DEPENDENCE ON EXTERNAL FINANCE BY MANUFACTURING SECTOR: EXAMINING THE MEASURE AND ITS PROPERTIES

George M. von Furstenberg and Ulf von Kalckreuth[1]

ABSTRACT. Rajan and Zingales (1998) use U.S. Compustat firm decadal data for the 1980s to obtain measures for manufacturing sectors' Dependence on External (-to-the-firm) Finance (DEF). Their way of obtaining representative values of DEF by sector and of interpreting differences in these values as fundamental, and hence applicable to other countries, have been adopted in additional studies seeking to show that sectors benefit unequally from a country's level of financial development. Using an alternative annual data base for 21 entire U.S. industry sectors, 1977-1997, we find that DEF figures calculated from micro data do not match cyclically-adjusted aggregate estimates. There is no support for attributing fundamental features to U.S. DEF values by industry that would justify applying them to other countries.

JEL Classifications: E50, G20, G30, O14, O16.

Keywords: Dependence on External Finance; Financial Development; Manufacturing Industry Structure; Cyclical Adjustment.

[1] George M. von Furstenberg, Program Director – Economics, National Science Foundation, Arlington, VA 22230, USA (corresponding author, gvonfurs@nsf.gov; vonfurst@indiana.edu; Tel. USA 703-292-8202). Ulf von Kalckreuth, Senior Economist, Research Centre of the Deutsche Bundesbank, Frankfurt, Germany (ulf.von-kalckreuth@bundesbank.de). We are indebted to Michael D. Glenn of the National Income and Wealth Division, and Gabriel Medeiros of the Industry Division of the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce for expert guidance to, and help with, the data sources. Comments received upon presentation at the Seventh Center for Financial Studies Conference, co-sponsored by the European Central Bank and the Deutsche Bundesbank, in Berlin on September 29, 2006, and at the March 27-28, 2007 CEFI/CEPII conference on "Opening and Innovation on Financial Emerging Markets" in Beijing helped improve successive drafts. Special thanks go to two anonymous referees and the editor of this journal who guided the final revisions. The views expressed are those of the authors and not of the National Science Foundation or the Deutsche Bundesbank.

1 INTRODUCTION

Explorations of the relation between *domestic financial development* (FD) and economic growth have addressed an ever wider range of issues. First, does FD lead to economic development or is it prompted by technological opportunities arising in the non-financial sector to allow those opportunities to be fully exploited? Secondly, what are the institutional, legal, social, and political prerequisites for it to stimulate economic growth? And finally, which manufacturing sectors benefit most from FD?[2]

In a celebrated article whose original measures and findings continue to be applied, Rajan and Zingales (RZ, 1998) addressed the last question by characterizing 36 manufacturing industry sectors by their *dependence on external finance* (DEF). They then hypothesized that the greater the DEF value they found for the median U.S. firm, listed on U.S. exchanges, in any of these sectors, the more their growth in other countries will benefit from (be hurt by) a high (low) level of their FD. Given its continued influence, (a) the construction of DEF, and (b) the fundamental characteristics attributed to it to give it universal applicability, merit close scrutiny and the use of a new data set for perspective.

1.1 Searching for Fundamental Determinants of External Financing Needs by Manufacturing Industry Sector

In close analogy to the Scandinavian (H-O) theory of comparative advantage, RZ (1998) proceed formally as follows: First output sectors in an advanced country are classified by parameters representing their inherent resource intensity characteristics, in their case, by U.S. DEF. Countries differing in endowments relevant to that characteristic, here the level of FD, when brought into contact with one another through external opening, then are expected to display predictable differences in the industrial structure of their growth as international specialization increases.[3] Given the U.S. DEF values by sector and assuming *local* financial

[2] Additional *structural* questions relate to the types of firms, investors, and even income classes (see Beck, Levine, and Levkov, 2007) that benefit most from domestic financial development. Focusing on level effects instead, Kose *et al.* (2006) have re-examined the effects of financial development on (a) risk sharing and consumption smoothing, (b) economic stability, and (c) economic growth in a global setting.

[3] FD is indicated by stock-to-flow ratios such as M2/GDP or credit to the private sector plus stock-market capitalization over GDP. Further distinctions are between bank-based and market-based systems (e.g., Beck and Levine, 2001) and by degree of concentration in the banking sector (Andersen and Tarp, 2003; Cetorelli and Strahan, 2006). Other characteristics considered are legal traditions relating to creditor rights and contract enforcement, and the quality of accounting systems and of regulations affecting intermediaries’

development matters, as later confirmed by Guiso, Sapienza, and Zingales (2004) and Stulz (2005), international differences in the structure of growth may be linked to differences in FD that make it easier to raise funds from outside the firm in some countries than in others.

RZ (1998, p. 563) subsumed that "there is a technological reason why some industries depend more on external finance than others... [T]hese technological differences persist across countries, so that we can use an industry's dependence on external funds as identified in the United States as a measure of its dependence in other countries." They then tested the inference that a high (low) level of FD in a country favors the growth of industries most (least) dependent on external finance as revealed by US data for the 1980s.[4] Pre-2004 studies surveyed in von Furstenberg (2004) directly using RZ's estimates, and more recent studies using RZ-like data constructs[5] (e.g., Ciccone and Papaioannou, 2006; de Serres *et al.*, 2006) have tended to support this inference. With the notable exception of Beck et al. (2006), few have questioned whether the estimated degree of dependence on external finance is, in fact, a fundamental, and hence fairly durable and global, characteristic of an industry sector's basic needs. We would have to know the 1980-89 characteristics of U.S. firms that are relevant to DEF in each sector before being able to decide whether the DEF data have any fundamental connection to the industry classification that would make the data fit for foreign application.

---

development and efficiency (see RZ, 1998, p. 576; Levine, Loayza and Beck, 1999; Ito 2006; de Serres *et al.*, 2006; and Ciccone and Papaioannou, 2006). The latter, as well as Caballero (2007) and others, also consider how much financial development reduces financial frictions and speeds technology adoption and capital reallocation. Berger and Udell (2005) consider the entire menu of lending and transactions technologies in use in a country, plus its structures of relationship lending, to predict the effectiveness of financial services for particular sectors. Edison *et al.* (2002), Abiad, Oomes, and Ueda (2004) and Bekaert, Harvey, and Lundblad (2005) focus instead on identifying the effect of *international* financial integration on economic growth to which FDI may contribute.

4 Because of the cross-sectional orientation of their work, RZ (1998) do not consider how especially rapid advances in FD may affect the structure of growth in a country even if the sample-period average level of its FD is low. This is done in von Furstenberg (2004) for Poland after its emergence from socialism. The study finds no support for the hypothesis, analogous to the Rybczynski-effect, that greater availability of "finance" through rapid FD favors the growth of industry-sectors more the higher their DEF. The Fisman and Love (2004) finding (with RZ data) that financial development facilitates the reallocation of resources to industries with good growth opportunities regardless of their reliance on outside finance could be part of the explanation because Poland's opening to the West produced shocks to its industry growth opportunities.

5 An RZ-like measure is defined as the median of the time-averaged DEF values of firms in each industry sector. This median is regarded as yielding a fixed and universal characteristic of that sector. Laeven, Klingebiel, and Kroszner (2002) (see also Kroszner, Laeven, and Klingebiel, 2007) apply the RZ data construction method exactly but to a particular set of 3-digit ISIC industries. Firm-level databases other than Compustat and averages for periods other than the 1980s may also be used in RZ-like measures.

As technological factors why some sectors depend more on external finance than others, RZ (p. 563) list differences in initial project scale, the gestation period, the cash harvest period, and the amount of follow-on investments required. RZ did not test whether any of these correlate as expected with their measure of DEF by sector. And indeed the bearing of the factors they listed on the DEF values of firms could well be limited to the start-up phase of their business and to any subsequent growth spurts. As others since have demonstrated directly, industries that are populated by young and small firms have the highest sensitivity to cash flow and the greatest DEF.[6] Yet, considering, say, the increasingly cash-rich history of Microsoft's position in its sector, the distribution of firms by size, age and financing needs is not likely to be fixed and universal in a sector.[7] For another example, the U.S. auto industry has gone into steep decline: It has registered cumulative operating losses so far this decade and become deeply indebted. In other cases, re-leveraging through private equity buyouts is creating financially engineered dependence on external finance that has little to do with fundamental industry characteristics. *These considerations lead us to formulate and test the Null hypothesis that DEF and conceptually related measures by industry sector do not reflect fundamental, and hence durable and potentially universal, structural/technological features of these sectors in the United States. If the Null cannot be rejected, there would be no support for attributing such features to U.S. DEF in applications to other countries.*

To address the problem of sectors maturing and experiencing changing financing needs, RZ gave separate attention to the "young" (listed on a U.S. exchange within the last 10 years) and "mature" among "all" companies and to the extent to which growth is produced by an increase in the number of firms in a sector rather than an increase in their average size. They found (pp. 577-579) that while the development of financial markets has a disproportional impact on the growth in the number of firms, the interaction between their measure of DEF and an array of proxies for FD is not statistically significant for growth in the average size of firms and, unexpectedly, much weaker for "young" than for "all" companies in a sector. Hence what exactly is behind differences in DEF by industry sector that could make these differences structural/technological as RZ maintain has remained uncertain.

---

6 See, for instance, Beck *et al.* (2005), and Acharya, Imbs, and Sturgess (2006). Cooley and Quadrini (2001), and Clementi and Hopenhayen (2006) discuss models in which the cash flow sensitivity of investment varies with size only because size is positively correlated with the age of firms, or vice versa.

