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Economics and Finance Papers

LG Tax System for Federal Individual Income Tax Compliance Study

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Abstract

Tax evasion costs the IRS and state governments billions of dollars each year. The proposed LG tax system is used to reduce or prevent potential evasion and tax fraud from employees and governments by tax withholding reports. Oftentimes, the IRS and many state governments processed two tax systems for employers and individuals. The different systems would cause verse standards to similar tax rates. On another occasion, before sending out tax refunds from the IRS and state governments, the detailed tax information is unclear and not determined. The W-2 Form provides only limited information on processing individual returns. This paper enlightens these two major loopholes and provides proposed tax withholding reports with the LG tax system to replace W-2 Form for reducing some potential tax noncompliance issues, which could save significant costs for both individuals and governments.

Introduction and Literature Reviews

Tax evasion is a practice of tax fraud or noncompliance with the tax laws when the taxpayer is deliberate attempt to misrepresent personal or entity taxable income to the Internal Revenue Service (IRS) and state governments. Some tax evasions are caused by mistakes from employees and governments. Tax invasion involves of several fraudulent forms, including taxpayers may try to under pay or to avoid paying taxes, underreport or hide their income, overstate expenses or deductions, employ in accounting indiscretions, omit or transfer income or assets illegitimately. These types of tax evasions are intentional tax liability's concealment to the government by not paying taxes. The consequence of the tax noncompliance is subject to substantial penalties and criminal punishment.

The Tax Relief and Health Care Act of 2006 (Pul. L. 109-432, 120 Stat.2922) is a federal statute that expanded the rights of individuals who provide the IRS with information about tax law violations. Under section 7201 of the Internal Revenue Code, tax evasion which is punishable by a fine of up to $100,000 for an individual or $500,000 if the taxpayer is a corporation, imprisonment of up to five years, or both. The IRS has created incentives to encourage disclosure from individuals who are aware of significant incidents of tax fraud.

In the IRS 2001 report, the underreporting of income remained the biggest contributing factor to the tax gap in 2006. Under-reporting across taxpayer categories accounted for an estimated $376 billion of the gross tax gap in 2006, up from $285 billion in 2001. Tax non-filing accounted for $28 billion in 2006, up from $27 billion in 2001. Underpayment of tax increased to $46 billion, up from $33 billion in the previous study. Overall, compliance is highest where there is third-party information reporting and/or withholding. For example, most wages and salaries are reported by employers to the IRS on Forms W-2 and are subject to withholding. As a result, a net of only 1 percent of wage and salary income was misreported. But amounts subject to little or no information reporting had a 56 percent net misreporting rate in 2006. Thus, there was 18 to 19 percent of total reportable income is not properly reported to the IRS. In 2010, tax revenue lost had been reduced some and estimated around $305 billion.

Hyman (2014) has stated that tax compliance study for the income tax. He suggests that some effective ways to decrease tax evasion, including the increase of both the probability of IRS tax audits for taxpayers and the requirements for reporting income to the IRS as well as the withholding taxes from earnings. However, beginning in 1963 and continuing every 3 years until 1988, the IRS analyzed 45,000 to 55,000 randomly selected households for a detailed audit as part of the Taxpayer Compliance Measurement Program (TCMP) in an attempt to measure unreported income and the "tax gap" (Andreoni, Erard, Feinstein, 1998). The program was discontinued in part due to its intrusiveness, but its estimates continued to be used as assumptions. In 2001, a modified random-sampling initiative called the National Research Program was used to sample 46,000 individual taxpayers and the IRS released updated estimates of the tax gap in 2005 and 2006 (Slemrod, 2007).

However, critics point out numerous problems with the tax gap measure. The IRS direct audit measures of noncompliance are augmented by indirect measurement methods, most prominently currency ratio models (Feige, 1989). The Internal Revenue Service (2012) released a new set of tax gap estimates for tax year 2006. The voluntary compliance rate — the percentage of total tax revenues paid on a timely basis for tax year 2006 is estimated to be 83.1 percent. The voluntary compliance rate for 2006 is statistically unchanged from the most recent prior estimate of 83.7 percent calculated for tax year 2001.

Also the current filing deadlines do not permit the IRS and taxpayers to access third-party information on a timely basis. Taxpayers' filing detail tax data for such as tax filing status, deductions, exemption number, taxable income, tax rate and tax, which are not covered by W-2 form, are known after the IRS receives their tax returns by April 15. Before receiving tax returns, the IRS has no detail individual tax data as references to be ready for comparisons. As a result, the current tax systems limit taxpayers' information to file accurate and timely returns. Then the IRS has no enough time to do verification on the taxpayers' returns before sending refunds to taxpayers, which give criminals a chance for possible tax evasion, such fraud created the cost of some $5.2 billion for the IRS in 2013 (Shipley, 2015).

Kao and Lee (2013) have developed a linear and gradual (LG) tax system to simplify the current U.S. individual income taxation in 2011 and 2012. This study is to eliminate the current complex Tax Tables (12 pages) and Tax Rate Schedules without tax estimation by accurate tax rate and tax calculations. Kao and Lee (2014a) have further developed the LG tax system to simplify the current U.S. federal and state corporate income taxation in 2012 and 2013 from eight federal corporate tax brackets to four with 50% or more reduction. Kao and Lee (2014b) also have simplified current state individual income systems practically. The advantages of the LG tax system include simplifications on tax/tax rate calculation, analysis, modification, reform, and projection with reductions of tax processing time and management cost for individuals, corporations, and governments.

This research paper is based on the LG tax system to simplify federal individual and corporate tax systems in 2013, 2014 and 2015. The proposed LG tax system combines the existing complex Tax Rate Schedules, Tax Table (12 pages) and Tax Computations together for employers and employees, provides computer programs to calculate tax rate and tax automatically. Employers may let the IRS to access tax withholding reports with taxpayers' detail information such as name, SS number, filing status, exemption number, retirement, deduction, credit, Social Security tax, Medicare tax, gross income, taxable income, tax rate and tax could be used for detail comparison and verification by January 15 from employers for accurate tax information. Also, tax withholding reports may provides the possibility for many taxpayers with one income source to pay exact taxes from withholding taxes and have option on filing exemption for their tax returns. The LG tax simplification means to simplify tax rate/tax calculations, analysis, modification, reform and projection for Tax Administration without changing existing tax rates, which may be performed by the IRS. The LG tax system simplified tax rates effectively according to actual situations for tax legislation.

Implications

Tax evasion costs billions of dollars to federal and state governments and taxpayers yearly. There are three major reasons. One is federal IRS and many state governments make two tax systems for employers to estimate withholding income taxes and for individuals to calculate accurate taxes in tax returns. The two tax systems are not connected each other. Employers and individuals have different standards or references even the two tax systems have similar tax rates. Then employers report W-2 forms, which do not include detail tax information such as tax filing status, exemption, deductions and taxable income, to the IRS by March 15. Another reason relates to timing problem. When receiving tax returns from individuals, the IRS and state governments have no detail tax information as references to compare and verify these tax returns and send tax refunds with 45 or even 15 days. These two major reasons give delinquents a chance for possible tax evasion. The third reason is some people do tax frauds purposely, which need lawful actions. Partial third reason may be prevented by verifying or further inspecting tax withholding reports and tax returns. The first two problems may be overcome by the proposed LG tax system. The above two tax systems can be simplified and combined together. Also the IRS and state governments can receive detail tax information from employers by January 15 or February 15 with modifications. Before receiving tax returns, the IRS and state governments have detail individual tax information as references to be ready for comparisons and verification. Then tax invasions could be reduced or avoided for individuals and governments.

Reasons to cause potential tax evasion by the existing tax systems:

A. Existing two tax systems used by employers and individuals

In our existing federal tax system for individuals, there are 7 tax brackets with 10%, 15%, 25%, 28%, 33%, 35% and 39.6% with tax rates 10%-39.3% for the four filing statuses: (1) Married filing jointly or qualifying widow(er); (2) Head of household; (3) Single and (4) Married filing separately.

The IRS and many state governments make two tax systems currently. One is used for employers to estimate withholding income taxes with Tax Rate Schedules and related tables. The Tax Rate Schedules for Married filing jointly (2014 and 2015) are shown in Table 1, which are used for employers to estimate withholding income taxes for employees. The Tax Rate Schedules in 2014 are modified slightly comparing with the Tax Rate Schedules in 2015. The first tax rate is at 10% for taxable incomes from 0 to $18,150 in 2014 or from 0 to $18,450 in 2015 with the difference $300 (18,450-18,150).

Table 1 Federal Individual Tax Rate Schedules (2014 and 2015) for Tax Estimation (Partial)

Taxable income (TI) Over	Not over	2014 Tax is	of the mount over	Taxable income (TI) Over	Not over	2015 Tax is	of the mount over
Schedule Y 1 - Married Filing Jointly or Qualifying Widow(er)							
0- 18,150		10%		0 - 18,450		10%	
18,150- 73,800		$1,815 + 15%	$18,150	18,450 - 74,900		$1,845 + 15%	$18,150
73,800-148,850		$10,162.50 + 25%	73,800	74,900-151,200		$10,312.5 + 25%	74,900
148,850-226,850		$28,925 + 28%	148,850	151,200-230,450		$29,387.5+28%	151,200
226,850-405,100		$50,765 + 33%	226,850	230,450-411,500		$51,577.5 + 33%	230,450
405,100-457,600		$109,587.5 + 35%	405,100	411,500-464,850		$111,324 + 35%	411,500
457,600		$127,962.5 + 39.6%	457,600	464,850		$129,996.5+39.6%	464,850

Table 2: Federal Tax Table for Married Filing Jointly or Qualifying Widow(er) (12 pages)

Taxable income (TI)	*Tax is*	*Taxable income (TI)*	*Tax is*	*Taxable income (TI)*	*Tax is*
0 – 5	0	10,000 – 10,050	1,003	.....	
.....		10,050 – 10,100	1,008	75,900-75,950	10,041
2,000-2,050	201	.....		75,950-76,000	10,054
2,050-2,100	204	30,000 –30,050	3,634	.....	
.....		30,050 –30,100	3,641	99,950-100,000	17,054

Another tax system, which includes Tax Tables and Tax Computations, is used for individuals to calculate accurate taxes in tax returns. Table 2 is the federal Tax Table and is used for individuals (such as Married filing jointly), who have less than taxable income $100,000, to search and find their tax payments. These tax payments in the 12-page Tax Table have no directed connection each other. The tax numbers in the Tax Table can be programmed by tax software with more data space and complex search function, which is used for automatic search. Table 3 shows Tax Computations in 2014, which has slight modifications comparing with 2013. For taxable incomes less than $450,000, the differences between the two years are minor. Tax Table, Tax Computations and related taxable income ranges are modified every year such as from 146,400 to 148,850 and from 0.25 TI - 8,142.5 to 0.25 TI - 8, 287.5. 2014 Tax Table and Tax Computations are slightly different from 2013. The 2015 Tax Table and Tax Computations are available by the IRS after January, 2016. Tax Schedules are used for estimating income taxes. Tax Table and Tax Computations are used for calculating accurate income taxes. However, Tax Schedules and Tax Table/Tax Computations have no direct relationship.

Table 3: Tax Computations for Married Filing Jointly or Qualifying Widow(er)

Taxable income (TI)		*2014 Tax*	*Taxable income (TI)*		*2013 Tax*
Over	*Not over*		*Over*	*Not over*	
0	100,000	Tax Table (12 pages)	0	100,000	Tax Table (12 pages)
100,000	148,850	0.25×TI – 8,287.5	100,000	146,400	0.25×TI – 8,142.5
148,850	226,850	0.28×TI – 12,753	146,400	223,050	0.28×TI – 12,534.5
226,850	405,100	0.33×TI – 24,095.5	223,050	398,350	0.33×TI – 23,687
405,100	457,600	0.35×TI – 32,197.5	398,350	450,000	0.35×TI – 31,654
457,600		0.396×TI – 53,247	450,000		0.396×TI – 52,354

The two different tax systems make employers to use Tax Rate Schedules and individuals to use Tax Tables and Tax Computations. There is no direct connection between the two tax systems even they have similar tax rates. Before receiving tax returns, the IRS has no detail tax information such as filing status, exemption, deduction, retirement, credit, taxable income, tax rate and tax as references and do not know these tax returns are from real individuals or not because there is no reference to be compared, which may cause potential tax invasions. Many states have similar two tax systems such as CA, IA, AR and HI. One tax system is for employers to estimate withholding income taxes. Another tax system is used for taxpayers to calculate accurate taxes. The two tax systems give criminals for possible tax frauds. State governments face the same challenge of tax evasions.

B. Tax refunds, timing, and verification

After receiving tax returns, the IRS and state governments usually send out tax refunds within 45 or even 15 days. Most taxpayers send out their tax returns between March 1 and April 15. Some taxpayers require tax refunds and some taxpayers do not require tax refunds. There is significant work for the IRS and state governments to do specially for those tax returns, which require tax refunds. Employers report individual income information to governments with Form W-2 by March 15, which covers social security income, federal withholding income tax and state withholding income tax. There is no detail tax information such as filing status, exemption, deduction, credit, taxable income, tax rate and tax from Form W-2.

Verification and timing are two key issues. When the IRS and state governments have no tax information of filing status, exemption, deduction, credit, retirement and taxable income before receiving tax returns, then verification cannot be done by comparisons before sending out tax refunds, which give criminals a chance for possible tax invasions. Verification with comparison is needed before sending out tax refunds to reduce to avoid potential tax gap.

There are about 138 million federal taxpayers in the United States reported earning $9.03 trillion in AGI and paid $1.23 trillion in income taxes in 2013. The top 50% of all taxpayers paid 97.2% of all income taxes, while the bottom 50 percent paid the remaining of 2.8% in 2012. All state tax return numbers may be somewhat lower than 138 million because some states have no state tax. The IRS and state governments are very busy to process tax returns and tax refunds during the tax season. When employers transfer withholding income taxes for many employees, who have non-complex tax situations, one-source income and gross income less than $100,000/year to federal and state governments, these employees may have no or very small amounts of tax dues or tax refunds. The complexity of the existing two federal tax systems with Tax Rate Schedules, Tax Tables, Tax Computations, changeable taxable income ranges and tax rates could be simplified and improved to let many taxpayers to have option to not file tax returns. The processing time and operating cost could then be reduced significantly. Then, the IRS and state governments can have more time to verify tax returns with comparisons.

2. The proposed LG Tax System for reducing or avoiding tax evasion

A. Combining and simplifying existing two tax systems into one system

Complex existing federal Tax Rate Schedules and Tax Tables/Tax Computations with changeable taxable income (TI) ranges can be combined together simply. 2011 and 2012 tax systems have been discussed with a linear and gradual (LG) tax system by Kao and Lee (2013 and 2014b). Tables 4 shows the LG tax system for 2014. The 7 tax brackets in the existing two tax systems are reduced to 4 with 43% reduction. Its taxable income ranges are simplified into such as 0-100,000, 100,000-250,000, 250,000-450,000, and over 450,000. All Tax Schedules and Tax Tables/Tax Computations can be replaced by Table 4.

When individuals (Married Filing Jointly or Qualifying Widow(er)), have their taxable incomes from 0 to $100,000, a linear formula of y = a + x/b is found to match tax rates from the Tax Rate Schedules and 12-page Tax Table. There is a check tool for tax rates within a narrow range of 10%-16.71%. Here 1/1,490,313 is a constant, which is the slope of y = a + x/b. Tax rates change linearly over taxable incomes from 0 to $100,000. The bottom tax rate is 0.1 or 10% (a).

Tax rate = 0.1 + TI/1,490,313 (tax rate range check: 0.1- 0.1671) ..... (1)

Example 1: When a Married filing jointly has a taxable income of $39,855.26, the tax rate formula is 0.1+TI/1,490,313 (for 2014) with the range check (10%-16.71%). Then 0.1+39,855.26/1,490,313=12.67% is the tax rate (tax is $5,056.84). When 2014 Tax Table (39,850-39,000) is used, the tax is $5,074 and tax rate is at 12.72%. Their tax rate difference is 0.05%, which is very minor. The item (39,850-39,000)/39,875 causes tax rate difference 0.13%.

Table 4 LG Tax System for Federal Individual Tax Return (2014)
(1) Married Filing Jointly or Widow(er), (2) Head of Household, (3) Single, and (4) Married Filing Separately

Filing Status	Taxable Income (TI) Over	Not over	Your TI	LG tax rate formula	Tax rate	Range check	Your Tax
1/1	0	100,000		0.1+ TI×F / 1,490,313		0.1-0.1671	
1/2	100,000	250,000		0.1228 + TI×F/2,255,639		0.1671-0.2336	
1/3	250,000	450,000		0.3346 - 25,256.3/TI×F		0.2336-0.2785	
1/4	450,000			0.396 - 52,875/TI×F		0.2785-0.396	
2/1	0	100,000		0.1 + TI×F / 1,062,699.3		0.1-0.1941	
2/2	100,000	250,000		0.1562 + TI×F/ 2,636,203.9		0.1941-0.251	
2/3	250,000	450,000		0.3383 - 21,881.3 / TI×F		0.251-0.2899	
2/4	450,000			0.396 - 47,745 / TI×F		0.2899-0.396	
3/1	0	75,000		0.1 + TI×F / 791,139.2		0.1-0.1948	
3/2	75,000	200,000		0.1621 + TI×F / 2,293,578		0.1948-0.2493	
3/3	200,000	400,000		0.3299 - 16,120 / TI×F		0.2493-0.2896	
3/4	400,000			0.396 - 42, 560 / TI×F		0.2896-0.396	
4/1	0	50,000		0.1 + TI×F / 745,156.5		0.1-0.1671	
4/2	50,000	125,000		0.1228 + TI×F/ 1,127,819.5		0.1671-0.2336	
4/3	125,000	225,000		0.3346 - 12,628 / TI×F		0.2336-0.2785	
4/4	225,000			0.396 - 26,437.5 / TI×F		0.2785-0.396	

When the simple LG tax rate formulas in the Table 4 are used to replace Tax Tables (12 pages), the filing status has been simplified and improved significantly. Their results are very compatible. Figure 1 shows tax rate differences between LG tax system and 2014 Tax Tables and Tax Computations. There are minor differences except low taxable incomes less than $1,000. From the existing Tax Table, tax rates at low taxable incomes from $5 to $1,000, tax rates are from 20% to 16%, and 11% respectively, which are not reasonable. The tax rates at low taxable incomes (< $1,000) should be close to 10%.

For different filing periods, employers may consider filing period factor (F) and government regulations and modify tax rate formulas. Table 5 shows different filing period factors. For tax simplification and reform, these constants (a, b, c and d) in the LG tax system (Tax rate= a + TI/b or c – d/TI) may be modified and adjusted for more efficient way. In y = a + x/b, tax rates (y) against taxable incomes (x) change smoothly with constant slope 1/b, which is not related to taxable income and is more reasonable. The equation of y = a + x/b is suggested to be used for all taxable income ranges except last taxable income range. In y = c - d/x, tax rate slope relates to taxable income and always changes at d/x2, which are used in the existing U.S. federal systems. For last taxable income range, y = c - d/x is suggested.

Table 5 LG Tax Rates for Federal and state Individuals on Different Filing Periods

D (daily)	W (weekly)	BW (bi-weekly)	SM (semi-month)	M (month)	Q (quater)	SY (semi-year)	Y (yearly)
365	52	26	24	12	4	2	1

When employers and employees (individuals) use the same LG tax system (Table 4) instead of the two tax systems (Tables 1, 2 and 3), both employers and individuals have the same standard and reference to be used for comparisons. Employers use the LG tax system (Table 4) to calculate withholding income taxes and transfer to governments. When employees provide accurate tax information such as filing status, exemption number, retirement, deduction and credit, withholding income taxes will be more accurate. Especially employees have simple tax situations with stable income, fixed retirement, standard deduction, and credit that are less than $100,000, accurate income taxes can be calculated by employers. These employees may have option to let the IRS and state governments to know they would not file tax returns because there is no difference between withholding income taxes and taxes in tax returns. Less tax return numbers can reduce work of governments to process during the tax season, which is helpful for governments to verify more tax returns and reduce potential tax evasions.

