Portfolio Choice, Background Risk, and University Endowment Funds

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Abstract

Using a unique dataset of university endowment fund holdings I test the implications of theories of portfolio choice in incomplete markets. I find that the standard deviation of the growth rate of non-endowment income affects risk taking by endowments. Universities with riskier non-financial income invest significantly more in fixed income and less in alternative assets such as hedge funds. There is also evidence that revenue flexibility, fixed costs, liquidity, cost structure flexibility, and credit constraints have a significant effect on asset allocation. I find no evidence that the correlation of non-endowment income with asset returns affects portfolio allocations to asset classes or to equity styles.

JEL Classifications: G11, D52, I22

Keywords: Portfolio Choice, Background Risk, Incomplete Markets, Endowment Funds

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In a world with perfect markets portfolio choice is simple. Investors determine their level of risk aversion and then choose the appropriate combination of the risk free asset and the market portfolio. However, this simple argument collapses if there are market imperfections. If investors are endowed with non-tradable risks, or background risks, then all investor should optimally choose unique portfolios which best hedge their personal risks.

There is a large and growing body of theory which shows that market imperfections should have a large impact on portfolio choice, and that there are significant welfare costs for investors who ignore this. The most ubiquitous finding is that investors with a high standard deviation of non-financial income should hold safer portfolios[1]. Similarly, a high correlation between risky assets and labor income reduces the optimal allocation to risky assets. Other factors which may affect portfolio choice include credit constrains[2], labor supply flexibility[3], liquidity[4], and habits[5].

A number of studies have tested background risk theory using household portfolio data. Guiso, Jappelli and Terlizesse (1996), Massa and Simonov (2006), and Vissing-Jorgensen (2002) show that a higher standard deviation of labor income leads to lower equity ownership. Massa and Simonov (2006) and Vissing-Jorgensen (2002) both find no evidence to suggest that households consider the correlation between security returns and their labor income when forming portfolios.

[1] For example Campbell and Viceira (2002), Cocco, Gomes and Maenhout (2005), Gollier (2001), Heaton and Lucas (2000), Kimball (1993) and Viceira (2000).
[2] Cocco, Gomes and Maenhout(2005) and Davis, Kubler and Willen (2005).
[3] Bodie, Merton and Samuelson (1992), Chan and Viceira (2000) and Jagannathan and Kocherlakota (1996)
[4] Faig and Shum (2002).
[5] Heaton and Lucas (1997).

While much of the theory tested in this paper is developed in the context of household portfolio choice it applies equally to endowment funds[6]. There are, however, advantages to testing these theories on endowment fund data. First, universities are infinitely lived and do not have a life cycle. This greatly simplifies matters, as the value of human capital diminishes with age implying that many effects should vary over the life cycle[7]. Second, endowments are professionally managed so there is less likely to be the ignorance and inertia exhibited by households. Third, endowments and universities are tax exempt which reduces the complexity of the portfolio problem. Fourth, endowment funds and universities produce audited financial statements ensuring data accuracy. Fifth, endowments invest in a much wider range of asset classes than households, including hedge funds and venture capital. Finally, most theories of household portfolio choice were specifically developed to explain the known empirical facts of household portfolios. As a result endowment fund data provides an opportunity to test these theories in a way which is independent of the data that inspired the theory.

Another key advantage to studying endowment funds is that they receive new money from external sources and are generally legally prohibited from spending more than the return on investment. This means that endowment fund size is exogenous, unlike the case of households, which simultaneously determine portfolio allocations and savings[8]. As wealth is empirically the most important determinant of household portfolio choice its endogeneity is a major problem in interpreting these studies.

[6] Campbell and Viceira (2002 pg. 162) note that some aspects of household portfolio choice theories in the presence of background risk apply equally to university endowment funds. Merton (1992) models optimal endowment fund investment in a world with background risk.
[7] See Cocco, Gomes and Maenhout (2005) for an excellent discussion of this point.
[8] See Gomes and Michaelides (2005).

The results show that the standard deviation of non-endowment income has a significant effect on the portfolio choices of endowment funds. Universities with greater income risk invest more in fixed income assets and avoid alternative assets such as venture capital. However, there is no evidence that universities take the correlation between their non-financial income and asset returns into account when investing.

There is strong evidence of fixed costs to investing in certain asset classes. Large funds invest significantly more in alternative assets such as hedge funds. However, there is no evidence that the size of the endowment fund relative to total revenues affects portfolio choice.

Endowment funds need to provide regular cash flows to their affiliated universities. As a result portfolio liquidity can be a concern. Universities with greater selectivity, a proxy for the elasticity of demand, hold significantly less liquid portfolios as they have a greater ability to raise cash through tuition changes. Universities with a high ratio of donations to endowment fund size also hold significantly less liquid portfolios.

As theory predicts credit constrained universities hold significantly safer portfolios. A high ratio of debt-to-assets results in a relatively large allocation to fixed income securities. Public universities also invest more in fixed income securities and generally invest more in transparent asset classes.

Research intensive universities hold significantly safer portfolios than liberal arts colleges. This suggests that there are costs associated with fluctuations in research funding and universities attempt to hedge these costs through their endowment funds.

The remainder of the paper is structured as follows. Section I reviews the existing literature and develops testable hypotheses. Section II describes the data. Section III

examines allocations to risky assets. Section IV examines asset allocation at the level of individual asset classes. Section V examines equity investment style. Section VI concludes.

I. Theory and Hypotheses

Each endowment portfolio manager faces a unique problem when selecting investments. While all endowments have the same investment opportunity set, each endowment fund is inextricably linked to a specific university. Each university has its own unique set of institutional features and financial risks. To form an optimal portfolio these factors must be considered as part of the investment allocation process. In this section I discuss the existing literature on portfolio choice and specific hypotheses for endowment funds.

A. Standard Deviation of Non-Endowment Income

A number of authors[9] have shown that if an economic agent is endowed with a non-tradable risk, or background risk, this should decrease their appetite for other risks even if all sources of risk are statistically independent. Cocco, Gomes and Maenhout (2005), Heaton and Lucas (2000), and Viceira (2001) show that risky labor income should lead to smaller portfolio allocations to equity. Empirically Guiso, Jappelli and Terlizzese (1996), and Vissing-Jorgensen (2002) have shown that a high standard deviation of labor income leads to lower equity investment.

[9] Eeckhoudt, Gollier and Schlesinger (1996), Gollier and Pratt (1996), Kimball (1993), and Pratt and Zeckhauser (1987) all discuss the problem of background risk. Gollier (2001) devotes several chapters to the issue of background risk and provides a good review of existing work.

For university endowment funds there is a clear testable empirical implication. Universities with a higher standard deviation of non-endowment income should hold safer portfolios.

B. Correlations Between Asset Classes and Non-Endowment Income

If an investor's background risk is positively correlated with the returns of an asset class, that asset class will be a particularly unattractive investment. Cocco, Gomes and Maenhout (2005), Heaton and Lucas (2000) and Viceira (2001) show that households with a high positive correlation between labor income and equity returns should allocate less of their wealth to equity. Empirically Massa and Simonov (2006) and Vissing-Jorgensen (2002) find that there is no significant relationship between the correlation of household income with equity returns and portfolio choice.

In the context of university endowment funds a high correlation between an asset class and non-endowment income should lead to lower portfolio allocations. Since total allocations must sum to 100% a high correlation between a given asset class and non-endowment income should also lead to higher investment in other asset classes.

C. *Fund Size*

In the context of household portfolio choice Halliassos and Bertaut (1995) and Vissing-Jorgensen (2002) argue that limited equity market participation can be partially explained by the presence of a fixed cost of entry. The endowment funds in this study are large enough to overcome the direct financial costs of entering equity or fixed income markets. However, the cost of selecting and monitoring alternative asset investments is

high. Larger funds have a greater ability to afford fund managers and consultants with expertise in hedge funds, private equity, and venture capital partnerships.

