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Income Inequality and Stock Pricing in the U.S. Market

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I hereby reaffirm the Lawrence University Honor Code

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Abstract

In this research, the effect of income inequality as measured by the share of national income going to the wealthiest 10% of the nation in the U.S. is assessed for its significance at explaining stock returns in the U.S from 1927 to 2012. Income inequality has always been an important economic indicator and it has the potential to become one of the fundamental sources of risk that affect stock prices. By utilizing the Fama-French three-factor model, this research obtains the inequality beta coefficient, and the inequality risk premium. In turn, the findings of this research suggest the existence of a relationship between income inequality and the rate of market participation, which ultimately influences the rate of return on stocks.

Introduction

Is income inequality, an important structural characteristic of a market, relevant when talking about stock prices? My paper develops a model that can explain and measure the effect of income inequality on the stock market. By working with the Fama-French's (1993) three-factor model, I am able to evaluate the marginal explanatory power of income inequality on stock returns. The Fama-French model is one of the most robust contemporary asset-pricing models that is designed to be empirical, thus justifying including a fourth variable such as income inequality. Having a well-established base model makes seeing the marginal effect of income inequality as an explanatory factor more clearly than working with a new empirical model.

This research is motivated by the lack of literature exploring income inequality under the light of asset pricing. According to one hypothesis reviewed in my paper (Zhang, 2012), a market with high inequality implies that only a small percentage of the population will be able to purchase stocks, reducing the ability to hedge risks and the liquidity of traded securities, making stocks more risky and increasing the rate of return on stocks. Despite income inequality's implications in the asset market, little effort has been dedicated to uncovering this relationship relative to that of inequality and economic development. This research has value for investors; inequality is an easily observable signal that investors can refer to when making an investment decision. Such data are not costly to obtain and can help improve the accuracy of pricing stocks. In addition, my paper attempts to refocus the policy debate on the significance of reducing inequality. A good economy usually comes with a healthy financial system. Therefore, by establishing the connection between income inequality and asset prices, this research aims to motivate policy makers to reduce income inequality and improve the functioning of their respective financial markets.

By exploring the implications of income inequality in the U.S. using the Fama-French model, my research establishes income inequality as a relevant macroeconomic indicator when talking about stock pricing. Using the work of Zhang (2012) and Johnson (2012), I generate testable hypotheses that allow income inequality to be assessed for its significance in the stock market. My findings suggest that there is a degree of relevance between income inequality and stock prices, especially when looking at the inequality risk premium. The risk premium of income inequality indicates a connection between the share of national income going to the top 10% of the nation and the rate of market participation and market liquidity. In turns, the findings of my paper assist in uncovering possible fundamental risks of the original Fama-French three-factor model, something that numerous researchers have attempted to do.

Literature review

Zhang (2012) establishes economic inequality, most commonly measured by the Gini index, as an important structural factor of financial markets. In her paper, Zhang measures the stock market aggregate performance using the market average price/dividend (P/D) ratio. As she decomposes the P/D ratio (total expected return) into expected excess return and risk-free rate, Zhang predicts that the rate of return on stocks in a highly unequal society would be higher due to a lower rate of market participation. Based on a set of panel data of 154 countries from 1950 to 2008, Zhang reports that a rise in the Gini coefficient of 0.01 point is associated with up to 2% lower stock price/dividend ratio (Zhang, 2012, p. 20). This finding suggests that an increase in income inequality increases the rate of return in the stock market due to a lower overall price level. Furthermore, through the risk-free rate channel, she finds a significant and positive relationship between the risk-free rate and the inequality variable. The risk-free rate, as measured by the interest rate on T-bill, or alternatively, the difference between a country's average lending rate and prime rate, is found to show an increase of 0.18% for each additional unit of income inequality as measured by the variable giniall_adj (Zhang, 2012; Table 9). In her most robust model, Model 8 in Table 9, the explanatory variable giniall_adj's coefficient is significant at the 1% level, and the model yields a high explanatory power with an R^2 value of 0.71. In general, her research establishes a respectable connection between income inequality and the stock market, especially through the interest rate channel.

However, Zhang's research does not demonstrate a similar level of success in establishing a connection between the stock returns and income inequality. Using panel data of 154 countries between 1950 and 2008, her models could not establish any evident connection between income inequality and expected excess return on stocks. Utilizing the MSCI international indices as a measure of expected excess return on stocks, her most comprehensive model demonstrates poor explanatory power and an insignificant coefficient of income inequality. With an R^2 value of 0.175 and 16 explanatory variables, Model 8 might not have the correct specification to study the excess return on stocks. A study of stock pricing can benefit from employing the specification of better-known asset-pricing models such as the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), and Mossin (1966); or, in the case of my paper, the Fama-French three-factor model (1993). Furthermore, Zhang's Model 8 is hardly a concise model: With a large set of explanatory variables, it is difficult to isolate the risk premium associated with inequality. In addition, her model has a propensity to generate measurement error. For example, Zhang uses many qualitative dummy variables for country-specific political and institutional characteristics, which are relatively hard to quantify and measure (2012; Table 9). My paper focuses only on the US, which allows my analysis to avoid those problems. In general, despite drawing reliable and evident connections between income inequality and the stock market, Zhang's research inadequately captures the connection between income inequality and stock returns.

The connection between income inequality and stock return has also been suggested to be negative. Johnson (2012) explores the determinants of the relationship between consumption inequality and the rate of return on risky assets. According to his theoretical model, incomplete markets keep market participants from being able to completely hedge against adverse shocks to their wealth and consumption during bad times. Since only non-diversifiable, systemic risks should be priced according to modern asset pricing theory (Bodie et al., 2009, p. 416), inequality risk could be viewed as a source non-diversifiable risk. Thus, an asset that allows investors to partially hedge against inequality risk may command a premium. Johnson does not specify the type of asset on which he focuses. These assets can be anything that represents an alternative source of income capable of smoothing consumption during periods of shock to labor income. Stocks that are countercyclical and pay dividends are good examples of such assets, but rent from real estate can also be a good example also.

Johnson (2012) argues that, overall, the relationship between income inequality and asset prices can be either positive, negative or zero. To illustrate the relationship between consumption inequality and asset prices, Johnson uses a model with two kinds of agents, the rich and the poor, whom face an equal-sized income shock. Agents have two available assets with the same payoff to smooth consumption: Asset 1 and Asset 2. The rich prefers Asset 1, while the poor prefers Asset 2. During times of shock, Asset 2 reduces consumption inequality because it is purchased by the poor while Asset 1 increases consumption inequality because it is bought by the rich. Essentially, the relationship between asset prices and income inequality is determined by the demand for each asset, and in this case, it can be both negative and positive. For example, given that there is enough demand for both assets, the relationship between the rate of return on Asset 1 and income inequality would be negative, and that of Asset 2 would be positive. If the rich's demand for Asset 1 is high, as they want to smooth their consumption, the price of Asset 1 will be driven up and its rate of return will drop. In the meantime, because Asset 1 increases the rich's wealth relative to that of the poor's, the level of income inequality raises. The opposite is true for Asset 2 when its price is driven up. Whichever asset has a higher demand will be able to affect the relationship more considerably.

Johnson's (2012) work is valuable to my paper because it explains why some assets have a negative relationship with income inequality and others do not. While my paper does not focus on type of market participant (whether or not a portfolio is preferred by the rich or the poor), such concepts are helpful when formulating hypotheses and assessing different portfolios of stocks found in this analysis. Additionally, although my paper focuses on income inequality while Johnson's focuses on consumption inequality, his findings are still relevant because consumption and income are positively correlated.

In order to appropriately study income inequality as a source of risk premium and establish its connection to stock returns, my paper employs the Fama-French three-factor model (1993). Because of its empirical nature, the Fama-French model invites the inclusion of income inequality and other economic factors as potential sources of systemic risk that can be used to improve the accuracy of stock pricing. Fama and French (1993) acknowledge the potential for their model to be expanded by posing the question, "Can specific fundamentals be identified as state variables that lead to common variation in returns that is independent of the market and carries a different premium than general market risk?" (Fama and French, 1993, p.55). In addition, by working with the three-factor model, my research benefits from excellent model specifications and data provided by one of the authors on his online database (French, 2012). Since the three Fama-French factors are all mimicking portfolios are proxies for different risk premiums, income inequality should also be assessed as an explanatory variable using its risk premium.

Employing the Fama and Macbeth (1973) technique, my regressions can obtain the risk premium of income inequality for each year from 1927 to 2012. This risk premium is predicted to capture the variation in stock return among the 25 Fama-French portfolios double sorted on size and value better than the raw income inequality data. Since the three Fama-French factors are proxies for different risk premium that are measured by interest rates, transforming the raw data of income inequality into a measure of risk premium using a second-pass regression will give the new four-factor model a more appropriate factor. The same technique has been used in other literatures to obtain the risk premiums of risk-mimicking portfolios. Bodie, Kane, and Marcus (2009) used the second-pass regression to obtain the risk premium of the market. They regressed stock returns on the market beta obtained from the first-pass regression to obtain the market risk premium, which they find to be 4.2% annually (Bodie et al., 2009, p. 413; see Methodology for details).