B. Tax refunds, timing and verification

Employers estimate income taxes according to different filing periods. Yearly tax withholding tax reports can be done and reported to the IRS and state governments by Jan 15 or 31. When employers withhold taxes, the following information such as name, SS number, filing status, exemption number, retirement, child credit and working hours are required. Then related taxes and tax rates are calculated and recorded. The tax withholding report for each employee can have tax information of name, social security number, filing status, exemption number, retirement, deduction, credit, taxable income, tax rate, tax and address. Taxpayer's filing status, exemption number, retirement, deduction, credit, gross income, taxable income, tax rate and tax could be used for detail comparison and verification, which can be done automatically, when to the IRS and state governments receive tax returns. Filing status, exemption number, deduction, credit and taxable income, tax rate and tax are not covered in Form W-2. Tax withholding reports improve Form W-2. If there is unmatched item or large difference such as taxable income difference more than $2,000 or tax rate difference more than 10%, tax refunds can be hold for further inspection, which reduce or avoid potential tax frauds.

From timing issue, the tax report summary can go to the IRS and state governments electronically by Jan 15 or Feb 15 with modifications. Some individuals, who meet certain conditions, such as gross income less than $100,000, interest/capital gain less than $2,000 and tax difference less than $200, may have option to not file tax returns. Some employees may modify their tax information through their employers electronically by Feb 10. Then the IRS and state governments have all employees' tax information of filing status, exemption number, retirement, deduction, credit, gross income, taxable income, tax rate and tax by Feb 15. Before receiving tax returns by April 15, the IRS and state governments already have tax information ready and enough time to verify tax returns for all employees. If employees change tax information (except deduction, retirement, credit and income) between their employers' reports and tax returns, their tax refunds may be postponed reasonably because of the significant changes, which need extra verifications. The LG tax system could help the IRS (and State governments) to reduce or avoid potential tax evasions.

Related computer programs to calculate taxable income, tax rate, and tax amount automatically have been developed for the LG federal individual tax system in 2012, 2013, 2014 and 2015 and some states with complex individual tax situations such as CA and HI. A tax filing status from the four statuses is selected. When gross income, exemption, retirement, deduction, credit and withholding income tax are inputted, the computer programs recognize the tax filing status, pick up related LG tax rate formula and calculate taxable income, tax rate, tax refund or tax due automatically. A tax rate range check is provided to check its tax rate calculation, which must be within the narrow tax rate range check to reduce calculation mistakes.

C. Tax return option on filing exemption from tax withholding reports

The total amount of resources needed to support the IRS activities for FY 2012 is about $13.6 billion, which is $1.5 billion more than the FY 2010 level of $12.1 billion. The IRS examined the collection cost was $4.7 billion in 2011(Greenberg, 2015). The simple linear and gradual (LG) tax system provides governments, employers, and individuals to calculate accurate taxes yearly, which may help many taxpayers with non-complex tax situations such as one income source, less than $100,000 income and unchangeable filing status and exemption number to match withholding income taxes with tax returns. So many taxpayers may have option to file no tax returns. Tax returns may be replaced by tax withholding reports. If 30% tax returns are reduced, billions of dollars can be saved, which also can reduce potential tax evasions.

Example 2: A mother as Head of Household with two dependents (under 17) has one-income source at $75,000 yearly. She claims standard deductions. Her employer deducts related tax payments (including withholding income tax) for every two weeks and that year. Her Standard Deductions in 2014 are $9,100 for Head of household and $3,950 for each personal exemption. Other deductions are various, such as retirement, health deduction and credit. Her retirement is $300 bi-weekly. Each child has tax credit $1,000. Tax data may be calculated by a computer software product automatically.

Taxable income (TI) = Income (I) - Standard Deductions (SD) - Exemption (E) - Other Deductions (OD) .... (2)

1) Gross Income (two weeks): 75,000/26 = 2,884.62

Taxable income = 75,000 – 9,100 – 3,950 × 3 – 300 × 26 = $46,250

TI (2 weeks) = 2,884.62 – (9,100 + 3,950 × 3)/26 – 300 = 1,778.85

Tax rate = 0.1 + TI/1,062,699.3 (2/1) = 0.1 + 46,250/1,062,699.3 = 14.35%..... (3)

Income tax (two weeks) = Tax rate x 1,778.85 – 1000 x 2 / 26 = $178.38

2) There is an additional payment with $2,500 (bonus or salary raise) in December:

Final tax rate=0.1 + TI/1,052,631.6 (2/1) = 0.1+ (46,250 + 2,500)/1,062,699.3 = 14.59% ..... (4)

Total income tax = Final tax rate × 48,750 – 2000 = $5,111.35 ..... (5)

Last income tax payment = 5,111.35 – 178.38 × 25 = $651.85 ..... (6)

The IRS may have her detail tax information records from her employer (tax withholding report) as Head of household with two children, one-income source $75,000 yearly, Standard Deduction $9,100, 3 exemptions, retirement $7,800, child credit $2,000, taxable income $48,750 and total withholding income taxes $5,111.35 at yearly tax rate of 14.59% from her employer's tax summary reported by Jan 15 or 31. She may have an option to not file tax return if she has her total interest and capital gain less than such as $2,000.

Example 3: When a man, who files as married couple with two children, works and lives in California and has a one-source annual based income of $95,000 from his company. His employer may use our tax software product to deduct related withholding taxes and credits on a bi-weekly and yearly basis. His federal standard deductions are $12,400 for Married Filing Jointly and $3,950 for each personal exemption. He has state standard deductions of $7,812 and exemption credit of $212 for Married Filing Jointly and dependent exemption credit of $326. He has one child credit for federal tax return. His retirement is at $146.15 biweekly and medical insurance is at $153.85 biweekly.

His employer calculates his initial federal income tax rate is at 13.96% and income tax (bi-weeks) is $278.30. His withholding taxes (bi-weeks), including withholding income tax, Social Security and Medicare from both employee and his employer, are $837.34 for the federal government. His initial California income tax rate is at 3.13% and income tax (bi-weeks) is $53.59 to his state. His biweekly payroll is $3,042.44. By the end of the year, if he receives a bonus of $4,500, which needs to be adjusted, his yearly overall federal income tax rate is at 14.26%, which is slightly increased from 13.96%. His total withholding taxes, which include total income withholding tax, social security and Medicare from both employee and his employer, are $23,279.14 to the federal government. His total federal income tax is $8,055.64. His yearly overall California income tax rate is at 3.24% %, which is slightly increased from 3.13%. His total state taxes are $1,590.73 to the State of California. His last biweekly payroll is $6,180.84 in the December. His yearly total federal taxable income is $63,500. His yearly total payroll is $82,241.88. These calculated numbers are shown by the tax software automatically.

The IRS may have his tax records from his employer's tax withholding report of Married Filing Jointly with two dependents, one-income source $95,000 yearly, Standard Deduction $12,400, retirement $3799.90 and total federal withholding income taxes of $8,055.64 at 14.26% and state income taxes of $1,590.73 at 3.24%. The State of California may have his state tax records of $1,590.73 at 3.24% besides his tax filing status, exemption, deduction, retirement and taxable income. If the family has no other income except from their bank saving interest of $225.87, which may be not considered as

a major taxable income or use the above federal and state deductions and tax credits, the family has income taxes the same as $8,055.64 and $1,590.73 respectively for the family to file the federal and state tax returns. The family may have an option to file no the federal and state tax returns if total interest and capital gain is less than such as $2,000.

If he reports the above bank saving interest of $225.87 to his employer or the IRS and adds it as his income, the family needs to pay total federal income tax of $8,097.51 with the difference of $41.87 and total state tax of $1,600.82 with the difference of $10.09, which is shown by the tax software product automatically. Total extra federal and state taxes are $51.96 (= $41.87+$10.09). It is not worth to file their federal and state tax returns by paying an extra $41.87 to the federal government and $10.09 to his state government, which involve more tax processing costs and time to the governments. This case has been discussed in 2015 AEF Conference (Kao and Lee, 2015). If bank interest and investment capital gain are less than $2,000 and federal tax difference less than $200 between income withholding tax and calculated tax in the federal tax return, it may be suggested to offer these taxpayers to have an option to file no federal tax returns, which reduce tax return numbers for saving tax processing time and costs, and eventually reducing potential tax invasions.

Conclusion

The three major reasons to cause potential tax evasions or noncompliance are discussed in the paper. The IRS and many state governments make two tax systems for employers and individuals separately. Tax Schedules are used to estimate withholding income taxes. Tax Tables and Tax Computations are used for individuals to calculate their tax returns. The two tax systems are not connected with each other. Employers and individuals have different standards or references, and two tax systems may have no similar tax rates. Timing is also a problem to process so many tax returns during the tax season. Detail tax information, such as tax filing status, exemption, deductions, taxable income, overall tax rate and tax amounts, is not known by the IRS (and state governments) before receiving tax returns by April 15. When receiving tax returns from individuals, the IRS and state governments have no detail tax information as references to compare and verify these tax returns, which may give a chance of fraud for a possible tax evasion.

The current two federal individual tax systems with Tax Schedules and Tax Tables/Tax Computations have been recognized and combined together. Then governments, employers, and individuals can use the same LG tax system as standard and common reference. Employers can provide tax withholding reports with detail tax information, such as tax filing status, exemption, deductions, taxable income, tax rate and tax, which is not covered in W-2 Form by March 15, to the IRS and state governments by Jan 31. Before receiving tax returns by April 15, the IRS and state governments already have tax information and enough time to verify tax returns for all employees, which could help the IRS and state governments to reduce or avoid potential tax fraud.

The supporting computer programs to calculate taxable income, tax rate and tax automatically have been developed according to tax filing status, gross income, exemption, retirement, deduction, credit, and withholding income tax. The computer programs recognize the tax filing status, pick up related LG tax rate formula, and calculate taxable income, tax rate, tax refund or tax due automatically.

There are about 138 million tax returns per year. The average cost of estimated average taxpayer burden for individuals is about $210 by the IRS. If 20% of tax returns are exempted from filing out of total filings, the substantial amount of $5.8 billion can be saved. Significant time and costs could be reduced for the IRS and state governments. When tax return numbers are reduced, potential tax evasions or tax noncompliance could also be reduced.

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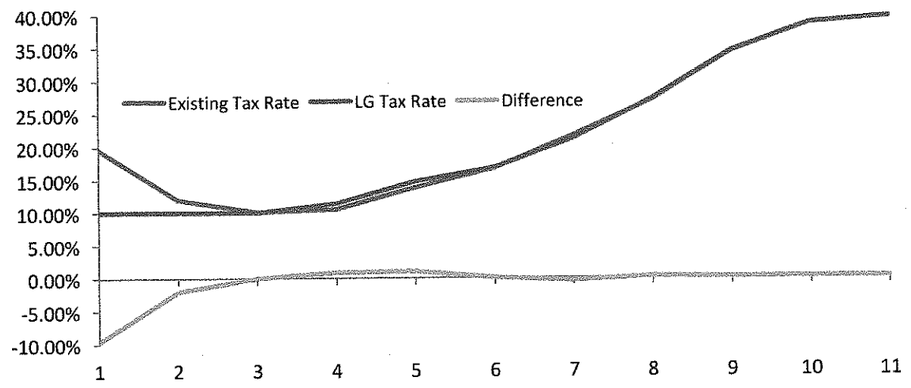
Figure 1 Existing Federal Individual Tax System and LG Tax System



(Taxable income: 1=$5.1, 2=$50.1, 3=$1,001, 4=$20,000, 5=$70,000, 6=$100,000, 7=$200,000, 8=$400,000, 9=$1,000,000, 10=$5,000,000, 11=$10,000,000.)

Automatic Tax Calculations for 2014 and 2015 Federal Individual Tax Returns by LG Tax System

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Abstract

In our existing federal tax system for individuals, there are 7 tax brackets, which are 10%, 15%, 25%, 28%, 33%, 35%, and 39.6. When taxable income is to be determined, taxpayers use a resource provided by the government: tax tables. Tax tables are used for individuals to search, and find their taxes. Unfortunately, for taxable incomes below $100,000, tax tables contain about 10,832 numbers and 12 pages. This research paper is based on the Linear Gradual (LG) tax system to simplify federal individual tax systems in 2014, and 2015 into a computer program that calculates tax rate and tax automatically.

Introduction

Marginal or flat tax systems are used in the U.S. and many other countries. The 2014 and 2015 U.S. federal individual tax system has 7 tax brackets at 10%, 15%, 25%, 28%, 33%, 35%, and 39.6%. Marginal tax systems require multiple tax brackets for smooth tax rate changes. A marginal tax rate is a percent tax rate, which is a flat tax rate, during a tax bracket. A flat tax rate is too simple, which cannot cover different taxable incomes reasonable and simply. The existing federal individual tax system has two tax systems. One is Tax Rate Schedules, which is for employers to estimate withholding taxes. Another is Tax Table and Tax Computation Worksheets, which are for employees to calculate exact taxes for filing tax returns. Tax Tables have their downsides, so not only do the numbers within the tables not have any relationship with each other, and seem rather random, tax tables span 12 pages, and the taxable income ranges and tax computations change yearly. To combat these issues, the new linear and gradual (LG) tax system has been developed with the publications in The Academy of Economics and Finance Journal and Journal of Business and Economics for 2010 – 2013 tax returns by Robert Kao and John Lee. Kao and Lee developed the LG tax system to simplify the current U.S. Individual income taxation to eliminate the current complex tax tables (12 pages) and tax rate schedules without tax estimation and provide accurate tax rate and tax calculations (Kao and Lee). The LG tax system utilizes computer software to quickly, and accurately calculate taxes automatically. This paper proposes the 2015 LG tax system which combines the existing Tax Rate Schedules, Tax Tables, and Tax Computations together for employers and employees, and incorporates it into a computer program. According to the Tax Foundation, 90% of tax returns have an AGI less than $127,695 and 75% of tax returns have an AGI less than $74,955, so it's safe to assume that at least ~75% of taxpayers use tax tables.

Implications

Automatic Calculation for 2015 Tax Returns

The 2015 Federal Tax Calculator is split up into three different parts. First, is the selection of ones' filing status: Single, Head of Household, Married Filing Jointly, or Married Filing Separately. The second part is to deduct all the related items from the yearly total gross income. The third part is tax credits and tax withholding which are then used appropriately during calculation. When all the related data is inputted and the calculate button is clicked, the filling status, taxable income, yearly tax, and tax owed or refund is displayed in a separate window. 2015 federal standard deductions are $12,600 for Married Filing Jointly, $9,250 for Head of Household, $6,300 for Single or Married Filing Separately, and $4,000 for each personal exemption. Child credit (children less than 17 years old) is $1,000. Since states have different tax situations and regulations, tax calculators for Kansas, Missouri, Hawaii, and California have also been created.

Example 1 (Federal Single): A single man has a wage of $65,000 in 2015. His tax situation is rather simple with a standard deduction of $6,300, exemption of $4,000, IRA of $2,000 and no tax credit. His employer has already paid $6,450 of federal income tax withholding through his payroll to the federal government. After running the 2015 federal tax calculator, his 2015 federal taxable income is $52,700.00 and federal tax is $6472.01 with a tax of $22.01 owed to the government.

Example 2 (Federal Married Filing Jointly): A married couple has a wage of $98,500 in 2015. Their tax situations are rather complicated with an itemized deduction of $15,500.55, exemptions of $12,000 ($4,000 each), an IRA of $9,000, other deduction of $1,000 and tax credit of $2,000 ($1,000 for each child). His employer has already paid $8,988.94 of federal income tax withholding through his payroll to the federal government. After running the 2015 federal tax calculator, their 2015 federal taxable income is $60,999.45 and federal tax is $6,552.04 ($8552.04 - $2,000) with a tax refund of $2,436.90.

Example 3 (Kansas Single): The same single man from Example 1 has a wage of $65,000 in 2015. His federal adjustable income (AGI) is $63,000. His state standard deduction is $3,000 ($7,500 for Married Filing Jointly, $5,500 for Head of Household and $3,750 for Married Filing Separately), personal exemption of $2,250 and other deductions of $0. His employer has already paid $2,350.25 of his state income tax withholding through his payroll to the Kansas government. After running the 2015 Kansas tax calculator, his 2015 state taxable income is $57,750.00 and state income tax is $2,371.50 with $21.25 owed to the Kansas government.

Example 4 (California Married Filing Jointly): When the married couple from Example 2 has a California taxable income of $60,000 in 2015, after running the California tax calculator, their state income tax is $1,662.00.

Table 1: 2015 Federal Tax Calculator

Select Filing Status

O Single O Married Filing Jointly

O Head of Household O Married Filing Separately

Yearly total gross income: _____

Yearly itemized or standard deductions: _____

Yearly exemptions: _____

Yearly IRA deduction: _____

Other deduction: _____

Total tax credits: _____

Federal tax withholding: _____

Calculate

Existing 2014 and 2015 Federal Individual Tax Systems

There are currently two types of tax systems. One system is the 2015 Tax Rate Schedules, which is available in December 2014, and are used for employers to estimate their employees' withholding income taxes and transfer the related taxes to the federal Internal Revenue Service in terms such as monthly, quarterly, or annually. Another tax system is the 2014 Tax Tables and Tax Computations, which are used for employees to calculate accurate income taxes when filing their tax returns. Typically, the 2015 Tax Tables and Tax Computations will be available in January or February of 2016.

Table 2 shows 2014 and 2015 tax rate schedules for Married Filing Jointly. There are very minor changes between 2014 and 2015, which slightly affect income taxes. For example, the tax rate at the 15% tax bracket in 2014 has a range of $18,150 - $73,800, while in 2015, the 15% tax bracket has a range of $18,450 - $74,900 with a $300 difference. It can also be seen that in the 39.6% tax bracket in 2014, the range is above $457,600, while in 2015, the 39.6% tax bracket range is above $464,850 with a difference of $7,250. Also, their related tax formulas change, for example, 1,815+15% (TI-18,150) in 2014 to 1,845+15% (TI-18,450) in 2015. At the taxable income of $100,000, their tax rates are changed from 16.7% ((10,162.50+25% (100,000-73,800))/100,000) in 2014 to 16.6% ((10,312.5+25% (100,000-74,900))/100,000) in 2015. The difference between the two tax

rates is only at 0.1% (16.7% - 16.6%) which is very minor and causes the tax system to be changed from 2014 to 2015. These changes increase tax processing costs and time for government, individuals and businesses. Table 3 shows 2015 Tax Rate Schedules for all four tax filing statuses.

