The Contribution of Innovation to Economic Growth: An Econometric Study at the Firm Level

by

John Tim Hember

3595443

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Professor L. Karnizova

Department of Economics

University of Ottawa

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1. Abstract

This paper performs a firm-level econometric study to determine the contribution of innovation to the economic growth of firms, and to determine whether that contribution varies across industry sectors. Based on review of prior research, the results of this study are consistent with that of the prior research. The author believes that the data set, the means of data retrieval, and the industry sector results are novel.

The econometric analysis was performed based on an extended Cobb-Douglas production function. The firm level data of Fortune Magazine's "Fortune 1000" (F1000) companies were obtained via the magazine's website. The data was further categorized and analyzed by industry sector. The results provide quantitative insight into the relative importance of innovation, labour and physical capital to the productivity growth in each sector.

2. Introduction

There has been significant prior research, pertaining to empirical studies of innovation at the firm level, taking place predominantly from the early 1980's through to the present. It appears that the most prolific author has been Zvi Griliches, of Harvard and the NBER, from the early 1960's until his death in 1999. Other significant contributors include Jacques Mairesse, Bronwyn H. Hall, Samuel Kortum, to name a few.

"R&D and Productivity: A Survey of Econometric Studies at the Firm Level" (Mairesse and Sassenou 1991) and "R&D and Productivity Growth: Evidence from the UK"

Cross-sectional studies analyze a collection of data across several firms, whether that collection is a single year of data or several years averaged to smooth anomalies. The major criticism about cross-section studies of innovation at the firm level is the omission of information characterizing the inherent differences between firms such as industry peculiarities. These omissions tend to bias the results towards an over-estimation of the output elasticity to innovation. (Mairesse and Sassenou 1991)

Time-series studies analyze a collection of data along several years. Likewise these studies are not without their criticisms and these being associated with lack of available years of data, omissions of information or other data problems along the time dimension. These include collinearity between variables such as the R&D capital and physical capital, and omission of business cycle information. (Mairesse and Sassenou 1991)

This paper performs a firm-level econometric study to determine the contribution of innovation to the economic growth of firms, and to determine whether that contribution varies across industry sectors. Based on review of prior research, the results of this study are consistent with that of the prior research. The author believes that the data set, the means of data retrieval, and the industry sector results are novel.

Section 2 of this study discusses the estimation methodology and the model used the difficulties and deficiencies regarding the choice of the model, and its associated explanatory input and dependent output variables. Section 3 overviews the data set and

The majority of prior research has focused on an extended Cobb-Douglas production function of the form:

$$Y = AL^{\alpha} K^{\beta} R^{\gamma} \tag{1}$$

where:

- Y represents a measure of output and the dependent variable;
- L, K and R are the explanatory variables and represent measures of labour, physical capital, and R&D capital respectively;
- A is a constant multiplier
- α, β, γ represent the elasticity of the output with respect to the labour; physical capital and R&D capital respectively.

The main intention of this study and that of prior studies is to determine the elasticity of output with respect to the R&D capital (γ), which is in turn a measure of innovation's contribution to growth at the firm level.

In addition to the elasticity property represented above, the Cobb-Douglas production function also has a property such that the sum of the elasticities ($\alpha + \beta + \gamma$) provides information about the returns to scale of the function, or in other words, the response of the output to a proportionate change in all the inputs. As is well known, empirical studies of the economy using the Cobb-Douglas model in its simplest form of

$$Y = AL^{\alpha} K^{\beta} \tag{2}$$

Furthermore, accounting for research and development simply exacerbates this problem by evolving the goods and inducing additional complexities to competition and productivity (Griliches 1979).

R&D and innovation are far more intangible than people or physical capital and hence are far more difficult to model both theoretically and empirically. R&D expenditure does not always translate directly into R&D stock, R&D expenditures often being wasted and not translating into any knowledge at all. (Hall and Mairesse 2006, Morck and Yeung 2001).

There are spillover effects with R&D and knowledge that both affect and are affected by competition. The spillover effect comes from the fact that knowledge is both non-rival and difficult to exclude (hence the need for patents). As a result innovation in one company has effects on the innovation in other companies and other industries, unlike that of physical capital which is both rival and excludable by its nature.