7 See the discussion of Microsoft and lack of financial constraints in Kaplan and Zingales (2000, pp. 709-710).

Reducing that uncertainty is difficult because *structural/technological*, when used to describe factors accounting for differences in DEF between sectors, technically is a fuzzy characteristic. Properties of production functions such as the specification of human capital and technological progress, scale effects, elasticity of factor substitution, and factor intensity may have nearly 100 percent membership in the concept. Characteristics of input use within sectors, such as the depreciation rate and materials intensity, or the degree of dependence on external inputs, have a smaller, but still high, degree of membership. Characteristics that may be relevant to the cash flow process in relation to investment, such as the business risk of a sector and its leverage and collateralization potential, may also claim some degree of membership in the concept of being structural/technological.

RZ's own conjectures offer some guidance on where to look for structural/ technological origins of differences in U.S. DEF by industry sectors: They have to lie in financing structures directly associated with the cash flow generation process and its relation to planned investment. Indeed, they (1998, pp. 581-583) demonstrate (through the absence of significant interaction of DEF with endowment variables other than the level of FD) that differences in their measures of U.S. DEF by sector are indeed inherently financial. RZ likewise reject the hypothesis that financial development is just a concomitant of economic development. They then look upon the DEF values observed in the United States as a fundamental characteristic of industry sectors that interacts with the degree of FD in 41 other countries to determine their structure of growth by manufacturing sector.

Whether DEF can in fact be viewed as a fundamental characteristic of manufacturing sectors in the United States and, at least latently, in other countries and through time may have implications for price relations in finance as well as for the expected industry structure of economic growth. Cochrane (2005, p. 18; see pp. 95-103 for references) notes that, to explain pricing anomalies, empirical papers now routinely form portfolios by sorting on characteristics other than the three Fama-French "priced factors" that include firm size and book-to-market-value portfolios. Among such other sorting criteria for listed firms may be their industry-production (e.g., primary metals) or final-demand (e.g., consumer durables) sector when differences in return characteristics of firms in such sectors are not fully explained by CAPM valuation plus priced factor models. Cochrane (2005, p. 22) conjectures that good cash-flow news could bring growth options into the money, and this event could increase the systematic risk (betas) of the winner stocks. If high-DEF are more financially constrained than low-DEF industry sectors, good cash-flow news could affect them more (for cautions see Kaplan and Zingales, 2000), though less intensely the higher a country's level of FD. Hence the question of whether DEF is anchored in stable fundamentals by industry could be of broad consequence for financial analysis beyond the work of RZ (1998) that brought it up. That question cannot be examined with RZ's data for the median firm ordered by DEF because that firm may not be representative for its sector in other respects.

1.2 Outline by Section

Using a rich macroeconomic data source that has not previously been used for this purpose, we rely on aggregate U.S. industry-level data from the (U.S. Department of Commerce) Bureau of Economic Analysis (BEA), rather than firm-level data, to yield annual DEF_{it} values for the i = 1,…S, S = 21 manufacturing sectors reported there and t = 1,...T, T = 21 years, 1977-97. This is the maximum number of years, straddling RZ's 1980-89 data combination period, for which all the data to be used here were available on a consistent basis. For a firm or entire sector, DEF is defined as the difference between *Capital Expenditures* (CE) on fixed assets and *Cash Flow* (CF) from operations divided by CE, DEF ≡ (CE - CF)/CE = 1 – CF/CE. RZ (1998) derived that measure from Compustat Statements of Cash Flow and other Compustat data items for listed U.S. companies, selecting the median firm (ranked by DEF) per sector. It will be convenient for presentation to use *Reliance on Internal Finance* (RIF) where RIF = 1 – DEF = CF/CE, instead of DEF, because our 21x21=441 DEF values often are negative as they would be for companies that pay dividends and still have enough cash flow from operations left for their CE, so that CF > CE.

In Section 2 we compare the databases and measures used by RZ and by us and subject our annual RIF data to explicit cyclical adjustment rather than using decadal aggregates of CF and CE as in RZ. We check the correlation and differences in means between these two types of U.S.-based measures and weight by the relative importance of industry sectors to check on the robustness of construction and the representativeness of the measures derived. Our weights, W_i, are the average annual ratios for 1980-89 of CE_{it} to year t's capital expenditures in all sectors. The 21 between-sector deviations and the 441 within-sector deviations in these and related measures then are defined that are used as the respective observations. In this decomposition the primary grouping criterion is either the manufacturing sector (i) or the year of observation (t), and weights W_i again are applied. Section 3 identifies and models non-cyclical constituents of RIF_{it} that are determinants of RIF_{it}^{adj}. These constituents are time series of intermediate input, net interest paid, and depreciation rates and of growth-of-capital data, all by sector. Using the between-sector and within-sector deviations of all variables separately, this section then presents and discusses the two sets of regression results for RIF_{it}^{adj}. Section 4 considers to what extent these results shed light on what could be fundamental about this RZ-like measure and concludes that it is not meaningful to regard it as attaching to industry sectors as a technological characteristic.

2 DATA, THEIR CYCLICAL ADJUSTMENT AND DECOMPOSITION

This section answers the first of our two research questions, about the representativeness of the RZ measures, by contrasting their construction with that of our alternative measures derived from a different source. It then describes the cyclical adjustment of the latter data and its decomposition into between-sector and within-sector deviations.

2.1 Available Macroeconomic and Microeconomic U.S. Databases Compared

The RZ Compustat-based measures, one per sector i, are the DEF_i values obtained for the median exchange-listed firm in the respective distributions by DEF_i of “young”, “mature” and “all companies.” To recall, the ratio on which we focus is $RIF_{it} = (CF/CE)_{it} = 1 – DEF_{it}$. Cash Flow, CF, is estimated as the gross (of capital consumption allowances) return on capital, minus taxes, including product and (corporation) income taxes, and minus net interest paid. Although not only fixed capital assets, but also intangible capital and working capital, including inventories, need to be financed and require a return, RZ use Compustat North America’s annual data item #128, defined as consisting of gross “additions to the company’s property, plant, and equipment, excluding amounts arising from acquisitions.” Capital Expenditures, CE, thus consist of gross investment in fixed capital assets alone.

The BEA data are aggregates for all the establishments of corporations and proprietors engaged in manufacturing in the United States. They thus represent entire industry sectors rather than having each sector represented by its median (by size of DEF) Compustat-based measure for exchange-listed U.S. firms. Compustat assigns each firm to a single Standard Industrial Classification (SIC) that is derived from its largest sector of operations even though the firm may have operations in several sectors and consolidated subsidiaries in several countries (on consolidation see Mills and Plesko, 2003, p. 869). By contrast, establishments are U.S.-based and much more specialized and numerous than firms. Establishments, defined for the purposes of the SIC as "economic units, generally at a single physical location, where business is conducted or where services or industrial operations are performed," are far less likely than entire firms to straddle industry sectors.[8] In short, listed firms, on account of their size, may be conglomerates operating in several production sectors, while establishments in a given SIC class are much more homogeneous in that regard.

Furthermore, if sectors typically consist of a few large and many more small listed firms, chances are that the median firm is small, though not necessarily young,[9] and that the large, well-established firms that carry much of the weight lie on the left (right) side of it in the distribution by size of DEF (RIF).[10] This may explain in part why the BEA-based average aggregate measures of $DEF^{adj} = 1 - RIF^{adj}$ shown in column [4] of Table 1 are lower than the RZ measures for the median listed firm even when that firm is drawn from the subset of "mature" companies that went public ten or more years ago.[11] The fact that median firms may not well represent the balance-sheet and income-sector account aggregates for their

8 The definition is from http://www.bea.doc.gov/bea/dn/FAweb/Articles.Intro.html. Investment in fixed assets by establishment is benchmarked to the Census of Capital Expenditures conducted in conjunction with the decennial Economic Census (its most recent date was 1997) and updated with data from the Annual Capital Expenditure Survey. Principal source data for value-added components and the extent to which they were obtained on an establishment basis or require conversion from an enterprise to an establishment basis are identified in Moyer et al. (2004, especially Table C, p. 46). The allocation of net interest paid by each firm to establishments in the different SIC sectors it may contain, which is done on the basis of their net stock of fixed capital, indicates that CF reported for establishments is not entirely divorced from characteristics, such as the borrowing ability, of the firm to which they belong.

9 If the median firm is relatively small, it does not fit well with RZ's (1998, p. 560) characterizations: "Under the assumption that capital markets in the United States, *especially for the large listed firms we analyze*, are relatively frictionless, this method allows us to identify an industry's technological demand for external financing. Under the further assumption that such a technological demand carries over to other countries, we examine whether industries that are more dependent on external financing grow relatively faster in countries that, a priori, are more financially developed" (italics added). On the other hand, if the median firm were large and mature, none of the reasons RZ suggested for regarding differences in the resulting measures of DEF between sectors as structural/technological would apply.

10 Beck *et al.* (2006) found that small firms report significantly higher financing obstacles than large firms and such obstacles decrease in the age of the enterprise.