Table 2: Federal Individual Tax Rate Schedules (2014 and 2015) for Tax Estimation (Partial)

Taxable income (TI) Over	Not over	2014 Tax is	Taxable income (TI) Over	Not over	2015 Tax is
Schedule Y 1 - Married Filing Jointly or Qualifying Widow(er)					
0	18,150	10%	0	18,450	10%
18,150	73,800	$1,815 + 15% x (TI - 18,150)	18,450	74,900	$1,845 + 15% x (TI - 18,450)
73,800	148,850	$10,162.50 + 25% x (TI - 73,800)	74,900	151,200	$10,312.5 + 25% x (TI - 74,900)
148,850	226,850	$28,925 + 28% x (TI - 148,850)	151,200	230,450	$29,387.5+28% x (TI - 151,200)
226,850	405,100	$50,765 + 33% x (TI - 226,850)	230,450	411,500	$51,577.5 + 33% x (TI - 230,450)
405,100	457,600	$109,587.5 + 35% x (TI - 405,100)	411,500	464,850	$111,324 + 35% x (TI - 411,500)
457,600		$127,962.5+39.6% x (TI - 457,600)	464,850		$129,996.5+39.6% x (TI - 464,850)

Table 3: Federal Individual Tax Rate Schedules (2015) for Income Tax Estimation

Taxable income (TI) Over	Not over	Tax is	The Amount is over	Tax Computation
Schedule Y 1 - Married Filing Jointly or Qualifying Widow(er)				
0	18,450	10%	0	0.1 x TI
18,450	74,900	$1,845 + 15%	$18,450	1,845 + 0.15 x (TI - 18,450)
74,900	151,200	$10,312.50 + 25%	74,900	10,312.50 + 0.25 x (TI - 74,900)
151,200	230,450	* $29,387.50 + 28%	151,200	29,387.50 + 0.28 x (TI -151,200)
230,450	411,500	$51,577.50 + 33%	230,450	51,577.50 + 0.33 x (TI - 230,450)
411,500	464,850	$111,324.00 + 35%	411,500	111,324.00 + 0.35 x (TI-411,500)
464,850		* $129,996.50 + 39.6%	464,850	129,996.50 + 0.396 x (TI-464,850)
Schedule Z - Head of Household				
0	13,150	10%	0	0.1 x TI
13,150	50,200	$1,315.00 + 15%	$13,150	13,150 + 0.15 x (TI - 13,150)
50,200	129,600	$6,872.50 + 25%	50,200	6,872.5 + 0.25 x (TI - 50,200)
129,600	209,850	$26,722.5 + 28%	129,600	26,722.5+0.28 x (TI - 129,600)
209,850	411,500	$49,192.5+33%	209,850	49,192.5 + 0.33 x (TI - 209,850)
411,500	439,000	$115,737 + 35%	411,500	115,737 + 0.35 x (TI - 411,500)
439,000		$125,362 + 39.6%	439,000	125.362 + 0.396 x (TI - 439,000)
Schedule X – Single				
0	9,225	10%	0	0.1 x TI
9,225	37,450	$922.50 + 15%	$9,225	892.50+ 0.15 x (TI - 9,225)
37,450	90,750	$5,156.25 + 25%	37,450	4,991.25 + 0.25 x (TI - 37,450)
90,750	189,300	$18,481.25 + 28%	90,750	17,891.25 + 0.28 x (TI - 90,750)
189,300	411,500	$46,075.25 + 33%	189,300	44,603.25 + 0.33 x (TI - 189,300)
411,500	413,200	$119,401.25 + 35%	411,500	115,586.25 + 0.35 x (TI - 411,500)
413,200		$119,996.25 + 39.6%	413,200	116,163.75 + 0.396 x (TI-413,200)
Schedule Y 2 - Married Filing Separately				
0	9,225	10%	0	0.1 x TI
9,225	37,450	$922.50 + 15%	$9,225	922.50 + 0.15 x (TI - 9,225)
37,450	75,600	$5,156.25 + 25%	37,450	5,156.25 + 0.25 x (TI - 37,450)
75,600	115,225	$14,693.75 + 28%	75,600	14,693.75 + 0.28 x (TI - 75,600)
115,225	205,750	$25,788.75 + 33%	115,225	25,788.75 + 0.33 x (TI - 115,225)
205,750	232,425	$55,662.00 + 35%	205,750	55,662.00 + 0.35 x (TI - 205,750)
232,425		$64.998.25 + 39.6%	232,425	64.998.25 + 0.396 x (TI - 232,425)

Table 4 below, shows a partial of the 2014 Tax Tables because the 2014 Tax Tables has 12 pages, which is very long. 2010 – 2013 Tax Tables also have 12 pages respectively. When a computer program is designed to search, treat, and calculate tax data from Tax Tables, complicated codes and space are not seen or used by the user making it much easier, ultimately saving time and costs. Tax Computations for Married Filing Jointly in the years 2014 and 2015 are shown in Table 5. As seen, the differences between the taxable income ranges and tax formulas are minor.

Table 4: 2015 Federal Tax Table for Married Filing Jointly or Qualifying Widow(er) (12 pages)

Taxable income (TI)	*Tax is*	*Taxable income (TI)*	*Tax is*	*Taxable income (TI)*	*Tax is*
0 – 5	0	48,000 – 48,050	6,281	.....	.....
.....		48,050 – 48,100	6,289	93,000-93,050	14,844
2,000-2,025	201	.....	.....	93,050-93,100	14,856
2,025-2,050	204	56,900 –56,950	7,616	.....	.....
.....		56,950 –57,000	7,624	99,950-100,000	16,581

Table 5: Tax Computations for Married Filing Jointly or Qualifying Widow(er)

Taxable income (TI)		*2014 Tax*	*Taxable income (TI)*		*2015 Tax*
Over	*Not over*		*Over*	*Not over*	*(Tax Rate Schedules)*
0	100,000	Tax Table (12 pages)	0	100,000	Tax Table (12 pages)
100,000	148,850	0.25×TI – 8,287.5	100,000	151,200	0.25×TI-8,412.5
148,850	226,850	0.28×TI – 12,753	151,200	230,450	0.28×TI-12,948.5
226,850	405,100	0.33×TI - 24,095.5	230,450	411,500	0.33×TI-24, 471
405,100	457,600	0.35×TI - 32,197.5	411,500	464,850	0.35×TI-32,701
457,600		0.396×TI - 53,247	464,850		0.396×TI-54,084

The two existing federal tax systems of Tax Rate Schedules and Tax Tables/Tax Computation have very similar tax rates but different taxable income ranges and tax formulas making our existing federal individual tax systems very complex. Both employers and employees use different tax systems to estimate withholding income taxes or calculate accurate taxes when filling tax returns even with similar tax rates. The two existing federal tax systems require every taxpayer to file tax returns whether their income is low or high.

2015 LG Tax System and Comparison with 2014

The two current federal tax systems are Tax Rate Schedules, which are used by employers to estimate withholding income taxes, and Tax Table/Tax Computations, which are used by employees to calculate accurate income taxes when filing their tax returns, with minor changeable taxable income (TI) ranges and tax rate formulas, can be combined into one simple tax system together with fixed taxable income (TI) ranges and simple tax rate formulas. The 2015 LG Tax System is shown in Table 6 below. With a 43% reduction, the 7 tax brackets in the existing two-tax system are reduced to 4. Also, the existing taxable income ranges are simplified into uncomplicated numbers such as 0 – 100,000, 100,000 – 250,000, 250,000 – 450,000 and over 450,000. F is for the filing period factor, which is 52, 26, 24, 13, 12, 4 or 1 based on weekly, bi-weekly, semi-monthly, monthly, quarterly or annually basis, which is used for employers to calculate withholding income taxes. The simple 2015 LG one-tax system can be used by both employers and employees to calculate accurate income taxes with accurate tax information.

For Married Filing Jointly or Qualifying Widow(er) with taxable incomes are from 0 to $100,000, a linear formula of y = a + x/b is found to match tax rates from the Tax Rate Schedules and 12-page Tax Tables. There also contains a check tool for checking tax rates within a narrow range. Here, 1/b is a constant, or slope of y = a + x/b. Tax rates change linearly over taxable incomes from 0 to $100,000. The bottom tax rate is 0.1 or 10%. For 2015: Tax rate = 0.1 + TI/1,515,151 (tax rate range check: 0.1- 0.166). For 2014: Tax rate = 0.1 + TI/1,490,313 (tax rate range check: 0.1- 0.167).

Example 5: When a married filing jointly has a taxable income of $39,875.85, their 2015 tax rate is 0.1 + TI/1,515,151.5 with a range check of 10% - 16.6%; 0.1 + 39,875.85/1,515,151.5 = 12.63% (Tax rate of 12.63%, so tax is $5037). Their 2014 tax rate would be 0.1 + TI/1,490,313 with a range check of 10% - 16.7%; 0.1 + 39,875.85/1,490,313 = 12.68% (Tax rate of 12.68%, so tax is $5056). When the 2014 Tax Table (39,850 – 39,000) is used, the tax is $5074 and the tax rate is at 12.72%. The tax rate difference in 2014 is 0.04% (12.72% – 12.68%) between the calculated LG results and the tax table results.

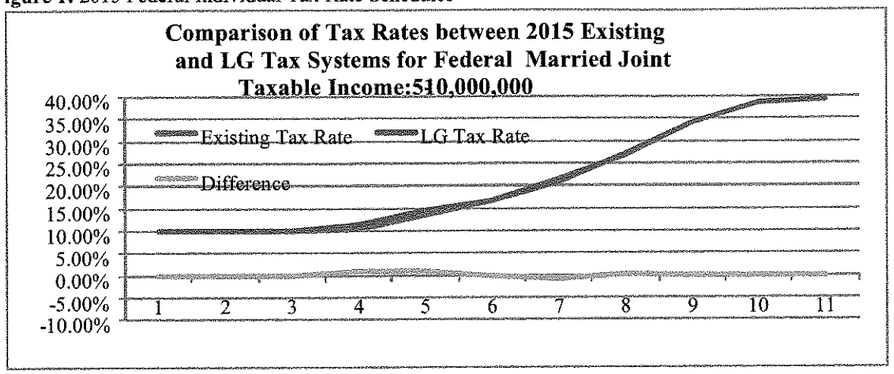
The 2014 LG Tax System for the federal individual tax system for both employers and employees to calculate accurate income taxes can be figured out the same way as the 2015 LG Tax System for federal individual tax system. Either a + x/b or c – d/x can be used. In y = a + x/b, tax rates (y) against taxable incomes (x) change smoothly with a constant slope of 1/b, which is more reasonable and not related to the taxable income. y = a + x/b is suggested to be used for all taxable income ranges except the last taxable income range. In y = c – d/x, the tax rate slope relates to taxable income and always changes at d/x*x, which is used in the existing federal systems in the United States and many other countries. The tax rate slope changes significantly for low taxable incomes rather than high taxable incomes, which is unreasonable.

Table 6: LG Tax System for Federal Individual Tax Return (2015)
(1) Married Filing Jointly or widow(er), (2) Head of Household, (3) Single, and (4) Married Filing Separately

Filing Status	Taxable Income (TI) Over	Not over	Your TI	LG tax rate formula	Tax rate	Range check	Your Tax
1/1	0	100,000		0.1 + TI*F / 1,515,151.5	0.1-0.166		
1/2	100,000	250,000		0.122+TI*F/2,272,727.3	0.166-0.232		
1/3	250,000	450,000		0.176+TI*F/4,444,444.4 or 0.3338-25,425/TI*F	0.232-0.277		
1/4	450,000			0.396 - 53,550/TI*F	0.277-0.396		
2/1	0	100,000		0.1+TI*F/1,075,269	0.1-0.193		
2/2	100,000	250,000		0.155+TI/2,631,579	0.193-0.250		
2/3	250,000	450,000		0.2025+TI/5,263,158 or 0.3364-21,656.3/TI*F	0.250-0.288		
2/4	450,000			0.396 - 48,600 / TI*F	0.288-0.396		
3/1	0	75,000		0.1+TI*F/797,872.3	0.1-0.194		
3/2	75,000	200,000		0.1616+TI*F/2,314,815	0.194-0.248		
3/3	200,000	400,000		0.207+TI*F/4,878,049 or 0.33-16,400/TI	0.248-0.289		
3/4	400,000			0.396-42, 800 / TI*F	0.289-0.396		
4/1	0	50,000		0.1 + TI*F / 757,575.8	0.1-0.166		
4/2	50,000	125,000		0.122+TI/1,136,363.6	0.166-0.232		
4/3	125,000	225,000		0.176+TI/2,222,222.2 0.3338-12,712.5/TI	0.232-0.277		
4/4	225,000			0.396-26,775/TI	0.277-0.396		

When the simple LG tax rate formulas in Table 6 are used to replace Tax Tables (12 pages), tax computations, tax rate schedules, tax data, and the overall tax system will be simplified and improved significantly with very similar and compatible results. Figure 1 shows the tax rate differences between the LG tax system and the 2015 Tax Rate Schedules with barely any difference.

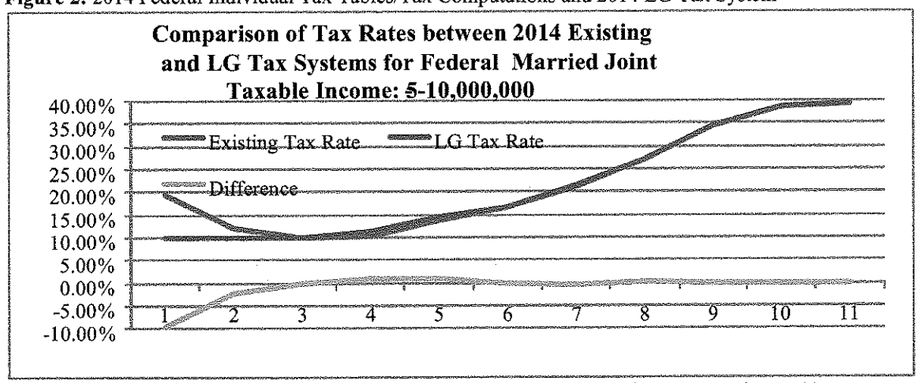
Figure 1: 2015 Federal Individual Tax Rate Schedules



(Taxable income: 1=$5.1, 2=$50.1, 3=$1,001, 4=$20,000, 5=$70,000, 6=$100,000, 7=$200,000, 8=$400,000, 9=$1,000,000, 10=$5,000,000, 11=$10,000,000.)

Figure 2 shows the tax rate differences between the LG tax system and the 2014 Tax Tables and Tax Computations, in which there are minor differences except low taxable incomes less than $1,000. From the existing tax table, tax rates at low taxable incomes from $5 to $1,000 are started from 20% and reduced to 16%, 12%, and 10% respectively, which are not reasonable and relate to one of the disadvantages of the existing tax tables. Tax rates at low taxable incomes (< $1,000) should be close to ~10%. When taxable incomes increase, tax rates should be increased linearly or gradually.

Figure 2: 2014 Federal Individual Tax Tables/Tax Computations and 2014 LG Tax System



(Taxable income: 1=$5.1, 2=$50.1, 3=$1,001, 4=$20,000, 5=$70,000, 6=$100,000, 7=$200,000, 8=$400,000, 9=$1,000,000, 10=$5,000,000, 11=$10,000,000.)

Conclusion

Our current tax system is overly complex, and this paper explains how to make it much easier with the use of the new LG tax system and computer software. Our existing federal tax system for individual has 7 tax brackets, which are 10%, 15%, 25%, 28%, 33%, 35%, and 39.6% for the four filing statuses: Married Filing Jointly or Qualifying Widow(er), Head of Household, Single and Married Filing Separately. With the new LG tax system, we're able to reduce the current 7 tax brackets, down to 4 tax brackets with a 43% reduction. Not just that, but we're able to convert the complex ranges in our current tax system such as 148,850 – 226,850 and 226,850 – 405,100 to simpler ranges such as 100,000 – 250,000 and 250,000 – 450,000. We're also able to completely eliminate the use of a tax table which has many downsides, besides the random tax ranges, like the numbers

being random and not having any relationship with each other, having taxable income ranges and tax computations change on a yearly basis, and the fact that the tax table spans a total of 12 pages. Through the tax simplification of the new LG tax system, and the use of computer software to calculate tax data accurately and automatically, our current tax system is able to be changed significantly while also saving the government, employers, and taxpayers a substantial amount of time, effort, and money.

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Do Good Students Have Better Credit Scores?

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Abstract

In this study, we compare students' credit scores with their GPA to investigate whether good students have significantly higher credit scores than do 'poor students'. We find that GPA demonstrates a statistically significant, positive relationship in our regression model predicting the student's credit score. The study also looks at whether students with high levels of self-assessed financial skills have significantly higher credit scores than those that report lower levels of self-assessed financial skills. We find that the self-assessed financial skills does not have a significant relationship in our regression model predicting the student's credit score.

Background and Literature Review

The credit score is becoming an increasingly more popular device for decision making. While most people are familiar with their use as to make lending decisions, fewer are aware that the credit score is also used for employment screening and as an insurance rating device. Not only do financial institutions use credit scores for granting and pricing credit and loans, other companies are using credit scores to set pricing on insurance policies, cell phone contracts, utility services and even to make employment decisions (Kim, 2007).

For some time, auto insurers have been using credit scores rather than driving record to calculate insurance policy rates. Since 'good students' have historically been given a discounted price on their coverage, an empirical question arises: Do 'good students' have better credit scores?

The credit scores of students in general should not be high. The five key variables utilized by Fair, Isaac's credit scoring model are total credit balances, length of credit history, number of recent applications, payment history and types of credit utilized, Noam (2002), p 41. Since students are generally in their early 20's, they have only been legally able to contract for a short period of time; hence the length of their credit history is short. Nevertheless, on many campuses, students are bombarded with offers for credit, increasing the likelihood that they will have several recent credit applications.

The benefits of credit scoring models allegedly include better decision making, compliance with fair lending requirements, designed consistency of decisions, the ability to quantify various credit and liability risk variables, thus allowing changes in hurdle rates to either increase or decrease approval rates, and also aid monitoring, among others. Credit scoring models allow for the possibility of faster, automated decisions as well as the centralization and specialization of loan officers and underwriters to make exceptions to the model's decisions. Some proponents of lending models hold the hope of reducing the need and expense of ordering credit reports and employing loan officers at every branch office. At the extreme, credit scoring models allow for a data entry operator to enter the loan specifics and quickly return consistent and quantifiable loan decisions. "It is claimed that their use reduces bad debt loses, that more consumers are granted credit, and that organizational consistency in decision making is achieved. Further, the costs of granting credit are reduced since less skilled personnel are required and fewer credit reports need be purchased," Capon (1982) p 85. In 1995 motor vehicle reports cost up to $11 each, while Fair, Isaac's ASSIST reports cost on $2 to $3, Haggerty (1995) p5.

A number of papers in the credit scoring literature explain the legislative history, benefits and weaknesses of credit scoring and judgmental analysis and also the basic process of developing a credit scoring mode. Included in this literature are Chandler and Coffman (1979), Chandler (1985), *Yale Law Review* (1979, Hsia (1978), Capon (1982), Mazier (2002), and Kelly (2002).

Chandler and Coffman (1979) begin with an overview of the size of the consumer credit market. They note that consumer credit in 1978 was over $1100 billion, while for comparison, the gross amount of federal government debt was $780 billion. They proceed to explain the impact of the Equal Credit Opportunity act (ECOA) and Regulation B's prohibition on the use of sex, marital status, age, receipt of income from public assistance as well as the borrower's exercise of the rights assured under the consumer credit protection act. The paper then lists and explains ten major differences between empirical and judgmental credit evaluation methods.

Many of the differences between judgmental and empirical credit evaluation methods enumerated by Chandler and Coffman include the use of a different information base. Judgmental analysis focuses on the individual borrower, and empirical methods identify differences between "good" and "bad" borrowers. The second theme of the differences focus on the consistency of the empirical method, allowing for identical treatment of applicants, the improved ability to forecast results and the empirical method's ability to make small changes in credit risk easy to implement and monitor.

Coffman and Chandler conclude:

> "...on the whole, the empirical evaluation process has no serious deficiencies not also shared by judgmental evaluation. It also appears that empirical evaluation of creditworthiness has certain advantages that do

not exist with judgmental evaluation. On the other hand, judgmental evaluation may have an advantage in dealing with individual cases that are truly exceptions from past experience. Thus, there may be room for both empirical evaluation and the exercise of good credit judgment within the same credit granting system" p 26.

Hsia (1978) and the *Yale Law Journal* (1979) both provide excellent descriptions of the process of developing credit scoring models and the legislative history of the federal regulation that encouraged their development. Their target audience is the legal community, however, and the *Yale Law Journal* spends a considerable number of pages relating the similarities of the ECOA with the Equal Employment Opportunity Act. As with other articles discussed in this section, a list of strengths and weaknesses is presented. Among these are that credit scoring models are allowed to use age as a basis of differentiating applicants. "Any empirically derived credit system which considers age if such system is demonstrably and statistically sound in accordance with regulations of the [Federal Reserve] Board, except that in the operation of such system the age of an elderly applicant may not be assigned a negative factor or value," Hsia (1978) p 378.

The other advantages listed by these articles are similar to the ones reported by Chandler and Coffman (1979). These include low operating cost of the credit scoring system, consistency of decision making, and the ability of credit scoring models of "providing the exact probability of repayment associated with a particular score," Hsia (1978) p 379. A final advantage is that "the creditor understands both the individual score and the scoring system and controls all aspects of their use, whereas the credit report emanates from a credit bureau whose operations are beyond control of the creditor," Hsia (1978) p 381.

Chandler (1985) is directed at credit unions and in addition to extolling the virtues of credit scoring also provides four limitations of their use for credit unions. Among the benefits is that "many users of credit scoring systems experience reduction credit bureau expenses by 20% to 40%," p 10. Among the limitations he provides are that the statistical process of establishing a credit scoring model require a large sample of both "good" and "bad" loans, and some small credit unions may not have a large enough loan portfolio. In addition, he notes that credit scoring models are expensive in both time and money and have lives generally, from three to seven years. A final limitation is that credit applicants in unusual circumstances may not be fairly evaluated by the credit scoring model.

Chandler (1985) provides one limiting warning of credit scoring models not noted in other articles. "It is very important that the details of the credit scoring system not become public knowledge. If that occurs, your credit union could be exposed to extensive fraud," p 12.

Capone's Table 2 lists some factors used to develop credit scoring systems that he claims violate the spirit of the ECOA. These include ownership of life insurance, width of the product being purchased, the first letter of the last name, age difference between man and wife, age of automobile, make and model of automobile and the location of relatives.