Furthermore, there are causality issues pertaining to R&D. It is well accepted that the level of R&D capital has a contribution to the growth of output, although over the last half century it has been well theorized, debated and analyzed as to whether that contribution is positive or negative. Conversely it is well accepted that the level of output has a positive contribution to the level of R&D. In other words the more successful a company, the more likely that that company will invest in additional R&D. Thus it is

4. The Data

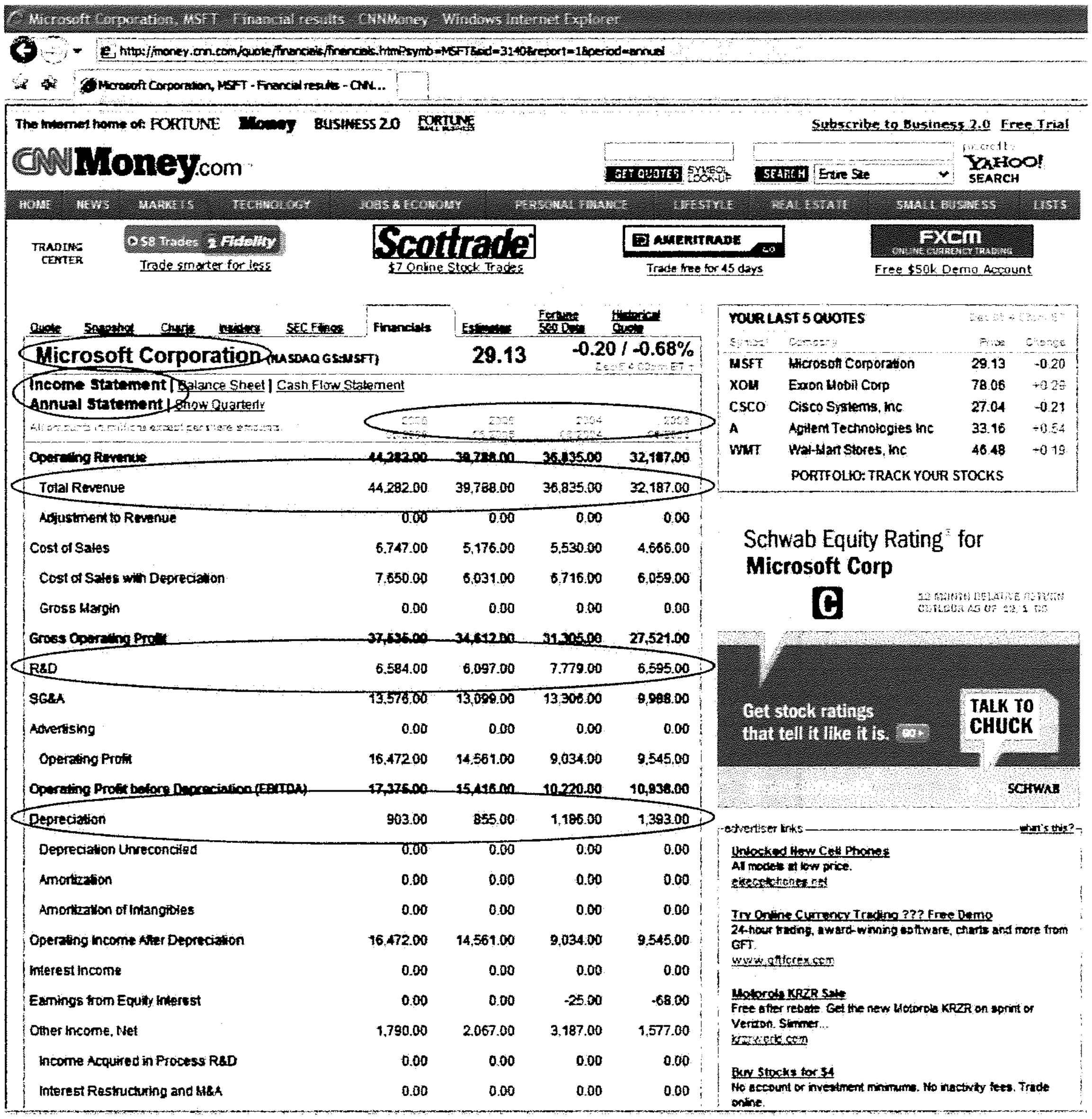
The author believes that this study uses a novel data set to evaluate the contribution of innovation to growth at the firm level.

4.1. The Data Sets of Prior Studies

Mairesse and Sassenou (1991) surveyed thirty-one econometric studies of the contribution of R&D to productivity growth at the firm level and Kafouros (2004) surveyed an additional eight. They grouped those studies into three categories consisting of the analysis of R&D elasticity using cross-sectional data, the analysis of the same using time-series data, and the analysis of the rate of return on R&D. Twenty-two of the thirty-nine studies surveyed used data from U.S. companies, and the majority of those obtaining their data from the U.S. Government's National Science Foundation (NSF) which has tracked R&D expenditures on a firm-level basis since the 1950's. Unfortunately, the NSF publicly presents only aggregated data and does not publicly disclose firm level data due to confidentiality reasons, and it is assumed that researchers have obtained the firm-level data under non-disclosure agreement.

