Cross-Subsidies, External Financing Constraints, and the Contribution of the Internal Capital Market to Firm Value

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We examine the link between the excess value of a diversified firm and the value of its internal capital market. Subsidies to small financially constrained segments with good relative investment opportunities significantly increase excess value, while transfers of resources from segments with good relative investment opportunities significantly decrease excess value. Of interest is that subsidies to small financially constrained segments with poor relative investment opportunities also significantly increase excess value. However, there is little evidence that this result depends on the diversity of a firm's investment opportunities. We conclude that financing constraints drive the relationship between the internal capital market and firm value.

Numerous studies document that diversified firms have lower valuations than comparable portfolios of specialized firms.[1] A plausible explanation for this discount is that diversified firms allocate capital inefficiently, and that this reduces firm value. In support of this view, Jensen (1986) and Stulz (1990) argue that cash-rich firms may overinvest in business segments with poor investment opportunities. More recently, Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000) argue that rent-seeking or power-grabbing behavior by segment managers may lead to inefficient capital allocation in diversified firms.[2] However, a number of authors argue that internal capital markets can enhance firm value if firms

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[1] See, for example, Lang and Stulz (1994), Berger and Ofek (1995), Comment and Jarrell (1995), and Servaes (1996). Lins and Servaes (1999) document a diversification discount in Germany, Japan, and the United Kingdom.

[2] Other articles that examine the workings of internal capital markets include Meyer, Milgrom, and Roberts (1992), Gertner, Scharfstein, and Stein (1994), Maksimovic and Phillips (2002) and Matsusaka and Nanda (2002).

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face external financing constraints. In such a setting, Weston (1970), Williamson (1975), and Stein (1997) argue that the allocation of capital within a diversified firm can create value if funds are diverted to business segments rich in investment opportunities but lacking sufficient self-generated funds.

The empirical literature is mixed over the questions of whether diversification leads to inefficient internal capital allocation, and whether internal capital allocation influences diversified firm value. Lamont (1997), Scharfstein (1998), Shin and Stulz (1998), and Rajan, Servaes, and Zingales (2000) find evidence of cross-subsidization in diversified firms and show that capital allocation tends to be inefficient. Rajan, Servaes, and Zingales also find evidence consistent with the claim that inefficient capital allocation reduces diversified firm value, and Berger and Ofek (1995) find that the diversification discount is increasing in the amount of investment in segments operating in industries with low Tobin's Q. However, Villalonga (2000) and Whited (2001) argue that much of this evidence is misleading because of biased estimates of the investment opportunities of the business segments of diversified firms. Indeed, Villalonga shows that if this bias is corrected or if the firm's activities are broken down into business units instead of Compustat segments, then the diversification discount reverts to a diversification premium. In addition, Chevalier (2000), Campa and Kedia (2002), and Hyland and Diltz (2002) argue that selection bias may explain the diversification discount and the evidence of inefficient cross-subsidies offered to explain it. In particular, Campa and Kedia and Hyland and Diltz find that diversified firms trade at a discount to their industry peers *prior* to becoming diversified, and Chevalier finds that the cross-subsidization patterns documented in the literature can be found among merger partners *prior* to merging.

The objective of this article is to directly examine the link between the excess value of a diversified firm and the value of its internal capital market. We develop a measure of the value of the firm's internal capital market that separately accounts for subsidies and transfers, the relative efficiency of these resource flows, and conditions on whether the segments receiving subsidies would be financially constrained if they were stand-alone firms. Our measure of the value of a diversified firm's internal capital market uses measures of segment investment opportunities that are relatively free of the biases incorporated in earlier studies and is the first such measure of the value added by capital allocation that conditions on financing constraints. The latter innovation allows us to highlight the critical role that the internal capital market plays in allocating capital to segments that would otherwise be financially constrained in their investment decisions. Finally, our measure of the value of a firm's internal capital market allows us to directly assess the impact on diversified firm excess value of the various components of a firm's internal capital market,

including the separate effects of efficient and inefficient subsidies and transfers.

Our measure of the value of a firm's internal capital market has three key components. Focusing on reported segments of a diversified firm, we first compute the amount by which a segment's capital expenditures either exceed or fall short of its own after-tax cash flow. Positive differences identify subsidy segments, with the amount of the subsidy isolating those capital expenditures that could not be made in a single-segment firm without external financing or the depletion of existing assets. Negative differences identify transfer segments that are then allocated a share of the firm's dividend payment to compute the net amount of the transfer. We then use two different procedures to compute the relative efficiency of these subsidies and transfers. The first approach uses the segment's return on assets minus the weighted average return on assets of the firm's other segments. The second approach estimates a fitted Q for each segment and computes efficiency as the difference between the segment's fitted Q and the weighted average fitted Q of the firm's other segments. Finally, we use a logistic model estimated with single-segment firms to compute the probability that a subsidy segment would face an external financing constraint if it were a stand-alone firm. This procedure allows us to group subsidies into those received by financially constrained and unconstrained segments. We compute an overall measure of the value of a diversified firm's internal capital market as the sum across segments of the relative efficiency-weighted subsidies and transfers. We further split this overall measure into six components: efficient and inefficient subsidies to financially constrained segments, efficient and inefficient subsidies to unconstrained segments, and efficient and inefficient transfers.

In a sample of 4204 firm-year observations of multisegment firms during the period 1990–1998, we estimate the excess value of a diversified firm using Berger and Ofek (1995) excess value measures based on assets, sales, and earnings multiples. Similar to the findings of Berger and Ofek, we find that diversified firms in our sample trade at a significant discount relative to comparable portfolios of stand-alone firms. However, we find no reliable statistical evidence that these excess value measures are significantly related to our overall internal capital market measure. We therefore sharpen the focus of the analysis by examining the links between excess value and the six internal capital market components. Consistent with efficient internal capital market theory, we find that efficient subsidies to otherwise financially constrained segments significantly increase excess value. In sharp contrast, efficient subsidies to unconstrained segments are never a significant determinant of excess value. The implication is that financing constraints drive the link between internal capital market subsidies and diversified firm excess value. Specifically, subsidization of segments with good investment opportunities is valuable only when the

segment would have difficulty funding the investment as a stand-alone firm. We also find that inefficient transfers (dollar flows away from segments having good relative investment opportunities) significantly decrease excess value. By contrast, efficient transfers (dollar flows away from segments having poor relative investment opportunities) have virtually no effect on excess value.

Of interest is that inefficient subsidies to financially constrained segments also significantly increase excess value. While inconsistent with efficient internal capital market theory, this result is consistent with the theory of Rajan, Servaes, and Zingales (2000). In their model, headquarters transfer resources from large segments with good investment opportunities to small segments with poor investment opportunities to mitigate divisional managers' incentives to choose self-serving investments. In our sample, inefficient constrained subsidy segments are small and clearly have poor relative investment opportunities. Of importance is that the Rajan, Servaes, and Zingales model predicts that this inefficient cross-subsidization is more important when a firm has high diversity of size-weighted investment opportunities across segments. Consistent with this prediction, we find that the amount of subsidies flowing to inefficient constrained segments increases with diversity. However, we find little evidence that the positive relationship between inefficient constrained subsidies and excess value is stronger in more diverse firms.

Our work is related to several recent articles that examine the influence of financial constraints on the value of diversification. Hubbard and Palia (1999) examine the value of diversifying acquisitions during the conglomerate merger wave of the 1960s, when arguably U.S. capital markets were less developed than they are today. They find that bidder returns in conglomerate mergers were significantly higher when financially unconstrained buyers acquired constrained targets. Fauver, Houston, and Naranjo (1999), Khanna and Palepu (2000), and Lins and Servaes (2002) examine the link between the value of diversification and capital market development. All three articles find little evidence of a diversification discount in emerging market countries, suggesting that large diversified firms in these countries are better able to access external financing. By comparison, the findings of this article suggest that financing constraints continue to play an important role in the determination of the benefits of diversification for U.S. firms, despite the fact that U.S. capital markets have clearly reached a high level of development.

The remainder of the article is organized as follows. Section 1 describes the sample, develops our internal capital market measure, and provides descriptive statistics. Section 2 presents the empirical results linking the value of a diversified firm to the components of its internal capital market. Section 3 examines the sensitivity of the results to alternative procedures of measuring internal capital market subsidies and transfers. Section 4 concludes.

1. Sample and Variable Construction

We first describe the sample of diversified firms used in the empirical analysis. We then discuss the development of our empirical proxies for the value of the internal capital market and define the other variables used in the analysis. Lastly, we provide descriptive statistics for the sample.

1.1 Sample of firms

The Statement of Financial Accounting Standards (SFAS) No. 14 and Securities and Exchange Commission Regulation S-K require firms to report information on business segments that contribute 10% or more to consolidated firm sales, assets, or profits. The required information includes segment-level capital expenditures, earnings before interest and taxes, depreciation, sales, and assets for up to 10 business segments. The active and inactive Compustat Industry Segment (CIS) files report segment information for all Compustat firms other than utility subsidiaries. This segment information is used to identify diversified firms and to construct the internal capital market and diversified firm value measures. We require sample firms to have at least two business segments, total consolidated firm sales of at least $20 million, and not be in the financial industry or have segments in the financial industry.[3]

Multisegment firms may not fully allocate accounting items to their reported business segments. This lack of consistency in reporting may induce a problem with the use of business segment data. We therefore adopt Berger and Ofek's (1995) convention of requiring that the sum of segment sales (assets) be within 1% (25%) of consolidated firm totals. For those firms meeting the above criteria, we then explicitly allocate any unallocated sales, assets, capital expenditures, operating income, and depreciation to the segments on an item-weighted basis. For example, if firm-level assets are 10% smaller (larger) than the sum of segment assets, then each segment's assets are reduced (increased) by 10%.[4] We also include firm-specific fixed effects in our regressions to control for any differences across firms in segment reporting practices. Finally, we require that sample firms have sufficient data on both the Compustat and CIS data files to compute all of the variables used in the analysis for at least two sample years. The final sample consists of 4204 firm-year observations of 921 multisegment firms over the nine-year period from 1990 to 1998. Additional sample restrictions imposed by variable construction requirements are discussed below.

[3] Berger and Ofek (1995) argue that their excess value measures are not reliable for firms with operations in the financial services industries, and so firms with any segments in these industries are excluded from the analysis.

[4] An alternative approach is to attribute any unallocated accounting items to a "headquarters" segment. The results reported below are virtually the same if we adopt this alternative approach for dealing with unallocated amounts.

1.2 Internal capital market measure

Our measure of the value of a firm's internal capital market has three key components: the exchange of resources within a multisegment firm, the relative efficiency of these exchanges, and whether segments receiving subsidies would face external financing constraints if they were stand-alone firms. We categorize segments as providers of internal capital (transfer segments) or consumers of internal capital (subsidy segments) based on the difference between a segment's after-tax cash flow and its capital expenditures. If a segment's after-tax cash flow is less than its capital expenditures, then this difference directly identifies the component of a segment's capital expenditures that is subsidized by the firm's internal capital market. By contrast, if a segment's after-tax cash flow exceeds its capital expenditures, then this excess amount is available to subsidize investment in other segments. As discussed below, we subtract an allocated share of firm dividends from a segment's transfer amount, and we require that the resulting net transfer does not exceed the segment's allocated share of subsidies to other segments.

