HUMAN CAPITAL AND RISKY ASSET ALLOCATION

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Abstract

Much research has been done to examine the relation between investors' human capital and their financial asset allocation. While some showed that the value of human capital should be taken into consideration to make financial asset allocation decisions on the composition of investing portfolios, most argued not. In this paper, we selected the monthly return of 9 industrial ETFs from June of 2007 to July 2011, used the present value of total future income as estimate of human capital, and relied on the Mean-Variance Optimal Asset Allocation framework to reexamine if human capital will impact investors optimal financial portfolios. Based on our tests, we found significant connection between human capital and risky asset allocation, which resulted in significant change to weights allocated to the risk assets to create a Mean-Variance optimal portfolio.

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Qun Yu

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1: Introduction

The definition of human capital is complicated. We can gain our human capital in many different ways, either by learning some knowledge in school or by getting training at work. All the skills and education people acquire can be considered as human capital.

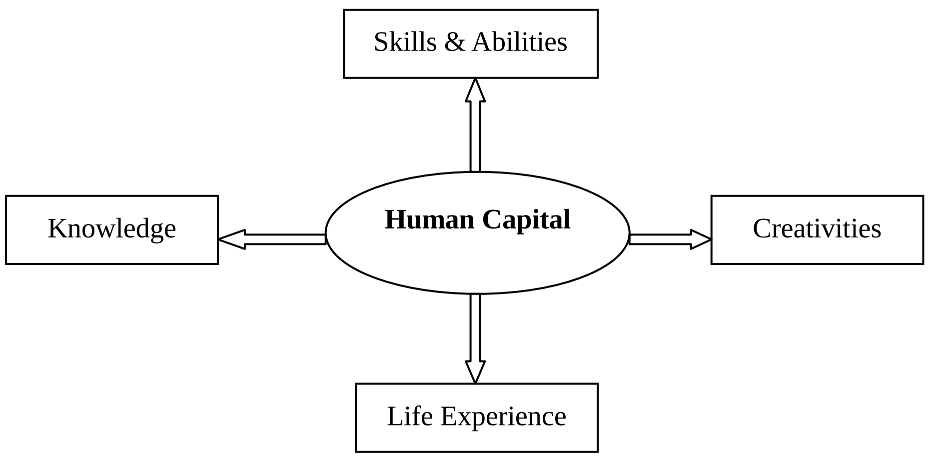

Figure 1. Components of Human Capital

In reality, since human capital is abstract and unobservable, people usually use the labor income or salary, which is an obvious reflection on one's education level, personal experience, job characters and so on. That is, human capital is very individually different. Generally the value of human capital decreases with age, finally to zero after retirement or death when people decide not to work any longer or are not able to; however, financial capital probably increase over time due to accumulation. For instance, one person of 30 years of age should have a higher value of human capital than one of 50 because the younger person has more future possible incomes while the older may have more deposits.

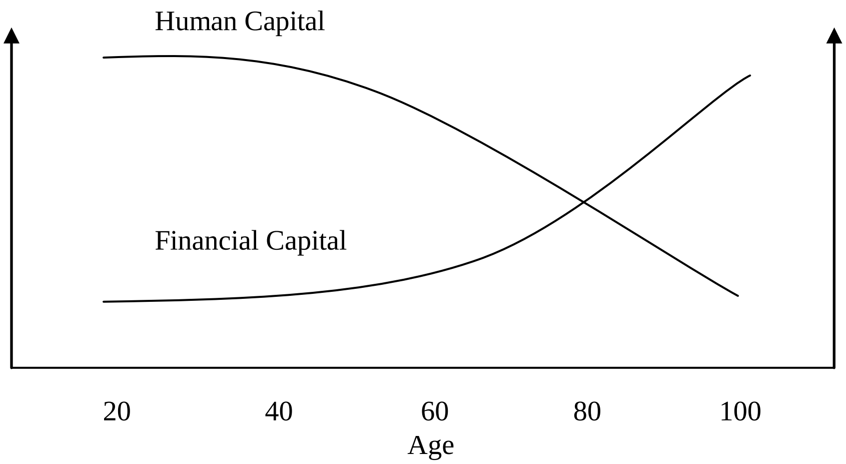

Figure 2. Human Capital and Financial Capital over Age

Academic research has defined human resources as part of an individual's total capital asset. In 1980 Joseph Liberman wrote a paper about testing the relationship between human capital and financial asset allocation. In this very influential paper, they only used the current labor income to test the model. The results showed that the relationship between these two assets is very weak and optimal weights of individual asset allocation were not affected by human capital.

The goal of our study is to use the present value of the total future labor income instead of only periodical labor earnings as a proxy of human capital, adopting the latest financial market and employment earnings data, to see whether there are some connections between human capital and risky asset allocation.

2: Literature Review and Theoretical Background

In the past several decades, much process has been made in the area of human capital and its effects on asset allocation, with significant influence upon academic thought and practical application.

Some papers concluded no significant relation between human capital and financial asset allocation, according to their selected data; others claimed the opposite consequence based on different data. The conclusion if a relationship exists or not depends on the data used (Sharpe and William, 1964).

However, empirically more and more financial advisors or planners have been aware of the importance of human capital valued by labor income when they suggest investment decisions for clients, because they believe that the nature and quality of income or salary may in some extent influence investors' attitude to risk (Williams and Joseph, 1978). For instance, investors with stable income streams in the future are willing to take relatively more risk since they do not worry their future living quality due to the guaranteed salary if their financial portfolio suffers loss (Bailey, 1974). Oppositely, investors with much volatile salary probably need to reduce their investment in risky assets to ensure they have sufficient money in the future to cover expected consumptions or liabilities (Fama and Schwert, 1977).

Peng Chen, Roger, Milevsky, and Kevin X.Zhu (2006) conclude that human capital can significantly impact the individual asset allocation and the need of insurance. They test the effect of human capital through a model which maximizes the utility of, alive and dead, two state total wealth. The results show that human capital can be perfectly hedged by insurance, and both of human capital and insurance can affect the optimal asset allocation in risky and risk free asset. The insufficiency of this paper is that they used capital market return assumptions, with only two assets, risky and risk-free assets, rather than considered the multiple risky assets, i.e., the composition of risky portfolio.

Fama and Schwert(1977) extended the popular two-parameter models of capital market equilibrium and test the relationships between the return on human capital and returns on various marketable assets. They determined that the existence of non-marketable human capital does not provide better empirical descriptions of expected return-risk relationship for marketable securities and the relation between human capital and marketable assets is weak(Fama and Schwert,1977).