4.2. The Fortune 1000

For the purposes of this econometric analysis, firm level data for Fortune Magazine's "Fortune 1000" (F1000) companies was obtained via the website of money.CNN.com. The F1000 companies are "America's largest corporations" as defined by Fortune



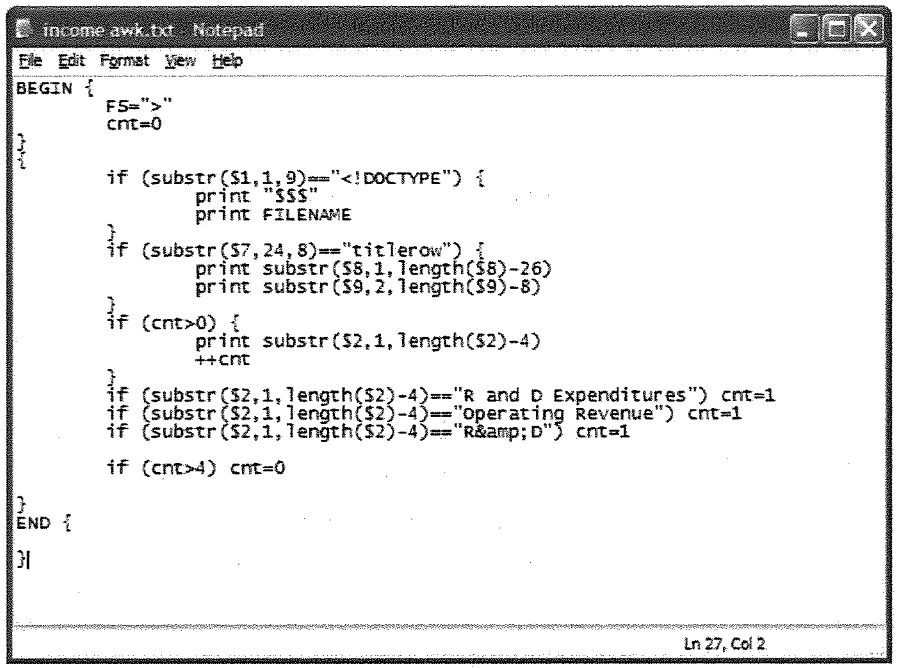
	2006	2005	2004	2003
Operating Revenue	44,282.00	39,788.00	36,835.00	32,187.00
Total Revenue	44,282.00	39,788.00	36,835.00	32,187.00
Adjustment to Revenue	0.00	0.00	0.00	0.00
Cost of Sales	6,747.00	5,176.00	5,530.00	4,666.00
Cost of Sales with Depreciation	7,650.00	6,031.00	6,716.00	6,059.00
Gross Margin	0.00	0.00	0.00	0.00
Gross Operating Profit	37,535.00	34,612.00	31,305.00	27,521.00
R&D	6,584.00	6,097.00	7,779.00	6,595.00
SG&A	13,576.00	13,099.00	13,306.00	9,988.00
Advertising	0.00	0.00	0.00	0.00
Operating Profit	16,472.00	14,561.00	9,034.00	9,545.00
Operating Profit before Depreciation (EBITDA)	17,375.00	15,416.00	10,220.00	10,938.00
Depreciation	903.00	855.00	1,186.00	1,393.00
Depreciation Unreconciled	0.00	0.00	0.00	0.00
Amortization	0.00	0.00	0.00	0.00
Amortization of Intangibles	0.00	0.00	0.00	0.00
Operating Income After Depreciation	16,472.00	14,561.00	9,034.00	9,545.00
Interest Income	0.00	0.00	0.00	0.00
Earnings from Equity Interest	0.00	0.00	-25.00	-68.00
Other Income, Net	1,790.00	2,067.00	3,187.00	1,577.00
Income Acquired in Process R&D	0.00	0.00	0.00	0.00
Interest Restructuring and M&A	0.00	0.00	0.00	0.00

YOUR LAST 5 QUOTES

Symbol	Company	Price	Change
MSFT	Microsoft Corporation	29.13	-0.20
XOM	Exxon Mobil Corp	78.06	+0.29
CSCO	Cisco Systems, Inc	27.04	-0.21
A	Agilent Technologies Inc	33.16	+0.54
WMT	Wal-Mart Stores, Inc	46.48	+0.19

PORTFOLIO: TRACK YOUR STOCKS

Figure 1: Excerpt of sample web page



```
BEGIN {
        FS=">"
        cnt=0
}
{
        if (substr($1,1,9)=="<!DOCTYPE") {
                print "$$$"
                print FILENAME
        }
        if (substr($7,24,8)=="titlerow") {
                print substr($8,1,length($8)-26)
                print substr($9,2,length($9)-8)
        }
        if (cnt>0) {
                print substr($2,1,length($2)-4)
                ++cnt
        }
        if (substr($2,1,length($2)-4)=="R and D Expenditures") cnt=1
        if (substr($2,1,length($2)-4)=="Operating Revenue") cnt=1
        if (substr($2,1,length($2)-4)=="R&amp;D") cnt=1

        if (cnt>4) cnt=0

}
END {

}
```

