, to find two (or more) funds in a fundtype that can give a consumer equal expected utility. The consumer is, therefore, indifferent between these two funds and so the consumer buys one of these funds while the identical consumer buys the other.

The consumer will choose fund $i$ over other funds in a fundtype if the net return she expects to get from $i$ is greater than those from all the other funds. No consumer is sure of what actual net returns will be but the observable fund characteristics provide some information. Consumer $k$ will choose fund $i$ out of all the funds in the fundtype ($n_f$ of them) by observing the fund's characteristics and relating them to her own beliefs about the value of their predictive qualities.

The composite consumer acts as a typical consumer would in the aggregate. There are $m$ consumers. The probability of fund $i$ being chosen by the composite consumer is

$$Pr_i = \frac{1}{n_f} + h(a_i), \text{ where } h(a_i) = \frac{1}{m} \sum_{k=1}^{m} h(a_{ik}).$$

$p^{12}$Although the theory is general, allowing investment in every fundtype is not worthwhile. It depends on values for $C_{fg}$ relative to $\mu_f$ and $\mu_v$. Not all fundtypes have a covariance of mean returns. This explains why consumers invest in a few fundtypes, particularly those that have no or small co-variation of mean returns (i.e.: balanced and growth).
The function \( h \) and, thus, the probability of being chosen are increasing in higher fund attributes, \( A_i \). It is hypothesized that they are decreasing a higher MER over average fundtype MER but this will be empirically determined later. An increase in the number of funds in a fundtype decreases the probability of a fund being chosen, regardless of its attributes.

There are two restrictions on \( h(a_i) \) that must be satisfied. First, the sum of \( h(a_i) \) over all funds in a fundtype is zero, since the sum of probabilities of being chosen over all funds in a fundtype must equal one (\( \sum_{i=1}^{n_f} \text{Pr}_i = 1 \)). Second, \( h(a_i) \) must be bounded by \( \{-1/n_f, 1-1/n_f\} \), so that the probabilities of any fund being chosen by any consumer are always between zero and one. If \( \varepsilon_i \) is distributed uniformly within the bounds of \( \{-1/n_f, 1/n_f\} \), a candidate is \( h(a_{ik}) = a_{ik} \). There are other possible candidates but this function will be used for simplicity. The empirical section will not distinguish between candidates. We already know that the sum of \( A_i \) over all funds in a fundtype is zero and, similarly, the sum of MERs over average fundtype MER for all funds in a fundtype is zero, by definition. The probability of fund \( i \) being chosen by the composite consumer is

\[
\text{Pr}_i = \frac{1}{n_f} - b(P_i - \bar{P}) + A_i.
\]

The expected utility function for the composite consumer is

\[
EU(R) = \ln \left\{ \sum_f \sum_{i=1}^{n_f} \mu_i \text{Pr}_i t_f - \frac{1}{2} \sum_f \sum_{g} t_f t_g C_{fg} \right\},
\]

where \( \mu_i = \mu_f - b(P_i - \bar{P}) + A_i \), \( \text{Pr}_i = E(I_{ik}) \) and \( t_f = \frac{1}{m} \sum_{k=1}^{m} t_{jk} \). An increase in the number of funds \( n_f \) in a fundtype does not affect aggregate consumer expected utility because, although there are more funds to chose from and, therefore, the probability of being chosen decreases, this is exactly equal to the additional net return.
The expected demand for fund $i$ in fundtype $f$ is derived as the number of consumers ($m$) times their average efficiently allocated mutual fund investment income ($i_f^* \times$ times income ($y$)) times the probability of being chosen by the average consumer

$$E[X_i] = mt_f^* y Pr_i = mt_f^* y \left[ \frac{1}{n_f} - b(P_i - \bar{P}) + A_i \right]$$

and $mt_f^* y$ is simply the amount of total spending on fundtype $f$. This is defined as $S_f$.

**Fund’s problem:**

Each fund, $i$, in fundtype $f$, has a total cost function with a quadratic relationship in asset size,

$$TC_i = F_f + c_i X_i + \frac{k_f}{2} X_i^2$$

where $F_f$ is a fixed cost, $c_i$ is a marginal cost, $k_f$ is non-positive and $X_i$ is fund $i$’s total assets.

Marginal costs are any costs that are on-going and increase proportionally with the fund size, such as operating expenses, research expenses or trailer fees. The subscript on the marginal cost parameter $c_i$ emphasizes that it is fund-specific. It is not fundtype-specific because even though some fundtypes, such as small-capitalization funds or emerging markets funds, may have higher marginal costs than others because of a higher degree of research, there will be some individual fund costs because of fund attributes. The fixed cost component reflects the start-up costs for each fund and the quadratic form of the equation captures the decrease in marginal cost due to economies of scale. This may be due to large-scale block trading orders that have discounted trading costs and other efficiencies of scale.

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13 The model does not explicitly take account of interaction among funds that one firm offers (economies of scope). However, the empirical section does control for funds’ family size and allows some inference about the relationship between price charged and associated family size.
The difference between the model in this paper and the more commonly used Dixit-Stiglitz form of monopolistic competition is in the functional form of the demand curve. Dixit-Stiglitz assume each seller, $j$, faces a non-linear demand curve of the following form:

$$X_j = \frac{P_j^{1-\rho}}{\sum_i P_i^{1-\rho}} S$$

where $\rho$ is the elasticity of substitution and $S$ is the size of the market. This paper will use a linear demand curve based on Krugman-Obstfeld that reflects the same fundamental assumptions of monopolistic competition. The interesting result of this different demand form will be shown in the effect of increases in market size on the number of funds and the size of the funds. Under Dixit-Stiglitz assumptions, the number of sellers increases proportionally to the size of the market, but the size of an individual fund$^{14}$ is not related to market size. Under Krugman-Obstfeld, the number of funds and mean fund size increase but by an amount less than the increase in market size. This characterization of demand relaxes the complete symmetry assumption of Krugman-Obstfeld by allowing differences in preferences across individuals.

From now on, the subscripts for fundtype will be suppressed because the fundtypes are mutually exclusive and every fund is found in only one fundtype. It will be implied that price, demand faced, individual attributes are always for an individual fund and the costs, number of funds, fundtype size and average prices are specific to the fundtype of the fund in question. Fund subscripts will also be dropped for simplicity.

As derived in the consumer problem, each fund faces a demand curve, $X$, of the following linear form:

$$X = S\left[1/n - b(P - \bar{P}) + A\right]$$ \hspace{1cm} (1)

$^{14}$The term “fund” instead of “firm” has been carefully used to reflect the assumption that each fund maximizes profits and, thus, each mutual fund firm, which may offer many funds, maximizes profits.
Profit ($\pi$) is total revenue less the associated total cost:

$$\pi = PX - \left( F + cX + \frac{k}{2} X^2 \right).$$

Substituting in the functional form of demand, $X$, and rearranging terms yields the profit function:

$$\pi = (P - c)S \left[ \frac{1}{n} - b(P - \overline{P}) + A \right] - \frac{k}{2} S^2 \left[ \frac{1}{n} - b(P - \overline{P}) + A \right]^2 - F.$$

Each fund maximizes profits with respect to price, assuming that their price change will not affect the average price. The first-order condition rearranges to

$$P = \frac{1 + bkS}{b(2 + bkS)} \left[ \frac{1}{n} + b\overline{P} + A \right] + \frac{1}{2 + bkS} c.$$

The definition for demand faced ($X$) can be substituted out of the above equation to get the pricing decision as a function of competition, individual characteristics and fund size. This is the final form of the pricing decision used for estimation.

$$P = \frac{1}{2b} \left[ \frac{1}{n} + b\overline{P} + A + bkX + bc \right]$$

(2)

Funds do not know their performance or profits before they enter the market, although they know their objective and orientation. There is free entry and the equilibrium is characterized by each fund expecting zero profits.

$$E[\pi] = E\left[ PX - \frac{k}{2} X^2 - cX - F \right] = 0$$

Inserting the form of the pricing equation as a function only of demand ($X$), the equilibrium is now in terms of $X$.

$$E[\pi] = E\left[ \left( \frac{1}{bS} X + kX + c \right) X - \frac{k}{2} X^2 - cX - F \right] = \left( \frac{1}{bS} + \frac{k}{2} \right) E\left[ X^2 \right] - F = 0$$

Using the definition of the second moment ($E\left[ X^2 \right] = \text{VAR}[X] + (E[X])^2$) and the form of $X$ that is a function only of $I/n$, A's and constants,
\[ X = S \left[ \frac{1}{n} - \frac{1}{2 + bkS} A + \frac{1 + bkS}{2 + bkS} \right]^{15}, \]

the definitions \( E[A]=\bar{A} =0 \) and \( VAR[A]=\sigma^2 \) can now be employed. It follows that

\[ E[X^2] = E \left[ S^2 \left( \frac{1}{n^2} + \frac{1}{(2 + bkS)^2} A^2 + ... \right) \right] = S^2 \left[ \frac{1}{n^2} + \frac{1}{(2 + bkS)^2} \sigma^2 \right] \]

and substituting this into \( E(\pi)=0 \) gives

\[ E[\pi] = \left( \frac{1}{bS} + \frac{k}{2} \right) S^2 \left[ \frac{1}{n^2} + \frac{1}{(2 + bkS)^2} \sigma^2 \right] - F = 0. \]

**Effect of Market Size on Number of Firms:** If \( n_0 \) is the number of funds when the market size is \( S_0 \) and \( n_i \) is for \( S_i \), the above condition gives

\[ F = \left( \frac{1}{b} + \frac{kS_0}{2} \right) S_0 \left( \frac{1}{n_0^2} + \frac{\sigma^2}{(2 + bkS_0)^2} \right) \quad \text{and} \quad F = \left( \frac{1}{b} + \frac{kS_i}{2} \right) S_i \left( \frac{1}{n_i^2} + \frac{\sigma^2}{(2 + bkS_i)^2} \right) \]

for the two different market sizes. Suppose that the market size multiplies by some \( \delta \)-tuple amount \( (S_i=\delta S_0) \). Since fixed costs do not change with market size, the fixed costs can be equated for the two different market sizes.

\[ \delta \left( \frac{1}{b} + \frac{kS_1}{2} \right) \left[ \frac{1}{n_i^2} + \frac{\sigma^2}{(2 + bkS_i)^2} \right] = \left( \frac{1}{b} + \frac{kS_0}{2} \right) \left[ \frac{1}{n_0^2} + \frac{\sigma^2}{(2 + bkS_0)^2} \right] \]

To calculate simple comparative statics, the parameter that reflects the decrease in marginal cost due to economies of scale will be ignored for the time being \((k=0)\). This restriction will be relaxed later, when the equations are estimated and the comparative statics are revisited. The relationship reduces to

\[ \delta \left( \frac{1}{b} + \frac{kS_1}{2} \right) \left[ \frac{1}{n_i^2} + \frac{\sigma^2}{(2 + bkS_i)^2} \right] = \left( \frac{1}{b} + \frac{kS_0}{2} \right) \left[ \frac{1}{n_0^2} + \frac{\sigma^2}{(2 + bkS_0)^2} \right] \]

\[ \delta (1 + \frac{kS_1}{2}) \left[ \frac{1}{n_i^2} + \frac{\sigma^2}{(2 + bkS_i)^2} \right] = \delta (1 + \frac{kS_0}{2}) \left[ \frac{1}{n_0^2} + \frac{\sigma^2}{(2 + bkS_0)^2} \right] \]

\[ \delta (1 + \frac{kS_1}{2}) \left[ \frac{1}{n_i^2} + \frac{\sigma^2}{(2 + bkS_i)^2} \right] = \delta (1 + \frac{kS_0}{2}) \left[ \frac{1}{n_0^2} + \frac{\sigma^2}{(2 + bkS_0)^2} \right] \]

To arrive at this equation, notice that the prices of any two funds \( i \) and \( j \) in the same fundtype are related to each other by the differences in their individual characteristics and that if one fund is fixed, the average price can be defined as a function of the price of only that fund and the difference between its characteristics and the average characteristic in that fundtype \( (A) \).
The monopolistic competition model predicts that the number of funds should increase by more
than the square root of the increase in market size:

$$\left(\frac{n_1}{n_0}\right)^2 = n_1^2 \frac{\sigma^2}{4} (\delta - 1) + \delta .$$

One can see that without the fund-specific characteristics ($\sigma^2 = 0$), a doubling of market
size increases the number of funds by the square root of that amount (about 1.4 times). The same
effect happens with the added individual variables but the effect on the number of funds is an
increase of more than the square root of the increase in the market size. This is because the first
term inside the square root of the above expression is always positive.

**Effect of Market Size on Expected Price:** The price equation for the representative fund,
assuming $k=0$, in terms of number of rival funds and fund attributes is

$$P = \frac{1}{b} \left[ \frac{1}{n} + \frac{1}{2} (A + \overline{A}) \right] + c$$

and its expected value is

$$E[P] = \frac{1}{bn} + c .$$

The equilibrium condition can be rearranged rearranging to obtain $1/n$ on one side of the
equation. Substituting this into the expected price equation gives

$$E[P] = \frac{1}{b} \left[ \sqrt{bF/S} - \frac{\sigma^2}{2} \right] + c = \sqrt{F/Sb} - \frac{\sigma^2}{2b} + c ,$$

which shows that an increase in market size leads to lower expected prices.
Effect of Market Size on Mean Fund Size: It has already been shown that when $S$ doubles, $n$ increases by more than the square root of the increase. Since $X = \frac{S}{n}$, it follows that the mean fund size should increase by less than the square root of the increase in market size.

One way to determine how closely the model fits the data is to compare the actual sizes of funds and the number of funds with the predictions from the model. The results of this exercise are in Table 1.4. The first column displays the eight mutually exclusive categories of equity fund types that both countries have in common. The second column is the ratio of U.S. to Canada total value of each fund type or the number of times larger is the U.S. fund type. Recall that the model outlined specifies that if there are no individual characteristics included, then if a market increases by a certain amount, the average fund size and number of funds should increase by the square root of that amount. If, however, individual characteristics are included, the mean fund size was determined to increase by less than the square root and the number of funds should increase by more than the square root of the inflation of market size. The next column displays the square root of the ratio of market sizes and the last two columns then show the actual ratios of mean fund sizes and number of funds.
**Pricing Equation:** A fund in a given fundtype sets its MER taking into consideration its size, the competition it faces within its fundtype, the fund's individual characteristics, the average price in the fundtype and some marginal cost. This is the general form of equation (2):

\[ P = h(X, \frac{1}{n}, A, \bar{P}, c). \]

The variable \( A \) is a linear summation of individual fund attribute variables. The average fundtype MER variable is separated into an average MER for each fundtype in the U.S. and Canadian mark-up component. The estimated coefficient on the Canadian dummy proves the most interesting, as it reflects the average mark-up on Canadian funds after accounting for all other variables. Regression techniques require that the equation to be estimated contain a random error term. The theoretical equation derived in this paper does not explicitly contain a random element but it can be assumed that there is an unobserved element of cost that gives rise to an error term. The marginal cost term \( (c) \) will serve as the random error term for the purposes of estimation because it is fund-specific and its elements are immeasurable due to lack of consistent reporting\(^{16}\). Although there is reason to believe that there are cross-country differences in marginal costs that can at least partially account for the difference in MERs and it can be argued that the Canadian dummy should enter as a part of the marginal cost term, as long as the Canadian dummy enters a part of the mean fundtype MER, it measures the average Canadian mark-up due to both marginal and non-marginal cost differences.

**Demand Equation:** A fund faces demand that is a function of the number of funds in and size of its fundtype, its price relative to the average price in its fundtype and the fund’s individual characteristics. This is the general form of equation (1):

\(^{16}\) Not all funds give their associated trailer fees to tracking agencies. They are found embedded somewhere in fund prospectuses but what with over 7000 funds in the data set, the labour needed to compile them is beyond what we have available. Even if this was possible, Canadian funds are sold with differing load and trailer options and it would be impossible to determine how much of the fund was sold with one trailer and how much with another.
The significance of the estimated attribute coefficients will indicate whether it has an effect on demand. It is assumed that there are unobservable elements of demand not explicitly defined in the demand equation. The second stage of the consumer problem involves the consumer choosing one fund from all the other funds in its category. Therefore, the demand faced by an individual fund is relative to the other funds in its category and should be measured as its share of its fundtype’s total assets. We use the fund’s share of its fundtype market size to estimate the theoretical demand equation by scaling the equation by fundtype size.