Joseph Liberman(1980) has attempted to examine empirically the effect of non-marketable human capital upon both capital asset pricing and individual composition of risky portfolio. He picks ten multiple stocks from different industries to compose a risky portfolio. He points out the key factor that affects both parts is the covariance between the human capital and risky assets. He applies the empirical methodology to a number of different sets of labor earning data distinguished by industry affiliation, particular occupation, or level of schooling. The results strongly confirm that human capital in aggregate has little to do with capital market pricing as well as individual portfolio composition.

In Liberman's paper, the theoretical background is based on model derived by Mayers (1972). The model is introduced below.

$$X_i = \frac{1}{2}\left(\frac{\partial \sigma_i^2}{\partial E_i}\right)\Sigma^{-1}\left[E(V_t) - (1+R_{ft})V_{t-1}\right] - \Sigma^{-1}\Sigma_i^H \qquad (1)$$

Where X_i is the optimal investment proportions vector for investor i; E_i is the expected market value at time t of all investments held by investor from t-1 to t; σ_i^2 is the variance of this market value as of time t; V_{t-1} is the vector of individual asset values as of time t-1; Σ^{-1} is the inverse of the variance-covariance matrix of asset values as of t; and R_{ft} is the risk-free rate of return; Σ_i^H is the column vector of covariance between investor's human capital cash flow, H_i; and the random market values of the individual liquid assets, V_t.

The vector of optimal investment proportions now contains a scalar term $\frac{\partial \sigma_i^2}{\partial E_i}$ unique to investor *i*, and an entire vector Σ_i^H. Theoretically, investors should take human capital into consideration when choosing their optimal asset allocation. We should expect differences to exist between investor portfolios if the pattern of their respective human capital covariance vector values differs meaningfully (Mayers, 1973).

Since $\overline{V}_{jt} = V_{j,t-1}(1+\overline{R}_{jt})$, we may write Σ_i^H as

$$\Sigma_i^H = \begin{pmatrix} \text{cov}(\overline{H}_i, \overline{R}_{1t}) \cdot V_{1,t-1} \\ .... \\ \text{cov}(\overline{H}_i, \overline{R}_{Nt}) \cdot V_{N,t-1} \end{pmatrix}. \qquad (2)$$

That is, whether the value of human capital has influences on optimal asset allocation depends on the item Σ_i^H, the covariance matrix of human capital and each of the selected marketable securities. So the covariance vector Σ_i^H is the key part to be examined (Black and Scholes, 1972).

The data set people use in research varied from paper to paper. In this paper, Liberman (1980) used the following data to test Equation (1).

To capture the diversity of individually held human capital, they use three different sets of per capita earnings data.

To examine the effect of industry affiliation, they use Bureau of Labor Statistics data of monthly per capita production worker earnings for all eight industry classifications reported for in BLS's Employment and Earnings.

For the effect of occupation type, they use a time series of median annual per capita labor earnings data for men classified by occupation collected from annual issues of the Bureau of the Census's Current Population Reports: Consumer Income beginning with 1985.

And for the effect of educational attainment, they use the University of Michigan's Panel Study of Income Dynamics (Morgan and Smith 1972). This consists of annual longitudinal labor earnings data by individual from a representative sample of white male Americans for the years 1967 through 1974 arranged by years of school attended.

For the rates of return on marketable securities, the author used four different groups of marketable securities to study the industry and occupation effects and one group for the educational attainment effect.

The four groups are

(1) a valued-weighted index of NYSE stocks for the period 1947-72 constructed by Myron Scholes;

(2) a government bond portfolio developed by Fama and Schwert;

(3) a set of 10 common stock portfolios formed according to the ranked values of their SL risk measure estimates from all stocks listed on the NYSE for the period from March 1931 to June 1970 and first used in the paper by Black, Jensen, and Scholes;

(4) a selection of industry portfolios formed according to their SEC industrial classifications from NYSE listed stocks by James MacBeth (1974) for the period of July 1945 to June 1968. The last group used for the educational attainment effect is a set of 10 value-weighted common stock portfolios formed according to the ranked value of their rate of return variance estimates from all NYSE listed stocks beginning with 1963.

In his testing consequences, Liberman summarized that there is little connection between financial asset allocation and human capital valued just by earning per capita.

In our paper, we would like to address one shortcoming in the Liberman paper and use present value of total future labor income as a proxy for human capital. In our opinion, the periodical earning data is not sufficient to represent human capital. The labor earning only reflect the trend of your income. By definition human capital consists of the income, knowledge, experience and other factors and should be considered in a long time span, for instance, one’s life period. Intuitively the value of human capital should contain any possible income or cash-flows from individual's experience, knowledge and so on. Thus the labor income in just one period cannot reflect this property of human capital. So we think the return of present value of total future labor incomes is a better data set to test the relation between human capital and financial capital than periodical labor income only.

In addition, we would like to use data that better reflects the current economic conditions. The data selected by Liberman is not sufficient to prove his conclusion to still stand well in current economic situation. The periodical earning data he used was decades ago. As the development of economy and technology, some industries are evolving rapidly and profoundly as well as the labor income of each industry. So the old data set can not well reflect the characteristic of modern industry and the current human capital. We want to use the latest data of labor income to test the relation between human capital and risky asset allocation to see if any change will occur today.

3: Empirical Analysis

An underlying assumption is that human capital estimated by present value of total future income should show some correlation with financial market. Overall, under upward economic situation, people's wages increase with the whole GDP; in some rapidly-growing industries, like IT services and high-tech electronic providers, employees tend to earn more than those in other shrinking industries, such as transporting and manufacturing. Specifically, one employee's income in a publicly-traded company should show obvious correlation with its operating performance or net income, depending on his or her position. For example, a senior manager is usually rewarded with basic salary and incentive bonus which directly comes from the good performance of his company. So it is indeed reasonable and logical to say in our daily life that human capital influences financial portfolio composition. And in our paper, we will analyze the internal process to prove this relation.

First, we carefully selected latest data to examine if the relation does exist today since current economic structure and labor structure are quite different from those decades ago.

Second, we took the present value of human capital into consideration rather than just periodical earning data.