Figure 3: Example AWK script

4.4. Description of the Data Sample

Of the F1000 companies, 756 firms are publicly traded on the U.S. NASDAQ or NYSE stock exchanges. By the rules of the Security Exchange Commission (SEC), these companies must report a set of financial data that is adequate for analysis. Of those 756 firms, 161 have and report R&D expenditures, thus implying that approximately one in five large firms perform any R&D at all. The remaining 595 firms do not perform R&D as per the nature of their business (such as financial services, retail or distribution) and hence do not report R&D expenditures. The 161 firms performing R&D were further subdivided into four broad industry sectors consisting of Computer and Communications, Heavy Equipment and Transportation, Life Science, and Material and Chemicals. The purpose for categorizing the companies was to determine whether the contribution of innovation to the economic growth of firms varies across those industry sectors. The employment in the U.S (U.S. Department of Labour). The 162 companies performing R&D reported R&D expenditures totaling US$100 billion annually which represents more than half the industrial total R&D of US$190 billion performed in the U.S. in 2002 (National Science Foundation 2002).

4.5. Adapting the Data to the Model

The www.CNN.com website provides a consistent representation of each of the financial reports from each firm. The information that they present is extracted from each of the firm's 10-K filing as submitted to the Securities Exchange Commission.

The income statement of each firm presents the amount of revenue earned, costs and expenses incurred including R&D expenditures, and resulting profits during the firm's fiscal year. The cash flow statement reports the firm's inflows and outflows of cash over that same period of time, including depreciation of physical capital. The balance sheet reports the firm's amount of assets, equities and liabilities at an instant in time which is typically the firm's fiscal year end. Additionally, www.CNN.com presents a "snapshot" of each firm in which pertinent information, including the number of employees and the firm's particular industry, is extracted and presented from the 10-K filing.

The following is a list of the data that was obtained from the F1000 financial reports and their associated variables for econometric analysis:

The R&D expenditures were depreciated by the generally accepted value of 15% annually and accumulated as per Equation (4) to obtain a representation of R&D capital. If should be noted that the base of R&D capital going into the year 2002 is unknown, and thus for the purpose of this modeling it is assumed to be zero. Section 6.2 on robustness testing provides a brief investigation into the impact on the R&D stock value of not having a longer history of R&D expenditure data. Based on the results of that investigation the author believes that only four years of data provides an adequately accurate estimation.

The rates of depreciation of physical capital, as reported by each firm, are based on industry accepted values as dictated by the U.S. Financial Accounting Standards Board (FASB). Although the rates of depreciation are consistent across firms, the rates are different and specific to the different types of physical capital.

5. Analysis, Results and Discussion

The resulting F1000 financial data was analyzed both statistically and via econometric methods, and the results compared to that of prior studies.

5.1. Statistical Analysis

Figure 4 illustrates the simple relationship between output and innovation for the 161 public firms performing R&D. As one might expect based on generally accepted prior theory, there is a positive relationship between revenue and R&D expenditure. Again,