This direct approach to measuring cross-subsidies differs from the two approaches taken in the existing literature. The first approach, adopted by, for example, Shin and Park (1998) and Shin and Stulz (1998), is to regress a segment's capital expenditures on a proxy for the segment's (unobservable) Tobin's Q, the segment's own cash flow, and the cash flow of the firm's other segments. A positive coefficient estimate on other segment cash flow is interpreted as evidence of cross-subsidized capital expenditures. Whited (2001) criticizes this approach, arguing that measurement error in Q will severely bias the coefficient estimates on the cash flow variables. Indeed, she finds no evidence of cross-subsidization or of inefficient allocation of resources in diversified firms after using measurement error consistent estimators in these investment-Q regressions. Chevalier (2000) also criticizes this method, arguing that the cash flow of other segments may be correlated with the investment opportunities of the investing segment. In a sample of diversifying mergers, she finds that the investment of one merger partner is correlated with the cash flow of the other partner *prior* to the merger, when there can be no cross-subsidization.

The other approach, pursued in Scharfstein (1998) and Rajan, Servaes, and Zingales (2000), is to measure cross-subsidies by the difference between a segment's capital expenditures and the average or median capital expenditures of single-segment same-industry firms. This approach has the virtue of capturing both cross-subsidies to (as measured by positive differences) as well as cross-subsidies from (as measured by negative differences) segments of a diversified firm. Nevertheless, this approach assumes that the investment opportunities facing divisions of conglomerate firms are identical to those of stand-alone firms in the same

industry. However, Chevalier (2000), Villalonga (2000), Campa and Kedia (2002), and Hyland and Diltz (2002) show that the investment opportunities of firms that choose to diversify systematically differ from those that choose to remain as stand-alone firms. As such, it is problematic to use the capital expenditure decisions of stand-alone firms as the basis of comparison to the capital expenditures of same-industry segments in conglomerates. These capital expenditure differences are likely biased estimates of subsidies and transfers. We avoid this bias by comparing the capital expenditures of segments to these segments' *own* after-tax cash flows.

Thus, in a given sample year, we compute the subsidy that segment i of sample firm j receives as

$$Subsidy_i = \max(CAPEX_i - ATCF_i, 0),$$

where $CAPEX_i$ is the segment's reported capital expenditures and $ATCF_i$ is the segment's after-tax cash flow. Segment i's after-tax cash flow is computed as

$$ATCF_i = (EBIT_i - I_i)(1 - T_i) + D_i,$$

where $EBIT_i$ is segment i's reported earnings before interest and taxes, I_i is segment i's imputed interest expense, T_i is segment i's imputed tax rate, and D_i is segment i's reported depreciation expense. Imputed interest expense I_i is computed as the product of segment i's reported sales and the median ratio of interest expense to sales of single-segment firms in segment i's industry. The imputed tax rate T_i is the median ratio of taxes paid to pretax income of single-segment firms in segment i's industry. The segment's industry is based on the narrowest SIC grouping (starting with four digits) that yields at least five single-segment firms with data on the Compustat tapes. Note that the amount of any subsidy that segment i receives from the internal capital market, $Subsidy_i > 0$, directly measures the component of segment i's capital expenditures that would have required external financing or the depletion of existing assets if the segment were a stand-alone firm.

Our subsidy measure is potentially biased to the extent that we use single-segment firms to impute the interest expense and tax rate of the segment. If as argued above, segments of diversified firms are fundamentally different from same-industry single-segment firms, then the imputed accounting variables may bias the segment's estimated after-tax cash flow and therefore measured subsidy. We investigate the severity of measurement error in segment after-tax cash flow using out-of-sample 1999 and 2000 Compustat segment data. As a result of the new reporting requirements under SFAS No. 131, the Compustat segment tapes should have richer segment accounting data for fiscal years beginning after

December 15, 1997. Of the 3626 segment-year observations in 1999 and 2000, 1488 have sufficient data to estimate our measure of after-tax cash flow, and of these segments only 190 report the additional variable net income required to compute actual after-tax cash flow. Nevertheless, for these 190 observations, we compute actual after-tax cash flow as the sum of segment net income plus segment depreciation. For comparison, we also compute our estimate of segment after-tax cash flow using the imputation procedure described above.

For this admittedly small sample of segments, we compute the difference between the estimated after-tax cash flow and the actual after-tax cash flow and scale the difference by the absolute value of the actual after-tax cash flow. The mean and median percentage deviations (between estimated and actual) are 23.5% and 4.6%, respectively. The mean difference is not significantly different from zero, but according to a signed-rank test, the median difference is significantly different from zero at the 5% level. Although it is difficult to draw solid conclusions from this small amount of out-of-sample segment data, the analysis suggests that our cash flow imputation procedure overestimates segment after-tax cash flow and thereby underestimates segment subsidies. However, as discussed in Section 3, our results are not sensitive to reasonable alternative measures of segment after-tax cash flow.

If $Subsidy_i = 0$, then $ATCF_i \geq CAPEX_i$ and segment i is a potential contributor of resources to firm j's internal capital market. In this case, we first compute segment i's potential transfer of resources as

$$PTransfer_i = \max(ATCF_i - w_i DIV_j - CAPEX_i, 0),$$

where DIV_j is the cash dividend paid by the firm and w_i is the asset weight of transfer segment i, which is computed as the ratio of segment i's assets to the sum of the assets of the *transfer* segments, that is, those segments for which $ATCF > CAPEX$. Thus our potential transfer, $PTransfer_i$, recognizes that any resources plowed back into the internal capital market must be net of the segment's asset-weighted share of firm dividends. We then compute segment i's transfer as

$$Transfer_i = \min\left[PTransfer_i, \frac{PTransfer_i}{\sum_{i=1}^{n} PTransfer_i}\left(\sum_{i=1}^{n} Subsidy_i\right)\right],$$

where the summations are over the n segments of firm j. Segment i's transfer, $Transfer_i$, is the minimum of its potential transfer and its weighted share of total internal capital market subsidies. Thus we do not allow transfers to exceed subsidies, but we do allow subsidies to exceed transfers.

Our formulation of subsidies and transfers is motivated by the idea that a necessary condition for a positive role for an internal capital market is the existence of market imperfections that make it more costly for firms to raise external funds than to finance operations with internally generated funds [see, e.g., Lamont (1997) and Stein (1997)]. As such, clearly identifiable internal capital market transactions can be identified as those where segments of a diversified firm invest more than their own after-tax cash flow. The additional dollars for investment can come either from transfers from other segments — in which case subsidies equal transfers — or from external financing — in which case subsidies exceed transfers. In either case, the segment's excess investment is subsidized. For example, if the segment as a stand-alone firm could access the external capital market, then it may invest more than its own after-tax cash flow. However, the cost of raising this additional capital would likely be greater for the segment as a stand-alone firm than it would be if a diversified multi-segment firm raised it. The coinsurance effect of diversification presumably lowers the cost of debt financing because cash flow volatility is reduced and the asset base of the consolidated entity backs the debt [see, e.g., Galai and Masulis (1976), Kim and McConnell (1977), Israel (1991), Billett (1996), and Billett, King, and Mauer (2003)]. By contrast, a single-segment stand-alone firm can only borrow against its own smaller asset base. Given these considerations, we allow subsidies to exceed transfers, but require transfers to be no greater than subsidies.

For the sample of 4204 firm-year observations over 1990–1998, aggregate subsidies exceed aggregate transfers in 1296 cases (i.e., 31% of the time). Furthermore, aggregate subsidies are greater than zero and aggregate transfers are equal to zero in 703 cases (i.e., 17% of the time). Thus, although transfers from other segments support a large proportion of subsidized investment, a significant proportion of subsidized investment must be externally financed. We show in Section 3 that our results are similar if subsidies are required to equal transfers (i.e., if we ignore externally financed subsidized investment).

Since the segments of diversified firms are not traded, the relative efficiency of cross-subsidies is measured in the literature using the average or median Tobin's Q of single-segment same-industry peers. For example, Rajan, Servaes, and Zingales (2000) measure the efficiency of a segment's industry-adjusted capital expenditures (their measure of cross-subsidy) as the difference between a segment's asset-weighted average industry Q and the asset-weighted average of segment industry Qs for the firm. This would be perfectly reasonable if the Qs of single-segment same-industry firms were unbiased proxies for the unobservable Qs of diversified firms' segments. However, a growing body of empirical evidence suggests that this is not the case. Lang and Stulz (1994), Berger and Ofek (1995), Chevalier (2000), Villalonga (2000), Campa and Kedia (2002), and

Hyland and Diltz (2002) all provide evidence that the investment opportunities of same-industry single-segment firms are not representative of those of segments of diversified firms. There are at least two problems. First, firms that diversify tend to have different (typically worse) investment opportunities than firms that do not. Second, if the characteristics or number of diversified firm segments are different from those of single-segment same-industry peers, then the use of only single-segment peers to proxy for the investment opportunities of segments induces a selectivity bias. Indeed, Villalonga (2000) illustrates that this bias alone can account for the diversification discount computed in studies that use single-segment firm Qs in the computation of the value of a diversified firm.

We use two measures of relative efficiency for segment subsidies ($Subsidy_i$) and transfers ($Transfer_i$) that attempt to mitigate these biases. First, we measure relative efficiency using the segment's sibling-adjusted return on assets (ROA), $ROA_i - \overline{ROA}$, where ROA_i is the ratio of earnings before interest, taxes, and depreciation to total assets for segment i and $\overline{ROA}$ is the corresponding asset-weighted average ROA of the firm's *remaining* segments. We classify a subsidy as efficient (inefficient) if $ROA_i > \overline{ROA}$ ($ROA_i < \overline{ROA}$), and measure the contribution of the subsidy to the value of a firm's internal capital market as $(ROA_i - \overline{ROA})$ $(Subsidy_i) > 0 (< 0)$. By contrast, we classify a transfer as efficient (inefficient) if $ROA_i < \overline{ROA}$ ($ROA_i > \overline{ROA}$), and measure the contribution of the transfer to the value of the firm's internal capital market as $(\overline{ROA} - ROA_i)$ $(Transfer_i) > 0 (< 0)$. Note that a subsidy is efficient (inefficient) if the segment receiving the subsidy has a larger (smaller) ROA than the asset-weighted average of the firm's other segments, and a transfer is efficient (inefficient) if the segment making the transfer has a smaller (larger) ROA than the asset-weighted average of the firm's other segments.