One might have already noticed an endogeneity between the pricing and demand equations. The pricing equation regresses MERs on assets and the demand equation regresses market share (assets over fundtype size) on MERs differenced from fundtype average MER. In addition, the competition effect (inverse of the number of funds in a fundtype) is determined simultaneously with market size and fundtype size. A common method for dealing with this structure is to instrument for the endogenously determined variables using their lagged values (exactly one year previous) and the exogenous variables not included each equation. There are three exogenous fund attributes that will be included in both the pricing and demand equations because they are believed to have an effect on both the cost of a mutual fund and the demand. These are the fund’s age, a dummy for load and the number of associated family members. For the pricing equation, the excluded exogenous variables are those variables included in the demand equation: 3 year annualized fund return differenced from its fundtype average return\(^{17}\) and a dummy that indicates whether a fund is eligible for a retirement plan. Both of these variables do

\[ X = S \cdot g(\frac{1}{n}, P - \bar{P}, A). \]

---

\(^{17}\) The one-year difference of fund return from average fundtype return was used in place of the 3-year annualized difference as a robustness check. The results for the pricing estimation were virtually identical. The estimated coefficient on the return variable in the demand estimation had a t-statistic of 5.404 compared to 8.20 for the 3-year annualized return. The other estimated coefficients did not change substantially. We would expect a robustness check with a 5-year annualized return to follow the same pattern.
inverse of number of funds and, as the next table uncovers, this accounts for part of the
discrepancy. The estimated coefficient on the inverse number of funds (the variable accounting
for different competition in different fundtypes between countries) has the predicted direction and
is significant. There is reason to believe that because there are some very large funds that skew
the distribution of asset size, the asset variable would be more accurately defined in logarithmic
form. The results are shown in Appendix 1.2 and have a similar structure to Malhotra and
McLeod's study. The inference on all variables is robust and the effect of an increase in fund size
on MER is stronger. In fact, a doubling of the mean fund size would decrease its MER by 5.4
basis points bringing the economies of scale effect closer to Malhotra and McLeod's findings.

All of the individual fund characteristics are estimated with good significance indicating
that they have a strong net cost and demand effect. The estimated coefficient for the age variable
indicates that an older fund will have a lower MER possibly because of efficiencies of
experience. This result contrasts a conclusion that Tufano and Sevick (1997) make. They found
that older funds tend to charge higher MERs (p.347). As explained earlier, funds with loads tend
to have inflated MERs and the positive sign of the coefficient corroborates the story. Funds with
many family members appear to have lower MERs because of economies of scope. As expected,
index funds have lower MERs because they require less research expense.

The regression shows that even after accounting for the smaller average fund size of the
Canadian companies and difference in competition, there is still a significant unexplained average
mark-up in Canadian equity MERs. The unexplained mark-up is estimated to be an average of 73
basis points or 85% of the Canadian mark-up. Table 1.5a decomposes the difference in the
Canada and U.S. MERs using the estimated parameters of the model to determine the percent of
the difference in MERs explained by each variable. The contribution of economies of scale in
explaining the difference in MERs is surprisingly small. Appendix 1.2 shows the same
decomposition for the log-linear model. Economies of scale play a stronger role in the log-linear
model. It accounts for almost 6% of the difference in MERs and the difference in competition
market shares. Funds that are associated with larger families are predicted to have larger market shares. This is most likely because mutual fund consumers may look to purchase funds that allow them to switch costlessly among funds in the same family. Being registered retirement savings plan (RRSP), in Canada, or individual retirement account (IRA), in the U.S., eligible does not appear to affect market share. This effect is reduced by combining the Canadian and American datasets. In the U.S., IRA-eligible funds tend to be distributed evenly among equity fund types with fund families making the decision whether to allow the eligibility. Whereas in Canada, RRSP-eligibility is strictly due to foreign content of the fund and, therefore, are mostly restricted to the domestic fund types. Since the demand equation is fund type-specific, it is almost impossible to extract the effect on Canadian demand of RRSP-eligibility. If the demand is regressed just on the U.S. data, the IRA-eligibility variable is strongly, positively significant.

Since MERs are the price of a fund, the estimated attribute coefficients in the pricing regression will include both the cost and demand effects. If a certain attribute reduces costs it will potentially also increase demand and this demand may be reflected in an increase of price due to market power. The effects are indistinguishable in the pricing equation but the demand effects are tractable using the estimation of the demand equation. The results from Table 5 and Table 6 show that the cost and demand effects are estimated to offset each other for every attribute. It is possible to extract the cost effects of individual attributes by subtracting the estimated coefficients of the demand regression from those in the pricing equation (after accounting for differences in dependent variable units). For instance, the coefficient of $\log(\#\text{family members})$ in the pricing equation is -0.0695 less the coefficient in the demand equation (0.0501) is -0.1196. This indicates that large families have a negative cost effect (i.e.: economies of scope). This does not indicate which effect is stronger. However, it is possible to conclude that load funds have a stronger cost effect than demand effect because its coefficient in the demand equation is not significant but the net effect in the pricing equation is significant.
The estimated parameters can now be used to determine more precisely how well the monopolistic competition model fits the North American mutual fund market. Equation (3) can be manipulated into a quadratic expression in \( n_j \).

\[
\frac{1}{n_j^2} = \frac{1}{\delta} \left( \frac{1}{b} + \frac{kS_0}{2} \right) - \frac{1}{\left( \frac{1}{b} + \frac{\delta k S_0}{2} \right)} \left[ \frac{1}{n_0} + \frac{\sigma^2}{(2 + bkS_0)^2} \right] - \frac{\sigma^2}{(2 + \delta bkS_0)^2}
\]

All of the parameters inside the brackets are known or can be estimated. If we view \( S_0 \) as the U.S. mutual fund market size and \( \delta = S_j/S_0 \) as the amount that the Canadian market size is smaller than the U.S., we can solve the above expression for the predicted number of Canadian mutual funds.

![Chart 1.2: Number of Actual and Predicted Canadian Funds](image)

**Chart 1.2: Number of Actual and Predicted Canadian Funds**

Chart 1.2 displays the actual number of Canadian mutual funds and the predicted number of funds according to the Dixit-Stiglitz version of monopolistic competition and the Krugman-Obstfeld version of monopolistic competition (without heterogeneous funds). The 8 fundtypes are listed in the same order as in Table 1.4. The dashed series is the number of Canadian funds, given the U.S. market as a base, as predicted by the Dixit-Stiglitz model. Recall that the Dixit-
Stiglitz version of monopolistic competition has the number of funds increasing proportionally with the increase in market size. It under-predicts the actual number of Canadian equity funds for every fundtype. The bold series is the actual number of mutual funds in Canada and the thinner series is the prediction by the Krugman-Obstfeld model (without heterogeneous funds). It comes closer to the actual number of funds in Canada but it slightly over-predicts every category except two (Domestic Blend and Global).

![Chart 1.3: Number of Actual and Predicted Canadian Funds](image)

**Chart 1.3: Number of Actual and Predicted Canadian Funds**

Allowing funds to have different attributes gives an even closer prediction of the number of funds in Canada than the simpler Krugman-Obstfeld model, as is shown in Chart 1.3. Again, the actual number of Canadian funds in each fundtype and the prediction using the simple version of Krugman-Obstfeld are displayed. The dotted line is the prediction using the model developed in this paper (referred to as Krugman-Obstfeld with heterogeneous funds). The addition of heterogeneous funds does not adversely change the prediction of the number of Canadian funds. However, for every fundtype, the allowing for heterogeneity among funds brings the predicted
number of funds closer to the actual number. The version of monopolistic competition developed in this paper provides a closer fit of the North American mutual fund market than does the simple Krugman-Obstfeld and the Dixit-Stiglitz versions of monopolistic competition.

1.5 Conclusion

This paper investigates the factors that determine MERs in North American mutual funds in an attempt to explain the mark-up in Canadian MERs. It is commonly believed that Canadian MERs are higher because Canadian funds are, on average, smaller and there are fewer rival funds. A monopolistic competition framework was used to model the mutual fund market because it directly addresses the issues of economies of scale and degree of competition. The framework was further developed to incorporate a distinctive consumer choice theory that allows funds to charge different MERs in equilibrium. The model fits the North American data well and its estimation determines the extent to which the two common explanations account for the discrepancy in MERs. The difference in fund sizes, degree of competition and measurable fund attributes are determined to explain about 15% of the Canadian mark-up.

There are other factors that may be influencing the MER difference. Trailer fees in Canada are anecdotally thought to be twice as large as 12b-1 fees in U.S. Trailer/12b-1 fees are a marginal cost and can only account for up to one third of the difference in MERs. A significant difference in costs, such as labour costs, would influence a difference in MERs between the two markets. We have no reason to think these are significantly different but this remains uninvestigated because there are no available data on cost factors. Lastly, we anecdotally know that Canadian investors buy rear-loaded funds four times as often as front loaded funds whereas U.S. investors buy them equally as often. This remains a feasible but, as of yet, immeasurable reason for part of the difference in MERs.
Chapter 2:

U.S.-controlled Mutual Funds in Canada
2.1 Introduction

As discussed in Chapter 1 (see p.16), the Canadian and U.S. mutual fund industries operate as segmented markets due to regulations that restrict the ability of Canadians to buy U.S.-owned mutual funds and Americans to buy Canadian-owned mutual funds. There is, however, an increasing level of U.S. control over funds offered in Canada. There are two methods through which a U.S. mutual fund firm or family can control a fund in Canada. The firm can incorporate in Canada and offer the fund through its Canadian subsidiary (foreign direct investment or "FDI") or it offer it through a Canadian host company by exporting its advisement services ("advisement"). There are 174 equity funds in Canada controlled by U.S. companies with a total value of $37.3 US billion or 18.2% of Canadian equity market.18

This chapter investigates the characteristics of U.S. mutual funds offered in Canada, the characteristics of the companies that offer them and how these characteristics affect the method chosen to enter Canada. Markusen (1995) asserts a number of characteristics of firms that perform FDI as stylized facts from a compilation of different studies. These characteristics are used in the model of this paper and the estimation of the model accounts for them simultaneously while determining their individual contribution to the probability of a company performing FDI or choosing to export. The significance of certain fund and company characteristics suggests the motivation for the move into the Canadian market. If a small firm is attempting to expand success of one fund, the firm is expected to offer just that one fund through advisement. If a large firm is attempting access to a larger market, the firm is expected to enter through FDI and offer average performing funds. This information affords Canadian policy makers a better

18 All data is as of January 31st, 1999. U.S. data is from Morningstar, Inc. and Canadian data is from Portfolio Analytics Ltd.
understanding of the implications of an increase or decrease of restrictions to foreign entrants on the predominance of certain funds in the Canadian market.

The model assumes that a firm chooses to enter the foreign market based on its potential profitability reflected by firm-level characteristics in its home market. In the case of mutual funds, a family of funds is the term used to describe a group of funds offered by the same mutual fund firm. The firm-level characteristics, in this case, are the asset weighted average characteristics of the family of funds. The channel chosen to enter the Canadian market is, in part, solved by a bargaining game with a Canadian host for an advisement fund. The bargaining section predicts that firms that choose the advisement route ("advisement families") tend to have a few outstanding funds in their family, while firms that choose FDI ("FDI families") tend to be larger and have a more equal family performance composition. A multinomial logit regression is used to estimate the probability of a U.S. fund being offered in Canada through either channel using characteristics of the fund itself and its associated family as regressors. The empirical results indicate that FDI families have a larger market share in the U.S. market than do advisement families and that the funds chosen to offer in Canada by advisement families are highly successful in the U.S. market in terms of individual fund market share and past returns. Funds offered by FDI families are not successful in the U.S. market in terms of past returns or market share. This suggests that advisement families are not large enough to cover the cost of incorporation but are attempting to expand on the success of individual funds and that FDI families are large enough to cover the costs of incorporation and are attempting to gain access to a larger market.

This chapter contributes to the existing literature on two levels. First, it models the firm-level decision for mutual fund companies to enter a foreign market and extends it to the product-level in determining the products offered there. Second, it estimates the choice to horizontally incorporate in the foreign market with the alternative of exporting services relative to not entering the foreign market at all. Theoretical models of horizontal multinational behaviour increasingly
recognize the trade-off between FDI and trade (recent contributions include Markusen (1995), Brainard (1993), Markusen and Venables (1998)) but predominately determine the relationship between country characteristics and the resulting composite of multinational and national (purely trading) firms. Furthermore, there are only a few empirical investigations. Brainard (1997), at the industry-level, and Carr, Markusen and Maskus (1998), at the country-level, acknowledge the interaction between exporting and incorporation when they determine that affiliate production rises with trade barriers. Although the model is developed for and estimated for its fit on the North American mutual fund industry, it can be generalized to fit most industries with heterogeneous products.

This chapter will proceed as follows. Section 2 describes in detail the relevant data. Section 3 outlines the theoretical model of the decision to enter the Canadian market. Section 4 estimates the model and Section 5 concludes the paper.

2.2 Descriptive Statistics

Table 2.1 displays the number of U.S. equity funds offered through FDI and advisement disaggregated into fundtypes. For precise definitions of fundtypes, see Appendix 1.1. There are 71 Canadian funds owned and 103 advised by U.S. companies out of 1455 equity funds in Canada in total. The column labeled "identifiable U.S. equivalents" displays the number of these funds that are identified as having a U.S. equivalent fund in terms of manager and investments. These funds are especially interesting because one would assume they would require no more research costs than those already expended in the U.S. operations. To view the funds offered in Canada with their U.S. equivalents, see Appendix 2.1.
by the U.S. subsidiary. O'Shaughnessy's large Canadian presence is mostly due to the size of one successful fund (Royal Bank's Canadian Strategic Index) relative to a small U.S operation. The most prominent pattern is that FDI families offer, on average, more than double the number of funds in Canada than do advisement families.

It is also informative to examine which types and how many funds U.S. companies are offering in Canada. Table 2.5 displays the number of funds in each fundtype offered by each U.S. fund family offering funds in Canada. In terms of which funds are offered, there is a high proportion of global funds (global bond, global equity, emerging markets) offered in Canada, especially through the advisement channel. Also, many U.S.-invested funds are offered in Canada, especially through advisement.
To sum up, families that offer funds in Canada tend to be larger than the average family in the U.S. and have a larger proportion of its U.S. operations in high MER categories. Advisement families tend to offer only these high MER fundtype funds in Canada, while FDI families attempt to capture Canadian demand by offering Canada-invested funds not offered in their U.S. operations. In addition, the funds offered as exact equivalents tend to charge below the average price in the U.S. market and charge above the average price in the Canadian market. The difference between FDI and advisement families is that FDI families are larger and advisement families appear to have only one or two outstanding funds. One can hypothesize that FDI families are large enough to cover the costs of incorporation and do not have any significant outstanding funds that would make the option of offering just those funds through advisement worthwhile. For an analysis of their possible strategies, including “specialty capitalization” (offering small-capitalization funds in Canada to recapture their extremely high research costs), see Appendix 2.2.

2.3 Theory

The theory section will develop a framework for understanding why firms choose their method of entering a foreign market. It will offer a prediction for the family-level characteristics that choose to enter Canada through FDI or advisement\(^{19}\) and predictions for the fund-level characteristics of those funds offered through advisement. These predictions will be empirically tested in the following section. The theory begins with an analysis of consumer behaviour.

The utility a representative consumer gains from investing in mutual fund \(i\), \(U_i\), depends on the fund’s current return. Since any fund’s current return is unknown, a consumer values other

\(^{19}\) A third method of entering a foreign market that is usually cited in literature on multinationals is licensing. Licensing is when a company gives the technology to reproduce its good to another company to sell in a specified market in exchange for royalties. This route is not relevant to the mutual fund industry because advisement funds are never reproduced in Canada. An advisement fund is 100% produced by the U.S. mutual fund company that owns it.
information to forecast future returns such as the fund's past returns, its market share within its 
fundtype, its age and MER relative to its fundtype MER. These attributes are reflected in one 
variable denoted as $A_i$, where higher values of $A_i$ increase consumer utility.

$$\frac{dU_i}{dA_i} > 0$$ (1)

A fund increases its attribute function through research expenditure. This assumption 
holds whether or not the reader believes that fund managers have different stock-picking talent. 
Grinblatt and Titman (1992) and Elton, Gruber, Das and Hlavka (1993) document mutual fund return predictability over 5 years and attribute it to manager stock-picking talent. In contrast, 
Carhart (1997) finds that the persistence is almost completely explained by common factors in 
stock returns and investment expenses and, therefore, claims that the results do not support the 
existence of skilled or informed mutual fund managers$^{20}$. Since there is no decisive conclusion, 
it cannot be ruled out that some managers are more proficient at their job than others. In this 
paper, this issue is not directly addressed. The theory developed in this paper accommodates the 
possibility that managers have stock picking ability, but it is also consistent with the idea that all 
managers have the same ability but that more research expenditure increases the probability of 
higher returns for a fund. If the reader believes in heterogeneous manager ability, then if a 
manager is indeed talented at her job, then she will command a higher wage and the costs of 
research for the fund will necessarily increase.

Fund $i$’s variable profit, $V$, is defined as fund price, $P$, less some small marginal cost, $c$, 
meant to reflect operating costs, times fund demand, $X$:

$$V(A_i) = [P(A_i) - c]X(A_i)$$ (2)

$^{20}$ Chevalier and Ellison (1999) find evidence that characteristics of managers (ie: schools they 
got to, experience) influence their performance. They conclude that differences in stock-
picking ability may be part of the explanation for the results, although the magnitudes of the 
effects are so large as to suggest that other factors must be at work as well.
A fund's attributes will positively affect both the price charged and the demand faced. The profit function for a representative company's U.S. operations with \( n^{m\text{th}} \) funds is the sum of each fund's variable profits less research costs, \( R(A_i) \),

\[
\pi^{us} = \sum_{i=1}^{n^{m\text{th}}} [V^{us}(A_i) - R(A_i)]
\]

(3)

The \( us \) superscript indicates the fund is in the U.S. market. A fund's research cost is directly related to fund attributes: \( R(A_i) = \gamma A_i \), where \( 0 < \gamma < 1 \), and are, thus, defined as fixed costs. If they were defined as marginal costs, high research categories would inappropriately benefit from economies of scale more than low research categories. Also note that research costs are fund-specific because every fundtype has an average amount of necessary research above which exemplary research is reflected in higher than average fundtype attributes.

