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Introduction

In January of 2016, a number of Laurier faculty signed a letter (hereafter "The Letter") urging the University to divest from fossil fuel companies in all endowment funds and the employee pension.[1] This research note addresses a number of issues related to the divestment strategy—in particular, the stranded asset thesis, financial strategy alternatives, implementation challenges and the financial effects of divestment strategies. This note does not consider alternative strategies for decarbonizing the economy. The Letter itself does not explain why divestment is superior to alternatives like promoting research into clean energy generation, renewable energy sources, climate science, and environmental economics.

The Letter articulates two goals. The first part of The Letter argues that, "Sooner or later, the world is going to get serious about regulating carbon emissions and when it does assets will likely be stranded." This argument supports a risk management goal: that portfolio managers should hedge the risk of stranded assets. The second goal, articulated later in The Letter, is more revolutionary. In particular, that "the present generation…have a duty to help decarbonize the global economy as rapidly as possible."

Establishing the goal is important because the goal informs the optimal financial strategy. If the goal is to hedge stranded asset risk, then the best risk management strategies are: 1) diversification; or 2) portfolio reweighting. If the goal is to decarbonize the economy, then diversification and reweighting will have little effect. The financial strategy with the most potential to influence corporate behavior is full divestment.

The remainder of this note is organized as follows. The second section defines the stranded asset thesis and contrasts it to another thesis. The third section defines two alternative financial strategies: divestment and reweighting. The fourth section discusses the challenge of using GHG emissions data to implement divestment or reweighting. The fifth section presents the financial theory of divestment and empirical evidence on the impact of divestment on risk and return. The sixth section concludes.

The Stranded Asset Thesis

In this section we define the stranded asset thesis and contrast it to an alternative thesis.

"Carbon stranded assets are assets that may lose economic value before the end of their expected life primarily driven by changes in regulation and technology...."[2] There are a number of potential strategies to manage this risk (reweighting, diversification or divestment) but each requires a precise articulation of the economic scenario so as to identify the set of companies to be reweighted or avoided.

A Stranded Asset Scenario

The stranded asset thesis envisions the imposition of severe and sudden environmental regulations (or very rapid technology changes) which render reserves of oil, gas and coal worthless. But it isn't just extraction firms that would be harmed in this scenario. Service firms would also be hurt. Consider AirBoss of America, which manufactures rubber conveyor belts for mining (based in Kitchener Ontario). A reduction in coal mining would reduce demand for AirBoss' products and its stock would fall.

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[1] Letter from Simon Dalby, Shohini Ghose and Byron Williston (Feb 1, 2016) to Max Blouw, Deborah MacLatchy, Robert Gordon and Jim Butler.

[2] Briand, R., L. Lee, S. Lieblich, V. Menou and A. Singh. (2015) Beyond Divestment: Using Low Carbon Indexes. Working Paper from MSCI ESG Research Inc. p. 6.

Companies up the supply chain--that use oil, gas and coal as inputs--would also be hurt. Steel companies, such as ArcelorMittal Dofasco in Hamilton, use coal as an input to its manufacture of steel and would be harmed by rising input costs. Indeed, over 60% of the electricity generated in North America is from fossil fuels. Regulations which reduce the amount (or raise the price) of oil, gas and coal will increase the cost of electricity, raise the cost of anything made with electricity and reduce the value of any company that substantially relies on electricity. The increased cost of fossil fuels and electricity would have a profound negative effect on the value of companies in the industrial, automotive and transportation sectors of the economy.

From this example, it is clear that fossil fuel extraction and energy generation are inextricably linked to many other companies in the economy. These connections have risk and portfolio implications that we will discuss later. The larger point of the example is that it is difficult (perhaps impossible) to identifying *a priori* the companies that should be targeted for divestment or reduced weighting.

An Alternate Thesis

The stranded asset thesis is only one possible future economic scenario. To build a portfolio around one thesis, an investor would have to be very confident of the scenario's likelihood. Here we present an alternative scenario that can be used to gauge the likelihood of stranded assets.