Capone also lists seven "real questions as to whether credit scoring systems satisfy the legal requirements of empirical derivation and statistical soundness," p 87. These include bias. "...It has been shown that not only are biased estimates obtained, it is not possible to estimate in which direction the bias lies," p 87. He recognizes that model developers will attempt to correct for any statistical bias, but "as Shinkel (1977) has shown, biased estimates are still obtained with these and alternative procedures," p 87.

The model builder's use of judgement in the specific groupings of variables is the subject of two criticisms. The creation of discrete histograms results in large changes in the applicant's score. "An applicant with a residency of seven years and five months scores 30 points and one month later scores 39 points...," p 89. The aggregation of individual variables in a non-empirical and arbitrary manner is a related complaint. "Thus, for example, a sales manager could be assigned as executive (62 points), manager (46 points) office staff (46 points), professional (62 points) of sales (46 points), "p 88.

Using credit payment information to calculate the ability or willingness to repay a loan may certainly be logical. Clearly, the history of credit scoring model creation indicates that the process was not a smooth one. Using the same information to rate insurance, however may be more problematic. It is possible, however, that the two measures are indications of the same traits. The analysis that follows measures the degree that GPA and Credit Scores are related.

Procedure and Methodology

The researchers set out to examine the impact that being a 'good' student would have on the credit score. This study describes the relationship between grade point average (GPA), self-assessed financial skills, number of credit cards owned, amount of credit card debt, previous requests for credit scores, and age on credit score.

Research question one is: Do 'good' students, as measured by high GPAs, have better credit scores?

The research hypothesis for research question number one is: 'Good' students, as measured by higher GPAs, will have a significant, positive relationship with the student's credit score.

The second research question is: Do students with a higher level of self-assessed financial skills have higher credit scores?

The research hypothesis for research question number two is: Students' reported levels of financial skills will have a significant, positive relationship with the student's credit score.

Since this study is looking at academic performance and its impact on credit scores, the population for this study is college students in the United States. Participants were recruited at a mid-sized Southwestern United States university after the researchers had received approval from the university's Institutional Review Board (IRB) to conduct the study.

The data in this study was collected through the use of a survey instrument. The survey questions related to the respondents' credit score, financial skills, grade point average (GPA), and demographics. The questions (available from the authors upon request) included five-point Likert scaled questions, categorical response questions, and fill-in the blank questions. The participants were provided a large envelope containing a financial questionnaire, an informed consent form, and instructions on how to obtain a copy of their Equifax credit score. Since Equifax charges consumers to obtain a copy of their credit score, the study participants were reimbursed the cost of the obtaining the credit score using a research grant awarded to the researchers. Two-hundred (200) participants completed and returned the survey instruments. Details on the respondents' demographics are provided in the Table 1 below.

Table 1: Respondents' Demographics

Gender:					
Male:		Female:		No Answer:	
95 (47.5%)		102 (51%)		3 (1.5%)	
Average Age (in years): 24.92					
Ethnicity:					
African-American:	Asian:	Hispanic/Latino:	White/Caucasian:	Other:	No Answer:
9 (4.5%)	20 (10%)	73 (36.5%)	95 (47.5%)	2 (1%)	1 (0.5%)
Marital Status:					
Married:	Living with Partner (not married):		Single:	No Answer:	
37 (18.5%)	27 (13.5%)		133 (66.5%)	3 (1.5%)	
Own Credit Card:					
Yes:	No:	No Answer:	Average Number of Credit Cards Owned: 2.42		
154 (77%)	41 (20.5%)	5 (2.5%)			
Student Loan Debt:					
Mean = $9,254		Median = $6,000			
Car Loan Debt:					
Mean = $5,997		Median = $0			
Credit Card Debt:					
Mean = $2,429		Median = $500			

Of the 200 participants in the study, 149 or 74.5 percent reported a credit score. Since the focus of this study is to determine the relationship between GPA and self-assessed financial skills to the respondents' credit score, only the data from the 149 participants that reported a credit score will be used. Table 2 below details the demographics of the respondents' that reported a credit score for this study. The respondents were approximately evenly split between male and female. The average age of 25.5 years old is reasonable for the respondents to have had time to establish a credit history with lenders. Approximately 92 percent of the respondents were either Hispanic/Latino or Caucasian. The majority of the respondents were single. Most of the respondents reported having some student loan, credit card, and/or car loan debt. The majority of the respondents had a credit card in their name and reported a mean credit score of 665.92.

Of the 200 participants in the study, 51 or 25.5 percent did not report a credit score. Some of the reasons that the 51 participants did not report a credit score include that some of the participants did not have a credit score to report, some of the participants were still using their parents' credit instead of having credit in their own name, and some of the participants were not citizens of the United States so they had not developed a credit record in the United States. Two-thirds of the non-reporting participants were international students from Asian and Central American countries and therefore had not established a credit history in the United States.

Table 3 lists the demographic data on the respondents that did not report a credit score. The non-reporting participants were similar to the reporting participants in terms of being approximately evenly distributed between males and females. Like the reporting group, the majority of the non-reporting group were single. The mean age of the non-reporters was 23.24 years old.

These relatively younger participants may still be relying on their parents' credit worthiness by having them co-sign on the few credit cards (mean = 0.94) that they do have and on the reported instances that resulted in positive means for student loan debt, credit card debt and car loan debt.

Table 2: Demographics of Respondents that Reported a Credit Score

Gender:					
Male: 69 (46.31%)		Female: 78 (52.35%)		No Answer: 2 (1.34%)	
Average Age (in years): 25.5					
Ethnicity:					
African-American: 6 (4.03%)	Asian: 3 (2.01%)	Hispanic/Latino: 56 (37.58%)	White/Caucasian: 81 (54.36%)	Other: 2 (1.34%)	No Answer: 1 (0.67%)
Marital Status:					
Married: 34 (22.82%)	Living with Partner (not married): 23 (15.44%)		Single: 90 (60.4%)	No Answer: 2 (1.34%)	
Own Credit Card:					
Yes: 125 (83.89%)	No: 21 (14.09%)	No Answer: 3 (2.01%)	Average Number of Credit Cards Owned: 2.91		
Credit Score:					
Mean = 665.92		Median = 667			
Student Loan Debt:					
Mean = $9,246		Median = $7,500			
Car Loan Debt:					
Mean = $7,134		Median = $0			
Credit Card Debt:					
Mean = $2,732		Median = $900			

Table 3: Demographics of Respondents that did not Report a Credit Score

Gender:					
Male: 26 (50.98%)		Female: 24 (47.06%)		No Answer: 1 (1.96%)	
Average Age (in years): 23.24					
Ethnicity:					
African-American: 3 (5.88%)	Asian: 17 (33.33%)	Hispanic/Latino: 17 (33.33%)	White/Caucasian: 14 (27.45%)	Other: 0 (0%)	No Answer: 0 (0%)
Marital Status:					
Married: 3 (5.88%)	Living with Partner (not married): 4 (7.84%)		Single: 43 (84.31%)	No Answer: 1 (1.96%)	
Own Credit Card:					
Yes: 29 (56.86%)	No: 20 (39.22%)	No Answer: 2 (3.92%)	Average Number of Credit Cards Owned: 0.94		
Credit Score:					
Mean = N/A		Median = N/A			
Student Loan Debt:					
Mean = $9,278		Median = $0			
Car Loan Debt:					
Mean = $1,974		Median = $0			
Credit Card Debt:					
Mean = $1,318		Median = $0			

Sixty percent of the respondents had responded that they had not ordered their credit score in the past. Additional data was collected on the respondents' Grade Point Average (GPA) using a categorical scale and the respondents' personal assessment of their financial skills on a five-point Likert scale ranging from '1-Very Low' to '5-Very High'.

Approximately 22.8 percent of the respondents reporting a credit score reported having a GPA between 3.50 to 4.0; thirty-seven percent reported a GPA between 3.00 to 3.49; twenty-nine percent reported a GPA between 2.50 to 2.99; nine percent reported a GPA between 2.00 to 2.49; and two percent did not respond to the question on GPA.

Approximately nine percent of the respondents reported having very high financial skills; forty-nine percent reported having a high level of financial skills; thirty-four percent reported having a medium level of financial skills; seven percent reported having a low level of financial skills; and one percent did not respond to the survey item.

Multiple linear regression analysis was used to develop a model of predicting credit scores from GPA, financial skills, age, number of credit cards, credit card debt, previously ordered score, and GPA (see Table 4).

The number of credit cards that a respondent owned significantly predicted the credit score ($\beta = .297$, $t_{(128)} = 3.143$, $p < .01$). Respondents with more credit cards tended to have a higher credit score. The amount of credit card debt significantly predicted the credit score ($\beta = -0.265$, $t_{(128)} = -2.619$, $p \leq .01$). Respondents with more credit cards tended to have a higher credit score ($\beta = 0.300$, $t_{(128)} = 3.197$, $p < .01$). The respondents' GPA significantly predicted the credit score ($\beta = 0.215$, $t_{(128)} = 2.457$, $p < .05$). Respondents with higher GPAs tended to have higher credit scores. The presence of multi-collinearity in a regression model can result in an unstable prediction model. An examination of the variance inflation factors (VIFs) was conducted to detect any potential issues with multi-collinearity. Generally when the VIF exceeds 10 then multi-collinearity exists in the model. As seen in Table 4 below, all of the VIF statistics for the predictor variables are below 10.

Table 4: Coefficients – Dependent Variable: Credit Score

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
Model	B	Std. Error	Beta	t	Sig.	VIF
(Constant)	575.398	52.918		10.873	.000	
GPA	16.309	6.638	.215	2.457	.015**	1.198
Tickets12	-12.959	7.702	-.137	-1.682	.095	1.033
Financial Skills	4.584	7.584	.050	.604	.547	1.082
Age	-.169	1.097	-.016	-.154	.878	1.632
Hispanic	-24.943	12.603	-.173	-1.979	.050**	1.191
Male	13.125	11.643	.094	1.127	.262	1.091
# Credit Cards	7.585	2.373	.300	3.197	.002*	1.374
CC Debt	-.004	.002	-.265	-2.619	.010*	1.602
Previous Score	10.750	11.938	.074	.900	.370	1.069
Married	-11.493	15.544	-.072	-.739	.461	1.465

* Significant at the 1% level, ** Significant at the 5% level

A multiple linear regression model including the predictor variables of GPA, number of traffic tickets over the past 12 months, self-reported financial skills, age, Hispanic, male, number of credit cards, amount of credit card debt, married, had previously ordered their credit score before, and GPA produces a significant model for predicting the credit score for university students. The predictor variables (four of which were significant) explain approximately 16 percent of the variability in the credit scores.

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.468[a]	0.219	0.155	63.9581

a. Predictors: (Constant), GPA, Tickets12, Financial skills, Age, Hispanic, Male, # Credit Cards, CC Debt, Previous Score, Married

Conclusions

Based on the data collected for this study, the number of credit cards that the respondent has, the amount of credit card debt that the respondent has, their GPA, and whether or not they were Hispanic were significant predictors in the calculation of their credit score. The data appears to support the first research hypothesis of "'Good' students, as measured by higher GPAs, will have a significant, positive relationship with the student's credit score". Thus, the first research question of "Do 'good'

students, as measured by high GPAs, have better credit scores?" can be answered in the affirmative. 'Good' students, as measured by GPA, do appear to have higher credit scores. The data does not appear to support the second research hypothesis of "Students' reported levels of financial skills will have a significant, positive relationship with the student's credit score". Thus, the second research question of "Do students with a higher level of self-assessed financial skills have higher credit scores?" can be answered negatively. Students with a higher level of self-assessed financial skills do not tend to have higher credit scores.

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Does the Source of a Cash Flow Affect Spending V Saving?

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Abstract

This study examines whether a lump-sum distribution or a regular, small distribution of the same total amount from several other types of hypothetical windfalls - bonus from work, game show winnings, lottery winnings or inheritance - would be spent or saved differently from a tax rebate, and whether timing matters for each source of windfall in the same way as earlier studies have predicted. Although economic theory would say that money is money and the source of the money is irrelevant, this study finds that the source of the money influences the amount spent or saved.

Introduction

The difference that exists between what taxpayers do with tax rebates that are paid out monthly versus tax rebates of a similar amount that are paid out in a lump-sum is now well-documented (Chambers and Spencer, 2008; Sahm, et al., 2012). But is this difference related to the source of the payment, specifically tax rebates, or does this effect extend to other sources of transitory payment, e.g. lottery winnings, when the timing of a fixed amount is altered? That is, do people's mental accounts (Thaler, 1999) depend not only on timing and use of money, but also on source? To answer this question, this study tests whether people spend distributions from hypothetical tax rebates as they would if the distribution came from any of these other sources: bonus from work, game show winnings, inheritance or lottery winnings.

How might the recipient consider some of these sources as similar and others as different? Lottery winnings are similar to tax rebates in the United States, in that both lottery systems and tax systems are run by a government or its appointed agency. Both types of payment amounts are largely outside the respondent's control. To what extent the money is "earned" is debatable in both cases, but bonuses and game show winnings - and sometimes inheritances - require some personal effort. Tax rebates sometimes differ from the other four sources of payment because the tax rebate is a refund or return of withholdings the taxpayer has previously paid in. That is, outside of refundable credits tied to specific performance, respondents generally cannot materially profit from a tax rebate because it is a refund of money already paid in, but can profit from a lottery, game show or bonus. An inheritance is not a profit, per se, but is generally not a return of one's own capital. Inheritances might be property or money that carries with it memories of the decedent, and those emotions might influence how the respondent intends to use the inheritance. Further, some political rhetoric frames taxes as money belonging fundamentally to taxpayers, not the government, whereas lottery winnings come with no similar sense of entitlement. Bonuses are likely to be closely tied to an individual's performance, however. Game show winnings might be as well, if the winner attributes success to a higher skill level than fellow contestants.

If significant differences were found, such results would imply that money is not as fungible as commonly thought, and people's mental accounts are not just a function of use and timing, but also of source, representing a contribution to literature.

Literature Review

Overview

According to mental accounting theory, people create different mental accounts (e.g. long-term savings), and correspondingly, have different marginal propensities to consume from each account. Numerous studies support mental accounting from a regular income flow or from an irregular, lump-sum windfall (Fogel, 2009; Souleles, 2002; and Johnson, et al., 2006). Informally, people periodically reconcile their mental accounts for income and expense (Read, et al., 1999; Camerer et al., 1997; Rizzo and Zeckhauser, 1998; and Heath and Soll, 1996).

Karlsson, et al. (1999) reported that cash spending on a durable good depended on compatible reasons for saving. Abeler and Marklein (2008) found that high school math grades seemed to matter in mental budgeting, and Benjamin, et al. (2006) found a relationship between low high school test scores and non-rational behavior in general. Cheema and Soman (2006) and Wertenbroch (2001) concluded that mental budgeting is a matter of self-control. Frederick (2005) reported a negative

relationship between non-rational behavior and cognitive reflection.

Source Literature

Some evidence suggests that the source of one's income does affect the use of those funds. In 1992, Henderson and Peterson reported that an individual would be more likely to spend $2,000 on a vacation if the funds were a gift rather than a work bonus. Arkes, et al. (1994) found that a greater percentage of a small amount of unexpected income (windfalls) was spent than the percentage of the same amount of anticipated income. Dobbelsteen and Kooreman found in 1997 that individuals were more sensitive to changes in a child's allowance than to other income sources for the decision to spend on their child's clothing. Winkelmann, et al. (2010) used evidence from German lottery winners and a theoretical model to show that different sources of income spent do confer different marginal utilities. Thus the purchase of an item with one source of funds provides a different marginal utility than another, and that it takes about two years before lottery winners feel that they 'deserve' their good fortune. Bradford (2008) found that individuals allocate gifted and inherited assets in support of relational goals. Similarly, Trump, et al. (2014) found that individuals made less risky choices with funds from sources of income the closer their relationships were to those sources.

Still, the framing of payments seems to matter: Baker, et al. (2007) found that more money was spent from likely recurring income (dividends) than less regular capital gain income from the sale of underlying transactions. Epley, et al. (2006) found that people spent more of a "bonus" increase than they did of a "rebate" of the same amount and timing. Similarly, Shefrin and Thaler (1988) found that more of a lump sum bonus is saved than if the same amount increases regular income, even when the bonus is fully anticipated.

Effort

The amount of effort required may affect responses. Boylan (2010) found that taxpayer compliance is influenced by whether taxable income is earned or endowed. Epley and Gneezy (2007) reviewed recent empirical findings and reported that the source of the surplus or windfall may change the use of the money with recipients of a bequest spending the gain differently than proceeds from a casino. Zagorsky (2013), using a cohort of baby boomers, studied consumption of inherited money and found that over 40% of those who inherited less than $1,000 spent their bequest. Only 18.7% of those receiving $100,000 or more spent it all. In all, this research indicates that only about one half of inherited money is retained, the remainder is reduced by capital losses or is spent.

Frequency of Distribution

Neo-classical economics assumes that the decision to spend, and how to spend, one's income would not depend on the way in which it is distributed. Yet the difference in spending patterns between tax rebates received from a limited number of monthly payments and a lump-sum tax rebate of the same amount is well-documented. Rucker (1984) studied the retroactive payment of a raise approved by a university, reversed by the Federal Pay Board but reinstated by the US Supreme Court. The size of the windfall was found to be the most important factor for deciding how the funds were spent. with smaller checks more likely to be consumed. In addition, the length of time that the recipient had to anticipate the receipt of the funds also influenced the use of the money. The shorter the time before the receipt of the money was anticipated, the more likely that the money was consumed.

Shapiro and Slemrod (1995) found that almost half of the respondents surveyed would spend the 1992 decreased tax withholding refunded to them, even though the total yearly tax liability remained unchanged, resulting in a lower end-of year tax refund. However, when in 2001 a tax cut took the form of either a $300 or $600 lump-sum rebate, only about one-fourth of those surveyed expected to spend the payment (Shapiro and Slemrod, 2003). Slemrod and Bakija (2004) attributed the change in behavior of taxpayers between the differently distributed rebates to changes in economic conditions, however applying Thaler's (1999) mental accounting theory, Chambers and Spencer (2008) found that the timing of payments (whether paid as a lump-sum, or spread out in equal monthly installments for a year) matters. This was confirmed by Sahm, et al. (2012).

Permanence of Distribution

Neoclassical economics tells us that neither the marginal cost nor the marginal benefit of a purchase is dependent on the source of the income spent. The permanence of payments may also be a factor in how much people choose to save. Blinder (1981) posited that a permanent tax decrease would elicit more spending than a temporary tax rebate, which he surmised would be treated as one half as a normal income tax change and the other half as a windfall. Parker (1999) studied tax cuts, finding that a temporary, end-of-year reduction in social security tax for high-income wage earners was spent when received, not

averaged evenly over the fiscal year. However, in this study, with the number of payments being of limited duration, the effect stems from the timing of the receipt, which is in contrast to Friedman's (1957) permanent income hypothesis, because both the limited series of monthly payments and the lump-sum are of limited duration. Karlsson (1999) noted that individuals considered the future consequences of spending in their mental budgeting, which may indicate a contemplation of permanent income.

Studies of unique, one time payments are rare. However, Bodkin (1959) estimated the marginal propensity to consume to be between 0.72 and 0.97 from a one-time dividend paid in 1950 to World War II veterans by the National Service Life Insurance. The payments averaged $175, roughly $1723.39 in 2015 dollars (BLS.gov). Similarly, Kreinin (1961) analyzed the spending of a sample of Israeli citizens receiving restitution payments from Germany in 1957 and 1958 and estimated that 35% was spent while 65% of the restitution payment was saved, with 45% saved in liquid assets and 20% in real estate (Kreinen, 389).

Materiality of Amount

Chambers, et al. (2009) studied responses to small hypothetical tax rebates, of the size distributed in 2008, $300 and $600, as well as larger amounts, $1,500 and $3,000. They found that at some amount over $600, materiality mattered greatly in how the money would be used. Under the $600 amount, individuals were likely to spend a rebate if that was the government's intent for distributing it, but at or above $600, the government's wishes were ignored (Chambers, et al., 2009).