11 As shown near the end of cols. [4] and [2] of Table 1, the annual average of cyclically adjusted DEF (DEF^{adj}) values for 1980-89 was -0.94 unweighted and -0.64 weighted, compared with values of 0.02 and 0.08 for RZ's mature companies (at least 10 years past their IPO). The preferred weighting here is by the square root of the CE weights, W_i, so that the variances-covariances will be weighted by these size weights, W_i. The weighting of the Sum of Squared Total (SST), Within-Sector (SSW), and Between-Sector (SSB) deviations in the Limdep Version 8 program used throughout is fully laid out in Appendix 3 in von Furstenberg and von Kalckreuth (2006); details on comparing BEA-based and RZ's data concepts and values are in Appendix 2.

Table 1 - Decadal RZ DEF measures for "all" and "mature" companies compared with our average of cyclically-adjusted annual measures, DEF^{adj}, 1980-89

	1980-1989 RZ DEF		1980-89	DEF^{adj}	t-values of Mean Diff		
	All	Mature	Avg=W_i	1980-89	STD-MD	t of[1]-[4]	t of[2]-[4]
Column:	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Lumber	0.280	0.250	0.0219	-2.684	0.567	5.228	5.175
Furniture	0.240	0.330	0.0090	-0.900	0.175	6.514	7.029
Stone Clay Glass	0.199	0.113	0.0302	0.031	0.154	1.091	0.532
Primary Metals	0.058	0.082	0.0570	0.045	0.121	0.107	0.306
Fabricated Metal	0.240	0.040	0.0504	-1.199	0.109	13.202	11.367
Machinery	0.626	0.232	0.1030	-0.651	0.180	7.094	4.906
Electric Machinery	0.954	0.339	0.1041	-0.864	0.364	4.995	3.305
Motor Vehicles	0.390	0.110	0.0666	-1.383	0.607	2.921	2.460
Other Transpo. Eq.	0.325	0.148	0.0499	1.225	0.324	-2.778	-3.324
Instruments	0.960	0.190	0.0471	0.477	0.337	1.433	-0.852
Misc. Manufacture	0.470	-0.050	0.0088	-3.279	0.368	10.188	8.774
Food & Beverages	0.127	-0.071	0.0848	-0.671	0.078	10.231	7.692
Tobacco	-0.450	-0.380	0.0087	-1.118	0.475	1.406	1.554
Textiles	0.137	0.043	0.0223	-0.222	0.064	5.609	4.141
Apparel	0.030	-0.020	0.0091	-2.355	0.175	13.629	13.343
Paper	0.160	0.120	0.0694	-0.198	0.069	5.188	4.609
Printing	0.200	0.140	0.0529	-1.241	0.087	16.563	15.874
Chemical Products	0.476	-0.052	0.1227	-0.849	0.168	7.887	4.744
Petrol.& Coal Prod.	0.078	0.004	0.0458	0.862	0.336	-2.333	-2.554
Rubber & Plastics	0.957	-0.120	0.0348	-0.144	0.122	9.025	0.197
Leather Products	-0.115	-1.019	0.0016	-4.532	0.691	6.392	5.084
Average	0.302	0.020	Sum: 1	-0.936			
--Weighted by$W_i^{0.5}$	0.370	0.078		-0.645			
-- Weighted by W_i	0.412	0.096		-0.567			

Notes: The data in columns [1] and [2], reclassified from 36 ISIC Rev. 2 sectors in RZ (1998) to 21 1987 SIC sectors, are derived in Appendix Tables A2 and A3, respectively in von Furstenberg and von Kalckreuth (2006). Weighting is by the 1980-1989 average annual capital expenditure (CE) weights by sector, with these weights, W_i, shown in column [3]. The square-root of these weights, $W_i^{0.5}$, conveniently normalized to sum to 1, is used to give a selection of weighted averages below the line. Column [4] presents the result of the cyclical adjustment explained later in Section 2.2 that yields RIF^{adj} and hence DEF^{adj} since, by definition, $DEF^{adj} = 1 - RIF^{adj}$. The standard deviation of the differences between the means of 10 annual rates, STD-MD, is shown in column [5]. Since RZ provide only a single decadal measure per sector, its variance is estimated on the assumption that had they reported DEF values for the median firm in each year's distribution, the variance of those DEF values would have been about the same as that of the average annual values we obtained by sector each year for the 10-year period in question. Calling the latter variance VAR, the entries in column [5] are therefore calculated as the square root of (2/10)VAR.This standard deviation then is used to estimate the t-value of the difference between corresponding entries in columns [1] and [4]or [2] and [4].

entire sector has been noted by others who also found that sector-wide DEF values are frequently negative, meaning that cash flow exceeds capital expenditures in the aggregate. To get closer to the RZ values, de Serres *et al.* (2006, p. 44), for instance, experimentally exclude all firms with more than 1,000 employees "to have more industries with positive dependence ratios." Values of $DEF_i < 0$ or $RIF_i > 1$ signify net portfolio investment (including net stock buybacks and net reduction of debt) in a sector if dividends are paid at a rate (in relation to CE) less than the excess of RIF over 1.

The weights W_i in column 3 of Table 1 that were derived from BEA data also show that, judging by capital expenditures (CE) on fixed assets, the largest and the smallest of the 21 SIC sectors differ in size by a factor of 75. Large sectors have aggregate RIF values that cluster together, are poorly aligned with those based on the median firm, and are lower on average than for the smaller sectors. The difference weighting by CE makes is underscored by the correlation between the RZ decadal (1980-89) measures (redistributed into the 21 BEA sectors) for "mature" companies and our average annual measures for 1980-89 being 0.53 unweighted, but -0.06 weighted. The correlation of our measure with the RZ measure for "all" companies is even more distant: 0.24 unweighted and -0.11 weighted. As shown in the last two columns of Table 1, at least three quarters of the t-values of the differences between the RZ decadal measure for "all" or just "mature" companies and our average of cyclically-adjusted annual measures for 1980-89 are above 2.26. This is the critical t-value for a sample of 10 at the 5 percent level of significance. Hence the RZ measures are at best weakly macroeconomically representative by their correlation properties, and not their size, for manufacturing sectors in the United States, the country from which they were derived.[12] Idiosyncrasies of the median listed firm[13] in the DEF distribution by sector may add to the lack of representativeness in other respects compared with our aggregate measure.

---

[12] The correlation between RZ's own measures of DEF for "all companies" and "mature" companies is 0.475 unweighted (and 0.612 with our weights). RZ (1998, p. 572, Part B[1]) report the almost identical value of 0.46 for their 36 sectors. This suggests that relevant features of their data have been preserved in the conversion to the 21 sectors for which data are provided by the BEA in the sources followed. These sources, the accounting definitions of variables, and correspondences by sector are detailed in Appendix 2 in von Furstenberg and von Kalckreuth (2006).

[13] For instance, for radio, television and communications equipment manufacturing (ISIC 3832), RZ (1998, p. 567) report that the median firm in "all" companies had external dependence greater than 1, with its 1980-89 aggregate of cash flow negative. At the same time, the ratio of its capital expenditures to net property, plant and equipment was the fifth highest among the 36 sectors, indicating strong growth. In

2.2 Cyclical Adjustment of RIF_{it} to Obtain RIF_{it}^{adj} and its Variations

The cyclical and transitory factors affecting RIF_{it} in the United States are not stable structural/technological characteristics of industry sectors. They are not likely to apply simultaneously in other countries. Continuing to take RZ (1998) as reference guide, whereas RZ sought to eliminate the influence of "cyclical" factors through decade-long aggregation, directly adjusting the annual RIF data for each sector provides better control and preserves annual residuals that may contain information on changing non-cyclical characteristics.[14]

As modeled in the appendix to this paper, cyclical adjustment aims to eliminate the effect of aggregate-demand shocks and sector-specific relative-price shocks from the solution of an employment and output optimization model with nominal wage rigidity. Aggregate-demand shocks are reflected in deviations of the logarithm of employment in manufacturing, L_{mt}, from trend. Sector-specific aggregate demand and supply shocks are represented by the net deviations from trend which they may cause in sector i's price level (P) of gross output (GO) relative to that of the manufacturing as a whole, PGO_{it}/PGO_{mt}, and in the price level of externally sourced inputs (J) relative to that of the value added (VA) by the establishments in sector i, PJ_{it}/PVA_{it}. Because of its integration with national income and product accounting, the BEA "industry" database has the advantage of containing the price indexes by manufacturing sectors required. We proceed to estimate, and then to eliminate, the effect of these cyclical disturbances on RIF_{it}, while keeping other, possibly structural, innovations.

The equation estimated separately for each sector i with T = 21 observations is:

$$RIF_{it} = a_i + b_i \, DlnL_{mt} + c_i \, Dln(PGO_{it}/PGO_{mt}) + d_i \, Dln(PJ_{it}/PVA_{it}) + e_{it} \qquad (1)$$

The cyclically-adjusted values, RIF_{it}^{adj}, are obtained by setting all three temporary deviations from trend, each starting with D, to zero. Equation (1) then yields RIF_{it}^{adj} as the sum of the sector's intercept, a_i, and its time-specific non-cyclical annual residual, e_{it}. The adjustment

---

fact, during this and the next decade, the radio and television equipment part of this sector was withering away in the United States while communications equipment manufacturing was still thriving. Hence it would not appear that the median U.S. firm could deliver a good approximation to equilibrium characteristics in the sector for the United States, let alone for the rest of the world, in this instance.

