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Operating leverage: an underutilized risk management tool

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Introduction

Operating leverage refers to the relation of a firm's fixed to variable costs.[1] This relation can be used to support specific business strategies, enhance growth opportunities as well as manage systematic risk. All of these aspects can impact firm value and performance. This article is intended to stimulate some additional thought on the implications of operating leverage and nudge CFO's into more actively managing their cost structure.

As a brief refresher on cost behavior, fixed costs are those costs which do not change with changes in volume. Fixed costs typically include things like rent, insurance, property taxes, fixed salaries and employee benefits (excluding hourly compensation) and depreciation on property, plant and equipment. In each of these cases, if the firm produces one more or less unit, the total fixed costs do not change. The firm does not need to hire additional management, or rent additional facilities just to produce one more unit. In fact, we call the range of activity where fixed costs do not require a change to be the relevant range as that is the range of activity across which a linear approximation of the total cost function applies. In other words, total costs are equal to the fixed costs plus the per unit variable costs times the number of units produced. At some point the enterprise cannot produce one more unit without adding additional capacity,

[1] The terms fixed and variable costs refer to how a firm's total cost responds to changes in business activity. Total fixed costs do not depend on volume, while total variable costs increase or decrease with changes in volume.

usually in the form of fixed costs, and that is when they violate the relevant range and have to change their fixed costs.

In contrast, variable costs are those where the total cost changes with activity. Variable costs typically include things like hourly compensation for direct labor, direct materials, variable overhead such as electricity and variable operating costs such as sales commissions. If the firm sells one additional unit, the total costs will increase by the cost of the material, labor, overhead and sales commission associated with that unit. The relationship between the firm's fixed and variable costs is referred to as their cost structure.

A useful summary measure of the cost structure is the degree of operating leverage (DOL). For a firm with a high DOL, a greater portion of their total costs are fixed in nature and thus do not change as much when volumes flex. Conversely, a firm with a low DOL will have a higher proportion of variable to fixed costs. Low DOLs are associated with greater changes in total costs in response to changing levels of demand and production.

The difference between fixed and variable costs becomes especially meaningful when a firm is growing or shrinking. In an expanding market, a firm with a high degree of operating leverage (DOL) will see its total costs increase at a slower pace than its sales. This happens because the firm's fixed costs do not increase with the activity level. The only costs that are added are the variable costs, and if the firm has a high DOL, the amount of variable costs is small. This means firm profit will grow faster than revenues on a percentage basis. For example if a firm produces units that it sells for $2.00 each that cost $1.00 in fixed costs, and $.50 in variable costs, adding one additional unit of demand will increase revenues by $2.00 and costs will only increase by $.50, leaving an extra $1.50 in profit. In contrast, a similar firm who sells an identical item for $2.00 that cost $.50 in fixed costs and $1.00 in variable costs, will see its

revenues increase by $2.00, while its costs will go up by another $1.00, leaving only a $1.00 change in profit for the firm with the low DOL. Alternatively, a firm with a high degree of operating leverage experiencing contraction in their product market will see total costs decline at a slower rate than revenue, leaving operating income falling even faster than sales on a percentage basis.

Leverage no matter what you call it

CFO's typically pay careful attention to their financial leverage, and have a view as to what their capital structure should be and why. High degrees of financial leverage are associated with higher costs of capital, increased macroeconomic exposure, higher risks of bankruptcy and tighter limitations on borrowing. In much the same way, operating leverage can have similar effects to financial leverage and should also be in the forefront of the CFO's planning and directing activities.

Because both financial leverage and operational leverage increase the firm's macroeconomic exposure, both should be considered in combination, and not separately as firms usually do. Firms may need to adjust their capital structure in order to fine-tune the macro-economic exposure they wish to take on after considering their operating leverage. Because capital structure is easier to modify in the short term, the analysis should start with operating leverage. The purpose of this article is to highlight the main implications of operating leverage including aspects that complicate its management, such as potential agency issues, as well as to make a case for its active management as part of an integrated business system. The best way to identify the cost structure of the firm is to break out all costs into their fixed and variable components, which is far easier said than done. Because this exercise is naturally difficult, I will provide a couple of additional approaches for the measurement of DOL later in this paper.