As my analysis introduces a fourth variable to the Fama-French model, it is important to acknowledge that numerous researchers have attempted to uncover underlying risks that are captured by Fama and French's two empirical variables, HML and SMB. Brennan (2005) and Amihud (2002) considered the Fama-French model when exploring the cost of illiquidity in the market, and have reported some success. Acharya and Pedersen (2005) suggests that some of the predictive power of the Fama-French three-factor model might be liquidity related as it is able to nicely capture the rate of returns on 25 portfolios sorted by liquidity (Bodie et al., 2009, p. 430). Based on the premises that a portfolio's illiquidity increases the transaction cost and liquidity risk, the rate of return for that portfolio will be higher than its more liquid counterpart. Acharya and Pedersen (2005) find that this illiquidity premium can be as high as 8% for the most illiquid portfolio (Bodie et al., 2009, p. 430). Therefore, the implications of illiquidity are analogous to those of limited stock market participation as described by Zhang (2012). For instance, lower market participation can lower the liquidity of assets that cannot be accessed by the mass market, increasing the liquidity risk of holding those assets and raising the required rate of return to sufficiently compensate higher risk.

However, the connection between income inequality and market participation and liquidity is unclear. If income inequality is a proxy for market participation, its relationship with the rate of market participation should be negative—which is not the case. As income inequality rises, then according to Zhang (2012), there will be a bigger population of the poor who cannot afford to enter the stock market. Despite rising income inequality in the U.S., the rate of market participation has gone up and investors face less liquidity risk when owning stocks now than when they did in 1927. Bogan (2008) found that the percentage of U.S. households owning stocks had increased from 30% to 50% between 1983 and 1998. In addition, with trading costs lowered significantly since the adoption of the Internet, one would expect illiquidity to be lowered (Bogan, 2008, p. 196). My findings suggest that the risk premium of income inequality is significantly more related to stock liquidity and market participation than my raw measure of income inequality.

In general, Johnson (2012) and Zhang (2012) have established the theoretical mechanism that connects income inequality to asset prices. Zhang suggests that income inequality can be considered a proxy for the limited stock market participation, as "with limited access to credit, the exploitation of investment opportunities depends on individuals' levels of assets and incomes. Specifically, poor households tend to forego human-capital investments that offer relatively high rates of return" (Zhang, 2012, p. 6). In contrast, Johnson (2012) proposes an asset-demand-driven story that helps explain the relationship between income inequality and stock market returns. My research builds on this foundation and empirically connects income inequality to asset prices using a prominent empirical asset-pricing model, allowing the role that income inequality plays in asset pricing to be better understood.

Model and Methodology:

First, this analysis reproduces the results of Fama and French (1993). Then after applying the model to a bigger set of data in a longer time period, the results from the two sets of regression will be compared. After demonstrating that the Fama-French three-factor model can retain its explanatory power and significance of the explanatory factors in a longer period, my analysis indicates that the robustness of the three-factor model found in Fama and French's 1993 paper is not the result of data mining. This part is important since data mining is the researchers' tendency to look for data patterns that would support their model (Black, 1993). In addition, the Fama-French model has been criticized for using empirical regularities as explanatory risk factors (Griffin, 2002). Therefore, as the Fama-French model performs well for data beyond the period 1963 – 1991, it establishes the validity needed to study the effect of income inequality on the U.S. stock market.

The next step introduces income inequality to the model. Then, after regressing portfolio returns on income inequality, the mimicking portfolio variables (SMB and HML), and the market portfolio, my analysis assesses the significance of income inequality as an explanatory variable in the stock market. Finally, once the betas for all the explanatory variables are obtained from regressing the returns of each portfolio from 1927 to 2012 on the explanatory variables, my analysis will run a Fama and Macbeth's (1973) second-pass-regression on cross-sectional data among 25 portfolios for each year between 1927 and 2012. This method will obtain the risk premium of each of the explanatory variables on the return of stocks. Finally, the risk premium obtained from the second-pass regression is used to construct a new four-factor model. By using the risk premium of income inequality instead of the income inequality measured by the share of national income going to the top 10% of the nation, my analysis would be able to construct a model where income inequality is a risk factor.

I. Reproducing the Results of Fama and French (1993)

In this part of the analysis, we reproduce what Fama and French did for their paper in 1993, and apply the model to monthly data outside 1967 – 1991. Specifically, the model is used to capture stock returns in 25 portfolios from 1927 to 2012. French (2012) provides the data on his online database.

<u>The Fama-French Three-Factor model is as follows:</u>

$$\boldsymbol{R_p - R_f = Constant + b(MKT) + s(SMB) + h(HML) + e} \qquad \textbf{(Equation 1)}$$

R_p = Rate of return of portfolio *p*

R_f = Rate of return of the risk-free asset

MKT= Rate of return of the market portfolio – Rate of return on risk free assets

SMB= Average rate of return of small companies – Average rate of return of big companies; mimicking portfolio for the risk factor related to size

HML=Average rate of return of High Book to Market ratio firms – Low Book to Market firms; mimicking portfolio for the risk factor of returns related to book-to-market equity

e = Random error term of the estimates

b = The portfolio sensitivity to market risk, (MKT)

s = The portfolio sensitivity to the risk measured by size (SMB)

h = The portfolio sensitivity to the risk measured by the book-to-market ratio (HML)

Hypothesis 1: First we test the hypothesis that income inequality is statistically significant and different from 0 using significance testing at the 5% and 10% level.

$$H_0: B_{\text{Inequality}} = 0$$

$$H_1: B_{\text{Inequality}} \neq 0$$

Specifically, there will be 25 sets of regression results for 25 different portfolios that are double sorted annually on size and book-to-market equity (See Table 1). The portfolios are formed as follows: the size of each company measured on the scale of 1 to 5, with 1 being the smallest and 5 the largest. Value is measured from 1 to 5 with 1 being the lowest book-to-market ratio and 5 the highest. The portfolio that has size 1 has companies with the smallest quintile of market capitalization in the market, and the portfolio that has value 5 has companies with the highest quintile of book-to-market ratio in the market. The stocks included in these portfolios are listed on NYSE, NASDAQ, and Amex (acquired by NYSE in 2008). Table 1 summarizes the name and the description of each portfolio. Essentially, these portfolios are formed by size and book-to-market value. For example, portfolio 1 contains small companies (measured by market capitalization) with low book to market ratio (measured by calculating the ratio of book value to market value). Each portfolio is regressed on MKT, SMB, and HML. MKT contains the excess return on the market portfolio from 1927 to 2012. It represents the market risk in the model. SMB and HML are also the rate of return described under Equation 1. The summary statistics of these variables are found in Table 6.

Table 1: Name and description of Fama-French's 25 portfolios double sorted on market capitalization (size), and book-to-market ratio (value)

II) Incorporating Income Inequality into the Model

The second part of the analysis is going to have the following specifications and hypothesis:

Table 2: Descriptions of the variables

	The variable	How to control/ measure
Independent variable	INEQUALITY	This research is going to use the annual data from 1927 to 2012 of the percentage of national income going to the top 10% in terms of income (excluding capital gains) of the nation. This data is obtained from the work of Saez (2011).
Dependent variables	Excess rates of return on the 25 Fama-French portfolios	Depending on how well INEQUALITY can explain stock returns in the American market from 1927 to 2012, and how correlated it is to other variables in the model, introducing INEQUALITY can improve, worsen, or produce other effects on the model. Generally, the importance of INEQUALITY in explaining stock market returns is gauged by significance testing at the 5% and 10% level (two-tailed t-test) and by looking at the overall adjusted R^2 power of the new four-factor model.
Control variables	• MKT • SMB • HML	In order to obtain comparable results between the original three-factor model and the four-factor model that involve INEQUALITY, this part of the analysis uses the Fama and French model with annual data from 1927 to 2012 for the U.S. market. The data for mimicking portfolios of the market (MKT), of size (SMB), and book/market value (HML) are obtained from French (2012). Controlling for these variables and the 25 portfolios will allow proper comparison between the two models.

The econometric model of the four-factor-model is as follows:

$$\boldsymbol{R_p - R_f = Constant + b\_ine(MKT) + s\_ine(SMB) + h\_ine(HML) + i(INEQUALITY) + e}$$

(Equation 2)

R_p = Rate of return of Portfolio p

R_f = Rate of return of the risk-free asset

MKT = Rate of return of the market portfolio – Rate of return on risk free assets

SMB = Average rate of return of small companies – Average rate of return of big companies; mimicking portfolio for the risk factor related to size

HML = Average rate of return of High Book to Market ratio firms – Low Book to Market firms; mimicking portfolio for the risk factor of returns related to book-to-market equity

INEQUALITY = Income inequality as measured by the share of national income going to the top 10% of the nation

e = Random error term of the estimates

b_ine = Market beta, or the portfolio sensitivity to market risk, (MKT)

s_ine = Size beta, the portfolio sensitivity to the risk measured by size (SMB)

h_ine = Value beta, the portfolio sensitivity to the risk measured by the book-to-market ratio (HML)

i = Income inequality beta, the portfolio sensitivity to income inequality measured by INEQUALITY

Hypothesis 2: In line with Johnson (2012), I hypothesize that the sign of the inequality beta can be either positive or negative. The sign of the beta of inequality for each of the 25 portfolios can help illuminate whether a portfolio is better categorized as Asset 1 (assets that increase consumption/ income inequality whose rate of return is negatively related to income inequality) or Asset 2 (assets that decrease consumption/ income inequality whose rate of return is positively related to income inequality).