If an American fund family wants to enter the Canadian market, it can do so through two channels: FDI or advisement. FDI involves a one-time fixed cost of incorporation while the advisement channel has no fixed cost but the Canadian host company takes a portion of the profit of the fund. The fraction of profit is determined by how well the fund performs relative to its rival funds and the characteristics of the associated fund family.

**FDI route:** If the U.S. company chooses to perform FDI in Canada, its Canadian profit (through FDI) would be

\[
\pi^{fdi} = \sum_{i=1}^{n^{m\text{th}}} [V^{ca}(A_i)] - F
\]

(4)

where \( F \) is the fixed cost of incorporation in Canada and the superscript \( ca \) indicates the Canadian market. Examples of the components of the fixed cost are the cost of setting up office space, personnel charges, and extra research for Canadian funds not offered in the U.S. operations. It is necessary to offer Canadian-invested funds to satisfy consumer RSP-eligibility demands. The
fixed cost is the only cost in the Canadian operations because research costs are expended only once in the U.S. operations. An increase in a fund’s attributes through more research will increase company total profit \((\pi = \pi^{\text{us}} + \pi^{\text{fdi}})\) for a fund offered in both countries because the increase in variable profits outweighs the research costs.

\[
\frac{d\pi}{dA_i} = \frac{dV^{\text{us}}}{dA_i} - \gamma + \frac{dV^{\text{ca}}}{dA_i} \geq 0 \tag{5}
\]

However, if the positive effect on variable profit is subject to decreasing marginal returns

\[
\frac{dV^2}{d^2A_i} < 0
\]

then there is a limit to beneficial research expenditure. The fact that a family can earn profits from both countries but only expend research in one reflects that entrance into the Canadian market is an attempt not only to gain access to more consumers but also to recapture high research costs given a fixed cost of incorporation. The subsequent estimation will determine which is the more dominant motivation.

The decision to incorporate in Canada depends on whether the U.S. company can offer a group of funds profitable enough to cover the fixed cost of incorporation. The family ranks the funds in their potential profitability in the Canadian market given their variable profits in the U.S. market. The fund-level variables that influence the choice will be estimated empirically in the following section. The U.S. company keeps offering funds as long as the additional marginal benefit outweighs the additional marginal cost or until \(V^{\text{ca}}_{m^n}(A_j) = 0\) (Baldwin and Ottaviano, 1998). The sum of variable profits in Canada though FDI is

\[
V^{\text{fdi}} = \sum_{i=1}^{m^n} [V^{\text{ca}}(A_i)] \tag{6}
\]

where \(i\) indicates funds chosen for FDI. The U.S. company would never perform FDI if it were unprofitable:
If FDI was potentially profitable (i.e.: the U.S. company could offer a group of funds that would cover the fixed cost of incorporation), the company may choose to perform FDI depending on whether it could make more Canadian profits through advisement.

**Advisement route:** If the U.S. company chooses instead to offer one of its funds, $i$, through a Canadian mutual fund company host through advisement, its Canadian profit would be a fraction of the fund’s profit in Canada:

$$\pi_{adv} = s_i V_{ca}(A_i)$$

where $s_i$ is the share of profits ($0 < s_i < 1$). The U.S. company only receives these profits if the fund is hosted by a Canadian company, otherwise it does not enter the Canadian market and earns no Canadian profit. For ease of notation, define $V_{ca}(A_i) = V_i$. The Canadian company is looking for a fund in a specific fundtype and will agree to host the fund with which it will earn the most revenue. Its revenue, $(1 - s_i) V_i$, depends not only on the fund’s potential profit but also on how much of a share it can receive for the given fund.

The shares are determined by a bargaining game solved in two stages. In the first stage, the Canadian company chooses which U.S. company to bargain with depending on the U.S. fund’s potential profitability. In this stage, the Canadian company has to trade-off the benefits from hosting a fund from a high research U.S. company and, thus higher potential profit, with the offsetting loss of taking a smaller share of the profit because the U.S. company has a stronger bargaining power with the higher potential profit. In the second stage, the Canadian company and the U.S. company then bargain for their share of the profits.

At this point, the decision to enter Canada and through which channel may be a little confusing. The following tree diagram is intended to clarify which actions are possible by which
company and at which time. The solution for how the Canadian company chooses which U.S. family to negotiate with will begin after the diagram.

![Tree Diagram of Family-level Possible Outcomes](image)

**Chart 2.1: Tree Diagram of Family-level Possible Outcomes**

The bargaining stage is solved with each company's best alternative being incorporated. The Canadian company ranks the eligible funds from best to worst potential profitability. Therefore, its threat point is the amount it would earn from a negotiation with another U.S. company for the next best fund. Also, U.S. firms only offer funds that have positive expected variable profit ($V_i > 0$). The U.S. company's alternative is to perform FDI with the offered fund. However, when a company performs FDI, it has an incentive to offer more than just one fund because the fixed cost of incorporation is paid only once. Consequently, its threat point is the potential profits from offering its most profitable group of funds through FDI, as long as they are positive. If the U.S. company cannot offer enough funds in Canada through FDI to cover the fixed cost of incorporation, its threat point is zero.
The Canadian firm earns \((1 - s_i)F_i\). It has an alternative of earning \((1 - s_{i-1})F_{i-1}\), where \(i-1\) is the best alternative fund. The U.S. firm earns \(s_iF_i\) through advisement. If it is profitable, the U.S. firm has the alternative of performing FDI and earning \(V_{FDI} - F\). Thus, the U.S. company’s alternative is \(I_{i}^{FDI}(V_{FDI} - F)\), where \(I_{i}^{FDI}\) equals 1 if FDI profitable for the family associated with fund \(i\) and 0 otherwise. This equals the FDI profits if FDI is profitable or 0 if it is not. For simplicity, we will assume there are only two potential advisement funds, although the results can be generalized to an indefinite number of funds (see Appendix 2.3). Employing Nash bargaining to solve this stage, the function

\[
H = \left[ (1 - s_i)F_i - (1 - s_{i-1})F_{i-1} \right]^{1/2} \left[ s_iF_i - I_{i}^{FDI}(V_{FDI} - F) \right]^{1/2}
\]

is maximized with respect to \(s_i\) to attain the optimal share equation \((s_i^*)\).

The amount of profit the U.S. company receives (the optimal share equation times the variable profit), given the fund is chosen by the Canadian host, is always positive:

\[
s_i^*F_i = \frac{1}{2}V_i - \frac{1}{4}V_{i-1} + \frac{1}{2}I_{i}^{FDI}(V_{FDI} - F) + \frac{1}{4}I_{i-1}^{FDI}(V_{FDI} - F) > 0
\]

Using this equation, the first term on the right hand side indicates that the amount of profit the American company receives increases in potential profitability of its own fund. The second term indicates that it decreases in profitability of the best alternative fund and the third and fourth terms indicate that it increases with its own family profitability and the best alternative fund’s family profitability.

The amount of profits the Canadian host receives after negotiation is

\[21\] An alternative model would consider multiple Canadian hosts but the bargaining process modeled in this chapter is intended to investigate the channel of entry into the Canadian market from the prospective of the U.S. mutual fund company in the most uncomplicated and clearest way possible.
The amount the Canadian host offers to its chosen fund family depends on the best alternative fund and the strength of both the chosen family and the best alternative’s family. It has the incentive to negotiate with the family that has the maximal difference between the potential profits of the advisement fund and the potential FDI profits of the fund’s family:

$$V_i = \frac{1}{2} \left[ V_i - I_{i}^{FDI} \left( V_{FDI} - F \right) \right] + \frac{1}{4} \left[ V_{i+1} - I_{i+1}^{FDI} \left( V_{FDI} - F \right) \right]$$

If two funds have identical potential profits ($V_i = V_{i+1}$) but only one family can offer enough funds through FDI to cover the incorporation costs, the Canadian host has the incentive to negotiate for the fund associated with the family not able to perform FDI. This is because the profits it receives decrease in family FDI potential profitability of the chosen fund and the best alternative fund but especially in the family potential profitability of the chosen fund. To maximize profit received, it will choose to negotiate with the family not able to perform FDI ($I_{i}^{FDI} = 0$). Even if both U.S. families are large enough to have the option of FDI, the Canadian company will maximize its profits by negotiating with the U.S. family that has the smaller potential FDI family (or has the least leverage). This is directly correlated with the size of the U.S. family and the amount of over-all family research performed.

The Canadian host will prefer to negotiate for a fund that is associated with a family that has only one outstanding fund as opposed to a family that owns many fairly good funds. If both U.S. fund families have the option of performing FDI and have identical potential FDI family profits, the Canadian host will have the incentive to negotiate for the fund associated with the family that has the more profitable fund up for negotiation. For instance, if the two U.S. families had equal Canadian FDI profits but one family had one outstanding fund making up most of the profits while the other family had only average funds, the Canadian company would negotiate with the U.S. family with the outstanding fund. This will be empirically investigated.
using family asset-weighted returns as an indicator of whether a family profitability is mostly comprised of average return funds or one or two outstanding funds.

Comparative statics are performed to determine the extent to which increases in fund attributes through higher research affect the potential Canadian profits in either channel of entry into the Canadian market. The change in U.S. company profits through FDI and advisement (assuming the fund is hosted by a Canadian company) from increasing fund attributes through research are positive:

$$\frac{d(\pi_{jfi})}{dA_i} = \frac{dV_i}{dA_i} > 0 \quad \text{and} \quad \frac{d(\pi_{adv})}{dA_i} = \frac{1}{2}\left[1 - \frac{I_i}{I_{jfi}}\right] \frac{dV_i}{dA_i} > 0$$  \hspace{1cm} (12)

but FDI benefits to a greater degree:

$$\frac{d(\pi_{jfi})}{dA_i} \geq \frac{d(\pi_{adv})}{dA_i}$$  \hspace{1cm} (13)

Since the amount of profits received by the U.S. company through advisement, given a fund is accepted by a Canadian host, is always positive, a fund is offered in Canada through advisement only if is chosen by a Canadian host. The Canadian host chooses the fund, $i$, with which it can earn the highest revenues. These revenues depend on the variable profit of the fund in question and its family attributes relative to other families.

This theory suggests that funds that are offered through advisement are outstanding in the U.S. market in terms of market share and past returns. However, the choice of which fund is offered through advisement does not just depend on fund-level characteristics. It also depends on family-level characteristics because family size affects bargaining power in the negotiations with the Canadian host. FDI families have a large enough asset base to cover the fixed costs of incorporation, while advisement families do not. These predictions will be tested in the following section, while accounting for other fund- and family-level characteristics.
2.4 Estimation

Recall from the tree diagram in Chart 2.1 that there are three possible outcomes: enter Canada through FDI, enter Canada through advisement or stay in the U.S. market. The U.S. company will not enter the Canadian market if it is not potentially profitable. If it is potentially profitable to enter Canada, the method chosen will depend on which is more lucrative. Note that only the chosen advisement family gets positive profits through advisement, all other U.S. families receive nothing through advisement.

Stay in the U.S. market: if $\pi_{fdi} \leq 0$ and $\pi_{adv} = 0$,

Enter through advisement: if $\pi_{adv} > \pi_{fdi}$ and $\pi_{adv} > 0$, and

Enter through FDI: if $\pi_{fdi} \geq \pi_{adv}$ and $\pi_{fdi} > 0$.

Where $\pi_{fdi} = V_{fdi} - F$ is family potential profit through FDI and $\pi_{adv} = s_i V_i$ is family potential profit through advisement. Since fund potential variable profits comprise family potential profits through either channel, in order to estimate the specification, the variables that comprise the potential variable profit function need to be defined. Then, a multinomial logit estimation of these outcomes will allow us to determine which family-level characteristics are more relevant for the route chosen to enter Canada.

An individual fund’s potential profitability in a foreign market depends on three things: its success in the home market, its experience and its efficiency. Success, in the context of mutual funds, is reflected by both large market share and high fund return. A highly successful fund clearly should have high returns relative to its fundtype and over time this results in larger fund assets (market share) due to consumers being attracted to higher than average returns. Experience is reflected by a fund’s age and is also an indicator of reputation. A fund’s management expense ratio or MER (see Chapter 1) is a good indicator of the costs expended in managing the fund and consumers prefer funds with a lower MER than its fundtype average MER. Each of these fund-
specific attributes is affected by the amount of research expended. A fund manager would expect that research expenditure over that average required for its fundtype would improve a fund’s market share, returns, age and MER.

Recall that family profit through FDI is the sum of variable profits of the funds offered through FDI less the fixed incorporation cost: \( \pi_{fd} = \sum_{i} V_i - F \). The characteristics that reflect a family’s potential profitability through FDI are determined using either an aggregation or asset-weighted average of the fund-level characteristics of the family funds. Family market share is reflected in the family’s share of the over-all mutual fund market. Family return is reflected by asset-weighted returns over average fundtype returns of all the funds in its family. A simple average of the variables across the family funds would not appropriately give weight to the larger and more successful funds. A family’s age is a straightforward measure of the length of time the family has existed and family MER is the asset-weighted MER differenced from fundtype MERs for all family funds.

Since not all U.S. funds enter the Canadian market, a fund’s potential profitability in Canada is predicted by its characteristics in the U.S. market. These attributes include its market share, MER, return, and age, as defined at the fund and family level in Table 2.7. In addition to these four attributes, recall that in the model, the Canadian host of an advisement fund chooses a fund from a given fundtype. This is intended to model the dominance of foreign and specialty funds found in advisement funds, as shown in the descriptive statistics section. A fifth attribute affects the chances of a fund being offered in Canada even though it does not affect its potential profitability. At the fund-level, this is whether a fund is from a high MER category (small-capitalization, specialty, foreign, emerging markets) and, at the family-level, this is the proportion of family funds invested in these categories.
in different units. However, the marginal elasticities\(^{23}\) measure the percentage change in the probability of families entering Canada through a given channel given a percentage change in the explanatory variable (see Hensher and Johnson, 1981) and allow a direct comparison of importance of specific variables to the channel chosen. For instance, consider Family Age’s role in the results. It has a positive estimated coefficient for both advisement and FDI families. This indicates that as Family Age increases, it positively affects the probability of entering Canada through either channel, relative to not entering the Canadian market. A percentage increase of Family Age decreases the probability of entering Canada through FDI by 0.53\%. This reveals that an increase in Family Age actually decreases the probability of entering the Canadian market through FDI but it decreases the probability of not entering the Canadian market more.

The variables are all estimated in the expected direction except Family MER for both types of families and Family Returns for FDI families. Recall that Family MER is defined as the family asset-weighted MER differenced from fundtype average MER. It was expected that a negative value of this variable would be correlated with entering the Canadian market, however, the estimated coefficients are positive for both channels. However, the marginal elasticities indicate that a one percent change in Family MER only changes the probability of entering Canada by a small amount. Recall from Table 2.3 that FDI families tend to have lower asset-weighted family returns compared to stay-at-home families. This regression estimate determines this not true (although with weak significance).

The results indicate that families that have large market share, are older and have a large proportion of assets in high MER fundtypes tend to enter Canada through advisement. All

\(^{23}\)The formula for the marginal elasticity of variable \(q\) on the probability of entering Canada through advisement is \(\hat{E}_q = \sum \hat{P}_{\text{advisement}} \left[ (1 - \hat{P}_{\text{advisement}}) \hat{\beta}_{1q} X_{1q} - \hat{P}_{\text{advisement}} \hat{\beta}_{2q} X_{2q} \right] \right] \sum_{i} \hat{P}_{\text{advisement}}\) where \(\hat{P}_{\text{advisement}} = \exp(\hat{\beta}_1 X_{i}) / [1 + \exp(\hat{\beta}_1 X_{i}) + \exp(\hat{\beta}_2 X_{i})]\) and \(\hat{\beta}_{1q}\) is the estimated coefficient for variable \(q\) for advisement families. \(\hat{E}_q^2\), \(\hat{P}_{\text{advisement}}\) and \(\hat{\beta}_{2q}\) would be defined similarly but for FDI families (see Christofidies et al., 1997 and Zepeda, 1990).
of these results were expected given the preliminary family descriptive statistics found in Table 2.3 except the Family Age variable. It is expected that FDI families would be older than advisement families as trade in advisement services is viewed as a preliminary step to entering a foreign market, with incorporation following. The single most significant attribute of families who chose FDI is that they have a large market share in the U.S. market.