We assume that investors' average working period is about 25 years. So we use finite Gordon Growth Model to capture the present value of human capital, i.e. the present value of total future labor income.

$$P_t = \sum_{i=t+1}^{T} D_t \frac{(1+g)^i}{(1+k)^i} \qquad (3)$$

Where P_t is the present value of human capital at time t, D_t is the after-tax nominal income at time t, k is nominal risk-adjusted return, including risk-free rate plus risk premium, g is the nominal expected growth rate on income; T is the length of time period for Gordon Growth Model, 25 years in our case·

In order to reflect the market required growth rate, k should take both interest rate and risk premium into consideration. Actually, the interest rate, risk premium and the growth rate g change over time. Generally the market required risk premium moves in the same direction as the expected growth rate, i.e. positively correlated. So they can effectively offset their respective effects on present value of human capital by subtracting the growth rate from risk premium. So it will not affect the testing result if the risk premium and expected growth rate are assumed constant for simplicity.

Then we define R_t as the return of present value of human capital at time t. Later we will transform the labor income into return of the present value of labor income and test the relationship between human capital and financial capital afterwards.

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \qquad (4)$$

Where P_t is the present value of human capital at time t; R_t is the nominal return of present value.

For the finite Gordon Growth adopted in our paper, we focus the time-varying interest rate include in risk-adjusted return, and time-varying income at time t. The two volatile processes will collectively influence the present value. Finally we concentrate on examining the correlation between the return on present value of human capital, shown in Equation (4), and the return on risky assets, represented by the nine industrial ETFs.

4: The Data and Results

In Liberman's paper, he used earnings per capita to represent the value of human capital, and then to estimate the relation between human capital and risky asset allocation. Consequently, he found no obvious connection between risky asset allocation and human capital valued by earnings per capita from different industries, respectively.

In our paper, we did the testing process as follows.

First, we selected out the latest earnings data of different major industries, monthly from June of 2007 to July of 2011, to test if Liberman's testing consequences still stand well today. The data is hourly earnings from Private Nonfarm Payrolls (Bloomberg) sorted by the seven major industries. See Table 1 for details.

For marketable securities, we use nine industrial ETFs to duplicate the nature of marketable risky assets in each sector. The names and tickers are shown in Table 2. For details of each industrial ETF, see Appendix B.

In our data set, for each industry selected to categorize the earning data has at least one corresponding industrial ETFs, which is used to duplicate the performance of this industry or similar industry. The corresponding relation is simply shown as follows

Industry to categorize earnings		Corresponding ETFs Ticker (similar industry)
Mining	→	XME, IEO
Manufacturing	→	FXG, ITA
Construction	→	ITB
Financial Activities	→	IYG
Services	→	IHF, IGV, IGN
Transport & Utilities	→	IEO
Wholesale trade	→	IGN

Figure 3. Corresponding Relation

Before starting our case studies, we first assume that individuals will make investments in the 9 sector ETFs to create an equity portfolio. So we need to identify the dollar amounts or weights that an investor would allocate to each of the sector ETFs. The method we adopted to determine the weight is using the idea of neutral starting point from Black-Litterman.

The neutral starting point gives us an initial portfolio allocation of the nine industrial ETFs, a weight vector which is roughly corresponded to the proportion of each ETF valued by market capitalization. Specifically, in our paper we selected the net asset value of each sector ETF, and then calculate the percentage of each ETF via dividing the net asset value of each one by the total net asset value of the nine ETFs. Finally we get a percentage vector which is roughly similar to the weight vector (Table 3) given by Matlab *frontcon.m* function (Appendix C) when neutral starting point (Table 4) is inputted as the expected return vector. The weight vector in Table 3 is for the average investor with average level of risk.

In the following two case studies, we first followed Liberman's methodology to use earnings per capita as estimated value of human capital, but adopted latest hourly earning data by seven major industries in US. Our purpose is to check if Liberman's observations and conclusions would still apply today.

In Case Two, we used the present value of total future possible income as value of human capital, which is different from what Liberman did, to examine if the relationship exist today.

After calculating the correlations of the returns of various categories of income in Table 5, we find that the seven categories of income are not perfectly correlated. Thus, the correlations of the returns of present value of various categories of income will not be perfectly correlated.

As a result, there is likely to be a difference in correlations of each form of income with the various sector ETFs. So it is expected that individuals in different industries should take labor income into account when choosing optimal weights for liquid assets. Case One and Case Two are used to examine this assumption.

Case One Human capital is valued by hourly industrial earnings in US

We separately took the different measures of human capitals in seven different industries into consideration, which is valued by industrial hourly earnings data to examine if human capital will influence the risky asset allocation. We assumed the human capital took up 50% of the total wealth, and the rest is financial capital.

We first calculate the correlations (Table 6) among each of the 7 industrial human capital measures and the 9 risky assets, i.e. industrial ETFs.

The calculated numbers of correlations do exist in our case, but not significant, which is proved by those numbers in the last row of Table 6, the average of absolute value of correlations. The magnitude of most correlations in our case is similar to the size of correlations observed by Liberman, with the following exceptions.

As to the positive correlations, Employees in Construction, Financial Activities and Services may decrease their holdings in equities of Financial Institutions; people in Wholesale Trade industry would better to take out some of their money from equities of Industrials and Energy & Utility; investors of mining and manufacturing industries may want to avoid holding too much risky assets in Consumer Discretionary Industry because mining and manufacturing industries provide raw materials for producers in Consumer Discretionary Industry. The underlying rule is avoiding holding too much risky assets of companies in the same supply chain due to the rapid conducting effect, which means bad performance of one part in a supply chain may directly or indirectly influence others' performances. The risky portfolio composition is shown in Table 7 after running Matlab function *frontcon.m.*

According to the consequences in Table 7, there is an large increase, more than 10%, in allocation in XME, representative of Materials Industry; allocations in other industrial ETFs change a little bit, but not so obvious. One possible explanation for this consequence is that the risk-adjusted return of XME has gradually increased during our time horizon from 2007 to 2011, regardless of the volatile industrial earning.

Other acceptable explanations may come from the limitation of our data source. As we introduced in Literature Review and Theoretical Background part, whether the relationship between human capital and risky asset allocation exists actually depends on the data we use. It is possible that the returns of other industries did not take other kinds of compensation into consideration, but XME, i.e. Materials sector did. Resultantly, XME showed a relatively higher return and sharp ratio than other ETFs.

It is also possible that we are using data for a time period when US economy has been under stress and the income numbers might not be representative of typical economic conditions.

In a word, these reasonable explanations drive up the risk-adjusted return of XME, attracting more investments in it.