The implications of operating leverage

A firm's level of systematic risk, or exposure to macroeconomic conditions in the product market, impacts firm performance through the DOL. Normally, we think of financial leverage as the primary mitigating factor for systematic risk exposure. However, operating leverage acts similar to financial leverage. When a firm has more debt, it is riskier than a firm with less debt because it faces fixed cash payments that if not made might threaten its ongoing concern. When the firm has a high degree of fixed costs, the consequences are the same. Increases in leverage of either a financial or an operating nature impact the firm's cost of capital, NPV calculation for project evaluation and potentially their ability to borrow in the debt market. The greater the fixed cost, the more risk the firm faces. This becomes extremely important during periods of economic recession, or when the firm faces significant headwinds such as price wars, trade disputes, labor strikes, etc.

For all firms, capital structure is readily available from the summary financial statements. While the historic values on the balance sheet may not exactly reflect current market values of debt and equity, they generally give a reasonable indication of the firm's capital structure. For publicly traded firms, we can also assess capital structure by simply looking up the firm's market capitalization (the equity value), and the market value of their debt on a financial website such as Yahoo Finance or Morningstar. Viewing the current values of debt and equity in the capital markets gives the most accurate view of capital structure and should be used whenever possible. Operating leverage on the other hand is typically much harder to assess. For financial leverage, the division between debt and equity is easy to estimate as previously mentioned. However, you will not find fixed and variable costs broken out in the financial statements, nor on a typical financial website such as Yahoo Finance or Morningstar.

Precisely identifying cost behavior requires additional financial analysis. Typically this analysis is much easier if viewed from within the internal reporting system of the firm. Firms could examine each purchase order and label the costs as either fixed or variable, or they might attempt to summarize by account in the chart of accounts. Either way, this type of detailed analysis is not available to outsiders that cannot view actual spend data in the firm's accounting system.

Breaking out costs into their fixed and variable components by invoice or account may be artificial, as many costs are more likely to be mixed in nature and not strictly fixed or variable. So this type of analysis is noisy. Even then, while it is possible that a firm may split fixed and variable costs within its chart of accounts for internal use, the separation of fixed and variable costs is not required by GAAP, so it usually goes unreported. The lack of reporting requirements, combined with a lack of clarity on classifying fixed and variable costs might lead to operating leverage receiving less executive discussion than financial leverage.

Most importantly, because senior management delegates to subordinate managers contracting decisions that influence the DOL, these factors may not be self-evident to senior leadership, and as such, the executive staff may not be fully aware of the individual effect of each contracting decision on the firm's overall operating leverage. Therefore, CFOs are less likely to be able to assess or actively manage operating leverage as compared to financial leverage.

When facing contracting decisions, lower-level managers often focus on average piece price minimization based on volume estimates without regard for the decisions impact on the firm's aggregate DOL. Obviously the CFO cannot be personally involved in every sourcing decision, therefore it is critical that front-line managers are thinking about how to make the right

strategic choices with respect to cost behaviors on a day-to-day basis when they are making sourcing decisions. This requires some guidance from the CFO as to what level of fixed cost exposure they want the firm to bear. Even then, it can be difficult for the CFO to communicate their target DOL as the measurement is inherently noisy.

Managers often think in terms of minimizing the total cost per unit of production, but that often involves committing to significant amounts of fixed cost that can be amortized across a large number of units, leaving the lowest possible price per unit. For example, imagine a factory is considering automating a work station that will result in the reduction of direct labor requirements by two workers. Assume the upgrade has a useful life of 8 years and requires a $1,600,000 investment upfront. This translates into annual depreciation expense of $200,000 (assuming zero salvage value for simplicity). Also assume there are some additional variable costs associated with the project such that energy consumption will increase by an estimated $10,000 per year (based on expected annual demand of 150,000 units) after launching the project. The workers have a fixed component to their cost of $50,000 per person for benefits, and another $50,000 per person in annual compensation that is purely variable in nature based on how many hours they work. Both options, upgrading or not, have mixed cost components with different degrees of operating leverage. At the expected volume of 150,000 units per year, the two employees will cost $.67 per unit in variable costs (variable labor of $100,000 divided by 150,000 units), plus $100,000 per year in fixed labor costs. The equipment will cost $.07 per

unit in variable costs (electricity costs $10,000 to produce 150,00 units), plus another $200,000 per year in fixed costs (depreciation). Total cost for the two alternatives can be estimated as[2]:

Option 1 - Automation upgrade: Total Cost = $200,000 + $10,000/150,000 x Quantity

Option 2 - Retaining direct labor: Total Cost = $100,000 + $100,000/150,000 x Quantity

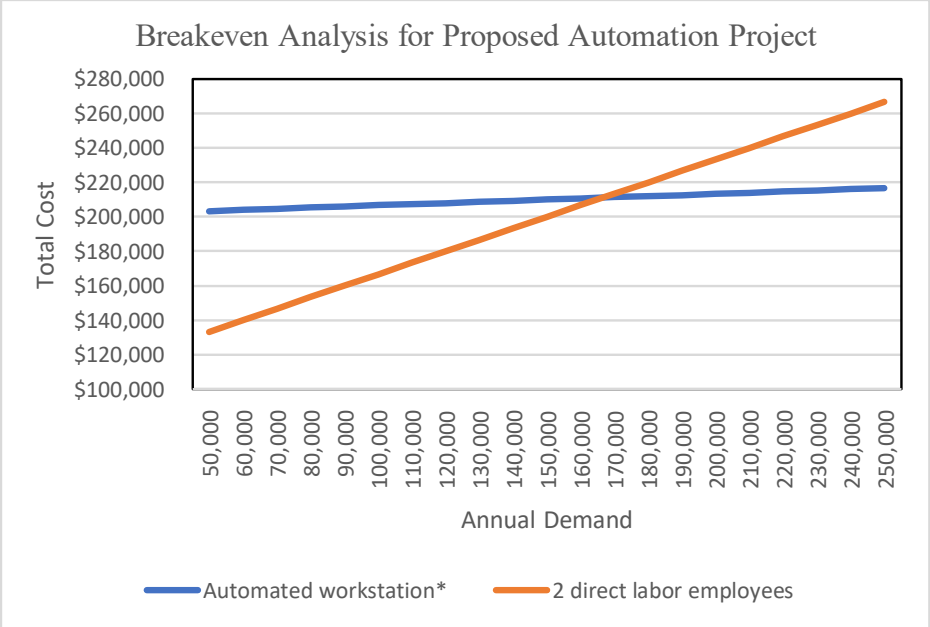
In the above equations, the quantity actually produced (Quantity) will drive total cost. The estimated annual quantity is only relevant for estimating the variable cost per unit. Total variable costs will be related to actual production.

Because each of these equations is a linear function of the quantity produced, and since each has a different slope (variable cost per unit), the two cost functions must equal each other at some volume (the breakeven point). In this example, when the quantity is 166,666 annual units, the total cost for both options would be exactly equal at $211,111. At the estimated volume of 150,000 units per year, the automation project would cost $210,000 in total and the current production system would cost $200,000 in total. As such, the average lower-level manager would recommend against upgrading the production line at annual volumes below 166,666 units. However, opting for the lowest cost per unit can leave a firm overly exposed to changes in demand. Demand is usually considered when analyzing a make-buy decision and as long as volumes work out to be exactly in line with the projections, the decision to make or buy is usually an easy and safe one. However, demand is a stochastic factor. For most businesses, expected demand should not be viewed as a specific number, but rather a distribution around a number with a variance embedded in the assumption. When the variance is high, the best

[2] Total costs can be estimated as Total Costs (TC) = Fixed Costs (FC) + Variable Costs/Unit (VC_u) x Quantity (Q), where the variable costs per unit can be stated as total expected variable costs divided by the expected volume of production and sales.

estimates of future demand are likely to be wrong, and the larger the variance, the larger the margin of error.

Therefore, the choice to upgrade or not should not be made strictly on the $10,000 cost difference between the two options, but rather also on the target operating leverage the firm wishes to have. Improving macroeconomic forecasts, favorable early product reviews or demand estimates that include a lower bound near the estimated volume, but that do not include an upper bound might all be reasons management would choose to increase their DOL, even if the total cost is slightly higher. If the firm wants a higher DOL, it may be worth upgrading the production process simply to take advantage of potential benefits in an expanding market. Adding some additional fixed costs, while it might appear counterintuitive, would allow the firm to better take advantage of the potential upside associated with product demand. If, instead, the demand is more likely to decrease than increase, then care should be exercised when adding fixed costs.