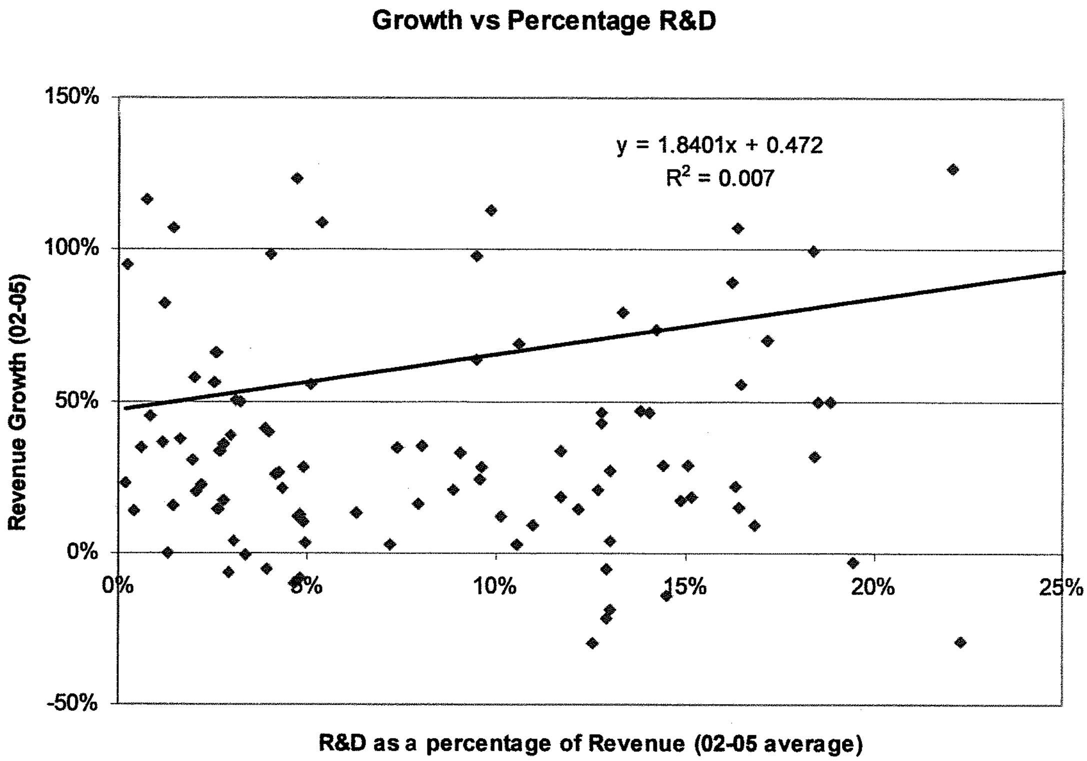


Figure 5: Growth versus R&D as a percentage of Revenue

Dependent Variable: RG
Method: Least Squares
Included observations: 157

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.416689022	0.141766744	2.939257907	0.003793496
RDR	2.349213728	1.58552836	1.48165986	0.140460921

R-squared	0.01396553	Mean dependent var	0.575224516
Adjusted R-squared	0.007604018	S.D. dependent var	1.169750263
S.E. of regression	1.165294375	Akaike info criterion	3.156481494
Sum squared resid	210.476202	Schwarz criterion	3.195414561
Log likelihood	-245.7837973	F-statistic	2.195315942
Durbin-Watson stat	1.619024703	Prob(F-statistic)	0.140460921

Table 2: Regression Results of Growth versus R&D as a percentage of Revenue

The results of econometric analysis are summarized in Table 3. Columns (1) and (2) represent the results of regressing the dependent variable output, of all firms and only those firms performing R&D respectively, on the explanatory variables of labour and physical capital. The elasticity of the output with respect to labour and physical capital is approximately 34% and 36% respectively for the 756 firms, and the constant term is 3.29. The author does not have a reasonable explanation as to why the analysis of all 756 firms appears to make little sense whereas the remainder of the results was as expected.

Regression:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sector:	**ALL**	**R&D**	**R&D**	**C&C**	**HE&T**	**LS**	**M&C**
Regressed on:	L,K	L,K	L,K,R	L,K,R	L,K,R	L,K,R	L,K,R
Constant:	3.29	0.50	0.32	-0.39	0.03	-0.59	2.12
	(0.18)	(0.36)	(0.34)	(0.54)	(0.77)	(1.01)	(0.56)
Labour:	0.34	0.66	0.64	0.66	0.62	0.84	0.30
	(0.02)	(0.05)	(0.05)	(0.07)	(0.12)	(0.17)	(0.09)
Capital:	0.36	0.28	0.20	0.06 *	0.13 *	-0.03 *	0.52
	(0.02)	(0.05)	(0.05)	(0.08)	(0.09)	(0.14)	(0.08)
R&D:			0.12	0.27	0.26	0.15 *	0.10
			(0.03)	(0.06)	(0.09)	(0.13)	(0.04)
Scale:	0.69	0.94	0.96	1.00	1.01	0.96	0.92
Observations:	756	161	161	68	19	30	37
R-squared:	0.60	0.81	0.83	0.85	0.95	0.82	0.90

Notes:

Regressions on Labour and Capital only:

(1)	ALL	all companies
(2)	R&D	all companies reporting R&D expenditures

Regressions on Labour, Capital and R&D expenditures:

(3)	R&D	all companies reporting R&D expenditures
(4)	C&C	within the Computer and Communications sector
(5)	HE&T	within the Heavy Equipment and Transportation sector
(6)	LS	within the Life Sciences sector
(7)	M&C	within the Materials and Chemicals sector

(x.xx) values in parentheses are the standard errors of the coefficients

* coefficient not significant

Table 3: Regression Results by Industry Sector

5.4. Discussions

As per the results listed in Table 3, the sum of the coefficients in the regressions of the 161 R&D-performing companies and their individual industry sectors (regression 3-7) demonstrate constant returns to scale with a range of 0.92 to 1.01, and an average value of 0.97.