The stranded asset thesis predicts regulatory and technology changes that are sufficiently sudden and severe that proven fossil fuel reserves are written off and associated assets are reduced in value. Mark Jaccard, a sustainable energy economist, predicts a smoother transition. He writes that "our vast fossil fuel resources, perhaps especially coal, are likely to remain among the cheapest sources of clean energy for the next century and perhaps longer, which is critical for the economic and social development of the world's poorer countries. By buying time for increasing energy efficiency, developing renewable energy technologies and making nuclear power more attractive, fossil fuels will play a key role in humanity's quest for a sustainable energy system."[3]

Under Jaccard's thesis, we should expect a slow decline of fossil fuel energy and a slow adjustment of the economy to alternative sources. Under this scenario, the optimal financial strategy is wide diversification with frequent portfolio rebalancing based on market values. As the demand for certain products declines (i.e., oil, gas, coal and derived products) the stock of companies producing those goods will decline. At the same time, the stock of companies producing alternative energy will rise in value. A portfolio that is based on market value weights will gradually shift away from fossil fuels and carbon intensive products. The diversification strategy does not involve the analytical complexity and foresight of divestment.

The asset stranding scenario is but one possible economic scenario. The authors of The Letter are confident of its likelihood. Investors who are confident of a scenario can use strategies to hedge the risk or, depending on risk tolerance, speculate. If an investor is uncertain about the likelihood, magnitude and timing of a thesis, then the optimal risk management strategy is simple diversification, which is the management strategy currently employed by the University.

[3] Mark Jaccard, (2007). Fossil fuels and clean, plentiful energy in the 21st century: The example of coal. EIB Papers, 12(1), 80-104.

Financial Strategies: Divestment and Reweighting

If one accepts the stranded asset thesis, then there are two available financial risk management strategies: 1) divestment, or 2) portfolio reweighting. In this section we briefly describe the two financial strategies.

Divestment

The divestment strategy involves not holding certain stocks in the portfolio. The identity of the avoided stocks depends on the goal and circumstances. Divestment is touted as a mechanism for placing economic pressure on companies to change their behavior. Divestment is an alternative to more direct tactics such as boycotts and demonstrations. A classic example is the South African divestment movement which sought to force the end of apartheid by avoiding investment in the shares of companies that did business in South Africa. More recently, some investors avoid sin stocks (tobacco and guns) or the shares of companies that are not socially responsible. We will have more to say about the potential financial (and economic) impact of divestment in Section 5. Here we focus on the challenges to implementing a divestment strategy.

The Letter demands divestment of "fossil fuels". This is imprecise and not sufficient for achieving the stated goal of "decarbonizing" the economy. Imprecise, because the University does not invest in commodities. Not sufficient, because the scope is too narrow. Whether the goal is risk management or to decarbonize the economy, all carbon intensive companies should be divested. As we noted above, fossil fuels are inextricably linked to many other companies in the economy. *A priori* identification of all carbon intensive companies is difficult. An alternative approach is to obtain a measure of the carbon footprint of each public company and diversify from the worst offenders. Section 4 discusses this approach.

The divestment approach has both costs and benefits. The costs are: reduced diversification, potentially reduced returns, increased tracking error relative to market baskets, and increased exposure to systematic risk factors. The benefit of divestment is twofold: 1) it best hedges stranded asset risk; and 2) it is highly visible and so clearly signals virtue to stakeholder groups. In Section 5 we present a theoretical model of the consequences of divestment.

Reweighting

Reweighting means reducing the proportionate investment in particular assets. In the case of mitigating stranded asset risk, a reweighting strategy would invest a smaller proportion of a portfolio in companies that are 'at risk' compared to a value-weighted market basket of stocks. At-risk stocks, are those that are likely to lose value under the stranded asset thesis. As with the divestment strategy, *a priori* identification of 'at risk' stocks is complicated and an alternative is to reweight based on measures of carbon footprint (described in Section 4).

Portfolio reweighting has both costs and benefits. The costs are: it is not as effective (as divestment) in pressuring companies to decarbonize; it does not mitigate stranded asset risk as effectively as divestment (because the portfolio still contains 'at risk' assets); and it does not signal climate virtue as effectively as divestment. The benefits are that it (largely) maintains diversification; it maintains exposure to the boycott systematic risk factor (described below), it minimizes the deleterious impact on returns and it reduces tracking error relative to market baskets.