Markusen (1995) lists some firm-level and industry-level micro facts about FDI firms taken from various other studies. The firm-level ones are: 1. FDI firms have high levels of R&D to sales and advertising to sales, 2. FDI firms have high levels of intangible assets, 3. there appears to be a threshold size for FDI firms above which size is unimportant, 4. corporate age is highly correlated with MNs. The attributes listed above that are available and measurable are used in this investigation. A contribution of this study is that all of these attributes have been asserted in different studies but this investigation determines whether they are relevant while controlling for the others and the degree to which of these attributes contribute to the probability of performing FDI. It also compares them to firms that chose the trade-route to enter Canada and those that chose to not enter Canada. It appears that Markusen's prediction that FDI firms tend to dominate is shown in the estimation but families with a large degree of research, as proxied by Family MER variable, appears to be more relevant for the trade-route firms. Surprisingly, age appears to be more relevant to trade or advisement firms than to FDI firms.

The theory predicts that fund families choose which funds to offer in Canada by how their potential profitability compares to other funds in their respective fundtypes. The choice to offer fund $i$ through either route ($I_{offer} = 1$) depends on how the fund compares in terms of potential profitability with other funds in its fundtype.

\[
I_{offer} = 0 \quad \text{if } V_i \leq V_a \text{ or } \pi^{adv} = 0 \text{ or } \pi^{fdi} \leq 0
\]

\[
I_{offer} = 1 \quad \text{if } V_i > V_a \text{ and } \pi^{adv} > \pi^{fdi} \text{ and } \pi^{adv} > 0
\]

\[
I_{offer} = 2 \quad \text{if } V_i > V_a \text{ and } \pi^{fdi} \geq \pi^{adv} \text{ and } \pi^{fdi} > 0
\]
offered in Canada through advisement, 2 if through FDI and 0 if it was not offered in Canada. The results are relative to the dependent variable equal to zero, so the inference on the estimated coefficients is the importance of the particular variable to the probability of the fund being offered in Canada without distinguishing between family characteristics.

All the coefficient signs are estimated in the expected direction except Fund MER for advisement funds. This is surprising given the statistics displayed in Table 2.6, although the estimate is insignificant. That table showed that the U.S. equivalents of funds that are offered in Canada tend to have MERs lower than their fundtypes’ MERs. An explanation for why advisement funds tend to be from high research fundtypes\(^{24}\) is that Canadian mutual fund firms may not have funds offered in certain fundtypes and they may choose to host successful U.S. funds from these categories. It would make sense that if a family was deficient in any fundtype categories, it would be in ones that would require high research expenditure outlays such as globally-invested funds.

Other results indicate that advisement funds tend have large fundtype market share, have high returns, are older and are from high MER categories. FDI funds have large market share in their fundtypes, fairly old and are from high MER categories. It appears that high past returns increase the probability of entering the Canadian market through advisement funds more than through FDI. This was predicted by the preliminary descriptive statistics.

The theory predicts that fund families choose which funds to offer in Canada by how their potential profitability compares to other funds in their respective fundtypes. It is possible to estimate the probability of a fund being offered in Canada simultaneously with the family decision to enter Canada at the fund-level. The choice to offer fund \(i\) through either route \((I_{opr} = 1)\) depends on how the fund compares in terms of potential profitability with other funds in its fundtype. The family decision to enter Canada has been shown to depend on family-level

\(^{24}\) I acknowledge Bruce Blonigen for this interpretation.
characteristics. The decision to offer a certain fund in Canada depends not only on how it ranks in its fundtype but also on whether it is in a family capable of entering Canada. We will now examine the effect of each variable on the probability of a fund being offered in Canada and the route chosen by estimating the following *multinomial logit* regression:

\[
I_{offer} = 0 \quad \text{if } V_i \leq V_i \text{ or } \pi^{adv} = 0 \text{ or } \pi^{fdi} \leq 0
\]

\[
I_{offer} = 1 \quad \text{if } V_i > V_i \text{ and } \pi^{adv} > \pi^{fdi} \text{ and } \pi^{adv} > 0,
\]

\[
I_{offer} = 2 \quad \text{if } V_i > V_i \text{ and } \pi^{fdi} \geq \pi^{adv} \text{ and } \pi^{fdi} > 0.
\]

Where \(-i\) indicates all other funds in \(i\)'s fundtype, \(V_i = h\) (fund \(i\)'s market share, return, MER, age and fundtype research), \(\pi^{fdi} = g\) (family the owns fund \(i\)'s market share, returns, MER, age and research) is family profits through FDI and \(\pi^{adv} = s_i V_i = f(V_i, V_{i-1}, \pi^{fdi})\) for family that owns fund \(i\), \(\pi^{fdi}\) for family that owns \(i\)-1 is family profits through advisement. The estimation results are in Table 2.11a. The dependent variable is 1 if the fund is offered in Canada through advisement, 2 if through FDI, and 0 if not offered in Canada. The independent variables are the fund-level variables in the variable profits equation and the family-level asset-weighted variables from the pricing equation. Again, the results are relative to the dependent variable equal to zero, so the inference on the estimated coefficients is the importance of the particular variable to the probability of the fund being offered in Canada through the specified channel.
The empirical results corroborate the story suggested by the theory and the data analysis of advisement funds: funds offered through advisement are successful in the U.S. market in terms of having large fundtype market share and high returns relative to their fundtypes. An unexpected finding is that advisement funds are again found to have high MER (although insignificantly so). Families associated with advisement funds do not have large market share in the U.S. market, although this result is insignificant and not robust to the family-level regression estimated earlier. Families that have a higher asset-weighted average return have a tendency to offer funds through advisement. This was not estimated significantly in the family-level regression but was displayed in the data analysis. It was expected to be significant because advisement families tend to be smaller than FDI families and they also tend to have one or two funds performing extremely well. Thus, the proportion of high return funds can be higher for advisement families than for FDI, thereby increasing the asset-weighted family return. Families that are older and have a large proportion of their assets in high MER fundtypes tend to offer funds in Canada through advisement. This is reiterated in the family-level regression (Table 2.9).

Funds from high MER fundtypes are the most common FDI funds to be offered in Canada even though it has been shown that there are relatively more advisement funds that are in high MER fundtypes (i.e.: emerging markets compared to FDI funds in Canadian equity fundtypes). Unfortunately, most of the FDI funds in Canadian fundtypes do not have identifiable U.S. equivalents and are not included in the sample. Fund market share and return do not appear to be as important in choosing a fund for FDI. Family market share is the most important factor in determining the probability of a fund being offered through FDI. This result is robust to the family-level regression. The empirical results indicate that the families associated with FDI funds tend to have low family returns compared to stay-at-home families, as expected although this is insignificant. Older families tend to offer funds in Canada but, surprisingly, the age appears to be more relevant to the advisement channel than the FDI channel.
families than for FDI families. However, the t-test is not a strong result but is interesting because one of Markusen’s stylized facts about FDI firms is that their existence is highly correlated with corporate age.

2.5 Conclusion

This paper investigated the different characteristics of U.S. mutual funds offered in Canada along with their associated families and how these characteristics affect the method chosen to enter Canada. A multinomial logit regression was used to estimate the probability of a U.S. fund being offered in Canada through either channel using characteristics of the fund itself and its associated family as regressors. The empirical estimation suggests that U.S. companies that choose the FDI route are attempting to gain access to a greater consumer market while being large enough to cover the costs of incorporation while U.S. families that choose the advisement route are not profitable enough to incorporate but usually have one or two very successful (in terms of returns and/or market share) funds in high research categories. This suggests that advisement families are attempting to recapture high research expenditure more than FDI families.

Any move to restrict the advisement route into the Canadian market would reduce the access Canadian mutual fund consumers have to high performing funds from the U.S. It remains unclear why the U.S. funds offered in Canada with exact equivalents in the U.S. have higher MERs than the average MER in Canada for their fundtype. If this is associated with initial cost outlays such as advertisement in a new market, then this phenomenon is expected to be temporary. If, however, the MERs for the funds with identifiable U.S. equivalents do not drop to the average over time, it is questionable who benefits from the influx of U.S. mutual funds in Canada. Canadian mutual fund policy makers should consider allowing Canadian investors direct access to U.S. expertise by reducing protectionist regulations in the industry.
Chapter 3:

Technology Sourcing Through Acquisitions:

Evidence from the U.S. Drug Industry
3.1 Introduction

Acquiring companies in high-technology industries is a common and important method of gaining access to existing technology. Between 1993 and 1999, there were, on average, 330 firms in the U.S. drug industry (biotechnology\textsuperscript{26} and pharmaceutical industries combined) and 93 acquisitions, one quarter by foreign acquirers and three quarters by domestic acquirers. An example of a foreign acquisition is Bayer AG, which acquired the diagnostics business of Chiron Corp in 1998. Before the acquisition, Bayer was involved in diagnostics to a small degree and only in non-blood diagnostics. The target was a world leader in the “new” technique of blood gas diagnostics. The year after the acquisition, sales for Bayer’s diagnostics division increased by 55% and Bayer pledged a significant and on-going investment into the R&D in this area.

“R&D [is the] growth driver for our health business. This is why we will invest over [\$US5.5 billion] in R&D in the Health Care business segment over the next 5 years. Our commitment to the future is likewise evident in the field of diagnostics, where we are among the world’s top companies following the acquisition of Chiron Diagnostics Corp.” (Bayer AG 1999 Annual Report, p.39)

Contrasting this image of a Bayer AG taking over a company in an unfamiliar area is Watson Pharmaceuticals Inc. (a U.S. firm), which acquired three different firms between 1995 and 1997 that produced very similar product lines. This suggests that Watson was focusing its research and product lines narrowly and the subsequent R&D necessary to synthesize the acquisitions was lower than for Bayer. This paper finds that these are typical examples of foreign and domestic acquisitions in this industry.

This chapter compares the acquisition motivation and experience of foreign and domestic acquisitions of U.S. drug firms, especially with regards to technology transfer.\textsuperscript{27} It does this by

\textsuperscript{26} Biotechnology is a general term describing the directed modification of biological processes. In its purest form, the term "biotechnology" refers to the use of living organisms or their products to modify human health and the human environment.

\textsuperscript{27} Licensing is another avenue that is used by drug companies to gain access to technology. There are problems with licensing that some firms prefer to internalize through acquisition. Acquisitions will be the only method to gain access to technology investigated in this chapter.
examining target characteristics of drug industry acquisitions and compares domestic and foreign acquirer characteristics to their targets to better understand the decision to acquire. In addition, it investigates pre- and post-acquisition innovation levels and product lines of both the targets and acquirers to reveal differences between the domestic and foreign acquisition experience.

An estimation of an acquirer’s choice of a target from the pool of all potential targets suggests the motivation behind an acquisition. Along with sourcing existing technology, two other common motivations for acquisition (geographic location and size of customer base) will be controlled for, while comparing the characteristics of the acquirers to all the potential targets in a conditional logit estimation. This choice estimation indicates that domestic acquirers value target R&D intensity more as its own R&D intensity increases, while foreign acquirers value target R&D intensity more as its own R&D intensity decreases. An analysis of patent to R&D expenditure ratios of the combined firms before and after acquisition shows the change in innovative productivity. The results show that domestic acquisitions tend to increase firms’ innovative productivity and foreign acquisitions do not increase innovative productivity. A closer inspection of the acquisitions reveals that domestic acquirers tend to take over targets with similar product and research lines to their own while foreign acquirers tend to take over firms in unfamiliar research areas. They may do this because the U.S. is doing pioneering work in the biotechnology industry and foreign acquirers may be attracted to using their acquisitions to move into new research areas more than domestic acquirers. This suggests that domestic acquirers have a significant amount of over-lapping resources that can be eliminated post-acquisition, thus decreasing the R&D intensity, while foreign acquirers do not enjoy any R&D resource redundancies and their acquisitions are in relatively highly technical areas that require a long-term commitment of higher R&D expenditures.

Another approach involves looking at stock market valuation before and after acquisition. Swenson (1993) found that post-acquisition stock valuation of foreign acquisitions are higher than domestic acquisitions. Looking at research integration allows a longer time period for
The main contribution of this chapter to the existing literature is its comparison of domestic and foreign acquisition motivation with respect to innovation. All known technology sourcing studies investigate either FDI or domestic acquisitions but not both. Kogut and Chang (1991) pioneered the knowledge sourcing literature. They compared acquirer and target country R&D intensities but at the industry-level and found that Japanese FDI, and acquisitions specifically, in the U.S. were strongly correlated with both countries' R&D intensities but only weakly correlated with the U.S.'s relative research dominance. Neven and Siotis (1996) did similar study for Japanese FDI into Europe and Anand and Kogut (1997) for total FDI into the U.S. Both found similar results to Kogut and Chang (1991). Many firm-level studies suggest technology sourcing has occurred by only investigating either the acquirer or the target characteristics. At the firm-level, Shan and Song (1997) investigated target patent counts as an incentive for foreign acquisitions in the U.S. biotechnology industry and found a significant correlation with probability of acquisition. Looking at domestic acquisitions, Blonigen and Taylor (2000) investigated the U.S. electronics industry at the firm-level and found that acquirer R&D intensity is strongly negatively related to acquisitions, implying that acquirers may be externally sourcing R&D. The secondary contribution of this paper is that it evaluates, at the firm-level, the characteristics of both domestic and foreign acquirers with their targets. Hall (1987) is the only firm-level paper I have found that compares acquirer and target characteristics directly. Hall analyzed domestic acquisitions across all manufacturing industries and found that mergers tend to happen between firms of like size and R&D intensity implying a synergy story between domestic acquirer and target innovation intensity. Although not a technology sourcing paper, Hitt, Hoskisson, Ireland and Harrison (1991), found that (domestic) acquisitions had a negative effect on parent company R&D and patent intensity.

analysis (years rather than days) and is more descriptive in terms of post-acquisition research productivity.
The next section of the chapter will describe in greater detail technology as a motivation for acquisitions in the drug industry. The third section will describe other motives for acquisition. The fourth section will provide some background information about the U.S. drug industry. The fifth section will describe and estimate the choice model and the sixth section display results of a post-acquisition analysis of the combined firms. The final section will emphasize the conclusions and findings of the paper.

3.2 Technology as a Motivation for Acquisition

The countries or areas or companies that are technological leaders have accumulated substantial scientific and technological capacities. These technological endowments can be attained through acquisition of existing companies and the knowledge that the multinational gains can be transferred back to the parent company. If a company is being acquired mainly for this purpose, then this action is referred to technology sourcing. This can also be referred to as knowledge sourcing, externally innovating or external sourcing. Technology sourcing usually implies the action is done by a foreign multinational but this is not unlike the action of a domestic firm that externally sources technology through acquisition rather than innovating in-house.

This description of technology sourcing says nothing about how the knowledge or technological capability of the acquirer relates to that of the target. It implies that an acquirer is technology sourcing only if the technological capability of the target is high. An additional distinction that describes how technological capability of the target relates to the acquirer must be created to better understand why the acquirer is taking over the target (see Kogut and Chang, 1991, for a similar line of reasoning at the industry-level).

Let an acquirer $a$'s value of a potential target $t$ at the time of acquisition be

$$V_{at} = V(R_t, R_a, X_t, L_t, e_{at}) - V_t$$

(1)
where $R_t$ and $R_a$ are the R&D intensities\(^{29}\) of the target and acquirer, $X_t$ is the sales of the target, $L_t$ is the target’s location, $\varepsilon_{it}$ is an idiosyncratic effect and $V_t$ is the value of firm $t$ as a standalone company. In this paper, technology is a general term that is embodied in technology assets, ideas, knowledge and processes. R&D intensity is used as a proxy for technological capacity. The linear representation of the function $V_{at}$ that will be used in the model for this paper is

$$V_{at} = \alpha R_t + \beta R_a + \gamma R_t R_a + \delta X_t + \lambda L_t + \varepsilon_{it} - V_t$$

(2)

The function $V_{at}$ is the maximum willingness acquirer $a$ has to pay for target $t$ and it can be thought of as the present discounted value of the revenue streams that could be generated from target $t$’s assets in combination with acquirer $a$’s assets (Hall 1987). An acquirer values a potential target more as the target’s R&D intensity rises if

$$\frac{dV_{at}}{dR_t} > 0 , \text{ holding all other variables constant.}$$

(3)

The biotechnology and pharmaceutical industries are considered high technology because of the amount of R&D expended relative to total costs. It follows that because research and innovation are so highly valued in this industry that acquisitions would be more likely for targets with high R&D intensity.

**Hypothesis 1:** Acquirers in the drug industry choose targets with high R&D intensities.

In a well-working market for corporate control, a firm acquires a target because it places a higher value on that target than all other acquirers and higher than the stock market valuation.

\(^{29}\) R&D intensity is usually thought of as a technology (or innovation) input while patents are a technology (or innovation) output. In the context of this study, the delay between the expenditure of R&D, innovation, the application for a patent and the final awarding of a patent is the biggest problem with using patents as a definitive proxy for firm innovativeness. A prospective acquirer may instead value the amount of R&D expenditure already invested in the firm as an indication of the future technology capacity (or innovation rents) the target may bring to the acquirer. The investigation will concentrate on R&D intensity but the results will be checked for robustness with patent intensity in Appendix 3.1.
Sometimes an acquirer will value a target highly because it complements something in the parent firm and together the value of the potential union would be greater than the value of the two firms separately. The acquirer may value something the target already has in existence that would cost the acquirer more to attain through other means. Using the linear representation of the value function presented above, I will define an acquirer as pursuing a strategy of technological complementarity if

$$
\frac{d^2V_{at}}{dR_a dR_t} = \gamma > 0, \text{ holding all other variables constant.}
$$

If the above inequality holds, then an acquirer is said to be pursuing a strategy of technological complementarity if it values targets with high R&D intensity more as its own R&D intensity increases. Likewise, it may also be valuing targets with lower R&D intensity more as its own R&D intensity decreases.

