R&D TAX INCENTIVES: HOW DOES THE US COMPARE?

MASTER'S PROJECT

Emily Carwell
Submitted: April 19th, 2013
Faculty Advisor: Professor Robert Conrad
Duke University, Sanford School of Public Policy

Table of Contents

1. EXECUTIVE SUMMARY

The goal of this analysis is to determine how the United State's research and development (R&D) incentives compare to those in other countries. The US spends more than any country on governmental and total R&D expenditures. However, the US is only ninth globally in R&D intensity, defined as the ratio of R&D expenditures to GDP.

In comparing how tax incentives contribute to the amount of tax a firm pays on a representative R&D investment, across a sample of countries, the US had the highest net tax due but a relatively high tax savings.

Additionally, Marginal Effective Tax Rates (METRs) were calculated for the sample countries. METRs represent the amount of tax arising from a profit maximizing firm's decision to invest in a marginal unit of capital, given competition in the capital market and provisions for depreciation, deductions, credits, and tax rates. METRs provide a more comprehensive measure of the value of the incentive within the individual countries' tax systems.

Across a variety of scenarios, the US had the highest METRs. Three factors contribute to its high METRs. First, the US corporate tax rate is relatively high at 35 percent. Second, the US's Research and Experimental (R&E) tax credit reduces the amount of R&D a taxpayer may expense. Third, the high METRs reflect Congress' intent to reward only incremental expenditures.

Recommendations for improving the effectiveness of US R&D incentives include:

1. Maintain the R&E Tax Credit because it can be made easier to administer and less expensive than a deduction.

2. Make the credit refundable. This will expand the credit by providing an incentive for start-ups and enterprises without taxable income.

3. Simplify the base formula to increase the number of companies eligible for the maximum credit.

4. Improve the administration of the credit to decrease legal costs and uncertainty associated with the credit.

2. INTRODUCTION

Research & Development (R&D) is an important driver of economic growth. The US government has supported various interventions to stimulate private R&D. However, there is concern that the R&D investment in the US is too low, which has motivated proposals for government action to encourage more R&D. Thus, the objective of this paper is to provide an international comparative evaluation of R&D policies to determine how US incentives compare with those in other countries. It will also provide inputs for recommendations of possible improvements to US incentives.

I begin with a general discussion of why and how governments support R&D. I then compare counties' R&D expenditures. In addition to an overview of US R&D tax incentives, for the countries chosen for this paper, summaries of their R&D incentives are provided. These counties include Australia, China, Germany, India, and Taiwan and were selected by the client, representing countries in which it has significant interest.

To compare the effectiveness of these incentives, I calculate the net of tax due in each country based on a hypothetical investment scenario. I also calculate the METRs, which show the proportion of an R&D investment a firm would pay in taxes at the margin. Finally, a brief discussion of recommendations for how the US could improve its R&D incentives is provided.

3. IMPORTANCE OF RESEARCH AND DEVELOPMENT (R&D)

R&D is a key mechanism for spurring economic growth. Technological progress makes production more efficient and increases the variety of outputs.[1] Firms may use R&D and technological innovation to accrue private and public benefits. A firm's investment in R&D is often justified by the competitive advantage it brings to the firm. For example, innovations, such as technology to lower the cost of producing an output, may provide a business with an advantage relative to its competitors. However, this competitive advantage alone does not justify government intervention in R&D.

Situations where R&D outcomes exhibit public good characteristics and contain benefits that private sector firms cannot capture may warrant public intervention. Insufficient patent protection and ways of copying innovations mean that investing firms may not receive the full benefits of their investments.

Hall, Mairesses, and Mohnen (2009) provide a survey of studies that measured spillover effects. Using methods ranging from case studies to econometrics, the authors of the studies calculated the social rate of return, defined as the benefit to society or to the overall economy,[2] as a means to demonstrate the presence of consistent R&D spillovers- both positive and negative. The social rate of return on R&D less the private rate of return on R&D equals the spillover effect.[3] For example, Berstein (1988) considered 680 manufacturing firms from 1978 to 1981 and found that the private return to R&D was 12 percent, while the social rate of return was 22 percent. The spillover effect then was 10 percent, and represents the amount of benefit firms were unable to capture. An abbreviated version of the data found in Hall, Mairesses, and Mohnen 2009 is summarized in Table 1.

Table 1: Private and Social Returns to R&D

Study	*Sample*	*Period*	*Own R&D Rate of Return (Private)*	*External R&D Rate of Return (Social)*
Bernstein (1988)	Canada 680 mfg firms	1978-81	12%	22%
Griliches-Lichtenberg (1984a)	US 193 mfg industries	1959-78	11% to 31% (8%)	50% to 90% (36%)
Sterlacchini (1989)	UK 15 mfg industries	1945-83	12% to 20%	19% to 20%
Wolff-Nadiri (1993)	U.S. 19 mfg industries	1947, 58, 63, 67, 72,77	11%	14%
Bernstein-Mohnen (1998)	Canada and Japan; 11 industries	1962-86	44% (US) 47% (Japan)	47% (US) 0% (Japan)
Griffith-Redding-van Reenen (2004)	OECD 12 industries 12 countries	1974-90	47% to 67%	57% to 105%
Mohnen (1990b)	Canadian mfg sector	1965-83	20%	29%
Mohnen (1992b)	OECD 5 countries	1964-85	6% to 9%	4% to 18%
Coe-Helpman (1995)	22 countries	1971-90	123% (G7) 85% (other)	32% (G7 to ROW)
Kao et al (1999)	22 countries	1971-90	120% (G7) 79% (other)	29% (G7 to ROW)

If the social return to R&D is greater than the private return, a distortion exists. As a result, public intervention may be appropriate to correct the marginal price of R&D so that the price represents the full social value of the investment. Various policy instruments such as, direct expenditure, regulation, and tax incentives, could help correct this distortion.

4. FINANCING R&D

While both the public and private sectors finance R&D, this paper focuses on public sector financing. The public sector primarily finances R&D in two ways. First, direct funding is accomplished through grants and other subsidies. Grants from the Institute of Medicine and the National Science Foundation are examples of such subsidies. Second, R&D is financed through tax incentives such as tax credits and accelerated deductions. This paper will be limited to a discussion of tax incentives.

5. INTERNATIONAL R&D TRENDS

A. R&D EXPENDITURES

R&D intensity, a common measurement of R&D activity, will be defined as the percentage of Gross Domestic Product (GDP) a country spends on R&D.[4] Table 2 contains R&D intensity rankings by country for 2009. The top 10 countries accounted for 80 percent of global total expenditures on R&D. Israel had the highest R&D intensity, with 4.28 percent. The United States ranked ninth, with an R&D intensity of 2.88 percent.[56]

TABLE 2: Percent Change in R&D Intensity 1999-2009

Rank	Countries	2009	1999	Percent Change
1	Israel	4.28	3.52	22%
2	Finland	3.96	3.17	25%
3	Sweden	3.62	3.58	1%
4	Korea (2008)	3.36	2.17	55%
5	Japan	3.33	3.02	10%
6	Denmark	3.02	2.18	39%
7	Switzerland (2008)	3.00	2.53	18%
8	Taiwan	2.93	-	-
9	**United States**	2.79	2.64	5%
10	Germany	2.78	2.40	16%

Source: NSF Science and Engineering Indicators 2012

Table 2 contains the rates of growth for a sample of countries. The rate of change of R&D intensity increased only 5 percent during the sample period in the United States while R&D intensity for Israel and Finland increased 22 percent and 25 percent, respectively. As seen in Table 3, R&D intensity has increased the most for countries such as Portugal and China, (140 percent, 125 percent respectively), that had low R&D intensity rates in 1999.This is an indication that countries are investing more in R&D.[7]

TABLE 3: R&D Intensity from 1999 to 2009 (or most recent year)

Rank	Country	Percent Change	1999	2009
1	Portugal	140%	0.69	1.66
2	China	125%	0.76	1.70
3	Estonia	108%	0.68	1.42
4	Turkey	82%	0.47	0.85
5	Hungary	71%	0.67	1.15
6	Spain	61%	0.86	1.38
7	Korea (1999, 2008)	55%	2.17	3.36
8	Ireland	51%	1.18	1.79
9	Australia (2000, 2008)	51%	1.47	2.21
10	Austria	45%	1.90	2.75
18	Israel	22%	3.52	4.28
26	**United States**	**5%**	**2.64**	**2.79**

Source: OECD Science, Technology, and Industry Score Card, 2011[8]

China is an example where R&D has intensified. According to the NSF Science and Engineering Indicators, China's R&D expenditures have grown substantially in the last 10 years, with an average annual increase of 19 percent adjusted for inflation.[9] However, much of China's growth is due to the fact that Chinese investment levels were extremely low in the 1990's.