D. Relative Fund Size

Bodie, Merton and Samuelson (1992), Chan and Viceira (2000), and Jagannathan and Kocherlakota (1996), argue that the relative size of financial wealth versus human capital can explain a popular investment adage. Households are frequently advised that they should invest heavily in stocks when they are young, and decrease their allocation as they age. Younger households hold a higher proportion of their total wealth in the form of human capital. Since the return on human capital is relatively safe younger households effectively have a large position in a low risk asset. As a result young households can invest their financial wealth in riskier securities such as stocks. As households age the net present value of their human capital declines and they must invest more of their financial assets in bonds to maintain their portfolio's overall risk profile.

As universities have infinite lives they do not have a life cycle. However, universities vary considerably in the percentage of their total wealth which is held in their endowment. For some universities the majority of their income comes from endowment returns; for others the endowment is relatively unimportant. This leads to the hypothesis that universities with a large proportion of total revenues from their endowment should hold less risky portfolios.

E. Revenue Flexibility

Bodie, Merton and Samuelson (1992) and Chan and Viceira (2000) show that when a household has greater flexibility to vary their labor supply they should choose to take on greater financial risk. Since labor supply flexibility allows households to replace financial losses through increased labor earnings, investors with greater flexibility should be willing to assume greater financial risk.

While universities do not make a leisure-labor tradeoff they face an analogous situation. Universities control their tuition income and their portfolio of programs offered. Typically, universities do not maximize tuition revenue but instead balance the need for funds with their desire for quality students. Across universities, however, the ability to raise tuition and to introduce new, profitable programs, without negatively impacting university quality, varies with demand for entrance. This leads to a clear implication for portfolio choice. Universities which are more selective can take on greater portfolio risk as the excess demand for entrance allows these institutions to smooth portfolio fluctuations via their revenue flexibility.

F. Donations and Liquidity

Portfolio liquidity is a concern for endowment managers for two reasons. First, endowments must make transfers to university operating budgets. Second, portfolio liquidity affects the ability of endowment funds to periodically rebalance. As Lerner and Schoar (2004) document, alternative assets such as private equity funds are typically highly illiquid. Donations allow endowments to invest in illiquid assets as these donations provide a direct source of liquid cash. Faig and Shum (2002) demonstrate that

liquidity should directly affect risk taking. This leads to the hypothesis that universities with a high ratio of donations to endowment fund size will choose to invest a higher proportion of their portfolio in alternative assets.

G. Research and Teaching

Universities have two mandates, to teach and to conduct research, with different universities focusing on these activities in varying proportions. Differences in institutional focus may affect portfolio choice for a number of reasons. First, research and teaching activities drive costs. If some costs are less flexible than others this should affect optimal portfolio choice. Second, research insensitivity is directly related to reputational capital. A university with greater reputational capital will desire to preserve this capital and so will exhibit greater risk aversion. As a result the proportion of a universities budget spent on research may significantly affect risk taking by endowments.

H. Fund Governance

Lakonishok, Shleifer and Vishny (1992) argue that institutional governance affects portfolio decision making[10]. One measurable governance differences between universities is that some are public and others private. As more detailed information about fund governance is not available I use an indicator variable that equals one for public universities. Public universities answer to a wider constituency and there is likely

[10] University endowments typically have a governance committee responsible for the funds investments and one or more employees to implement their decisions. Unfortunately the NACUBO NES survey does not report fund governance information for individual universities. Summary statistics show that investment committees average 10 members (with a range of 3-50) and usually have one full time staff member whose primary responsibility is investment management. Slightly fewer than 75% of the funds employ an outside consultant. See Brown, Garlappi and Tiu (2006) for a detailed discussion of fund governance.

to be political oversight of the fund which could lead to less risk taking. Alternatively however, government ownership creates the moral hazard problem of free implicit insurance which could cause excess risk taking.

I. Credit Constraints

Universities can use credit to smooth their spending from year to year. Cocco, Gomes and Maenhout (2005) and Davis, Kubler and Willen (2005) argue that credit constraints should affect portfolio choice. Empirically, Guiso, Jappelli and Terlizzese (1996) show that credit constrained households hold safer portfolios. Similarly, credit constrained universities should hold relatively safer portfolios.

II. Data

A. Endowment Funds

Hansmann (1990) argues that endowments exist to: serve as a financial buffer, ensure the survival of the institutions reputational capital, and protect universities' intellectual freedom. To achieve these goals endowment funds[11] are held separate from other university funds and are managed to maintain their purchasing power while providing funds for current operations[12].

The main source of information about university endowment funds comes from the 2003 National Endowment Survey (NES). This survey is conducted and prepared by

[11] In legal jargon the term "endowment funds" refers only to funds which are donated with explicit legal restrictions preventing the university from spending any portion of the principal. Frequently university endowments include donations which were given without any such restrictions. These funds are legally termed quasi-endowments. Endowment and quasi-endowment funds are reported pooled together in the NACUBO data. Throughout this paper "endowment funds" refers to both true and quasi endowment s.

[12] The most common system is to spend 5% of a moving average of fund value (often the average value over the last 12 quarters).

TIAA-CREF under the direction of the National Association of College and University Business Officers (NACUBO).

Out of 880 institutions invited to participate, 723 responded to the 2003 wave of the survey for a response rate of 82%. The 2003 study was conducted in the fall of 2003 and gathered data about the 2002-2003 academic year. Survey information includes: portfolio holdings, returns, and endowment size. Returns and some other information are reported by a confidential numeric code while other information, such as portfolio holdings, is reported by university name. Confidentiality of return information is provided to encourage participation.

The 723 initial observations are reduced to 677 observations for a variety of reasons. Some institutions only partially respond to the survey and do not report their asset allocations. I drop Canadian universities as I do not have information about their incomes. Other institutions report their foundations separately from their university's endowment information. In these cases I aggregate the foundation and university information to form a single observation. Some universities in the same system report information at the campus level, but portfolio holdings are identical across campuses. In these cases I aggregate information to the university system level. In the statistical tests reported in subsequent sections some observations are lost due to missing explanatory variables.

Table I shows summary statistics about university endowment funds. The average endowment fund size[13] in this study is a little over a quarter of a billion dollars.

[13] Data is reported as of fiscal year end. 89.3% of the sample has a June 30 year end. 10.7% of the endowment funds in this sample report data have a different year end, usually May 31.

However, as the percentiles show, fund size is highly skewed. Average endowment size is similar between public and private universities.

B. Portfolio Allocation Data

The NES data contains rich and detailed information about portfolio holdings. In most cases I can see the exact funds held by each university. The style of each fund held is categorized by TIAA-CREF. For example, the single largest equity investment made by Michigan State University is managed by WP Stewart & Company, is classified as a US, large growth fund, and comprises 11.6% of the total value of the endowment fund.

Panel A of Table II shows ownership across broad asset classes. Virtually all endowment funds own both equity and fixed income. However, the allocations vary widely. For example, equity allocations across equity owning institutions vary from 1.6% to 100%, while bond ownership varies from 0.3% to 91.5%.

Panel B shows the equity allocations broken down into styles. Almost all funds own at least some large cap equity and this usually comprises a large proportion of the endowment fund. Value is slightly more popular than growth but core investments are larger than either.

Panel C shows that slightly over half of all endowment funds own at least some real estate although the amount is usually quite low. Universities typically own their campus, the buildings on it, and student housing. This represents a substantial investment in real estate, albeit one held outside of endowment funds, and may explain the low allocations to real estate.

Just over 70% of endowment funds own at least some alternative assets. As Panel D shows, almost half of endowment funds own hedge funds and the allocations are typically substantial. Private equity and venture capital are both popular but the allocations are quite modest. Oil and gas partnerships, commodities, and timber are held by a small minority of funds and allocations are small.