Conversely, a strategy of technological substitutability will be defined as

$$
\frac{d^2V_{at}}{dR_a dR_t} = \gamma < 0, \text{ holding all other variables constant.}
$$

An acquirer pursuing this strategy values targets with high R&D intensity more as its own R&D intensity decreases. It may also value targets with lower R&D intensity as its own R&D intensity increases. It is important to not take the definition for the strategy of “technological substitutability” literally. This does not imply that acquirers pursing this strategy are substituting the target’s innovativeness for their own. It would be extremely difficult to definitively test for this.

Strategic technological complementarity and substitutability, as I have defined them, describe how the acquirer values its target’s R&D intensity relative to its own R&D intensity. These strategies borrow their terminology and definition directly from strategic complements and substitutes used in Industrial Organization literature. See Tirole (1995), p.208.
These two definitions do not describe the how absolute levels of R&D intensities for the acquirer and target relate to each other. Kogut and Chang (1991) considered the absolute difference between acquirer and target R&D intensity, albeit at the industry-level. The shortcoming of this method is that two possible acquisitions with the same difference in absolute value of R&D intensities between acquirer and target would be viewed as equally likely whether the acquirer is of an extremely high R&D intensity and extremely low R&D intensity. The method used in this chapter assigns a different probability of these two potential acquisitions occurring depending on which strategy the acquirer is pursuing. It would be useful to compare results using absolute differences, however the regression technique used to estimate the acquisition decision in this paper (conditional logit) does not allow for absolute differences between acquirer and target, only relative differences. This will be discussed in detail when the conditional logit is described in the estimation section. In addition, conditional logit does not allow us to distinguish whether acquirers pursuing technological complementarity are valuing targets with high R&D intensity more as their own R&D intensity increases or if they are valuing targets with low R&D intensity more as their own R&D intensity decreases. This can be seen visually in Charts 3.2a and 3.2b.

The sign on \( \frac{dV_{at}}{dR_t} \) tells us whether an acquirer prefers an R&D intensive target and the sign on \( \frac{d^2V_{at}}{dR_c dR_t} \) tells us, given a target's R&D intensity, if the acquirer values this target more as it's own R&D intensity increases or decreases. This provides four possible scenarios displayed in Chart 3.1.
**Chart 3.1: Diagram of Strategies**

<table>
<thead>
<tr>
<th>$\frac{d^2V_{at}}{dR_a dR_t} &lt; 0$</th>
<th>$\frac{d^2V_{at}}{dR_a dR_t} \geq 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Vertical integration”</td>
<td>“Gap filling”</td>
</tr>
<tr>
<td>Ex: a pharmaceutical firm</td>
<td>Ex: low R&amp;D intensity acquirer</td>
</tr>
<tr>
<td>acquiring a manufacturer.</td>
<td>taking over a biotech target.</td>
</tr>
</tbody>
</table>

Firms in high technology industries, such as the drug industry, value innovation. “The most valuable assets of biotechnology companies are their intangible research capabilities, which represent the potential to develop and deliver new drugs. These research bases need to be continually nurtured and developed” (p. 954, DeCarolis and Deeds, 1999). Because of this, we expect that both foreign and domestic acquirers in the drug industry will both target firms with high R&D intensities (the rightmost column of the diagram).

A firm with a relatively low innovativeness in a high-technology industry has put itself in a position where it needs to either invoke a large degree of internal innovation or externally source existing innovation just to survive. A firm with a low R&D intensity that is acquiring a target with a high R&D intensity is said to be “gap filling”. That is, they are opting to fill the gap of innovation between itself and the market by externally sourcing innovation. Conversely, a company with relatively high R&D intensity may also highly value a potential target because of its high levels of R&D intensity but not to externally source. It may value the target because the potential union of the two companies’ research assets may easier synthesize. I call this scenario...
"building on strength" (R&D intensive version). That is, a firm choosing this strategy already has a comparative advantage in innovation and is using economies of scale to further this advantage.

To determine which strategy we can expect foreign and domestic acquirers to pursue, Charts 3.2a and 3.2b will display the R&D intensity of the targets to the R&D intensity of the acquirers for domestic and foreign acquisitions separately. It will also give an indication of whether the R&D intensity of the targets is related to the R&D intensity of the acquirers and if it is, in which direction. That is, does the R&D intensity of the targets tend to be higher as the R&D intensity of the acquirers decrease or increase? The answer to this question will give an indication of the strategy of technological complementarity or substitution but is not a definitive test for it because the R&D intensity of the targets is not held constant, nor is the other motivations for acquisitions to be discussed next. Used as a descriptive device before the actual empirical test, this graph will display whether the R&D intensities of the targets are, indeed, higher than the average U.S. drug industry firm's R&D intensity.
**Chart 3.2a:** Domestic Acquisitions
R&D intensities (in logs) of targets and acquirers

**Chart 3.2b:** Foreign Acquisitions
R&D intensities (in logs) of targets and acquirers
The points on the graphs are the observations for actual acquisitions. The average R&D intensity (in logs) of U.S. drug industry firms is -1.62. It appears that more than half of the targets of domestic acquisitions have R&D intensities above the average but only about half of the targets of foreign acquisitions have R&D intensities above the average. This gives more confirmation, albeit weaker for foreign acquisitions, that we expect acquirers to target firms with high R&D intensities or pursue a strategy of technology sourcing. If there were no correlation between R&D intensity of targets and acquirers, we would expect the linear trend line to be horizontal. Instead, there is a distinct difference between the two graphs. The R&D intensity of targets of domestic acquisitions tends to be higher as the R&D intensity of the acquirer increases. Conversely, the R&D intensity of targets of foreign acquisitions tends to be higher as the R&D intensity of the acquirer decreases. This indicates that domestic acquirers may be pursuing a strategy of technological complementarity while foreign acquirers may be pursuing a strategy of technological substitutability.

_Hypothesis 2: Foreign acquirers value potential targets' R&D intensity more as their own intensity decreases, while domestic acquirers tend to value their target R&D intensities higher as their own R&D intensity rises._

As mentioned earlier, the regression technique used will not distinguish whether acquirers pursuing technological complementarity are valuing targets with high R&D intensity more as their own R&D intensity increases or if they are valuing targets with low R&D intensity more as their own R&D intensity decreases. It can be seen only visually by observing Chart 3.2a. If domestic acquirers were valuing targets with low R&D intensity more as their own R&D intensity decreases, then the points on the chart would be placed more towards the lower left corner. Anecdotally, the points tend to be places towards the upper right corner. This indicates that domestic acquirers may be value targets with high R&D intensity more as their own R&D
intensity increases. The same exercise can be performed for foreign acquirers. Chart 3.2b suggests that foreign acquirers value targets with high R&D intensity more as their own R&D intensity decreases (upper left corner).

3.3 Alternate Motivations for Acquisition

1. Customer base capture.

An acquirer might not value only a potential target’s innovativeness. Instead, it might be interested in capturing the target’s existing customer base. For domestic acquisitions, this motivation might stem from an existing rivalry. Foreign acquirers incur a substantial risk in entering a new country and may prefer to reduce that risk by choosing a target with an established customer base to form an immediate outlet for products. A customer base in the drug industry can be anything from downstream pharmacies or pharmaceutical companies or doctors who trust a certain pharmaceutical company. The trust needed to form these relationships takes years to build up and some acquirers may not have the time or expertise needed to form these relationships. If \( X_t \) is the sales of the target, we can infer that an acquirer would be employing a customer base capture strategy if

\[
\frac{dV_{acq}}{dX_t} > 0, \text{ holding all other variables constant.}
\]

\textit{Hypothesis 3: Acquirers will place higher value on potential target firms with large customer bases.}

2. Geographic Location.

Acquirers may value a target’s geographic location because of the potential access to innovation spillovers (for an overview see Audretsch and Feldman 1996 or Jaffe, Trajtenberg and Henderson 1993). The close proximity of research organizations with similar interests promotes the natural exchange of ideas through networks established (DeCarolis and Deeds, 1999). This
may be particularly important for foreign acquirers who have to incur large risks by investing out of country in the first place and may wish to reduce that risk by potentially gaining access to many other R&D intensive firms by proximity. If \( L_t \) is the number of R&D intensive firms in the same city as the target \( t \), then an acquirer would be acquiring the target because of the spillover benefits of the area if

\[
\frac{dV_u}{dL_t} > 0, \text{ holding all other variables constant. (7)}
\]

Significant contributions in this literature are Audretsch and Feldman (1996) who found that even after accounting for the geographic concentration of the production location, industries where research is important have a higher propensity to cluster together. Jaffe, Trajtenberg and Henderson (1993) investigated localization of innovativeness through patent citations and found evidence that they are indeed geographically localized. Head, Ries and Ruckman (1998) sought to understand why Japanese investors tend to locate foreign affiliates near concentrations of establishments in their industry. Their findings indicate that these Japanese foreign affiliates in skill-intensive industries appear especially attracted to concentrations of similar firms in the U.S. but agglomerate less strongly with each other. Recently, DeCarolis and Deeds (1999) investigated the U.S. biotechnology industry and statistically linked geographic location to firm performance.

Hypothesis 4: Acquirers will place higher value on potential target firms located in highly innovative areas for the drug industry.

Hypothesis 4a: Foreign acquirers value this even higher than domestic acquirers.

3.4 Industry Background

It is important to clarify how the biotechnology and pharmaceutical fields relate to each other and comprise the drug industry. Essentially, a pharmaceutical firm is a mature
actual levels of the R&D intensities of the targets relative to the acquirers. This is not possible to test with a conditional logit model because the estimation results are within group and each acquirer is a group. Therefore, any level variables related to the acquirer drop out of the estimation.

3.6 Post-acquisition Analysis

An examination of the R&D intensity post-acquisition of the combined firm further uncovers the motivation behind a knowledge-based acquisition. If the joining of two entities makes a unit that is greater than the sum of the two parts, this unit is said to have positive economies of scale. That is, the positive aspects of combining the two entities outweigh the drawbacks. In terms of R&D intensity, if the target R&D intensity is higher than the acquirer's, we would expect the post-acquisition synthesized firm to have a higher R&D intensity than the original parent firm. There are, however, a number of reasons why an acquisition might decrease R&D intensity for the post-acquisition combined firm.

Hitt et al. (1991) investigated domestic U.S. acquisitions for all manufacturing industries to find that there is a negative relationship between acquisitions and post-acquisition firm R&D and patent intensity. They suggest this might happen because, over time, the innovativeness of the acquired firms decline. This might be due to the loss of the most innovative employees of the acquired firms due to high post-acquisition staff turn-over. It might also occur because the acquiring firms are not fully exploiting acquired technologies and the subsequent economies of scale and scope of research may be lower than expected (p.702). In a subsequent paper, Hitt et al. (1996) add that post-acquisition asset synthesis can consume a considerable amount of manager’s energy that would otherwise be devoted to innovative activities (p.1088-89).

I assert that there may be another important reason why R&D intensity can decrease after acquisition. If an acquirer takes-over a company with a similar product and research line, the post-acquisition combined company would have a number of research resources (both human and
technological) duplicated and the synthesis of knowledge would be simpler than between two firms in completely different areas. Once the redundant resources are eliminated, the total R&D expenditure will decrease, lowering R&D intensity. If the resulting output of R&D expenditure, usually measured by patents, did not decrease, then the post-acquisition net output of innovation increased. On the other hand, if an acquirer takes over a target specializing in an unfamiliar research area, the synthesis of research knowledge might not be as quick and simple as if the two companies were already familiar with each other's areas. The R&D intensity of the post-acquisition firm of this type may not decrease and if the patent-intensity did not increase, then this company's post-acquisition net output of innovation can be said to have decreased.

An acquirer's post-acquisition innovative productivity is said to increase if the ratio of patents to R&D expenditure increases. This will not distinguish the mechanism behind the increase. Did R&D expenditures drop at the same time as patents awarded increase? Or did patents remain unchanged? I will test for post-acquisition innovative productivity change using both the ratio of patents to R&D expenditure as well as with both R&D-intensities and patent intensities separately.

Let $R_c$ be the R&D intensity and $P_c$ be the patent intensity of the combined company of the acquirer and its target. Post-acquisition, these would be the observed values and pre-acquisition, they would be a hypothetical combination weighted by the size of their assets.

$$R_c = \begin{cases} R_h = \lambda R_a + (1 - \lambda)R, & \text{pre-acquisition} \\ R_c \text{ observed}, & \text{post-acquisition} \end{cases}$$  \hspace{1cm} (9)$$

$$P_c = \begin{cases} P_h = \lambda P_a + (1 - \lambda)P, & \text{pre-acquisition} \\ P_c \text{ observed}, & \text{post-acquisition} \end{cases}$$  \hspace{1cm} (10)$$

where $\lambda = \text{assets}_a/(\text{assets}_a + \text{assets}_t)$.

An acquirer's innovation productivity is said to have increased if the ratio of $P_c$ to $R_c$ increases post-acquisition. In addition, investigating the post-acquisition change in R&D
intensity and patent intensity separately will distinguish which had the greater effect: the research input (R&D) or the research output (patents). An increase in post-acquisition net innovative output implies that the positive aspects of combining the research resources of the two companies outweighed the drawbacks.

Appendix 3.4 lists each acquirer with their target and the product and research lines for both. Domestic acquirers tend to take over firms of similar R&D interests and product lines so that the combined companies have a substantial amount of duplication of resources and the synthesis process involves a reduction of this waste. Foreign acquisitions, on the other hand, more so tend to be forages into new research areas or product lines and the post-acquisition firm tends to gain more innovatively because of lack of overlap in existing knowledge. The listing of the acquisitions also lists the product and research lines for each company involved. Of the acquisitions in this data set, 44% of the foreign acquisitions were between acquirers and targets with similar product or research lines, whereas 74% of the domestic acquisitions were between acquirers and targets with similar product or research lines.

**Hypothesis 5:** Post-acquisition innovative productivity increases for domestic acquisitions and does not increase for foreign acquisitions.

The following ordinary least squares regressions will determine the validity of Hypothesis 5. The hypothesis will be supported if the foreign acquirers’ post-acquisition ratio of patents to R&D expenditure is lower than the hypothetical pre-acquisition combination and if the domestic acquirers’ ratio rises.
research-intensive firm with a relatively small amount of sales while Elan, at the time of the acquisition, was a large pharmaceutical firm doing some R&D but concentrated on the sales of established, generic drugs. It also stated that “Elan’s strategy illustrated a shift going on at other drug delivery companies” (p.28). One would expect that acquisitions of this nature: established pharmaceutical firms acquiring research-intensive biotechnology firms would gain in innovation productivity more than acquisitions of another model (i.e., biotechnology firms acquiring other biotechnology firms, or pharmaceutical firms taking over manufacturing companies) because the impact of the new knowledge would be relatively greater. A research-intensive firm acquiring a similar research-intensive firm would have an innovation productivity gain from new knowledge infused into the combined company but the impact of the target’s R&D intensity will not affect the combined company’s R&D intensity as much as for an acquisition between an acquirer who previously did not invest in research to a large degree. If domestic acquisitions were of this model (biotech-biotech) significantly more so than foreign acquisitions, we could expect the results already derived in post-acquisition estimations.

In the detailed listing of acquirers and targets for this study in Appendix 3.4, each company is defined to be an “integrated”, “biotech”, “manufacture” or “CRO” (contract research organization) using both the description each firm gave of itself in its 10k form filed for the SEC the year before the acquisition and the ratio of R&D expenditure to sales. An “integrated” firm is one with some R&D expenditure but more sales than R&D. A “biotech” firm is one whose R&D expenditure is greater than its sales. A “manufacture” company has extremely low R&D expenditure and a “CRO” is a firm that does research for other drug companies on a contractual basis. Foreign and domestic acquisitions do not appear to differ from each other in this respect. About one third of both types of acquisitions are between integrated acquirers and biotech targets. This cannot be an explanation for the difference in post-acquisition innovative productivity differences between the two groups.
The second possible explanation for the post-acquisition results would be if the targets of foreign acquisitions tended to be large in relation to the size of the acquirer, while domestic targets were small relative to the acquirers. (This argument only holds if \( R_t < R_a \).) Arguably, the impact of the target on the combined firm of foreign acquisitions would be greater than for domestic acquisitions. This could increase total firm R&D expenditures immediately to a proportionally large amount while the subsequent increase in patents could be delayed.

Domestic acquirers, on average, are 73 times larger than their targets and foreign acquirers are on average 30 times larger. There appears to be two outlying observations for the domestic acquirers that were both about 1500 times larger than their targets (American Home Products Corp. acquired Apollon Inc. in 1997 and Merck & Co. acquired Sibia Neurosciences Inc. in 1998). When these two acquisitions are omitted, the average domestic acquirer is 30 times larger than its target, the very same value for foreign acquisitions. This cannot be an explanation for the post-acquisition results.