During a February 2013 Committee on Science, Space, and Technology hearing on the role of R&D in American competiveness, testimony from Richard K. Templeton, CEO of Texas Instruments, said that the increases in R&D in China and throughout Asia, are signs that the US is losing a portion of its global competitive edge.[10] Organizations such as the Center for American Progress and the Information Technology & Innovation Foundation have published reports agreeing that other countries are closing the gap in conducting R&D. [11]

B. SAMPLE COUNTRIES' R&D EXPENDITURES

Private vs. Public Expenditures on R&D

Table 4 contains a comparison of government and private expenditures on R&D in United States, Australia, China, Germany, India, and Taiwan. The US ranks first in total expenditures with $403,668 million and has the highest government and business expenditures, with $118,239 million and $258,626 million, respectively. Australia had the lowest R&D expenditure with $19,028 including $6,557 million in government expenditures and $11,797 million in business expenditures. [i]

Table 4 also contains R&D intensities, as defined above. In 2009, Taiwan had the highest R&D intensity, with 2.93 percent. The US followed closely behind with 2.90 percent. The latest figure for India, from 2007, was .89 percent, representing the lowest R&D intensity.

TABLE 4: Selected Country Expenditures on R&D 2009 (Current Millions of US Dollars)

	Domestic R&D Expenditure	Domestic R&D Intensity	Government R&D Expenditures	Business Enterprise R&D Expenditures
United States	403 668	2.9	118 239	258 626
Australia	19,028	2.21	6,557	11,797
China	154,147	1.70	36,085.84	110, 592
Germany	81 970	2.78	23,282	55,144
India	24,439	.76 (2007)	15,079	8,284
Taiwan	21,571	2.93	3,624	15,315

Sources: OECD Scorecard, 2011, NSF Indicators, 2012[12]

[i] Non-profit spending and funds from abroad comprise the difference between business and government spending and total R&D expenditures.

In most of the countries, business enterprise performs the majority of the R&D. As seen in Table 5, private investment accounts for over 70% of R&D in the US, China and Taiwan. India is an exception, with the government performing 61.7 percent of R&D.

TABLE 5: Gross Expenditures On R&D By Performing Sector (2009)
(Percent)

Country	Business	Government	Higher Education	Private Nonprofit
United States (2009)[a]	70.3	11.7	13.5	4.4
China (2009)	73.2	18.7	8.1	0.0
Germany (2009)	67.5	14.9	17.6	**
India (2007)	33.9	61.7	4.4	**
Taiwan (2008)	70.1	16.8	12.8	0.4

Source: NSF Science and Engineering Indicators, 2012[13]

6. RESEARCH AND DEVELOPMENT IN THE UNITED STATES

A. BACKGROUND

1. Expenditures

National R&D spending steadily increased from 1953 to 2008, at a rate of 2 to 3 percent per year. However, due to the recession, total R&D spending decreased 1.7 percent (adjusted for inflation) in 2009.[14] In 1953, the government expenditures on R&D represented 53.9 percent of total expenditures while business R&D comprised 43.5 percent of expenditures. Those percentages have shift over time to where businesses funded 61.6 percent of R&D in 2009, and the government 31.1 percent.

2. Types of R&D

There are three types of R&D: basic, applied, and development. Table 6 contains a breakdown of total US R&D expenditures from 1979 – 2009, by research category. In 2009, the distribution of expenditures was: basic 19 percent, applied 17.8, and development 63.2 percent. As seen in the lower part of Table 6, the proportions allocated across categories have remained stable. Additional information regarding historical US R&D trends is found in Appendices A and B.

TABLE 6: Total US R&D Expenditures, By Type of R&D: 1979–2009

Character of work	1979	1989	1999	2004	2009
	$billions (real)				
All R&D	55.4	141.9	245.0	302.5	400.5
Basic	7.8	21.9	38.9	56.1	76.0
Applied	12.1	32.3	52.0	69.2	71.3
Development	35.4	87.7	154.4	177.2	253.2
	Percent distribution				
All R&D	100.0	100.0	100.0	100.0	100.0
Basic	14.1	15.4	15.9	18.5	19.0
Applied	21.8	22.8	21.2	22.9	17.8
Development	63.9	61.8	63.0	58.6	63.2

SOURCE: National Science Foundation Science and Engineering Statistics [15]

As for the federal government, it spent $156 billion on R&D in 2009, with 23 percent of its R&D expenditures funding basic research. Defense related research accounted for 55 percent of total expenditures. Health related R&D has increased in the last three decades. In 1980, 12 percent of the US R&D budget was allocated for health expenditures, in 2009 that percentage had risen to 26 percent.[16]

B. TAX INCENTIVES

The two most important tax incentives for encouraging R&D are the expensing of certain R&D costs and the Research and Experimentation Tax Credit. In 1954, Congress changed the US Internal Revenue Code, Code Sec. 174, to specifically allow businesses to expense R&D costs that are incurred during a tax year in connection with a trade or business. This is an incentive because R&D is an investment expenditure and, like any investment, should be amortized over time to accurately reflect net economic income. Expensing, by providing an immediate deduction, reduces the present value of tax payments and therefore makes the investment more attractive. Under current law, taxpayers can choose to expense the R&D costs or to defer and amortize the costs, in effect to capitalize these costs for a period of not less than 60 months.[17] In most cases, taxpayers choose the expensing method. [ii]

[ii]Although the expense method is usually the most beneficial for profitable firms, there are situations where amortization might be preferred. Such situations include tax losses resulting from business start-up or from other factors.

C. THE RESEARCH AND EXPERIMENTATION TAX CREDIT

The R&E Tax Credit was established in 1981 as part of the Economic Recovery Tax Act (ERTA). According to Department of Treasury, in 2008, 12,736 corporations claimed $8.3 billion in research credits and 64,000 individual taxpayers claimed $463 million in research credits.[18] Congress has extended the credit 14 times since 1981. The credit expired at the end of 2011, but was renewed in January 2013. The tax credit's design has been amended several times. Code Sec. 41 entitled "Credit for Increasing Research Activities" contains the most recent version of the tax credit. [19]

1. R&E Credit's Design and the Federal Government's Rationale

According to the signing statement, Congress passed the 1981 Economic Recovery Tax Act to promote economic growth through upgrading the nation's industrial base, stimulating productivity and innovation, and lowering tax burdens.[20]

In the 1970s, as US's GDP increased, R&D intensity declined from 2.91 percent in 1967 to 2.26 percent in 1977. In 1980, the total civilian R&D expenditures (excluding military and space R&D) to GNP ratio was 1.5 percent compared to 1.9 percent in Japan and 2.3 percent in Germany.[21]

Congress wanted to reverse the private sector decline relative to R&D spending and decided to implement an incremental tax credit to stimulate private spending on R&D. [22] An incremental, non-refundable, credit was made available for R&D expenditures exceeding a certain base.[23] The original bill provided a 20 percent credit of R&D expenditures above the base. The logic was that the incremental nature of the credit would encourage businesses already conducting R&D to increase their efforts. Congress did not want to provide a subsidy for spending that would have been undertaken absent of the credit.[24]

Congress limited the credit to certain direct wages and equipment research expenditures. The credit does not apply to indirect, administrative, or overhead expenditures.[25] These limitations were intended to prevent ambiguity and reduce abuse. Under the credit, qualifying activities must be performed within the US and qualifying R&D expenditures must be incurred by a US taxpayer.[26]

2. Calculating the R&E Tax Credit

Congress provides two types of credits, the Regular Research Credit and Alternative Simplified Research Credit. Taxpayers' eligibilities for the credit depended on their taxpayer statuses and circumstances.

The first step in calculating the R&E Tax Credit is to determine the Qualified Research Expenses (QRE). For purposes of the law, the term "Qualified Research Expenses (QRE)" is defined as research and expenditures paid or incurred during the taxable year in connection with trade or business as expenses not chargeable to capital account.

Furthermore, research expenditures are defined as those expenditures undertaken for the purpose of discovering information which:

- is technological, meaning the research relies on physical and biological sciences, engineering, or computer science; and
- is intended to be useful in the development of a new or improved business component for the company.[27]

Regular Research Credit

To qualify for the Regular Research Credit a taxpayer must be considered an established entity in the sense that it has gross receipts accrued for the tax years 1984-1988. Three steps are required to compute the Regular Research Tax Credit in this case. [28]

1. A base percentage is calculated as the ratio of qualified R&D expenditures to gross receipts averaged over a four-year period from 1984-1988.
2. A base amount is then computed as the average of the gross receipts for the 4 previous years, multiplied by the fixed base percentage.
3. The credit is then computed by multiplying 20 percent by the difference between current qualified expenditures and the base amount. [29]

These steps are illustrated by the following numerical example. Suppose a firm's QREs are $56 million and gross receipts are $1,350 million. The fixed based percentage will be 4% (or $56 million/$1,350 million). If the four-year average gross receipts are $1,539 million, then the base amount is $62 million (.04*$1,539 million). Incremental expenditures are defined as the difference between the current year's QRE's and base amount ($100 million - $62 million), which equals $38 million. The credit equals 20 percent of this incremental amount (0.2*$36 million) or $7.6 million.