Measuring Carbon Intensity

The diversification and reweighting strategies both depend on identifying carbon intensive companies. A priori identification from economic first principles is difficult. An alternative approach is to identify based on greenhouse gas (GHG) emissions.

Two companies sell measures of GHG emissions of publicly listed companies: MSCI and TruCost. The MSCI data set covers 8,500 globally-listed companies going back to 2008. The TruCost data goes back to 2005 and includes approximately 6,000 global companies including the S&P 500 in full and 98-99% of the Russell 1000. Neither dataset includes all North American public companies, particularly Canadian companies. Both are quite recent. Thus, neither dataset is an instant solution to the problem of identifying the emissions of every stock in the public markets.

Another problem with MSCI and TruCost data is that it does not measure all of the emissions of each company, and so rankings of companies by their measures will produce identification errors. Both sources measure the carbon imbedded in the reserves of oil, gas and coal extraction companies, and there is relatively little error expected in those measures. The errors occur in the measurement of greenhouse gas (GHG) emissions from non-extraction companies.

Both MSCI and TruCost measure GHG emissions using the Greenhouse Gas Protocol standards.[4] The standards define three levels of GHG emissions: Scope 1 includes all direct greenhouse gases (GHG) emissions from company sources, Scope 2 includes all indirect GHG emissions associated from the consumption of purchased electricity while Scope 3 includes other indirect GHG emissions. Scope 3 includes GHG emissions from the extraction and production of materials and services that are inputs to a company's production. In the case of technology companies which represent a growing proportion of publicly listed companies, Scope 3 is likely the most important source of GHG emissions. Unfortunately few companies report Scope 3 emissions and the measurement of Scope 3 across these companies is highly inconsistent.

Let us take the example of Apple Inc. Only 1% of the corporation's GHG emissions are Scope 1 and Scope 2. This is because the company is mainly a marketing and sales enterprise that outsources the manufacturing and delivery of its own products. 80% of Apple Inc.'s GHG emissions are Scope 3 associated with outsourced manufacturing and transportation of its product with most of the remaining Scope 3 emissions (17%) associated with product use. Many of Apple's subcontracted manufacturing activities through subsidiaries like Foxconn are in Asia in which the use of coal-powered energy is common. Thus, a focus on Scope 1 and Scope 2 GHG emissions will give a very incomplete picture of the carbon intensity of a particular company's activities.

Until GHG emissions reporting including that of Scope 3 is performed by much larger numbers of publicly listed companies, the data on GHG emissions will not be a valid tool with which to make portfolio decisions. There are too few companies with comprehensive emissions data to properly implement either a divestment or reweighting strategy. In fact, the current approach by some investors to limit their exposure to high carbon intensity companies by relying on Scope 1 and 2 GHG emissions data only, may in fact be tilting their portfolios to companies that emit low quantities of Scope 1 and 2 GHG emissions but large quantities of Scope 3 emissions. Given Laurier's pension and endowment

[4] http://ghgprotocol.org/standards

exposure to Canadian and U.S. companies, an initiative to reduce the Scope 1 and 2 GHG emissions of the portfolio (without attention to Scope 3 emissions) may in fact lead to more outsourcing by these companies to high GHG emitting suppliers in Asia and more GHG emissions associated with long distance transportation.