The advantage of using segment ROA to measure a segment's investment opportunities is that it ties the efficiency of a transfer or subsidy directly to the segment's *own* performance relative to the performance of the firm's other segments. However, we clearly recognize that ROA is a flow-based measure of efficiency, which does not directly *capitalize* the value of a subsidy or transfer as would a Q-based measure of efficiency. Thus, for our second measure of efficiency, we *fit* a Q for each segment. For each sample year we take all single-segment firms within the same two-digit SIC code and estimate the following regression:

$$Q_{jt} = \beta_0 + \beta_1 SIZE_{jt} + \beta_2 CFA_{jt} + \beta_3 TO_{jt} + \varepsilon_{jt},$$

where Q_{jt} is the Q-ratio (book value of assets plus the difference between the market and book values of equity to the book value of assets) of single-segment firm j in a given two-digit SIC industry in sample year t; $SIZE_{jt}$ is the log of total assets (consumer price index [CPI] adjusted to 1997 dollars) of single-segment firm j in sample year t; CFA_{jt} is the ratio

of earnings before interest, taxes, and depreciation to total assets of single-segment firm j in sample year t; and TO_{jt} is the ratio of sales to total assets (turnover) of single-segment firm j in sample year t.[5]

This regression is separately estimated for every two-digit SIC industry grouping of single-segment firms for each sample year from 1990 to 1998. We then fit a Q for each segment in each sample year by using that year's estimated regression parameters for the segment's two-digit SIC industry and the segment's $SIZE$, CFA, and TO. For example, segment i's fitted Q in sample year t, $\hat{Q}_{it}$, is computed as $\hat{Q}_{it} = \hat{\beta}_0 + \hat{\beta}_1 SIZE_{it} + \hat{\beta}_2 CFA_{it} + \hat{\beta}_3 TO_{it}$, where the estimated regression parameters are those from the segment's two-digit SIC industry in year t. To ensure the reasonableness of segment fitted Qs, we require that $\hat{Q}_{it}$ fall within the minimum and maximum Qs of its two-digit single segment peers for sample year t. If fitted $\hat{Q}_{it}$ is larger than the maximum of its two-digit peers, we set it equal to the maximum; and if fitted $\hat{Q}_{it}$ is smaller than the minimum of its two-digit peers, we set it equal to the minimum.[6]

Analogous to ROA, we use these fitted Qs to compute the relative efficiency of subsidies and transfers. Thus $Subsidy_i$ is efficient (inefficient) if $\hat{Q}_i > \underline{\hat{Q}}(\hat{Q}_i < \underline{\hat{Q}})$ and $Transfer_i$ is efficient (inefficient) if $\hat{Q}_i < \underline{\hat{Q}}(\hat{Q}_i > \underline{\hat{Q}})$, where $\hat{Q}$ is the asset-weighted average fitted Q of the firm's remaining segments, and we have dropped the time subscript to reduce notational clutter. The contribution of subsidies and transfers to the value of the firm's internal capital market is therefore computed as $(\hat{Q}_i - \underline{\hat{Q}})(Subsidy_i)$ and $(\underline{\hat{Q}} - \hat{Q}_i)(Transfer_i)$, respectively.

Relative to using single-segment firm Qs as proxies for the unobservable Q of a segment, the fitted Q efficiency measure has the advantage that it is based on a segment's own characteristics. However, the Q regressions must be estimated with single-segment firms and we are limited by the availability of segment data in the choice of right-hand-side variables. Below we report results based on ROA and fitted Q side-by-side.

The final step in the construction of our internal capital market measure is to condition internal capital market *subsidies* on whether the segment receiving the subsidy would have been financially constrained if it were a stand-alone firm. All else being equal, a subsidy should not enhance diversified firm value if the segment receiving the subsidy could have achieved the same level of investment as a stand-alone firm at the same cost. The only way that this could be accomplished is if the segment would have access to external financing on the same terms and conditions as the diversified firm to which the segment belongs. If this is not true, then we

[5] Note that our choice of right-hand-side variables is limited by the availability of segment data, because we use the estimated parameters from these regressions in conjunction with segment data to compute fitted Q.

[6] The results reported below using fitted Qs are similar if we do not apply this winsorization.

would classify the segment as financially constrained, and we would expect that *efficient* subsidies to such segments should enhance diversified firm value.[7]

Following Fazzari, Hubbard, and Peterson (1988), Hubbard, Kashyap, and Whited (1995), and Hubbard and Palia (1999), we use dividend policy to predict the likelihood of a subsidy segment facing a binding financing constraint if it were a stand-alone firm.[8] The idea is that a firm paying dividends is much less likely to face external financing constraints than a firm with no dividend payout. Since dividends are sticky and not easily reversed, these authors argue that only firms with ready access to external financing would commit to dividend payouts. By contrast, firms facing binding financing constraints or very costly external financing would not pay dividends. Since a segment of a diversified firm does not have an individual dividend policy, we need to predict what the segment's dividend policy would be if it were a stand-alone firm.[9] Based on these predictions, we can classify subsidy segments as financially constrained or unconstrained.

An alternative measure of financial constraint would be to attempt to estimate the sensitivity of a segment's investment to its own cash flow. However, there currently is a debate about whether investment cash flow sensitivities provide useful measures of *firm-level* external financing constraints [see Kaplan and Zingales (1997, 2000), Hubbard (1998), and Fazzari, Hubbard and Petersen (2000)]. As such, we choose to avoid attempting to adapt this methodology to segments of firms. Although the use of dividend policy to measure financing constraints is not a central concern of this debate, Kaplan and Zingales (1997, 2000) do question whether non-dividend-paying firms actually face a larger cost of external financing than do dividend-paying firms. In addition, since we have to estimate what the dividend policy of a segment would be if it were a stand-alone firm, our approach inevitably introduces measurement error. Our results should therefore be viewed with these caveats in mind.

We estimate a logit model of the probability of *not* paying a dividend using all single-segment firms over the sample period from 1990 to 1998. The model includes Q (market-to-book ratio), size (log of total assets in 1997 dollars), return on assets (ratio of earnings before interest, taxes and depreciation to total assets), turnover (ratio of sales to total assets), year

[7] Note that we might also like to classify transfer segments by whether the transfer flows to otherwise financially constrained or unconstrained subsidy segments. Unfortunately this is impossible to accomplish because we have no way of identifying what subsidy "bucket(s)" the transfer enters.

[8] See Hubbard (1998) for a review of the literature that uses dividend policy to predict financing constraints.

[9] Note that tracking stock firms have segments with their own separate dividend policies. See Billett and Mauer (2000) for a discussion of the unique characteristics of tracking stock.

dummies, and industry dummies (based on two-digit SIC codes).[10] As expected, the estimated logit model reveals that the probability of not paying a dividend is increasing in Q, and decreasing in size, return on assets, and turnover. All of the slope coefficients on these variables have asymptotic t-statistics that are significant at the 1% level.

The likelihood ratio test that all of the slope coefficients in the logit model are zero is easily rejected; the chi-squared statistic is 7100 and is significant at well better than the 1% level. The goodness-of-fit statistics for the model appear to be reasonably good. The McFadden ρ^2 statistic indicates the percentage of likelihood explained by variables other than the constant. A naive forecast of whether a firm does or does not pay dividends would predict the observed mean [69% of single-segment firm-year observations over 1990–1998 (16,570 out of 24,041) have a zero dividend]. The ρ^2 statistic for the logit model of 0.28 indicates that the model is able to improve the likelihood value by 28% relative to this naive model. In addition, analogous to an R^2 statistic for a linear regression model, the psuedo-R^2 for the logit model is 0.56. Finally, another goodness-of-fit measure is the ability of the model to correctly classify the observed choices in the sample. The estimated model correctly predicts 85% of the observed dividend choices in the sample.[11]

The estimated logit model is then used to predict the dividend policy that subsidy segments of diversified firms would have if they were stand-alone firms. For each sample year we use the reported segment data for inputs into the estimated logit model, except for a segment's Q ratio, which is the segment's fitted Q (discussed above) for the sample year. A subsidy segment is classified as financially constrained if the probability of not paying a dividend is greater than one-half.[12]

We are now ready to compute the overall value of a diversified firm's internal capital market and its component parts. Consider the case where efficiency is measured using ROA, and define the following indicator variables for segment i:

$$Positive_i = \begin{cases} 1 & \text{if } ROA_i > \overline{ROA} \\ 0 & \text{if } ROA_i \leq \overline{ROA} \end{cases} \quad \text{and}$$

$$Constrained_i = \begin{cases} 1 & \text{if Pr(no dividend)} > 0.50 \\ 0 & \text{if Pr(no dividend)} \leq 0.50. \end{cases}$$

[10] Similar to the fitted Q regressions, we are limited in our choice of predictor variables because we use the logit coefficient estimates on the same variables constructed from the reported accounting items of segments to predict a segment's dividend policy.

[11] Several alternative logit models were estimated, including the estimation of a separate logit model for each sample year from 1990 to 1998. However, the goodness-of-fit statistics for the model discussed in the text are generally superior. Nevertheless, the results discussed below are not sensitive to the use of these alternative specifications to predict financing constraints.

[12] Although the one-half probability cutoff is admittedly ad hoc, the results reported below are not sensitive to reasonable alternative choices of the cutoff.

Then the internal capital market components for an n-segment diversified firm in a given sample year are computed as

$$ESCS = \sum_{i=1}^{n} \frac{(ROA_i - \overline{ROA})(Subsidy_i)(Constrained_i)(Positive_i)}{TA}$$

$$ESNS = \sum_{i=1}^{n} \frac{(ROA_i - \overline{ROA})(Subsidy_i)(1 - Constrained_i)(Positive_i)}{TA}$$

$$ISCS = \sum_{i=1}^{n} \frac{(ROA_i - \overline{ROA})(Subsidy_i)(Constrained_i)(Positive_i - 1)}{TA}$$

$$ISNS = \sum_{i=1}^{n} \frac{(ROA_i - \overline{ROA})(Subsidy_i)(1 - Constrained_i)(Positive_i - 1)}{TA}$$

$$ETS = \sum_{i=1}^{n} \frac{(\overline{ROA} - ROA_i)(Transfer_i)(1 - Positive_i)}{TA}$$

$$ITS = \sum_{i=1}^{n} \frac{(\overline{ROA} - ROA_i)(Transfer_i)(Positive_i)(-1)}{TA},$$

where $ESCS$ ($ESNS$) denotes the value of efficient subsidies to constrained (not constrained) segments, $ISCS$ ($ISNS$) denotes the value of inefficient subsidies to constrained (not constrained) segments, and ETS (ITS) denotes the value of efficient (inefficient) transfer segments. Note that each component is scaled by the sum of segment assets (TA), and each component is constructed to be nonnegative. Also note that any one or all of the components for a firm in a given sample year can be zero. For example, if a firm has no subsidy segments in a given sample year, then as discussed above, transfers are zero and all components for that year are zero. The overall value of a diversified firm's internal capital market (ICM) in a given sample year is therefore equal to

$$ICM = ESCS + ESNS - ISCS - ISNS + ETS - ITS.$$

To diminish the influence of outliers in the regression analysis, we delete overall internal capital market firm-year observations above the 95th percentile and below the 5th percentile.