Research on large, regular bonuses includes Hsieh (2003) who studied consumption associated with receipt of the Alaska Permanent Fund. The annual receipt is fully anticipated and no spike in consumption is found. However, consumption by the same households was very responsive to income tax refunds. Hsieh writes, "This evidence suggests that households will take anticipated income changes into account in their consumption decisions when the income changes are large, regular and easy to predict, but will not do so when they are small and irregular" (Hsieh, 2003, 397). Another situation with large, regular and predictable bonuses was documented by Browning and Collado (2001). They studied Spanish panel data to measure the effect of the bonus payments customary in that market. Workers in this bonus paying scheme usually receive payments of $1/14^{th}$ of their annual wage per month for 10 months. However, in two months, usually December and June or July, they receive $2/14^{th}$s of their salary. They "do not find any effect of anticipated changes in income on expenditure patterns over the year for those who receive the bonus payments are indistinguishable from the patterns of those who do not receive a bonus," (Browning and Collado, 2001, 682).

Research Questions

In light of this literature, does a different source of payments, for example, from a tax rebate or work bonus to lottery winnings or other windfall source, change a consumer's amount saved, controlling for the distribution frequency? Or is the timing of the payments a phenomenon that is more general and stubbornly entrenched enough to be the same no matter the source? Stated as research questions in Table 1 below, for the possible combinations of bonus from a tax rebate, work, game show winnings, lottery winnings or inheritance.

Methodology

Experimental questionnaires were distributed to university students at these universities: Coastal Carolina University, Francis Marion University, Longwood University, Metropolitan State University of Denver, Texas A & M University - Corpus Christi, University of Alabama – Birmingham, and University of Houston-Clear Lake. Students were considered provisionally acceptable respondents per Walters-York and Curatola (1998). (See also Ashton and Kramer, 1980.)

All research questions were analyzed with descriptive statistics, converted to percentages, and then then analyzed using four sets of OLS regressions, where choices (1) through (3) and (6) are savings, and choices (4), (5) and (7) are spending. Two of the sets of regressions used short term savings (one monthly, the other annual) and the other two sets used total savings (annual and monthly) as the dependent variables. The percent invested monthly and yearly were regressed to control for income, gender, age, importance to the budget, business experience level and education level.

The regression models were of the form:

Savings = F(income, zero income, amount, education, gender, age, importance, seatbelt use, smoker, default for spender, experience level, presence of credit card debt, the source of the payment (Lottery, tax refund, inheritance, game show, or bonus), and a dummy for the order of presentation (monthly payment first, or annual payment first))

Results

The data were gathered in 2013. There were 1844 responses, of which 936 had complete data for regression analysis. Table Two (available upon request) presents the descriptive statistics for the variables collected. The average income was $38,610, which compares to an average $57,706 for 2010 from the IRS Statistics of Income (IRS 2012). Respondents averaged 5.15 years of work experience and had some college education (which is to be expected as the sample was collected primarily from college students); 48% of the respondents were women. These respondents perceived themselves to have moderate business experience, as indicated by a 2.83 average score out of a possible 5.0.

To answer the first set of ten research questions presented in Table 1 (does the source of the payment matter), four sets of regressions were run. In the first set, the dependent variable (stsavy) short term savings for the annual payment were regressed. Short term savings was created from the answers to the questions about the amount (a) invested in stocks, bonds, savings accounts, etc.; (b) used to pay off credit card debt; and (c) used to pay off notes such as mortgages, car notes, etc. The results are presented in Table 3 (available upon request).

The percentage saved, short term, when given a single lump sum was found to be positively related to (the log of) income ($p = 0.0575$). Respondents who reported a zero income also saved more than those that reported earning an income. The parameter estimate indicates that those reporting zero income, saved roughly 23% more than those reporting an income ($p = .0232$). Though the variable Importance is significant only at the ten percent level, as the size of the payment relative to the respondent's income increased less was saved ($p = 0.0742$). In other words, if the payment was significantly large relative to income, savings decreased.

Table 1. Research Questions

RQ1	Do people intend to save the same amount of a hypothetical lump sum (monthly) bonus payment as they would a hypothetical lump sum (monthly) game show winning?
RQ2	Do people intend to save the same amount of a hypothetical lump sum (monthly) bonus payment as they would a hypothetical lump sum (monthly) inheritance?
RQ3	Do people intend to save the same amount of a hypothetical lump sum (monthly) bonus payment as they would a hypothetical lump sum (monthly) lottery winning?
RQ4	Do people intend to save the same amount of a hypothetical lump sum (monthly) bonus payment as they would a hypothetical lump sum (monthly) tax rebate?
RQ5	Do people intend to save the same amount of a hypothetical lump sum (monthly) from game show winnings as they would a hypothetical lump sum (monthly) inheritance?
RQ6	Do people intend to save the same amount of hypothetical lump sum (monthly) game show winnings as they would a hypothetical lump sum (monthly) lottery winning?
RQ7	Do people intend to save the same amount of hypothetical lump sum (monthly) game show winnings as they would a hypothetical lump sum (monthly) tax rebate?
RQ8	Do people intend to save the same amount of a hypothetical lump sum (monthly) inheritance as they would a hypothetical lump sum (monthly) lottery winning?
RQ9	Do people intend to save the same amount of a hypothetical lump sum (monthly) inheritance as they would a hypothetical lump sum (monthly) tax rebate?
RQ10	Do people intend to save the same amount of a hypothetical lump sum (monthly) lottery winning as they would a hypothetical lump sum (monthly) tax rebate?
RQ 11	Does the order of presentation matter? (Does the savings change if the annual or monthly amount was given first?)

The level of the payment was also positively related to savings. Those that received a higher payment saved more than those that received the smallest payment. Those receiving $600 saved 7.0% more of the payment than those receiving $300 ($p = 0.0204$), while those receiving $3000 (ten times more), saved about 7.9% more of that payment than those receiving the $300 payment ($p = 0.0111$). Those receiving the $1500 payment saved about 5.98% more of the payment than those receiving the $300 payment, but that result is only significant at the 10 percent level ($p = 0.0641$).

Those that answered "undergraduate" saved 5.4% more than those that reported "high school" ($p = 0.0362$). Those that reported "Associate Degree" or "Graduate or above" had a positive sign, but were not statistically different from zero.

Self-reported experience levels did not significantly influence the percentage of the lump sum payment saved. The measures of risk employed, smoking and seatbelt use, were also insignificant. On the other hand, the variable Spend1, a dummy variable =1 if the respondent answered "spend" to the question, "*When you normally get "extra money," do you spend it or save it?*" was economically and statistically significant. Those that answered "Spend" saved almost 10% less than those that answered "Save" ($p < 0.0001$).

Table 4(available on request) provides the results for the regression when the (ltsavy) Total Savings annual payment is used as the dependent variable. This variable is composed of the short term amount plus the amount saved for infrequent expenses such as vacations, bigger holiday gifts, or something you've been wanting, thus representing the total amount devoted to savings. (Note that various formulations of the credit card debt variable were introduced to observe whether debt in dollars or as some proportion would affect the results; the results showed evidence of multicollinearity and two of these variables were dropped.)

Comparing the results to Table 3, the variables Income, zero income, importance to the budget, and Spend1 are all significant at least at the 5% level in Table 4. In Table 3, the income and importance variables are significant at the 10% level. Education at the BA level is significant at the 5% level in Table 3 while the associate degree level of education is significant at the 10% level ($p = .052$) in Table 4.

No longer significant are the dummy variables from the different amounts of the payments. The percentage saved in total is not statistically different for those receiving $300 than those getting the higher amounts. Those reporting an undergraduate or graduate or higher level of education did not save a statistically significant amount more than those reporting a high school level of education when presented a single lump sum.

Tables 5 and 6 below are similar to Tables 3 and 4. For this part of the analysis, the respondents were given a recurring monthly payment for one year. In the prior regressions, the results from a one-time, lump sum payment were used. The total of the monthly payments equaled the annual payment. For instance, if the annual amount was a one-time payment of $600, the monthly payment was $50 for one year.

In Table 5 (short term savings with a monthly payment), the variable for income is still positive and significant but only at the 10% level ($p = .063$). As more income is earned, more of the amount received is saved. However, the dummy variable for those reporting a zero income is significant only at the 10% level, and variable for importance is no longer significant at all. As the monthly amount is only 1/12 of the amount received in the annual question (Table 3), though, this is not surprising. For the smallest amount, $300, the monthly payment amounts to only $25. In other words, even for those reporting zero income, a greater percentage of the smaller receipt would be spent rather than saved.

Consistent with the findings in Table 3 (Short-term savings from an annual payment), more is saved as the payment becomes larger. Those receiving a payment of $600 ($50 a month) save 8.9% more of the payment than those that received $300 ($25 a month) ($p = 0.008$). Those receiving $3000 per year ($250 per month) saved 8.2% more of the payment than those receiving $25 a month ($p = 0.017$). Similar to the results in Table 3, those that received $1500 ($125 a month) saved 7.3% more than those receiving $25 a month, ($p = 0.0392$).

Contrary to the results in Table 3, none of the education variables were significant at even the ten percent level. Again, the primary difference between tables 3 and five are the amounts in Table 5 are $1/12^{th}$ the size as Table 3 as the total is the same, but spread over the 12 months.

The variable representing the respondents prerogative for additional money (whether to spend it or save it), continues to be significant. The results indicate that if a respondent indicates that they generally spend additional money, they do. When the respondent indicates that they are a spender, they save 9.83% less ($p < 0.001$) than one who is a saver.

A new finding is exposed in Tables 5 and 6. The order of presentation now matters. On the survey, half of the forms had the question for annual payment first, and the other half had the monthly payment first. When the annual values were used (Tables 3 and 4), this variable was insignificant. When the smaller, but recurring, values are used in Tables 5 and 6, those receiving the monthly payment saved (both economically and statistically) more. For short term savings with monthly payments (Table 5), when the monthly question was provided first, respondents saved 7.9% more ($p = 0.001$) more than when the annual question was first. (In Table 6, representing Total Savings, 15.7% more was saved ($p < 0.001$) than when the lump sum, annual amount was presented first.)

The results shown in Table 6 are similar to those above in many respects. Income is still significant ($p = 0.0188$) and positive in Table 6, though it was significant at only the 10% level ($p= 0.063$) in Table 5. The coefficient for those reporting a zero income is now insignificant at the 10% level

Compared to the $300 payment ($25 per month), as a greater monthly payment is received, the greater the percentage of the payment is saved. Those receiving $50 a month ($600 a year) save 10.1% more of the payment than those receiving $25 a month ($300 a year) ($p = 0.002$). Those receiving $125 a month ($1500 a year) save 7.6% more of the payment than those receiving $25 a month, while those receiving $250 a month ($3000 per year) saved 8.1% more of the payment ($p = 0.015$).

The education variables are insignificant. Survey participants reporting more than a high school level of education did not save any more or less than those reporting that their highest level of education was high school. This result is similar to Table 5, but contrary to Tables 3 and 4, where a lump sum payment was analyzed.

The self-reported "spenders" (those who answered "spend" to the question about what they would typically do with additional money), spend (save) 10.9% more (less) than the "savers" ($p < 0.001$).

As described above, the order variable is statistically and economically significant. When the questionnaire ordered the monthly payment first and the annual question second, participants total savings increased 15.7% more than those that got the larger, annual, but one- time payment first ($p < 0.0001$).

Table 7 Significance of the Source of Payment

A. Short term Savings – Annual Payment

Sources	Beta	P-value	Research Question
	At the 1 % significance level		
Game Show V Taxes	-.094	.006	7
	At the 10% Significance Level		
Game Show V Lottery	-.059	.091	6
Bonus V Tax Refund	-.056	.099	4

A lower amount was saved from game show winnings are saved than from a tax refund. Less of a game show winning is also saved than a lottery payment, but only at the 10% significance level. Less of a bonus was saved than a tax refund, but this is significant at a 10% level.

B. Total Savings – Annual Payment

Sources	Beta	P-value	Research Question
No statistically significant differences between sources			

C. Short term Savings – Monthly Payment

Sources	Beta	P-value	Research Question
	At the 5% significance Level		
Inheritance V Tax Refund	-.075	.048	9
Game Show V Tax Refund	-.078	.038	7
	At the 10% Significance Level		
Game Show V Bonus	-.069	.062	1
Inheritance V Bonus	-.066	.078	2

Strong economic and statistically significant results showing that savings from game show winnings and inheritances are less than tax payments. Weak statistical support indicating savings from game show winnings being lower than bonus payments and for savings from inheritance funds being lower than bonus payments.

D. Total Savings – Monthly Payment

Sources	Beta	P-value	Research Question
	At the 1 % significance level		
Game Show V Bonus	-.112	.002	1
Inheritance V Bonus	-.101	.005	2
	At the 10% Significance Level		
Game Show V Lottery	-.071	.056	6

Strong economic and statistically significant results showing that savings from game show winnings are less than a bonus payment. In addition, less of an inheritance is saved than from a bonus payment. Weak evidence suggests that savings from game show winnings are less than from a lottery

The results summarized in Table 7 show the results of the tests for Research Questions 1-10 in Table 1. In at least one set of regressions, the results indicate that savings from game show winnings are significantly lower than from a bonus payment, inheritance, lottery winning or tax rebate.

There can be little doubt that Game Show Winnings are different from Tax Refunds (Research Question 7) in the minds of the winners. Regressions with all four dependent variables show that less of a game show winning is saved than is a tax refund, though when total savings with the annual payment was the dependent variable, the significance is only at the 10 percent level.

Saving from game show winnings was statistically (and economically) lower than lottery payments in three of the four sets of regressions (Research Question 6). Only the regression results for the dependent variable Long Term Savings, annual payment were insignificant.

Some support for several of the other research questions is provided. Research Question 1 was significant at least at the 10% level in two regressions. When the monthly payments for short term and total savings were the dependent variables, savings from game show winnings were significantly lower than savings from bonus payments. Alternatively, more of a game show winning is spent than is spent from a bonus payment.

When short term saving from an annual payment was analyzed, savings from a game show payment were lower than the savings from a one-time inheritance payment. The answer to Research Question 5, then, at least for this dependent variable, is 'no,' less (more) of a game show winning is saved (spent) than from an inheritance windfall.

When monthly payments are analyzed, the results suggest that short term and total savings from inheritance payments are lower than savings from bonus payments, tax refunds and lottery payments (though the last two are significant at only the 10% level). Research questions 2, 8 and 9 are supported to some degree.

Weak support, only at the 10% level, can be found in one set of regression results for Research Question 4, comparing tax refunds and bonus payments. When short term savings with a single annual payment are analyzed, more (less) of a tax refund (bonus) is saved.

The results for Research Question 11, does the order of presentation matter, are mixed. When the respondents evaluated the single lump sum payment (presented in Tables 3 and 4), the order was not significant. However, when the monthly regressions were analyzed, (Tables5 and 6), the results are significant both economically and statistically.

When short term savings is the dependent variable, and it is distributed in monthly payments (Table 5), the coefficient for "monthlypmt," the variable indicating that the monthly payment was presented first and the annual payment second is 0.061 ($p = 0.011$) indicating that when the monthly payment was presented first, respondents saved 6.1% more than those that responded concerning the annual payment first. Similarly, when total savings is the dependent variable and the payment is monthly (Table 6), the coefficient for the order variable "monthlypmt" is .134 ($p < 0.001$). When the monthly payment is presented first, the respondent saved 13.4% more in total savings than when the annual payment was presented first. (When the annual payment is presented first, respondents spent more money when answering the monthly question).

Conclusions and Implications

Overall, the evidence indicates that the source of the payment does indeed matter. Some evidence exists that game show winnings are spent differently than payments from bonuses, tax refunds or the lottery. As game show winnings are a once-in-a-lifetime opportunity, this may explain the difference. Tax refunds are common and are likely to be within the control of the taxpayer. A bonus could and hopefully would be repeated, and the recipient's incentives are toward that goal. Similarly, though multiple winnings of the lottery are rare, winning a lottery does not preclude someone from playing again, and the events are independent. As a game show winning is not likely to be repeatable, one could argue that the level of permanent income from such a winning is much lower than with the other forms of payments. As such, a greater amount of the money would likely be spent than saved. Further, the name 'game show' essentially connotes "fun" and may subconsciously shift the payment toward consumption.

Order of presentation mattered. When the annual payment was viewed first, spending was higher for the monthly sum. This finding may have the greatest practical implication for those in the financial planning arena. Presenting clients with annual values (for retirement income, for example) may entice the client to increase current spending compared to providing estimates for monthly income.

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Towards an Optimal Strategy For Monopoly: The Mega Edition Using Genetic Algorithms & Simulations

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Abstract

Monopoly Mega Edition adds two new mechanics: a Speed Die and Bus Tickets, which give players additional choices in the dice roll and token movement. These new features and their associated choices limit the usefulness of Markovian models as a tool for analyzing the Mega Edition. This paper discusses the method and challenges in modeling this new version of the Monopoly game using evolutionary algorithms and computer simulations, and analyzes the strategic implications of the data obtained from the simulations. In particular, we discuss the difference of aggressive versus strategic gameplay, and the expected cost of using a bus ticket.

Introduction

Monopoly is a popular board game that involves elements of strategy, skill and luck. Numerous guides have been published that instruct the reader with the optimal strategy of how to play the original Monopoly game. Authors like Koury (2012) and Orbanes (2007) have published guidebooks on winning strategies for Monopoly. This game has also been used to teach the strategies behind Real Estate. Janik (2009) published her book on profitable investing that is based on the original Monopoly game. Similarly, Orbanes (2013) uses the Monopoly game in his guide to make smarter financial decisions. On the other hand, Monopoly has also been used to teach Markovian chains in college mathematics. Johnson (2003) published a detailed paper that describes how to use Monopoly, and other similar board games, to teach stochastic models to students.

There have been many analysis of the original game of Monopoly that include simplifying assumptions to translate the game into a mathematical model that can be used to verify the legitimacy of existing strategies. The early work of Ash and Bishop (1972) provides a rigorous analysis of the mathematics behind the game, using limit frequencies of convergence for a simplified model of the game using eigenvalues. Stewart (1996a) published a paper on the fairness of Monopoly in the Scientific American journal where he concluded that the game was fair since the steady state probability of the game approaches to 1/40. However, in a subsequent publication, Stewart (1996b) concluded that some squares are more likely to be visited than others if rules like Go to Jail, doubles, Community Chest and Chance cards are included. Abbott and Richey (1997) published a similar analysis of the Monopoly game where they suggested "the accuracy and usefulness of a particular model depends largely on how well the realities of the system survive the translation into a mathematical language". In their analysis they pose questions like how to accommodate within the model such non-Markovian aspects like the Chance cards that direct players to the nearest railroad where they consequently pay double rent. Murrell (1999) conducts a similar analysis for 100 dice rolls in a simplified version of the game, and explains how the landing frequency provides but an initial analysis of the game, and it is important then to consider the cost and revenue generated from each property as well.

However, analysis of the Mega Edition of Monopoly has not been carried out in the literature. This new and alternative version of the game includes randomness and other elements of strategy in the dice roll itself. Introduction of new rules like Bus Ticket give the player more control of movement within a side of the board, making strategy a crucial aspect of the game. If a player rolls a Bus Ticket on the Speed Die, the player gets to skip squares on the current side of the board or keep a Bus Ticket for later use. The new version is bigger, faster, and provides more capital to invest as well as freedom of movement to the player making for richer strategic gameplay. The Mega Edition introduces an additional die and 12 new squares with new rules and properties. Analyses of strategies for playing the original version of the game have been carried out using Markovian models and computer simulations; however, the Mega Edition of the Monopoly game has not previously been analyzed for its strategic implications. Nevertheless, guides on how to play the Mega Edition have been published including the U.S. National Monopoly Champion, Matt McNally's "Winning Tips to Own It All." What has not been undertaken in the literature is a rigorous update to the probabilities associated with the revised Mega Edition, which is the focus of this research. We began by first obtaining the steady-state probability of visiting each square for Monopoly: The Mega Edition using the static Markovian model, similar to the approximation used by previous analyses including the Stewart (1996b).