According to the results of Case One, there may be a weak correlation between human capital and returns of industry ETFs, and there might only be a small relationship between human capital and risky asset allocation decision. So the only thing we can recommend is that several decades after Liberman's summary, new market data begins to support people's willingness to concern on human capital.

Case Two Human Capital is valued by present value of total future labor income

According to generally accepted definition of human capital, the value of human capital today should be the present value of total future labor income. So, in our discussion, we adopted finite Gordon Growth model to estimate the present value of total future possible incomes; then we calculate the return of the present value. Ideally it would be realistic to take age into consideration when deciding the time length for finite Gordon Growth Model. For instance, young investors would have incomes expected to grow for 30 years while the income of older group would only grow for less than 10 years. However, for simplicity, we use the average age before retirement when income terminates. It is 25 years.

We selected CBOE Interest Rate 10-Year T-No (^TNX) as our benchmark for interest rate process, and the same earnings data used in Case One. The risk premium and expected growth rate of income are assumed to 0.05 and 0.04, respectively, roughly close to historical values. As we stated in Empirical Analysis, although in reality the growth rate and risk premium should be different over time and various for each industry, empirical experiences show that the two factors are usually positively correlated with each other, a situation that they would most likely offset each other’s influences on the present value given by Gordon Growth Model, especially in a longer period. So it is quietly reasonable to assume constant values for the growth rate and risk premium to simply the analyzing process.

Substitute them into Gordon Growth Model shown in Formula (3) to calculate the present value of human capital (Table 8), and then figure out the return on present value of human capital (Table 9).

In the last row of Table 10, the absolute value of correlations increased almost 20% when compared with the last row in Table 6 of Case One. For example, the relative value (Table 11) for the third industry, i.e. Constructions, in Case Two is 3.54 times more than that in Case One. Apparently, after we take the present value of total future labor income to estimate the value of human capital, the risky asset allocation is significantly influenced.

There are so many negative correlations existing between each of the 9 industrial ETFs and each of the industrial human capital valued by present value because the yield of ^TNX is positively correlated with the returns of 9 ETFs in our selected time period from June of 2007 to July 2011. See Table 12 for details. According to Equation (3), if interest rate, which is in the denominator as part of discount rate, is positively correlated with ETFs, the returns of present value of human capital should show negative correlations with the returns of those ETFs.

Based on those negative correlations, we expected that investors will apparently increases weights in corresponding risk assets negatively correlated with their human capital. See Table 10 for details.

According to the results in Table 13, investors increase their holdings in IGN, i.e. the Communications Industry, and XME, i.e. Materials Industry; meanwhile, they tend to decrease allocations in Health Care, Industrials and Technology even to zero. This change is more obvious and significant when compared with the allocation changes in Case One.

So, according to the results of Case Two, investors from different industrial do need to consider the influence of human capital valued by earnings data while making decisions on risky asset investment.

5: Conclusion and Future Research

Conclusion

In case one that human capital is valued just by earing per capita, the same method used by Liberman, the overall risky asset allocation is slightly influenced by human capital. The consequence is a little different from what Liberman stated decades ago because currently some significant factors, such as the economic structure and growing model, labor force structure and people's attitude to life and investment have changed to a situation that empirically people start to consider their human capital when making investment decisions.

In case two, based on our modification on valuation of human capital, we do find come obvious correlations between human capital value by present value of total future income and risky asset allocation, which is different Liberman's findings. The key reason is that we adopted the appropriate method to estimate the value of human capital. After people see all of their future possible income as their value of human capital, the risky asset portfolio composition would be significantly affected.

Future Research

Although we have drawn some conclusions based on the selected statistics data, those consequences are just a general results, which are not absolutely matched with individual investor's taste. They could be used as a reference, but not a final decision. Hopefully a more well-designed and specific model could be built up to examine the nature and quality of human capital, taking more actual elements and individual demands into consideration.

In the other hand, future testing is also needed to cover as many representative marketable securities as possible, with more detailed data, such as earning data in different regions, for different positions in one large corporation and so on. The consequences with more detailed data could be more specific and persuadable.

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Appendix A Tables

Table1. Seven Major Industries Selected to Distinguish Hourly Industrial Earnings

No.	Major Industries	Introduction
1	Mining	oil and gas extraction, coal mining, metal ore mining, non-metallic mineral mining and quarrying, and support activities for mining
2	Manufacturing	durable and non-durable goods production
3	Construction	building new structures, and maintenance, repair, and improvements on these structures
4	Financial Activities	banking, insurance, financial securities investments and so on advertising, health care, tourism, marketing , IT and so on,
5	Services	without financial services
6	Transport & Utilities	transportation of passengers and cargo; supply of electric power, natural gas, water and so on
7	Wholesale trade	wholesaling merchandise, includes the outputs of agriculture, mining, manufacturing, and certain information industries, such as publishing

Table 2. Industrial ETFs

Industries	ETFs Name	Ticker
Communications	S&P North American Technology-Multimedia Networking Sector Index Fund	IGN
Consumer Discretionary	Dow Jones U.S. Home Construction Index Fund	ITB
Consumer Staples	First Trust Consumer Staples Alpha DEX Fund	FXG
Energy & Utility	Dow Jones U.S. Oil & Gas Exploration & Production Index Fund	IEO
Financials	Dow Jones U.S. Financial Services Index Fund	IYG
Health Care	Dow Jones U.S. Healthcare Providers Index Fund	IHF
Industrials	Dow Jones U.S. Aerospace & Defense Index Fund	ITA
Materials	SPDR S&P Metals and Mining ETF	XME
Technology	S&P North American Technology-Software Sector Index Fund	IGV

Table3. Risky Asset Allocation Given by Neutral Starting Point

Industry	Communications	Consumer Discretionary	Consumer Staples	Energy & Utility	Financials	Health Care	Industrials	Materials	Technology
Ticker	IGN	ITB	FXG	IEO	IYG	IHF	ITA	XME	IGV
Weights	0.0172	0.0604	0.0494	0.0661	0.0250	0.0412	0.0262	0.1302	0.0843

Table 4. Return Vector-Neutral Starting Point

Industry	Communications	Consumer Discretionary	Consumer Staples	Energy & Utility	Financials	Health Care	Industrials	Materials	Technology
Ticker	IGN	ITB	FXG	IEO	IYG	IHF	ITA	XME	IGV
Returns	0.0031	0.0029	0.0016	0.0028	0.0026	0.0021	0.0023	0.0040	0.0023