[14] Constructing a decennial (decadal) data set does not provide the best estimate of the desired information. It may be granted that in sectors with low growth and little price change, aggregating numerator and denominator of RIF over a decade, before dividing, yields a value that is almost the same as the 10-year average of *annual* values of RIF for the same sector. Yet, as a BIS publication (Skoczylas and Tissot, 2005, p. 11) has criticized, cyclical adjustment by means of averaging over a complete cycle assumes that no structural change can occur during a business cycle, "an assumption that seems too restrictive."

leaves the mean of RIF_{it}^{adj} for the data period as a whole precisely the same as that of RIF_{it} for any i but with a variance that is only two-thirds (68-69%) as large as that of RIF_{it} on average per sector, both with and without weighting. This variance ratio ranges from 23% in the highly cyclical Primary Metal Industries to 96% in the category of Miscellaneous Manufacturing Industries producing mostly consumer items that are in steady demand.

2.3 Decomposition of RIF_{it}^{adj} into Between-Sector and Within-Sector Deviations

As the second of our two research tasks, variations in RIF_{it}^{adj} primarily by S=21 sectors (between group) and secondarily over T=21 years (within group) are to be analyzed in the next section for fundamental causes. The definitions that follow will help prepare for this.

When Group = Sector(i), decomposition into the underlying between-sector deviations and within-sector deviations is comparatively simple because the weights are aligned with the grouping criterion. In that case, the S=21 between-sector deviations of sector-specific means of any variable X from the overall (weighted) average are:

$$BSX_i \equiv \overline{X_i} - \sum_t \sum_i (W_i X_{it}) / (T \sum_i W_i) \qquad (2)$$

where the last term is the weighted average of all observations. These deviations, which enter into the calculation of the *Sum of Squared deviations Between sectors* (SSB_i), also are constructed for the independent variables used to explain sectoral differences in RIF_{it}^{adj} in subsequent regressions. Similarly, the total number of SxT=441 within-sector deviations of the annual data from their sector-specific mean over time t for all sectors i are:

$$WSX_{it} \equiv X_{it} - \sum_t (W_i X_{it}) / (\sum_t W_i) = X_{it} - \overline{X_i}. \qquad (3)$$

These deviations enter into the calculation of *Sum of Squared deviations Within sectors* (SSW_i) and are constructed also for independent variables used (together with *Time-Fixed effects* (TFX)) in regressions attempting to explain within-sector variations in RIF_{it}^{adj}.

When Group = Time(t) analogous definitions apply for BSX_t and WSX_{ti} and hence SSB_t and SSW_t. Because the number of sectors (S) and years (T) both happen to be 21, there are always 21 observations between groups and SxT = 441 within all the groups. The *Sum of Squared deviations in Total, SST*, must equal the sum of the respective SSB and SSW values, SST_i or SST_t, regardless of whether sector or time is used as the primary grouping criterion.

With or without use of sectoral weighting by W_i, SSB_i/SST is 0.69 to 0.71 while SSB_t/SST is 0.04 to 0.05. This shows that between-sector variation is much more important than systematic between-year variation of the kind that would be caught by TFX effects in the cyclically adjusted data. SSB_i/SST is also several times greater than SSB_t/SST for all the explanatory variables deduced from constituents of RIF^{adj} in the next section.

Weighting once again makes a big difference in other respects. It turns out that doing so improves the representativeness of results by achieving outlier control of the low-weight sectors: The SST of RIF_{it}^{adj} falls by over 60 percent when weighting-factor W_i, normalized to w_i, is applied. For any year t, the sum of these normalized weights is equal to the number of sectors, S = 21. Repeated T = 21 times, the sum of the weights on all observations thus is equal to their number (N), or to N = SxT = 441. Because the sum of the weights w_{it} then is the same as in the "unweighted" case where $w_i = 1$ for all *i* at any *t*, "unweighted" and "weighted" results reported in this article can be compared directly.

3. ARE THERE FUNDAMENTAL REASONS WHY RIF_{it}^{adj} DIFFERS BY SECTOR?

As noted in Section 1.1, RZ's own conjectures about where to look for structural/ technological origins of differences in their decadal measures of DEF_i by industry sector point to structures directly associated with the cash flow generation process and its relation to planned investment. Hence we start with factors suggested by decomposing the definition of numerator of $RIF_{it}^{adj} \equiv (CF/CE)_{it}^{adj}$. Each term in the numerator and denominator is divided by the current replacement cost of the net stock of fixed capital assets, NK, to yield the rates shown in equation (4) below. In the numerator these are ρ, the rate of return on NK after allowing for depreciation; NIP/NK, net interest paid as a fraction of NK; z, taxes as a fraction of NK; and DELTA, the depreciation rate applicable to NK. In the denominator, DELTA appears in the gross investment rate together with GK, the instrument for the underlying growth rate of NK. In addition there is Δinv, the net inventory investment rate. Because inventory change is not reported by sector in the BEA source followed, its underlying non-cyclical level is proxied by J/GO, the ratio of intermediate inputs (J) to gross output (GO). J/GO is positively linked to Δinv on the theory that a low value-added percentage implies that establishments' working capital is high relative to their fixed capital, NK.

$$RIF_{it}^{adj} = \frac{\rho_{it} - (NIP / NK)_{it} - z_{it} + DELTA_{it}}{GK_{it} + DELTA_{it} + \Delta inv_{it}}. \qquad (4)$$

Of these elements, only differences in tax-intensity per unit of capital, z_{it}, are assumed to have no sector-systematic effects because of offsetting movement in ρ_{it}: Systematic differences in net-of-depreciation after-tax returns on capital created by non-neutralities of the business income tax system will not persist as they tend to be offset through tax shifting by surviving firms. There are also well-developed theories of invariance to dividend taxation for firms that use retentions, rather than equity issues, as a marginal source of funds and pay dividends with residual cash flow (Auerbach and Hassett, 2003).[15]

Only one of the components identified in equation (4), DELTA, can be related to the technological factors suggested by RZ (1998, p. 563). A low value of DELTA usually signifies that the capital stock is structure- and land-intensive, rather than equipment-intensive: It has to be built up to a high initial project scale with infrastructure and extensive follow-on investments over a long gestation period, while the cash harvest arrives only slowly. RZ imply that such conditions would produce a high degree of dependence on external finance (DEF_i) in a sector and a correspondingly low value of RIF_{it}^{adj}. Hence while equation (4) suggests that the effect of raising DELTA on RIF_{it}^{adj} could go either way depending on whether RIF_{it}^{adj} is greater or less than 1, the RZ-expected effect is positive.

Of course if fast-growing companies that are making extensive use of ICT-equipment and software are important in the sectors characterized by a high value of DELTA, the combined result could be a wash for RIF_{it}^{adj} as when the negative effect of a higher growth rate GK, clearly identified in equation (4), offsets the positive RZ-expected effect of a higher DELTA. RZ do not explicitly identify growth of capital as having a positive (negative) effect on DEF_i (RIF_{it}^{adj}). However their distinction between "young" and "mature" companies, though aged from the date of their IPO, and the finding of higher values of DEF_i for "young" companies, which typically grow faster than "mature" companies, could imply such a premise.

Lack of data on inventory change by sector prevent us from adding Δinv_{it} in the denominator of equation (4) or subtracting it from the numerator, as is done in the Compustat measure of

[15] Chetty and Saez (2005) and Auerbach and Hassett (2006) since have empirically rejected such invariance. If sector-specific U.S. tax factors had a non-neutral effect on RIF_{it}^{adj}, its application could not be universal.

cash flow from operations. This omission could cause an upward bias in our measure of RIF_{it}^{adj} which is greater the higher $(J/GO)_{it}$.[16] Furthermore, the residual rate of return on capital in the numerator of equation (4), ρ_{it}, is construed as derived solely from NK rather than the broader concept that includes working (and other) forms of capital which also earn a return. Including $(J/GO)_{it}$ thus should account for the extra return in RIF_{it}^{adj} that must be expected when capital other than fixed capital is important in the production process of establishments but not accounted for in the investment or capital stock data by sector.

RZ (1998) do not address the effect of differences in the net interest burden (NIP/NK), between sectors on their DEF_i (and equally our RIF_{it}^{adj}) measure even though application of the Modigliani-Miller theorem yields a clear prediction. If that theorem holds, the form of financing has no influence on the rate of return on invested capital ρ required in any given business risk class. Then if more of that return is used for net interest payments going to bondholders and loan departments, that much less is left in CF. Hence if leverage differs systematically by sector for any reason, so should RIF_{it}^{adj}: Its relation with $(NIP/NK)_{it}$ is expected to be negative, just as equation (4) suggests.

3.1 Regression Results

To test the above conjectures about the signs of GK (-), NIP/NK (-), J/GO (+), and DELTA (+) empirically and to lay the groundwork for identification and assessment of effects that might be structural/technological, we now run two types of regressions. These are based on the partition of all variables into their 21 between-sector deviations, constructed as BSX_i (equation (2)), and their 441 within-sector deviations, constructed as WSX_{it} (equation (3)). Estimates using the within-sector deviations are presented with and without the small TFX effects. Results are shown in Table 2, first with unweighted data and then when derived with the weighting variable W_i. RIF_{it}^{adj} is the dependent variable in the panel analysis by sector.

[16] Even though inventory-to-sales ratios have declined progressively, cyclical fluctuations aside the trend of inventory change has remained positive for the U.S. manufacturing sector as a whole. The same measurement-bias issues as with the exclusion of working capital and inventory change arise with intangible capital assets and investments therein, such as in patentable knowledge (see BEA, 2006).