1.3 Value of diversification measure

We require a measure of diversification's effect on firm value to examine the link between our internal capital market measures and diversified firm value. Following Berger and Ofek (1995), we measure the value of diversification as the excess value of a diversified firm relative to a portfolio of industry-matched single-segment firms. We compute excess value as the natural logarithm of the ratio of the firm's actual value to its imputed

value. A firm's actual value is the sum of the total book value of debt, liquidation value of preferred stock, and market value of equity.[13] A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets, sales, or earnings before interest and taxes multiplied by its industry median ratio of total capitalization to that accounting item. Industry median ratios are computed using only single-segment firms, and are based on the narrowest SIC grouping that yields at least five single-segment firms with sufficient data to compute the ratio. Thus, for each firm-year in the sample we compute an excess value based on industry asset multiples, sales multiples, and earnings multiples.[14]

As discussed above, a number of authors argue that measures of the diversification discount are systematically biased because they use characteristics of single-segment firms to proxy for the unobservable attributes of diversified firms' segments. This criticism is largely directed at the measure used in Lang and Stulz (1994), Servaes (1996), and Rajan, Servaes, and Zingales (2000), where the value of diversification is computed as the difference between a firm's Tobin's Q and the weighted average Qs of the firm's segments' single-segment same industry peers. This measure implicitly assumes that the investment opportunities of a segment are the same as those of the segment's single-segment firm peers. Although the Berger and Ofek (1995) excess value measure uses multiples of capitalization to accounting variables of single-segment firm peers, it does not use the Tobin's Qs of single-segment firms as proxies for the unobservable Qs of segments. However, Villalonga (2000) argues that *any* excess value measure based on segment data is biased because segment data is inherently noisy. She uses the new Business Information Tracking Series (BITS) of the Census Research Data Center to construct the business units of firms and finds that diversified firms actually trade at a significant premium to comparable portfolios of single-business firms. However, unlike Compustat segment data, the BITS data contain no accounting variables (other than employment and annual payroll of a firm's business units) and therefore BITS *cannot* be used to construct our internal capital market measures.

[13] Berger and Ofek (1995) do not include preferred stock in their computation of firm value.

[14] Following Berger and Ofek (1995), we exclude from the analysis firm-year excess values where the firm's actual value is more than four times imputed value or less than one-fourth imputed value. As noted earlier, we also exclude firm-year observations when the sum of segment sales (assets) deviates from the consolidated firm's total sales (assets) by more than 1% (25%). In addition, when computing excess value based on earnings multiples, we require that the sum of segment earnings be within 25% of the consolidated firm's total earnings. Finally, segment imputed values are grossed up or down by the percentage deviation between the sum of segment assets, sales or earnings and the consolidated firm's corresponding accounting item when computing excess value based on asset multiples, sales multiples or earnings multiples, respectively.

1.4 Control variables

We include a number of control variables in our regressions. Berger and Ofek (1995) find that excess value is decreasing in the number of business segments and increasing in the number of related business segments. We use both variables. The number of related business segments is defined as the difference between the total number of segments reported for a firm and the number of segments with different main two-digit SIC codes. We include four additional control variables: size, measured as the natural logarithm of total assets in 1997 dollars; leverage, measured as the book value of debt (long-term debt plus debt in current liabilities) divided by total assets; liquidity, measured as cash plus marketable securities divided by total assets; and profitability, measured as total consolidated firm earnings before interest, taxes, and depreciation divided by total assets.

1.5 Descriptive statistics of firms and segments

Table 1 reports descriptive statistics for the sample of 4204 firm-year observations of 921 diversified firms (two or more segments) from 1990 to 1998. Mean and median excess value measures are negative, with the means ranging from -4.6% for the measure based on earnings multiples to -11.2% for the measure based on sales multiples. The magnitudes of the diversification discount are similar to those reported in Berger and Ofek (1995) for a sample of multisegment firms during the period 1986–1991. Consistent with the notion that inefficient internal capital market transactions are a driver of the diversification discount, the mean values of the overall internal capital market measures (based on ROA or fitted Q) are negative. Recalling that the internal capital market measures are scaled by the sum of segment assets, the mean values based on ROA and fitted Q are -0.2% and -0.6%, respectively. Note that the distributions of the internal capital market measures are negatively skewed, with for example the fitted Q version ranging from -10.2% to 1.4%.

Table 2 reports descriptive statistics of segment-year observations classified by whether a segment receives a subsidy or makes a transfer, whether the subsidy or transfer is efficient or inefficient, and by whether a subsidy segment would or would not be financially constrained if it were a standalone firm. For each segment classification, we report mean (median) values of ROA, $ROA - \overline{ROA}$, $\hat{Q}$, $\hat{Q} - \overline{\hat{Q}}$, subsidy divided by segment assets, transfer divided by segment assets, segment assets (millions of 1997 dollars), and segment assets divided by firm assets. Panel A reports statistics for efficiency based on ROA and panel B reports statistics for efficiency based on fitted $Q(\hat{Q})$. Note that descriptive statistics are only reported for those segments with nonzero internal capital market components.[15]

[15] For example, the sum of the segment sample sizes in the six internal capital market classifications in panel A is 5857 segments. However, there are 11,592 segment-years in the sample. The remaining

Table 1
Descriptive statistics of firm-year observations of multisegment firms for the period 1990–1998

Variable	Mean	Median	Std. dev.	Minimum	Maximum	*N*
Excess value based on asset multiples	−0.080	−0.094	0.402	−1.384	1.367	4204
Excess value based on sales multiples	−0.112	−0.114	0.493	−1.383	1.360	4204
Excess value based on earnings multiples	−0.046	−0.060	0.369	−1.376	1.340	3190
Internal capital market based on ROA	−0.002	0.000	0.005	−0.033	0.001	4204
Internal capital market based on fitted *Q*	−0.006	0.000	0.016	−0.102	0.014	4200
No. of segments	2.757	2.000	0.975	2.000	9.000	4204
No. of related segments	1.284	2.000	1.317	0.000	6.000	4204
Firm size (millions of 1997 dollars)	2842	580	6175	7	55,204	4204
Leverage (total debt to total assets)	0.312	0.300	0.190	0.000	0.897	4204
Liquidity (cash and mkt. securities to total assets)	0.050	0.026	0.069	0.000	0.907	4204
Profitability (EBITD to total assets)	0.090	0.088	0.062	−0.299	0.413	4204

Excess value is the natural logarithm of the ratio of the firm's actual value to its imputed value. A firm's actual value is the sum of the total book value of debt, liquidation value of preferred stock, and market value of equity. A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets, sales, or earnings multiplied by its industry median ratio of total capitalization to the corresponding accounting item. Internal capital market is the sum across a firm's business segments of the product of each segment's subsidy or transfer and relative efficiency, scaled by the sum of segment assets. If segment capital expenditures exceed segment after-tax cash flow, then segment subsidy is the difference between segment capital expenditures and after-tax cash flows. Otherwise, segment transfer is the minimum of segment after-tax cash flow minus the sum of segment capital expenditures and an allocated share of the firm's dividend, and its weighted-share of total internal capital market subsidies. The efficiency of segment subsidies and transfers is computed as the difference between segment return on assets (fitted *Q*) and the asset-weighted average return on assets (fitted *Q*) of the firm's other segments. A segment's fitted *Q* for a given sample year is computed by using the segment's characteristics in a *Q* regression that is estimated using the segment's same industry single-segment peers. No. of segments is the number of segments reported for a firm in a given sample year. No. of related segments is the difference between the total number of segments reported for a firm and the number of segments with different main two-digit SIC codes. Firm size is the book value of total assets measured in 1997 dollars using the consumer price index. Leverage is total debt to assets, where total debt is long-term debt plus debt in current liabilities. Liquidity is the ratio of cash plus marketable securities to total assets. Profitability is the ratio of total consolidated earnings before interest, taxes, and depreciation to total assets.

Whether efficiency is based on ROA (panel A) or fitted *Q* (panel B), the majority of segments either receive subsidies despite having poor relative investment opportunities or make transfers despite having good investment opportunities. In panel A (B), 75.7% (73.9%) of the segments are either classified as inefficient subsidy segments or inefficient transfer segments. Of interest is that this inefficient flow of resources is typically characterized by transfers from large segments having superior absolute and relative investment opportunities to small segments having inferior

5735 (11,592 – 5857) segments do not receive a subsidy and are not classified as a transfer provider. These segments are virtually all transfer segments that received a zero value because there were no subsidy segments in the firm to receive the transfer or because the segment's allocated dividend amount was greater than the potential transfer.

Table 2
Mean and (median) descriptive statistics of segment-year observations by internal capital market components for the period 1990–1998

Variable	Efficient subsidy constrained segment	Efficient subsidy unconstrained segment	Inefficient subsidy constrained segment	Inefficient subsidy unconstrained segment	Efficient transfer segment	Inefficient transfer segment
Panel A: Efficiency based on ROA						
ROA	0.117	0.150	−0.005	0.084	0.106	0.209
	(0.115)	(0.134)	(0.031)	(0.088)	(0.103)	(0.180)
$ROA - \overline{ROA}$	0.062	0.056	−0.153	−0.067	−0.047	0.128
	(0.042)	(0.034)	(−0.106)	(−0.048)	(−0.031)	(0.083)
$\hat{Q}$	1.700	1.567	1.468	1.344	1.741	2.069
	(1.537)	(1.361)	(1.346)	(1.235)	(1.640)	(1.927)
$\hat{Q} - \overline{\hat{Q}}$	0.206	0.085	−0.359	−0.299	−0.165	0.406
	(0.147)	(0.064)	(−0.301)	(−0.155)	(−0.142)	(0.276)
Subsidy divided by segment assets	0.066	0.044	0.103	0.047	NA	NA
	(0.035)	(0.023)	(0.049)	(0.032)		
Transfer divided by segment assets	NA	NA	NA	NA	0.008	0.029
					(0.004)	(0.014)
Segment assets (millions of 1997 dollars)	262	2409	348	2121	1488	1259
	(58)	(1020)	(79)	(1053)	(268)	(171)
Segment assets divided by firm assets	0.327	0.417	0.295	0.344	0.351	0.364
	(0.260)	(0.354)	(0.209)	(0.233)	(0.290)	(0.285)
No. of segments	548	302	1880	622	573	1932
Panel B: Efficiency based on fitted Q						
ROA	0.126	0.155	−0.042	0.083	0.105	0.211
	(0.123)	(0.138)	(0.029)	(0.087)	(0.102)	(0.180)
$ROA - \overline{ROA}$	0.073	0.065	−0.189	−0.069	−0.053	0.134
	(0.050)	(0.040)	(−0.108)	(−0.049)	(−0.036)	(0.082)
$\hat{Q}$	1.657	1.561	1.432	1.330	1.756	2.055
	(1.512)	(1.362)	(1.321)	(1.230)	(1.661)	(1.927)
$\hat{Q} - \overline{\hat{Q}}$	0.151	0.055	−0.359	−0.303	−0.147	0.420
	(0.108)	(0.049)	(−0.292)	(−0.163)	(−0.126)	(0.291)
Subsidy divided by segment assets	0.070	0.046	0.140	0.045	NA	NA
	(0.039)	(0.026)	(0.048)	(0.031)		
Transfer divided by segment assets	NA	NA	NA	NA	0.009	0.029
					(0.004)	(0.013)
Segment assets (millions of 1997 dollars)	289	2379	351	2115	1443	1291
	(72)	(966)	(76)	(1037)	(243)	(179)
Segment assets divided by firm assets	0.364	0.454	0.276	0.333	0.356	0.365
	(0.292)	(0.405)	(0.193)	(0.228)	(0.294)	(0.283)
No. of segments	595	331	1839	614	596	1855