Table 5. Correlations of the Returns of Various Categories of Income

	1 Mining	2 Manufacturing	3 Construction	4 Financial Activities	5 Services	6 Transport & Utilities	7 Wholesale trade
1	1.0000	0.2514	0.2079	-0.1377	0.3041	-0.1222	-0.0967
2	0.2514	1.0000	-0.0772	0.0984	0.3564	0.1445	0.1018
3	0.2079	-0.0772	1.0000	0.1300	0.1044	-0.1175	0.1171
4	-0.1377	0.0984	0.1300	1.0000	0.3503	0.5704	0.3388
5	0.3041	0.3564	0.1044	0.3503	1.0000	0.2443	0.0353
6	-0.1222	0.1445	-0.1175	0.5704	0.2443	1.0000	0.3325
7	-0.0967	0.1018	0.1171	0.3388	0.0353	0.3325	1.0000

Table 6. the Respective Correlations Distinguished by Securities and Earnings by Industries

Industrial	ETF Ticker	1 Mining	2 Manufacturing	3 Construction	4 Financial Activities	5 Services	6 Transport & Utilities	7 Wholesale trade
Communications	IGN	-0.0074	0.0821	-0.0443	-0.2589	0.0805	-0.0884	0.1404
Consumer Discretionary	ITB	0.3111	0.116	-0.0257	-0.1143	0.1622	0.0359	-0.0211
Consumer Staples	FXG	-0.0625	-0.029	0.1177	-0.2618	-0.106	-0.2001	-0.0347
Energy & Utility	IEO	-0.0155	0.0942	-0.0153	-0.0556	0.1734	-0.0002	0.1947
Financials	IYG	0.1079	0.0658	0.1148	-0.088	0.1275	-0.132	0.1403
Health Care	IHF	0.0684	0.0963	0.0695	-0.2108	0.0137	-0.1884	0.05
Industrials	ITA	0.067	0.071	-0.01	-0.1066	0.1569	-0.0621	0.1596
Materials	XME	-0.069	0.0704	-0.095	-0.105	0.1087	-0.1616	0.0964
Technology	IGV	0.0842	0.0435	0.1557	-0.1712	0.2037	-0.1635	0.0969
Average (absolute value of correlations)		**0.088111**	**0.074256**	**0.072**	**0.152467**	**0.125844**	**0.114689**	**0.103789**

Table 7. **Comparison of Risky Asset Allocation influenced by Industrial-different Human Capital (Earning Data)**

	Communications	Consumer Discretionary	Consumer Staples	Energy & Utility	Financials	Health Care	Industrials	Materials	Technology	
	IGN	**ITB**	**FXG**	**IEO**	**IYG**	**IHF**	**ITA**	**XME**	**IGV**	**sum of weights**
ETFs Only	0.0486	0.0207	0.1095	0.07	0.0129	0.0742	0.0518	0.014	0.0983	0.5
ETFS + Industrial Human Capital										**Human Capital**
Mining	0.0561	0.0403	0.0719	0.0506	0.0447	0.0296	0	0.1669	0.04	0.5
Manufacturing	0.0321	0.0644	0.0278	0.0547	0.0296	0.039	0.0234	0.1532	0.0758	0.5
Construction	0.0375	0.0727	0.032	0.056	0.0145	0.0399	0.0398	0.154	0.0537	0.5
Financial Activities	0.0592	0.0654	0.0327	0.0551	0.0258	0.0548	0	0.1453	0.0616	0.5
Services	0.051	0.0624	0.0514	0.0525	0.0316	0.0512	0	0.1553	0.0447	0.5
Transport & Utilities	0.0303	0.0572	0.0332	0.0448	0.0397	0.0515	0.0022	0.1605	0.0807	0.5
Wholesale trade	0.0306	0.07	0.0334	0.0503	0.0224	0.0432	0.02	0.1567	0.0733	0.5
Average Weights	0.0424	0.0618	0.0403	0.0520	0.0298	0.0442	0.0122	0.1560	0.0614	0.5
Ratio (Average Weights/ETFs Only)	**0.8724**	**2.9841**	**0.3684**	**0.7429**	**2.3068**	**0.5953**	**0.2355**	**11.1418**	**0.6246**	**1.0000**

Note: the percentage of human capital in total wealth is assumed to 50%.