Table 2 - Regression results and correlations, without and with weighting

A. Results with all sectors weighted equally

RIF^{adj} – *Between groups* deviation of sectoral means from overall mean - OLS

	GK	NIP/PK	J/GO	DELTA	R^2
Regression Coefficient	-26.72	19.65	-6.50	27.14	0.587
(t-value) or S	(-1.60)	(2.54)	(-1.98)	(1.11)	21

RIF^{adj} – *Within groups* deviation of data from respective sectoral mean - OLS

	GK	NIP/PK	J/GO	DELTA	R^2
Regression Coefficient	-24.84	-3.41	-11.23	-8.64	0.277
(t-value) or TxS	(-9.73)	(-2.42)	(-7.66)	(-1.17)	441
Previous with Time Fixed Effects					
Regression Coefficient	-22.37	-4.67	-11.98	-22.91	0.333
(t-value) or TxS	(-6.84)	(-3.07)	(-8.12)	(-2.39)	441

Correlation matrix: Lower diagonal, *between groups*; Upper, *within groups*

	GK	NIP/PK	J/GO	DELTA	RIF^{adj}
GK	**1**	-0.07	0.06	-0.35	-0.42
NIP/PK	-0.30	**1**	-0.50	0.13	0.09
J/GO	-0.23	-0.28	**1**	-0.15	-0.32
DELTA	0.44	-0.40	-0.33	**1**	0.14
RIF^{adj}	-0.25	0.61	-0.53	0.02	**1**

B. Results with weighting variable W_i

RIF^{adj} – *Between groups* deviation of sectoral means from overall mean – OLS

	GK	NIP/PK	J/GO	DELTA	R^2
Regression Coefficient	-34.84	13.42	-3.71	46.81	0.315
(t-value) or S	(-2.33)	(1.91)	(-1.47)	(2.16)	21

RIF^{adj} – *Within groups* deviation of data from respective sectoral mean – OLS

	GK	NIP/PK	J/GO	DELTA	R^2
Regression Coefficient	-7.98	-2.49	-6.30	12.71	0.167
(t-value) or TxS	(-4.34)	(-1.99)	(-5.86)	(2.68)	441
Previous with Time Fixed Effects					
Regression Coefficient	-7.39	-2.71	-6.60	6.90	0.257
(t-value) or TxS	(-3.27)	(-2.09)	(-6.14)	(1.09)	441

Correlation matrix: Lower diagonal, *between groups*; Upper, *within groups*

	GK	NIP/PK	J/GO	DELTA	RIF^{adj}
GK	**1**	-0.30	-0.23	0.44	-0.25
NIP/PK	-0.37	**1**	-0.28	-0.40	0.61
J/GO	-0.20	-0.29	**1**	-0.33	-0.53
DELTA	0.46	-0.42	-0.32	**1**	0.02
RIF^{adj}	-0.31	0.65	-0.53	-0.01	**1**

Source: Authors' estimates. Input data available upon request; group = sector.

GK. This variable captures the effect of differences in underlying growth rates of the real net stock of fixed capital (NK) between sectors, and within sectors over time. Rather than using the actual annual rate of growth of the net stock of capital at time t which would be quite variable over the cycle, we take a longer-term average growth rate of NK over the six most recent years, from t-6 to t, as our instrument to characterize the underlying growth conditions in each sector. Furthermore, the values of NK used to calculate GK are stabilized at both ends by using a geometric average of three years of observations centered on t-6 and t, respectively.[17] Thus, only a third of the annual capital stock data entering into the calculation of GK is replaced each year.

The regression results in Table 2 show that GK bears the required negative relation to both the BSX_i and WSX_{it} components of RIF_{it}^{adj} but the reasons may be different. Differences in rates of growth of capital *between* sectors, on 21-year average, could well be due to like differences in profitability that were not only expected, but also realized in part, given the length of the sample period. To the extent some of this lagged co-movement between GK_{it} and ρ_{it} has affected the industry sample-period average values of RIF_{it}^{adj}, it may have reduced size and significance of the negative effect of GK_{it} on RIF_{it}^{adj} that remains across sectors. This may account for the statistically insignificant negative coefficient found between sectors without weighting. Within sectors however, or from year to year, GK_{it} may well rise in expectation of higher future profits well down the road, particularly in new industries, so that little simultaneity between GK_{it} and ρ_{it} is expected. Hence within sectors, the ceteris paribus effect of an increase in GK_{it} *lowering* RIF_{it}^{adj} in equation (4) comes through most clearly.

The negative relationship in the data for the United States spells conceptual trouble for RZ's starting assumption according to which the level of domestic financial development (FD) determines which industries may be expected to grow more rapidly than captured by industry and country fixed effects in all countries. The problem posed for this theory by our finding a negative effect of GK_{it} on RIF_{it}^{adj} with data for the United States is this: If the industries whose capital stock is growing fastest (after allowing for fixed effects) in other countries differ from those growing fastest in the United, as they must if theories of comparative

[17] Hence the bases from and to which to calculate GK are constructed with net stocks of capital for years t-7 to t-5, and for years t-1 to t+1, reaching forward as far as 1998. Fortunately, the required chain-type quantity indexes for the net stock of private fixed assets are reported on the SIC87 basis through 2001.

advantage are at work, those industry sectors growing fastest abroad inevitably have higher U.S.-RIF_{it}^{adj} values assigned to them than the sectors growing fastest in the United States. The reason is that the latter sectors typically have high DEF_{it} or low RIF_{it}^{adj} values in the United States, as the negative between-sector effect of GK_{it} on RIF_{it}^{adj} makes clear. Then since almost all of the foreign countries also are at lower levels of FD than the United States, RZ's hypotheses about the structure of growth in different countries would appear to be validated essentially automatically. Hence the more pronounced the negative effect of GK_{it} on RIF_{it}^{adj} in the United States, the greater is the risk of Type II error.

NIP/NK. This variable, with and without the use of weighting variable W_i, has a positive effect on the BSX_i representation, while having a negative effect in the WSX_{it} (i.e., within-sector) representation of RIF_{it}^{adj}. *Between* sectors, a high rate of net interest payments in relation to the current cost of the net stock of fixed capital thus does not appear to imply low cash flow after interest payments as the Modigliani-Miller theorem would have indicated. The lower-diagonal cross-correlation entries in Table 2 suggest what may be going on, especially for weighted data: In sectors dominated by highly leveraged oligopolistic "old-line" (low DELTA) producers, cash flow may be high but growth opportunities low − with leverage maintained at high levels perhaps through special dividend distributions and stock buybacks. Correspondingly, the correlation between DELTA and GK is positive and their correlations with NIP/NK are negative. Then RIF_{it}^{adj} could remain relatively high even after a high rate of net interest payments. Indeed, companies that earn a normal rate of return on invested assets, but are not growing, have to pay out their net (of depreciation and taxes) return on capital as interest and dividends unless they choose to be net financial investors.

However, long-term average differences in leverage between sectors and changes in leverage within sectors may have quite different explanations. The latter could well be due to rating downgrades and liquidity problems affecting producers in that sector as their leverage and interest rates on borrowing rise. Episodes of distress borrowing experienced by any sector would be associated with a reduction in cash flow, which is net of interest payments, and thus of RIF_{it}^{adj}, unless CE is reduced proportionally even more than CF. Hence equilibrium differences in leverage between sectors and changes in leverage within any of them may have quite different consequences for RIF_{it}^{adj}.

J/GO. As for DELTA, 80 percent or more of the total variation (sum of squared deviations) in this variable is due to between-sector, rather than within-sector, variations, thereby giving this variable a strong claim to being structural. The finding on this variable in Table 2 is that the higher the ratio of intermediate inputs in gross output, the lower is RIF_{it}^{adj}, more significantly in the WSX_{it} than the BSX_{i} representation. Our prior on the sign of the between-sector effect had pointed in the opposite direction. Although data-driven "explanations" are of limited value, it is tempting to rationalize the consistently negative and statistically highly significant effects that were found on $(J/GO)_{it}$ within sectors through reverse causation: A rise of $(J/GO)_{it}$ over time may indicate that the relative price of the value added by establishments in that sector has declined and that these establishments have been shedding functions to outside suppliers. Loss of competitiveness associated with a decline in RIF_{it}^{adj} thus could partly be responsible for a rise in $(J/GO)_{it}$ within sectors. However, the regression findings clash with the positive equilibrium effect of $(J/GO)_{it}$ expected between sectors.

DELTA. The depreciation rate in a sector is another variable that may be deemed structural/technological. The between-sector effect of this variable on RIF_{it}^{adj} is to be positive according to our interpretation of RZ. This expectation is supported by our results but the effect is not statistically significant with unweighted data and only barely significant at the 5 percent level with weighted data and 21 between-sector observations. The within-sector effect of a rise in DELTA changes sign between Part A of Table 2, using unweighted data, and Part B of Table 2, using weighted data, but the only statistically significant effect is again positive. Because RZ provided only a single decadal measure per sector (for each of their three age categories of firms), their work could relate only to between-sector effects.

Among the explanatory variables, J/GO and DELTA have the best claim to representing fairly deep and universal characteristics of efficient production organization and outsourcing by establishment and of the most appropriate technology embodied in the composition of the stock of capital by sector. The results on GK and NIP/PK provide useful insights into the direction of effects, yet these variables relate specifically to U.S. growth and leverage patterns by sector. The consistently negative effect of GK_{it} on RIF_{it}^{adj} found in Table 2 irrespective of weighting was strongly expected. Opposite signs of the effects of $(NIP/PK)_{it}$ on RIF_{it}^{adj} between (+) and within (-) sectors showed that the direction of effects with long-run average values, construed as "equilibrium" values characteristic for each sector, and with year-to-year changes can be quite different. If this indicates that firm structures and financing practices are continuously changing within U.S. sectors, long-term averages of RIF_{it}^{adj} (and DEF_i) for such sectors could not reveal any fixed equilibrium condition.