TABLE 7: Regular R&E Tax Credit

1	Qualified Research Expenses (QREs) (1984-1988)	$56 million
	Gross Receipts (1984-1988)	$1,350 million
	Fixed base percentage (QREs/ Gross Receipts)	**4%**
2	Average Gross Receipts (2008-2010)	$1,539 million
	Base Amount (Average gross receipts * 4%)	**$62 million**
3	QREs 2011	$100 million
	Incremental R&D (QREs- Base Amount)	$38 million
	Regular R&E Credit (Incremental R&D)* 20%	**$7.6 million**

Alternative Simplified Credit (ASC)

Taxpayers that do not qualify for the Regular Credit, qualify for the Alternative Simplified Credit (ASC). Calculating the ACS requires the below steps.

1. Compute the average qualified research expenses for the prior three years.

2. Compute the credit, which equals 14 percent of the difference between qualified expenses for this year and fifty percent of the average expenditures for the prior three years.

If there were no qualified research expenditures in any one of the prior three 3 previous years, the credit is 6 percent of qualified expenditures in the current tax period.

These steps are illustrated by the following numerical example and are also represented in Table 8. Suppose average QREs from the previous 3 years (2008-2010) are $82 million. One-half of this average equals $41 million. If QREs for this year are $100 million, then the credit is equal to $8.26 million or .14*($100 million- $41 million).

TABLE 8: Alternative Simplified R&E Tax Credit

1	Average QREs (2008-2010) divided by 2	$41 million
	QREs 2011	$100 million
2	**Alternative Simplified Research Credit (QREs 2011-$41 million)*14%**	**$8.26 million**
3	**No Previous QRE's (QREs 2011*6%)**	**$6 million**

3. Criticism of the R&E Tax Credit

Criticisms of the US R&E Tax Credit include: its lack of permanence, the amounts used to compute the measure of increment, and the difficulty of using the credit.[30]

- *Lack of Permanence*

  Both the Government Accountability Office (GAO) and Congressional Research Service (CRS) agree that the credit's lack of permanence inhibits planning. The National Association of Manufacturers (NAM) says that uncertainty of the on and off again credit affects companies' future R&D budgets, particularly when planning for projects that last 5-10 years.[31] Companies may not invest in R&D because they are uncertain about the credit's availability and the ability to obtain future benefits.[32] Thus, the credit may not influence R&D investment decisions to the extent Congress intended.

- *Methods*

  The fixed base percentage is computed from accrued gross receipts between 1984 and 1988. However, the economy and competitiveness of the R&D industry continues to change, especially during financial shocks such as the 2007 – 2009 recession. Thus, even if firms spend a considerable amount on R&D, if it is not above the base average, they are unable to claim the credit.[33] Furthermore, basing calculations on expenditures from over 20 years ago limits new companies from receiving the credit's maximum benefit.

- *Difficulties Using the Credit*

  The complex regulations surrounding the credit make it difficult for taxpayers to take full advantage of the credit. Some taxpayers say that the IRS often rejects claims because of documentation issues and that the IRS has never clarified exactly what is necessary for proper documentation.[34]

Another problem with using the US credit is that the tax subsidy is provided for inputs not outputs. Thus, a firm could spend money on the inputs and receive the credit, without generating substantial R&D outputs and the firm may not have an incentive to conduct R&D in an efficient manner. However, because inputs are easier to measure than intangible outputs, such as scientific knowledge, governments generally choose to subsidize R&D inputs.

4. Current Political Context

During the 112th Congress, 16 bills were proposed regarding the R&D Tax credit – nine in the Senate and seven in the House of Representatives. Most bills called either for making the credit permanent or extending it through 2016. Other proposals included increasing the Alternative Simplified Credit to 20 percent and increasing benefits for small companies. At the start of the 2013, Congress reinstated the credit through December 31, 2013.

The Obama Administration has also proposed making the tax credits permanent as well as simplifying the rate calculations. The Administration advocates for increasing the Alternative Simplified R&D tax credit rate from 14 percent to 17 percent of qualified research expenses that exceed 50 percent of the average qualified research expenses in the three preceding taxable years.[35]

5. Standard Tax Provisions

The R&E Credit needs to be placed in the context of the generally applicable US tax. For current purposes the discussion is restricted to the US corporate tax. The US corporate tax rate is 35 percent.[36] Because taxpayers must reduce the deduction claimed under IRS Section 174 by the amount of the credits claimed, the GAO estimates that the marginal effective rate of the credit decreases from 20 percent to 13 percent.[37]

Property, plant and equipment may be written off over the effective useful life using the Modified Accelerated Cost Recovery System (MACRS). Tangible personal property usually falls in the three, five, or seven-year categories. For residential real property, the effective useful life is 27.5 and non-residential property it is 39 years.[38]

7. DESCRIPTION OF SELECTED COUNTRIES' R&D INCENTIVES

A. BACKGROUND

This section includes a description of the R&D tax incentives for the sample group of countries. Table 9 contains summaries of relevant R&D tax incentive provisions. Two types of incentives are most common: expensing and credits, with expensing sometimes in excess of 100 percent. Germany is an exception in that it primarily encourages R&D through grants while still allowing the expensing of non-physical capital R&D. The US is the only country that uses an incremental basis. Other countries' incentives are volume based, using the value of the current R&D expenditures.

Numerical examples are used to illustrate how the provisions operate in each country and to compare the tax savings across countries. An identical investment is made in country consisting of: $105 in tangible assets such as personal property, $115 in real property, and $100 in intangible asset such as labor, all of which are attributable to R&D. Taxable income is assumed to be sufficient for the firm to take full advantage of the credit. In each country, the total eligible R&D expenditures are measured by the combination of tax incentive design and tax depreciation.

TABLE 9: Sample Countries R&D Incentives

Country	*Description of Incentives*
United States	• Regular Tax Credit: 20% of Qualified Research Expenses (QRE) • Alternative Credit: 14% of QREs, targeted towards companies who don't qualify for the regular credit. 6% credit for start up companies • R&D expenses are deductible from income tax • Taxpayers must reduce the current deduction by the amount of the credit
Australia	• A 45 % refundable tax offset for eligible companies with less than $20 million per year • A non-refundable 40 percent tax offset for all other eligible companies[39]

China	• 150% super deduction of qualifying R&D expenses • Reduced income tax rate of 15% for 3 years for High and New Tech Enterprises (HNTE)
Germany	• Expensing of R&D costs
India	• 200% super deduction for in house R&D facilities in the bio technology and manufacturing sectors • 125% to 200% deduction of payments for entities conducting R&D in India • 100% deduction of R&D expenses that do not qualify for the super deductions • Deduction of employee salaries and materials of R&D entities for the 3 years preceding the start of a business • 125% weighted deduction for contributions to approved research associations, universities, and other institution for research in social sciences or statistical research[40]
Taiwan	• Credit for 15% of R&D expenditures limited to 30% of a company's tax liability and cannot be carry forward. • Bio-Tech and Pharmaceutical Industries qualify for a credit of 35 or 50 percent of expenditures, depending on the amount of R&D expenditures.

B. UNITED STATES

The specification of US R&D incentives are found above, but to see how these incentives functions within the US tax system, suppose that taxable income before R&D is $1,000. Taxable income ($1000) multiplied by the US corporate income tax rate (35 percent) results in a tax of $350, without regard for the credit. This amount is the tax accrued assuming that R&D expenditures this year are fully capitalized with no deduction. If the total R&D expenditures equal $144.95 and amount of incremental expenditures are $100, then the maximum amount of the credit is $20. Taxable income after the credit is calculated by subtracting the total R&D ($144.95) from the taxable income ($1,000) and adding the amount of the credit ($20). This equals $875.05, and is then multiplied by the corporate tax rate (35 percent). The credit ($20) is subtracted for a net tax due of $286.27 and a tax savings of $63.73.

United States Numerical Example

Sales	$1,500
Other Cost	$500
Taxable Income Before R&D	$1,000
Tax Before Credit (taxable income*35%)	$350
Total R&D	$144.95
Incremental R&D Expenditures	$100.00
Maximum Credit	$ 20.00
Taxable After R&D Including Credit	$875.05
Tax Before Credit	$306.27
Net Tax Due	**$286.27**
Tax Savings	**$63.73**

C. AUSTRALIA

1. Description of R&D Incentives

Under the Tax Laws Amendment (Research and Development) Act 2011, the two main R&D incentives are:

- A 45 percent refundable tax offset (credit) for eligible companies with an aggregated turnover of less than $20 million per year.[41] According to the Australia Taxation Office, this offset is equivalent to a 150 percent tax deduction. When the amount of the credit exceeds a company's tax liability, the company receives a cash refund.