That foreign acquirers take over firms with unfamiliar product lines while domestic acquirers take over firms in familiar areas, remains a feasible explanation for the post-acquisition results. The product line phenomenon also reconciles the results from earlier in the paper. Earlier we found that foreign acquirers tended to value targets with high R&D intensities the more that its own R&D intensity decreased. We can infer that foreign acquirers use their acquisitions to move into new and more R&D intensive areas which need a long-term commitment to R&D expenditures. The conditional logit estimation found that this trend appears to be even more important for foreign acquirers with especially low R&D intensities. They may do this because the U.S. is doing pioneering work in the biotechnology industry and foreign acquirers may be attracted to using their acquisitions to move into new research areas more than domestic acquirers. Domestic acquirers use their acquisitions to reduce redundancy of research resources by taking over companies in familiar R&D intensive product lines but whether this is
fundamentally motivated by a desire to better achieve economies of scale of research or to eliminate competition is unclear. The conditional logit estimation found that this trend appears to be even more important for foreign acquirers with especially high R&D intensities.

3.7 Conclusion

The choice analysis indicates that domestic acquirers choose targets with high R&D intensities, however, domestic acquirers value the R&D intensity of their targets at an increasing rate with their own R&D intensity and that foreign acquirers value the R&D intensity of their targets at a decreasing rate with their own R&D intensity. This implies that foreign acquirers care more about how high the R&D intensity of their potential target is, the lower is its own R&D intensity. Domestic acquirers, on the other hand, value targets with high R&D intensities, the higher is its own R&D intensity. Using the terminology defined earlier in the text, domestic acquirers are employing a strategy of technological complementarity while foreign acquirers are using a strategy of technological substitutability with their acquisitions of the U.S. drug industry.

An analysis of the ratio of patents to R&D expenditure of the combined companies shows that domestic acquirers' innovation productivity increases post-acquisition while foreign acquirers' innovation productivity does not increase. A further investigation into the specific product and research lines of the companies involved showed that domestic acquisitions tend to be between companies with similar research lines while foreign acquisitions tend to be between companies with different research lines. The higher amounts of research overlap for domestic acquisitions would, at least partially, explain why domestic acquirers' post-acquisition R&D intensities fall and foreign acquirers' rise. The product line phenomenon also reconciles the results from earlier in the paper. We can infer that foreign acquirers use their acquisitions to move into new and more R&D intensive areas, which need a long-term commitment to R&D expenditures and that this trend appears to be even more important for foreign acquirers with low R&D intensities. Domestic acquirers use their acquisitions to reduce redundancy of research
resources by taking over companies in familiar R&D intensive product lines but whether this is fundamentally motivated by a desire to better achieve economies of scale of research or to eliminate competition is unclear.
Appendices
Appendix 1.1: Chapter 1 Data Appendix

Each mutual fund claims to have a specific investment objective usually outlined in the prospectus and incorporated into the name of the fund. This creates a problem if fund managers deviate from the stated objective to the point that the fund would be appropriately listed as another fundtype altogether. Morningstar and Paltrak attempt to account for this behaviour by allocating funds to categories based on portfolio statistics and composition over the previous three years. However, Brown and Goetzmann (1997) find that the categories used by mutual fund tracking organizations are a poor characterization of fund returns. They conduct an analysis of mutual fund categories using past returns to determine a natural grouping of funds that has some predictive power in explaining the future cross-sectional dispersion in fund returns. The data set used in this paper is a compromise. We group the categories given in Morningstar and Paltrak using the criteria found in Brown and Goetzmann (1997). The following table describes in detail the composition of the fundtypes used in this paper.
### Appendix 2.2: U.S. Firms Managing Canadian Funds (Table A2.2.1)

<table>
<thead>
<tr>
<th># of funds managed (# with U.S. equivalents)</th>
<th>Number of &quot;specialty&quot; funds managed</th>
<th>Fundtypes</th>
<th>Number of Cdn. companies offered through</th>
<th>Chronology</th>
<th>Apparent strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alliance</strong> 2 (1)</td>
<td>1</td>
<td>US-invested</td>
<td>2: Ethical, MD</td>
<td>1st was almost 30 years ago (Ethical) and is a N.Amer. equity fund (no exact equiv). 2nd was 6 years ago and is one of their best US funds (in terms of returns and assets) and is doing extremely well in Canada.</td>
<td>Specialty capitalization &amp; offer high return fund</td>
</tr>
<tr>
<td><strong>Dresdner</strong> 10 (2)</td>
<td>2</td>
<td>Global bond</td>
<td>1: Guardian</td>
<td>1st is 28 years old (global equity), others mostly b/w 12 and 3. A few months ago offered the only equiv (is a specialty: global small cap). This is offered with a front or rear load, so offered twice.</td>
<td></td>
</tr>
<tr>
<td><strong>Franklin-Templeton</strong> 9 (7)</td>
<td>5</td>
<td>Global equity Emerging</td>
<td>5: MD, Ind'l Alliance, Northwest Life, CDA, National</td>
<td>1st two offered about 30 years old (1 is a Cdn. fund) for MD. Everything since have equivs and were within last 3 years. There aren't particularly great returns on those funds. There was 1 fund (Temp. Growth) that was offered through FDI 43 years ago a</td>
<td></td>
</tr>
<tr>
<td><strong>Goldman Sachs</strong> 4 (4)</td>
<td>3</td>
<td>US-invested</td>
<td>3: CCPE, NAL, Elliot &amp; Page</td>
<td>Appears that they are mostly pension funds for individual unions. Oldest is 5 (NAL), youngest 1 and a half. Returns are low but they are the better ones that the US co. has to offer.</td>
<td>Offer high return funds</td>
</tr>
<tr>
<td><strong>Hancock</strong> 8 (8)</td>
<td>1</td>
<td>Global equity</td>
<td>1: Maritime Life</td>
<td>Oldest 5 years old (global and US-invested offered at same time), youngest 2. Not great returns on funds either here or in US.</td>
<td></td>
</tr>
<tr>
<td><strong>Harris</strong> 8 (8)</td>
<td>1</td>
<td>Global bond</td>
<td>1: Bank of Montreal (First Canadian)</td>
<td>1st was 5 years ago (US-invested), 3 are very new. Most US-invested, global funds only offered recently. Equivs have performed well in US family.</td>
<td>Offer high return funds</td>
</tr>
<tr>
<td><strong>Invesco</strong> 6 (6)</td>
<td>3</td>
<td>Global equity</td>
<td>1: AIM</td>
<td>1st is 10 years old (global), mostly global funds. First specialty fund was the third fund to be offered (6 years ago).</td>
<td>Specialty capitalization</td>
</tr>
<tr>
<td><strong>Ivy-MacKenzie</strong> 8 (4)</td>
<td>3</td>
<td>Global bond</td>
<td>1: Investor's Group (Universal)</td>
<td>1st was 5 years ago (specialty US-invested), mostly global funds, 1 of the specialty doesn't have an exact equiv but is a combo of US ones, appear to perform pretty well.</td>
<td>Specialty capitalization &amp; offer high return international fund</td>
</tr>
<tr>
<td><strong>Janus</strong> 2 (2)</td>
<td>1</td>
<td>Global equity</td>
<td>1: MAXXUM</td>
<td>Both offered 4 years ago, US-invested one is a better performer.</td>
<td>Offer high return international funds</td>
</tr>
<tr>
<td><strong>MFS</strong> 5 (4)</td>
<td>1</td>
<td>Global equity</td>
<td>1: Spectrum United</td>
<td>1st one 40 years ago (US-invested), 2nd 30 (US) and the others during last 8 years, only 1 without equiv (but it is specialized in asia), last one offered is the specialty, good performers in Canada and US.</td>
<td>Offer high return international funds</td>
</tr>
<tr>
<td>Fund Types</td>
<td>Chronology</td>
<td>Apparent strategy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cdn. bond</td>
<td>Atlas fund 4 years old (Cdn. Bond, no US exact equiv but uses same manager as M.L. World Income fund in US). IG funds are 3 years old, looks like they picked one of the each basic category. The FDI funds came after the managed funds (just recently).</td>
<td>Offer high return funds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global bond</td>
<td>2: CT and Clarington</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global equity</td>
<td>2 with CT (first is 11 years old, global), other 2 in Clarington and oldest is 2 (global).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emerging</td>
<td>1: TD Bank (Greenline)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 and 4 years old. Both are emerging funds but one is general (first), the other Latin America (fairly specialized).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2: CIBC, Talvest</td>
<td>CIBC fund (emerging) is 3 years old and other (specialty) is 1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: Royal Bank</td>
<td>All offered at same time, just over a year ago, it only has 4 funds in the US to choose from but the ones offered here aren't the best performers.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2: Atlas, Clarington</td>
<td>Atlas fund (US-invested) 4 years ago, other 2 (global and US-invested) half a year ago, all not great performing in US or Canada.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: TD Bank (Greenline)</td>
<td>5 (specialized fund), 2 and 1 years old, appear to be capitalizing on specialty funds.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: Great-West Life</td>
<td>Specialty capitalization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6: CT, Ind'l Alliance, Northwest Life, CIBC, Royal Bank, Altamira.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 are index funds, 4 are econfxes (possible specialties). CT's 2 funds (global and US-invested index funds) are the oldest and are only 1 and 2/3 years old. The next 3 co's offered funds at the same time (1 year ago).</td>
<td>Offer index funds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: Talvest</td>
<td>First offered 7 years ago and the 2nd a year ago. Both have good returns in Canada.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 years old, health care fund.</td>
<td>Specialty capitalization &amp; offer high return fund</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: Talvest</td>
<td>Offer high return funds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: Spectrum United</td>
<td>Called quantitative equity. 5 years old.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2.3: Generalizing the advisement channel to many potential U.S. funds and allowing the bargaining power of the Canadian host to vary.

The Canadian firm earns \((1 - s_i) V_i\). It has an alternative of earning \((1 - s_{i-1}) V_{i-1}\), where \(i-1\) is the best alternative fund. The U.S. firm earns \(s_i V_i\) through advisement. If it is profitable, the U.S. firm has the alternative of performing FDI \((I^{fdi}_i = 1)\) and earning \(V^{fdi}_i - F\). Thus, the U.S. company’s alternative is \(I^{fdi}_i (V^{fdi}_i - F)\), which equals the FDI profits if is FDI possible or zero if FDI is not possible. Employing Nash bargaining to solve this stage, the function

\[
H = \left[ (1 - s_i) V_i - (1 - s_{i-1}) V_{i-1} \right] \left[ s_i V_i - I^{fdi}_i (V^{fdi}_i - F) \right]^{-\alpha},
\]

is maximized with respect to \(s_i\) to attain the optimal share equation \((s^*_i)\) where \(\alpha\) is the Canadian company’s bargaining power \((0 \leq \alpha \leq 1)\). If there are \(p\) potential funds for the Canadian company to choose from, the optimal solution for \(s_i\) is

\[
s^*_i = 1 + \frac{\alpha}{V_i} \sum_{k=0}^{p-1} (1 - \alpha)^k \left[ -V_{i-k} + I^{fdi}_i (V^{fdi}_i - F) \right].
\]

Note that as the Canadian company’s bargaining power increases, the share it negotiates for increases:

\[
\frac{d(1 - s^*_i)}{d\alpha} = 1 - \frac{1}{V_i} \sum_{k=0}^{p-1} (1 - \alpha)^k (1 - (k + 1)\alpha) \left[ -V_{i-k} + I^{fdi}_i (V^{fdi}_i - F) \right] > 0
\]

because the sum

\[
\sum_{k=0}^{p-1} (1 - \alpha)^k (1 - (k + 1)\alpha)
\]

is always approaches 0 as \(p\) increases.

One can perform comparative statistics on the optimal profits solution. The term

\[
\alpha \sum_{k=0}^{p-1} (1 - \alpha)^k V_{i-k}
\]

is simply a profitability-weighted average summed over all the choice funds (including fund \(i\)). Therefore, the share of the profits the U.S. firm will gain depends on how well the fund itself compares to its rival funds and their associated families’ best alternatives using a
profitability-weighted average. All of the comparative statistics performed in the simple case of two U.S. funds and a fixed Canadian bargaining power still hold in the general case:

**Comparative Statistics on Canadian Profits**

<table>
<thead>
<tr>
<th>Advisement route</th>
<th>FDI route</th>
<th>Effect on profits comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{d(\pi^{adv})}{dA} = \frac{dV}{dA} [1-\alpha + \alpha t_i^{fdi}] &gt; 0$</td>
<td>$\frac{d(\pi^{fdi})}{dA} = \frac{dV}{dA} &gt; 0$</td>
<td>$\frac{d(\pi^{fdi})}{dA_i} \geq \frac{d(\pi^{adv})}{dA_i}$</td>
</tr>
</tbody>
</table>

In the case of many potential U.S. funds and an indefinite Canadian company bargaining power, the nominal share of profits, given a fund is accepted by a Canadian host, is always positive:

$$s_i^{V} = V - \alpha \sum_{k=0}^{n} (1-\alpha)^k V_{i-k} + \alpha \sum_{k=0}^{n} (1-\alpha)^k t_i^{fdi} (V_{i-k}^{fdi} - F) > 0.$$

And the incentives on the part of the Canadian host with respect to which fund to negotiate for still hold in the general case.
Appendix 3.1: Chapter 3 Data Appendix

Company financial information: Compustat
Company product/research lines info: 10k forms filed with SEC and annual reports.
Acquisition information: Mergers & Acquisitions Journal (M&A)
Foreign acquirers' information: Compustat 20-F forms or annual reports.

The companies in the dataset are publicly traded companies whose Standard Industrial Classifications (SICs) are: 2833 (Drugs: Medicinals and Botanicals), 2834 (Pharmaceutical Preparations), 2835 (Prepared Diagnostic Substances) and 2836 (Biological Products) and 8731 (Biotech Research). There are a number of companies that were added to the dataset whose SICs are not listed above. They were classified in Compustat under SICs that probably described the company at its conception but using the “description of business” in their 10k reports, these companies clearly should be classified in the drug categories above.

SIC 2800 (Chemicals and Allied Products)
152. AMERICAN CYANAMID CO
1605. MONSANTO CO

SIC 3841 (Surgical and Medical Instruments and Apparatus)
319. BECTON DICKINSON & CO
467. C.R. BARD INC
651. COHESION TECHNOLOGIES INC
2048. RESEARCH MEDICAL INC

SIC 2840 (Soaps, Cleaning Products, Perfumes, Cosmetics, Other Toilet Preparations)
1990. PROCTER & GAMBLE CO

SIC 5122 (Wholesale Drugs: Proprietary)
502. CARDINAL HEALTH INC

SIC 8734 (Services: Commercial Physical and Biological Research),
621. CHRYSLIS INTL CORP

SIC 3842 (Orthopedic, Prosthetic & Surgical Appliances and Supplies)
656. COLLAGEN AESTHETIC INC

SIC 5912 (Retail: Drugs Stores and Proprietary Stores)
1806. OMNICARE INC

SIC 3826 (Laboratory Analytical Instruments)
1927. PERSEPTIVE BIOSYSTEMS INC
## Appendix 3.5: Table A3.5.1: List of Acquisitions