III) Finding the income inequality risk premium

As the coefficients for the four explanatory variables MKT, SMB, HML and INEQUALITY are obtained for each of the 25 portfolios, they are regressed with the return of each portfolio again for each year from 1927 to 2012 in order to obtain the risk premium of each factor. This second-pass-regression employs Fama and Macbeth (1973)'s technique.

The econometric model for each year between 1927 and 2012 is as follows:

$$\boldsymbol{R_p - R_f = \gamma_0 + \gamma_b b\_ine + \gamma_s s\_ine + \gamma_h h\_ine + \gamma_{ine} i + e} \qquad \textbf{(Equation 3)}$$

$R_p - R_f$ = Excess return on portfolio p

b_ine = Market beta, or the portfolio sensitivity to market risk, (MKT)

s_ine = Size beta, the portfolio sensitivity to the risk measured by size (SMB)

h_ine = Value beta, the portfolio sensitivity to the risk measured by the book-to-market ratio (HML)

i = Income inequality beta, the portfolio sensitivity to income inequality measured by INEQUALITY

γ_b = Risk premium of the market portfolio

γ_s = Risk premium of the mimicking portfolio for size SMB

γ_h = Risk premium of the mimicking portfolio for book to market value

γ_{ine} = Risk premium of income inequality

γ_0 = Constant term of the model

e = Error term

Hypothesis 3: With 86 observations of the risk premium of income inequality between 1927 and 2012, we can observe the trend of income inequality premium over time. If income inequality is a proxy for the rate of market participation or illiquidity, the risk premium of income inequality (the second-pass-regression's coefficient of the inequality beta) is predicted to decrease over time as the rate of market participation has increased between the period of 1927 and 2012.

In addition, the ability of the four variables (MKT, SMB, HML, INEQUALITY) to capture systemic risks in the stock market can be assessed using the following regression.[1]

$$\overline{\boldsymbol{R_p - R_f}} = \boldsymbol{\gamma_0 + \gamma_b b_{ine} + \gamma_s s_{ine} + \gamma_h h_{ine} + \gamma_{ine} i + \gamma_1 \sigma^2(e^*) + e} \qquad \textbf{(Equation 4)}$$

$\overline{R_p - R_f}$ = Mean excess return on Portfolio p

b_ine = Beta coefficient of MKT

s_ine = Beta coefficient of SML

h_ine = Beta coefficient of HML

i = Beta coefficient of income inequality/ risk premium of income inequality

γ_b = Risk premium of the market portfolio

γ_s = Risk premium of the mimicking portfolio for size SMB

γ_h = Risk premium of the mimicking portfolio for book to market value

γ_{ine} = Risk premium of income inequality

γ_0 = Constant term of the model

γ_1 = Systemic risks that are not captured by the four variables

$\sigma^2(e^*)$ = The estimated variance of the error term from the first-pass regression of portfolio p

e = Error term

[1] The same regression is utilized to obtain the average risk premium of the market portfolio in the CAPM model by Merton Miller and Myron Scholes in 1972 (Bodie et al. 2009, p. 415)

Hypothesis 4:

H_0 : $\gamma_0 = 0; \gamma_b = \overline{MKT}; \gamma_s = \overline{SMB}; \gamma_h = \overline{HML}; \gamma_{ine} = 0; \gamma_1 = 0$

H_1 : $\gamma_0 \neq 0; \gamma_b \neq \overline{MKT}; \gamma_s \neq \overline{SMB}; \gamma_h \neq \overline{HML}; \gamma_{ine} \neq 0; \gamma_1 \neq 0$

Instead of regressing the cross-section of excess portfolio returns on factor betas for each year like Equation 3, Equation 4 regresses the cross-section of mean portfolio returns over the period between 1927 and 2012 on the beta coefficients obtained for each of the portfolios from the first-pass regression in Equation 2. Additionally, it also regresses the mean returns of portfolios with the variance of each portfolio's error terms (e^*) obtained from the first-pass regression. In other words, we are looking at cross-sectional regression of 25 mean returns on 25 sets of betas and 25 variances of the error terms.

If the four-factor model adequately captures the variation in stock return of 25 portfolios, then the predicted risk premium of the market should not be significantly different from the mean excess return of the market portfolio from 1927 to 2012. The same goes for γ_s *and* γ_h and their respective hypotheses. In addition, since these four factors are assumed to capture all systemic, un-diversifiable risks, the coefficients of the variance of the error terms and the constant term of the regression are predicted to be not significantly different from zero. Because the error term e from the first-pass regression represents random variation unexplained by the model, it is not expected to be significant when attempting to explain the effect of systemic risks on the rate of return.

Since we are testing for the significance of income inequality, the null hypothesis is that income inequality has no risk premium, indicating that it has no effect on the rate of return of stocks. The risk premium of income inequality is expected to be different from zero and statistically significant.

IV) Building a new four-factor model with income inequality risk premium

From the income inequality premium obtained from the second-pass regression for each year between 1928 and 2012, I will be able to build a model that tests for the significance of income inequality as a risk factor. The econometric model is as follows

$$\boldsymbol{R_p - R_f = Constant + b\_pr(MKT) + s\_pr(SMB) + h\_pr(HML) + i\_pr(Ine\_Premium) + e}$$

(Equation 5)

R_p = Rate of return of Portfolio p

R_f = Rate of return of the risk-free asset

MKT = Rate of return of the market portfolio – Rate of return on risk free assets

SML = Average rate of return of small companies – Average rate of return of big companies; mimicking portfolio for the risk factor related to size

HML= Average rate of return of High Book to Market ratio firms – Low Book to Market firms; mimicking portfolio for the risk factor of returns related to book-to-market equity

Ine_Premium = The risk premium of income inequality obtained from the second-pass regression

e = Random error term of the estimates

b_pr = The portfolio sensitivity to market risk, (MKT)

s_pr = The portfolio sensitivity to the risk measured by size (SMB)

h_pr = The portfolio sensitivity to the risk measured by the book-to-market ratio (HML)

i _pr = The portfolio sensitivity to the risk measured by income inequality risk premium

Hypothesis 5: Finally, we test for the significance of income inequality risk premium as an explanatory factor of the variation of stock returns among 25 portfolios at the 5% and 10% level.

$$H_0: B_{\text{Inequality Premium}} = 0$$

$$H_1: B_{\text{Inequality Premium}} \neq 0$$

Analysis part 1: Reproducing Fama and French's Results

1) The first part of the analysis starts with reproducing the 1993 results of Fama and French. Using the econometric model in Equation 1, the regression yields the results shown in Table 3:

Table 3: **Reproduction of Fama French Results using Monthly Data from July 1963 to 1991**

Table 4 shows the regression results of the three-factor model regressed on the monthly data of stock return between 1927 and 2012. In general, the R^2 remains high despite having some difficulties at explaining the returns of portfolio 1 and 25. The explanatory powers of the Fama-French three-factor model at explaining the variation in portfolio returns in two periods are compared in Table 5.

Table 4: Regression Results using Monthly Data from 1927 to 2012

Table 5: Comparison of R^2 Value of the Fama-French Model between Two Time Periods

In general, the Fama-French model retains its significant explanatory power when applied to a larger data set. The results in Table 3 are consistent with the findings published by Fama and French (1993), and the results in Table 4 show that the significant explanatory power of the Fama-French model also apply to a longer period of data. The unexpectedly low explanatory power of the Fama-French model for the monthly data of the returns of portfolios 1 and 25 might have to do with the distribution of returns in those portfolios, which is explored in the next part of the analysis.

Analysis Part 2: Incorporating Income Inequality to the Model

This part of the analysis studies the various effects that introducing INEQUALITY has on the Fama-French model. In order to appropriately integrate INEQUALITY to the original three-factor model, it is reasonable to first test for the relationship between INEQUALITY and the explanatory variables before using it as an explanatory variable. If INEQUALITY is highly correlated with the existing explanatory variables of the Fama-French model, then including it will not increase the explanatory power of the model can potentially reduce the significance of other variables.