- A non- refundable 40 percent tax offset (credit) for all other eligible companies. Excess credits can be carried forward but not back. [42]

In Australia, qualifying R&D expenditures are based on what its R&D incentive program defines as "core R&D activities" and include the following activities.

- Activities where the outcome cannot be known or determined in advance based on current knowledge.

- Activities that are conducted for the purpose of generating new knowledge. This includes new knowledge in the form of new or improved materials, products, devices, processes, or services.[43]

- R&D activities that are conducted outside of Australia but have a significant scientific link to Australia. Under the R&D Tax Incentive, the expenditure claimed on eligible R&D activities performed overseas can be up to the value spent on related eligible Australian R&D activities.[44]

Eligible entities are corporations that are incorporated under Australian law or are incorporated under foreign law, but considered Australian residents for income tax purposes.

2. Standard Tax Provisions

Australia has a corporate tax rate of 30 percent and intangible R&D assets, such as labor, are expensed. Capital expenditures, including plant equipment, and other depreciable items are written off during their effective lives. Either straight line or diminishing value depreciation methods may be used.[45]

3. Numerical Example

For the below numerical example, the assumed taxable income before R&D is $1,000, and the taxable income before the benefit is $300 (.3*1,000). For the refundable credit, qualifying R&D expenditures total $144 and represent the amount of the investment that would qualify as R&D expenditures. When multiplied by 45 percent – the offset rate – the amount of the offset is $64.8 (.45*$144). The tax before credit ($300) less the amount of the offset ($64.8) equals a net tax due of $235.2 and a tax savings or $64.8.

For the non-refundable credit, qualifying R&D ($144) is multiplied by the rate of the offset (40 percent) and the amount of the offset is $57.6. Tax before credit less the amount of the non-refundable credit is $235.3 and the tax savings is $57.6.

Australia Numerical Example

Sales	$1,500
Other Cost	$500
Taxable Income Before R&D	$1,000
Tax Before Credit	$300
Refundable	
Qualifying R&D	$144

Offset (R&D * 45%)	$64.8
Net Tax Due	**$235.2**
Tax Savings	**$64.8**
Non-Refundable	
Qualifying R&D	$144
Offset (R&D * 40%)	$457.6
Net Tax Due	**$242.4**
Tax Savings	**$57.6**

D. CHINA

1. Description of R&D Incentives

China's tax incentives include benefits for High and New Tech Enterprises (HNTE) and a 150 percent super deduction of qualifying research expenses.[46] HNTEs receive a reduced corporate income tax rate of 15 percent for 3 years, as opposed to 25 percent for non-HNTES.[47] To qualify as an HNTE a company must meet the following criteria:

- Be resident in China;

- Own the intellectual property for the key technologies of products;

- Fall within one of the following eight areas:
    1. Electronic information technology
    2. Biological and new pharmaceutical technology
    3. Aviation and aerospace technology
    4. New material technology
    5. High technology service industry
    6. New energy and energy conservation technology
    7. Resources and environmental technologies
    8. High and new technology (HNT) for traditional industries innovation and;

- Perform R&D and incur sufficient R&D expenses.[48]

China's R&D qualifying expenditures include*:*

- Design fees, technical programming fees and direct expenses for technical materials and translation of new products;

- Direct costs of materials, fuel and power;
- Direct salaries, bonuses, and allowances; and
- Direct amortisation of intangible assets including software.

2. Standard Tax Provisions

The corporate tax rate is 25 percent and intangible assets, such as labor costs, are expensed.[49] Fixed assets are depreciable on a straight-line basis over their useful lives. The Chinese tax authorities may allow companies to use accelerated depreciation in special circumstances. [50]

3. Numerical Example

In the below numerical example, the taxable income before R&D is assumed to be $1000 and an amount of tax due before the incentive is $250. In this case, eligible R&D expenditures total $125.75. R&D expenditures are then multiplied by 150 percent for a super deduction of $190.15. The $190.15 is then subtracted from the $1,000 taxable income for a taxable income after the incentive deduction of $809.88. The result is a net tax due of 202.47 and a tax savings of $47.53.

China Numerical Example

Sales	$1,500
Other Cost	$500
Taxable Income Before R&D	$1,000
Tax Before Credit	$250
Eligible R&D expenditures	$126.75
Amount of Super Deduction (R&D*150%)	$190.13
Taxable income after R&D Deduction	$809.88
Net Tax Due	**$202.47**
Tax Savings	**$47.53**

E. GERMANY

1. Description of R&D Incentives

Since 2006, Germany has used its High Tech Strategy Initiative to promote innovation. In 2010, following the success of the initial program, the German government expanded the strategy to the High-Tech Strategy 2020. [51] This strategy has sought to promote innovation throughout the economy. In 2009, the German government spent €17.7 billion on its high tech strategy including €12 billion on R&D. Most of the German government's R&D spending is non-repayable cash grants that are given on a per project basis and usually for collaborative projects.[52] R&D costs are, however, fully deductible from a company's income tax.

Qualifying R&D expenditures include expenses related to fundamental, industrial, and experimental research. Grants are most often awarded to the biotechnology, life sciences, ICT, manufacturing, energy and utilities industries. Banks, financial services, and insurance companies are not eligible. R&D activities and costs must be in Germany and project results, including intellectual property rights must also remain in Germany.[53]

2. Standard Tax Provisions

The corporate tax rate is 30%.[54] Tangible fixed assets are written off over their estimated useful lives. For tangible goods bought after 31 December 2007, only the straight-line method of depreciation can be used.[55]

3. Numerical Example

Even though Germany does not have tax deductions or credits, it still allows the expensing of R&D expenditures. For the below example, taxable income ($1,000) multiplied by the corporate income tax rate of 35 percent results in $350 of net tax. The eligible R&D ($140.8) is subtracted from taxable income before R&D, resulting in $859.3 in taxable income. This taxable income multiplied by the 35 percent corporate income rates results in $257.78 of net tax due and a tax savings of $92.22.

Germany Numerical Example

Sales	$1,500
Other Costs	$500
Taxable Income Before R&D	$1,000
Tax Before Deduction (taxable income*35%)	$350
Eligible R&D	$140.8
Taxable income after R&D Deduction	$859.3
Net Tax Due	**$257.78**
Tax Savings	**$92.22**

F. INDIA

1. Description of R&D Incentives

India offers various accelerated deductions for R&D expenditures. It provides a 200 percent super deduction for in house R&D expenses in the bio technology and manufacturing sectors. If R&D expenses qualify for the super deduction, than they do not qualify for other tax provisions. To qualify for the deduction, an R&D entity must meet the following requirements"

- The Department of Scientific and Industrial Research must approve the R&D facility;
- The R&D unit must be in a separate area;
- The R&D unit must have its own staff; and
- The facility cannot be used for market research, sales promotion, quality control, testing, commercial production, style changes, or data collection.[56]

Other deductions include:

- 125 percent to 200 percent deduction of payments to entities conducting R&D in India; [57]
- 100 percent deduction of R&D expenses; [58]
- Deduction of employee salary and materials of R&D entities for the 3 years preceding the start of a business; and [59]
- 125 percent weighted deduction for contributions to approved research associations, universities, and other institution for research in social sciences or statistical research.[60]

Qualifying expenditures are wages, supplies, utilities, and expenses directly related to R&D other than land. General and administrative costs, depreciation, overheads, and allocated expenditures are not considered R&D expenses.[61] R&D must be conducted in India.

2. Standard Tax Provisions

The corporate income tax rate is 32.45 percent.[62] Wages and salaries are deductible. Assets including buildings, plants, and machinery are depreciated at different rates depending on the nature of the asset.[63]

3. Numerical Example

Once again, the taxable income before R&D is assumed to be $1,000. This income multiplied by the corporate income tax rate (32.45 percent), results in a tax before credit of $324.5. The eligible R&D expenditures ($163) are then multiplied by the super deduction rate of 200 percent to equal $326. The $326 is subtracted from the $1,000 taxable income for an after deduction taxable income of $674. To calculate the net tax due, the taxable income after the R&D deduction is multiplied by the corporate income tax rate, resulting in $218.71 of net tax due and a tax savings of $105.79.

India Numerical Example

Sales	$1,500
Other Cost	$500
Taxable Income Before R&D	$1,000
Tax Before Deduction (taxable income*32.45%)	$324.5
Eligible R&D	$163
Application of Super Deduction (R&D *200%)	$326.0
Taxable Income After R&D	$674.0
Net Tax Due	**$218.71**
Tax Savings	**$105.79**

G. TAIWAN

1. Description of R&D Incentives

The 2010 Statute for Innovation Upgrading Industries (SIUI) replaced the Statute for Upgrading Industries, eliminating tax holidays and accelerated depreciation. The Investment Tax Credit (ITC) for R&D is 15 percent of R&D expenditures, and limited to 30 percent of a company's tax liability. Unused tax credits cannot be carried forward. [64]

The ITC under the Statute for Bio-Tech Pharmaceutical Industries (SBI) is 35 or 50 percent of expenditures. The tax credit is limited to 50 percent of the company's tax liability and tax credits can be carried forward up to four years.