<table>
<thead>
<tr>
<th>Year of acquisition</th>
<th>Foreign Acquirer</th>
<th>Country</th>
<th>Classification</th>
<th>Drug product and research lines (pre-acquisition)</th>
<th>Target</th>
<th>Classification</th>
<th>Drug product and research lines (pre-acquisition)</th>
<th>Similar product lines?</th>
<th>Parent integrated and target biotech?</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
<td>BIOVAIL CORP INTERNATIONAL</td>
<td>Canada</td>
<td>manufacture &amp; cro</td>
<td>once-a-day generic pharmaceuticals (analgesics, angina, anti-inflams, hypertension), drug delivery techniques (controlled release) health care development and products, polymers, agriculture and chemicals. Pharmaceuticals include antibiotics, cardiovascular drugs, antidiabetics, treatment for hemophilia, cholesterol lowering drug, over-the-counters including aspirin, urine diagnostics.</td>
<td>FUISZ TECHNOLOGIES LTD</td>
<td>manufacture &amp; cro</td>
<td>drug delivery techniques (controlled release), yes generic pharmaceuticals (analgesics, angina, anti-inflams, hypertension, antibiotics).</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>98</td>
<td>Bayer AG</td>
<td>Germany</td>
<td>integrated (chemicals)</td>
<td></td>
<td>CHIRON CORP</td>
<td>biotech</td>
<td>IN VITRO diagnostics business. World leader in the diagnostics techniques in the fields of blood gas analysis, automated immunodiagnostics and NAD (used to identify the presence of serious infectious diseases).</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>96</td>
<td>Biomerieux SA</td>
<td>France</td>
<td>integrated</td>
<td>in vitro diagnostics, gene therapy</td>
<td>AQUILA BIOPHARM INC</td>
<td>biotech</td>
<td>retroviral diagnostics business.</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>98</td>
<td>Elan Corp. PLC</td>
<td>UK</td>
<td>integrated</td>
<td>drug delivery technologies, hypertension, pain-relief (angina) and anti-inflams, congestive heart failure.</td>
<td>NEUREX CORP</td>
<td>biotech</td>
<td>hypertension drug, treatment of severe pain in no terminal patients with AIDS and cancer, treatment of brain damage following closed head trauma and stroke. Research: programmed cell death (apoptosis) and its link to neurodegenerative diseases; the role of potassium channels in MS.</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>98</td>
<td>Elan Corp. PLC</td>
<td>UK</td>
<td>integrated</td>
<td>drug delivery technologies, hypertension, pain-relief (angina) and anti-inflams, congestive heart failure.</td>
<td>SANO CORP</td>
<td>manufacture</td>
<td>drug delivery techniques (controlled release), yes generic off-patent pharmaceuticals (analgesics, angina, anti-inflams, hypertension, anxiety/depression).</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>94</td>
<td>Fresenius AG</td>
<td>Germany</td>
<td>integrated</td>
<td>renal management (dialysis), i.v. s. transfusion techy, anti-rejection drugs.</td>
<td>GULL LABORATORIES INC</td>
<td>integrated</td>
<td>diagnostics for microbial agents and autoimmune disorders.</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>95</td>
<td>Hoechst AG</td>
<td>Germany</td>
<td>integrated (chemicals)</td>
<td></td>
<td>MARION MERRELL integrated DOW INC</td>
<td>biotech</td>
<td></td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>93</td>
<td>Novo Nordisk A/S</td>
<td>Denmark</td>
<td>integrated</td>
<td>diabetes, women's health (menopause), anticoagulants, human growth hormone.</td>
<td>BRISTOL Myers SQUIBB ORAVAX INC</td>
<td>manufacture</td>
<td>penicillin plant.</td>
<td>no</td>
<td>no</td>
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<tr>
<td>99</td>
<td>PEPTIDE THERAPEUTICS GROUP PLC</td>
<td>UK</td>
<td>integrated</td>
<td>travel, therapeutic and preventative vaccines.</td>
<td></td>
<td>biotech</td>
<td>vaccines for human infectious diseases.</td>
<td>yes</td>
<td>yes</td>
</tr>
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<table>
<thead>
<tr>
<th>ID</th>
<th>Company Name</th>
<th>Country</th>
<th>Type of Service</th>
<th>Industry</th>
<th>Parent Company</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
<td>PHOENIX INTERNATIONAL LIFE SCIENCES</td>
<td>Canada</td>
<td>cro</td>
<td>cro services</td>
<td>CHRYSLIS INTL CORP</td>
<td>acetaminophen (paracetamol) business.</td>
</tr>
<tr>
<td>97</td>
<td>Rhone-Poulenc SA</td>
<td>France</td>
<td>integrated (chemicals)</td>
<td>chemicals, plant/animal health, life sciences and pharmaceuticals (antibiotics, plasma proteins, oncology, respiratory, vaccine, CNS but no analgesics)</td>
<td>CHIREX INC</td>
<td>manufacture &amp; cro recombinant tissue plasminogen activator (for no blood clots); recombinant growth hormone; human growth hormone; cystic fibrosis; and recombinant interferon gamma (for a rare genetic immunity disease but looking into use for kidney cancer).</td>
</tr>
<tr>
<td>94</td>
<td>Roche Holding AG</td>
<td>Switzerland</td>
<td>integrated</td>
<td>diagnostic systems, pharmaceuticals (antibiotics, acne medication, anesthesia, anticonvulsant, cancer drugs, autoimmun suppressant for organ rejection, retinitis, aids drugs).</td>
<td>GENENTECH INC</td>
<td>integrated medical diagnostics systems, pharmaceuticals (analgesics, diseases of the peripheral nervous system, anti-inflams, and bone disorders).</td>
</tr>
<tr>
<td>94</td>
<td>Roche Holding AG</td>
<td>Switzerland</td>
<td>integrated</td>
<td>diagnostic systems, pharmaceuticals (antibiotics, acne medication, anesthesia, anticonvulsant, cancer drugs, autoimmun suppressant for organ rejection, retinitis, aids drugs).</td>
<td>SYNTAX CORP</td>
<td>integrated Cardiovascular, Gynecology/Endocrinology, Urology, Oncology, Hematology and Gastroenterology sustained-release injectable therapeutic products. broad-based generic pharmaceuticals (penicillins, antibiotics, analgesics, anti-infectives, anti-depressants, bronchial dilator, gastrointestinal, anti-spasmodic).</td>
</tr>
<tr>
<td>99</td>
<td>SHIRE PHARMACETCLSGRP -ADR</td>
<td>UK</td>
<td>integrated</td>
<td>central nervous system disorders.</td>
<td>ROBERTS PHARMACEUTICAL CORP</td>
<td>integrated target biotech.</td>
</tr>
<tr>
<td>96</td>
<td>Teva Pharmaceutical Industries Ltd.</td>
<td>Israel</td>
<td>integrated</td>
<td>no information.</td>
<td>BIOCRAT LABORATORIES INC</td>
<td>manufacture &amp; cro sustained-release injectable therapeutic products. broad-based generic pharmaceuticals (penicillins, antibiotics, analgesics, anti-infectives, anti-depressants, bronchial dilator, gastrointestinal, anti-spasmodic).</td>
</tr>
<tr>
<td>99</td>
<td>Teva Pharmaceutical Industries Ltd.</td>
<td>Israel</td>
<td>integrated</td>
<td>no information.</td>
<td>COLEY PHARMACEUTICAL INC</td>
<td>integrated target biotech.</td>
</tr>
<tr>
<td>94</td>
<td>Trinity Biotech PLC</td>
<td>UK</td>
<td>integrated</td>
<td>diagnostics for HIV and other infectious diseases. specialty chemicals used for pharmaceutical production, food additives, cosmetics, paints, dyes, and plastics.</td>
<td>DISEASE DETECTION INTL</td>
<td>yes yes blood and saliva-based diagnostic tests. Proliigo subsidiary: a manufacturer of oligonucleotides and other specialty chemicals for the pharmaceuticals industry.</td>
</tr>
<tr>
<td>98</td>
<td>VIAG AG</td>
<td>Germany</td>
<td>integrated (technology &amp; chemicals)</td>
<td>yes yes % with similar product lines: 44.44% % with parent integrated and target biotech: 35.00%</td>
<td>NEXSTAR PHARMACEUTICALS</td>
<td>yes yes blood and saliva-based diagnostic tests. Proliigo subsidiary: a manufacturer of oligonucleotides and other specialty chemicals for the pharmaceuticals industry.</td>
</tr>
<tr>
<td>Year of acquisition</td>
<td>Domestic Acquirer</td>
<td>Classification</td>
<td>Drug product and research lines (pre-acquisition)</td>
<td>Target</td>
<td>Classification</td>
<td>Drug product and research lines (pre-acquisition)</td>
</tr>
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<tr>
<td>98</td>
<td>ABBOTT LABORATORIES</td>
<td>integrated</td>
<td>in vitro diagnostic products (thyroid tests, therapeutic drug monitoring, cancer monitoring tests, hepatitis and AIDS antibodies)</td>
<td>INTL MUREX TECH manufacture CORP</td>
<td>medical diagnostic products and provides medical services for the screening, diagnosis and monitoring of infectious diseases (HIV, HTLV, hepatitis)</td>
<td>yes</td>
</tr>
<tr>
<td>97</td>
<td>AGOURON PHARMACEUTICA LS INC</td>
<td>integrated</td>
<td>marketed: drug for treatment of HIV infection. phase III trials: drug for treatment of lung and prostate cancer. phase II/III trials: an immune-based therapeutic agent for treatment of HIV infection</td>
<td>Alanex Corp.</td>
<td>biotech</td>
<td>core drug discovery technology: accelerates the steps necessary to discover small molecule drug candidates. Alanex has used this technology to identify one preclinical drug development candidate for the treatment of pain and a number of lead compounds in four other programs that address diseases or conditions for which existing therapies are inadequate or unavailable, including diabetes, obesity, depression and anxiety.</td>
</tr>
<tr>
<td>96</td>
<td>AKORN INC</td>
<td>manufacture &amp; cro</td>
<td>over-the-counter ophthalmic products, injectable pharmaceutical products, cro services.</td>
<td>JOHNSON &amp; JOHNSON</td>
<td>manufacture</td>
<td>pasadena research laboratories division: a developer and distributor of injectable products</td>
</tr>
<tr>
<td>98</td>
<td>AKORN INC</td>
<td>manufacture &amp; cro</td>
<td>over-the-counter ophthalmic products, injectable pharmaceutical products, cro services.</td>
<td>ALZA CORP</td>
<td>manufacture</td>
<td>drug delivery systems</td>
</tr>
<tr>
<td>99</td>
<td>ALZA CORP</td>
<td>manufacture</td>
<td>drug delivery systems</td>
<td>SEQUUS PHARMACEUTICA LS INC</td>
<td>manufacture</td>
<td>drug delivery systems</td>
</tr>
<tr>
<td>93</td>
<td>AMERICAN CYANAMID CO</td>
<td>integrated</td>
<td>merged into Lederle Oncology Corporation, a subsidiary of American Cyanamid.</td>
<td>IMMUNEX CORP</td>
<td>biotech</td>
<td>products for the treatment of cancer, infectious diseases and autoimmune disorders</td>
</tr>
<tr>
<td>94</td>
<td>AMERICAN HOME PRODUCTS CORP</td>
<td>integrated</td>
<td>pharmaceuticals: female health care products, infant nutritional, cardiovascular and metabolic disease therapies, mental health products, anti-inflammatory products, anti-infectives and vaccines. over-the-counter health care products: analgesics, cough/cold/allergy remedies, hemorrhoidal and asthma relief items, oral health care and in-hose diagnostic test products.</td>
<td>AMERICAN CYANAMID CORP</td>
<td>integrated</td>
<td>branded and generic pharmaceutical products (antibiotics, cardiovascular agents, nicotine patches, anti-cancer agents); over-the-counter products including multivitamins; vaccines; instruments for minimally invasive surgery; ophthalmic pharmaceuticals and intraocular lenses.</td>
</tr>
<tr>
<td>Company</td>
<td>Type</td>
<td>Description</td>
<td>Company</td>
<td>Type</td>
<td>Description</td>
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</tr>
<tr>
<td>American Home Products Corp</td>
<td>Integrated</td>
<td>female health care, infant nutritional, cardiovascular, mental health, anti-inflammatory, anti-infective, anti-cancer, analgesic and vaccine products, as well as generics. over-the-counter: analgesics, cough/cold/allergy remedies, hemorrhoidal and asthma relief items, vitamins and in-home diagnostic test products.</td>
<td>REPLiGen Corp</td>
<td>Biotech</td>
<td>treatments for cardiopulmonary bypass (coagulant), sarcoma, melanoma/renal cell carcinoma, Chronic lung inflammation, transplantation, autoimmune disease, gene therapy.</td>
<td></td>
</tr>
<tr>
<td>American Home Products Corp</td>
<td>Integrated</td>
<td>same as above</td>
<td>Genetics Institute Inc</td>
<td>Integrated</td>
<td>products: recombinant human antihemophilic factor (for hemophilia), erythropoietin (EPO) (for kidney dialysis patients), granulocyte-macrophage colony stimulating factor (to induce formation of new cartilage and bone) and tissue plasminogen activator. Research: an immune system modulator.</td>
<td></td>
</tr>
<tr>
<td>American Home Products Corp</td>
<td>Integrated</td>
<td>same as above, except included now are: gastroenterology products, biopharmaceuticals including recombinant Factor VIII.</td>
<td>Apollon Inc.</td>
<td>Integrated</td>
<td>DNA-based vaccine and gene therapy products aimed at the prevention and treatment of infectious and autoimmune diseases such as genital and oral/labial herpes, viral hepatitis, AIDS, genital warts and tuberculosis, as well as autoimmune diseases and cancer.</td>
<td></td>
</tr>
<tr>
<td>Amgen Inc</td>
<td>Integrated</td>
<td>2 products: one stimulates the production of a type of white blood cell for use in chemotherapy and the other stimulates the production of red blood cells: used for the treatment of anemia associated with chronic renal failure and HIV. Vaccines to prevent pneumonia, Lyme disease, malaria</td>
<td>Synergen Inc</td>
<td>Biotech</td>
<td>neurobiology and inflammation products.</td>
<td></td>
</tr>
<tr>
<td>Aquila Biopharm Inc</td>
<td>Integrated</td>
<td></td>
<td>Procept Inc</td>
<td>Biotech</td>
<td>a vaginal topical microbicide to prevent transmission of HIV-1 and other sexually transmitted disease (&quot;STD&quot;) pathogens, autoimmune disease/transplant rejection, intracellular infectious diseases.</td>
<td></td>
</tr>
<tr>
<td>Avant Immunotherapeutics Inc</td>
<td>Integrated</td>
<td>treatments for cardiovascular, pulmonary and immune disorders, research on a vaccine for atherosclerosis.</td>
<td>Virus Research Institute Inc</td>
<td>Integrated</td>
<td>vaccines and immunotherapeutics (treatment of disease by stimulating the body's own immune system. This is a type of therapy currently being researched as a treatment for cancer.).</td>
<td></td>
</tr>
<tr>
<td>Axys Pharmaceuticals Inc</td>
<td>Integrated</td>
<td>protease programs targeting the inhibition of enzymes implicated in asthma, inflammatory disease, blood clotting disorders, infectious diseases, osteoporosis, cancer and autoimmune disease.</td>
<td>Sequana Therapeutics Inc</td>
<td>Biotech</td>
<td>gene discovery technology.</td>
<td></td>
</tr>
</tbody>
</table>