The table reports mean and (median) descriptive statistics for segments grouped by internal capital market components based on ROA efficiency (panel A) and fitted Q efficiency (panel B). A segment receives a subsidy if segment capital expenditures are greater than segment after-tax cash flow, and a segment makes a transfer if segment after-tax cash flow is greater than the sum of segment capital expenditures and an allocated share of the firm's dividend. Note that total transfers are required to be less than or equal to total subsidies. Efficient subsidy segments have either a return on assets greater than the asset-weighted average return on assets of the firm's other segments, $ROA - \overline{ROA} > 0$ (panel A), or fitted Q greater than the asset-weighted average fitted Q of the firm's other segments, $\hat{Q} - \overline{\hat{Q}} > 0$ (panel B). Inefficient subsidy segments have either $ROA - \overline{ROA} < 0$ (panel A) or $\hat{Q} - \overline{\hat{Q}} < 0$ (panel B). A segment receiving a subsidy is classified as financially constrained (unconstrained) if the estimated probability of not paying a dividend is greater (less) than one-half if the segment were a stand-alone firm. Efficient transfer segments have either $ROA - \overline{ROA} < 0$ (panel A), or $\hat{Q} - \overline{\hat{Q}} < 0$ (panel B). Inefficient transfer segments have either $ROA - \overline{ROA} > 0$ (panel A) or $\hat{Q} - \overline{\hat{Q}} > 0$ (panel B). A segment's fitted Q for a given sample year is computed by using the segment's characteristics in a Q regression that is estimated using the segment's same-industry single-segment peers.

absolute and relative investment opportunities. For example, in panel B, where efficiency is based on fitted Q, inefficient transfer segments outnumber efficient transfer segments by more than three to one. These relatively large segments have a mean fitted Q ratio larger than two, which exceeds the weighted average fitted Q of the firm's remaining segments by a wide margin. Correspondingly, inefficient constrained subsidy segments outnumber efficient constrained subsidy segments by more than three to one, and are characterized by relatively small size and fitted Q ratios. This pattern of inefficient resource allocation clearly drives the negative overall mean internal capital market values reported in Table 1. Nevertheless, it is clear from an examination of Table 2 that firms in the sample do subsidize efficient segments that would be financially constrained if they were stand-alone firms, and that firms in the sample do transfer resources from segments having relatively poor investment opportunities. In particular, 16.4% (17.6%) of the subsidy segments in panel A (B) are classified as efficient-constrained, and 22.9% (24.3%) of the transfer segments in panel A (B) are classified as efficient.

2. Empirical Results

We first examine the relationship between diversified firms' excess value and the overall value of the internal capital market and its component parts. Some of our results contradict the efficient internal capital markets hypothesis, but may be explained by the predictions of the model in Rajan, Servaes, and Zingales (2000). We test the key prediction of the Rajan, Servaes, and Zingales model by examining the role of diversity of investment opportunities in the link between excess value and internal capital market transactions.

2.1 Excess value and internal capital market transactions

The segment-based descriptive statistics in Table 2 illustrate that diversified firms engage in inefficient internal capital market transactions, subsidizing segments with relatively poor investment opportunities by transferring resources from segments with relatively good investment opportunities. Notwithstanding, the table also illustrates that there are efficient subsidies and transfers. However, as argued by Lamont (1997), Stein (1997), and Shin and Stulz (1998), efficient subsidies should only enhance diversified firm *excess* value when external capital markets are costly *and* the internal capital market relieves an otherwise binding external financing constraint.[16] Accordingly, the efficient internal capital market hypothesis predicts that efficient subsidies to otherwise financially

[16] Of course, by "otherwise" we mean that the segment would incur greater costs in financing its current investment plan if it were a stand-alone firm.

constrained segments should have a positive effect on excess value, while efficient subsidies to unconstrained segments should have no effect on excess value. By contrast, inefficient subsidies to either constrained or unconstrained segments should have a negative effect on excess value. Finally, efficient internal capital market theory predicts that efficient transfers (transfers from segments with relatively poor investment opportunities) should have a positive effect on excess value and inefficient transfers (transfers from segments with relatively good investment opportunities) should have a negative effect on excess value.

Table 3 reports regressions of excess value (based on asset multiples) on the overall internal capital market measure [Regressions (1) and (3)], the internal capital market components [Regressions (2) and (4)], and the various control variables. Regressions (1) and (2) have internal capital market components that use ROA to measure efficiency, and Regressions (3) and (4) have internal capital market components that use fitted Q to measure efficiency. All regressions are estimated using a fixed-effects model with firm-specific intercepts. This allows for shifts in the regression line if firms differ significantly in any omitted variables or in their sensitivity to the included variables. In addition, as noted earlier, firm-specific fixed effects help control for differences in segment reporting across firms. The regressions also include calendar year dummies to capture any time-specific structural shifts in the data. To conserve space, we do not report firm-specific intercepts or calendar year dummies. We also do not report the corresponding sets of regressions where excess value is based on either sales or earnings multiples; however, the results are qualitatively similar when excess value is based on either sales or earnings multiples. White's (1980) heteroscedasticity-consistent t-statistics are reported in parentheses below the parameter estimates.

Surprisingly, the coefficient estimates on the overall internal capital market measures in Regressions (1) and (3) are negative, but neither estimate is statistically significantly different from zero at a reasonable confidence level. Since the overall measure captures the net effect of efficient and inefficient subsidies and transfers, we would have expected positive coefficient estimates instead. This finding portends some interesting results when we estimate the separate effects of the internal capital market components on diversified firm excess value.

As predicted, regardless of whether efficiency is based on ROA or fitted Q, the coefficient estimates on efficient subsidies to constrained segments in Regressions (2) and (4) are significantly positive. These coefficient estimates also appear to be economically significant. For example, a one standard deviation increase in the efficient-constrained subsidy component of Regression (2) increases excess value by 1.8 percentage points, increasing the mean of excess value from -8.0% to -6.2%. By contrast, the coefficient estimate on efficient subsidies to unconstrained segments is

Table 3
Regressions explaining excess value of multisegment firms for the period 1990–1998

	Efficiency based on ROA		Efficiency based on fitted Q	
Explanatory variable	(1)	(2)	(3)	(4)
Internal capital market	−1.511		−0.408	
	(−1.32)		(−1.45)	
Efficient subsidies to constrained segments		20.132		2.144
		(2.76)***		(2.31)**
Efficient subsidies to unconstrained segments		−6.382		0.240
		(−0.81)		(0.14)
Inefficient subsidies to constrained segments		7.293		1.721
		(4.31)***		(3.61)***
Inefficient subsidies to unconstrained segments		3.217		0.015
		(1.03)		(0.02)
Efficient transfer segments		24.099		−1.024
		(1.50)		(−0.25)
Inefficient transfer segments		−9.105		−1.806
		(−2.68)***		(−2.03)**
No. of segments	0.004	0.003	−0.010	−0.009
	(0.37)	(0.33)	(−1.04)	(−1.01)
No. of related segments	−0.006	−0.004	0.000	0.000
	(−0.70)	(−0.56)	(0.04)	(0.01)
Firm size (log of total assets)	−0.077	−0.082	−0.079	−0.081
	(−4.41)***	(−4.73)***	(−4.65)***	(−4.75)***
Leverage (total debt to total assets)	0.237	0.249	0.208	0.214
	(4.39)***	(4.70)***	(3.33)***	(3.48)***
Liquidity (cash and mkt. securities to total assets)	0.652	0.643	0.648	0.646
	(4.80)***	(4.71)***	(4.44)***	(4.40)***
Profitability (EBITD to total assets)	2.302	2.442	2.048	2.161
	(18.58)***	(19.72)***	(15.07)***	(16.76)***
Adjusted R^2	0.71	0.71	0.70	0.70
No. of observations	4204	4204	4200	4200

Fixed-effects regressions allowing for firm-specific intercepts and calendar year dummies. The dependent variable, excess value, is the natural logarithm of the ratio of the firm's actual value to its imputed value. A firm's actual value is the sum of the total book value of debt, liquidation value of preferred stock and market value of equity. A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets multiplied by its industry median ratio of total capitalization to total assets. The explanatory variables are defined as follows. Internal capital market is the sum across a firm's business segments of the product of each segment's subsidy or transfer and relative efficiency, scaled by the sum of segment assets. If segment capital expenditures exceed segment after-tax cash flow, then segment subsidy is the difference between segment capital expenditures and after-tax cash flow. Otherwise, segment transfer is the minimum of segment after-tax cash flow minus the sum of segment capital expenditures and an allocated share of the firm's dividend, and its weighted-share of total internal capital market subsidies. The efficiency of segment subsidies and transfers is computed as the difference between segment ROA (fitted Q) and the asset-weighted average ROA (fitted Q) of the firm's other segments. A segment's fitted Q for a given sample year is computed by using the segment's characteristics in a Q regression that is estimated using the segment's same-industry single-segment peers. The firm's internal capital market is decomposed into six components: efficient subsidies to financially constrained and unconstrained segments, inefficient subsidies to financially constrained and unconstrained segments, and efficient and inefficient transfers. Efficient (inefficient) subsidies have either return on assets greater (less) than the asset-weighted average ROA of the firm's other segments or fitted Q greater (less) than the asset-weighted average fitted Q of the firm's other segments. Efficient (inefficient) transfers have either the ROA less (greater) than the asset-weighted average ROA of the firm's other segments or fitted Q less (greater) than the asset-weighted average fitted Q of the firm's other segments. A segment receiving a subsidy is classified as financially constrained (unconstrained) if the estimated probability of not paying a dividend is greater (less) than one-half if the segment were a stand-alone firm. No. of segments is the number of segments reported for a firm in a given sample year. No. of related segments is the difference between the total number of segments reported for a firm and the number of segments with different main two-digit SIC codes. Size is the natural logarithm of assets measured in 1997 dollars using the consumer price index. Leverage is total debt to assets, where total debt is long-term debt plus debt in current liabilities. Liquidity is the ratio of cash plus marketable securities to assets. Profitability is the ratio of total consolidated firm earnings before interest, taxes, and depreciation to total assets. White's (1980) heteroscedasticity-consistent t-statistics are in parentheses below the parameter estimates. An ***, **, * indicates significance at the 1%, 5%, and 10% level, using a two-tailed test.

negative and insignificant in Regression (2), and positive and insignificant in Regression (4).[17] These results strongly support the efficient internal capital market theory, which predicts that only efficient cross-subsidies to otherwise financially constrained segments are value enhancing.