4 INTERPRETATION OF RESULTS AND CONCLUSION

Domestic financial development by itself and through its correlates, such as the general level of education, legal and institutional development, and technological sophistication, disproportionately benefits entities that make the greatest use of these national assets for production support.[18] FD also has been found to reduce financing obstacles to investment (Beck *et al.*, 2006). Then if (a) the degree of dependence on external finance is a fundamental and universal characteristic of industry sectors (b) that can be inferred from 1980-89 data provided by RZ for the United States, a high or rising level of financial development in any country could be expected to boost growth in the industry sectors identified with U.S. data as inherently more dependent on external finance.[19] The question examined in this paper is whether these two conditions hold.

Confidence in the durability and universality of the RZ measures would be enhanced if structural/technological reasons for sectoral differences in DEF_i or in RIF_{it}^{adj} could reliably be identified for the United States, the country from which the data were derived. One could then assess whether these financing ratios are intrinsic to each sector so that they could represent latent, maximum-efficiency-frontier conditions applying elsewhere. Unfortunately, the median firm used by RZ to represent the sector has no defined characteristic or claim to representativeness other than that it lies at the median of the distribution of DEF_i over firms in sector i listed on U.S. exchanges. In order to relate financing ratios such as DEF_i to potentially fundamental determinants of these measures by sector, a richer and more representative database had to be used. It covered all establishments in a sector for 21 years and provided annual data on economic conditions and characteristics for 21 sectors. Matching corresponding averages of our cyclically-adjusted annual measure RIF_{it}^{adj} against

[18] Wood (1995), for instance, showed the development of skills and analytical capabilities to be a key determinant of comparative advantage and manufacturing export performance.

[19] Relating differences in national levels of FD to differences in countries' structure of growth by manufacturing sector could still run into some logical difficulties. The dynamic Rybczynski effect of increasing FD, treated like a factor of production, may trump the comparative-static effect of increased specialization in trade in sectors of comparative advantage if low-FD countries experience the greatest growth in FD upon opening up.

RZ's decadal measures DEF_i showed that the RZ measures were not representative for the sector as a whole either by size or by virtue of a high degree of correlation with our sector-wide measures. If the RZ data were not intended to be representative for the sector as a whole, it would be necessary to show what they reveal reliably about it through the DEF_i value of the median firm, but the Compustat data used by RZ does not serve this purpose.

For our part, we found that 41 percent of the between-sector variation in RIF_{it}^{adj} unweighted, and 68 percent weighted ($1 – R^2$ in Table 2), could not be explained by the factors suggested by this variable's definitional components. Furthermore, what *is* explained, in particular by sectoral differences in the average rate of growth of the stock of U.S. capital by sector, GK_{it}, itself, cannot be a characteristic that is durable and universal: Different sectors grow fastest in different countries and at different times on account of industrial succession and changing comparative advantage. In addition, the positive between-sector effect of $(NIP/NK)_{it}$ on RIF_{it}^{adj} was unexpected since cash flow is reported net of net interest paid. Similarly, the effect was negative for the ratio of intermediate inputs to the value of gross output by establishments, $(J/GO)_{it}$, while we had expected a positive effect between sectors. Only the positive between-sector effect of $DELTA_{it}$ on RIF_{it}^{adj}, though not statistically significant with unweighted data, was in line with RZ's illustrative suggestions of why differences in the financing ratios between sectors could be of structural/technological origin.

4.1 Conclusion

Overall, we could not reject the Null hypothesis that DEF_i, or the conceptually related measure RIF_{it}^{adj}, by industry sector does *not* reflect fundamental and hence durable and potentially universal, structural/technological features of these sectors in the United States. This result is obtained despite RIF_{it}^{adj} having been constructed from data for all establishments contributing to activity in a sector. Such a measure is bound to be more representative of conditions in that sector than a measure based on sectors' median exchange-listed firm that is assigned to just one sector even though it may have establishments in several others. Even then the distribution of RIF_{it}^{adj} by the industrial classification of the sector in which these establishments operate could not be shown to be held in place by factors that are recognizably fundamental and universal. Other factors, such as age since establishment, size, ownership structure, and organization of firms and their potential growth rates (see

Demirguc-Kunt and Maksimovic, 1998) are likely to have much stronger claims to representing fundamental and universal characteristics of firms' dependence on external finance than the U.S. DEF_i values of the manufacturing industry sector to which they belong. If the complexion of industry sectors by the distributions of the above firm characteristics, that may be behind DEF_i, changes within countries and differs between them, as for instance in the textile industry, both the durability and universality of the financing ratios found for the United States would be undercut and their application to other countries spurious.

Overall our finding is consistent with the alternative hypothesis that financing structure and reliance on external finance primarily reflect a dynamic strategy adopted by a firm with distinct resources, opportunities, and constraints in an evolving financial-market and country setting. As observed in other contexts (see Rugman and Verbeke, 2002), the validity of classifications by industry rather than by firm and country characteristics, for examining the interplay between financing that is external to the firm and FD, is very much in doubt.

References

Abiad, A.G., Oomes, N., Ueda, K., 2004. The quality effect: Does financial liberalization improve the allocation of capital? *IMF Working Paper* No. 04/112.

Acharya, V.V., Imbs, J., Sturgess, J., 2006. Finance and the efficiency of capital allocation: Do bank branching regulations matter? Draft: September 9.

Andersen, T.B., Tarp, F., 2003. Financial liberalization, financial development and economic growth in LDCs, *Journal of International Development* 15 (2), 189-209.

Auerbach, A.J., Hassett. K.A., 2003. On the marginal source of investment funds, *Journal of Public Economics* 87 (1), 205-232.

Auerbach, A.J., Hassett, K.A., 2006. Dividend taxes and firm valuation: New evidence, *American Economic Review, Papers and Proceedings* 96 (2), 199-123.

Beck, T., Levine, R., 2001. Stock markets, banks, and growth: Correlation or causality, *World Bank Policy Research Working Paper* No. 2670.

Beck, T., Demirguc-Kunt, A., Laeven, L., Levine, R., 2005. Finance, firm size and growth, *World Bank Policy Research Working Paper* No. 3485.

Beck, T., Demirguc-Kunt, A., Laeven, L., and Maksimovic, V., 2006. The determinants of financing obstacles, *Journal of International Money and Finance* 25 (6), 932-952.

Beck, T., Levine, R.., Levkov, A., 2007. Bank regulation and income distribution: Evidence from branch deregulation, draft: March.

Bekaert, G., Harvey, C.R., Lundblad, C., 2005. Does financial liberalization spur growth? *Journal of Financial Economics* 77(1), 3-55.

Berger, A.N., Udell, G.F., 2005. A more complete conceptual framework for SME finance, draft: October, available from aberger@frb.gov.

Bureau of Economic Analysis, U.S. Department of Commerce (cited as BEA), 2006. *Research and Development Satellite Account*. Preliminary estimates released Sept. 28. http://www.bea.gov/bea/newsrelarchive/2006/rdreport06.pdf

Caballero, R.J., 2007. *Specificity and the Macroeconomics of Restructuring*, Yrjo Jahnsson Lecture 2005, Cambridge: MIT Press.

Cetorelli, N., Strahan, P.E.. 2006. Finance as a barrier to entry: Bank competition and industry structure in local U.S. markets, *Journal of Finance* 61 (1), 437-461.

Chetty, R., Saez, E., 2005. Dividend taxes and corporate behavior: Evidence from the 2003 dividend tax cut, *Quarterly Journal of Economics* 120 (3), 791-833.

Ciccone, A., Papaioannou, E., 2006. Adjustment to target capital, finance and growth, draft: September.

Clementi, G.L., Hopenhayn, H.A., 2006. A theory of financing constraints and firm dynamics, *Quarterly Journal of Economics* 121 (1), 229-265.

Cochrane, J.H., 2005. Financial markets and the real economy, *Foundations and Trends in Finance* 1 (1), 1-103.

Cooley, T.F., Quadrini, V. 2001. Financial markets and firm dynamics, *American Economic Review* 91 (5), 1286-1310.

de Serres, A., Kobayakawa, S., Sløk, T., Vartia, L., 2006. Regulation of financial systems and economic growth, draft: August 2.

Demirguc-Kunt, A., Maksimovic, V., 1998. Law, finance, and firm growth, *Journal of Finance* 53 (6), 2107-2137.

Edison, H.J., Levine R., Ricci, L.A., Sløk, T., 2002. International financial integration and economic growth, *Journal of International Money and Finance* 21 (6), 749-776.

Fisman, R., and Love, I., 2004. Financial development and intersectoral allocation: A new approach, *Journal of Finance* 54 (6), 2785-2805.

Guiso, L., Sapienza, P., Zingales, L., 2004. Does local financial development matter? *Quarterly Journal of Economics* 119 (3), 929-969.

Ito, H., 2006. Financial development and financial liberalization in Asia: Thresholds, institutions and the sequence of liberalization, *North American Journal of Economics and Finance* 17 (3), 303-327.