Table 8. Present Value of Human Capital Sorted by Seven Major Industries

Date (monthly)	Jul-11	Jun-11	May-11	Apr-11	Mar-11	Feb-11	Jan-11	Dec-10	Nov-10	Oct-10	Sep-10	Aug-10	Jul-10	Jun-10	May-10	Apr-10	Mar-10
Mining	640.90	604.25	624.26	582.64	577.02	572.59	578.89	585.15	654.38	684.21	710.86	708.57	636.24	628.21	571.27	534.73	518.92
Manufacturing	491.66	471.50	485.59	457.60	441.47	446.42	450.43	455.09	512.88	538.73	553.68	554.97	494.73	489.46	449.13	413.32	397.70
Construction	616.20	586.50	605.00	567.89	546.18	552.31	555.38	566.57	642.34	678.45	689.59	698.71	617.62	609.78	557.00	512.64	495.45
Financial Activities	563.68	539.50	558.26	527.74	507.61	509.62	520.47	521.21	592.53	624.29	633.75	645.52	572.93	565.29	521.93	478.94	461.22
Services	445.64	429.25	443.48	417.45	402.44	406.33	411.01	416.00	471.56	493.50	505.82	507.45	454.57	450.23	414.79	381.41	368.84
Transport & Utilities	445.12	426.25	440.65	415.03	398.47	403.97	407.69	405.62	462.25	489.46	500.80	502.97	447.12	442.59	407.29	375.38	359.80
Wholesale Trade	574.86	550.25	564.42	530.64	510.42	515.52	520.00	525.79	594.72	628.61	639.36	644.02	573.20	566.34	519.27	478.71	459.93
	Feb-10	**Jan-10**	**Dec-09**	**Nov-09**	**Oct-09**	**Sep-09**	**Aug-09**	**Jul-09**	**Jun-09**	**May-09**	**Apr-09**	**Mar-09**	**Feb-09**	**Jan-09**	**Dec-08**	**Nov-08**	**Oct-08**
Mining	536.50	528.12	509.69	575.96	551.51	561.02	546.71	534.79	528.97	539.82	591.69	662.72	597.74	634.56	755.93	612.71	481.08
Manufacturing	418.03	417.13	397.09	455.87	434.48	445.20	431.84	421.08	417.61	422.53	458.41	512.09	465.94	488.85	580.02	471.41	373.94
Construction	520.23	518.42	494.43	567.79	546.30	548.47	538.44	525.32	517.93	526.53	567.46	635.59	573.80	605.31	723.83	586.71	466.43
Financial Activities	482.24	483.00	454.25	525.94	498.68	506.00	495.18	478.86	476.74	484.32	522.52	585.57	533.39	555.75	658.99	540.22	427.51
Services	382.77	381.03	362.50	416.50	396.57	403.94	392.36	380.41	378.50	386.62	417.77	469.41	421.15	443.08	522.57	426.77	338.58
Transport & Utilities	380.05	378.78	355.40	411.05	392.55	400.56	391.42	379.02	376.42	382.65	414.99	465.74	423.98	443.35	518.07	427.03	339.83
Wholesale Trade	483.15	483.45	458.12	523.96	499.63	507.94	497.31	482.33	478.58	486.65	521.77	581.04	527.98	550.60	650.64	533.39	423.53
	39692	**Aug-08**	**Jul-08**	**Jun-08**	**May-08**	**Apr-08**	**Mar-08**	**Feb-08**	**Jan-08**	**Dec-07**	**Nov-07**	**Oct-07**	**Sep-07**	**Aug-07**	**Jul-07**	**Jun-07**	**May-07**
Mining	499.54	498.59	468.84	454.43	443.39	476.08	523.29	502.55	492.88	448.67	439.44	399.65	390.28	393.85	376.35	358.91	368.50
Manufacturing	384.35	384.00	370.47	370.27	363.49	385.63	413.65	403.37	393.36	362.45	364.73	329.87	324.30	325.14	310.38	298.03	303.88
Construction	481.46	479.35	457.56	453.17	445.04	469.53	503.33	490.15	476.29	442.26	445.09	404.21	397.55	396.66	379.05	360.81	368.33
Financial Activities	440.33	439.14	422.06	423.31	416.00	441.78	473.52	460.54	447.16	412.69	414.74	376.26	370.34	368.69	354.36	336.84	344.67
Services	349.47	348.32	335.60	336.43	331.77	351.55	378.20	362.28	352.79	325.65	326.65	295.65	290.38	289.66	277.39	264.92	271.57
Transport & Utilities	350.33	350.49	337.90	337.69	331.98	352.42	378.91	368.48	358.40	327.92	331.04	302.87	298.02	296.61	286.23	271.30	276.51
Wholesale Trade	435.59	438.70	421.43	419.55	412.91	437.41	470.00	458.93	446.71	411.66	415.58	376.26	367.91	368.88	352.73	337.70	342.55

Table 9. Returns of Present Value of Human Capital Sorted by Seven Major Industries

Date (monthly)	**Jul-11**	**Jun-11**	**May-11**	**Apr-11**	**Mar-11**	**Feb-11**	**Jan-11**	**Dec-10**	**Nov-10**	**Oct-10**	**Sep-10**	**Aug-10**	**Jul-10**	**Jun-10**	**May-10**	**Apr-10**	**Mar-10**
Mining	0.0607	-0.0320	0.0714	0.0097	0.0077	-0.0109	-0.0107	-0.1058	-0.0436	-0.0375	0.0032	0.1137	0.0128	0.0997	0.0683	0.0305	-0.0328
Manufacturing	0.0428	-0.0290	0.0612	0.0365	-0.0111	-0.0089	-0.0102	-0.1127	-0.0480	-0.0270	-0.0023	0.1218	0.0108	0.0898	0.0866	0.0393	-0.0486
Construction	0.0506	-0.0306	0.0653	0.0398	-0.0111	-0.0055	-0.0198	-0.1180	-0.0532	-0.0162	-0.0131	0.1313	0.0128	0.0948	0.0866	0.0347	-0.0476
Financial Activities	0.0448	-0.0336	0.0578	0.0396	-0.0039	-0.0208	-0.0014	-0.1204	-0.0509	-0.0149	-0.0182	0.1267	0.0135	0.0831	0.0898	0.0384	-0.0436
Services	0.0382	-0.0321	0.0623	0.0373	-0.0096	-0.0114	-0.0120	-0.1178	-0.0445	-0.0244	-0.0032	0.1163	0.0096	0.0854	0.0875	0.0341	-0.0364
Transport & Utilities	0.0443	-0.0327	0.0617	0.0416	-0.0136	-0.0091	0.0051	-0.1225	-0.0556	-0.0226	-0.0043	0.1249	0.0102	0.0867	0.0850	0.0433	-0.0533
Wholesale Trade	0.0447	-0.0251	0.0637	0.0396	-0.0099	-0.0086	-0.0110	-0.1159	-0.0539	-0.0168	-0.0072	0.1236	0.0121	0.0906	0.0847	0.0408	-0.0481
	Feb-10	**Jan-10**	**Dec-09**	**Nov-09**	**Oct-09**	**Sep-09**	**Aug-09**	**Jul-09**	**Jun-09**	**May-09**	**Apr-09**	**Mar-09**	**Feb-09**	**Jan-09**	**Dec-08**	**Nov-08**	**Oct-08**
Mining	0.0159	0.0362	-0.1151	0.0443	-0.0170	0.0262	0.0223	0.0110	-0.0201	-0.0877	-0.1072	0.1087	-0.0580	-0.1605	0.2337	0.2736	-0.0370
Manufacturing	0.0022	0.0505	-0.1289	0.0492	-0.0241	0.0309	0.0255	0.0083	-0.0116	-0.0783	-0.1048	0.0990	-0.0469	-0.1572	0.2304	0.2607	-0.0271
Construction	0.0035	0.0485	-0.1292	0.0393	-0.0040	0.0186	0.0250	0.0143	-0.0163	-0.0721	-0.1072	0.1077	-0.0521	-0.1637	0.2337	0.2579	-0.0312
Financial Activities	-0.0016	0.0633	-0.1363	0.0547	-0.0145	0.0219	0.0341	0.0044	-0.0156	-0.0731	-0.1077	0.0978	-0.0402	-0.1567	0.2198	0.2637	-0.0291
Services	0.0045	0.0511	-0.1297	0.0502	-0.0182	0.0295	0.0314	0.0051	-0.0210	-0.0746	-0.1100	0.1146	-0.0495	-0.1521	0.2245	0.2605	-0.0312
Transport & Utilities	0.0034	0.0658	-0.1354	0.0471	-0.0200	0.0233	0.0327	0.0069	-0.0163	-0.0779	-0.1090	0.0985	-0.0437	-0.1442	0.2132	0.2566	-0.0300
Wholesale Trade	-0.0006	0.0553	-0.1257	0.0487	-0.0164	0.0214	0.0311	0.0078	-0.0166	-0.0673	-0.1020	0.1005	-0.0411	-0.1538	0.2198	0.2594	-0.0277
	39692	**Aug-08**	**Jul-08**	**Jun-08**	**May-08**	**Apr-08**	**Mar-08**	**Feb-08**	**Jan-08**	**Dec-07**	**Nov-07**	**Oct-07**	**Sep-07**	**Aug-07**	**Jul-07**	**Jun-07**	
Mining	0.0019	0.0635	0.0317	0.0249	-0.0687	-0.0902	0.0413	0.0196	0.0985	0.0210	0.0996	0.0240	-0.0091	0.0465	0.0486	-0.0260	
Manufacturing	0.0009	0.0365	0.0006	0.0187	-0.0574	-0.0677	0.0255	0.0254	0.0853	-0.0063	0.1057	0.0172	-0.0026	0.0476	0.0414	-0.0192	
Construction	0.0044	0.0476	0.0097	0.0183	-0.0522	-0.0672	0.0269	0.0291	0.0770	-0.0064	0.1011	0.0168	0.0022	0.0465	0.0506	-0.0204	
Financial Activities	0.0027	0.0405	-0.0030	0.0176	-0.0584	-0.0670	0.0282	0.0299	0.0835	-0.0049	0.1023	0.0160	0.0045	0.0405	0.0520	-0.0227	
Services	0.0033	0.0379	-0.0025	0.0141	-0.0563	-0.0705	0.0440	0.0269	0.0834	-0.0031	0.1049	0.0181	0.0025	0.0442	0.0471	-0.0245	
Transport & Utilities	-0.0005	0.0373	0.0006	0.0172	-0.0580	-0.0699	0.0283	0.0281	0.0929	-0.0094	0.0930	0.0163	0.0048	0.0363	0.0550	-0.0189	
Wholesale Trade	-0.0071	0.0410	0.0045	0.0161	-0.0560	-0.0693	0.0241	0.0274	0.0851	-0.0094	0.1045	0.0227	-0.0026	0.0458	0.0445	-0.0142	