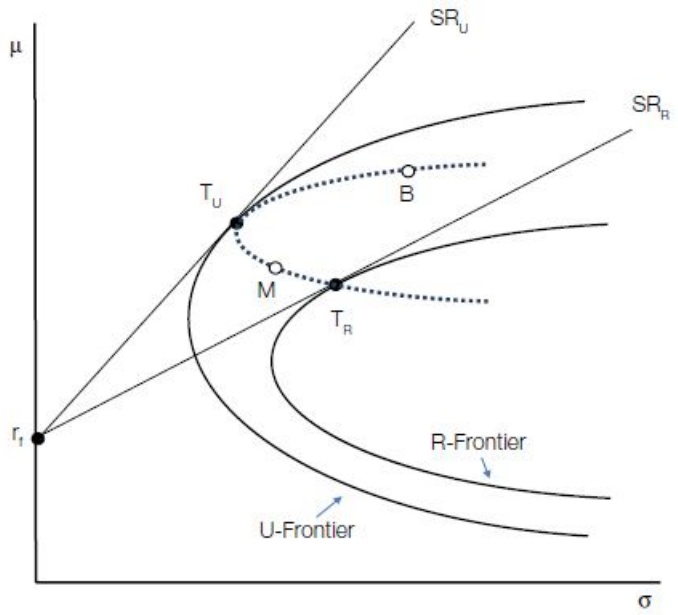
The Effect of Divestment on Risk and Return: Theory and Evidence

Financial Theory of Divestment

If investors divest from a set of stocks, then they select from a smaller feasible set, as shown in Figure 1. The U-frontier shows the unrestricted feasible set and the R-frontier shows the set of risk and return combinations available from the divested (restricted) set of assets.

Figure 1

Risk and Return for Restricted and Unrestricted Assets



If the restricted frontier is sufficiently different from the unrestricted frontier, then divestment can reduce return and increase risk which would harm the utility of restricted investors.

In the context of the Capital Asset Pricing Model, a divested portfolio would have unnecessary diversifiable risk and would therefore plot below the security market line, with a lower return. Much of the empirical research (surveyed below) on socially responsible investing (SRI) use the CAPM (and other factor models) to estimate whether the returns to socially responsible (restricted) portfolios are below the return estimated by the CAPM.

Merton (1987) as one of the first used to tackle effect of neglecting stocks in an equilibrium setting. Under the Merton model idiosyncratic risk is priced because investors have limited diversification opportunities when they neglect to invest in a given set of stocks. Also, neglected stocks have higher idiosyncratic risk since their risk is split over a smaller set of investors. Fama and French (2007) present a different analysis, arguing that investors may have nonpecuniary preferences for holding assets. For example, investors may derive a disutility from holding fossil fuel stocks, and, in that case, the Capital Asset Pricing Model (CAPM) fails to hold.

More recently, using Merton 1987 and Fama and French (2007) intuition, Luo and Balvers (2017) propose a general equilibrium model to explain the asset prices when a set of stocks is boycotted by socially responsible investors. An immediate implication is that two types of investors no longer have identical investment opportunity sets and choose different portfolios. The standard CAPM is no longer valid, and additional to the market factor, a second systematic risk factor emerges, which they refer to as the investor boycott risk factor or simply the boycott factor.

In the Luo and Balvers model, the unrestricted investors hold all neglected stocks so they are overweighted in neglected stocks relative to the market portfolio.. The lower demand for neglected stocks lowers their price and makes them more attractive for unrestricted investors. In equilibrium, unrestricted investors require an additional risk premium to hold the surplus of neglected stocks. The returns to all stocks, not only the rejected ones, are affected by their return covariances with the boycott risk factor. Thus, neglecting some stocks affects the neglected stocks and other stocks whose returns are correlated with those of the neglected stocks (i.e., any company in a related business). Their model also predicts that the boycott risk premium will rise with the intensity of socially responsible investing and fall during recessions when restricted investors may be less willing to sacrifice for their principles.

Lou and Balvers conclude that if the goal of SRI is to increase the cost of capital of socially objectionable businesses and, consequently, reduce their presence, then divestment can achieve that goal. The boycott accomplishes the restricted investors' desired objective to lower values of objectionable businesses, reducing their incentive to expand. However, the boycott also raises the cost of equity for stocks that are correlated with boycotted stocks. If those correlated stocks are not sin stocks, then the boycott is a "somewhat blunt instrument for discouraging morally or socially objectionable activity."