Qualifying R&D activities involve innovation processes carried out for the purpose of creating new or improved products, techniques, services and systems. This includes developing or designing production processes, service processes and developing new materials.[65] Eligible R&D expenditures include:

- Salaries of full time R&D staff;
- Consumable equipment and materials for R&D;
- Fees or costs for patents, special technology or copyrights exclusively purchased for R&D; and
- Expenditures for outsourcing or partnership R&D activities.[66]

For a company to be eligible for the incentives, it must be incorporated in Taiwan. This does not include branches of overseas companies. While there are no industry requirements under the SIUI, ITC for SBIs are limited to the bio-technology industry. [67]

2. Standard Tax Provisions

The corporate income tax rate is 17 percent for companies with taxable income greater than 120,000 New Taiwan dollars (NT). The net tax due cannot exceed 50 percent of the portion of taxable income over NT 120,000. The following depreciation methods are used: straight-line, declining balance, sum-of-year's-digits, production quantity and machine/working hour.[68]

3. Numerical Example

For the below numerical example, the taxable income before R&D is $1,000. Taxable income multiplied by the corporate tax rate of 17 percent makes the tax before credit $170.

Qualifying R&D expenditures total $126.75 dollars and when multiplied by rate of the credit (15 percent) the amount of the credit equals $19.01. The tax before credit ($170) less the amount of the credit ($19.01) results in a net tax due of $150.99 and a tax savings of $19.01.

Taiwan Numerical Example

Sales	$1,500
Other Cost	$500
Taxable Income Before R&D	$1,000
Tax Before Credit (taxable income* 17%)	$170

Eligible R&D	$126.75
Application of Credit (R&D*15%)	$19.01
Net Tax Due	**$150.99**
Tax Savings	**$19.01**

H. DISCUSION OF COMPARISONS

As seen in Table 10, Taiwan's incentive is the most generous. Taiwan's corporate tax rate of 15 percent is likely the defining factor for the low tax. India and China saw the next lowest taxes, with $191.46 and $202.47, respectively. Theses countries' super deductions greatly reduced their taxable incomes. The United States had the highest taxes paid. Even though it offers an incentive, the 35 percent corporate tax rate contributed to a higher net tax due.

However, when examining the tax savings and the effect of the incentives in relation to the overall tax system, India had the highest savings with $105.79 and Taiwan had the lowest tax savings of $19.01. The US had the third highest with $63.3 of savings due to its tax incentives. Thus, the actual benefit of the US credit is higher than it appears when looking at the net tax due. These results demonstrate that incentives matter more in countries with a higher tax burden.

Table 10: Summary of Net-Tax Due, Tax Savings, and Net-tax (US Dollars)

Country	***Net Tax Due***	***Tax Savings***
United States	286.27	$63.73
Australia	242.4	$57.6
China	202.47	$47.53
Germany	257.78	$92.22
India	218.71	$105.79
Taiwan	150.99	$19.01

8. EVALUATION METHOD

A. MARGINAL EFFECTIVE TAX RATE (METR)

The numerical examples summarized in Table 10 represent one method of comparing the benefits different countries provide. This kind of comparison could be misleading however because the full effect of the incentive depends on the present value of the investment. For example, a dollar expensed this year will reduce taxes in the current year but increase taxes in future years. As a result, the net effect of the incentive will be the present value of tax savings and not a one period tax reduction. A METR is the present value of the tax arising from a competitive profit maximizing firm's decision to invest in a marginal unit of capital.[69] Thus, the METR is a more comprehensive measure of the value of a marginal incentive because inflation, depreciation, and timing differences are taken into account.

The METRs computed are based on the below assumptions.

1. The cost of capital is exogenous to the firm.

2. There is no uncertainty (ex post).

3. All prices are exogenous.

4. The firm seeks to maximize the present value of shareholder wealth.

Equation 1 measures the user cost of capital when taxes are zero and assumes that the rate of change in the price of capital goods (g) is zero. The unit cost of capital is equal to the purchase price of capital multiplied by the cost of financing (r) plus economic depreciation (δ). As a result of the firm's desired to maximize shareholder wealth, in equilibrium, the cost of capital is equal to the value of the marginal product of capital.[70]

Equation 1:

$$p\ MPk = c = q(r + \delta - g)$$

c= cost of capital
q= purchase price of capital
r= cost of financing
g= rate of price change of capital goods
δ*= depreciation*

Taxes can distort this condition. Equation 2 shows the value of the marginal product of capital in the presence of taxes when the cost of debt finance is equal to the cost of equity.

Equation 2:

$$pMP_k = q\frac{r+\delta}{1-u}\left(1-\frac{u\alpha}{r+\alpha}\right)$$

q= money spend (investment)
δ= depreciation
u= corporate tax rate
r= cost of financing
α= declining balance rate

A METR, on a tax inclusive basis, is then the expected pre-tax rate of return minus the expected after tax rate of return on the marginal investment divided by the pretax rate of return.[71]

Equation 3:

$$t = \frac{p^{c}\text{-}s^{c}}{p^{c}}$$

p^c= expected pre tax rate of return
s^c= after tax return on marginal investment
t= tax rate

In discussing whether or not the tax code provides an incentive for a particular activity, it is it important to discuss neutrality. Neutrality in the context of equation 3 is defined as a situation where equation 3 equals equation 1. In general, this occurs when the marginal tax is zero.

I assume that the marginal investment in R&D is comprised of an investment consisting of a number of assets including real property, tangible personal property, and intangible expenditures. Intangible expenditures, in this context are labor cost and consumables attributable to R&D. It is generally assumed that between 70-80 percent of R&D investment expenditures are related to intangible assets. Thus, I assume that a marginal dollar of R&D is allocated: 75 percent to intangible expenditures, 15 percent to real property, and the remaining 10 percent to tangible personal property. I also make the below assumptions:

1. *The firm has sufficient tax liability to use the credits and deductions.* This means that the values will reflect the maximum benefit a firm can realize using the R&D incentive.

2. *The tax inclusive real return on capital is 10 percent.*

3. *Economic depreciation rates are 20 percent for tangible property, 2 percent for real property, and 12.5 percent for intangible property* These rates are based on Hulten and Wykoff's paper entitled, "The Estimation of Economic Depreciation Using Vintage Asset."[72]

B. CALCULATIONS

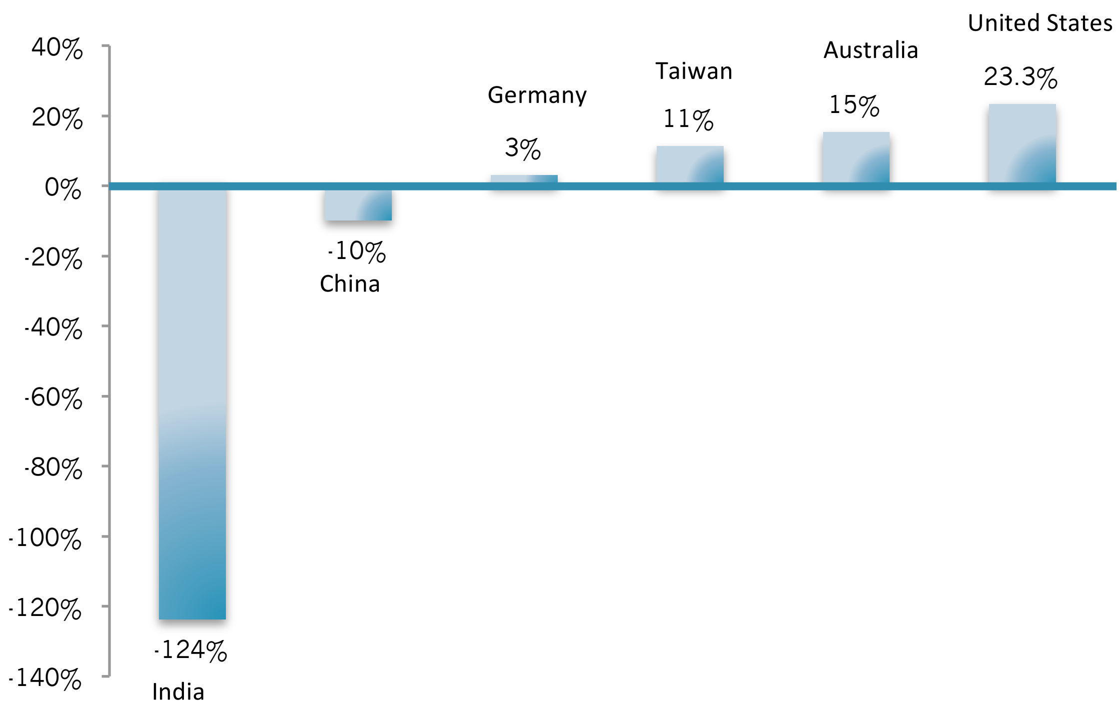
I calculated the METR for the sample countries, assuming an identical investment is made in each country and the countries' applicable taxes are considered. This approach enables a consistent comparison of the effect of the tax incentives on a marginal investment.