Table 6: Summary Statistics of INEQUALITY, MKT, SMB, and HML

The following regressions are significance tested at the 5% and 10% level using a two-tailed t-test with H0: beta = 0 for all parameters. INEQUALITY is the measure of the percentage of annual income in America going to the top 10% of the population from 1927 to 2012. The summary statistics for this variable can be found in Table 5. The data for income inequality is only available annually. Therefore, the following regressions also use annual data for MKT, SMB, and HML, which are also available through French (2012)

1) $\boldsymbol{INEQUALITY = Constant + b(MKT) + s(SMB) + h(HML) + e}$

2) $\boldsymbol{INEQUALITY = Constant + s(SMB) + h(HML) + e}$

3) $\boldsymbol{INEQUALITY = Constant + b(MKT) + e}$

Table 7: Regression Results of Model 1, 2, and 3

	Constant	b	s	h	R^2	Adj-R^2	F (86 observations)
Model 1	37.97 (56.3)**	-0.0136 (0.032)	0.0124 (0.27)	-0.0811 (-1.85)*	0.0437	0.0087	1.25
Model 2	37.9 (58.5)**		0.00431 (0.10)	-0.082 (-1.90)*	0.042	0.019	1.8
Model 3	37.642 (57.9)**	0.0157 (-.53)			0.0034	-0.009	0.28

(t-statistics are in parentheses)

**= Significant at 5%

* = Significant at 10%

Given the results above, it is reasonable to say that the explanatory power of the Fama-French factors, jointly and individually, are limited at explaining the variation of income inequality between 1927 and 2012. This result suggests that most of the variation in income inequality is not captured by the market factor, the size factor, or the value factor, giving the constant term of the model a very high t-value and the model a very low value for R^2. Thus the Fama-French three-factor model is appropriate for isolating and measuring effect of income inequality on the returns of the 25 stock portfolios.

Next, in order to properly compare the original Fama-French model and the modified four-factor model with INEQUALITY, it is important to use the same range and frequency of data for the input. In other words, because the data for INEQUALITY are only available annually from 1927 to 2012, the regression for the Fama-French three-factor model has to be reproduced using annual data. The results of this regression can be found in Table 8.

Table 8: Regression Results of the Three-Factor Model using Annual Data from 1927 to 2012

Relative to the results obtained from the regressions using monthly data for the same period, the regressions using annual data still shows strong explanatory power as demonstrated by the R^2 values with only few changes in the significance of the SMB factors for Portfolios 23 and 24. The R^2 values of the regressions using annual data and those using monthly data are listed in Table 9. The most significant difference between the two sets of results is the explanatory power of the model for Portfolio 1 and 25. With a R^2 of 0.31, the regression using monthly data explains poorly the variation in the returns of Portfolio 25 in the months between 1927 and 2012. The model does not have that problem when it uses annual data. Therefore, it is important to look at the distribution of returns in those portfolios. The summary statistics of the 25 portfolios for both annually and monthly are available in Table 10 and Table 11.

Table 9: **Summary of R^2 for the Fama-French Model Regression using Data from 1927-2012**

Table 10: Summary Statistics for the Annual Data of the 25 Portfolios between 1927-2012

Table 11: Summary Statistics for the Monthly Data of the 25 Portfolios between 1927-2012

The three-factor model explains poorly the monthly variation in the rates of return of Portfolio 1 and 25 as shown by the R^2 Table 9. The model may not be able to capture much of the variation of the two portfolios because the monthly standard deviations of these two portfolios are much higher than those of other portfolios. For example, the mean standard deviation of all portfolios for monthly data is 7.9% while the standard deviation of Portfolio 25 is

13.2%. The difference between the two when looking at annual data is less extreme, with the mean standard deviation of 29.09% for all portfolios and 31.1% for Portfolio 25. In general, the annual data is less volatile than monthly data.

Now, since the Fama-French factors cannot capture the variation in income inequality individually and jointly, the effect of income inequality on the rate of return of 25 portfolios is well isolated and easier to evaluate. From the econometric model specified in Equation 2, the regression of portfolio returns on MKT, SMB, HML, and INEQUALITY from 1927 to 2012 yields the results shown in Table 12.

Table 12: Regression Results of the Four-Factor model with INEQUALITY using Annual Data from 1927 to 2012

From the results found in Table 12, INEQUALITY is a significant explanatory variable for stock returns for portfolios 1,2, 5, 7, 13, 17, 22. It seems that the returns of four out of five portfolios with a B/M ratio in category 2 (portfolios 2, 7, 17, 22) can be explained well by INEQUALITY. In addition, three out of five portfolios in the smallest category with the size measurement of 1 (portfolios 1, 2, 5) are also well explained by INEQUALITY. In general, this pattern suggests that INEQUALITY is most significant when trying to explain stock returns of small companies and also companies with low book-to-market ratio. Essentially, this pattern fits the profile of growth companies – those that have small capital base relative to the value that the market is paying for them. This pattern is consistent with the hypothesis that income inequality is related to liquidity, which is suggested by the small firm effect in the market (Banz, 1981). According to Bodie et al. (2009), the returns on small companies' stocks are usually higher than predicted by the CAPM model because those stocks are sparsely traded and usually overpriced. Additionally, the relationship between income inequality and portfolio returns as measured by the inequality beta is negative for some and positive for others, which is consistent with Hypothesis 2.

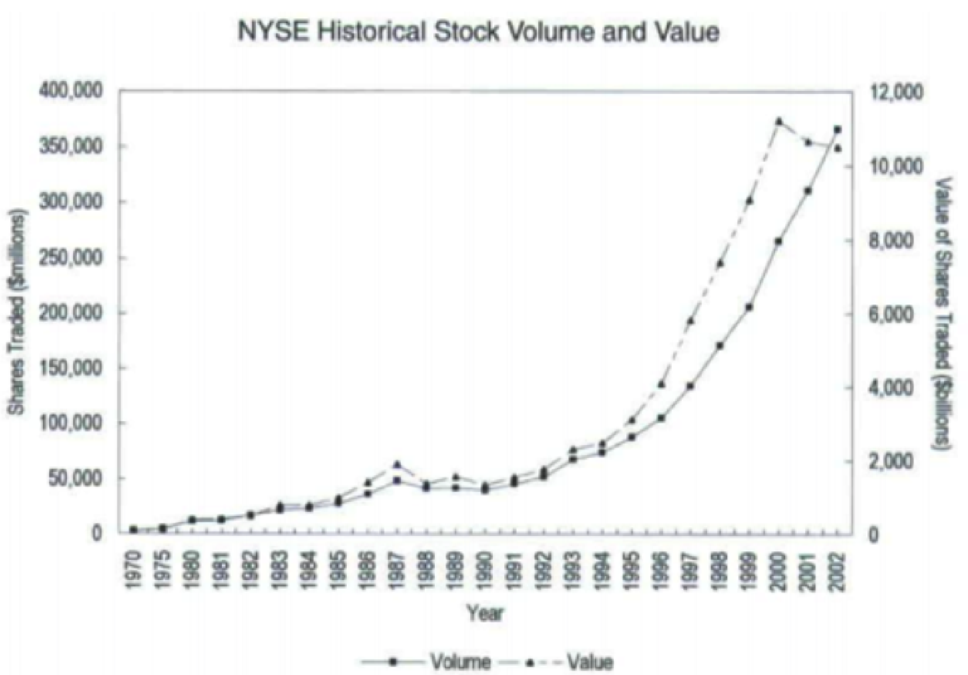
Next, the adjusted R^2 of the three-factor and the four-factor models are compared in Table 13. The adjusted R^2 value is used instead of the R^2 to account for an increase in the number of explanatory variable. The R^2 usually increases even when adding insignificant explanatory variables to the model, but the adjusted R^2 only increases if the added explanatory variable increases the explanatory power of the model. From the results in Table 13, the adjusted R^2 values of the four-factor model with INEQUALITY are higher than those of the three-factor model for portfolios 1, 2, 4, 5, 6, 7, 9, 10, 13, 15, 17, 19, and 22. The hypothesis that income inequality is related to liquidity remains consistent as we look at the adjusted R^2 value. From the regression results, the addition of INEQUALITY matters the most for portfolios of companies with size 1 and 2 (the smallest and the second smallest – portfolios 1 to 10). In addition, the four-factor model with INEQUALITY has higher values for adjusted R^2 than the three-factor model on all portfolios where INEQUALITY is statistically significant, suggesting that INEQUALITY can, in fact, increase the explanatory power of the Fama-French model especially for small firms.

Table 13: The Adjusted R^2 Value of the Fama-French Original Three-Factor Model and the Four-Factor Model with INEQUALITY