C. University Statistics

The main source of university financial data is the Department of Education's National Center for Education Statistics (NCES) [14]. The NCES gathers data on all U.S. based postsecondary education institutions through surveys. Participation in these surveys is mandatory for all institutions that participate in, apply for, or wish their students to be eligible for, any form of funding from the federal government. Universities which fail to complete all required surveys by the mandated deadline may be fined or barred from accessing federal funds. This ensures high participation and accurate reporting.

From the NCES data I find total 2002-2003 fiscal year non-endowment income[15], referred to as *Income* for the remainder of this paper (variable names and definitions used in this paper may be found in Table III). As Table IV shows average university revenues were a little over $300 million[16]. As with most financial variables in this study this is highly skewed with the mean larger than the 75th percentile.

[14] I am grateful to Cathy Statham of the NCES for assistance using IPEDS.
[15] NCES data is submitted separately for each campus while endowment data is sometimes reported at the university system level. In cases where the endowment data is reported at the university system level I aggregate campus level data prior to merging. Frequently the university system is composed of only one campus and this is not an issue.
[16] This variable is winsorized at the 99th%. Highly skewed variables are winsorized at the 99th% and, if unbounded at the lower end of the distribution, at the 1st% as well.

As Table IV shows university revenues come from a variety of sources. Tuition, *Rev_Tuition,* is the largest source of revenue at 41.1%. Government appropriations, *Rev_Gov,* are a large source of funds for public universities. As the majority of university in this sample are private (63.9%) this is not a large source of funds on average. Revenues from private gifts and grants, *Rev_Private,* includes donations made directly to current revenues (donations not designated for endowment purposes) as well as research funding from private foundations and companies. Revenue from government grants and contracts, *Rev_Grants,* comes from all levels of government but the majority comes from federal research funding. The final category, *Rev_Other*, is composed of: hospital revenues, sales of services and educational activities, and auxiliary enterprises (including student housing and food services).

The proportion of *Income* spent on research, *Prop_Research*, is based on self-reported information provided to the National Science Foundation and compiled by TheCenter at the University of Florida[17]. Their definition of research spending is very narrow and likely underreports true research spending but it is consistent across universities.

Data on donations comes from the NCES dataset. As annual donations are highly variable across years I use a 5-year average of donations taken over the period ending

[17] NCES data on research spending uses definitions of research that differ depending on if the university reports using GASB or FASB accounting standards. Despite the accounting differences NCES and TheCenter research spending figures have a correlation coefficient of 0.83 with a p-value of less than 0.0001.

June 2003[18]. Average annual donations are $23,576,020 and the average ratio of giving to total endowment fund assets, *Donate_Size*, is 16.6%[19].

A university's financial flexibility should affect their portfolio choice. I proxy for each university's credit constraints using their debt-to-assets ratio[20], *Debt_Assets*. A high debt load implies greater financial constraints. As can be seen in Table IV *Debt_Assets* is around 30% for an average university but this ranges from less than 1% to greater than 150%.

I use university selectivity as a measure of university quality. Selectivity is defined as the ratio of accepted applicants to total applicants[21], *Prop_Admit*. A typical university accepts 68% of applicants but this varies widely. Some universities have an open admissions policy while others accept fewer than 10% of applicants.

D. Background Risk

The primary source of background risk for a university endowment fund comes from the university's non-endowment income. Using revenue data from the NCES I construct the non-endowment income of each institution in this study from fiscal year 2002-2003 through the 1983-1984 fiscal year, the first fiscal year the NCES data is

[18] Donations for all years are inflation adjusted to June 2003 dollars using the all items CPI index for all urban consumers.
[19] This contains some both true and quasi-endowment giving as well as some gifts to current spending (i.e. donations used to construct new buildings). Data from the VSE dataset compiled by the Council for Aid to Education shows that the IPEDS measure of donations has a correlation of 0.897 with endowment donations. Unfortunately the VSE dataset covers only 70% of the firms in the NES dataset.
[20] 60.4% of universities in this sample have Moody's credit ratings. The correlation between debt to assets and ranks based on credit ratings is 0.21 and is highly significant (p-value of less than 0.0001). Because debt-to-assets is available for all universities, while credit ratings are not, I use debt-to-assets throughout the remainder of this paper.
[21] The correlation between the proportion of applicants admitted and the U.S. News academic rankings is 0.74 for national universities and 0.78 for liberal arts colleges. In both cases the correlation has a p-value less than 0.0001. Only 63% of the universities reporting endowment fund data are ranked by US News.

available. From this time-series of non-endowment income I calculate the annual percentage change in the growth rate of non-endowment income.

Table IV shows summary statistics of the standard deviation of the time-series of percentage changes in non-endowment income, *Stdev*. The average *Stdev* is 10.6% and there is considerable variation across universities. By comparison Carroll and Samwick (1997) report an average standard deviation of household income growth is 18.8%.

Table V shows the average value of different variables within four standard deviation sorted groups. In general large, research intensive, public universities have the lowest standard deviations. Private universities, particularly liberal arts schools, have the highest standard deviations.

Correlations between changes in non-endowment income and various asset return indexes are also shown in Table IV[22]. The average correlation with the CRSP value weighted market index, *Corr_CRSP*, is low and close to zero but there is wide variation across universities. The correlations with the Fama-French HML and SMB factors, *Corr_HML* and *Corr_SMB* respectively, indicate that on average university finances move with larger growth firms. However, the average correlations are not large and there is considerable variation across institutions. The final measure of background risk is the ratio of the endowment size to non-endowment income, *Size_Income*. The average endowment is about twice the size of annual non-endowment income.

[22] I assume that university budgets are set by the beginning of the fiscal year, and transfers from endowment funds are available at the start of the fiscal year. The change in non-endowment income between the prior fiscal year and the forthcoming fiscal year is lined up with the index return. For example, the index return from June 1999 to June 2000 would be lined up with the change in non-endowment income between the academic fiscal years July 1999 to June 2000 and July 2000 to June 2001.

III. Allocation to Risky Assets

Most theoretical models of portfolio choice with background risk assume a single risky asset and a risk free asset. In this section I divide assets into risky and safe categories and estimate a Tobit model where the dependent variable is the percentage of the portfolio allocated to risky assets. Because the line between safe and risky assets is not always as clear in practice as it is in the world of theory I use two definitions of risky assets. With either definition the results are similar. In the first two columns of Table VI risky assets are defined as the sum of alternative assets (commodities, hedge funds, private equity, and venture capital) and equity. The last two columns show results when risky assets are defined as the sum of: alternative assets, equity, high yield bonds, and real estate.

Stdev is significant in all cases. Consistent with the most basic prediction of background risk theory universities with greater income risk allocate less of their portfolios to risky assets. This provides evidence that non-financial risk affects the level of financial risk investors assume. I find no support for the second major prediction of background risk theory. The coefficient on *Corr_CRSP* is insignificant in all cases. While this contradicts the theoretical predictions it is consistent with empirical studies of household portfolios such as Massa and Simonov (2006) and Vissing-Jorgensen (2002).

The results show that large endowment funds allocate a greater proportion of their investment pool to risky assets. In the next section I will show that this is mainly driven by the fact that larger endowments allocate much more of their portfolios to alternative assets. Brown, Garlappi and Tiu (2006) show that large endowments have considerably

higher risk adjusted returns, consistent with the idea that there are sizable fixed costs to effective investment management.

The ratio of fund size to university income is not significant. This is a surprising result as it suggests that the financial importance of the endowment fund to the university does not affect investment policy. The proportion of applicants admitted, the ratio of five-year average donations to endowment fund size, and the indicator variable for public universities are all not significant. These results indicate that university selectivity, donation patterns, and governance do not directly affect risk choices in this sample.

The debt-to-assets ratio is significant as predicted by theory papers such as Cocco, Gomes and Maenhout (2005) and Davis, Kubler and Willen (2005). Universities with greater debt levels invest in safer portfolios. Greater amounts of debt lead to safer investments due to the financial risk the university faces and concerns about exhausting borrowing capacity.