Kaplan, N.S., Zingales, L., 2000. Investment-cash flow sensitivities are not valid measures of financing constraints, *Quarterly Journal of Economics* 115 (2), 707-712.

Kose, M.A., Prasad, E., Rogoff, K., Wei, S-J., 2006. Financial globalization: A reappraisal, *NBER WP* 12484.

Kroszner, R.S., Laeven, L., Klingebiel, D., 2007. Banking crises, financial dependence, and growth, *Journal of Financial Economics* 84 (1), 187-228.

Laeven, L., Klingebiel, D., Kroszner, R.S., 2002. Financial crises, financial dependence, and industry growth, *World Bank Policy Research Working Paper* No. 2855.

Levine, R., Loayza, N., Beck, T., 1999. Financial intermediation and growth: Causality and causes, *World Bank Policy Research Working Paper* No. 2059.

McCallum, B.T., 2001. Monetary policy analysis in models without money, *Federal Reserve Bank of St. Louis Review*, July/August, 145-160.

Mills, L.F., Plesko, G.A., 2003. Bridging the reporting gap: A proposal for more informative reconciling of book and tax income, *National Tax Journal* 56 (4), 865-893.

Moyer, B.C., *et al.*, 2004. Integrating the annual input-output accounts and gross-domestic-product-by-industry accounts, *Survey of Current Business* 84 (5), 38-51.

Rajan, R.G., Zingales, L., 1998. Financial dependence and growth, *American Economic Review* 88 (3), 559-586.

Rugman, A.M., Verbeke, A., 2002. Edith Penrose's contribution to the resource-based view of strategic management, *Strategic Management Journal* 23 (8), 769-780.

Skoczylas, L., Tissot, B., 2005. Revisiting recent productivity developments across OECD countries, *BIS Working Papers* No. 182, www.bis.org .

Stulz, R., 2005. The limits of financial globalization, *Journal of Finance* 60 (4), 1538-1638.

von Furstenberg, G.M., 2004. The contribution of rapid financial development to asymmetric growth of manufacturing industries: Common claims versus evidence from Poland, *Journal of Economic Asymmetries* 1 (2), 87-120.

von Furstenberg, G.M., von Kalckreuth, U., 2006. Dependence on external finance: An inherent industry characteristic? Deutsche Bundesbank Discussion Paper Series 1: No 30/2006. http://217.110.182.54/download/volkswirtschaft/dkp/2006/200630dkp.pdf.

Wood, A., 1995. *North-South Trade, Employment, and Inequality: Changing Fortunes in a Skill-Driven World.* Oxford: Clarendon Press.

Appendix. Short-Run Determinants of Output Used for Cyclical Adjustment

Overview

A monetary approach is used both to represent economy-wide aggregate-demand, or LM, disturbances and to anchor price expectations. These depend on a preset target level of the money supply, M, and enter into forward-looking wage contracts. The labor market clears ex ante as the nominal wage rate has been set in advance on the basis of rational expectations (consistent with expected fulfillment of the relevant first-order condition) for homogeneous labor employed in a competitive labor market. Ex post, however, aggregate manufacturing employment and output, and their breakdown by sector, deviate from expected levels. Temporary deviations from trend of two relative prices also influence sectoral output levels. With this innovative addition of relative-price shocks to cyclical effects on manufacturing industry sectors, the appendix then shows in several steps that the unexpected rate of deviation (D) from trend of an industry sector's output at time t is:

$$Dln(Q_{it}) = (1-\beta_i)^{-1}[\alpha_i\ s_i\ (DlnL_{mt}) - \alpha_i\ (\theta-1)Dln(PGO_{it}/PGO_{mt}) - \beta_i\ Dln(PJ_{it}/PVA_{it})]. \qquad (A1)$$

Here PGO_{it}/PGO_{mt} is the Price (P) index of the sector's Gross Output (GO) relative to that of the entire manufacturing sector, and PJ_{it}/PVA_{it} is the price index of the intermediate inputs (J) used in sector i relative to the price index of its Value Added (VA). Any deviation of s_i from its model value 1 indicates whether the cyclical sensitivity of demand for an industry sector's output is above ($s_i > 1$) or below ($s_i < 1$) average. Conceptually, the deviations of output from trend are linked to deviations in cash flow and RIF. Yet when cash flow (CF) in a sector responds to the short-run deviations identified in equation (A1), capital expenditure on fixed assets (CE) in that sector will show some of the same short-run sensitivity, albeit ─ on account of pre-commitment to lengthy investment projects and *future* profits ─ usually less. Hence the equation used for adjusting RIF_{it} uses the same explanatory variables as equation (A1).

Three-Factor Production Function

A CD production function $F_i(K_i, J_i, L_i)$ is adopted for industry sector i. The goods and services inputs in that function are a beginning-of-period capital stock, K_i, of fixed assets and (raw, intermediate, work in progress, and finished-goods) inventories, as well as purchased inputs or intermediates, J_i, and labor, L_i. In the model, labor is homogeneous and the labor market competitive so that all workers earn the same nominal wage, W. Then with total factor productivity scalar A_i and with fixed input elasticities of output with respect to labor and intermediates, $\alpha(i)$ and $\beta(i)$, the gross output of sector i at factor cost (excluding indirect taxes) is:

$$Q_i = A_i\ F_i(K_i, J_i, L_i) = A_i\ K_i^{\ 1-\alpha(i)-\beta(i)}\ J_i^{\ \beta(i)}\ L_i^{\alpha(i)}. \qquad (A2)$$

Dixit-Stiglitz Aggregation[20]

Using the final-sales method of aggregation, the Dixit-Stiglitz aggregate of total output is:

$$Q = \left[\int_0^n Q(i)^{(\theta-1)/\theta} di \right]^{\theta/(\theta-1)}, \quad \theta >> 1. \qquad \text{(A3)}$$

Here the elasticity of substitution between any two products, θ, is required to be greater than 1 -- usually much greater: McCallum (2001, p. 149) settles on a value of 5. The corresponding aggregate for the price level, P, is,

$$P = \left[\int_0^n P(i)^{(1-\theta)} di \right]^{1/(1-\theta)}, \qquad \text{(A4)}$$

and Dixit-Stiglitz demand for product i is an inverse function of its price, P_i, relative to P and unit-elastic with respect to total gross income, Q:

$$Q_i = \left[\frac{P(i)}{P} \right]^{-\theta} Q. \qquad \text{(A5)}$$

Model Disturbances and Assumptions

The types of shocks considered that can have an effect on RIF in the short run, here defined as the length of a business-cycle, are:

- An aggregate demand shock that is interpreted as a shock to the GDP-transactions velocity of money, e^v, where $v \sim N(0, \sigma_v^2)$, so that the shock process is stationary with 0 mean and the actual value of V is given as $V = e^v V^e$. Expected values are characterized throughout by the superscript e, while $e^v \equiv \exp(v)$. While a shock v>0 would be expected to lower interest rates and expand the economy in the short run, it would affect only the price level in the long run. Monetary policy is taken to refrain from attempting to fine-tune the economy and not to react immediately to current shocks to aggregate demand. Hence any cyclical instability observed in the economy can be attributed, for simplicity, to fluctuations in v that have not yet given rise to monetary-policy feedback.

In addition, two relative prices in the model may be subject to disturbances:

- the relative price of intermediate inputs used in sector i, PJ_i/PGO_i ,
- the relative price of industry sector i's gross output relative to the price index for manufacturing as a whole, PGO_i/PGO_m.

[20] Adopting the Dixit-Stiglitz consistent aggregation scheme for model specification and coefficient identification poses certain difficulties for empirical work in part on account of the assumption of uniform income and demand elasticities. Some of these are noted toward the end of this appendix.

Short-run shocks to relative prices will be identified simply by deviations in the logarithms of the respective explanatory variables from their trend values. For specific industry sectors, changes in relative input prices may indicate productivity shocks and other supply, rather than mostly demand, disturbances. Changes in relative output prices could reflect industry-specific demand-switch factors but supply factors may again be more important for these relative price changes. Since the stock of fixed capital is taken as given in the short run, unexpected changes in the relative price of fixed capital inputs are not shown since they do not affect the factor composition used in the short run.

Three basic modeling assumptions distinguish the short run from the long run:

1. The beginning-of-period stock of capital whose services are used for this period's production is treated as a constant even though capital expenditures occur during the current period. Hence, unlike J_i and L_i, K_i is predetermined in the short-run.

2. In the short run, the desired level of employment, L_i*, as opposed to the actual level of employment during the contract period, L_i, is treated as constant.

3. The nominal wage rate, W, equal to the expected marginal revenue (MR) product, is agreed upon in advance of the contract period on the basis of expectations (superscript e) about economy-wide productivity (A) and price-level developments (PGO) during that period (of one year). Beyond that timeframe, compensation rates are flexible and always set so that the labor market clears ex ante at the intersection of labor demand and supply, thus yielding the updated desired employment level L* if expectations are satisfied.