	Required investment	Annual Fixed Costs	Expected Annual Variable Costs	Variable Costs Per Unit
Automated workstation*	1,600,000	200,000	10,000	$ 0.07
2 direct labor employees		100,000	100,000	$ 0.67

*Note: the automated workstation has a useful life of 8 years and depreciation is assumed to be straight line for demonstration purposes, annual production is estimated to be 150,000.

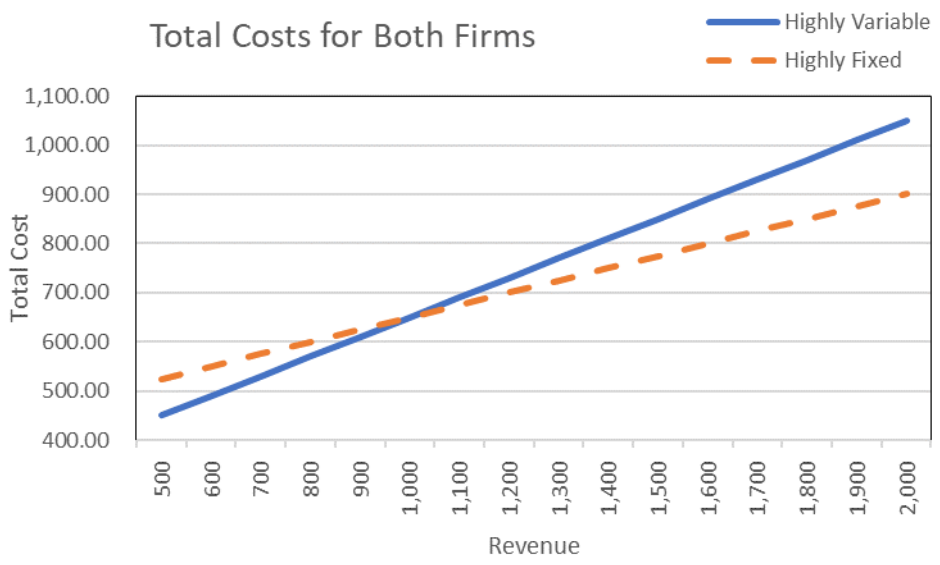
As we will see in the next section, operating leverage is dynamic in nature. DOL is inversely correlated with operating income. If volumes are over-estimated, the demand miss will result in lower operating income, leaving the firm with an even higher degree of operating leverage and as such a higher exposure to further decreases in demand. The change in DOL exposes the firm to even more risk if subsequent periods continue to manifest lower than expected volumes, which could create a vicious cycle that can threaten the business.

For example let's compare two firms: one with a higher degree of operating leverage (Highly Fixed Cost Structure) and one with a lower degree of operating leverage (Highly

Variable Cost Structure). Both companies start off with a base level of $1,000 of revenues in a normal economy, and both companies double their revenues in an economic boom, and halve their revenues in a recession. The variable costs are constant as a percentage of sales under each business model and the fixed costs are held constant in Dollar terms under each business model. Total costs in the normal economy are equal for the two businesses.

	Highly Variable Cost Structure						**Highly Fixed Cost Structure**					
	Recession		Normal		Boom		Recession		Normal		Boom	
Revenues	500		1,000		2,000		500		1,000		2,000	
Variable Costs *(as % of sales)*	200	*40%*	400	*40%*	800	*40%*	125	*25%*	250	*25%*	500	*25%*
Contribution Margin	300		600		1,200		375		750		1,500	
Fixed Costs *(as % of sales)*	250	*50%*	250	*25%*	250	*13%*	400	*80%*	400	*40%*	400	*20%*
Operating Income	50		350		950		(25)		350		1,100	
Degree of Operating Leverage	6.00		1.71		1.26		n/a		2.14		1.36	
*Note: Total Costs *(as % of sales)*	450	*90%*	650	*65%*	1,050	*53%*	525	*105%*	650	*65%*	900	*45%*

The higher degree of operating leverage causes the Highly Fixed Cost Structure firm's operating income to vary more with the changes in the economic cycle. In the recessionary state, the Highly Fixed Cost Structure's operating income turns negative and may threaten the firm with bankruptcy. At no point is Highly Variable Cost Structure in danger of bankruptcy. However, in exchange for the additional risk, Highly Fixed Cost Structure also has the highest overall performance under a boom economy when Highly Variable Cost Structure trails in operating income. In this example, the two firms have the same total costs when revenue equals $1,000. At any volume above $1,000, the Highly Fixed Cost Structure firm presents lower total costs than Highly Variable Cost Structure, which in turn will yield greater profits for the same level of revenues. The inverse is also true, below $1,000 in revenues Highly Variable Cost Structure has lower total costs than Highly Fixed Cost Structure and will have greater income.