Analysis part 3: The Income Inequality Risk Premium

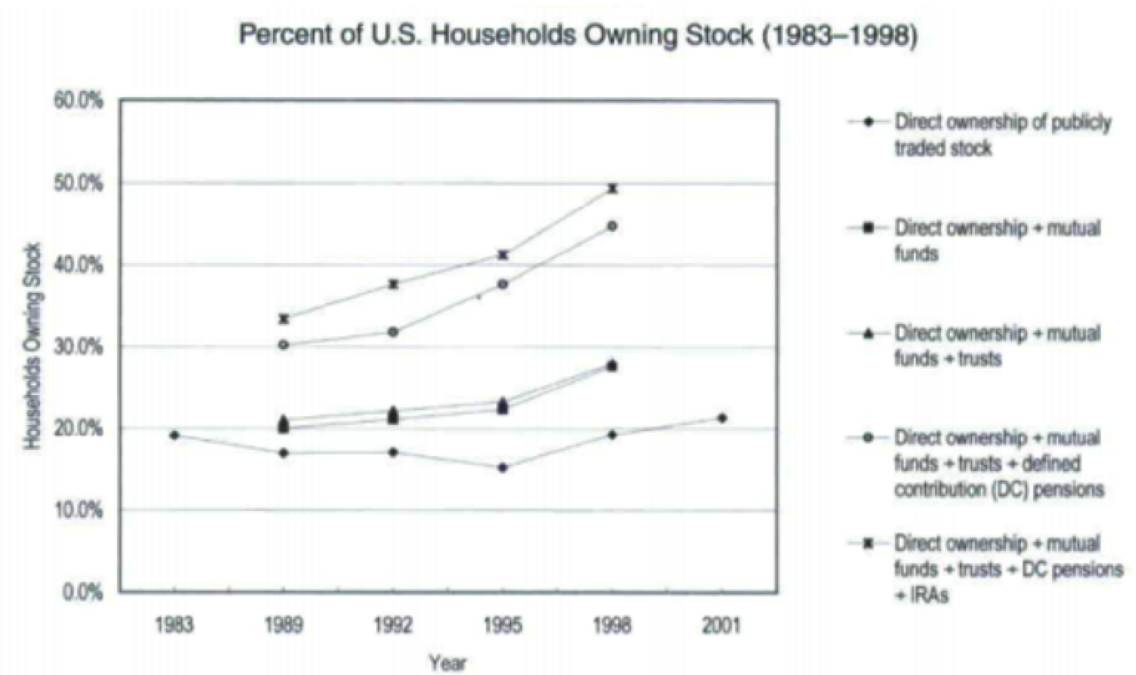
In order to understand the effect of income inequality on the rate of return on stocks better, we look at the risk premium of income inequality for each year between 1927 and 2012. For each year, the annual returns of all 25 portfolios are regressed with the beta coefficients obtained from the first-pass regression. The results from this part of the analysis will be used to test for Hypothesis 3. If income inequality is related to market liquidity or market participation, its risk premium is expected to drop as the liquidity risk of holding stocks has decreased over time. For example, the number of stocks traded on the New York Stock Exchange had increased 600% between 1987 and 2002 as shown in Graph 1. Moreover, the rate of market participation had also gone up between 1989 and 2001 as the number households in the U.S. that own stocks increased as shown in Graph 2.

Graph 1: Evidence of Increasing Liquidity in the Stock Market



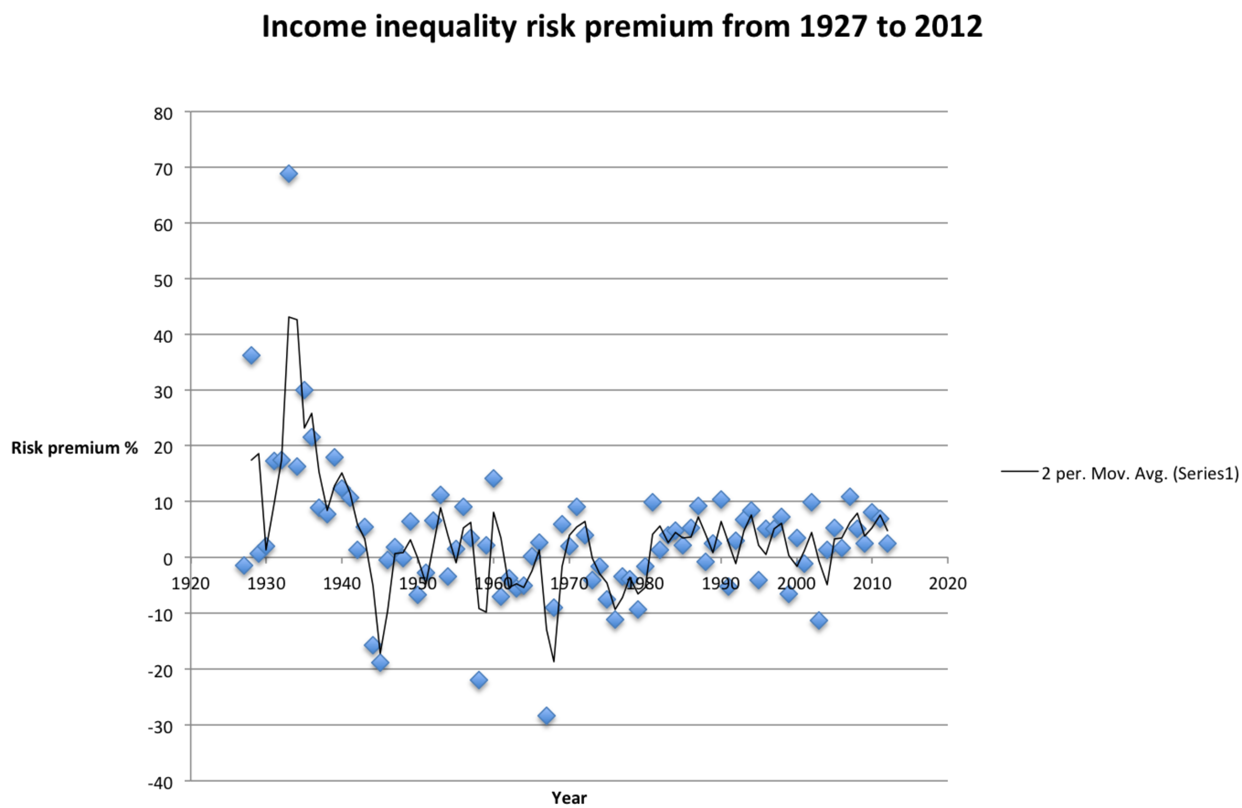
(Bogan, 2008)

Graph 2: Evidence of Increasing Participation in the Stock Market



(Bogan, 2008)

Graph 3: The Coefficients (gamma) of the Income Inequality's Beta obtained using Fama and Macbeth's (1973) Method



Overall, Graph 3 shows a decrease over time of the inequality risk premium, which is consistent with Hypothesis 3. The two-period moving average trend line shows a sharp decrease in the inequality risk premium after 1930s. However, in recent periods, the decreasing trend is no longer clear. Relative to the sharp increase in liquidity as indicated by the steep upward movement in the number of stocks traded in Graph 1, the income inequality premium merely fluctuates.

In general, there is sufficient evidence to show that the risk premium of income inequality on stocks has been decreasing over time, which is consistent with Hypothesis 3. However, after 1980, there has been a divergence between income inequality and inequality risk premium. The drop in income inequality resulted in a reduction of its risk premium between 1927 and 1980 (See Appendix 1), but the sharp rise in income inequality as measured by the percentage of national income going to the top 10% income earners has not affected the risk premium at all since 1980. If income inequality does, in fact, capture a degree of market liquidity and the connection between them is equivalent to what suggested by Zhang (2012), then the upward trend of income inequality is not significant enough to raise the risk premium of inequality and illiquidity since 1980. Therefore, even though income inequality may contribute to limited market participation as suggested by Zhang (2012) and shown between 1927 and 1980, its effects are largely offset by forces that can increase market liquidity and the rate of market participation. Those forces can come from a bigger population, a more educated audience, and a decrease in the costs of stock trading due to better technology. The founding of NASDAQ in 1980 might have contributed to this offsetting effect. All of these forces can increase the percentage of the population that own stocks and the liquidity of owning stocks.

Finally, we estimate Equation 4 to test for the ability to capture systemic risks of the four variables (MKT, SMB, HML and INEQUALITY). The results in Table 14 and Table 15 show that income inequality does command a positive risk premium and is significantly different from 0 at the 10% level. On the other hand, the market risk premium predicted by the model is significantly lower than what historical data suggest. This finding is consistent with the findings of Fama and French (1993), and other studies. For example, Merton Miller and Myron Scholes (1972) found that while historical data obtains an average return of 16.5%, the CAPM model predicts that the annual market excess return of 4.2% (Bodie et al. 2009, p. 415). For the risk premium of the market, even though significance testing cannot reject the null hypothesis, we have to treat the result with caution. With a standard error of the beta at 3.16, the variation in the beta is too large to come up with a precise coefficient.

Table 14: Second-Pass Regression Results for the Risk Premiums of the Four-Factor Model with INEQUALITY

Table 15: Comparison Between the Predictions and Results of the Risk Premiums

Independent variables	Predictions (γ) of the risk premium from the regression	Expected values from the hypotheses
Excess market return (MKT)	4.569	8.04
SMB	4.130	3.57
HML	4.711	4.81
INEQUALITY	1.679*	0
Variance of the error term	-0.0176**	0
Constant	4.026	0

- * = Significantly different from the null hypothesis at the 10% level
- **= Significantly different from the null hypothesis at the 5% level

H_0 : $\gamma_0 = 0; \gamma_b = \overline{MKT}; \gamma_s = \overline{SMB}; \gamma_h = \overline{HML}; \gamma_{ine} = 0; \gamma_1 = 0$

H_1 : $\gamma_0 \neq 0; \gamma_b \neq \overline{MKT}; \gamma_s \neq \overline{SMB}; \gamma_h \neq \overline{HML}; \gamma_{ine} \neq 0; \gamma_1 = 0$

In general, despite having a high explanatory power in the first-pass regression, the four-factor model still cannot fully capture all the systemic risks. The significant coefficient of the variance of the error term suggests that either non-systemic risk is priced or the four variables do not exhaustively capture some systemic risks. However, relative to the original Fama-French three-factor model (Equation 1), the addition of INEQUALITY to the three-factor model has reduced the significance and the magnitude of the premium associated with the variance of the error term. Comparing the results of the two models' second pass regressions, which are listed in Table 14 and 16, we can see that the error term's t-value is reduced from -5.6 to -3.09. In addition, the adjusted R^2 of the second-pass regression has also improved from 0.9 to 0.92.