In sharp contrast to the prediction of the efficient internal capital market theory, the coefficient estimates on inefficient subsidies to constrained segments are significantly positive. All else being equal, this indicates that transfers to small segments with relatively poor investment opportunities actually enhance diversified firm value.[18] The coefficient estimates are also economically significant. For example, a one standard deviation increase in the inefficient-constrained subsidy component in Regression (2) increases excess value by 2.8 percentage points, increasing mean excess value from -8.0% to -5.2%.[19] Since inefficient-constrained subsidy segments are the largest subsidy group in the sample (see Table 2), and since this component is subtracted in the computation of the overall internal capital market measure (see Section 1), the positive relationship between excess value and this component probably explains why the coefficient estimates on the overall internal capital market measures in Regressions (1) and (3) are negative. The coefficient estimates on inefficient subsidies to unconstrained segments in Regressions (2) and (4) are also positive, but are not significantly different from zero.

The signs of the coefficient estimates on efficient transfers are mixed, with a predicted positive sign in Regression (2) and a negative sign in Regression (4). However, neither coefficient estimate is significantly different from zero. By contrast, the coefficient estimates on inefficient transfers have the predicted negative signs and are statistically significant. Economically, a one standard deviation increase in the inefficient transfer component decreases excess value by 1.6 and 1.1 percentage points in Regressions (2) and (4), respectively.

Overall, the regressions establish that internal capital market transactions are significant determinants of diversified firms' excess value. As predicted by efficient internal capital market theory, but not previously tested, efficient subsidies significantly increase excess value only when the segment receiving the subsidy would be financially constrained if it were a stand-alone firm. Furthermore, diversified firms are clearly penalized when resources are transferred from segments with superior relative investment opportunities, since these inefficient transfers significantly

[17] Although not reported in the table, the coefficient estimate on efficient subsidies to constrained segments is significantly larger than the coefficient estimate on efficient subsidies to unconstrained segments in both Regressions (2) and (4).

[18] Whether efficiency is measured by ROA or fitted Q, Table 2 shows that these segments tend to be small and to have very poor relative investment performance.

[19] The corresponding comparative static in Regression (4) is 2.1 percentage points.

decrease excess value. However, efficient internal capital market theory cannot explain why inefficient subsidies to otherwise financially constrained segments significantly increase excess value.

2.2 Diversity of investment opportunities

Recent work by Rajan, Servaes, and Zingales (2000) offers an explanation for why inefficient subsidies to constrained segments can enhance diversified firm value. In their model, headquarters allocates resources to division managers who choose either efficient or self-serving investments. If divisions within a firm have widely diverse size-weighted investment opportunities, managers of large divisions with good investment opportunities have an incentive to choose low-return defensive investments, since the surplus created from efficient investments is shared with other divisions. They show that headquarters can improve incentives to make efficient investments by tilting the capital budget toward small divisions with relatively poor investment opportunities.[20] Rajan, Servaes, and Zingales (2000, p. 38) summarize this implication of their model by stating:

> Thus, the diversified firm may misallocate some funds at the margin (relative to first best) to prevent greater average investment distortions. The more diverse a firm's divisions are, the greater the need to reallocate funds in this way. Thus corporate redistribution may be a rational second-best attempt to head off a third-best outcome.

The Rajan, Servaes, and Zingales model has two important implications for our analysis. First, inefficient subsidies should be more prevalent among those firms having more diverse size-weighted investment opportunities across segments. Since the segments classified as financially constrained in our sample are small and since the predicted direction of transfers is from large segments with good investment opportunities to small segments with poor investment opportunities, we would expect that inefficient subsidies to constrained segments increase with diversity. Second, the model admits that observed inefficient subsidies can actually be value enhancing, since these internal capital market transactions help prevent an even worse outcome. As such, diversified firm excess value can be positively related to the inefficient constrained subsidy component of the value of a firm's internal capital market, especially when the firm has diverse size-weighted investment opportunities.[21] This can explain our

[20] Consistent with their model, Rajan, Servaes, and Zingales (2000) find that allocations to small segments with poor relative investment opportunities increase and allocations to large segments with good relative investment opportunities decrease as the diversity of a firm's segments' size-weighted investment opportunities increases.

[21] Note that we're obviously not saying that *average* excess value would be positive for those firms tilting the capital budget toward small segments with poor relative investment opportunities. Rather, the marginal impact on (positive or negative average) excess value would be positive, since these allocations reduce diversity and thereby enhance incentives to choose efficient investments.

regression result that inefficient subsidies to otherwise financially constrained segments significantly increase excess value, but a more refined test should condition on diversity.[22]

In an agency cost model, Scharfstein and Stein (2000) also reach the conclusion that strong divisions will subsidize weaker divisions, with this inefficient allocation of resources becoming more severe as the diversity of investment opportunities across divisions increases. However, their model predicts that observed inefficient subsidies and transfers are *always* value-destroying. The regression results in Table 3 are partially consistent with this prediction, since inefficient transfers significantly reduce excess value. However, the Scharfstein and Stein model cannot explain why subsidies to small segments with relatively poor investment opportunities significantly increase excess value. Nevertheless, like the Rajan, Servaes, and Zingales model, the key driver in the Scharfstein and Stein model is diversity of investment opportunities. Supporting evidence in favor of their model would require that inefficient subsidies to constrained segments decrease excess value for high-diversity firms.

We measure firm diversity as the standard deviation of segment asset-weighted fitted Qs divided by the equally weighted average fitted Q:

$$Diversity = \frac{\sqrt{\sum_{i=1}^{n} (w_i \hat{Q}_i - \text{Average}((w_i \hat{Q}_i))^2 / (n-1)}}{\text{Average}(\hat{Q}_i)},$$

where the weight of segment i, w_i, is computed as segment assets divided by the sum of segment assets, and $\hat{Q}_i$ is the fitted Q of segment i. This follows the diversity specification in Rajan, Servaes, and Zingales (2000), except that we use a segment's fitted Q, and they use the asset-weighted average Q for single-segment firms in the segment's industry as a proxy for the segment's Q.

Table 4 reports segment-year descriptive statistics by internal capital market components for firms with low diversity (panel A) and high diversity (panel B). A firm is classified as having low diversity if its computed diversity is less than or equal to the median computed diversity for the firms in the sample. The table reports segment-year descriptive statistics for internal capital market components where efficiency is based on fitted Q.[23] As can be seen in the table, within both low- and high-diversity groups, inefficient constrained subsidy segments are small and have poor relative

[22] At first blush, one might argue that our finding that inefficient transfers significantly decrease excess value is inconsistent with the Rajan, Servaes, and Zingales (2000) model. However, we have no way of tracking whether the transfers go to small inefficient constrained segments or to large inefficient unconstrained segments.

[23] The corresponding statistics for internal capital market components where efficiency is based on ROA are very similar.

Table 4
Mean and (median) descriptive statistics of segment-year observations by internal capital market components for low- and high-diversity firms for the period 1990–1998

Variable	Efficient subsidy constrained segment	Efficient subsidy unconstrained segment	Inefficient subsidy constrained segment	Inefficient subsidy unconstrained segment	Efficient transfer segment	Inefficient transfer segment
Panel A: **Low firm diversity**						
ROA	0.127	0.166	0.009	0.082	0.106	0.219
	(0.122)	(0.150)	(0.038)	(0.086)	(0.105)	(0.185)
$ROA - \overline{ROA}$	0.066	0.067	−0.135	−0.071	−0.049	0.121
	(0.045)	(0.039)	(−0.095)	(−0.054)	(−0.034)	(0.074)
$\hat{Q}$	1.677	1.644	1.509	1.441	1.776	2.105
	(1.507)	(1.448)	(1.378)	(1.261)	(1.710)	(1.976)
$\hat{Q} - \overline{\hat{Q}}$	0.164	0.062	−0.268	−0.312	−0.136	0.435
	(0.101)	(0.067)	(−0.234)	(−0.210)	(−0.135)	(0.289)
Subsidy divided by segment assets	0.068	0.053	0.081	0.045	NA	NA
	(0.039)	(0.033)	(0.042)	(0.026)		
Transfer divided by segment assets	NA	NA	NA	NA	0.009	0.031
					(0.003)	(0.014)
Segment assets (millions of 1997 dollars)	337	2284	479	2660	1659	1182
	(86)	(1069)	(105)	(1473)	(295)	(216)
Segment assets divided by firm assets	0.309	0.344	0.302	0.351	0.322	0.259
	(0.298)	(0.306)	(0.262)	(0.313)	(0.301)	(0.225)
No. of segments	298	183	919	285	387	1116
Panel B: **High firm diversity**						
ROA	0.124	0.142	−0.092	0.085	0.104	0.200
	(0.126)	(0.129)	(0.021)	(0.088)	(0.099)	(0.172)
$ROA - \overline{ROA}$	0.080	0.063	−0.242	−0.067	−0.059	0.152
	(0.056)	(0.041)	(−0.126)	(−0.046)	(−0.039)	(0.097)
$\hat{Q}$	1.636	1.458	1.356	1.235	1.719	1.980
	(1.522)	(1.288)	(1.270)	(1.216)	(1.502)	(1.855)
$\hat{Q} - \overline{\hat{Q}}$	0.139	0.046	−0.450	−0.296	−0.167	0.397
	(0.112)	(0.043)	(−0.354)	(−0.127)	(−0.116)	(0.295)
Subsidy divided by segment assets	0.072	0.036	0.199	0.045	NA	NA
	(0.039)	(0.020)	(0.169)	(0.035)		
Transfer divided by segment assets	NA	NA	NA	NA	0.011	0.028
					(0.004)	(0.011)
Segment assets (millions of 1997 dollars)	241	2497	223	1643	1043	1457
	(58)	(850)	(51)	(744)	(130)	(152)
Segment assets divided by firm assets	0.418	0.591	0.251	0.317	0.420	0.524
	(0.269)	(0.738)	(0.140)	(0.164)	(0.231)	(0.648)
No. of segments	297	148	920	329	209	739