The elasticity of the output with respect to R&D capital for the entire group of 161 R&D-performing companies is approximately 12%. The elasticity of output with respect to labour stays relatively constant at 64% versus its value of 66% when analyzed without the R&D capital input. But the elasticity with respect to the physical capital contributions drops significantly to 20% in comparison to its value of 28% when analyzed without the R&D capital input. The author believes that this would imply that when analysis is performed without including the R&D capital input variable then the majority of R&D's contribution to elasticity is otherwise embedded in the physical capital's elasticity.

The results are most illuminating when comparing industry sectors. The distribution of the elasticities of the labour, physical capital and R&D capital change significantly from sector to sector. Figure 6 provides a good illustration of the dramatic differences between sectors. The elasticity of output to R&D capital is greatest at 27% in the Computer and Communications sector, and appears to draw that almost exclusively from the physical capital's elasticity, which is reduced to only 6%. Contrasting that is the Materials and Chemicals sector in which physical capital seems to be the relatively more

In summary, these results provide quantitative insight into the relative importance of innovation, labour and physical capital to the level of output of each sector. One might imply that from a relative standpoint, R&D capital is most important in the Computer and Communications sector, whereas labour in most important in the Life Sciences sector and physical capital is most important in the Material and Chemicals sector.

6. Testing the Robustness of the Analysis

To test the robustness of the results, the analysis was re-estimated in an attempt to verify that the weaknesses in the data were not significantly and/or negatively impacting the results.

6.1. Re-estimation using Only One Period

The analysis was re-estimated without averaging the output and physical capital over the four years and instead only using the 2005 data as is only available for the labour data. The results are presented in Table 4 and illustrated in Figure 7. These results are fairly consistent with the results of obtained when averaging over the four periods. Based on these results the author believes that impact is not significant and the one year of labour information provides an adequately accurate estimation.

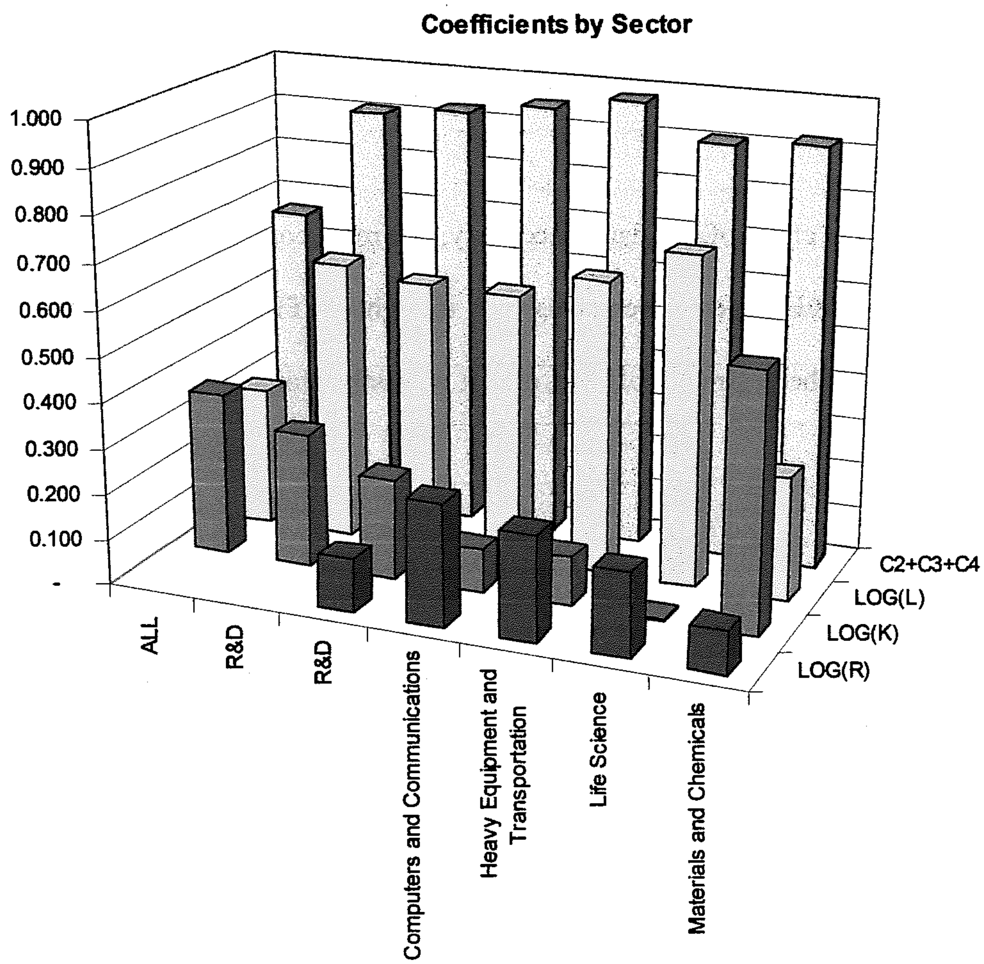


Figure 7: Regression Results using only One Period of Data

6.2. R&D Stock Calculation

As per Section 3.2 the R&D stock value was obtained by depreciating the R&D expenditures by the generally accepted value of 15% annually and accumulating them as per Equation (4). As noted the base of R&D capital going into the year 2002 is unknown, and thus for the purpose of this modeling it is assumed to be zero. This