Table 16: Second-Pass Regression Results for the Risk Premiums of the Original Fama-French Three-Factor Model

$$\overline{R_p - R_f} = \gamma_0 + \gamma_b b_i + \gamma_s s + \gamma_h h + \gamma_1 \sigma^2(e^*) + e \qquad \textbf{(Equation 6)}$$

Analysis Part 4: Building a Model with the Income Inequality Risk Premium

After obtaining 86 observations of inequality premium from the second-pass regression estimated by Equation 3, we now have a direct measure of income inequality as a risk premium. Regressing the model in Equation 5 is estimated to yield more robust results compared to those of the first-pass regression estimated by Equation 2. Inequality risk premium is expected to be more significant than income inequality as measured by INEQUALITY because it demonstrates a stronger relationship with market participation and liquidity—factors that have been shown to be associated with the Fama-French model (Amihud, 2002).

As a risk premium, income inequality becomes considerably more statistically significant as an explanatory variable than when it was measured by the share of national income going to the top 10% of the nation. As a result, the new Four-Factor model becomes much more robust than before, especially at capturing the variation in stock returns of portfolios size I and II (Portfolios 1 to 10). While preserving the significance of the original three variables from the Fama-French Three-Factor model, the inclusion of income inequality risk premium as a source of systemic risk has improved the explanatory power of the original model in 17 out of 25 portfolios as measured by the adjusted R^2 value as shown in table 18. In addition, the inequality premium becomes statistically significant at the 5% level in 14 portfolios and at the 10% for 1 portfolio as listed in Table 17, a big improvement compared to the significance of the variable INEQUALITY as shown in Table 12.

Table 17: Regression Results of the Four-Factor model with Inequality Premium using Annual Data from 1927 to 2012

Table 18: Comparison of the adjusted R^2 values among the Original Three-Factor Model, The Four-Factor Model with INEQUALITY, and The Four-Factor with Inequality Premium

Discussion and Evaluation

After utilizing the French-Fama model and estimating the first-pass and second-pass regression of the four-factor inequality model in Equation 2, 3, and 4, my analysis is able to come up with the income inequality premium for each year from 1927 to 2012. This set of data is not only useful in helping one interpret the direct effect that income inequality has on stock returns, but also valuable in incorporating another source of economic risk to the Fama-French three factor model. From different theories and studies, income inequality seems to be connected to market liquidity and market participation—that connection can be observed by looking at the inequality premium. Clearly, income inequality is not the best proxy for either one of those factors. The Amihud (2002) illiquidity index can get at the cost of illiquidity more directly and some measures of the percentage of households that own stocks can address the rate of market participation. However, having the inequality premium has significantly improved the explanatory variable of the French-Fama three factors especially for portfolios of small companies. The adjusted R^2 value of the four-factor model with the inequality premium is 0.927 for Portfolio 1 compared to 0.744 of the original three-factor model. Nevertheless, it is too early at my level of analysis to conclude that the inequality premium is exceptionally well suited to explain the small firm effect, but perhaps that is the direction that my future research should take.

However, despite its considerable marginal explanatory power, the income inequality premium should not be fully taken at face value before utilizing it in another model or having its four-factor model regressing on another dataset of returns. The regression that I did in part 4 of my analysis is unconventional. Technically, one can regress the new output coefficients and possibly get better results every time on the same dataset. Therefore, it is more suitable to have the inequality premium highlight the role of income inequality as an economic variable in the stock market than to have it as its own independent variable. For the first purpose, the inequality premium has definitely confirmed all of the hypotheses about income inequality that this research set out to test.

Income inequality as measured by the share of national income going to the wealthiest 10% of the nation is not a strong explanatory variable to include in stock pricing literature. On its own, the variable is statistically insignificant most of the time and demonstrates little correlation with liquidity and market participation, the two indicators that Zhang (2012) predicted that it is proxy for. Additionally, Zhang also mentioned in her literature that she expected to see income inequality as a more pronounced factor in developing markets. Because the U.S. is a developed market where low income earners can afford to trade stocks, a rise in income inequality becomes insignificant once the transaction costs of doing so have gone down significantly since 1980. Perhaps there are better ways to measure income inequality and it might have been better to use international data like Zhang to get enough variation in the level of inequality. However, there would have been more variables to control for if this research had taken that route. In general, because a rise in income inequality did not demonstrate to have an impact on its risk premium, perhaps using the stock market to look at the negative impact of rising income inequality is not the best way to communicate the effects of income inequality. As many literatures have stated that an unequal society can lead to complicated political issues, social unrest, and access to opportunities, using the risk of owning stock in the U.S. market does not tell the whole story because we did not see those impacts here. From my analysis, a rise in income inequality only marginally affected the rate of return on stocks.

Conclusion

In conclusion, income inequality is usually a crude variable in the field of finance. Since there are many channels that it can affect the economy, its effect on stock returns can go largely unnoticed if not analyzing the appropriate asset. Zhang (2012) did not find any connection between her measure of income inequality and stock return possibly because the MSCI equity index is too general does not capture the sensitivity of individual asset to changes in income inequality. By looking at the stocks of NASDAQ, NYSE and Amex through 25 different portfolios, my research was able to identify that the effect of income inequality is most significant when talking about returns on portfolios of small companies. Additionally, income inequality is not as pronounced as I anticipated it would be. A possible reason for this is that the

U.S. stock market does not feel much of the effect because it is a developed market where even low income earners can afford stocks. In general, there is evidence for connections between income inequality and market participation/ liquidity in my analysis. Though the link is weak for the U.S. market, I believe that applying a similar framework to a developing economy will yield better results.

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Table 1: Name and description of Fama-French's 25 portfolios double sorted on market capitalization (size), and book-to-market ratio (value)

Portfolio	Size	Value
1	I	1
2	I	2
3	I	3
4	I	4
5	I	5
6	II	1
7	II	2
...		
23	V	3
24	V	4
25	V	5

Table 3: **Reproduction of Fama French Results using Monthly Data from July 1963 to 1991**

Portfolio	b	s	h	R^2	Adjusted R^2
1	1.036	1.408	-0.289	0.939	0.939
2	0.964	1.277	0.077	0.957	0.957
3	0.938	1.159	0.264	0.965	0.965
4	0.891	1.102	0.383	0.965	0.964
5	0.951	1.191	0.612	0.964	0.963
6	1.100	1.003	-0.478	0.957	0.956
7	1.013	0.934	0.025	0.959	0.958
8	0.966	0.841	0.238	0.959	0.959
9	0.967	0.710	0.471	0.956	0.956
10	1.067	0.853	0.699	0.957	0.957
11	1.103	0.705	-0.431	0.960	0.960
12	1.023	0.623	0.041	0.947	0.947
13	0.970	0.543	0.311	0.933	0.932
14	0.972	0.451	0.502	0.939	0.939
15	1.063	0.649	0.703	0.929	0.928
16	1.060	0.301	-0.446	0.947	0.947
17	1.072	0.268	0.021	0.923	0.923
18	1.047	0.250	0.315	0.913	0.913
19	1.033	0.224	0.564	0.910	0.910
20	1.152	0.355	0.734	0.897	0.896
21	0.956	-0.200	-0.445	0.938	0.937
22	1.019	-0.195	-0.023	0.925	0.924
23	0.963	-0.257	0.202	0.857	0.856
24	1.008	-0.191	0.561	0.905	0.904
25	1.027	-0.043	0.760	0.827	0.825

Table 4: Regression Results using Monthly Data from 1927 to 2012

Portfolio	b	s	h	R^2	Adjusted R^2
1	1.31**	1.29**	0.40**	0.65	0.65
2	1.09**	1.61**	0.34**	0.81	0.81
3	1.08**	1.19**	0.47**	0.86	0.86
4	0.97**	1.23**	0.59**	0.93	0.93
5	0.99**	1.35**	0.91**	0.93	0.93
6	1.07**	1.05**	-0.26**	0.90	0.90
7	1.04**	0.99**	0.19**	0.93	0.93
8	0.96**	0.86**	0.36**	0.94	0.94
9	0.98**	0.82**	0.56**	0.95	0.95
10	1.05**	0.94**	0.86**	0.95	0.95
11	1.14	0.79	-0.19	0.93	0.93
12	1.01**	0.52**	0.08**	0.93	0.93
13	1.01**	0.42**	0.34**	0.92	0.92
14	0.96**	0.47**	0.51**	0.93	0.93
15	1.15**	0.50**	0.92**	0.93	0.93
16	1.07**	0.29**	-0.36**	0.93	0.93
17	1.03**	0.25**	0.14**	0.92	0.92
18	1.01**	0.22**	0.30**	0.91	0.91
19	1.04**	0.21**	0.59**	0.92	0.92
20	1.23**	0.30**	0.99**	0.92	0.92
21	1.03**	-0.15**	-0.25**	0.95	0.95
22	0.96**	-0.19**	-0.01	0.93	0.93
23	0.97**	-0.22**	0.32**	0.91	0.91
24	1.06**	-0.17**	0.72**	0.92	0.92
25	1.11**	0.01	0.86**	0.31	0.31