Preliminary Research

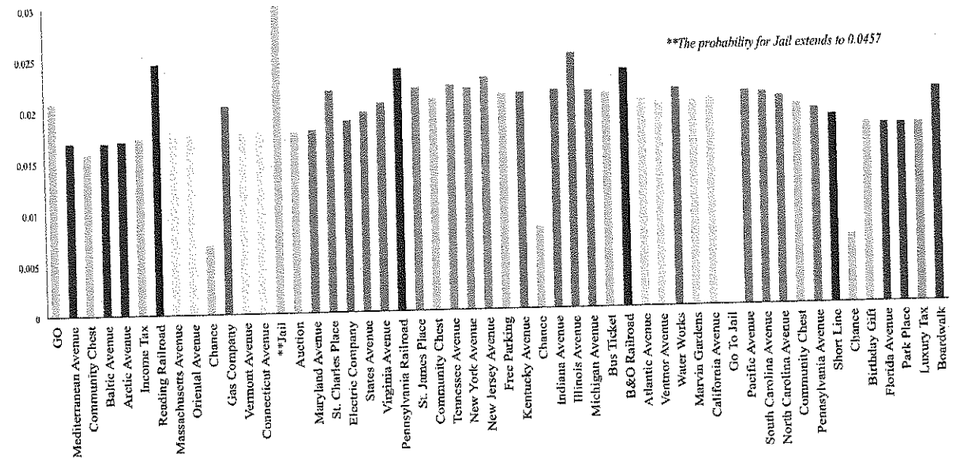
The Markovian approximation estimates the expected long-run probability of visiting each square taking into consideration the movement of players due to random dice rolls, JAIL, and cards that redirect the player to another location (Shrestha, Lewin and Seitzer 2015).

Using a computer simulation of 250 dice rolls (the average used by previous analyses), we calculated the probability distribution for the 52 squares on the board under the Markovian model. Following Frayn (2005), we model Community Chest and Chance Card by assuming they are drawn at random from a complete stack, as opposed to modeling the composition of the Chance and Community Chest decks at each moment in the simulation.

Properties that are more likely to be landed on are regarded as being more valuable since these properties act as a source of income in form of rent to the owner of the property. A summary of the results obtained is given in Figure 1. According to the relative probability distribution of the color groups, it can be concluded that the orange, red, yellow and green groups have the highest chance of being landed which implies a higher return on investment in these properties on the long run. This preliminary analysis agrees with the strategies suggested by Matt McNally, the U.S. National Monopoly Champion, for the Monopoly Mega Edition (McNally, 2007). Please refer to Appendix IV for the complete Java code and results.

Although other complex rules like the triples, doubles, Mr. Monopoly, Bus, and Bus Ticket were not accounted for, the analysis of the game purely by chance leads its way to simple strategies that one can implement to make one's opponent go bankrupt faster in the long run. However, the long term probability of visiting each property does not lead us to any insight on the short term strategies a player can implement to take advantage of the additional rules in the Mega Edition like the Bus Ticket, which probabilistically occurs once every 3 turns as one face of the Speed Die is a Bus Ticket.

Figure 1. Long term probability distribution of landing on each square for each 52 squares of the Monopoly: The Mega Edition game. The color on each bar corresponds to the color group of the property. In addition, black refers to Railroads, dark-gray to Utilities and light-gray to non-property squares.



The Evolutionary Approach

Evolutionary algorithms have been used to optimize complex systems with large number of variables effectively. These algorithms draw inspiration from the biological process of evolution, where an initial population evolves into a new generation with bias to members of the population that perform well in the environment. Each new generation has, on average, higher fitness than its parents, and therefore represents a better set of candidate solutions to the problem under consideration. Frayn (2005) used this computation to analyze the valuation of properties for the original game of monopoly. In the scope of our experiment, the "environment" resembles the game of Monopoly and is implemented using a computer simulation.

This method can take into account complex rules easily and effectively, including those that are a challenge to incorporate into more formal Markovian models, such as Go to Jail, doubles, Community Chest and Chance Cards. Each member of the population is an array of numbers that represents the strategic behavior of an individual Mega Edition player. In our simulation, each array consists of ten values between 0 and 1, one for each of the eight color groups, the utilities, and the railroads. Each number represents the probability of purchasing any property belonging to its associated category. For example, a population member with a value of .75 in the entry corresponding to orange-colored properties will choose to purchase properties in that group 75% of the time and decline to purchase the remaining 25% of the time. Each time a simulated player lands on a purchasable property, the simulation generates a random value between 0 and 1, and then uses the player's strategy vector to make a purchasing decision.

Upgrade decisions are handled in a similar fashion. Each player's strategy vector contains ten additional values between 0 and 1 representing the value that player assigns to upgrading properties in each of the ten categories. Therefore, the player's complete strategy vector is described by twenty values in (0,1). On a player's turn, that player may spend cash to upgrade the properties it owns, with the priority for competing upgrades resolved based on the value the player assigns to properties in each category. Players never voluntarily drop their cash reserves below a set minimum threshold.

Each member of the population competes in simulated games of Monopoly against three other random individuals. The player receives points for based on its finishing position in each game. Following Frayn (2005), we award four points for a first place finish, two for second place, one for third place, and zero points for the fourth place. The total fitness of an individual is the sum of the points earned in 100 of simulated games against random opponents. This process is repeated for all the members of the initial population.

Once the fitness scores for all members of the initial population have been tabulated, we apply natural selection, crossover and mutation to form the next generation. One percent of each generation with the highest fitness scores in a generation survive to the next by right as top performers. The remaining 99 percent of the next generation is formed by crossover between the members of the current generation such that the process is biased for individuals that have a higher fitness score. Then, with a small probability, we change independently mutate each element of the strategy vector for all the members of the new generation. This introduces some randomness into the process to prevent solutions from becoming trapped in local optima.

The process is then repeated indefinitely or until a termination criterion is achieved. The following algorithm summarizes the methodology used in the genetic process:

1. Generate a random initial population of 1000 players.
2. Evaluate fitness for each individual in the population.
    a. Fitness is the total score of the individual for 100 games played against randomly generated opponents.
3. Apply selection and crossover on best-fit individuals to generate the next generation.
    a. The fittest 1 percent continue to the next generation by default.
    b. 99 percent of the new generation is made by crossover between randomly chosen individuals, with higher-fitness individuals having a greater selection probability.
4. Apply mutation on the newly generated population to escape local optima
    a. Each parameter of each member of the population is mutated with the probability of 1 percent
5. If termination criterion is not met, repeat from step 2.

The constants for generating new population – the selection percentage and the mutation rate are arbitrary values; however, certain values converge faster than others. Upon adjusting the variables numerous time, the 1 percent default allowed convergence to be achieved in a reasonable amount of time.

Initial Results

Our initial simulation model included support for several key rules, including extra turns for rolling doubles, Go to Jail, In Jail, Community Chest and Chance Cards, but did not include support for the more complex Bus Tickets, which allow movement to any square ahead of the player on the same side of the board. Temporarily ignoring Bush Tickets allowed us to test if our results agreed with the Markovian analysis carried out in previous studies. The next section removes this restriction and considers the strategic trade-offs of when to use Bus Tickets.

Triples pose an additional complexity. Upon rolling triples, the player may move to any square on the board. To account for this rule, we assumed the player will move to the unowned square that it perceives as being the most valuable; if all the properties are owned, the player deliberately moves to the Go to Jail square where the player then goes to Jail and waits to roll doubles for 3 consecutive turns. This strategy, well known among competitive players, allows the player to remain in Jail to decrease the chances of paying high rents in the late phase of the game when all properties are owned.

Upon running the algorithm for 70 generations, it was observed that the probabilities for both the perceived value of purchase converged close to 1, implying that *all* properties are valuable to buy and upgrade, independent of their steady-state

landing probabilities. This result contradicts the results from the Markovian analysis that has been presented in the preliminary research section, which estimated that certain property groups were more valuable than others based on empirical differences in the steady-state landing probabilities.

An interesting observation from this result can be made that has an important strategic implication on the new upgrade rules. The Mega Edition has four properties for each color group, but a player only needs to own three to begin upgrading properties within a group. Therefore, players must purchase aggressively to prevent their opponents from collecting three properties within a group, and if a player has purchased two properties in a group, it makes strategic sense to acquire at least one more to enable upgrades. Further, in a game again three opponents, a player cannot realistically expect to return to a property again before it is visited and possibly acquired by another player. Therefore, players generally face a one-time yes/no decision to purchase each property they land on, with the practical consequence that a no decision entails abandoning that property to an opponent for the duration of the game. Thus, players are incentivized to play aggressively and always purchase properties they land on, given sufficient resources.

Including Bus Tickets

The Bus Ticket allows the player to jump ahead to any forward squares on the current side of the board. To get a Bus Ticket, the player has to roll a Bus on the Speed Die and choose to keep the ticket for later use. The introduction of this new rule not only speeds up the gameplay but also introduces a new strategic element to the game.

The analysis in this section considers the strategic implications of using a Bus Ticket in the late phase of the game, when all properties have been purchased. Further, we consider the *worst-case* situation, where opponents own all reachable properties. In this case, a player's safest move is to always advance to a corner square if possible, because none of the corner squares required the payment of rent. Further, advancing to GO awards $200 and advancing to the Go To Jail space places the player in Jail, which is a safe place to spend turns without the danger of paying rent on opponent-owned properties (Frayn, 2005).

Suppose that a player is currently on square *S* of the Mega Edition board and has one Bus Ticket. There are three strategies the player might pursue over the next two turns:

1. Use the Bus Ticket to jump to the end of the current side and then move using a normal die roll on the next turn
2. Move using a normal die roll on this turn, then use a Bus Ticket on the next turn.
3. Move using two normal die rolls.

To evaluate the relative trade-offs of these three approaches we consider the worst-case expected rent a player might have to pay under each strategy. Figure 2 presents simulated results of these values for each starting square *S*. For a complete code that implements the algorithm in Python, please refer to Appendix III.

Figure 2 shows that using a Bus Ticket decreases the expected rent paid for all of the squares. This is expected, as the player always uses the Bus Ticket to transition to a square that does not require any rent payment. Further analysis of the difference between the rents shows us that using a Bus Ticket on the third side of the board, i.e. from Free Parking to California Avenue, to move to the Go To Jail square significantly decreases the expected rent paid in the next die roll to almost 0. Similarly, there is a comparative advantage in using the Bus Ticket to skip the fourth side of the board, from Pacific Avenue to Short Line, where the expected rent paid on a die roll is the highest of all the properties on the board.

Results

Based on the results of Figure 2, we re-ran the genetic algorithm to identify effective strategies for the Mega Edition game including Bus Tickets. The updated simulation algorithm assumes that players will now use an available Ticket to skip the third side of the board and the fourth side prior to the Short Line. The termination criterion was set to terminate at 70 generations, as in the initial test run; this length was sufficient to reach a plateau in the evolutionary algorithm's fitness progress. Figure 3 represents the results for the average perceived value of purchase and upgrade for each property group.

It can be seen that the dark blue, green and yellow property groups are devalued compared to other property groups. This result is expected since due to the presence of Go to Jail in the third corner of the board between the yellow and the green property groups, players are likely to move to the Jail square instead of traversing the fourth side of the board where the green and dark blue property groups reside. Furthermore, the Bus Ticket can also be used to skip through these properties to move to the Go to Jail square and then to Jail, where the player gets to wait until a double is rolled to get out of the jail. In addition to the perceived purchase values, the average perceived value of upgrade for each property group is presented in Figure 4.

Figure 2. Expected rent paid for each square for three scenarios Bus Ticket and Dice Roll (BD), Dice Roll and Bus Ticket (DB), and Dice Roll and Dice Roll (DD) over a million simulated games.

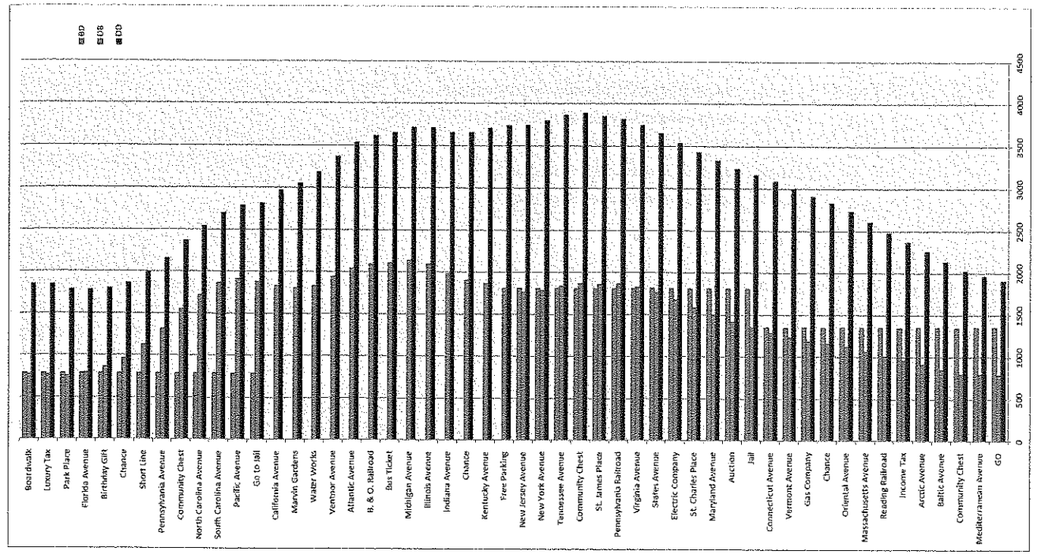


Figure 3. Average of the perceived value of purchase for each property group across 70 generations of optimal candidates. Higher probabilities represent a higher likelihood of the player buying the property upon landing on the respective square. Smaller probabilities represent a lesser likelihood of purchase. For a detailed analysis of how the perceived value of purchase evolves over generations, please refer to Appendix I.

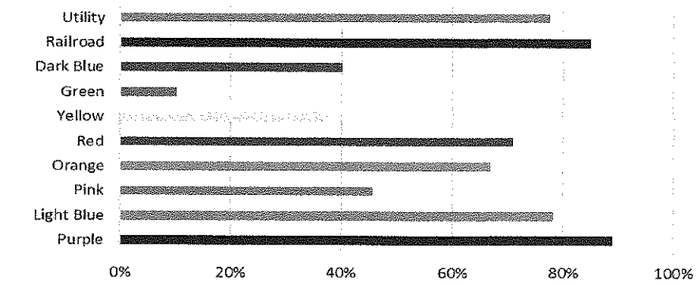
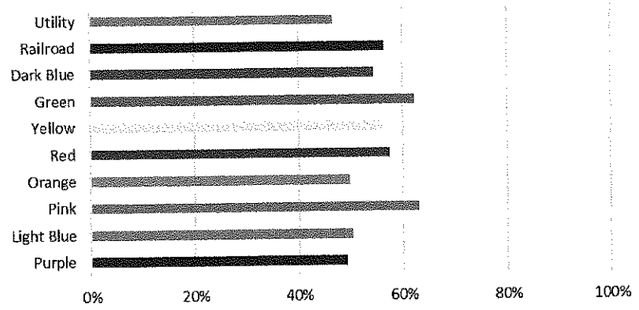


Figure 4. Average of the perceived value of upgrade for each property group across 70 generations of optimal candidates. Higher probabilities represent a higher likelihood of the player upgrading the property if owned. Smaller probabilities represent a lesser likelihood of upgrade. For a detailed analysis of how the perceived value of purchase evolves over generations, please refer to Appendix II.



Even though the dark blue, green and yellow properties were devalued for purchase, which was the expected effect of the Bus Ticket, Figure 4 shows us that these properties are worth upgrading. Due to higher rent values for these properties, it may be that upon upgrading, these properties generates higher rent than other properties even if they are not visited as frequently as the other properties. Note that, as Bus Tickets are not guaranteed, players may still visit properties on the third and fourth sides of the board, albeit less frequently than in the original version of Monopoly.

Higher perceived value of purchase and an average perceived value of upgrade for the Railroad, Utility and Purple property groups imply that these properties can serve as a consistent source of rent. Since these properties come at a relatively lower costs for both purchase and upgrade, these produce higher return on investment than the other properties.

Conclusion

The Mega Edition of the Monopoly game offers more strategic freedom to the player than the original version of the Monopoly game. Although genetic algorithms are at an early stage of development, this method has been used to optimize complex systems with large number of variables such as Monopoly. Frayn (2005) successfully analyzed the original version of the Monopoly game using the genetic approach using simulations. Using a similar genetic approach for analyzing the Mega Edition with additional elements to take into account the additional rules like Bus Ticket and the Speed Die, we were able to find out that certain property groups like dark blue, green and yellow are devalued whereas property groups like railroads, utilities and purple have a larger average perceived value implying they have a higher return on investment. However, rules like mortgage, and property trading are yet to be accounted for in the simulated version of the game due to the complex nature of such rules. Further insight on such rules that involves elements of skill rather than pure luck can lead to a better understanding of property trading in real world financial investing.

Notes

1. Department of Mathematics & Computer Science
2. Department of Business
3. This research was supported by The Edward and Stella C. Van Houten Memorial Fund through the Student-Faculty Collaborative Scholarship Program at Rollins College.

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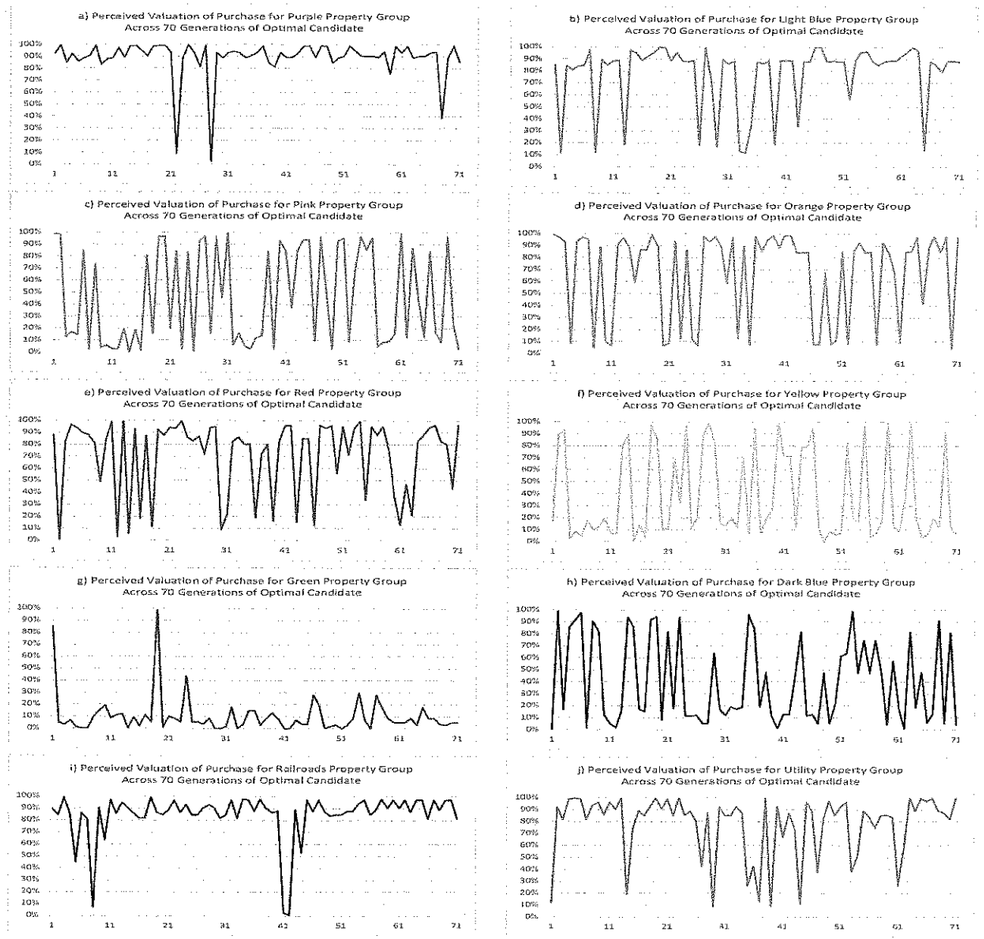
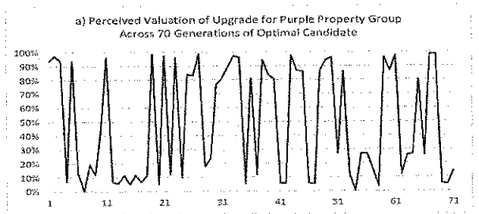
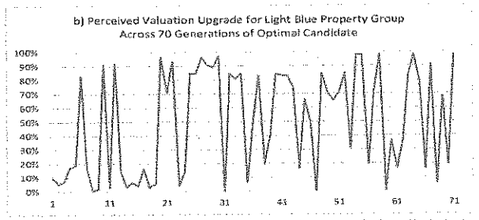
Appendix

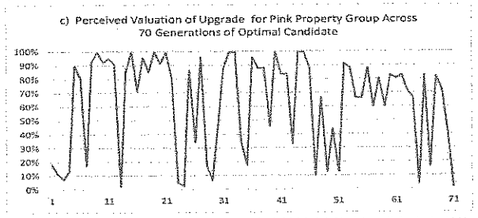
The figures below show how the perceived value of purchase for each color group changes across 70 generations of optimal candidates. Figure a. through j. are color coded with their respective color group with the exception of Railroads and Utility which are coded as Dark Gray and Light Gray respectively.