The table reports mean and (median) descriptive statistics for segments grouped by internal capital market components based on fitted Q efficiency. Firm diversity is the standard deviation of segment asset-weighted fitted Qs divided by the equally weighted average fitted Q. A firm is classified as having low (high) diversity if its computed diversity is less than or equal to (greater than) the median computed diversity for the firms in the sample. A segment's fitted Q for a given sample year is computed by using the segment's characteristics in a Q regression that is estimated using the segment's same-industry single segment peers. A segment receives a subsidy if segment capital expenditures are greater than segment after-tax cash flow, and a segment makes a transfer if segment after-tax cash flow is greater than the sum of segment capital expenditures and an allocated share of the firm's dividend. Note that total transfers are required to be less than or equal to total subsidies. Efficient subsidy segments have fitted Q greater than the asset-weighted average fitted Q of the firm's other segments, $\hat{Q} - \overline{\hat{Q}} > 0$, and inefficient subsidy segments have $\hat{Q} - \overline{\hat{Q}} < 0$. A segment receiving a subsidy is classified as financially constrained (unconstrained) if the estimated probability of not paying a dividend is greater (less) than one-half if the segment were a stand-alone firm. Efficient transfer segments have $\hat{Q} - \overline{\hat{Q}} < 0$, and inefficient transfer segments have $\hat{Q} - \overline{\hat{Q}} > 0$. The variable *ROA* is the segment's return on assets and the variable $ROA - \overline{ROA}$ is the segment's return on assets minus the asset-weighted average return on assets of the firm's other segments.

performance. Furthermore, there is more of this type of subsidy segment than of any of the three other types of subsidy segments combined. In the low-diversity group, 54.5% (919/1685) of the subsidy segments are inefficient constrained, while in the high-diversity group, 54.3% (920/1694) of the subsidy segments are inefficient constrained. However, consistent with the prediction of both the Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000) models, the amount of subsidies to inefficient-constrained segments is significantly larger for high-diversity firms than for low-diversity firms. The mean (median) subsidy divided by segment assets is 19.9% (16.9%) per year for high-diversity firms and 8.1% (4.2%) per year for low-diversity firms. Both the means and medians are significantly different at the 1% level. Thus, although both low- and high-diversity firms subsidize small segments with poor relative investment opportunities, the amount of subsidization is clearly greater for high-diversity firms.

Table 5 reports regressions of excess value (based on asset multiples) on internal capital market components of low- and high-diversity firms for efficiency based on ROA and fitted Q. As in Table 3, all regressions are estimated using a fixed-effects model with firm-specific intercepts and calendar year dummies. White's (1980) heteroscedasticity-consistent t-statistics are reported in parentheses below the parameter estimates.

The coefficient estimates on inefficient subsidies to constrained segments are positive in both sets of low- and high-diversity regressions, and are significantly positive in the low- and high-diversity regressions where efficiency is based on fitted Q. These results are clearly inconsistent with the value-destruction prediction of the Scharfstein and Stein (2000) agency model. Although positive coefficient estimates are consistent with the prediction of the Rajan, Servaes, and Zingales (2000) model, their model further predicts that subsidies to small segments with poor investment opportunities should be more valuable to firms having greater disparity of investment opportunities. The pattern of coefficient estimates on inefficient subsidies to constrained segments is only weakly consistent with this prediction. When efficiency is based on ROA, only the coefficient estimate on inefficient-constrained subsidies in the high-diversity regression is significantly positive. Notwithstanding, the significant coefficient in the high-diversity regression does not appear to reflect a higher valuation impact, since the coefficient estimates on inefficient-constrained subsidies in the low- and high-diversity regressions are not statistically or economically significantly different from each other. Furthermore, when efficiency is based on fitted Q, both low- and high-diversity coefficient estimates on inefficient-constrained subsidies are significantly positive and they have roughly equal economic significance.[24] The coefficient estimates

[24] Alternative regression specifications fail to find a link between diversity and the impact on firm value of inefficient subsidies to constrained segments.

Table 5
Regressions explaining excess value of low- and high-diversity multisegment firms for the period 1990–1998

	Efficiency based on *ROA*		Efficiency based on fitted *Q*	
Explanatory variable	Low diversity	High diversity	Low diversity	High diversity
Efficient subsidies to constrained segment	13.134 (1.78)*	21.030 (1.89)**	2.478 (2.39)**	1.214 (0.67)
Efficient subsidies to unconstrained segments	−33.709 (−1.63)*	6.905 (0.53)	−3.352 (−1.25)	2.058 (0.71)
Inefficient subsidies to constrained segments	4.672 (1.60)	5.574 (2.83)***	1.990 (2.92)***	1.567 (2.81)***
Inefficient subsidies to unconstrained segments	7.759 (1.35)	−0.002 (0.00)	0.560 (0.45)	−0.466 (−0.61)
Efficient transfer segments	5.569 (0.11)	−4.537 (−0.05)	−6.094 (−1.37)	3.767 (0.42)
Inefficient transfer segments	1.976 (0.39)	−18.947 (−4.03)***	−0.552 (−0.53)	−3.227 (−2.20)**
No. of segments	0.008 (0.75)	−0.007 (−0.31)	0.015 (1.40)	−0.044 (−2.08)**
No. of related segments	−0.024 (−2.48)***	0.015 (0.92)	−0.032 (−3.27)***	0.044 (2.69)***
Firm size (log of total assets)	−0.015 (−0.65)	−0.126 (−5.07)***	−0.010 (−0.44)	−0.120 (−4.65)***
Leverage (total debt to total assets)	0.299 (4.98)***	0.280 (3.71)***	0.261 (3.73)***	0.282 (3.24)***
Liquidity (cash and mkt. securities to total assets)	0.894 (4.12)***	0.485 (2.77)***	0.877 (4.09)***	0.593 (3.22)***
Profitability (EBITD to total assets)	2.631 (15.32)***	2.407 (12.71)***	2.653 (15.90)***	2.011 (11.51)***
Adjusted R^2	0.74	0.73	0.73	0.72
No. of observations	2102	2102	2100	2100

Fixed-effects regressions allowing for firm-specific intercepts and calendar year dummies. Firm diversity is the standard deviation of segment asset-weighted fitted *Q*s divided by the equally weighted average fitted *Q*. A firm is classified as having low (high) diversity if its computed diversity is less than or equal to (greater than) the median computed diversity for the firms in the sample. A segment's fitted *Q* for a given sample year is computed by using the segment's characteristics in a *Q* regression that is estimated using the segment's same-industry single-segment peers. The dependent variable, excess value, is the natural logarithm of the ratio of the firm's actual value to its imputed value. A firm's actual value is the sum of the total book value of debt, liquidation value of preferred stock, and market value of equity. A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets multiplied by its industry median ratio of total capitalization to total assets. The explanatory variables are defined as follows. Internal capital market is the sum across a firm's business segments of the product of each segment's subsidy or transfer and relative efficiency, scaled by the sum of segment assets. If segment capital expenditures exceed segment after-tax cash flow, then segment subsidy is the difference between segment capital expenditures and after-tax cash flow. Otherwise, segment transfer is the minimum of segment after-tax cash flow minus the sum of segment capital expenditures and an allocated share of the firm's dividend, and its weighted share of total internal capital market subsidies. The efficiency of segment transfers and subsidies is computed as the difference between segment ROA (fitted *Q*) and the asset-weighted average ROA (fitted *Q*) of the firm's other segments. The firm's internal capital market is decomposed into six components: efficient subsidies to financially constrained and unconstrained segments, inefficient subsidies to financially constrained and unconstrained segments, and efficient and inefficient transfers. Efficient (inefficient) subsidies have either ROA greater (less) than the asset-weighted average ROA of the firm's other segments or fitted *Q* greater (less) than the asset-weighted average fitted *Q* of the firm's other segments. Efficient (inefficient) transfers have either the ROA less (greater) than the asset-weighted average ROA of the firm's other segments or fitted *Q* less (greater) than the asset-weighted average fitted *Q* of the firm's other segments. A segment receiving a subsidy is classified as financially constrained (unconstrained) if the estimated probability of not paying a dividend is greater (less) than one-half if the segment were a stand-alone firm. No. of segments is the number of segments reported for a firm in a given sample year. No. of related segments is the difference between the total number of segments reported for a firm and the number of segments with different main two-digit SIC codes. Size is the natural logarithm of assets measured in 1997 dollars using the consumer price index. Leverage is total debt to assets, where total debt is long-term debt plus debt in current liabilities. Liquidity is the ratio of cash plus marketable securities to assets. Profitability is the ratio of total consolidated firm earnings before interest, taxes, and depreciation to total assets. White's (1980) heteroscedasticity-consistent *t*-statistics are in parentheses below the parameter estimates. An ***, **, * indicates significance at the 1%, 5%, and 10% level, using a two-tailed test.

on the other internal capital market components are roughly consistent across low- and high-diversity groups, and are quite similar to those in the overall sample regressions in Table 3.[25]

Overall, these results show that resource transfers to small segments with relatively poor investment opportunities can reduce the value loss from diversification irrespective of whether the firm's segments have high or low diversity of size-weighted investment opportunities. The lack of convincing evidence that diversity plays a pivotal role in this relationship is inconsistent with the fundamental premise of the Rajan, Servaes, and Zingales model. Furthermore, the result that inefficient subsidization increases as opposed to decreases excess value offers no support for the Scharfstein and Stein model.[26]

3. Robust Measurement of Subsidies and Transfers

This section examines the sensitivity of the results to alternative procedures of measuring internal capital market subsidies and transfers. We first examine alternative computations of segment after-tax cash flows which, in conjunction with segment capital expenditures, determine whether a segment receives a subsidy or transfer. We then examine the implications of requiring that subsidies equal transfers.

3.1 Alternative computations of subsidies and transfers

Recall that we classify a segment as having received a subsidy (transfer) if the segment's capital expenditures are greater (less) than the segment's after-tax cash flow. As we noted earlier, the classification and computation of subsidies and transfers are potentially biased because we have to impute a segment's interest and tax expenses from single-segment same-industry firms. There are at least two alternative ways to estimate a segment's unobservable interest and tax expenses.

The first procedure measures the deviation of the sum of the imputed segment interest and tax expenses from the actual firm-level interest and tax expenses and then prorates these deviations out to the segments.[27] For example, under this method a segment's tax expense is computed as the segment's imputed tax expense times the ratio of firm-level tax expense to the sum of the imputed tax expenses of the segments. Note that this

[25] However, note that the coefficient estimates on inefficient transfers are only significantly negative in the high-diversity regressions.

[26] To be fair, the Scharfstein and Stein (2000) model correctly predicts that inefficient transfers reduce excess value, a prediction that is borne out in both the overall regressions of Table 3 and the high-diversity regressions of Table 5

[27] A segment's imputed tax expense is computed as the segment's imputed tax rate times the segment's pretax income, where pretax income is segment earnings before interest and taxes minus the segment's imputed interest expense.

modified imputation procedure is analogous to the approach that we use to distribute any unallocated firm-level assets, sales, and earnings down to the segments. By contrast, the second procedure ignores a segment's imputed interest and tax expenses and simply allocates to the segments a share of the firm's actual interest and tax expenses, where the allocation is based on segment assets. Thus, under this procedure a segment's interest (tax) expense is simply the firm-level interest (tax) expense times the ratio of the segment's assets to the sum of segment assets. Under both procedures, we recalculate segment subsidies and transfers and use these to reconstruct the overall value of the firm's internal capital market and its component parts.