Regression:	(1)	(2)	(3)	(4)
Sector:	**R&D**	**R&D**	**R&D**	**R&D**
Regressed on:	L,K,R1	L,K,R2	L,K,R3	L,K,R
Constant:	0.48	0.34	0.32	0.32
	(0.34)	(0.34)	(0.34)	(0.34)
Labour:	0.63	0.64	0.64	0.64
	(0.05)	(0.05)	(0.05)	(0.05)
Capital:	0.19	0.20	0.20	0.20
	(0.05)	(0.05)	(0.05)	(0.05)
R&D:	0.13	0.13	0.12	0.12
	(0.03)	(0.03)	(0.03)	(0.03)
Scale:	0.96	0.96	0.96	0.96
Observations:	161	161	161	161
R-squared:	0.83	0.83	0.83	0.83

Notes: Regressions on Labour, Capital and R&D expenditures:

(1) one year (2005) of R&D expenditure data
(2) two years (2004-05) of R&D expenditure data
(3) three years (2003-05) of R&D expenditure data
(4) four years (2002-05) of R&D expenditure data

Table 6: Regression Results by Years of R&D Expenditure History

Furthermore, let's look at the impact of having less than four years of R&D expenditure data. Table 6 are results of regressing all 161 R&D performing firms on labour, physical capital and R&D capital. Regression one through four of Table 6 differ by the calculation of R&D capital such that the R&D capital of regression on is calculated with only one year of R&D expenditure history, regression two with two years, and so forth to four years of history. As one can see by the graphical illustration of the results in Figure 8, there is no substantial difference in the results regardless of the amount of R&D expenditure history used.

obtained in this study, as listed at the bottom of Table 7, are fairly consistent with those obtained in these prior studies.

Author	Published	Sample				R&D elasticity	standard error	R^2
		region	period	industry	size			
Minasian	1969	US	1948-57	unspecific	17	0.26	(0.03)	0.98
Griliches	1980	US	1963	unspecific	883	0.07	(0.01)	0.92
Schankerman	1981	US	1963	unspecific	110	0.16	(0.04)	0.91
Griliches Mairesse	1984	US	1966-77	all	133	0.05	(0.01)	0.52
				scientific	77	0.18	(0.01)	0.60
Cuneo Mairesse	1984	France	1972-77	all	182	0.20	(0.01)	0.52
				scientific	98	0.21	(0.01)	0.49
Cuneo Mairesse	1985	France	1974 & 79	scientific	296	0.16	(0.02)	0.96
Griliches	1986	US	1972	unspecific	491	0.11	(0.02)	n.a.
			1977	unspecific	491	0.09	(0.02)	n.a.
Jaffe	1986	US	1973 & 79	unspecific	432	0.20	(0.05)	0.44
Sassenou	1988	Japan	1976	all	394	0.10	(0.01)	0.20
				scientific	112	0.16	(0.42)	0.45
Hall	1993	US	1964-90	unspecific	1,600	0.03	(0.02)	0.96
Hall Mairesse	1995	France	1980-97	manufacturing	340	0.20	(0.01)	0.99
Adams Jaffe	1996	US	1974-88	chemical	80	0.08	n.a.	n.a.
Mairesse Hall	1996	US	1981-89	unspecific	n.a.	0.24	(0.01)	0.82
Harhoff	1998	Germany	1979-89	manufacturing	443	0.14	(0.01)	0.46
Dilling-Hansen	1999	Denmark	1995	unspecific	n.a.	0.08	(0.03)	n.a.
Wang Tsai	2003	Taiwan	1994-2000	unspecific	136	0.19	(0.03)	0.35
Karfouros	2004	UK	1989-2002	R&D	78	0.04	(0.01)	0.97
				chemical	n.a.	0.05	(0.02)	0.98
				mechanical	n.a.	0.06	(0.02)	0.96
				electrical	n.a.	0.15	(0.02)	0.96
median					**182**	**0.14**	**(0.02)**	**0.87**
average					**336**	**0.13**	**(0.04)**	**0.72**

Hember	2006	US	2002-05	R&D	161	0.12	(0.03)	0.83
				comp & comm	68	0.27	(0.06)	0.85
				equip & transp	19	0.26	(0.09)	0.95
				life science	30	0.15	(0.13)	0.82
				mat'l & chem	37	0.10	(0.04)	0.90

Table 7: Prior Cross-Sectional Studies

Based on review of prior research, the results of this study are consistent with that of the prior research.