METR's for the base case are found in Figure 3. The rates range from a low of -123 percent for India, to a high of 23.3 percent for the United States. It is important to note that negative METRs are effectively marginal subsidies (negative taxes in net present value terms) and therefore at the margin, government expenditures.

For the base case, the US corporate tax rate and credit design result in the US having the highest METR. The US corporate rate is relatively high at 35 percent in comparison to countries such as China where the corporate tax rate is 25 percent. Second, the credit reduces the amount of R&D a taxpayer may expense. India and China's negative rates result from the ability to expense 100 percent of the marginal investment. The present value of the tax benefit is greater than the amount of the private expenditure.

For the net tax due scenarios calculated in a previous section, country rankings for the amount of tax paid were as follows, US, Germany, Australia, India, China, and then Taiwan. However, when comparing METRs, the US still has the highest rate, but is followed by Australia, Taiwan, Germany, China, and then India. Germany and Taiwan saw the biggest changes. Though Taiwan had a low amount of tax due, it is ranked higher compared to other sample countries' METR. Germany on the other hand, had a higher amount of net tax due but its METR was only 3 percent.

Figure 3: Marginal Effective Tax Rates



2. Sensitivity Analysis

Sensitivity analysis was used to examine how the METR's are affected by changes in the assumptions. Variables selected for the analysis include rates of inflation, proportions of real property assets and debt asset ratios.

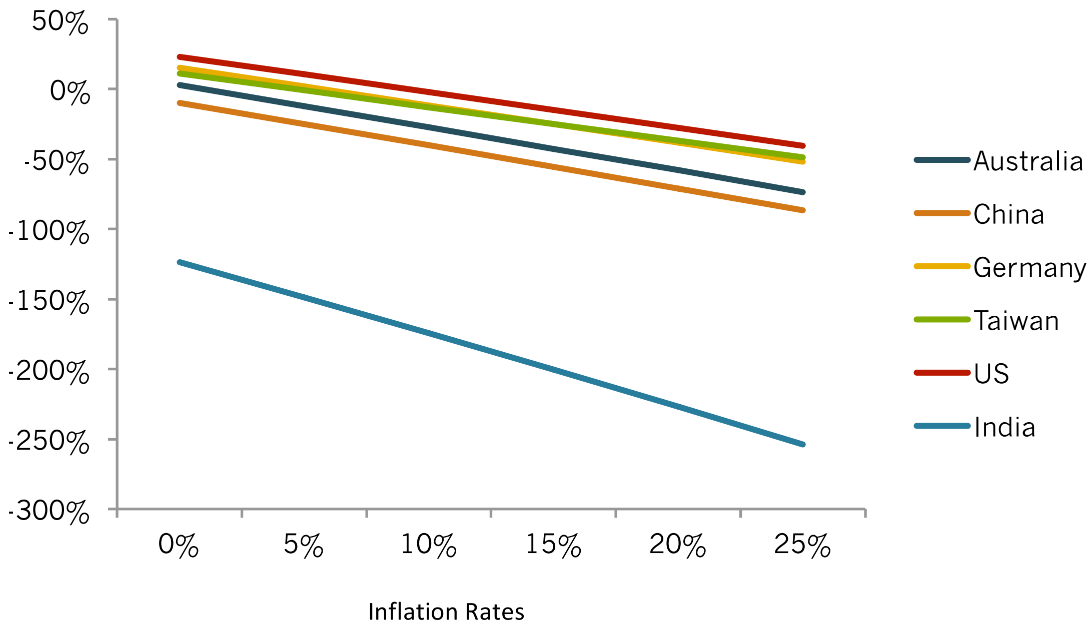
Inflation

METR's for inflation rates ranging from 0 to 25 percent are reported in Table 11 and represented graphically in Figure 4. The graph shows that the decline in METR's is essentially linear. The fact that METR's fall with inflation may seem counter-intuitive. In general, inflation increases METR because depreciation is not adjusted for inflation. However, R&D incentives occur mostly in the initial investment period. Thus, as inflation increases, the present value of the tax loss in the early period increases on a relative basis.

Table 11: METR at Varying Rates of Inflation

Inflation Rate	Australia	China	Germany	Taiwan	US	India
0%	3.0%	-9.8%	15.3%	11.3%	23.3%	-123.7%
5%	-12.1%	-24.9%	1.9%	-0.9%	10.5%	-148.7%
10%	-27.2%	-40.2%	-11.5%	-12.9%	-2.2%	-174.3%
15%	-42.5%	-55.5%	-24.9%	-24.9%	-15.0%	-200.3%
20%	-58.0%	-70.9%	-38.3%	-36.9%	-27.7%	-226.9%
25%	-73.6%	-86.5%	-51.8%	-48.8%	-40.6%	-254.0%

Figure 4: Marginal Effective Tax Rates at Varying Inflation Rates



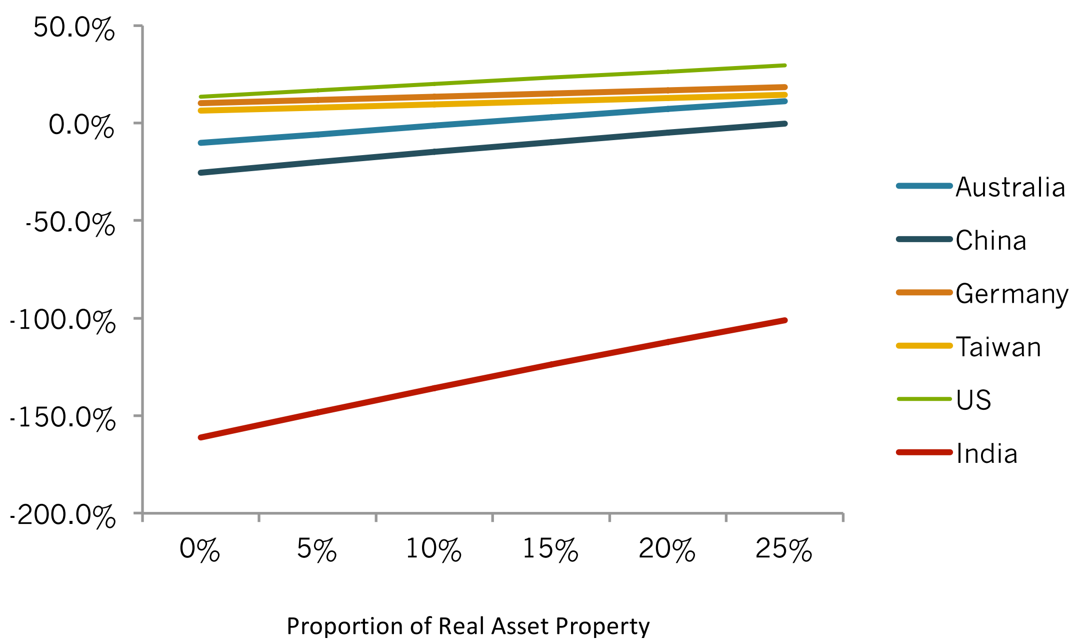
Proportion of Assets in Real Property

METR's for a range of investments in real property are reported in Table 12 and graphically illustrated in Figure 5. As the proportion of the investment devoted shifts from intangible assets to real asset property, the METR decreases in the present value. This pattern is representative of a general result where a decrease in the rate of tax depreciation increases the METR. The change is approximately linear for most countries.