Table 6 reports regressions of excess value on internal capital market components for the overall sample and for the low- and high-diversity subsamples for the cases where subsidies and transfers are based on the modified imputation procedure (1) and the firm-level allocation procedure (2). The internal capital market variables are based on fitted Q efficiency. Although not reported in the table, all regressions include firm-level fixed effects, calendar year dummies, and control variables. White's heteroscedasticty-consistent t-statistics are reported in parentheses below the parameter estimates.

The regression results in (1) and (2) are very similar and more importantly, virtually indistinguishable from the corresponding regression results in Tables 3 and 5. In particular, regardless of how we estimate segment interest and tax expenses, efficient and inefficient subsidies to constrained segments significantly increase excess value and inefficient transfers significantly decrease excess value. Furthermore, the pattern of coefficient estimates across low- and high-diversity firms in regression sets (1) and (2) is the same as that presented in Table 5 for the case where efficiency is based on fitted Q. Finally, although not reported in Table 6, the results are similar if efficiency is based on ROA.

3.2 Requiring subsidies equal transfers

Our formulation of subsidies and transfers allows a firm's subsidies to exceed transfers, but requires that transfers be no larger than subsidies. Briefly, the logic is that a segment's capital expenditures can be subsidized either by resource transfers from other segments, coinsured external financing, or by liquidation of assets (e.g., marketable securities). By contrast, when a segment's after-tax cash flows exceed the sum of its capital expenditures and an allocated share of the firm's dividend, the resulting difference cannot be unambiguously recorded as a transfer unless other segments receive subsidies of at least that amount.[28]

[28] Admittedly the resulting excess cash flow could be placed in cash and marketable securities with the intention of using these funds at a later date to subsidize investment. However, note that our formulation

Table 6
Regressions explaining excess value of multisegment firms based on alternative specifications of subsidies and transfers

	(1) Modified imputation of interest and tax expense		(2) Allocation of firm-level interest and tax expense		(3) Require the sum of subsidies equals transfers	
Internal capital market	−0.004		−0.271		0.754	
	(−0.02)		(−1.46)		(1.26)	
Efficient subsidies to constrained segments		1.691		1.771		11.024
		(1.69)*		(1.98)**		(1.15)
Efficient subsidies to unconstrained segments		0.254		0.187		12.527
		(0.24)		(0.11)		(1.44)
Inefficient subsidies to constrained segments		1.331		1.717		3.149
		(3.52)***		(5.33)***		(1.82)*
Inefficient subsidies to unconstrained segments		−0.533		−0.448		1.945
		(−0.92)		(−0.90)		(0.58)
Efficient transfer segments		−1.156		−0.522		−0.630
		(−0.36)		(−0.21)		(−0.12)
Inefficient transfer segments		−2.258		−1.857		−4.590
		(−3.24)***		(−3.55)***		(−2.51)***
Adjusted R^2	0.70	0.71	0.70	0.70	0.69	0.69
No. of observations	4148	4148	4168	4168	4215	4215

	Diversity					
	Low	High	Low	High	Low	High
Efficient subsidies to constrained segments	3.711	0.909	1.864	0.682	14.428	3.736
	(2.46)***	(0.62)	(1.72)*	(0.56)	(1.32)	(0.15)
Efficient subsidies to unconstrained segments	−1.799	1.366	0.586	0.895	14.108	0.421
	(−1.04)	(0.89)	(0.26)	(0.32)	(1.67)*	(0.01)

Inefficient subsidies to constrained segments	1.569 (2.93)***	1.285 (2.50)***	2.008 (4.61)***	1.442 (3.34)***	4.129 (1.53)	6.082 (1.79)*
Inefficient subsidies to unconstrained segments	−0.080 (−0.08)	−0.580 (−0.98)	0.247 (0.29)	−0.401 (−0.71)	2.769 (0.73)	4.819 (0.47)
Efficient transfer segments	−2.961 (−0.84)	−3.133 (−0.34)	−4.133 (−1.26)	5.300 (1.34)	−6.999 (−1.20)	9.663 (0.89)
Inefficient transfer segments	−0.690 (−0.84)	−3.027 (−2.62)***	−2.183 (−2.83)***	−2.382 (−2.82)***	−3.746 (−1.40)	−10.596 (−2.81)***
Adjusted R^2	0.73	0.73	0.73	0.73	0.73	0.71
No. of observations	2074	2074	2084	2084	2107	2108

Fixed-effects regressions allowing for firm-specific intercepts and calendar year dummies. The dependent variable, excess value, is the natural logarithm of the ratio of the firm's actual value to its imputed value. A firm's actual value is the sum of the total book value of debt, liquidation value of preferred stock, and market value of equity. A firm's imputed value is the sum of the imputed values of its segments, with each segment's imputed value equal to the segment's assets multiplied by its industry median ratio of total capitalization to total assets. All internal capital market explanatory variables (defined in previous tables) are based on fitted Q efficiency. In addition, although not reported in the table, all regressions include the number of segments, number of related segments, firm size, leverage, liquidity, and profitability as explanatory variables. Firm diversity is the standard deviation of segment asset-weighted fitted Qs divided by the equally weighted average fitted Q. A firm is classified as having low (high) diversity if its computed diversity is less than or equal to (greater than) the median computed diversity for the firms in the sample. In regression sets (1) and (2), segment subsidies and transfers are computed using segment after-tax cash flows where a segment's interest and tax expenses are estimated with a modified imputation procedure and by allocating actual firm-level items, respectively. In (1), a segment's interest (tax) expense is computed as the segment's imputed interest (tax) expense times the ratio of firm-level interest (tax) expense to the sum of the imputed interest (tax) expenses of the segments. A segment's imputed interest expense is computed as segment sales times the median ratio of interest expense to sales of single-segment firms in the segment's industry. A segment's imputed tax expense is computed as segment pretax income times the median ratio of taxes paid to pretax income of single segment firms in the segment's industry. Segment pretax income is computed as earnings before interest and tax minus imputed interest expense. In (2), a segment's interest (tax) expense is computed as the firm-level interest (tax) expense times the ratio of segment assets to the sum of segment assets. In regression set (3), we constrain a firm's total dollar amount of segment subsidies to equal the total dollar amount of segment transfers. For each firm-year, we take the minimum of the firm's summed subsidies and summed transfers. We then resize each subsidy (transfer) by multiplying the subsidy (transfer) by the ratio of the minimum amount to the sum of subsidies (transfers). White's (1980) heteroscedasticity-consistent t-statistics are in parentheses below the parameter estimates. An ***, **, * indicates significance at the 1%, 5%, 10% level, using a two-tailed test.

Nevertheless, an interesting question is what happens to our results when we only recognize subsidies that are accompanied by transfers (i.e., ignoring subsidies that are externally financed or financed through the liquidation of firm assets).

We can investigate this question by requiring the sum of subsidies to equal the sum of transfers. For a firm in a given sample year, we first sum segment subsidies and potential transfers:

$$SumSub = \sum_{i=1}^{n} Subsidy_i \quad \text{and} \quad SumTran = \sum_{i=1}^{n} PTransfer_i,$$

where n is the number of segments and $Subsidy_i$ and $PTransfer_i$ are defined in Section 1. We then choose the minimum sum, $MinSumST =$ min ($SumSub$, $SumTran$) and resize the subsidies and transfer as

$$Sub_i = Subsidy_i \times \frac{MinSumST}{SumSub} \quad \text{and}$$
$$Tran_i = PTransfer_i \times \frac{MinSumST}{SumTran}.$$

Note that in this formulation if summed subsidies are larger (smaller) than summed transfers, then each subsidy (transfer) will be scaled down so that the sum of the resized subsidies and transfers will be equal.

Not surprisingly, the imposition of this requirement significantly reduces the number of segment-years in the sample classified as receiving a subsidy. Referring to panel B of Table 2, where efficiency is based on fitted Q, the number of subsidy segment-years classified as efficient-constrained, efficient-unconstrained, inefficient-constrained, and inefficient-unconstrained decreases from 595 to 228, 331 to 110, 1839 to 1177, and 614 to 308, respectively. In comparison, the numbers of transfer segment-years are only slightly reduced from the numbers reported in panel B of Table 2. As discussed earlier, these findings simply reflect the fact that a significant proportion of firms in the sample has subsidies exceeding transfers.

Regression set (3) of Table 6 reports regressions of excess value on internal capital market components based on the requirement that subsidies equal transfers and using fitted Q to measure efficiency.[29] Overall, the results are remarkably consistent with the corresponding set of findings in Tables 3 and 5. However, the statistical significance of the coefficient estimates on efficient and inefficient subsidies to financially constrained segments is degraded and the coefficient estimates are inflated. One implication is that externally financed subsidies should not

will catch the subsequent subsidy if the cash and marketable securities are used to fund segment capital expenditures exceeding contemporaneous after-tax cash flow.

[29] The results are similar if ROA is used to measure efficiency.

be ignored when computing the value of a firm's internal capital market activity.[30] Nevertheless, it is useful to know that the article's results are generally robust to the narrow restriction that subsidies must equal transfers.

4. Conclusions

Previous studies have documented that diversified firms sell at a discount. In addition, studies tend to find that diversified firms engage in inefficient cross-subsidization. This literature suggests that these inefficiencies are a key driver of the diversification discount, but such a link has never been reliably established. The goal of this study is to examine the linkage between a diversified firm's excess value and its internal capital market and to investigate whether internal capital market transactions that relieve otherwise binding financing constraints enhance diversified firm value.

We construct an overall measure of the value of a diversified firm's internal capital market that includes the amount of subsidies and transfers, the efficiency of these capital flows, and the likelihood that a segment receiving a subsidy would be financially constrained if it were a stand-alone firm. In a large sample of diversified firms in the 1990s, we find little reliable evidence that the excess value of a diversified firm is related to the overall value of its internal capital market. However, decomposition of the overall measure into efficient and inefficient subsidies to financially constrained and unconstrained segments and efficient and inefficient transfer segments provides a much sharper picture. Consistent with the efficient internal capital market theory, we find that efficient subsidies to financially constrained segments significantly increase excess value, while inefficient transfers from segments with good relative investment opportunities significantly decrease excess value. Importantly, we find that efficient subsidies to unconstrained segments have no effect on excess value, which suggests that the key benefit of an internal capital market is the ability to fund good investment opportunities of segments that would be financially constrained if they were stand-alone firms. Finally, consistent with the predictions of the recent Rajan, Servaes, and Zingales (2000) model, we find that subsidies to small segments with poor relative investment opportunities also increase diversified firm value. However, we find little evidence that this relationship between inefficient subsidies and excess value depends on the diversity of the firm's segments' investment opportunities.

[30] It is tempting to think that we may be capable of isolating the differential impact on excess value of internally and externally financed subsidies. However, data limitations prevent us from accurately tracing whether a transfer from another segment, external financing, or the liquidation of firm assets finances a segment's subsidy.

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