*Significant at 10%

**Significant at 5%

Table 5: Comparison of R^2 Value of the Fama-French Model between Two Time Periods

Portfolio	R^2 (Monthly data 1927 – 2012)	R^2 (Monthly data from 1967 – 1991)
1	0.65	0.94
2	0.81	0.96
3	0.86	0.97
4	0.93	0.97
5	0.93	0.96
6	0.90	0.96
7	0.93	0.96
8	0.94	0.96
9	0.95	0.956
10	0.95	0.957
11	0.93	0.960
12	0.93	0.95
13	0.92	0.93
14	0.93	0.94
15	0.93	0.93
16	0.93	0.95
17	0.92	0.92
18	0.91	0.91
19	0.92	0.91
20	0.92	0.90
21	0.95	0.94
22	0.93	0.93
23	0.91	0.86
24	0.92	0.91
25	0.31	0.83

Table 6: Summary Statistics of INEQUALITY, MKT, SMB, and HML

Variable	Obs	Mean	Std. Dev.	Min	Max
INEQUALITY	86	37.52	5.594	31.38	46.55
MKT	86	8.04	20.7	-45.09	57.12
SMB	86	3.58	14.2	-29.8	54.1
HML	86	4.81	13.84	-34.0	39.5

Table 8: Regression Results of the Three-Factor Model using Annual Data from 1927 to 2012

Portfolio	b	s	h	R^2	R^2 Adjusted
1	1.165**	1.035**	-0.379**	0.753	0.744
2	1.063**	1.132**	0.071	0.870	0.865
3	1.030**	1.152**	0.289**	0.923	0.920
4	0.999**	1.331**	0.615**	0.944	0.942
5	1.141**	1.340**	0.783**	0.946	0.944
6	1.076**	0.989**	-0.269**	0.921	0.918
7	1.061**	0.905**	0.116*	0.929	0.926
8	0.958**	0.929**	0.352**	0.942	0.940
9	1.007**	0.908**	0.639**	0.927	0.924
10	1.035**	0.855**	0.809**	0.955	0.954
11	1.105**	0.784**	-0.419**	0.939	0.937
12	0.990**	0.682**	0.105*	0.923	0.920
13	0.974**	0.504**	0.383**	0.912	0.908
14	0.960**	0.604**	0.544**	0.944	0.942
15	1.002**	0.679**	0.915**	0.920	0.917
16	1.013**	0.305**	-0.444**	0.941	0.938
17	0.966**	0.426**	0.105	0.868	0.864
18	1.019**	0.363**	0.397**	0.911	0.907
19	0.983**	0.402**	0.602**	0.899	0.896
20	1.177**	0.502**	0.777**	0.845	0.840
21	1.052**	-0.219**	-0.298**	0.944	0.942
22	0.918**	-0.145**	0.067*	0.933	0.930
23	0.971**	-0.100	0.298**	0.877	0.873
24	1.042**	-0.089	0.596**	0.899	0.895
25	1.260**	-0.156	0.865**	0.857	0.851

*Significant at 10%

**Significant at 5%

Table 9: **Summary of R^2 for the Fama-French Model Regression using Data from 1927-2012**

Portfolio	R^2 (Monthly data 1927 – 2012)	R^2 (Annual data 1927 – 2012)
1	0.65	0.753
2	0.81	0.870
3	0.86	0.923
4	0.93	0.944
5	0.93	0.946
6	0.90	0.921
7	0.93	0.929
8	0.94	0.942
9	0.95	0.927
10	0.95	0.955
11	0.93	0.939
12	0.93	0.923
13	0.92	0.912
14	0.93	0.944
15	0.93	0.920
16	0.93	0.941
17	0.92	0.868
18	0.91	0.911
19	0.92	0.899
20	0.92	0.845
21	0.95	0.944
22	0.93	0.933
23	0.91	0.877
24	0.92	0.899
25	0.31	0.857

Table 10: Summary Statistics for the Annual Data of the 25 Portfolios between 1927-2012

Portfolio	Observation	Mean	Std. Dev.	Min	Max
1	86	7.74	37.6	-79.13	138.19
2	86	13.4	34.4	-66.86	104.92
3	86	16.8	33.4	-62.01	92.93
4	86	19.4	35.8	-54.76	173.45
5	86	22.5	39.1	-54.38	185.47
6	86	11.4	31.43	-53.41	80.24
7	86	15.9	30.51	-49.06	145.13
8	86	17.2	29.4	-49.98	130.55
9	86	18.2	31.8	-50.15	154.19
10	86	18.8	32.2	-56.2	125.96
11	86	12.6	29.6	-49.6	144.46
12	86	15.2	26.9	-48.41	121.51
13	86	16.2	25.9	-46.05	97.35
14	86	16.7	26.9	-52.52	96.46
15	86	18.1	31.6	-60.89	121.09
16	86	12.37	23.6	-40.02	69.53
17	86	13.14	24.6	-40.62	119.69
18	86	14.8	25.7	-53.02	111.28
19	86	15.9	26.6	-54.89	96.98
20	86	16.8	33.5	-61.06	170.73
21	86	11.2	21.0	-35.32	48.81
22	86	10.99	18.9	-45.7	47.65
23	86	12.1	21.4	-67.44	81.97
24	86	12.3	24.5	-64.71	102.03
25	86	13.7	31.1	-99.99	90.39

Table 11: Summary Statistics for the Monthly Data of the 25 Portfolios between 1927-2012

Portfolio	Observation	Mean	Std. Dev.	Min	Max
1	1032	.72	12.2	-49.4	147.5
2	1032	1.1	10.54	-43.1	139.27
3	1032	1.31	9.2	-36.6	81.04
4	1032	1.45	8.62	-35.8	105.07
5	1032	1.68	9.55	-34.9	105.31
6	1032	.86	7.97	-32.7	54.13
7	1032	1.24	7.86	-32.5	84.41
8	1032	1.32	7.32	-30.6	78.79
9	1032	1.37	7.6	-32.8	72.57
10	1032	1.47	8.73	-34.6	87.37
11	1032	.97	7.64	-29.63	60.75
12	1032	1.16	6.6	-29.1	44.32
13	1032	1.26	6.74	-33.5	64.27
14	1032	1.27	6.81	-31.6	56.21
15	1032	1.42	8.61	-37.3	82.06
16	1032	.97	6.23	-28.9	34.47
17	1032	1.03	6.29	-28.8	57.56
18	1032	1.13	6.40	-32.03	64.91
19	1032	1.2	7.00	-34.5	70.67
20	1032	1.33	8.96	-40.1	86.43
21	1032	.88	5.47	-28.2	35.52
22	1032	.88	5.2	-25.1	32.24
23	1032	.94	5.7	-31.1	48.41
24	1032	.97	6.9	-36.4	65.04
25	1032	.063	13.2	-99.99	56.82

Table 12: Regression Results of the Four-Factor model with INEQUALITY using Annual Data from 1927 to 2012

Portfolio	b_ine	s_ine	h_ine	i	R^2 ine	Adj R^2 ine
1	1.149**	1.049**	-0.472**	-1.144**	0.781	0.770
2	1.053**	1.141**	0.009	-0.757**	0.884	0.878
3	1.033**	1.150**	0.303**	0.173	0.923	0.920
4	1.003**	1.327**	0.636**	0.257	0.946	0.943
5	1.145**	1.336**	0.810**	0.334*	0.948	0.946
6	1.072**	0.992**	-0.292**	-0.293	0.924	0.920
7	1.066**	0.900**	0.146**	0.368**	0.933	0.930
8	0.960**	0.927**	0.365**	0.161	0.943	0.940
9	1.011**	0.905**	0.661**	0.272	0.929	0.925
10	1.032**	0.858**	0.789**	-0.247	0.957	0.955
11	1.107**	0.782**	-0.411**	0.098	0.939	0.936
12	0.992**	0.680**	0.117*	0.142	0.924	0.920
13	0.980**	0.498**	0.420**	0.452**	0.921	0.917
14	0.960**	0.605**	0.540**	-0.050	0.944	0.941
15	1.005**	0.676**	0.933**	0.218	0.922	0.918
16	1.014**	0.304**	-0.435**	0.114	0.941	0.938
17	0.971**	0.422**	0.132*	0.334*	0.874	0.868
18	1.019**	0.363**	0.399**	0.017	0.911	0.906
19	0.987**	0.399**	0.627**	0.310	0.903	0.898
20	1.175**	0.504**	0.768**	-0.107	0.846	0.838
21	1.053**	-0.220**	-0.292**	0.074	0.944	0.942
22	0.921**	-0.147**	0.082**	0.184*	0.936	0.932
23	0.970**	-0.100	0.295**	-0.034	0.878	0.871
24	1.042**	-0.090	0.599**	0.031	0.899	0.894
25	1.263**	-0.158	0.879**	0.173	0.858	0.851

**= significant at 5%

* = significant at 10%

Table 13: The Adjusted R^2 Value of the Fama-French Original Three-Factor Model and the Four-Factor Model with INEQUALITY