This simple example highlights how the degree of operating leverage magnifies the macro-economic or systematic risk a firm bears. Worse yet, as the recession hits and income shrinks, the degree of operating leverage naturally increases because the firm now effectively has even higher fixed costs, compared to variable costs, because fixed costs held constant in the recession, while the variable costs flexed down with the decrease in volume.

Industry aspects of operating leverage

Capital-intensive industries are characterized by higher fixed costs and thus higher operating leverage, while labor-intensive industries are characterized by higher variable costs, and thus lower degrees of operating leverage. As such, there are industry trends for operating leverage that should be considered when setting internal targets for DOL.

Other industry characteristics that should be considered are the volatility of their demand, and the growth rate of the industry. Industries that have higher volatility in demand exaggerate the risk presented by DOL. Firms in industries that are characterized by high growth are likely to need access to more capital. Sourcing with a higher proportion of variable costs can also be

associated with reduced capital expenditures (as evidenced by lower depreciation expense), which can free up capital to be used for investment necessary to support growth.

Degree of Operating Leverage by sample company

Company	2011	2012	2013	2014	2015	2016	5-Year Average
CVS Health Corp	0.60	0.62	0.58	0.59	0.59	0.73	0.62
Apple Inc.	1.00	0.88	1.09	1.09	1.02	1.12	1.03
McDonald's Corp	1.05	1.05	1.14	1.21	1.05	0.95	1.08
Ford Motor Company	0.62	0.29	4.16	0.54	0.66	0.79	1.18
Kellogg Co.	1.13	1.10	0.65	1.89	1.74	1.19	1.28
HCA Healthcare	4.87	5.45	4.85	4.89	5.06	5.41	5.09

Not unlike traditional wisdom on financial leverage, the safest degree of leverage is likely somewhere in the middle of an industry group. If a firm is at the higher extreme of leverage, their profits will be more volatile than their peers. If they opt for the lower extreme of leverage, the firm is likely to trail their competitors during the good times. A critical difference between managing financial leverage and operating leverage is that, as mentioned above, measuring the DOL is much more difficult than measuring capital structure.

Measurement of DOL

In multiperiod models, The DOL can be calculated as the change in operating income with respect to changes in revenues. In single period estimates, the DOL should be calculated as the contribution margin (sales less total variable costs) divided by the operating income for the firm. Both calculations will yield equivalent results as noted in the graphic below. However, as mentioned before, separating variable costs from fixed costs can be difficult, which makes the calculation of contribution margin equally challenging.

	Year 1	Year 2	Change
Sales	1,000	1,100	10%
Variable Costs	300	330	10%
Contribution Margin	700	770	10%
Fixed Costs	400	400	0%
Operating Income	300	370	23%

Contribution Margin/Operating Income: 700/300 or 2.33
% change in Operating Income/% change in Sales: 23%/10% or 2.33

In order to estimate the total costs for DOL calculation purposes, simply subtracting operating income from revenues will provide a reasonable estimate of the total operating costs. Using operating income instead of net income is appropriate because interest and tax expenses should be excluded from the analysis as the financing choices for a firm are made at only the most senior levels. The DOL calculation should focus on operating costs only which can better explain at the impact of operating leverage on the natural business of the firm.

Managers also need to consider the complexity of the product mix when calculating DOL. A firm with limited product offerings might want to estimate the variable costs of production as direct materials and direct labor, plus some amount of variable overhead if estimable. They would also need to estimate the variable portion of operating costs, which typically include, but are not limited to, sales commissions, and potentially outbound freight costs. Care needs to be taken not to simply divide total overhead (or operating costs) by units produced though as that would represent the average overhead per unit (or operating cost per unit), not the variable overhead (or operating cost) per unit. Overhead expenses are typically mixed costs and taking the total mixed costs per unit and treating them as a variable cost per unit will understate the firm's operating leverage. However, when the number of products (SKUs) is large, this approach can be extraordinarily difficult as product mix can significantly complicate the estimation unless the weights of mix components are precisely known.