The coefficient on the proportion of revenue spent on research is significantly negative in all specifications, suggesting that research intensive universities hold relatively safe portfolios. A successful research program involves a large number of implicit contracts about resource availability. Thus a research program creates a financial commitment to provide stable funding. While these implicit contracts are not legally enforceable, failure to meet these commitments could seriously damage a university's reputation.

Revenue sources also have a significant effect on portfolio choice. A higher proportion of revenues from tuition is associated with higher risk taking. This is likely because tuition is a very stable source of funds which is under the university's direct

control. Revenue from government appropriations is insignificant which is somewhat surprising, as this tends to be one of the safest and most stable forms of funding. Funding from private and public groups has a significant positive relationship with risky asset investment. This is also somewhat surprising as these tend to be the most volatile income sources.

The evidence shows that some theoretically important factors affect portfolio choice in this sample, but other hypothesized effects are not significant. However, in dividing assets into only two categories considerable information is lost. In the next section I look at allocations across a wider range of asset classes.

IV. Asset Class Allocations

A. Methodology

Estimating the effect of different factors on asset allocation is econometrically complicated because predicted portfolio shares must sum to 100% for each endowment fund. To examine portfolio choice across multiple asset classes I use the logically consistent sum constrained model developed by McGuire and Weiss (1976) and has been used to estimate portfolio allocations by Timmermann and Blake (2005).

$$y_{ij} = \alpha_j + \sum_{k=1}^{K} \beta_{jk} X_{ik} + \varepsilon_{ij} \quad \text{for j=1,…J} \qquad (1)$$

$$\text{s.t. } \sum_{j=1}^{J} \alpha_j = 100, \qquad \sum_{j=1}^{J} \beta_{jk} = 0 \text{ for k=1,…,K} \qquad (2)$$

Where y_{ij} is the percentage of endowment fund *i* allocated to asset class *j*. There are a total of J asset classes and K explanatory variables. The first constraint forces predicted values to equal 100% for each endowment fund. The second constraint reflects

the fact that if a given variable causes an X% increase in equity allocations it must cause exactly an X% decrease in the allocations to other asset classes[23].

B. Asset Allocation: All Funds

To examine asset allocation I place all assets into one of four categories: equities, fixed income and cash, alternative assets, and real estate. Table VII shows the sum-constrained model estimates of allocations to these asset classes. The final column contains the p-value from F-tests which show the overall significance of each variable within the overall system of equations.

Compared to the Tobit regressions in the previous section the R^2s are much higher. While the Tobit regressions' R^2s were all below 0.03, here they range from 0.04 to 0.32. The increase in predictive ability is most striking for alternative assets and fixed income.

Stdev is highly significant, primarily affecting allocations to fixed income and alternative assets. As predicted by background risk theory greater non-financial risk leads to safer portfolio choices. That higher background risk leads to higher investment in fixed income is unsurprising. However, it is surprising that background risk affects risk taking through alternative assets and not equity. Possibly this is due to the greater risk of venture capital, private equity, and some types of hedge funds. Alternatively, it may be that alternative assets are directly affected by background risk because alternative

[23] One drawback to this methodology is that it is possible for predicted values to be negative. However, as a practical matter this problem is limited. Predicted equity, fixed income, and real estate allocations are never negative. However, around 5% of the predicted values for alternative assets are negative. Typically the negative predicted values are close to zero but there are seven observations with predicted values less than -5% ranging to -9.6%.

asset's risks are more malleable than equity risk, and this allows endowments to better customize the correlation structure of their portfolio without sacrificing return.

While *Stdev* is statistically significant its economic effect is modest. An increase in the standard deviation from the 10th percentile to the 90th percentile decreases the allocations to equity and alternative assets by 1% and 2.5% respectively. The allocation to fixed income increases by 3.3%.

The correlation between non-endowment income and the CRSP value weighted market index does not have a statistically significant effect on allocations to any of the asset classes. This is disappointing as theory identifies this as an extremely important factor. However, correlation risk is subtler and more difficult for fund boards to grasp than standard deviation risk. Consequently it may not have the same affect on the decision making process.

Endowment fund size is statistically and economically the most important factor affecting asset allocation. Larger funds allocate a much higher proportion of their assets to alternative assets and real estate, supporting the notion that there are fixed costs of entering certain markets. Since alternative assets and private real estate (which comprises the majority of real estate investment in the sample) require greater expertise, smaller endowments are unable to participate in these asset classes. Moving from the 10th percentile of fund size to the 90th percentile results in an increase of 15.1% invested in alternative assets and a decrease of 15.9% in fixed income. There is also a 2.2% increase in the allocation to real estate.

The *Size_Income* ratio is not significant. Theoretically a university with a large proportion of total revenues derived from the endowment fund should hold a safer

portfolio than a university where the endowment is relatively unimportant. Empirically this does not appear to be the case[24].

The proportion of applicants admitted is highly statistically significant. Selective universities allocate a greater proportion of their portfolio to alternative assets instead of equities. The hypothesis is that more selective universities should take on greater risk as they have greater flexibility to replace financial losses through revenue flexibility. Since the effect is concentrated in allocations to equity and alternative assets rather than fixed income this significance does not appear to be directly related to portfolio risk. There are two potential explanations. First it is possible that more selective universities are willing to hold less liquid investments because they can readily generate liquid cash through revenue flexibility. Second, since endowment fund boards are primarily composed of alumni it is possible that selective universities have higher quality board members with greater financial sophistication. In either case, moving from the 10^{th} percentile of selectivity to the 90^{th} percentile increases the allocation to alternative assets by 6.2% and decreases allocations to equity by 7.8%.

The ratio of average donations to fund size, *Donate_Size*, is significant at the 10% level in the manner predicted. Universities with a higher donation levels invest allocate more to less liquid asset classes, such as private equity funds which typically have stringent lock-up provisions. Since donations provide cash directly portfolio investments can be less liquid while still maintaining the ability to make regular cash transfers to the university operating budget and periodically rebalance.

[24] In work not reported here I find that an interaction term between this variable and the standard deviation of non-endowment income is significant, but this result is sensitive to the inclusion of the most extreme observations.

The proportion of the budget spent on research is significant at the 10% level[25]. Research intensive universities hold less equity and more fixed income products. This suggests that there are important costs to fluctuations in research funding and universities invest in a manner that reduces the impact of these costs. This variable is far more significant when the percentage of revenue from different sources is included as seen in Table VIII. This is because, while there appear to be substantial costs associated with fluctuating research funding, research funding itself is typically quite volatile. Research grants from both public and private sources are far more variable than revenues from tuition and government appropriations. A university on the 10^{th} percentile of research funding holds 3.5% less fixed income than a university on the 90^{th} percentile, with a correspondingly higher allocation to equity.

An indicator variable which equals one for public universities is highly significant. Public universities hold less alternative assets and real estate, and more equity and fixed income. Since public universities hold more of both equity and fixed income this does not appear to be a risk effect. It appears to be a governance effect where public universities prefer to hold more liquid, transparent investments[26]. However, as Table VIII shows, the indicator variable for *Public* is not significant when the proportion of revenue from government appropriations is included.

The debt-to-assets ratio is significant at the 10% level and shows that, consistent with theory, universities with a greater debt load tend to invest more in fixed income and

[25] In work not reported here I include indicator variables for Carnegie Classifications of Institutes of Higher Education. Including the proportion of the budget spent on research eliminates the significance of these indicator variables. It appears that the effect of research spending on portfolio choice operates mainly through doctoral universities holding relatively safe portfolios.

[26] Among real estate investments there is a sharp difference between public and private universities' investments. Public universities primarily invest in REITs while private universities invest mainly in private real estate.

cash. This result is consistent with the idea that credit constraints result in a safer investment policy[27]. An increase in *Debt_Assets* from the 10th percentile to the 90th percentile results in a 3.0% increase in allocations to fixed income and a 1.3% decrease in allocations to alternative assets.