Portfolio	Adjusted R^2 for the original 3 factor Fama-French model	Adjusted R^2 for the Fama-French model with INEQUALITY
1	0.744	**0.770***
2	0.865	**0.878***
3	0.920	0.920
4	0.942	**0.943**
5	0.944	**0.946***
6	0.918	**0.920**
7	0.926	**0.930***
8	0.940	0.940
9	0.924	**0.925**
10	0.954	**0.955**
11	**0.937**	0.936
12	0.920	0.920
13	0.908	**0.917***
14	**0.942**	0.941
15	0.917	**0.918**
16	0.938	0.938
17	0.864	**0.868***
18	**0.907**	0.906
19	0.896	**0.898**
20	**0.840**	0.838
21	0.942	0.942
22	0.930	**0.932***
23	**0.873**	0.871
24	**0.895**	0.894
25	0.851	0.851

- * = Portfolios with significant INEQUALITY
- Bolded if adjusted R^2 is higher

Table 14: Second-Pass Regression Results for the Risk Premiums of the Four-Factor Model

Source	SS	df	MS
Model	242.65046	5	48.5300919
Residual	16.2128196	19	.853306293
Total	258.863279	24	10.78597

Number of obs =	25
F(5, 19) =	56.87
Prob > F =	0.0000
R-squared =	0.9374
Adj R-squared =	0.9209
Root MSE =	.92375

mean_exces~n	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
b_ine	4.569229	3.157648	1.45	0.164	-2.039803	11.17826
s_ine	4.130189	.4154451	9.94	0.000	3.260652	4.999726
h_ine	4.711302	.4944962	9.53	0.000	3.67631	5.746295
i	1.678853	.8552939	1.96	0.064	-.1112976	3.469004
var_e	-.0175743	.0056868	-3.09	0.006	-.0294769	-.0056717
_cons	4.026373	3.062699	1.31	0.204	-2.383929	10.43668

Table 15: Comparison Between the Predictions and Results of the Risk Premiums

H_0 : $\gamma_0 = 0; \gamma_b = \overline{MKT}; \gamma_s = \overline{SMB}; \gamma_h = \overline{HML}; \gamma_{ine} = 0; \gamma_1 = 0$

H_1 : $\gamma_0 \neq 0; \gamma_b \neq \overline{MKT}; \gamma_s \neq \overline{SMB}; \gamma_h \neq \overline{HML}; \gamma_{ine} \neq 0; \gamma_1 = 0$

Independent variables	Predictions (γ) of the risk premium from the regression	Expected values from the hypotheses
Excess market return (MKT)	4.569	8.04
SMB	4.130	3.57
HML	4.711	4.81
INEQUALITY	1.679*	0
Variance of the error term	-0.0176**	0
Constant	4.026	0

- * = Significantly different from the null hypothesis at the 10% level
- **= Significantly different from the null hypothesis at the 5% level

Table 16: Second-Pass Regression Results for the Risk Premiums of the Original Fama-French Three-Factor Model

(Equation 6)

Source	SS	df	MS
Model	237.575749	4	59.3939372
Residual	21.2875302	20	1.06437651
Total	258.863279	24	10.78597

Number of obs	=	25
F(4, 20)	=	55.80
Prob > F	=	0.0000
R-squared	=	0.9178
Adj R-squared	=	0.9013
Root MSE	=	1.0317

nean_exces~n	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
beta_new	4.941947	3.39939	1.45	0.162	-2.149056	12.03295
s_new	4.153625	.4659753	8.91	0.000	3.181618	5.125633
h_new	5.105474	.5048224	10.11	0.000	4.052433	6.158515
var_e_FF	-.0236851	.004228	-5.60	0.000	-.0325047	-.0148656
_cons	4.175908	3.344722	1.25	0.226	-2.801059	11.15288

Table 17: Regression Results of the Four-Factor model with Inequality Premium using Annual Data from 1927 to 2012

Portfolio	b_pr	s_pr	h_pr	i_pr
1	1.147**	1.052**	-0.486**	-1.323**
2	1.052**	1.142**	0.006	-0.799**
3	1.029**	1.153**	0.282**	-0.089
4	1.003**	1.327**	0.638**	0.291**
5	1.145**	1.335**	0.812**	0.359**
6	1.071**	0.993**	-0.296**	-0.342**
7	1.065**	0.900**	0.144**	0.350**
8	0.961**	0.927**	0.366**	0.178**
9	1.013**	0.903**	0.673**	0.420**
10	1.034**	0.856**	0.802**	-0.095
11	1.110**	0.779**	-0.392**	0.333**
12	0.993**	0.679**	0.125**	0.248**
13	0.978**	0.500**	0.406**	0.281**
14	0.959**	0.605**	0.540**	-0.061
15	1.002**	0.679**	0.914**	-0.011
16	1.013**	0.305**	-0.444**	0.004
17	0.971**	0.422**	0.132**	0.332**
18	1.020**	0.362**	0.406**	0.106
19	0.984**	0.402**	0.608**	0.075
20	1.177**	0.501**	0.782**	0.063
21	1.053**	-0.220**	-0.295**	0.037
22	0.918**	-0.145**	0.068*	0.014
23	0.973**	-0.102	0.310**	0.150**
24	1.044**	-0.091	0.609**	0.153**
25	1.263**	-0.158	0.881**	0.189*

*Significant at 10%

**Significant at 5%

Table 18: Comparison of the adjusted R^2 values among the Original Three-Factor Model, The Four-Factor Model with INEQUALITY, and The Four-Factor with Inequality Premium

Portfolio	Fama-French Three-Factor model	Four-Factor model with income inequality (INEQUALITY)	Four-Factor model with income inequality risk premium (Ine_Premium)
1	0.744	0.770*	**0.927***
2	0.865	0.878*	**0.944***
3	0.920	0.920	0.920
4	0.942	0.943	**0.951***
5	0.944	0.946*	**0.956***
6	0.918	0.920	**0.935***
7	0.926	0.930*	**0.945***
8	0.940	0.940	**0.944***
9	0.924	0.925	**0.949***
10	0.954	**0.955**	0.954
11	0.937	0.936	**0.954***
12	0.920	0.920	**0.932***
13	0.908	0.917*	**0.925***
14	0.942	0.941	0.942
15	0.917	**0.918**	0.916
16	0.938	0.938	0.938
17	0.864	0.868*	**0.889**
18	0.907	0.906	**0.909***
19	0.896	**0.898**	0.895
20	0.840	0.838	**0.838**
21	0.942	0.942	0.942
22	0.930	**0.932***	0.929
23	0.873	0.871	**0.879***
24	0.895	0.894	**0.900***
25	0.851	0.851	**0.855***

- * = Portfolios with significant INEQUALITY
- Bolded if adjusted R^2 is higher

Appendix 1: Data for Inequality and Inequality Risk Premium

Time	Inequality	Inequality risk premium
1927	44.67	-1.38
1928	46.09	36.31
1929	43.76	0.73
1930	43.07	1.98
1931	44.40	17.32
1932	46.30	17.46
1933	45.03	68.93
1934	45.16	16.22
1935	43.39	29.99
1936	44.77	21.50
1937	43.35	8.90
1938	43.00	7.80
1939	44.57	17.98
1940	44.43	12.40
1941	41.02	10.76
1942	35.49	1.27
1943	32.67	5.45
1944	31.55	-15.66
1945	32.64	-18.80
1946	34.62	-0.41
1947	33.02	1.87
1948	33.72	-0.10
1949	33.76	6.51
1950	33.87	-6.72
1951	32.82	-2.69
1952	32.07	6.66
1953	31.38	11.22
1954	32.12	-3.41
1955	31.77	1.53
1956	31.81	9.09
1957	31.69	3.45
1958	32.11	-21.85
1959	32.03	2.11
1960	31.66	14.18
1961	31.90	-7.07

1962	32.04	-3.80
1963	32.01	-5.59
1964	31.64	-4.99
1965	31.52	0.16
1966	31.98	2.61
1967	32.05	-28.32
1968	31.98	-8.98
1969	31.82	5.92
1970	31.51	1.99
1971	31.75	9.03
1972	31.62	3.93
1973	31.85	-4.09
1974	32.36	-1.58
1975	32.62	-7.44
1976	32.42	-11.04
1977	32.43	-3.33
1978	32.44	-3.83
1979	32.35	-9.23
1980	32.87	-1.61
1981	32.72	9.83
1982	33.22	1.37
1983	33.69	4.00
1984	33.95	4.78
1985	34.25	2.10
1986	34.57	5.26
1987	36.48	9.21
1988	38.63	-0.84
1989	38.47	2.48
1990	38.84	10.42
1991	38.38	-5.16
1992	39.82	2.92
1993	39.48	6.77
1994	39.60	8.42
1995	40.54	-4.12
1996	41.16	5.19
1997	41.73	5.05
1998	42.12	7.23
1999	42.67	-6.58
2000	43.11	3.43
2001	42.23	-1.06
2002	42.36	9.90

2003	42.76	-11.27
2004	43.64	1.39
2005	44.94	5.20
2006	45.50	1.67
2007	45.67	10.82
2008	45.96	5.07
2009	45.47	2.58
2010	46.35	8.09
2011	46.54	6.95
2012	46.55	2.49