Firms with a wide variety of SKUs and a long history of results can estimate the variable costs as a percentage of sales by regressing total costs on total revenues. Beta coefficients calculated in this fashion approximate the change in total costs for each dollar change in revenue. Regressing total costs on revenues should produce informative results that are useable for internal analysis. However, to control for any spurious correlation that may result from inflation, the most appropriate estimation will use the natural log of total costs and the natural log of sales. To calculate the natural log for costs and sales, you can simply type '=LN(COSTS)' and '=LN(SALES)' into Excel where COSTS and SALES are the variables that represent the total costs and revenues during any particular period. This approach can be difficult to communicate as most practitioners do not use logarithms in practice. If the regression is calculated on the logged values, the coefficient should be interpreted as the percentage change in total costs associated with a one percent change in revenues. If you multiply the beta coefficients from a logged model by the average total costs over the average revenues you will approximate the beta coefficients from the non-logged model. Note that you cannot compare the beta coefficients of a logged and non-logged model without multiplying the logged coefficients by the ratio of costs to revenues as they are scaled differently.

Multiplying the final result times the revenue for any given period will result in a good estimate of variable costs, which if subtracted from revenues will approximate contribution margin. Dividing the contribution margin by the operating income will provide the second method of estimating DOL.

Period	Sales	=LN(SALES)	Variable Costs	Fixed Costs	Total Costs	=LN(COSTS)
1	1,000	6.9	284.0	310.5	595	6.388
2	1,007	6.9	283.5	317.5	601	6.399
3	1,011	6.9	285.2	328.7	614	6.420
4	1,031	6.9	291.2	306.2	597	6.393
5	1,079	7.0	306.1	325.9	632	6.449
6	1,132	7.0	321.1	304.1	625	6.438
7	1,218	7.1	341.0	322.4	663	6.497
8	1,301	7.2	372.6	329.5	702	6.554
9	1,423	7.3	400.2	310.8	711	6.567
10	1,455	7.3	410.3	334.6	745	6.613
Average	***1,166***	***7.1***	***329.5***		***649***	***6.475***

1) Non-logged model, regressing Total Costs on Sales:

Beta: 0.302

2) Logged model regressing LN(COSTS) on LN(SALES):

Beta: 0.550

Scaling factor: 0.556

Beta x Scaling factor: 0.306

*In both models, the result can be interpreted as the percentage of sales that represents variable costs.

Conclusion

Operating leverage, like financial leverage, can be used to manage a firm's macroeconomic exposure. However, planning and executing the corporate plan for operating leverage is difficult. First, many agents play a role in the smaller operating decisions that add up to the total operating leverage. Second, estimating variable costs can be difficult, especially in firms with complex product mix. Third, operating leverage is highly dynamic, meaning that the DOL changes as the revenues change.

Unfortunately, the changes that naturally occur are counterintuitive in nature. When revenues shrink, which is precisely when you would want a lower DOL, because the variable costs shrink with the revenues, while the fixed costs remain constant, the DOL naturally

increases. This could lead to a vicious cycle. Similarly, as mentioned before, the best time to have a lot of leverage is when revenues are expanding. In that moment, you would want to have a high DOL and a low level of variable costs, so costs do not increase as fast as revenues. You would want increased systematic exposure, but precisely then the DOL naturally decreases. This happens because as revenues grow, variable costs increase with sales, and fixed costs remain constant. Since the fixed costs are increasing slower than the variable costs, the DOL decreases. Both of these effects go against the interest of the firm as they change the exposure to risk in the wrong direction which, if not actively managed, can lead to a problems for the firm, either in terms of adding too many variable costs, or not being able to shed fixed costs. These are all reasons why the CFO needs to develop an intentional plan for operating leverage, implement a measurement system and monitor the development of the DOL regularly. Firms that do not actively manage DOL may find themselves unknowingly bearing unwanted levels of risk while firms who consider their operating leverage while setting capital structure policy can gain advantages in cost of capital, access to loans and more favorable exposure to systematic risk.