Table 10. the Respective Correlations Distinguished by Securities and Preset Value of Human Capital by Industries

Industrial	ETF Ticker	1 Mining	2 Manufacturing	3 Construction	4 Financial Activities	5 Services	6 Transport & Utilities	7 Wholesale trade
Communications	IGN	-0.3429	-0.3666	-0.3707	-0.4121	-0.3584	-0.3918	-0.3726
Consumer Discretionary	ITB	-0.024	-0.1374	-0.1486	-0.1652	-0.1198	-0.14	-0.1554
Consumer Staples	FXG	-0.3537	-0.3666	-0.3343	-0.4024	-0.3793	-0.402	-0.3793
Energy & Utility	IEO	-0.3156	-0.3318	-0.3343	-0.3437	-0.31	-0.341	-0.3321
Financials	IYG	-0.1472	-0.1978	-0.181	-0.2156	-0.1803	-0.2269	-0.1958
Health Care	IHF	-0.1204	-0.1482	-0.1424	-0.1921	-0.1552	-0.1949	-0.1588
Industrials	ITA	-0.2257	-0.2674	-0.2684	-0.2876	-0.2463	-0.2864	-0.2671
Materials	XME	-0.2878	-0.2816	-0.2959	-0.3013	-0.2687	-0.3193	-0.2885
Technology	IGV	-0.1984	-0.2469	-0.2191	-0.2761	-0.2148	-0.2819	-0.2493
Average (absolute value of correlations)		**0.223967**	**0.260478**	**0.254967**	**0.288456**	**0.248089**	**0.287133**	**0.266544**

Table 11. Comparison of Correlations in Case One and Case Two

	1	2	3	4	5	6	7
Average Correlations in Case One	0.0881	0.0743	0.0720	0.1525	0.1258	0.1147	0.1038
Average Correlations in Case Two	0.2240	0.2605	0.2550	0.2885	0.2481	0.2871	0.2665
Relative Value (Case Two/ Case One)	2.54	3.51	3.54	1.89	1.97	2.50	2.57

Table 12. Correlations between ^TNX and Various Sector ETFs

	IGN	ITB	FXG	IEO	IYG	IHF	ITA	XME	IGV
CBOE Interest Rate 10-Year T-No (^TNX)	0.1855	0.2221	0.2258	0.2140	0.1320	0.1612	0.1511	0.2319	0.1779

Table 13. Comparison of Risky Asset Allocation influenced by Industrial-different Human Capital (Present Value)

	Communications	Consumer Discretionary	Consumer Staples	Energy & Utility	Financials	Health Care	Industrials	Materials	Technology	
	IGN	**ITB**	**FXG**	**IEO**	**IYG**	**IHF**	**ITA**	**XME**	**IGV**	**Human Capital**
ETFs Only	0.0486	0.0207	0.1095	0.07	0.0129	0.0742	0.0518	0.014	0.0983	0.5
ETFS + Industrial Human Capital										
Mining	0.1312	0.0333	0.0871	0.0735	0.0295	0	0	0.1453	0	0.5
Manufacturing	0.1276	0.0565	0.0758	0.0831	0.0243	0	0	0.1327	0	0.5
Construction	0.1314	0.0625	0.0763	0.0835	0.0131	0	0	0.1331	0	0.5
Financial Activities	0.1426	0.0591	0.0773	0.0773	0.0148	0	0	0.1289	0	0.5
Services	0.129	0.0557	0.0852	0.0735	0.0187	0	0	0.1379	0	0.5
Transport & Utilities	0.1208	0.0513	0.0856	0.0696	0.0292	0	0	0.1435	0	0.5
Wholesale trade	0.1244	0.0623	0.0824	0.0774	0.0163	0	0	0.1373	0	0.5
Average Weights	0.1296	0.0544	0.0814	0.0768	0.0208	0.0000	0.0000	0.1370	0.0000	0.5000
Ratio (Average Weights/ETFs Only)	**2.6661**	**2.6273**	**0.7432**	**1.0978**	**1.6157**	**0.0000**	**0.0000**	**9.7827**	**0.0000**	**1.0000**

Note: the percentage of human capital in total wealth is assumed to 50%.