Table 12: METR Varying by Proportion of Real Property

Proportion of Real Property	Australia	China	Germany	Taiwan	US	India
0%	-10.2%	-25.4%	10.1%	6.4%	13.4%	-161.3%
5%	-5.7%	-20.1%	11.9%	8.0%	16.7%	-148.3%
10%	-1.3%	-14.9%	13.6%	9.7%	20.0%	-135.8%
15%	3.0%	-9.8%	15.3%	11.3%	23.3%	-123.7%
20%	7.2%	-4.9%	16.9%	12.9%	26.5%	-112.1%
25%	11.3%	-0.2%	18.4%	14.4%	29.6%	-101.0%

Figure: 5 Marginal Effective Tax Rates Varying By Proportion of Real Property Assets



Debt Asset Ratios

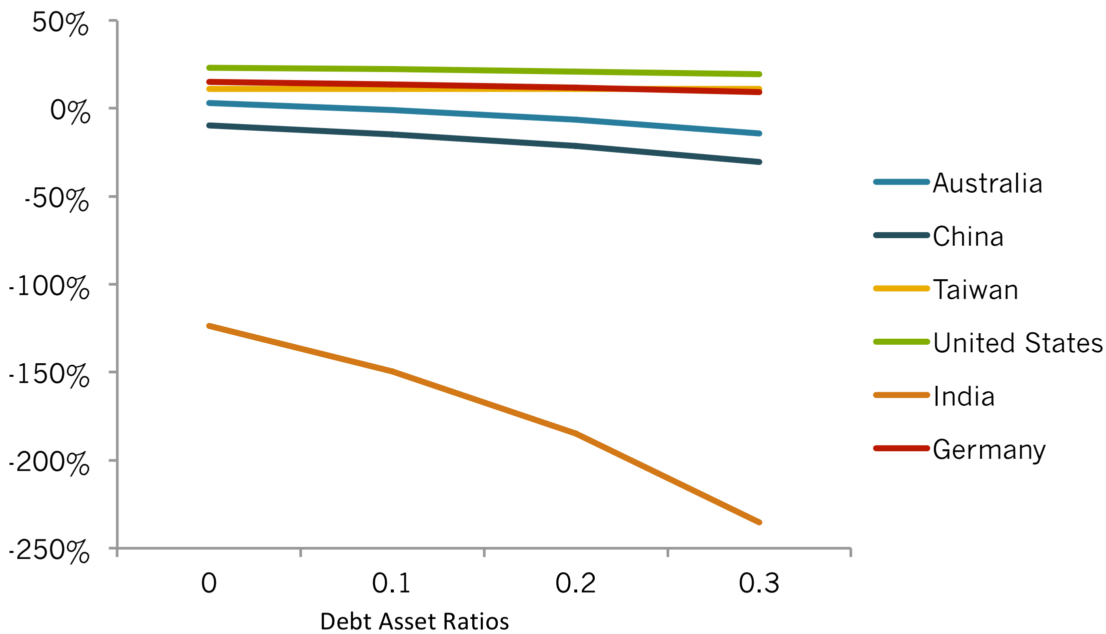
The proportion of debt was change from 0 to 0.3 and the results are reported in Table 13 as well as Figure 6. In the US, as the debt asset ratio increase from 0 to .3, the METR declines from 23.3 percent to 19.4 percent. The US has the highest METR, regardless of the debt asset ratio. As seen in Figure 6, the green line representing the US remains above the other countries' METRs.

METR's decline as debt increases because although the cost of debt service is a tax deduction, the cost of equity capital is not a deduction. Also, the deductibility of debt further increases the subsidy. Leverage will increase the net of tax return to equity as long as the interest rate on debt service is equal to the cost of equity. The relationship is nonlinear and more dramatic for India on a relative basis. India's METRs are already less than 100 percent with full equity finance.

Table 13: METRs Varying by Debt Asset Ratios

Debt Asset ratio	Australia	China	Germany	Taiwan	US	India
0	3.01%	-9.8%	15.3%	11.3%	23.3%	-124%
0.1	-1.03%	-14.8%	13.8%	11.2%	22.3%	-150%
0.2	-6.48%	-21.4%	11.8%	11.1%	21.1%	-185%
0.3	-14.20%	-30.6%	9.1%	11.0%	19.4%	-235%

Figure 6: METRs Varying by Debt Asset Ratios



9. RECOMMENDATIONS

The US's R&D incentives provide a significant tax benefit measured relative the statutory rate. In the base case, for example, the METR is 23.3 percent, which is considerably below that statutory rate. However, when measured against the countries examined in this study, the incentive is relatively low. Most other countries are aggressively use tax incentives to attract research investments. These aggressive incentives bear significant costs as negative METRs, sometime as in India's case, in excess of 100 percent, reduce revenues by more than the level of marginal investment expenditures.

Possible changes that would improve the credit should seek to make the US's marginal incentive more competitive, while protecting against inefficiencies and abuse. A few suggestions are given below. These suggestions are based on the following assumptions and viewpoints:

1. The US tax rate will not decrease significantly. Thus, any marginal incentive will be particularly effective relative to low tax countries, such as Taiwan.

2. From a policy perspective, incremental incentives are more effective because the government will not have provided a subsidy for what firms would have done absent the incentive. In a time of fiscal restraint, the government is hesitant to increase spending (including tax expenditures) and the intent of the incentive is to affect marginal decisions that are considered socially beneficial.

A. KEEP THE R&D CREDIT BUT MAKE IT REFUNDABLE

The rationale for the incremental credit was that the government did not want to provide a benefit for R&D that the companies would conduct absent of the credit. Moreover, the US has used a credit for the past 30 years, and it is commonly understood and moving to other systems would require significant adjustment costs. For the US, a credit is likely preferred.

The credit benefits those companies that have taxable income, thus the incentive is not as strong for start-up enterprises and other enterprises without taxable income. Implementing a refundable credit would allow such companies to benefit from the credit. Options for refunds could include allowing firms to sell excess credits or to require carry forwards with compound interest.

B. CHANGE BASE FORUMULA FOR INCRMENTAL EXPENDITURES

The complicated base formula for the Regular R&E Tax Credit involves using gross receipts from the 1980's as the basis for calculating the amount of incremental expenditures. Pegging the basis to an arbitrary past date limits the ability of newer companies to receive the maximum benefit from the credit. A more relevant measure would be to use a three to five year moving average of sales revenues [adjusted for inflation].

The cost of this approach is that a 3 to 5 year moving average would eventually include the benefits from the credit, making it difficult for the basis to remain endogenous to the credit. This cost could be partially offset by keeping the measure of incremental current.

C. IMPROVE ADMINISTRATION OF THE CREDIT

Further clarifying what constitute R&D expenditures would diminish the legal cost and bureaucracy associated with the credit. This is a complicated area but further clarification could provide better guidelines for taxpayers and tax administrators, enhancing the effectiveness of the credit. [73]

10. CONCLUSION

In terms of expenditures, the US has the highest overall expenditures on R&D and its R&D intensity ranks among the top 10 countries. Comparing how effective US R&D tax incentives are relative to other countries shows that US R&D tax incentives generate substantial tax saving. This is due in part to the fact that incentives are most effective in countries with higher tax rates. In all of the scenarios, the US had the highest METRs. The US's high corporate tax rate drives both the high METR and the tax savings. Thus, in determining R&D incentive design policy, it's important to realize that although the incentives matter, how they interact with the overall tax system determines the impact of the incentives for firms. Changes to how the US's R&E tax credit is calculated and administered could improve its effectiveness.

APPENDIX A

U.S. R&D expenditures, by character of work and performing sectors: 1979–2009

Character of work and sector	1979	1989	1999	2004	2009
			$billions		
All R&D	55.4	141.9	245.0	302.5	400.5
Basic	7.8	21.9	38.9	56.1	76.0
Applied	12.1	32.3	52.0	69.2	71.3
Development	35.4	87.7	154.4	177.2	253.2
			Percent distribution		
All R&D	100.0	100.0	100.0	100.0	100.0
Basic	14.1	15.4	15.9	18.5	19.0
Applied	21.8	22.8	21.2	22.9	17.8
Development	63.9	61.8	63.0	58.6	63.2
Basic research	100.0	100.0	100.0	100.0	100.0
Business	13.5	22.0	17.1	14.0	19.5
Federal intramural	14.2	10.5	8.6	8.4	7.2
FFRDCs	14.7	12.9	9.6	8.9	7.7
Universities and colleges	48.9	46.7	54.0	57.0	53.4
Other nonprofit organizations	8.8	7.9	10.8	11.8	12.2
Applied research	100.0	100.0	100.0	100.0	100.0
Business	57.7	69.1	70.4	65.7	57.6
Federal intramural	20.0	11.0	10.6	10.8	11.2
FFRDCs	5.0	3.2	3.2	4.5	6.5
Universities and colleges	11.7	13.0	11.1	13.0	16.7
Other nonprofit organizations	5.6	3.6	4.7	6.1	8.0
Development	100.0	100.0	100.0	100.0	100.0
Business	81.9	82.9	89.9	87.5	89.5
Federal intramural	11.1	10.7	6.0	7.2	6.9
FFRDCs	4.0	4.1	2.1	2.6	1.9
Universities and colleges	1.3	1.4	0.9	1.2	0.8
Other nonprofit organizations	1.7	0.9	1.0	1.5	1.0