In the case of a fossil fuels boycott, there are many companies in the economy that use fossil fuels as an input and many others that service the fossil fuel extraction firms. In addition, fossil fuels are the primary source of electricity in North America (>60%) and so any impact on fossil fuels will also have an impact on any energy intensive business. Thus, there are many companies that are correlated with fossil fuels companies. If a divestment campaign focussed on fossil fuels were even somewhat effective, Lou and Balvers predict that the fossil fuel companies would experience higher returns (and a higher cost of capital) and so would the returns on any company correlated with fossil fuels. The divestment campaign would hurt many other companies in the economy.

Empirical Evidence

Investments based on social, ethical and environmental criteria are a significant segment of the international capital markets. In 2016, about $8.7 trillion dollars were invested in socially screened

portfolios in the United States which is over 20% of all investment assets under management.[5] Empirical analysis of SRI funds dates back as early as 1972 (Moskowitz, 1972). Since then numerous studies have investigated the performance of SRI investments and compared the findings to the performance of conventional assets. The growing consensus in the literature is that SRI screens and constraints do not negatively affect investment returns. Hamilton, Jo, and Statman (1993) measure Jensen's alpha for a sample of 32 socially responsible mutual funds over the period from 1981 to 1990. They find that socially responsible funds do not earn statistically significant excess returns and that the performance of such funds is not statistically different from the performance of conventional mutual funds. Guerard (1997), Goldreyer, Ahmed, and Diltz (1999), and Bauer, Koedijk, and Otten (2005) provide similar evidence. Geczy, Stambaugh, and Levin (2003) do find screening has the potential to impose significant penalties, conditional on the beliefs of the investor about the ability of the fund manager to outperform the market through active management.

More recently, a number of studies have documented that "Sin" stocks earn significant positive abnormal returns after controlling for risk (i.e., Fabozzi, Ma, and Oliphant (2008), Hong and Kacperczyk (2009), and Statman and Glushkov (2009)). Sin stocks are issued by firms engaged in socially or morally objectionable activities, such as alcohol, adult services, gaming, tobacco and weapons. Sin stocks are the stocks that are avoided by the SRI screens mentioned above. Those studies attributed the return premium as a return for litigation risk, illiquidity, and neglect. In contrast, Luo and Balvers (2017) explain the sin stock premium to as a systematic risk premium arising as a consequence of the successful SRI divestment campaign.

To the best of our knowledge, there are no published studies of the long-term performance of portfolios that divest from fossil fuel producers or carbon intensive stocks more generally. We are at the early stages of studying this issue. Over the spring we plan to purchase the MSCI and TruCost GHG emissions data and use that to form low carbon portfolios. During the summer, we will estimate the abnormal returns of such portfolios using a variety of financial models and empirical techniques. We hope to have preliminary results by the late summer and would be willing to share those results with the Working Group.

Conclusions

The stranded asset thesis is one thesis of many. Only a very confident investor tailors their entire investment strategy around hedging one thesis. Investors who are uncertain about future risks use broad diversification as the optimal risk management strategy.

Even if one accepts the thesis and decides to hedge, implementing a divestment or reweighting strategy is fraught with problems. Selecting firms for divestment on a theoretical basis is conceptually difficult, and doing so on an empirical basis using GHG emissions data is complicated by misleading data. The current GHG emissions data incorrectly ranks companies.

Finance theory predicts that a divested portfolio will earn reduced returns and experience greater unsystematic risk. Divested portfolios would be expected to earn lower returns than predicted by equilibrium models like the Capital Asset Pricing Model. Lou and Balvers (2017) derive an equilibrium model of divestment which predicts that the stocks of divested (boycott) companies will earn higher

[5] The Forum for Sustainable and Responsible Investment. < http://www.ussif.org/index.asp>

returns. This raises the cost of capital to those companies and so should put economic pressure on them, however it also does the same thing to any company correlated with the object of divestment. Lou and Balvers refer to divestment as a blunt instrument.

The empirical evidence is that portfolios which divested from socially irresponsible companies (sin stocks) performed the same as unrestricted portfolios. However, portfolios of sin stocks have earned abnormally high returns, which is consistent with Lou and Balvers (2017) predictions. There is no published evidence about the performance of portfolios divested from fossil fuel stocks, but Professors McNally, Perez and Smith propose to research that topic over the next year.

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