Appendix B Details of Industrial ETFs

IGN

The investment seeks to replicate, net of expenses, the S&P North American Technology-Multimedia Networking index. The fund generally invests at least 90% of its assets in securities of the index and in depositary receipts representing securities in the index. The index includes companies that are producers of telecom equipment, data networking, and wireless equipment.

ITB

The investment seeks to replicate, net of expenses, the Dow Jones U.S. Select Home Construction index. The fund invests at least 90% of its assets in securities of the index and in depositary receipts representing securities of the index. The index measures the performance of the home construction sector of the U.S. equity market. It includes companies that are constructors of residential homes, including manufacturers of mobile and prefabricated homes.

FXG

The investment seeks investment results that correspond generally to the price and yield (before the fund's fees and expenses) of an equity index called the Strata Quant(R) Consumer Staples Index. The fund normally invests at least 90% of net assets in common stocks that comprise the index. The index is a modified equal-dollar weighted index designed by NYSE Euro next to objectively identify and select stocks from the Russell 1000(R) Index in the consumer staples sector that may generate positive alpha relative to traditional passive-style indices through the use of the Alpha DEX(R) screening methodology.

IEO

The investment seeks to replicate, net of expenses, the Dow Jones U.S. Select Oil Exploration & Production index. The fund invests at least 90% of its assets in securities of the underlying index and in depositary receipts representing securities of the index. The index measures the performance of the oil exploration and production sub-sector of the U.S. equity market. It includes companies that are engaged in the exploration for and extraction, production, refining, and supply of oil and gas products.

IYG

The investment seeks to replicate, net of expenses, the Dow Jones U.S. Financial Services index. The fund invests at least 90% of its assets in securities of the index and in depositary receipts representing securities of the index. The index measures the performance of the financial services sector of the U.S. equity market. It includes components of the following subsectors in the Dow Jones U.S. index: banks, asset managers, consumer finance, specialty finance, investments services, and mortgage finance.

IHF

The investment seeks to replicate, net of expenses, the Dow Jones U.S. Select Health Care Providers index. The fund invests at least 90% of its assets in securities of the index and in depositary receipts representing securities of the index. The index measures the performance of the health care providers sector of the U.S. equity market. It includes companies that are health care providers such as owners and operators of health maintenance organizations, hospitals, clinics, dental and eye care facilities, nursing homes and rehabilitation and retirement centers.

ITA

The investment seeks to replicate, net of expenses, the Dow Jones U.S. Select Aerospace & Defense index. The fund generally invests at least 90% of its assets in securities of the index and in depositary receipts representing securities of the index. The index measures the performance of the aerospace and defense sector of the U.S. equity market.

XME

The investment seeks to replicate, net of expenses, the S&P Metals & Mining Select Industry index. The fund generally invests substantially all, but at least 80% of its assets in securities comprising the index. The index represents the metals and mining sub-industry portion of the S&P Total Market index.

IGV

The investment seeks to replicate, net of expenses, the S&P North American Technology-Software index. The fund generally invests at least 90% of its assets in securities of the index and in depositary receipts representing securities in the index. The index includes companies that are producers of client/server, enterprise software, internet software, PC and entertainment software.

Appendix C Introduction of MATLAB function [frontcon.m]

Descriptions

[PortRisk, PortReturn, PortWts] = frontcon(ExpReturn, ExpCovariance, NumPorts, PortReturn, AssetBounds, Groups, GroupBounds, varargin)

It returns the mean-variance efficient frontier with user-specified asset constraints, covariance, and returns. For a collection of NASSETS risky assets, computes a portfolio of asset investment weights that minimize the risk for given values of the expected return. The portfolio risk is minimized subject to constraints on the asset weights or on groups of asset weights.

Arguments

ExpReturn	1 by number of assets (NASSETS) vector specifying the expected (mean) return of each asset.
ExpCovariance	NASSETS-by-NASSETS matrix specifying the covariance of asset returns.
NumPorts	(Optional) Number of portfolios generated along the efficient frontier. Returns are equally spaced between the maximum possible return and the minimum risk point. If NumPorts is empty (entered as[], frontcon computes 10 equally spaced points. When entering a target rate of return (PortReturn), enter NumPorts as an empty matrix [].
PortReturn	(Optional) Vector of length equal to the number of portfolios (NPORTS) containing the target return values on the frontier. If PortReturn is not entered or [], NumPorts equally spaced returns between the minimum and maximum possible values are used.
AssetBounds	(Optional) 2-by-NASSETS matrix containing the lower and upper bounds on the weight allocated to each asset in the portfolio. Default lower bound = all 0s (no short-selling). Default upper bound = all 1s (any asset may constitute the entire portfolio).
Groups	(Optional) Number of groups (NGROUPS)-by-NASSETS matrix specifying NGROUPS asset groups or classes. Each row specifies a group. Groups(i,j) = 1 (*j*th asset belongs in the *i*th group).Groups(i,j) = 0 (*j*th asset not a member of the *i*th group).
GroupBounds	(Optional) NGROUPS-by-2 matrix specifying, for each group, the lower and upper bounds of the total weights of all assets in that group. Default lower bound = all 0s. Default upper bound = all 1s.
varargin	(Optional) varargin supports the following parameter-value pairs: 'algorithm' – Defines which algorithm to use with frontcon. Use either a value of 'lcprog' or'quadprog' to indicate the algorithm to use. The default

is 'lcprog'.

- 'maxiter' – Maximum number of iterations before termination of algorithm. The default is 100000.
- 'tiebreak' – Method to break ties for pivot selection. This value pair applies only to 'lcprog'algorithm. The default is 'first'. Options are:
  - 'first' – Selects pivot with lowest index.
  - 'last' – Selects pivot with highest index.
  - 'random' – Selects pivot at random.
- 'tolcon' – Tolerance for constraint violations. This value pair applies only to 'lcprog' algorithm. The default is 1.0e-6.
- 'tolpiv' – Pivot value below which a number is considered to be zero. This value pair applies only to 'lcprog'algorithm. The default is 1.0e-9.

Returns

PortRisk is an NPORTS-by-1 vector of the standard deviation of each portfolio.

PortReturn is a NPORTS-by-1 vector of the expected return of each portfolio.

PortWts is an NPORTS-by-NASSETS matrix of weights allocated to each asset.