Aggregate Demand Shocks to Industry-Sector Employment

Aggregate demand is related in rudimentary fashion to real money balances M/P and to the demand for real balances that is inversely related to velocity, V. The nominal money supply, M, is exogenous while V is subject to spontaneous disturbances:

$$Q = AF(K, J, L) = V(M/P) \text{ , where } V = e^{v}V^{e},\ v \sim N(0,\sigma_v^{2}). \qquad \text{(A6)}$$

The nominal wage rate that had been set in advance on the basis of rational expectations for homogeneous labor employed in a competitive labor market is:

$$W = \alpha[(\theta -1)/\theta]PGO_i^{e}(A_i^{e})F(K_i, J_i^{e}, L_i^*)/L_i^*, \qquad \text{(A7)}$$

where $(\theta -1)/\theta = (MR^e/PGO^e)_i$ for all i from equation (A5). Equation (A7) holds equally for total manufacturing in the aggregate so that:

$$W = \alpha[(\theta -1)/\theta]PGO^{e}(A^{e})F(K, J^{e}, L^*)/L^*. \qquad \text{(A7a)}$$

Taking expectations of equation (A6) assuming the level of M planned for the next period is already known, using the result to substitute the point estimate V^eM/Q^e for PGO^e in equation (7a), and then canceling $Q^e = A^eF(K, J^e, L^*)$ yields the wage-determination equation:

$$W = \alpha[(\theta-1)/\theta]V^eM/L^*. \quad \text{(A7b)}$$

The corresponding expected aggregate income shares are as follows:

1. The expected share of labor is $WL^*/PGO^eQ^e = \alpha[(\theta -1)/\theta]$.
2. Analogously, the expected share of intermediates is $(PJ/PGO)^e(J^e/Q^e) = \beta[(\theta -1)/\theta]$.
3. Hence if the expected share of capital is $(1- \alpha - \beta) [(\theta -1)/\theta]$, there is a fraction θ^{-1} still to be accounted for if the shares are to sum to 1.
4. The monopolistic-competition component in the price, $(PGO^e – MR^e)/ P^e = \theta^{-1}$, is statistically part of the return on capital and hence of cash flow. Hence the total return credited to capital, including the monopolistic component used for the amortization of a fixed amount of "franchise" capital not included in accounting measures of the stock of capital or of capital expenditures is:

$$(1- \alpha - \beta) [(\theta -1)/\theta] + \theta^{-1} = 1 - (1- \theta^{-1})(\alpha + \beta). \quad \text{(A8)}$$

With W set, actual industry-sector employment, L_i, is demand-determined and thus given by the first-order condition:

$$W = \alpha[(\theta-1)/\theta] (PGO_i/PGO)PGO\ A_iF(K_i, J_i, L_i)/L_i . \quad \text{(A9)}$$

Using equations (A2), (A6) and then (A5) to substitute for PGO and then for Q_i/Q, equation (A9) reduces to:

$$W= \alpha[(\theta-1)/\theta] (PGO_i/PGO)^{1-\theta}e^vV^eM /L_i . \quad \text{(A9a)}$$

Hence, combining equations (A7b) and (A9a) and normalizing L* at 1 yields:

$$L_i = e^v(PGO_i/PGO)^{1-\theta} , \quad \text{(A10)}$$

or, taking logarithms and then deviations (D) from trend over time, t,

$$Dln(L_{it}) = v_t + (1-\theta)Dln(PGO_{it}/PGO_t). \quad \text{(A10a)}$$

Equation (A10a) shows that deviations in a sector's employment from trend are driven by aggregate demand disturbances, represented by velocity shocks, v, and by deviations from trend in the relative price of industry sector i's output, PGO_i/PGO, where $(1-\theta)<0$.

Because shocks to the relative price of intermediates and to the level of total factor productivity do not affect optimal employment in this simple model, aggregate demand shocks alone determine deviations of aggregate employment from the initially expected and desired level. The reasons for this independence are easy to explain:

(a) A uniform upward shock to the relative price of intermediate inputs (obtained from outside the manufacturing sector) in all manufacturing sectors lowers the marginal product of labor by the same rate by which it raises the price of output, P. Given W, the marginal product of labor and the real wage thus decline by the same amount at a given level of L. Hence there is no change in the quantity of labor demanded in the short run for which the money wage rate was preset, with labor committed to supply the amount employers wish to hire at that value of W.

(b) A uniform unanticipated rise in multifactor productivity raises the marginal product of labor at the same rate by which it lowers the price level at a given level of L. Hence the real wage rises at the same rate as the marginal product of labor, and there is no change in the amount of labor demanded in the short run.

Intermediates, Output, and Supply Disturbances

Having obtained equation (A10) to determine L_i, we next have to find the amount of intermediates, J_i, used in production by manufacturing sector i for given K_i and relative price PJ_i/PGO_i from the first-order condition:

$$PJ_i/PGO_i = \beta_i A_i (K_i^{1-\alpha(i)-\beta(i)} J_i^{\beta(i)-1} L_i^{\alpha(i)}).$$

The solution for J_i is:

$$J_i = [\beta_i (PGO_i/PJ_i) A_i K_i^{1-\alpha(i)-\beta(i)} L_i^{\alpha(i)}]^{1/(1-\beta(i))}. \qquad \text{(A11)}$$

The solutions for L_i and J_i from equations (A10) and (A11), in conjunction with the pregiven levels of K_i and A_i and with the aggregate demand shock v and relative prices PJ_i/PGO_i and PGO_i/PGO thus allow Q_i to be determined from equation (A2) as subject to unexpected change in the short run solely in v, PGO_i/PGO and PJ_i/PGO_i. Taking the logarithm of the resulting expression for Q_i and then the relative differences of all variables from their trend values (or from their stationary value, as with V^e) yields:

$$Dln(Q_{it}) = (1-\beta_i)^{-1}[\alpha_i(s_i\, v_t) - \alpha_i(\theta-1)Dln(PGO_{it}/PGO_t) - \beta_i Dln(PJ_{it}/PGO_{it}]. \qquad \text{(A12)}$$

Solving equation (A10a) for the entire manufacturing sector allows replacing v_t in equation (A12) with $Dln(L_t)$, the rate of deviation in employment in manufacturing from trend, where the value of $\alpha_i s_i$ would be expected empirically to exceed 1 for the representative manufacturing industry sector according to Okun's Law. In contrast to equation (A5), we do not impose the same cyclical sensitivity on all sectors in empirical estimation. Furthermore, the price index of a sector's intermediate inputs, PJ_i, enters into the price index of its gross output, PGO_i, but not into the price index of its value added, PVA_i. To prevent joint effects from input price shocks on both the numerator and denominator, $Dln(PJ_{it}/PVA_{it})$ was substituted for $Dln(PJ_{it}/PGO_{it})$ in equation (A1) to obtain better resolution in the equations used for cyclical adjustment. These were estimated separately for each of 21 sectors with annual data for the period 1977-1997.

Equations of form (A1) thus shows that an industry sector's output may be disturbed in the short run by the macroeconomic analogue of income (aggregate demand) and price (aggregate supply) disturbances, specifically by:

- aggregate demand shocks that raise total manufacturing employment above trend if positive (dlnL>0) with a model coefficient that is identified as s_i-times a fraction that is equal to the share of labor over the share of value added in gross output, $\alpha_i/(1-\beta_i) < 1$.
- deviations in the relative supply price of the sector's output from trend that, if positive, lower Q_i on account of their adverse effects on the quantity demanded with a model coefficient greater than absolute 1 on account of $\theta >> 1$, and
- deviations from trend in the supply price of intermediate inputs relative to value added, that, if positive, also lower Q_i because, given W and K_i, margins are squeezed when the relative price of materials inputs increases. The absolute value of the model coefficient on this term is greater than 1 if the share of value added is less than one-half and hence the share of intermediate inputs, β_i, greater than half.

The Cyclical Adjustment of RIF_{it}

The estimating equation derived from equation (A1) displays all the advantages of rigorous modeling in that it fully identifies the coefficients of the reduced form with structural parameters from the production and demand functions specified earlier. Yet the modeling is much too uniform to do justice to conditions in each sector in empirical applications. First, since corporate profits tend to lead and corporate investment and employment tend to lag the business cycle, RIF might show countercyclical tendencies in some sectors relative to employment deviations from trend in total manufacturing. For instance, when employment and investment in manufacturing are still unduly depressed in the early stages of "jobless recoveries," profits and cash flow may already have recovered nicely well before investment. Hence RIF_{it} could be higher in the early than in the late stages of recoveries in some sectors.

In addition, the Dixit-Stiglitz specification, while providing modeling discipline, tractability, and coefficient identification, unrealistically limits the set of product-market disturbances to those stemming from the supply side. If instead of figuratively just moving along negatively sloped (factor and product) demand curves, demand, and not supply, is actively disturbed in a sector, expected signs would change. For instance, if the demand for the finished goods of a sector making heavy use of intermediate inputs that are in inelastic supply increases, so may $Dln(PJ_{it}/PVA_{it})$ *and* RIF_{it}. A shift in final demand towards manufacturing sector i's gross output may also raise $Dln(PGO_{it}/PGO_{mt})$, the price index of its gross output relative to that of total manufacturing[21] (m) at time t, and again raise RIF_{it}, and not lower it as equation (A5) instead would predict.

Hence in adjusting the RIF_{it} data, separately for each sector, for their particular "cyclical" income and price effects, acceptable coefficients are distributed over a broader range than that admitted by the model with unchanging preferences and uniform parameters. So the cyclically-adjusted data, RIF_{it}^{adj}, simply are the solution for RIF_{it} that is obtained after setting all three temporary deviations (D…, in bold letters) to zero in the equations of type (1) in the text that were estimated for each of the 21 sectors.

[21] Substituting PGO_{mt} for the GDP deflator PGO_t (needed in the aggregate demand equation), thereby ignoring the trend decline in the relative price of manufactures in equation (A1), is helpful since only deviations from trend changes (D) in relative prices enter into equation (A12) in any event.