Table VIII is similar to Table VII but also includes the percentage of total revenue derived from various sources. Controlling for revenue source is an important robustness test because revenue sources differ not only in their risk, but also in their spending flexibility which is potentially important. The results for the other variables are generally similar except for the percentage of the budget spent on research, and the indicator variable for public universities. The significance of the coefficient on the standard deviation of non-endowment income is reduced, because a large proportion of *Stdev* is explained by revenue source mix.

C. Asset Allocation: Large and Small Funds

This section discusses results for sum-constrained regressions where the sample is divided based on fund size. Funds with at least $100 million in assets are considered "large" while the remaining funds are considered "small". Results for these funds are reported in Tables IX and X respectively. There are major differences in the R^2s across these two tables; the R^2s for the large funds are several times the size of the smaller fund's R^2s, and in general results are much clearer for large funds. There are two reasons to expect large and small funds to invest differently. First, minimum investment sizes

[27] If a credit constrained university invests a portion of their endowment in fixed income, and simultaneously borrows money at the same terms, they have effectively spent endowment principal without breaching any legal constraints. It is possible that this strategy is reflected in the positive coefficient on fixed income.

and other frictions may constrain the portfolio choices of smaller funds. Second, there are important governance differences between large and small funds.

The 2003 NACUBO NES report shows[28] that all funds with $100 million or more in assets have at least one full time employee working on investment management. Funds with less than $100 million usually have zero full time employees working on investment management. As a result it seems reasonable to expect larger funds to invest in a more sophisticated and professional manner.

The coefficient on the *Stdev* is highly significant for large funds but completely insignificant for small funds[29]. For large funds an increase from the 10th percentile to the 90th percentile of *Stdev* results in an increase allocation to fixed income of 5.0% and a decrease in equity and alternative asset investment of 3.3% and 1.9% respectively. Since background risk is a subtle concept it may be that smaller funds lack the sophistication to understand and properly implement investment strategies to minimize total university risk.

Fund size remains significant for both large and small funds. In both cases larger funds allocate a greater proportion of their endowments to alternative assets and less to fixed income. This suggests that the selection and monitoring costs of investing in alternative assets are very large as economies of scale still exist for funds larger than $100 million.

The ratio of fund size to university income, *Size_Income*, is significant at the 10% level for large funds but insignificant for small funds. The hypothesis is that universities with a large proportion of income derived from the endowment fund will hold safer

[28] See Table 13, Part Two, of the 2003 report. Results in this section are reported in aggregate, and aggregated within size categories, but not at the individual fund level.
[29] The average *Stdev* for large funds is 10.1% and 10.9% for small funds.

portfolios. Empirically, a high ratio of fund size to income results in higher equity holdings and lower alternative asset holdings. This is more consistent with a preference for liquidity by those funds with the greatest dependence on their endowments for a steady cash flow, than it is with a risk based effect.

The proportion of applicants admitted is highly significant for large funds, but insignificant for smaller funds. Large selective schools allocate less wealth to equity and more to alternative assets. Highly selective schools may allocate more to alternative assets because of either greater financial sophistication or liquidity concerns. However, there it is not clear why these reasons would not also apply to small endowment funds.

The ratio of donations to fund size is the only variable which is significant for small funds but not large funds. Universities with greater donations invest less in fixed income and more in alternative assets suggesting that they are willing to bear greater risk. Since the ratio of donations to fund size is both larger and more variable for smaller funds it is not surprising that this principally affects small funds.

Public universities with large endowment funds hold significantly more fixed income and less alternative assets. Since government funding is one of the safest revenue sources this appears to be a governance effect and not risk driven. If small funds are unable to overcome the fixed costs of investing in alternative assets, governance may be less relevant.

Large funds attached to universities with high debt-to-assets ratio invest significantly less in alternative assets and more in both equity and fixed income. Since these funds invest more in both equity and fixed income this cannot be interpreted as a

risk effect unless endowment managers consider equity to be safer than alternative assets. Thus this result appears more consistent with liquidity concerns than direct financial risk.

Overall the results in this section suggest that there are large differences in the behavior of large and small endowment funds. The allocations of large funds, which can afford higher quality employees and consultants, are more consistent with the hypotheses outlined in Section I. These results suggest that while the numerous factors identified by financial theorists are important it requires considerable sophistication to successfully implement these theories.

IV. Equity Investment Style

While most portfolio choice theory has been developed under the assumption that there is a single risky asset, several recent papers have considered equity investment style. Davis and Willen (2002) show that the correlation between labor income and equity styles should have a dramatic effect on household portfolio choice. Investors whose labor income correlates strongly with a particular equity style should avoid or short that style. Jurek and Viceira (2006) show that there are substantial welfare gains for investors who explicitly consider investment style.

The NACUBO dataset provides a significant amount of information about all equity funds including their size category and their value/growth orientation. I break equity style down into: large growth, large core, large value, mid-cap, and small cap. I do not break the small and mid-cap stocks into value/growth styles to keep the number of

equity styles manageable and to ensure that all styles comprise at least a minimum amount of total portfolio allocations[30].

As in the previous section I estimate a sum constrained system of equations with one equation for each equity style, as well as one equation for the remaining asset classes. This allows for a deeper look at equity styles while still meeting the requirement of logical consistency.

As the intercepts in Table XI show the default equity investment style is large core but there is substantial ownership of other equity styles. For all the different equity styles the R^2s are very low indicating that it is difficult to predict equity style allocations. *Stdev* is not significant; likely this is because, compared to other asset classes, all equity styles have similar risk characteristics.

Despite the theoretical importance of non-endowment income's correlations I do not find any evidence that these correlations affect equity investment. Not only are the correlation between non-endowment income and both the SMB and HML factors insignificant – in many cases the signs on the point estimates are opposite to theory's predictions. While insignificant results are typically given short shrift in the finance literature because of the theoretical importance of correlation risk I think this is one case where insignificant results are both interesting and informative.

Only three variables are significant within the system of equations: fund size, the proportion of applicants admitted, and the proportion of the budget spent on research. Larger funds invest less in large core and more in small stocks. Possibly this is driven by the fact that large funds typically invest in a larger number of distinct equity styles. The

[30] All of these equity styles comprise at least 5% of average portfolio allocations except for mid-cap equity which makes up 4.81% of portfolio allocations on average.

proportion of applicants admitted is highly significant suggesting that higher quality universities invest less in large value and small stocks, and more in alternative assets. This could be a liquidity effect. Since lower quality universities appear to place a higher value on liquidity they attempt to diversify across equity styles rather than through less liquid alternative assets. Research intensive universities hold less small stocks and more fixed income. Small firms are the riskiest of all equity styles so this result is likely driven by the high risk-aversion of research intensive universities.

Many variables are insignificant in this specification including the correlations between non-endowment income and both SMB and HML. Overall these results suggest only very limited ability to explain the equity style allocations of university endowment funds. It is worth noting however that many of the variables included in this section are motivated by theoretical models concerned with asset class allocations rather than style allocations within asset classes. Perhaps as portfolio theory develops to include more precise theoretical predictions for style allocation it will identify new variables with greater empirical power.

V. Conclusion

In this paper I use a unique dataset of university endowment fund portfolio holdings to test the effect of non-tradable risks on these endowment fund's investment choices. The results show that many of these non-tradable risks have a significant effect on portfolio choice.

As predicted by theory, the standard deviation of the growth rate of non-endowment income has a significant effect on endowment fund portfolio choice.

Universities with higher background risk allocate a larger proportion of their portfolio to fixed income and less to riskier asset classes. However, background risk theory predicts that the correlations between non-endowment income and asset returns should have a significant effect on portfolio allocations. I do not find support for this hypothesis at either the asset class level or across equity styles.

There is strong evidence of large fixed costs associated with investing in alternative asset classes such as hedge funds, private equity, and venture capital. Large funds invest a much higher proportion of their wealth in alternative assets. However, contrary to theory there is no evidence that universities at which the endowment fund provides a large proportion of revenue invest more conservatively.