It is deemed that another means of measuring R&D capital is via counts of patents at the firm level. Patents are an output resulting from the input of R&D expenditures, but unfortunately in practice the relationships between innovation, R&D capital, R&D expenditures versus the level of patenting respectively are very complex and less understood (Acs, Anselin, and Varga 2002). A possible area of future investigation could be pertaining to exploring the relationship between patents and R&D expenditures, or between patents and growth at the firm level.

In addition to the prior econometric research, there has also been a parallel track of significant research pertaining to the theoretical studies of innovation at the firm level. The most recent lead researchers in this area appear to be Philippe Aghion, of Harvard (as is Griliches) and CEPR, and Peter Howitt of Brown University. The author of this paper found it surprising that the theoretical and empirical researchers appeared to draw very little from each other, having little if no reference to each others works. Another possible area of future investigation could be pertaining to determining closer links between theory and analysis, but is unfortunately beyond the scope of this paper.

Appendix A: Econometric Analysis Output

LOG(Y) C LOG(L) LOG(K) ALL

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 12/09/06 Time: 11:58
Sample: 1 756
Included observations: 756

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.285728956	0.180974097	18.15579692	2.25E-61
LOG(L)	0.336740301	0.021966417	15.32977854	2.29E-46
LOG(K)	0.357915292	0.020505527	17.45457623	1.51E-57

R-squared	0.595021957	Mean dependent var	8.233500627
Adjusted R-squared	0.593946318	S.D. dependent var	1.027797185
S.E. of regression	0.654936433	Akaike info criterion	1.995403167
Sum squared resid	322.9931241	Schwarz criterion	2.013768411
Log likelihood	-751.2623972	F-statistic	553.180031
Durbin-Watson stat	1.311063043	Prob(F-statistic)	0

LOG(Y) C LOG(L) LOG(K) R&D

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 12/09/06 Time: 11:59
Sample: 1 161
Included observations: 161

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.50386815	0.356158695	1.414729323	1.59E-01
LOG(L)	0.655677219	0.051343366	12.77043689	4.14E-26
LOG(K)	0.281381596	0.047136278	5.969533674	1.51E-08

R-squared	0.813654376	Mean dependent var	8.308461808
Adjusted R-squared	0.811295571	S.D. dependent var	1.087199121
S.E. of regression	0.472280636	Akaike info criterion	1.355970945
Sum squared resid	35.24174188	Schwarz criterion	1.413388417
Log likelihood	-106.155661	F-statistic	344.9434143
Durbin-Watson stat	1.850338604	Prob(F-statistic)	0

LOG(Y) C LOG(L) LOG(K) LOG(R) **Computers and Communications**

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 12/09/06 Time: 12:01
Sample: 1 68
Included observations: 68

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.391431384	0.535114128	-0.731491403	4.67E-01
LOG(L)	0.662925684	0.071134527	9.319323688	1.57E-13
LOG(K)	0.060799261	0.079874335	0.761186437	4.49E-01
LOG(R)	0.274632673	0.056251864	4.882196863	7.32E-06

R-squared	0.846560379	Mean dependent var	8.153885245
Adjusted R-squared	0.839367896	S.D. dependent var	1.071895528
S.E. of regression	0.429604313	Akaike info criterion	1.205118043
Sum squared resid	11.81183139	Schwarz criterion	1.33567732
Log likelihood	-36.97401347	F-statistic	117.7007254
Durbin-Watson stat	1.849053783	Prob(F-statistic)	0

LOG(Y) C LOG(L) LOG(K) LOG(R) **Heavy Equipment and Transportation**

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 12/09/06 Time: 12:02
Sample: 69 87
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.029001905	0.770789104	0.037626252	9.70E-01
LOG(L)	0.61693195	0.115352693	5.348223217	8.13E-05
LOG(K)	0.126687649	0.094720265	1.337492548	0.200989892
LOG(R)	0.261882154	0.090750006	2.885753574	0.011316842

R-squared	0.947683142	Mean dependent var	8.52070699
Adjusted R-squared	0.937219771	S.D. dependent var	1.204024936
S.E. of regression	0.301680285	Akaike info criterion	0.625765894
Sum squared resid	1.36516492	Schwarz criterion	0.824595153
Log likelihood	-1.944775995	F-statistic	9.06E+01
Durbin-Watson stat	2.63110071	Prob(F-statistic)	7.77E-10

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