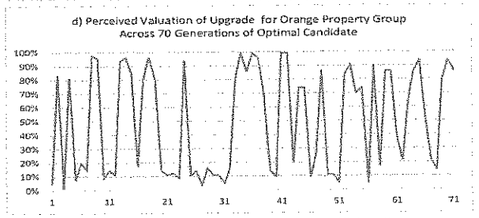


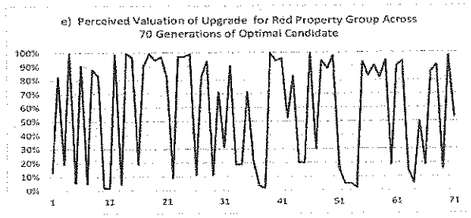
The figures below show how the perceived value of upgrade for each color group changes across 70 generations of optimal candidates. Figure a through j are color coded with their respective color group with the exception of Railroads and Utility which are coded as Dark Gray and Light Gray respectively.

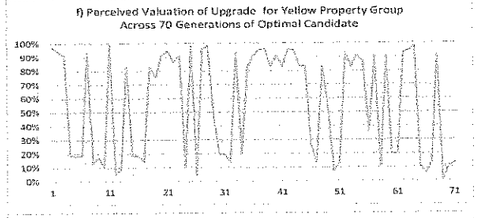


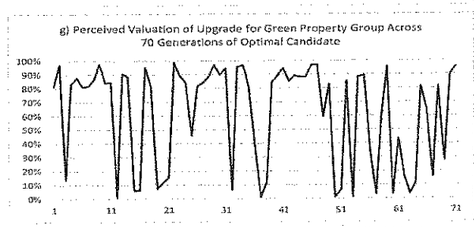


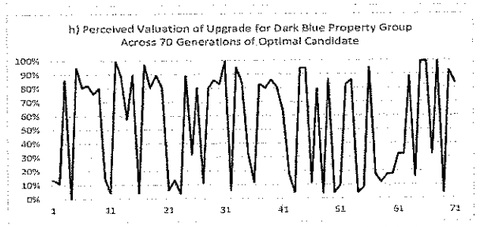


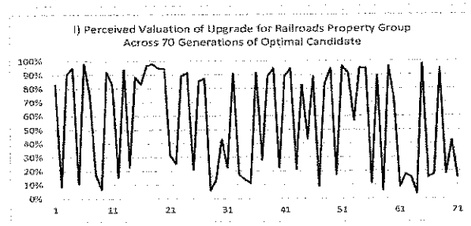


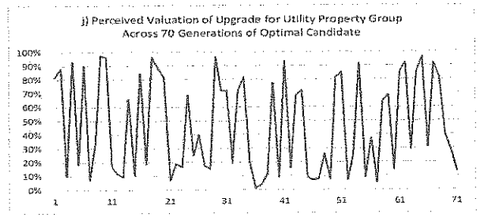












Please visit the following link to refer to the complete list of python scripts used for the analysis.
https://github.com/shreerajshrestha/Monopoly_Mega_Edition_Evolutionary_Optimization

The following link includes the Java files used in the simulation for the preliminary research where we analyzed the Mega Edition using Markovian analysis. The statistics that were generated are also included in this repository. https://github.com/shreerajshrestha/Monopoly_Mega_Edition_Markovian_Optimization

Does Impact Investing Lower The Cost Of Capital?

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Abstract

Some firms rely too heavily on high-priced equity to generate funds for impact-related projects and too little on a balanced leverage approach. Some research suggests positive effects on a firm's cost of capital that produce lower costs of equity, while others show that a firm's cost of debt may not be lowered significantly. This paper examines determinants of the cost of capital related to impact investments, and develops a model to explain implications for firm behavior. We consider endogenous and exogenous factors that drive the cost of capital and posit what impact-projects do to influence a firm's cost of capital.

Introduction

It is often considered that more debt yields poorer bond ratings and more risk associated with a firm. Several researchers have suggested that all forms of borrowing increase leverage and thus, beyond a point, will lower the credit rating of the firm. Hence most forms of debt are bad for the firm beyond a certain point, usually specified by the debt covenants on the firm's debt issues. However, this blurs together all different forms of corporate borrowing from project-related finance, inventory, or operations finance to impact based finance. Many of the different uses of a firm's cash are for the purpose of extending/sustaining existing businesses or establishing new business units. Where impact investing veers away from this traditional approach is that firms are making investments in existing operations to improve their efficiency or make the product or process more sustainable. In the short-run the debt levels will rise and possibly drive the credit rating down and thus ratchet up the cost of capital.

Cost of capital represents the key decision-making variable in the net present value decisions that management use to determine whether or not to move forward with various projects. The cost of capital is weighted between several different potential sources of funds: equity issuances, debt issuances and hybrid preferred equity issuances. Cost of equity can be driven up or down by the rate of return forgone by selling a share of stock. For example; if a share is expected to get a 12% return then the investor would be forgoing 12% on that share if they were to sell it. Internally the firm is also giving up a potential 12% return by selling shares. Usually the main investor to suffer the loss is not the firm itself but the existing shareholders, who find themselves diluted down and thus with a slightly lower rate of return, Barton (2011). Drivers to the cost of equity are higher/lower earnings, higher/lower taxes, and higher/lower debt levels. Drivers for the cost of debt are extraordinary firm borrowing or retirement of existing debt. There is a class of bonds that are not considered investable grade bonds that may fall somewhat outside the scope of the cost of debt as they are not anchored or secured to firm assets. However, these rates are extremely high and in many cases firms will avoid the use of this type of debt or debenture as a way of financing operations, because the cost of servicing this debt is extremely high and thus reduces the flexibility of the firm should an economic downturn reduce earnings. Therefore if we consider the traditional accounting equation:

$$\text{Assets} = \text{Liabilities} + \text{owners' Equity} \tag{1.1}$$

If we increase liabilities without proportional increase in assets, owners' equity must decline. However, assets under impact investment may take the form of capital improvements or process improvements which may not immediately seem like a decrease in cost to operations unless a higher level of profitability is immediately identified. This lead-lag arrangement warrants further analysis.

Equity metrics

The cost of equity is based on the CAPM equation where the return on the individual stock is a function of the risk-free rate the beta related to the stock times the market risk premium or the difference between the market and the risk-free rate:

$$R_i = R_f + \beta(R_m - R_i) + e \tag{1.2}$$

Beta is related to the covariance of the stock of the market over the variance of the stock market in general. The more out of phase the stock is with market movements the larger the covariance and thus the larger beta. However, in periods where

market volatility or variance are extremely large relative to the covariance of the stock, data will actually decline and thus the relationship between the stock and the risk-free rate becomes a lot closer i.e. the cost of equity would decline:

$$\beta = \frac{Cov(R_i, R_m)}{Var(R_m)} \tag{1.3}$$

Changes in the return of the stock may be driven by the underlying data and market rates of return. With regards to the return, "a rising tide raises all boats", so when the market rises so too does the rate of return on an individual stock provided the data is at parity of one or greater. However the more stable. Returns are or the more stable the risk-free rate is perhaps the lower the cost of equity maybe. This may turn up in a lower volatility and ultimately lower covariance and thus yielding a lower beta. Driving the return on the cost of equity down to that close to the cost that. This overall effect would drive the cost of capital the firm down closer to the cost of debt. Impact investments may have the effect of reducing the volatility of returns after all news and information of firms making internal impact investments may have a more positive effect on the share price to neutral but very really would have a negative impact on the share price. Conversely, new product ideas can create instability as markets waits to see how the effectiveness of the new product plays out. This might have the effect of causing more volatility in the share price and perhaps higher covariance value which would lead to a higher beta.

Debt metrics for impact investments

Consider that the overall debt of the firm is the sum of these three types of debt components:

$$K_t = W_o K_o + W_p K_p + W_i K_i \tag{1.4}$$

Where W_o, W_p and W_i are the respective weights associated with operations, projects and impact investments. Thus the overall firm's debt profile is a function of these weighted costs of debt.

Depending on the firm, higher cost of capital may be associated with some forms of these. Thus, the cost of debt (determined by the weighting of each of these ratios) may be higher or lower depending on the type of risks the firm is willing to take. Even though these impact investments might lead to a more profitable firm, managers may be unwilling to make these kinds of investments as it is unclear whether or not shareholders will recognize the value to the firm of impact investment and the resulting improved approach to profitability. Managers faced with this decision may choose the more conservative approach and not make these kinds of impact investments. At present, much of this can be seen from the strong approach that firms take towards corporate social responsibility or CSR. More often this is seen as a marketing expense or a way to improve the profile of the organization in the public eye, rather than an opportunity for real process improvements and long-term cost cutting.

Consider that debt has several components, the cost of debt related to funding existing operations K_o, this type of debt is often replacing older (which may be expiring due to the lifespan of specific) bonds. Many firms use various methods from sinking fund provisions to callable bonds to raise capital to finance cash flow shortfalls or existing operational demands.

Another type of debt may be project related debt K_p which carries a higher inherent level of risk as it is related to new projects which are ultimately new forms of businesses that may be generated by the firm. The reason these projects often carry a higher level of risk is that in many cases they are used to extend the existing business model of the firm into new product innovations, new product lines or product adaptations to maintain the competitive position of existing products. The risk level associated with them comes from the untested nature of these investments. Often when trying to establish net present value of these projects, the "cost of capital" used is not necessarily the firm's cost of capital but rather the cost of capital associated with similar risky projects. So, the threshold for these projects to move forward is often higher than investments in enhancements to existing operations. Quite often this disadvantages the firm which may decide that a project is too risky to move forward. Thus the cost of capital assigned to it may be so high that net present value is negative, even when the firm's cost of capital would have had a project looking positive and worthy of moving forward. The problem with this approach for the firm is that many good projects or new projects may be passed over by more conservative management, in choosing to use a higher cost of capital rather than the firm's cost of capital. At face value this seems prudent as it takes a much more conservative approach to addressing the pitfalls of new business models. However, older firms with more conservative outlooks may choose to turn down many profitable projects as a direct result. This can be seen time and time again in the history of business in dominant industries such as the steel industry, where investments in mini mill technology were deemed costly and untested; thus many firms refused to make investments in the new technologies which ultimately led to their downfall. At this point we should add

that sunk costs also played an important role. Firms were unwilling to make investments where they had a high degree of sunk costs since they often had high levels of debt associated with those.

There are others types of debt K_i we might call impact debt which relates to process or product system improvements that will ultimately lead to a change in the existing operations or products. These might take the form of an investment of operations for product improvements which would have a longer-range decrease in cost and increase in profitability. For example, assume a firm makes an impact investment in solar power or wind power generation to decrease costs and improve operational efficiency. Initially it registers as a higher level of debt. In the near to midterm, the profitability and cost decreases associated with this kind of investment will make the competitive position and the profitability of the product significantly better. Or consider another type of impact investment where a firm like Apple makes an investment in lower-cost recycled materials to decrease the weight of the laptop, or better battery technology to improve the lifespan of laptop batteries, thus lowering the carbon footprint of every user of its computers. The former will lead to higher profitability in the product, the latter is a value proposition to the consumer. This value proposition may not immediately have an impact on the bottom line of the firm. However, consumers will respond to the improved product profile and sustainability of that product.

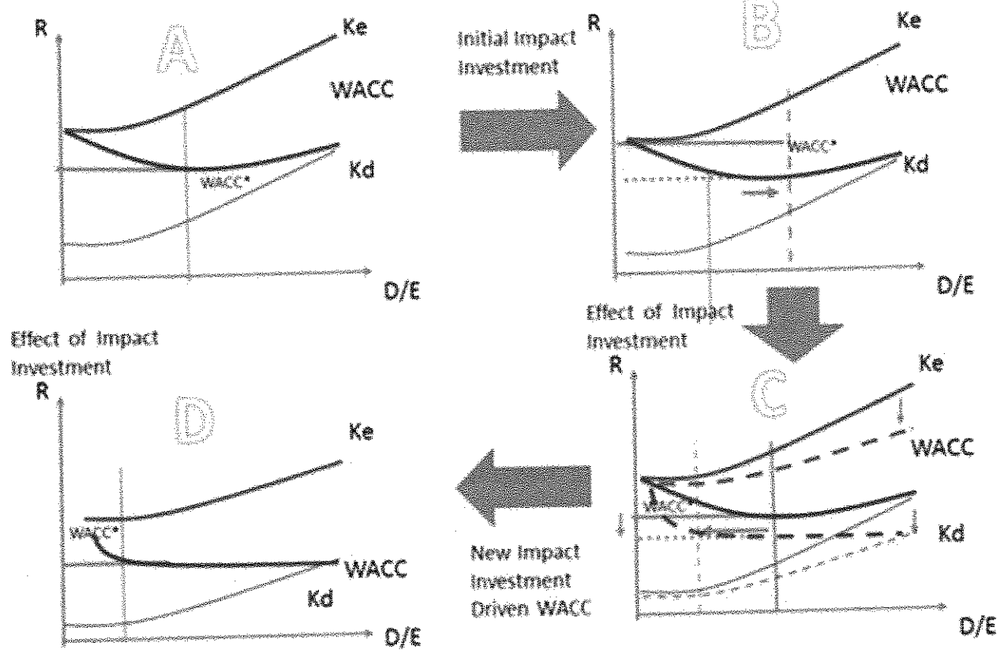
Profitability of impact firms

As the profitability of the firm increases there will be a parallel increase in the share price as the retained earnings contribute to improving the equity of the firm. Higher profitability of the firm will eventually lead to a lower cost of capital. Thus, these impact investments raise the level of debt of the firm on the balance sheet, but yield better earnings on the income statements and higher contributions ultimately go back to owner's equity. The timing of the increase in debt and the subsequent increase in equity may have a short or longer-term effect: initially we might see a decline in owner's equity related to the increase in debt associated with these impact improvements and then a subsequent rise in owner's equity directly related to the increase in operational efficiency or product/process improvement. The increase in owner's equity in many cases may be significantly higher than the decrease associated with the debt. An increase in profitability will ultimately lead to a lower debt to equity ratio. With the lower debt to equity ratio we would ultimately see a decrease in the cost of capital associated with the decline in the debt-to-equity ratio. So in the short run, we would see an increase in the cost of capital as initial debt investment was made. The firm's cost of capital may reflect the higher riskiness and the lower availability of debt as a means of financing the firm. As the cost improvements demonstrate themselves to be more valid, and the proportional rise in equity more prominent, cost of capital should decline.

Cost of capital implications

Initially as demonstrated in Figure 1 graph A, the optimal weighted average cost of capital is shown as WACC*. When an impact investment is made to the firm the debt level is raised and therefore the debt to equity ratio changes as a higher percentage of the firm is leveraged, as seen in graph B. However, as the investment makes the firm more profitable, earnings as well as perhaps retained earnings increase. Thus, the equity of the firm increases and debt to equity decreases. As the firm increases its equity position it may fundamentally change its ability to service debt and also change the shape of its cost of debt curve; this will also change the shape of the WACC curve. In Graph C we see these fundamental changes to the WACC curve. Ultimately, the WACC shifts along its curve to a newer lower optimal as the firm has structurally changed its WACC through modifications to debt costs and associated equity costs. In Graph D we see this change where the new WACC* is at a new lower optimal.

Figure 1: Impact Investment Effects on WACC



Revenue-generating ventures designed for positive social impact

Impact investing is built on the belief that financial tools and private capital can play a powerful role in solving the massive global challenges of our day, and that capital markets should work for good as well as profit. Impact investing is about using markets and money for social good. Although it is possible for impact investors to achieve social impact along with market rate returns, it is not easy to do, Bugg-Levine and Emerson (2011). One of the unfortunate characteristics of imperfect impact investing markets is their inability to attract the large majority of socially neutral investors who demand a market return. The majority of investors and finance institutions are either unable, or unwilling, to sacrifice financial performance for having an outstanding impact. According to the Global Impact Investing Network (2010), the market for impact capital, currently sized at $60 billion, could grow over the next decade to $2 trillion, or 1% of global invested assets. It is estimated that over $1tn (£615bn) of social investment funds could be unlocked around the world, giving welcome impetus to the idea that the power of enterprise can be harnessed to benefit - rather than hinder - society as a whole.

That claim is made by many social impact investment funds and a recent US study back this up, asserting that the majority of social impact investing produces market-rates of returns. Using calendar-time portfolio stock return regressions, Mozzafar, Serafeim, and Yoon (2015) find that firms with good performance on material sustainability issues significantly outperform firms with poor performance, suggesting that investments in corporate sustainability are shareholder-value enhancing. Those businesses which prioritized financial goals over social goals were much more likely to experience high rates of growth and have even greater social impact, Cohen and Sahlman (2013). Though the sample was relatively small, the trend was quite strong as the more likely entrepreneurs were to favor financial goals, the faster their companies grew. The ventures that grow fastest are likely to be the ones that have the most frictionless business models. A more robust strategy is to design business models that align financial and social goals as closely as possible to minimize tradeoffs and reduce friction. When tradeoffs must be made, social and financial goals must be married in a way that minimizes the firms' willingness to prioritize financial goals

over social ones and maximizes the long-term sustainability of the business. Investing in sustainability has usually met, and often exceeded, the performance of comparable traditional firms' specific investments, Clark, Feiner and Viehs (2015). Morgan Stanley (2015a), for example, reviewed a range of studies on sustainable investment performance and examined performance data for 10,228 open-end mutual funds and 2,874 Separately Managed Accounts (SMAs) based in the United States and denominated in US dollars. In the scope of the review, the company ultimately found that investing in sustainability has usually met, and often exceeded, the performance of comparable traditional investments. This is on both an absolute and a risk-adjusted basis, across asset classes and over time. There is a positive relationship between corporate investment in sustainability and stock price and operational performance, based on a review of existing studies, see Clark, Feiner, and Viehs (2014).

So according to Brest and Born (2013) when can investors expect both to receive risk-adjusted market-rate returns on their investments and to have real social impact? Can investors both make a difference and make money as claimed by many impact investment funds? Estimating the expected financial return from an investment is a difficult but familiar exercise. One recent study by Morgan Stanley (2010) asserts that most of what it estimates to be a $4 billion impact investing market in the US, as confirmed by Pacific Community Ventures (2015), involves investments producing market rate returns. Non-concessionary investors are not willing to make any financial sacrifice to achieve their social goals. Non-concessionary impact investors are especially likely to have investment impact in conditions of imperfect information—for example, in social or environmental niche markets where impact investment fund managers or other intermediaries have special expertise or intelligence on the ground. One of the unfortunate characteristics of imperfect impact investing markets is their inability to attract the large majority of socially neutral investors who demand market returns. Where such returns seem plausible, a respected institution can signal to other investors that a particular investment or an entire sector that others may have thought dubious is actually worthy of consideration. According to Strom (2011) "the main reason for investing in EcoTrust Forest in this way is to demonstrate that sustainable forest practices can generate a profit so that mainstream investors will become more interested in it." Motivated investors may be particularly interested in identifying these opportunities and thus may be able to have impact even at non-concessionary rates. This is the most likely explanation for asserting the double-bottom-line success of firms like Elevar Equity. Elevar Equity generates "outstanding investment returns by delivering essential services to disconnected communities underserved by global networks." The forthcoming analysis of impact investing funds by Clark, Emerson and Thornley (2016) should further illuminate the returns space.