Highly selective universities invest less in equities and more in alternative asset classes. This could be a liquidity effect possibly by the greater revenue flexibility of highly selective universities due to lower tuition elasticity. Alternatively, as endowment boards are typically composed of alumni, this could be driven by the greater financial sophistication of elite university graduates. There is also weaker evidence that a higher ratio of donations to endowment assets results in less liquid portfolio holdings.

Research intensive universities hold safer portfolios, investing more in fixed income and less in equities. This suggests that there are high costs associated with variable research funding that universities are anxious to avoid. There is also significant evidence of a governance effect in portfolio choice as public universities hold more transparent assets like equity and fixed income, and less alternative assets.

Universities with a higher ratio of debt-to-assets hold significantly more fixed income suggesting that credit constraints significantly affect portfolio risk taking. There

is also evidence that revenue composition is important. The proportion of revenues from tuition, as well as public and private grants, significantly affect risk taking.

Overall the results strongly support the hypothesis that background risk and other non-tradable risks have a significant effect on endowment fund portfolio choices. Endowment funds take actions that lower the overall risk of the entire university entity including both its endowment fund and its non-investment operations. However, there is no evidence that endowment funds take in to account correlation risk and endowment fund dependence. This suggests that endowments are not currently optimizing their portfolios with respect to all forms of institutional risk.

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Table I
Endowment Funds

This table summarizes information about endowment funds. Fund size is the dollar value of endowment funds as of the end of fiscal 2003.

	Mean	25th%	Median	75th%
Fund Size	286,497,800	28,386,000	67,260,500	185,139,800
Fund Size – Public	285,545,400	22,182,500	58,511,500	240,544,800
Fund Size – Private	286,940,900	31,105,250	68,422,000	167,529,800

Table II
Endowment Fund Summary Statistics

This table summarizes the holdings of endowment funds. The first column shows the percentage of institutions that hold a given asset. The second column shows the value weighted average allocation conditional on ownership. Value weighting uses the dollar value of each university's endowment fund as of the end of fiscal 2003. Column three shows the equal weighted average allocation across institutions conditional on ownership.

Panel A: Asset Allocation

	Percent Holding Asset	Value Weighted Average	Equal Weighted Average
Equities	99.6%	48.7%	57.4%
Fixed Income	98.7%	20.7%	26.1%
Real Estate	54.2%	5.2%	5.0%
Alternative Assets	70.6%	22.9%	14.1%
Cash	72.4%	2.7%	5.5%

Panel B: Equity

	Percent Holding Asset	Value Weighted Average	Equal Weighted Average
Large Cap	97.6%	39.2%	46.3%
Mid Cap	43.0%	9.2%	11.2%
Small Cap	62.6%	8.5%	10.4%
Micro Cap	5.0%	4.5%	12.8%
Growth	64.3%	15.0%	18.9%
Core	91.3%	30.7%	34.7%
Value	66.6%	17.0%	20.0%
Large Growth	54.2%	10.8%	15.5%
Large Core	87.4%	28.4%	31.9%
Large Value	55.1%	13.0%	16.0%

Panel C: Real Estate

	Percent Holding Asset	Value Weighted Average	Equal Weighted Average
Public (REITS)	25.1%	3.5%	3.9%
Private	39.9%	4.3%	4.3%

Panel D: Alternative Assets

	Percent Holding Asset	Value Weighted Average	Equal Weighted Average
Hedge Funds	45.8%	16.9%	13.2%
Venture Capital	34.0%	3.2%	2.2%
Private Equity	34.5%	4.8%	3.6%
Oil & Gas	12.6%	2.3%	2.2%
Commodities	4.3%	4.0%	3.4%

Table III
Variable Definitions

Variable Name	Definition
Fund Size	The dollar value of endowment funds as of the end of fiscal 2003
Income	Total non-endowment income
Rev_Tuition	Total revenue from tuition and fees
Rev_Gov	Total revenue from government appropriations
Rev_Private	Total revenues from non-government grants, non-endowment gifts, and contracts
Rev_Grants	Total revenues from government grants and contracts
Rev_Other	All non-endowment revenue that does not belong in another category
Prop_Research	The proportion of Income spent on research
Avg_Donate	The annual inflation adjusted dollar value of donations averaged over the previous five years
Donate_Size	The ratio of Avg_Donate to Fund Size
Debt_Assets	The ratio of total debts to university total non-endowment assets
Prop_Admit	The percentage of undergraduate applicants admitted to the university
Stdev	Standard Deviation of the growth rate of non-endowment income
Corr_CRSP	Correlation with CRSP Value Weighted Index
Corr_HML	Correlation with HML
Corr_SMB	Correlation with SMB
Size-Income	Endowment Size to Non-Endowment Income
Public	An indicator variable which equals one for public universities

Table IV
University Summary Statistics

This table contains summary statistics about universities' finances and background risk. Panel A shows information on financial information. Endowment fund size is the total reported dollar value of the endowment fund as of the end of the 2003 fiscal year. Average donations-previous 5 years is the average annual donation amount over the last 5-years. Non-endowment income is the 2002-2003 academic year university total revenue, less revenue received from the endowment fund. Panel B shows information about the background risk of universities in the sample. Standard deviation of non-endowment income is the standard deviation of the percentage change in non-endowment income calculated from the 1983-1984 academic year through the 2002-2003 academic year. Correlations are calculated between the return on various market indexes and the percentage change in non-endowment income.

Panel A: Financial Information				
	Mean	25th%	Median	75th%
Income	312,630,200	36,586,250	75,547,540	238,149,700
Rev_Tuition	41.1%	0.230	0.422	0.574
Rev_Gov	11.5%	0.0%	0.0%	26.9%
Rev_Private	15.1%	4.4%	11.9%	22.0%
Rev_Grants	8.6%	2.2%	5.3%	13.3%
Rev_Other	23.6%	16.3%	21.8%	27.4%
Prop_Research	6.1%	0.0%	0.2%	7.9%
Avg_Donate	24,665,480	4,087,941	8,928,014	19,758,800
Donate_Size	0.166	0.072	0.118	0.204
Debt_Assets	0.310	0.204	0.298	0.398
Prop_Admit	0.683	0.591	0.725	0.813

Panel B: Background Risk Information				
	Mean	25th%	Median	75th%
Stdev	10.6%	5.70%	8.30%	12.0%
Corr_CRSP	-0.011	-0.182	-0.001	0.159
Corr_HML	-0.024	-0.207	-0.037	0.150
Corr_SMB	-0.053	-0.228	-0.042	0.130
Size-Income	2.04	0.325	0.811	1.89

Table V
Average Variable Values by Standard Deviation Quartiles

This table shows the average values of different variables within each quartile of standard deviation. The sample is split into four groups based on the standard deviation of non-endowment income. The table shows the average value of each variable within each standard deviation sorted group.

Variable	Lowest Quartile	25% - 50%	50% - 75%	Top Quartile
Fund Size	333,266,500	197,761,100	206,706,500	405,233,700
Corr_CRSP	0.026	-0.073	-0.035	0.038
Size-Income	0.703	1.088	1.729	3.248
Prop_Admit	0.666	0.701	0.7003	0.663
Donate_Size	0.156	0.167	0.164	0.176
Prop_Research	0.114	0.046	0.029	0.055
Public	0.714	0.280	0.143	0.133
Debt_Assets	0.333	0.329	0.308	0.271
Income	577,597,100	257,662,200	190,191,700	227,105,100
Rev_Tuition	0.293	0.455	0.499	0.397
Rev_Gov	0.251	0.108	0.055	0.047
Rev_Private	0.138	0.078	0.063	0.065
Rev_Grants	0.067	0.124	0.161	0.253
Rev_Other	0.251	0.235	0.221	0.238

Table VI
Allocation to Risky Assets

This table shows Tobit estimates of allocations to risky assets. In the first two columns risky assets is defined as the sum of equity and alternative assets (hedge funds, venture capital, alternative assets, and commodities). In columns three and found risky assets is defined as the sum of equity, alternative assets, real estate and high-yield bonds.