APPENDIX B

Annual rates of growth in U.S. R&D expenditures, total and by performing sectors: 1989–2009 (Percent)						
	Longer term trend			Most recent years		
Expenditures and gross domestic product	1989–2009	1999–2009	2004–09	2006–07	2007–08	2008–09
	Current dollars					
Total R&D, all performers	5.3	5.0	5.8	7.7	6.9	-0.6
Business	5.3	4.5	6.3	8.7	8.0	-2.9
Federal government	3.6	5.7	4.1	5.5	1.8	3.3
Federal intramural[a]	3.6	5.6	4.4	5.7	-0.1	3.6
FFRDCs	3.6	5.8	3.6	5.1	5.6	2.8
Universities and colleges	6.4	6.8	4.7	4.4	5.4	5.3
Other nonprofit organizations	8.1	7.9	5.5	6.1	8.5	9.3
Gross domestic product	4.8	4.1	3.3	4.9	1.9	-2.5
	Constant 2005 dollars					
Total R&D, all performers	2.9	2.6	3.1	4.6	4.6	–1.7
Business	3.0	2.1	3.6	5.7	5.6	–3.9
Federal government	1.3	3.2	1.6	2.5	–0.5	2.2
Federal intramural[a]	1.3	3.2	1.8	2.8	–2.2	2.5
FFRDCs	1.3	3.3	1.0	2.1	3.3	1.7
Universities and colleges	4.0	4.3	2.2	1.4	3.1	4.2
Other nonprofit organizations	5.7	5.4	2.9	3.1	6.2	8.2
Gross domestic product	2.4	1.7	0.7	1.9	–0.3	–3.5

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics [74]

REFERENCES

[1] Denison, Edward. “The sources of economic growth in the United States and the alternatives before us. ” New York, Committee for Economic Development (1962)

[2] Hall, Maireses, Mohnen. “Measuring the Returns to R&D” NBER Working Paper Series. (Nov. 2009)

[3] Mohnen, Pierre, and Boris Lokshin. “What Does It Take for an R&D Tax Incentive Policy to be Effective?” Working paper (2009) pg. 27

[4] "Definition: R&D Expenditures Is Gross Domestic Expenditure on R&D (GERD)."*OECD ILibrary:*Web. 31 Mar. 2013. <http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/02/05/index.html?contentType=/ns/Chapter,/ns/StatisticalPublication>

[5] Some rankings, in particular the OECD, have the US ranked 8th, but for geopolitical reasons, these statistics do not include Taiwan. The United States National Science Foundation Science and Technology Indicators, 2012 include Taiwan, therefore the US moves to 9th.

[6] "Science and Engineering Indicators 2012: R&D: National Trends and International Comparisons." *Nsf.gov*. <http://www.nsf.gov/statistics/seind12/c4/c4s8.htm>

[7] Ibid.

[8] OECD Scorecard. Science and Technology (2011)

[9] "Science and Engineering Indicators: 2010: Research and Development: National Trends and International Linkages - International R&D Comparisons." *Nsf.gov*. <http://www.nsf.gov/statistics/seind10/c4/c4s5.htm>

[10] Templeton, Richard K. "Full Committee Hearing - American Competitiveness: The Role of Research and Development." *Welcome to Committee on Science*. N.p., 6 Feb. 2013. Web. 31 Mar. 2013. <http://science.house.gov/hearing/full-committee-hearing-american-competitiveness-role-research-and-development>

[11] Linden, Greg and Tyson, Laura. The Corporate R&D Tax Credit and U.S. Innovation and Competitiveness. Rep. Center for American Progress. (Jan. 2012)

[12] Ibid.

[13] Organisation for Economic Co-operation and Development, Main Science and Technology Indicators (2011/1). Data for Brazil and India from United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx, table 27, accessed 18 July 2011.

[14] "Science and Engineering Indicators 2012: R&D: Trends in National R&D Performance *Nsf.gov*.

[15] Ibid.

[16] Ibid.

[17] Rashkin, Michael. "Practical Guide to Research and Development Tax Incentives: Federal, State, and Foreign” Cch Inc, Dec. 2003

[18] United States Department of Treasury. “Investing in U.S. Competitiveness: the Benefits of Enhancing the Research and Experimentation (R&E) Tax Credit.” (2011)

[19] Internal Revenue Code, Section 41

[20] General Explanation Of The Economic Recovery Tax Act Of 1981, (H.R. 4242, 97th Congress, Public Law 97-34)

[21] Ibid.

[22] Ibid

[23] Ibid.

[24] Ibid.

[25] Ibid.

[26] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012
[27] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[28] Guenther, Gary. *Research Tax Credit: Current Law, Legislation in the 112th Congress, and Policy Issues*. Congressional Research Service, 2011
[29] ibid.
[30] Rashkin, Michael. "Practical Guide to Research and Development Tax Incentives: Federal, State, and Foreign" Cch Inc, Dec. 2003
[31] "ManuFACTS: R&D Tax Credit." *National Association of Manufacturing*. N.p., Aug. 2012. Web. <http://www.investinamericasfuture.org/PDFs/TalkingPointsbytheNAM.pdf>.
[32] *Report to the Committee on Finance, U.S. Senate: The Research Tax Credit's Design and Administration Can Be Improved*. Government Accountability Office, 2009.
[33] Guenther, Gary. "Research Tax Credit: Current Law Legislation in the 112th Congress, and Policy Issues." Congressional Research Service, 29 Nov. 2011
[34] *Report to the Committee on Finance, U.S. Senate: The Research Tax Credit's Design and Administration Can Be Improved*. Government Accountability Office, 2009.
[35] United States Department of Treasury. "Investing in U.S. Competitiveness: the Benefits of Enhancing the Research and Experimentation (R&E) Tax Credit." (2011
[36] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[37] Guenther, Gary. "Research Tax Credit: Current Law Legislation in the 112th Congress, and Policy Issues." Congressional Research Service, 29 Nov. 2011
[38] *United States Tax Guide 2012*. PFK, 2012
[39] "R&D Tax Incentive - Fact Sheet." *R&D Tax Incentive - Fact Sheet*. 05 Jan. 2013. <http://www.ausindustry.gov.au/programs/innovation-rd/RD-TaxIncentive/FurtherGuidance,EducationandInformationResources/Pages/RandDTaxIncentive-FactSheet.aspx>
[40] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[41] Ibid.
[42]"R&D Tax Incentive - Fact Sheet." AusIndustry: An Australian Government Initiative, n.d. Web. <http://www.ausindustry.gov.au/programs/innovation-rd/RD-TaxIncentive/FurtherGuidance,EducationandInformationResources/Pages/RandDTaxIncentive-FactSheet.aspx>.
[43] "Eligibility of Activities." AusIndustry: An Australian Government Initiative <http://www.ausindustry.gov.au/programs/innovation-rd/RD-TaxIncentive/FurtherGuidance,EducationandInformationResources/Pages/RandDTaxIncentive-EligibilityOfActivities-InformationSheet.aspx>
[44] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[45] *Australia 2012*. PFK, 2012.
[46] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[47] Ibid.
[48] "Securing R&D Tax Incentives in China." KMPG, 2012. <http://kpmg.de/docs/Securing-Research-Development-Tax-Incentives-in-China-201210.pdf>
[49] "State Administration of Taxation Issued New Rule to Further Clarify Certain Matters Related to Corporate Income Tax Reporting." *China Tax & Investment News*. Ernst and Young, 25 May 2012.
[50] Ibid.
[51] "2012 Federal Report on Research and Innovation: Innovation "Made in Germany""*Http://www.research-in-germany.de/dachportal/en/research-landscape/facts-and-figures/119090/bufi-2012-abstract-pdf.pdf*. Federal Ministry of Education and Research, 2012

[52] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[53] Ibid.
[54] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[55] *Germany 2012*. PFK, 2012.
[56] Ibid.
[57] Ibid.
[58] Ibid.
[59] Ibid.
[60] *Taxand Global Guide to R&D Tax Incentives 2011/2012*. Taxand, 2012
[61] Deloitte 2012 Global Survey of R&D Tax Incentives. Deloitte (2012)
[62] *India 2012*. PFK, 2012.
[63] Ibid.
[64] Ibid.
[65] "2011 Asia-Pacific R&D Incentives." Ernst and Young, 2011
[66] *R&D Incentives Overview - Adding Value Across ASPIC*. KMPG, 2012.
[67] Ibid.
[68] *Taiwan 2012*. PFK, 2012
[69] Fullerton, Don. "Marginal Effective Tax Rate." Urban Institute, <http://www.urban.org/uploadedpdf/1000538.pdf>
[70] Ibid.
[71] Ibid.
[72]. *"The Estimation of Economic Depreciation Using Vintage Asset Prices."* Journal of Econometrics 15: 367-396. (1981)
[73] "Tax Policy: The Research Tax Credit's Design and Administration Can Be Improved." Government Accountability Office Report to Committee on Finance, U.S. Senate, Nov. 2009. Web.
[74] Science and Engineering Indicators 2012: R&D: National Trends and International Comparisons." *Nsf.gov*. <http://www.nsf.gov/statistics/seind12/c4/c4s8.htm>