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<p>| 95 | BRISTOL MYERS SQUIBB | integrated | cardiovascular (hypertension, nasal spray analgesic, anti-depressive), anti-infective, anti-cancer drugs, antiretroviral drugs, penicillins, anti-diabetes, oral contraceptive, dermatological treatments for psoriasis, and wound care products. | MERCK &amp; CO | integrated | Calgon Veatl Laboratories: a wound and skin care and infection control products business. |
| 95 | C.R. BARD INC | integrated | bladder and angioplasty catheters, implantable blood vessel replacements; fabrics and meshes for vessel and hernia repair; surgical suction and irrigation devices; wound and chest drainage systems. | MEDCHEM PRODUCTS INC | integrated | Hemostasis products, wound closure devices and catheters. |
| 97 | CAMBREX CORP | integrated (chemicals) | gastro-intestinal preparations, cardiovascular, respiratory products, central nervous system, anti-inflammatory, anti-infective, endocrine products, immunology, diuretics. | BIOWHITTAKER INC | manufacture | cell culture and endotoxin (toxins closely associated with the living cytoplasm or cell wall of certain microorganisms, which do not readily diffuse into the culture medium, but are released upon rupture of the cells) detection products, allergy and other clinical diagnostics. |
| 98 | CAMBREX CORP | integrated (chemicals) | gastro-intestinal preparations, cardiovascular, respiratory products, central nervous system, anti-inflammatory, anti-infective, endocrine products, immunology, diuretics. | CELGENE CORP | manufacture | chiral intermediates business (compounds that are critical to the production of pharmaceuticals). |
| 98 | CARDINAL HEALTH INC | manufacture &amp; service | some broad-based generic pharmaceuticals. | SCHÉRER (R)P|DE | integrated | drug delivery products |
| 97 | CELL GENESYS INC | biotech | AIDS gene therapy is in Phase II human clinical testing, cancer gene therapy is in preclinical testing for colon, ovarian and other specific types of cancer. research: antibody therapies for inflammation, autoimmune disorders, cancer and other serious diseases. | SOMATIX THERAPY CORP | biotech | gene transfer and human gene therapy applied to the development of novel treatments for cancer, neurological diseases and genetic diseases. |
| 94 | CHATTEM INC | manufacture | Branded over-the-counter pharmaceuticals, such as aspirin, and functional toiletries and cosmetics, menstrual and premenstrual internal analgesics. | PROCTER &amp; GAMBLE CO | manufacture | a topical oral analgesic (pain reliever). |
| 93 | CHIRON CORP | no information. | | CENTOCOR INC | no information. |</p>
<table>
<thead>
<tr>
<th>Company</th>
<th>Sector</th>
<th>Description</th>
<th>Key Products</th>
<th>Yes/No</th>
<th>Yes/No</th>
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</thead>
<tbody>
<tr>
<td>CHIRON CORP</td>
<td>integrated</td>
<td>5 areas: (i) diagnostics, including blood screening tests, automated immunodiagnostic systems; (ii) therapeutics, with an emphasis on oncology, serious infectious diseases and cardiovascular diseases, including products for multiple sclerosis and kidney cancer; (iii) vaccines for genital herpes, hepatitis, HIV, cytomegalovirus and (iv) ophthalmic surgical products. (v) Chiron Technologies manages a new generation of chemical therapeutics being developed through advanced techniques of drug design and discovery and a program in gene therapy.</td>
<td>gene therapy and gene transfer products, and drug activation technology for the prevention and treatment of a broad range of human diseases.</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>COLLAGEN AESTHETIC INC</td>
<td>integrated</td>
<td>Collagen is a family of naturally occurring proteins that serve as the basic structural building blocks of the tissues of the body. Collagen's core products are principally used in cosmetic and reconstructive applications, the treatment of stress urinary incontinence, and bone repair.</td>
<td>the Company's lead biosealant product candidate designed for sealing organs and other tissues resulting from surgical wounds and incisions. The Company also sells an implant orthopedic product, and has research and development programs in other orthopedic areas and in recombinant human collagen and thrombin (protease used in blood clotting).</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CORIXA CORP</td>
<td>biotech</td>
<td>vaccine and other antigen-based products, specifically: T cell vaccines, monoclonal antibody-based therapeutics, and diagnostics for herpes, cancer, lymphoma, TB, psoriasis.</td>
<td>autoimmune technologies used for rheumatoid arthritis and MS.</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>CORIXA CORP</td>
<td>biotech</td>
<td>vaccine and other antigen-based products, specifically: T cell vaccines, monoclonal antibody-based therapeutics, and diagnostics for herpes, cancer, lymphoma, TB, psoriasis.</td>
<td>adjuvants that enhance infectious disease/cancer/allergy vaccines, cancer therapies.</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>CYTOGEN CORP</td>
<td>biotech</td>
<td>diagnostic imaging agent for colorectal and ovarian cancer, a cancer therapy agent for the treatment of bone pain associated with bone metastases, a prostate cancer diagnostic imaging product.</td>
<td>cellular therapies with initial application in the treatment of renal cell carcinoma and potential application in the areas of infectious disease, such as chronic hepatitis B.</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>DYNAGEN INC</td>
<td>biotech</td>
<td>therapeutic products: anti-smoking product, biodegradable bone cement system for bone and joint repair. Diagnostic products: for TB, mycobacteria, nicotine consumption (?).</td>
<td>Able subsidiary: manufactures and/or markets approximately 173 generic products, primarily in liquid, cream, ointment and suppository dosage forms. Cough/cold remedies, antibiotic and anti-inflammatory ointments, pregnancy tests.</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>94</td>
<td>ELI LILLY &amp; CO</td>
<td>integrated</td>
<td>antibiotics, Central-nervous-system agents, including the antidepressant agent Prozac, Diabetic care products including human insulin produced through recombinant DNA technology; treatment of acute leukemias and, in combination with other oncolytic agents, for treatment of several different types of advanced cancers: antiscur agent; human growth hormone produced by recombinant DNA technology.</td>
<td>SPHINX PHARMACEUTICA LS CORP</td>
<td>biotech</td>
</tr>
<tr>
<td>95</td>
<td>GENETICS INSTITUTE INC</td>
<td>integrated</td>
<td>products: recombinant human antihemophilic factor (for hemophilia), erythropoietin (EPO)(for kidney dialysis patients), granulocyte-macrophage colony stimulating factor (to induce formation of new cartilage and bone) and tissue plasminogen activator. Research: an immune system modulator.</td>
<td>SCIGENICS INC</td>
<td>biotech</td>
</tr>
<tr>
<td>96</td>
<td>GENZYME CORP-CONSOLIDATED</td>
<td>integrated</td>
<td>products for the treatment of Gaucher disease, hormone for use in the diagnosis and treatment of thyroid cancer, a line of products for use to limit the formation of postoperative adhesions and products for the treatment of cystic fibrosis, diagnostic reagents and kits.</td>
<td>NEOZYME II CORP</td>
<td>biotech</td>
</tr>
<tr>
<td>99</td>
<td>GILEAD SCIENCES INC</td>
<td>biotech</td>
<td>therapeutics for viral diseases such as a sight-threatening viral infection in patients with AIDS, HIV, hepatitis B, influenza.</td>
<td>NEXSTAR PHARMACEUTICA LS</td>
<td>biotech</td>
</tr>
<tr>
<td>96</td>
<td>HEMAGEN DIAGNOSTICS INC</td>
<td>integrated</td>
<td>2 diagnostic technologies: hemagglutination (&quot;clumping&quot; of red blood cells, test determines whether antigens present which are markers of certain autoimmune diseases) and enzyme-linked immunosorbence (determines whether a patient has antibodies for a certain disease).</td>
<td>CELLULAR PRODUCTS</td>
<td>integrated</td>
</tr>
<tr>
<td>93</td>
<td>IGI INC</td>
<td>no information.</td>
<td></td>
<td>UNIVAX BIOLOGICS INC</td>
<td>no information.</td>
</tr>
<tr>
<td>Company</td>
<td>Sector</td>
<td>Description</td>
<td>Companies</td>
<td>Sector</td>
<td>Description</td>
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<tr>
<td>INCARA PHARMACEUTICA LS CORP</td>
<td>biotech</td>
<td>congestive heart failure, catalytic antioxidant small molecules as therapeutics for a variety of conditions (including neonatal respiratory distress syndrome and resulting broncho-pulmonary dysplasia, cardiomyopathy and stroke), and research for treatment of liver disease.</td>
<td>INTERNEURON PHARMACEUTICA LS</td>
<td>biotech</td>
<td>four therapeutics: treatment for stroke, panic and anxiety, migraine headache and congestive heart failure.</td>
</tr>
<tr>
<td>INTEGRA LIFESCIENCES HLDGS</td>
<td>no info.</td>
<td>no information.</td>
<td>TELIOS PHARMACEUTICA LS INC</td>
<td>no info.</td>
<td>no information.</td>
</tr>
<tr>
<td>IVAX CORP</td>
<td>no info.</td>
<td>no information.</td>
<td>ZENITH LABORATORIES CENTOCOR INC</td>
<td>integrated</td>
<td>product for angioplasty and angina, crohn's disease, treatment of acute myocardial infarction, treatment of post-operative colorectal cancer.</td>
</tr>
<tr>
<td>JOHNSON &amp; JOHNSON</td>
<td>integrated</td>
<td>pharmaceuticals: allergy, anti-infective, anti-fungal, anti-anemia, central nervous system (CNS), contraceptive, dermatology, gastrointestinal, pain management fields (a transdermal patch for chronic pain); a biotech derived version of the human hormone erythropoietin (EPO) that stimulates red blood cell production, a colon cancer drug; hairy cell leukemia; reversing the rejection of kidney, heart and liver transplants; an antipsychotic drug.</td>
<td>WARNER-LAMBERT CO</td>
<td>manufacture</td>
<td>4 product lines: influenza virus vaccine, hemorrhoidal, treatment for arrhythmia, labor induction.</td>
</tr>
<tr>
<td>KING PHARMACEUTICA LS INC</td>
<td>manufacture</td>
<td>60% of sales in antibiotic and anti-inflammatory ophthalmic, otic and topical formulations indicated for eye, ear and skin infections, hypertension-diuretic, treatment of ocular herpes simplex virus, treatment of asthma, chronic bronchitis and emphysema.</td>
<td>GLYCOMED INC</td>
<td>no info.</td>
<td>no information.</td>
</tr>
<tr>
<td>LIGAND PHARMACEUTICA L-CB</td>
<td>no info.</td>
<td>no information.</td>
<td>ALLERGAN LIGAND RETND THERAP</td>
<td>biotech</td>
<td>retinoids (derivative of vitamin A and used for treatment of osteoporosis, psoriasis, cancers, sarcoma).</td>
</tr>
<tr>
<td>LIGAND PHARMACEUTICA L-CB</td>
<td>biotech</td>
<td>regulation of gene activity using (i) hormone-activated Intracellular Receptors (for cancers, disorders of women's health, cardiovascular diseases, metabolic diseases, inflammatory disorders and skin diseases) and (ii) cytokine-activated Signal Transducer (cytokines are similar to hormones, basically just signalling molecules that affect cells, especially those involved in immunity).</td>
<td>SERAGEN INC</td>
<td>biotech</td>
<td>treatment of psoriasis, tumors (cancer) and restenosis following angioplasty.</td>
</tr>
<tr>
<td>LIGAND PHARMACEUTICA L-CB</td>
<td>biotech</td>
<td>same as above.</td>
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<tr>
<td>No.</td>
<td>Company Name</td>
<td>Industry</td>
<td>Description</td>
<td>Parent Company</td>
<td>Products</td>
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<tr>
<td>97</td>
<td>MEDAREX INC</td>
<td>biotech</td>
<td>treatment of breast cancer, prostate cancer, head and neck cancer and a variety of other solid tumor cancers, leukemia, AIDS and certain autoimmune conditions.</td>
<td>HOUSTON BIOTECHNOLOGY INC</td>
<td>no</td>
</tr>
<tr>
<td>99</td>
<td>MEDIMMUNE INC</td>
<td>biotech</td>
<td>treatment of infectious diseases, transplantation medicine, autoimmune diseases and cancer.</td>
<td>U S BIOSCIENCE INC</td>
<td>yes</td>
</tr>
<tr>
<td>99</td>
<td>MERCK &amp; CO</td>
<td>integrated</td>
<td>pharmaceuticals for (anti-hypertension, anti-inflammation, analgesics, anti-cholesterol, anti-ulcers, vaccines, osoporosis, antibiotics, HIV, ophthamologicals), some development of treatments for depression and other neuropsychiatric disorders.</td>
<td>SIBIA NEUROSCIENCES INC</td>
<td>yes</td>
</tr>
<tr>
<td>98</td>
<td>MERIDIAN DIAGNOSTICS INC</td>
<td>integrated</td>
<td>diagnostic test products used for infectious diseases such as gastrointestinal, urinary tract and respiratory infections.</td>
<td>GULL LABORATORIES INC</td>
<td>yes</td>
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<tr>
<td>99</td>
<td>MILLENNIUM PHARMACUTLCS INC</td>
<td>biotech</td>
<td>antibiotics, atherosclerosis and congestive heart failure treatment, using human genetics to identify the genes responsible for CNS disorders and schizophrenia, fungal infections, inflammatory respiratory diseases, obesity, conducting gene identification.</td>
<td>LEUKOSITE INC</td>
<td>yes</td>
</tr>
<tr>
<td>95</td>
<td>MONSANTO CO</td>
<td>integrated</td>
<td>agriculture, chemicals, consumer products, pharmaceuticals: anti-infectives, anti-inflammatory, fertility control, gastrointestinals, cardiovasculars.</td>
<td>MERCK &amp; CO</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>MYLAN LABORATORIES NABI INC</td>
<td>integrated</td>
<td>no information.</td>
<td>PENEDERM INC</td>
<td>yes</td>
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<tr>
<td>95</td>
<td>NEXELL THERAPEUTICS INC</td>
<td>biotech</td>
<td>treatment of viral and retroviral diseases using synthetic hypercin.</td>
<td>INNOVIR LABORATORIES INC</td>
<td>no</td>
</tr>
<tr>
<td>96</td>
<td>NORTH AMERICAN VACCINE INC</td>
<td>no information.</td>
<td>no information.</td>
<td>CEPHALON INC</td>
<td>no</td>
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<td>Company Name</td>
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<td>Parent Company Name</td>
<td>Parent Industry</td>
<td>Parent Company Description</td>
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<tr>
<td>OMNICARE INC</td>
<td>manufacture</td>
<td>purchases, repackages and dispenses pharmaceuticals, both prescription and non-prescription, and provides computerized medical recordkeeping and third-party billing for residents in such facilities.</td>
<td>IBAH INC</td>
<td>biotech</td>
<td>drug identification technologies.</td>
</tr>
<tr>
<td>PERSEPTIVE BIOSYSTEMS INC</td>
<td>integrated</td>
<td>patented core technologies in the fields of chromatography, immunoassay, biological mass spectrometry, solid-phase synthesis and microfluidic assay devices.</td>
<td>ChemGenics Pharmaceuticals Inc.</td>
<td>biotech</td>
<td>cancer and diabetes and dermatologic, ophthalmic, neurologic and immune disorders. 1 product is designed to inhibit the growth and spread of cancer by preventing the formation of new blood vessels (angiogenesis) required to nourish the tumor. SUGEN is also applying its drug discovery and development platform to areas outside oncology, including ophthalmology, rheumatoid arthritis, cardiovascular disease, diabetes, and immunology.</td>
</tr>
<tr>
<td>PHARMACIA &amp; UPJOHN INC</td>
<td>integrated</td>
<td>pharmaceuticals: treatment for overactivity in the bladder, human growth hormone, solution for open-angle glaucoma and ocular hypertension, drugs for anxiety and depression, sleeping pill. The company is one of the world's leading producers of anticancer drugs, angina and hemodialysis, antibiotics, corticosteroids, erectile disfunction products, Parkinson's disease and HIV products. also involved in rheumatoid arthritis research.</td>
<td>SUGEN INC</td>
<td>biotech</td>
<td>bone and joint diseases</td>
</tr>
<tr>
<td>QUIDEL CORP</td>
<td>integrated</td>
<td>reproductive and women's health, infectious diseases, gastrointestinal and autoimmune disorders.</td>
<td>METRA BIOSYSTEMS INC</td>
<td>biotech</td>
<td>sterile penicillins and oral and sterile cephalosporins (broad-based antibiotics).</td>
</tr>
<tr>
<td>ROBERTS PHARMACEUTICAL CORP</td>
<td></td>
<td>no information.</td>
<td>BRISTOL MYERS SQUIBB</td>
<td>no information.</td>
<td></td>
</tr>
<tr>
<td>SCHEIN PHARMACEUTICAL CORP</td>
<td>integrated</td>
<td>generic products (such as: muscle relaxants, attention deficit disorder drug, sterile anti-infectives, penicillins and cephalosporins), an anesthetic product and the Company's primary branded product is the leading injectable product for the nephrology, oncology and hematology markets.</td>
<td>MARSAM PHARMACEUTICA LS INC</td>
<td>integrated</td>
<td></td>
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<tr>
<td>SELF CARE INC</td>
<td>integrated</td>
<td>pregnancy self tests and infectious disease diagnostic test kits for the professional market.</td>
<td>AMERICAN HOME PRODUCTS CORP</td>
<td>manufacture</td>
<td>supplements: Stress Tabs(R), Ferro-Sequals(R), Posture(R), Protega(TM), AllBec(R), and Z-Bec(R).</td>
</tr>
<tr>
<td>SUPERGEN INC</td>
<td>biotech</td>
<td>treatment for hairy cell leukemia and possibly lymphoma, treatment for solid tumors, such as pancreatic, breast, lung, colorectal, ovarian and prostate cancers, and hematological disorders. And proprietary drug delivery technology.</td>
<td>SPARTA PHARMACEUTICA LS INC</td>
<td>biotech</td>
<td>drug delivery technology, anticancer compounds, protease inhibitors (usually used for treatment of HIV).</td>
</tr>
<tr>
<td>Company</td>
<td>Sector</td>
<td>Description</td>
<td>Biotech Product Focus</td>
<td>Result</td>
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<tr>
<td>TECHNE CORP</td>
<td>integrated</td>
<td>Its two major product lines are hematology controls, which are used in hospital and clinical laboratories to check the accuracy of blood analysis instruments, and biotechnology products including purified proteins called cytokines.</td>
<td>cytokines (similar to hormones, basically just signalling molecules that affect cells, especially those involved in immunity).</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>TITAN PHARMACEUTICA LS INC</td>
<td>biotech</td>
<td>Ansam (the subsidiary where discovery was merged into) was pursuing a development program for an injectable formulation of a treatment for acute pancreatitis and a program for a topical formulation for chemotherapy-induced alopecia, or hair loss, in patients with cancer.</td>
<td>drugs for the lungs, post-menopausal women, pancreatitis, and hair loss in chemo patients.</td>
<td>no</td>
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<tr>
<td>VALENTIS INC</td>
<td>biotech</td>
<td>Inhalation, intravenous, muscular injection of gene therapy drugs for all sorts of diseases.</td>
<td>development of gene medicines for treating cancers, neuromuscular disorders, cardiovascular disease, and pulmonary diseases, as well as in the development of nucleic acid vaccines for therapeutic and prophylactic treatment of viral and bacterial infection.</td>
<td>no</td>
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</tr>
<tr>
<td>VAXCEL INC</td>
<td>biotech</td>
<td>Injectable, oral drug delivery systems (especially for vaccines) (Optivax is the tradename for a family of proprietary nonionic block copolymers which augment or modify the immune response to vaccines when administered primarily by injection.)</td>
<td>vaccine delivery technologies, selected drug and vaccine delivery opportunities.</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>WATSON PHARMACEUTICA LS INC</td>
<td>integrated</td>
<td>Anti-depressants, anti-hypertensions, oral contraceptives, anti-cholesterol, analgesic, anti-inflammatory, anti-diabetics.</td>
<td>gum-delivery technology, anti-diabetics, anti-hypertension.</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>WATSON PHARMACEUTICA LS INC</td>
<td>integrated</td>
<td>Anti-depressants, anti-hypertensions, oral contraceptives, anti-cholesterol, analgesic, anti-inflammatory, anti-diabetics.</td>
<td>manufacture analgesics, anti-hypertensions, anti-inflammation, anti-tranquilizers.</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>WATSON PHARMACEUTICA LS INC</td>
<td>integrated</td>
<td>Anti-depressants, anti-hypertensions, oral contraceptives, anti-cholesterol, analgesic, anti-inflammatory, anti-diabetics.</td>
<td>anti-hypertensions, anti-epilepsy, anti-migraine, anti-insomnia.</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>

% with similar product lines: 74.14%
% with parent integrated and target biotech: 33.33%
Bibliography