N = 605	Equity and Alternative Assets		Equity, Alternative Assets, Real Estate and High-Yield Bonds	
	Model 1	Model 2	Model 1	Model 2
Stdev	-19.235	-19.186	-17.973	-18.314
	(-2.56)***	(-2.36)**	(-2.47)**	(-2.33)**
Corr_CRSP	-0.097	-0.141	0.150	-0.087
	(-0.04)	(-0.06)	(0.07)	(-0.04)
Log of Fund Size	3.819	4.121	4.412	4.794
	(6.95)***	(6.86)***	(8.30)***	(8.25)***
Size-Income	0.117	0.091	-0.000	-0.076
	(0.40)	(0.29)	(-0.00)	(-0.25)
Prop_Admit	2.813	2.713	2.680	2.589
	(0.86)	(0.83)	(0.85)	(0.82)
Donate_Size	2.573	2.112	5.377	4.734
	(0.59)	(0.45)	(1.26)	(1.05)
Prop_Research	-14.328	-22.153	-15.220	-20.720
	(-2.03)**	(-2.48)**	(-2.23)**	(-2.39)**
Public	-1.033	3.387	-1.959	2.161
	(-0.77)	(0.97)	(-1.51)	(0.64)
Debt_Assets	-7.847	-7.931	-9.902	-9.429
	(-2.01)**	(-1.92)*	(-2.62)***	(-2.36)**
Rev_Tuition		13.152		14.484
		(2.34)**		(2.66)***
Rev_Gov		0.637		4.512
		(0.07)		(0.49)
Rev_Private		14.750		18.144
		(1.79)*		(2.27)**
Rev_Grants		24.582		20.403
		(2.05)**		(1.76)*
Constant	26.062	12.120	22.803	6.727
	(3.52)***	(1.23)	(3.18)***	(0.71)
R^2	0.020	0.022	0.026	0.028

*, **, *** Significant at the 10%, 5%, 1% level respectively.

Table VII
Sum Constrained Model of Portfolio Shares

This table shows the results of a sum constrained model of portfolio allocation. There is one equation per asset class and the equations are jointly estimated with the constraint that the intercepts must sum to 100 and the coefficients on each independent variable must sum to zero. The final column shows the results of F-tests of the overall significance of each variable within the system of equations. Stdev is the standard deviation of non-endowment income. Corr_Crsp is the correlation between non-endowment income and the CRSP value weighted index. Size_Income is the ratio of endowment fund size to total non-endowment income. Prop_Admit is the proportion of undergraduate applicants admitted. Donate size is the ratio of donations to endowment fund size. Prop_Research is the proportion of total non-endowment revenue spent on research. Public is an indicator variable which equals one for public universities. Debt_Assets is the ratio of total university debt to non-endowment assets.

N=605	Equity	Fixed Income	Alternative Assets	Real Estate	P-Value
Stdev	-5.812	18.635	-14.073	1.250	0.016
	(-0.71)	(2.75)***	(-2.20)**	(0.47)	
Corr_CRSP	-1.920	-0.479	2.144	0.255	0.715
	(-0.78)	(-0.24)	(1.12)	(0.32)	
Log of Fund Size	-0.374	-4.180	3.968	0.586	0.000
	(-0.62)	(-8.45)***	(8.51)***	(3.00)***	
Size-Income	0.169	-0.113	0.058	-0.114	0.679
	(0.53)	(-0.43)	(0.23)	(-1.10)	
Prop_Admit	17.124	-3.411	-13.601	-0.112	0.000
	(4.82)***	(-1.16)	(-4.91)***	(-0.10)	
Donate_Size	-3.107	-7.145	7.399	2.853	0.036
	(-0.65)	(-1.80)*	(1.98)*	(1.83)*	
Prop_Research	-15.481	15.566	0.819	-0.905	0.084
	(-2.01)**	(2.45)**	(0.14)	(-0.36)	
Public	2.456	1.977	-3.507	-0.926	0.004
	(1.68)*	(1.64)*	(-3.08)***	(-1.94)*	
Debt_Assets	-2.486	8.047	-3.545	-2.016	0.073
	(-0.58)	(2.29)**	(-1.07)	(-1.45)	
Constant	52.792	74.684	-24.296	-3.180	
	(6.54)***	(11.20)	(-3.87)***	(-1.21)	
R^2	0.061	0.172	0.323	0.037	

*, **, *** Significant at the 10%, 5%, 1% level respectively.

Table VIII
Sum Constrained Model of Portfolio Shares

This table shows the results of a sum constrained model of portfolio allocation. There is one equation per asset class and the equations are jointly estimated with the constraint that the intercepts must sum to 100 and the coefficients on each independent variable must sum to zero across the system. The final column shows the results of F-tests of the overall significance of each variable within the system of equations. Stdev is the standard deviation of non-endowment income. Corr_Crsp is the correlation between non-endowment income and the CRSP value weighted index. Size-Income is the ratio of endowment fund size to total non-endowment income. Prop_Admit is the proportion of undergraduate applicants admitted. Donate size is the ratio of donations to endowment fund size. Prop_Research is the proportion of total non-endowment revenue spent on research. Public is an indicator variable which equals one for public universities. Debt_Assets is the ratio of total university debt to non-endowment assets. The last four variables are the proportion of total non-endowment revenue from: tuition; government appropriations; private gifts, grants and contracts; and government grants and contracts.

Table VIII Continued

N=605	Equity	Fixed Income	Alternative Assets	Real Estate	P-Value
Stdev	-5.547	17.368	-12.730	0.909	0.056
	(-0.62)	(2.37)**	(-1.86)*	(0.31)	
Corr_CRSP	-2.642	-0.364	2.943	0.064	0.483
	(-1.07)	(-0.18)	(1.55)	(0.08)	
Log of Fund Size	0.021	-4.578	3.889	0.667	0.000
	(0.03)	(-8.48)***	(7.69)***	(3.11)***	
Size-Income	0.023	-0.105	0.244	-0.162	0.375
	(0.07)	(-0.37)	(0.93)	(-1.46)	
Prop_Admit	16.758	-3.252	-13.401	-0.105	0.000
	(4.71)***	(-1.11)	(-4.88)***	(-0.09)	
Donate_Size	-3.400	-7.242	7.953	2.689	0.050
	(-0.67)	(-1.73)*	(2.03)**	(1.62)	
Prop_Research	-5.619	21.606	-17.377	1.390	0.015
	(-0.58)	(2.69)***	(-2.31)**	(0.44)	
Public	4.716	-2.434	-1.063	-1.220	0.556
	(1.23)	(-0.77)	(-0.36)	(-0.98)	
Debt_Assets	-1.156	8.383	-5.739	-1.488	0.074
	(-0.26)	(2.26)**	(-1.65)*	(-1.01)	
Rev_Tuition	11.616	-15.359	2.381	1.363	0.024
	(1.89)*	(-3.04)***	(0.50)	(0.68)	
Rev_Gov	11.406	-3.164	-12.084	3.842	0.248
	(1.11)	(-0.37)	(-1.52)	(1.14)	
Rev_Private	15.507	-14.764	-4.046	3.303	0.108
	(1.72)*	(-1.99)**	(-0.58)	(1.12)	
Rev_Grants	-13.360	-22.075	39.529	-4.094	0.001
	(-1.02)	(-2.05)**	(3.92)***	(-0.96)	
Constant	39.761	90.941	-25.372	-5.330	
	(3.71)***	(10.29)***	(-3.07)	(-1.52)	
R^2	0.074	0.187	0.344	0.043	

*, **, *** Significant at the 10%, 5%, 1% level respectively.

Table IX
Sum Constrained Model of Portfolio Shares: Funds Larger than $100 Million

This table shows the results of a sum constrained model of portfolio allocation. There is one equation per asset class and the equations are jointly estimated with the constraint that the intercepts must sum to 100 and the coefficients on each independent variable must sum to zero across the system. The final column shows the results of F-tests of the overall significance of each variable within the system of equations. Stdev is the standard deviation of non-endowment income. Corr_Crsp is the correlation between non-endowment income and the CRSP value weighted index. Size-Income is the ratio of endowment fund size to total non-endowment income. Prop_Admit is the proportion of undergraduate applicants admitted. Donate size is the ratio of donations to endowment fund size. Prop_Research is the proportion of total non-endowment revenue spent on research. Public is an indicator variable which equals one for public universities. Debt_Assets is the ratio of total university debt to non-endowment assets.

N=259	Equity	Fixed Income	Alternative Assets	Real Estate	P-Value
Stdev	-18.925	28.815	-10.635	0.745	0.002
	(-1.75)*	(3.67)***	(-1.02)	(0.25)	
Corr_CRSP	-3.463	0.432	3.781	-0.750	0.539
	(-1.00)	(0.17)	(1.13)	(-0.80)	
Log of Fund Size	-1.738	-3.862	4.737	0.863	0.000
	(-1.60)	(-4.90)***	(4.52)***	(2.91)***	
Size-Income	0.868	-0.020	-0.685	-0.163	0.081
	(2.26)**	(-0.07)	(-1.85)*	(-1.55)	
Prop_Admit	19.662	-2.883	-16.358	-0.421	0.001
	(4.10)***	(-0.83)	(-3.53)***	(-0.32)	
Donate_Size	1.791	9.189	-9.746	-1.234	0.603
	(0.17)	(1.21)	(-0.96)	(-0.43)	
Prop_Research	-3.704	9.300	-4.520	-1.076	0.542
	(-0.42)	(1.46)	(-0.53)	(-0.45)	
Public	3.103	3.946	-5.863	-1.185	0.007
	(1.38)	(2.42)**	(-2.71)***	(-1.94)*	
Debt_Assets	14.327	10.650	-21.587	-3.390	0.014
	(1.82)*	(1.86)*	(2.84)***	(1.58)	
Constant	60.624	66.574	-21.640	-5.557	
	(4.05)***	(6.13)***	(-1.50)	(-1.36)	
R^2	0.166	0.198	0.282	0.076	

*, **, *** Significant at the 10%, 5%, 1% level respectively.

Table X
Sum Constrained Model of Portfolio Shares: Funds Smaller than $100 Million

This table shows the results of a sum constrained model of portfolio allocation. There is one equation per asset class and the equations are jointly estimated with the constraint that the intercepts must sum to 100 and the coefficients on each independent variable must sum to zero across the system. The final column shows the results of F-tests of the overall significance of each variable within the system of equations. Stdev is the standard deviation of non-endowment income. Corr_Crsp is the correlation between non-endowment income and the CRSP value weighted index. Size-Income is the ratio of endowment fund size to total non-endowment income. Prop_Admit is the proportion of undergraduate applicants admitted. Donate size is the ratio of donations to endowment fund size. Prop_Research is the proportion of total non-endowment revenue spent on research. Public is an indicator variable which equals one for public universities. Debt_Assets is the ratio of total university debt to non-endowment assets.

N=346	Equity	Fixed Income	Alternative Assets	Real Estate	P-Value
Stdev	-3.857	5.783	3.863	1.937	0.886
	(-0.31)	(0.52)	(-0.53)	(0.43)	
Corr_CRSP	-2.141	0.795	0.452	0.894	0.879
	(-0.61)	(0.25)	(0.22)	(0.70)	
Log of Fund Size	1.750	-5.099	2.671	0.678	0.000
	(1.49)	(-4.83)***	(3.85)***	(1.58)	
Size-Income	0.733	-0.610	-0.083	-0.040	0.830
	(0.91)	(-0.84)	(-0.17)	(-0.14)	
Prop_Admit	6.559	-7.470	0.121	0.789	0.538
	(1.12)	(-1.42)	(0.04)	(0.37)	
Donate_Size	-0.529	-12.002	8.937	3.594	0.004
	(-0.09)	(-2.37)**	(2.68)***	(1.74)*	
Prop_Research	-34.721	28.964	4.272	1.484	0.164
	(-2.18)**	(2.03)**	(0.45)	(0.26)	
Public	2.751	-1.392	-0.666	-0.693	0.602
	(1.25)	(-0.71)	(-0.51)	(-0.87)	
Debt_Assets	-4.620	5.080	1.067	-1.526	0.559
	(-0.89)	(1.09)	(0.35)	(-0.81)	
Constant	38.755	91.573	-25.131	-5.197	
	(2.78)***	(7.32)***	(-3.05)***	(-1.02)	
R^2	0.026	0.082	0.065	0.028	

*, **, *** Significant at the 10%, 5%, 1% level respectively.

Table XI
Sum Constrained Model of Equity Styles

This table shows the results of a sum constrained model of portfolio allocation. There is one equation per asset class and the equations are jointly estimated with the constraint that the intercepts must sum to 100 and the coefficients on each independent variable must sum to zero across the system. The final column shows the results of F-tests of the overall significance of each variable within the system of equations. Stdev is the standard deviation of non-endowment income. Corr_SMB and Corr_HML are the correlations between non-endowment income and the Fama-French SMB and HML factor. Size-Income is the ratio of endowment fund size to total non-endowment income. Prop_Admit is the proportion of undergraduate applicants admitted. Donate size is the ratio of donations to endowment fund size. Prop_Research is the proportion of total non-endowment revenue spent on research. Public is an indicator variable which equals one for public universities. Debt_Assets is the ratio of total university debt to non-endowment assets.

N=613	Large Growth	Large Core	Large Value	Mid Cap	Small Cap	Other Assets	P-Value
Stdev	-9.666	12.021	-9.398	6.661	-4.531	4.914	0.349
	(-1.45)	(0.93)	(-1.49)	(1.32)	(-1.09)	(0.59)	
Corr_SMB	1.510	-6.422	0.811	1.897	1.778	0.425	0.324
	(0.86)	(-1.87)*	(0.49)	(1.41)	(1.62)	(0.19)	
Corr_HML	0.557	0.284	0.789	1.054	-2.039	-0.644	0.389
	(0.32)	(0.09)	(0.49)	(0.81)	(-1.91)*	(-0.30)	
Log of	-0.058	-2.222	0.732	0.334	0.817	0.397	0.023
Fund Size	(-0.12)	(-2.36)**	(1.60)	(0.91)	(2.72)***	(0.66)	
Size-	0.057	0.067	0.345	-0.325	0.013	-0.158	0.403
Income	(0.23)	(0.13)	(1.43)	(-1.68)*	(0.08)	(-0.50)	
Prop_	4.421	4.549	6.531	-2.226	4.162	-17.437	0.000
Admit	(1.55)	(0.82)	(2.41)**	(-1.02)	(2.34)**	(-4.88)***	
Donate_	2.133	-4.588	1.394	-2.711	1.470	2.303	0.859
Size	(0.55)	(-0.61)	(0.38)	(-0.92)	(0.61)	(0.48)	
Prop_	-7.391	5.362	-6.530	-5.720	-9.228	14.878	0.011
Research	(-1.18)	(0.44)	(-1.10)	(-1.21)	(-2.37)**	(1.91)*	
Public	-0.963	3.838	-1.098	0.280	0.358	-2.416	0.383
	(-0.82)	(1.67)*	(-0.98)	(0.31)	(0.49)	(-1.64)	
Debt_	-1.493	-3.859	1.308	0.605	1.672	1.767	0.902
Assets	(-0.43)	(-0.58)	(0.40)	(0.23)	(0.78)	(0.41)	
Constant	7.963	50.202	-3.529	3.222	-5.036	47.172	
	(-0.43)	(3.96)***	(-0.57)	(0.65)	(-1.24)	(5.80)***	
R^2	0.015	0.028	0.019	0.016	0.026	0.082	

*, **, *** Significant at the 10%, 5%, 1% level respectively.