Investors at large may be unjustifiably skeptical that enterprises that are promoted as producing impact value are likely to yield market-rate returns. Impact investing typically does not take place in large capitalization public markets, but rather in domains subject to market frictions. While some of these frictions impose barriers to socially neutral investors, socially motivated impact investors may exploit them to reap both social benefits and market-rate financial returns. The counterfactual argument is that ordinary, socially neutral investors would have provided the same capital in any event. Under the additionality criterion for impact, how can an impact investor expect market returns and still provide capital benefits to the enterprise? What is less clear is how and when investors expecting market returns (or better) have investment impact. Yet much of the impact investment space is occupied by funds that promise their investors both socially valuable outputs and at least market returns. Most so-called "double-bottom-line" impact investors are non-concessionary. El Ghoul, Guedhami, Kwok, and Mishra's (2011) findings support arguments in the literature that impact enhances firm value. Based on a sample of 2,809 U.S. firms over the period 1992 to 2007 impact investments exhibit lower cost of equity capital after controlling for other firm-specific determinants, as well as industry and fixed year effects. Accordingly, impact investment 'substantially contributes to reducing firms' cost of equity which were robust to a battery of sensitivity tests'. Capital is a tool and market rates of return and high impact are expected. A binary focus could be applying 19th century science to a quantum world, where a binary approach causes you to misperceive both risk and opportunity. It may represent a set of outmoded narrow lenses that will cause any investor using them to underperform and not create all the blended value (s)he would have otherwise.

Consider two firms, one firm (firm a) which chooses to borrow in order to make an investment in solar or wind power for factories and other installations. Another firm (firm b) which chooses to make an investment in a new untested product line. While the marketing material and other related information may make the "firm b" look incredibly appealing with a new product on its way. The product may not be successful or may not hit the market in the way the firm expects, so justifiably the cost of capital for this firm will rise as the risk level of the projects will translate into higher rates of interest or a higher cost of equity. However, "firm a" which has invested in technology to reduce costs will see cost improvement across the board directly related to that investment. So "firm b" with its new product may find it harder to meet the debt service on the interest of the nonperforming or riskier product line. Meanwhile, "firm a" will more than likely be able to meet the debt service and improve their cost position. "Firm a" might be considered to have made an impact investment that might not necessarily be attractive to mainstream investors. While "firm b" may be considered to have made exactly the kind of investment expected by those same mainstream investors.

When we consider high impact investing practices that focus on internal efforts of firms to improve their people, products, health and wealth with respect to their firm (Herman, 2010) these firms tend to outperform other firms that are only bottom-line focused. More recently, investment capital flows have shown that these kinds of decisions have become more attractive to

mainstream investors as they have identified that these practices lead to higher profit margins and stronger market positions. The group of investors unwilling to see these kinds of improvements as value-added to the bottom line are shrinking daily, Bonini and Schwartz (2014).

Some countries like the UK have gone beyond firm-related impact investments to social bonds and other forms of investable instruments that track performance based on some kind of societal impact. One example is bonds related to recidivism rates of prison inmates. As the recidivism rate drops and the former inmates are able to more effectively integrate back into society the cost of managing those individuals born by the state significantly declined. Thus, the bond pays at higher rates of return to those that had invested in the debt instruments, which ultimately led to programs that help reduce recidivism further.

Perspicacity, or discerning opportunities that ordinary investors do not see, means someone with distinctive knowledge about the risk and potential returns of a particular opportunity may make an investment that others would pass up. These capital benefits enable the enterprise to experiment, scale up, or pursue impact objectives to an extent that it otherwise could not. Perspicacity may hold the key to achieving both market returns and social impact, as evidenced by pioneering firms like Bamboo Finance and many others who are achieving commercial returns and impact. A report conducted by Deutsche Bank Climate Change Advisors, Fulton et al. (2012), that was based on more than 100 academic studies, found impact strategies to be correlated with superior risk-adjusted returns at a securities level. In social or environmental niche markets impact investment fund managers or other intermediaries have special expertise or intelligence on the ground. Assuming that, at the time of an investment, the enterprise can productively absorb more capital, then an investment has impact if it provides more capital, or capital at lower cost, than the enterprise would otherwise get.

The enterprise itself has impact only if it produces social outcomes that would not otherwise have occurred. For example, socially neutral investors, motivated only by profit, have contributed to the social impact of telecommunications companies in both the developed and developing world. Socially neutral investors are indifferent to the social consequences of their investments. Many endowments invest in a socially neutral manner, as do individuals who invest through money managers or funds whose only mandate is to maximize financial returns. These are non-concessionary investments, which expect risk-adjusted market returns or better. Impact investing may be defined capaciously, as actively placing capital in enterprises that generate social or environmental goods, services, or ancillary benefits (such as creating good jobs), with expected financial returns at or above market. By hypothesis, an ordinary market investor, who seeks market-rate returns, would not provide the required capital on as favorable terms. Impact investors can invest on a spectrum ranging from risk-adjusted market returns at one end to highly concessionary investments at the other. Any individual investor may take a range of return positions depending on the investment in question. Having investment impact means capitalizing an enterprise beyond what would happen otherwise. If an enterprise offers risk-adjusted market rate returns, why aren't more ordinary, non-concessionary commercial investors funding it? Understanding the barriers to their doing so may hold the key to scaling up socially valuable enterprises. To reach scale, the impact investing sector needs to be more attractive to the large majority of non-concessionary investors' impact investing as a stage of its developmental process.

On the firm side, making impact investments might initially lead to higher costs of capital which may make it much more difficult for the firm to raise needed capital for other projects. However, they will invariably see a decrease in the cost of capital in the long run. Yet, if it were clearer to investors at the outset that the firms were choosing to make these kinds of internal impact investment, perhaps the cost of capital would not rise at all but instead would decline consistently with the productive use of such capital internally.

Conclusions

Impact investing is about using markets and money for social good as well as producing market-rate returns. This outperformance may come in the form of reduced risk, reduced volatility, or business growth. "Risk-adjusted" market rates of financial return, social and environmental factors are major drivers of investment risk mitigation and success. Investing in companies that are proactively responding to critical social and environmental factors will outperform (investing in) companies that lag behind in addressing these issues.

In the scope of our review, we ultimately found that investing in sustainability has usually met, and often exceeded, the performance of comparable traditional investments. Evidence in the literature supports that this is on both an absolute and a risk-adjusted basis, across asset classes and over time. Ultimately, we believe that sustainable investing is simply a smart way to invest, and our review of sustainable investing performance shows that preconceptions regarding subpar investment performance are out of step with reality, Fitzgerald (2016). The ideal outcome for most enterprises that initially rely on concessionary capital is that they eventually yield market returns and attract socially neutral investors.

Internally to the firm, making impact investments may initially lead to higher costs of capital which may make it more difficult for the firm to raise capital for other projects or impact investments. There will be a decrease in the cost of capital over the long run. The decline will come as a direct result of the investment in projects with the highest firm-related impact and the efficiencies gained by making these investments.

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Reducing Individual Tax Evasion with the LG Tax System

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Abstract

Tax evasion costs the IRS and state governments billions of dollars each year. The proposed LG tax system is used to reduce or prevent tax fraud. Oftentimes, the IRS and many state governments processed two tax systems for employers and individuals. These different systems would cause employers and individuals to have diverse standards or references to similar tax rates. On another occasion, before sending out tax refunds from the IRS and state governments, the detailed tax information on taxpayers' filing status, deductions, exemptions, taxable income, and others are unclear and not determined. The W-2 Form provides only limited information for the IRS and state governments to process individual returns. This paper enlightens these two major loopholes and provides a proposed LG tax system to reduce some potential tax noncompliance issues, which could save significant costs for both individuals and governments.

Introduction and Literature Reviews

Tax evasion is a practice of tax fraud when the taxpayer is deliberate attempt to misrepresent personal or entity taxable income to the Internal Revenue Service (IRS) and state governments. Tax invasion involves of several fraudulent forms, including taxpayers may try to under pay or to avoid paying taxes, underreport or hide their income, overstate expenses or deductions, employ in accounting indiscretions, omit or transfer income or assets illegitimately. These types of tax evasions are intentional tax liability's concealment to the government by not paying taxes. The consequence of the tax non-compliance is subject to substantial penalties and criminal punishment.

The Tax Relief and Health Care Act of 2006 (Pul. L. 109-432, 120 Stat.2922) is a federal statute that expanded the rights of individuals who provide the IRS with information about tax law violations. Under section 7201 of the Internal Revenue Code, tax evasion which is punishable by a fine of up to $100,000 for an individual or $500,000 if the taxpayer is a corporation, imprisonment of up to five years, or both. The IRS has created incentives to encourage disclosure from individuals who are aware of significant incidents of tax fraud.

In the IRS 2001 report, the underreporting of income remained the biggest contributing factor to the tax gap in 2006. Under-reporting across taxpayer categories accounted for an estimated $376 billion of the gross tax gap in 2006, up from $285 billion in 2001. Tax non-filing accounted for $28 billion in 2006, up from $27 billion in 2001. Underpayment of tax increased to $46 billion, up from $33 billion in the previous study. Overall, compliance is highest where there is third-party information reporting and/or withholding. For example, most wages and salaries are reported by employers to the IRS on Forms W-2 and are subject to withholding. As a result, a net of only 1 percent of wage and salary income was misreported. But amounts subject to little or no information reporting had a 56 percent net misreporting rate in 2006. Thus, there was 18 to 19 percent of total reportable income is not properly reported to the IRS. In 2010, tax revenue lost had been reduced some and estimated around $305 billion.

Hyman (2011) has stated that tax compliance study for the income tax. He suggests that some effective ways to decrease tax evasion, including the increase of both the probability of IRS tax audits for taxpayers and the requirements for reporting income to the IRS as well as the withholding taxes from earnings. However, beginning in 1963 and continuing every 3 years until 1988, the IRS analyzed 45,000 to 55,000 randomly selected households for a detailed audit as part of the Taxpayer Compliance Measurement Program (TCMP) in an attempt to measure unreported income and the "tax gap" (Andreoni, Erard, Feinstein, 1998). The program was discontinued in part due to its intrusiveness, but its estimates continued to be used as assumptions. In 2001, a modified random-sampling initiative called the National Research Program was used to sample 46,000 individual taxpayers and the IRS released updated estimates of the tax gap in 2005 and 2006 (Slemrod, 2007).

However, critics point out numerous problems with the tax gap measure. The IRS direct audit measures of noncompliance are augmented by indirect measurement methods, most prominently currency ratio models (Feige, 1989). The Internal Revenue Service (2012) released a new set of tax gap estimates for tax year 2006. The voluntary compliance rate — the percentage of

total tax revenues paid on a timely basis for tax year 2006 is estimated to be 83.1 percent. The voluntary compliance rate for 2006 is statistically unchanged from the most recent prior estimate of 83.7 percent calculated for tax year 2001.

Also the current filing deadlines do not permit the IRS and taxpayers to access third-party information on a timely basis. Taxpayers' filing detail tax data for such as tax filing status, deductions, exemption number, taxable income, tax rate and tax, which are not covered by W-2 form, are known after the IRS receives their tax returns by April 15. Before receiving tax returns, the IRS has no detail individual tax data as references to be ready for comparisons. As a result, the current tax systems limit taxpayers' information to file accurate and timely returns. Then the IRS has no enough time to do verification on the taxpayers' returns before sending refunds to taxpayers, which give criminals a chance for possible tax evasion, such fraud created the cost of some $5.2 billion for the IRS in 2013 (Shipley, 2015).

Kao and Lee (2013) have developed a linear and gradual (LG) tax system to simplify the current U.S. individual income taxation in 2011 and 2012. This study is to eliminate the current complex Tax Tables (12 pages) and Tax Rate Schedules without tax estimation by accurate tax rate and tax calculations. Kao and Lee (2014a) have further developed the LG tax system to simplify the current U.S. federal and state corporate income taxation in 2012 and 2013 from eight federal corporate tax brackets to four with 50% or more reduction. Kao and Lee (2014b) also have simplified current state individual income systems practically. The advantages of the LG tax system include simplifications on tax/tax rate calculation, analysis, modification, reform, and projection with reductions of tax processing time and management cost for individuals, corporations, and governments.

This research paper is based on the LG tax system to simplify federal individual and corporate tax systems in 2013, 2014 and 2015. The proposed LG tax system combines the existing complex Tax Rate Schedules, Tax Table (12 pages) and Tax Computations together for employers and employees, provides computer programs to calculate tax rate and tax automatically, let the IRS to access taxpayers' information by January 15 for reducing tax invasions, and provides the possibility for many taxpayers with one income source to pay exact taxes from withholding taxes and have option on filing exemption for their tax returns. The LG tax simplification means to simplify tax rate/tax calculations, analysis, modification, reform and projection for Tax Administration without changing existing tax rates, which may be performed by the IRS. The LG tax system simplified tax rates effectively according to actual situations for tax legislation.

Implications

Tax evasion costs billions of dollars to federal and state governments and taxpayers yearly. There are two major reasons. One is federal IRS and many state governments make two tax systems for employers to estimate withholding income taxes and for individuals to calculate accurate taxes in tax returns. The two tax systems are not connected each other. Employers and individuals have different standards or references even the two tax systems have similar tax rates. Then employers report W-2 forms, which do not include detail tax information such as tax filing status, exemption, deductions and taxable income, to the IRS by March 15. Another reason relates to timing problem. When receiving tax returns from individuals, the IRS and state governments have no detail tax information as references to compare and verify these tax returns and send tax refunds with 45 or even 15 days. These two major reasons give delinquents a chance for possible tax evasion. The two problems can be overcome by the proposed LG tax system. The above two tax systems can be simplified and combined together. Also the IRS and state governments can receive detail tax information from employers by January 15 or February 15 with modifications. Before receiving tax returns, the IRS and state governments have detail individual tax information as references to be ready for comparisons and verification. Then tax invasions could be reduced or avoided for individuals and governments.

1. Reasons to cause potential tax evasion by the existing tax systems

A. Existing two tax systems used by employers and individuals

In our existing federal tax system for individuals, there are 7 tax brackets with 10%, 15%, 25%, 28%, 33%, 35% and 39.6% with tax rates 10%-39.3% for the four filing statuses: (1) Married filing jointly or qualifying widow(er); (2) Head of household; (3) Single and (4) Married filing separately.

The IRS and many state governments make two tax systems currently. One is used for employers to estimate withholding income taxes with Tax Rate Schedules and related tables. The Tax Rate Schedules for Married filing jointly (2014 and 2015) are shown in Table 1, which are used for employers to estimate withholding income taxes for employees. The Tax Rate

Schedules in 2014 are modified slightly comparing with the Tax Rate Schedules in 2015. The first tax rate is at 10% for taxable incomes from 0 to $18,150 in 2014 or from 0 to $18,450 in 2015 with the difference $300 (18,450-18,150).

Table 1 Federal Individual Tax Rate Schedules (2014 and 2015) for Tax Estimation (Partial)

Taxable income (TI) Over	Not over	2014 Tax is	of the mount over	Taxable income (TI) Over	Not over	2015 Tax is	of the mount over
Schedule Y 1 - Married Filing Jointly or Qualifying Widow(er)							
0	18,150	10%		0	18,450	10%	
18,150	73,800	$1,815 + 15%	$18,150	18,450	74,900	$1,845 + 15%	$18,150
73,800	148,850	$10,162.50 + 25%	73,800	74,900	151,200	$10,312.5 + 25%	74,900
148,850	226,850	$28,925 + 28%	148,850	151,200	230,450	$29,387.5+28%	151,200
226,850	405,100	$50,765 + 33%	226,850	230,450	411,500	$51,577.5 + 33%	230,450
405,100	457,600	$109,587.5 + 35%	405,100	411,500	464,850	$111,324 + 35%	411,500
457,600		$127,962.5 + 39.6%	457,600	464,850		$129,996.5+39.6%	464,850
.....							

Table 2: Federal Tax Table for Married Filing Jointly or Qualifying Widow(er) (12 pages)

Taxable income (TI)	*Tax is*	*Taxable income (TI)*	*Tax is*	*Taxable income (TI)*	*Tax is*
0 – 5	0	10,000 – 10,050	1,003	.....	
.....		10,050 – 10,100	1,008	75,900-75,950	10,041
2,000-2,050	201	.....		75,950-76,000	10,054
2,050-2,100	204	30,000 –30,050	3,634	.....	
.....		30,050 –30,100	3,641	99,950-100,000	17,054

Another tax system, which includes Tax Tables and Tax Computations, is used for individuals to calculate accurate taxes in tax returns. Table 2 is the federal Tax Table and is used for individuals (such as Married filing jointly), who have less than taxable income $100,000, to search and find their tax payments. These tax payments in the 12-page Tax Table have no directed connection each other. The tax numbers in the Tax Table can be programmed by tax software with more data space and complex search function, which is used for automatic search. Table 3 shows Tax Computations in 2014, which has slight modifications comparing with 2013. For taxable incomes less than $450,000, the differences between the two years are minor. Tax Table, Tax Computations and related taxable income ranges are modified every year such as from 146,400 to 148,850 and from 0.25 TI - 8,142.5 to 0.25 TI - 8, 287.5. 2014 Tax Table and Tax Computations are slightly different from 2013. The 2015 Tax Table and Tax Computations is available by the IRS after January, 2016. Tax Schedules are used for estimating income taxes. Tax Table and Tax Computations are used for calculating accurate income taxes. However, Tax Schedules and Tax Table/Tax Computations have no direct relationship.

Table 3: Tax Computations for Married Filing Jointly or Qualifying Widow(er)

Taxable income (TI)		*2014 Tax*	*Taxable income (TI)*		*2013 Tax*
Over	*Not over*		*Over*	*Not over*	
0	100,000	Tax Table (12 pages)	0	100,000	Tax Table (12 pages)
100,000	148,850	0.25×TI – 8,287.5	100,000	146,400	0.25×TI – 8,142.5
148,850	226,850	0.28×TI – 12,753	146,400	223,050	0.28×TI – 12,534.5
226,850	405,100	0.33×TI – 24,095.5	223,050	398,350	0.33×TI – 23,687
405,100	457,600	0.35×TI – 32,197.5	398,350	450,000	0.35×TI – 31,654
457,600		0.396×TI – 53,247	450,000		0.396×TI – 52,354

The two different tax systems make employers to use Tax Rate Schedules and individuals to use Tax Tables and Tax Computations. There is no direct connection between the two tax systems even they have similar tax rates. Before receiving tax returns, the IRS has no detail tax information such as filing status, exemption, deduction, retirement, credit, taxable income, tax rate and tax as references and do not know these tax returns are from real individuals or not because there is no reference to be compared, which may cause potential tax invasions. Many states have similar two tax systems such as CA, IA, AR and HI. One tax system is for employers to estimate withholding income taxes. Another tax system is used for taxpayers to calculate accurate taxes. The two tax systems give criminals for possible tax frauds. State governments face the same challenge of tax evasions.

B. Tax refunds, timing, and verification

After receiving tax returns, the IRS and state governments usually send out tax refunds within 45 or even 15 days. Most taxpayers send out their tax returns between March 1 and April 15. Some taxpayers require tax refunds and some taxpayers do not require tax refunds. There is significant work for the IRS and state governments to do specially for those tax returns, which require tax refunds. Employers report individual income information to governments with Form W-2 by March 15, which covers social security income, federal withholding income tax and state withholding income tax. There is no detail tax information such as filing status, exemption, deduction, credit, taxable income, tax rate and tax from Form W-2.

Verification and timing are two key issues. When the IRS and state governments have no tax information of filing status, exemption, deduction, credit, retirement and taxable income before receiving tax returns, then verification cannot be done by comparisons before sending out tax refunds, which give criminals a chance for possible tax invasions. Verification with comparison is needed before sending out tax refunds to reduce to avoid potential tax gap.

There are about 138 million federal taxpayers in the United States reported earning $9.03 trillion in AGI and paid $1.23 trillion in income taxes in 2013. The top 50% of all taxpayers paid 97.2% of all income taxes, while the bottom 50 percent paid the remaining of 2.8% in 2012. All state tax return numbers may be somewhat lower than 138 million because some states have no state tax. The IRS and state governments are very busy to process tax returns and tax refunds during the tax season. When employers transfer withholding income taxes for many employees, who have non-complex tax situations, one-source income and gross income less than $100,000/year to federal and state governments, these employees may have no or very small amounts of tax dues or tax refunds. The complexity of the existing two federal tax systems with Tax Rate Schedules, Tax Tables, Tax Computations, changeable taxable income ranges and tax rates could be simplified and improved to let many taxpayers to have option to not file tax returns. The processing time and operating cost could then be reduced significantly. Then, the IRS and state governments can have more time to verify tax returns with comparisons.

2. The proposed LG Tax System for reducing or avoiding tax evasion

A. Combining and simplifying existing two tax systems into one system

Complex existing federal Tax Rate Schedules and Tax Tables/Tax Computations with changeable taxable income (TI) ranges can be combined together simply. 2011 and 2012 tax systems have been discussed with a linear and gradual (LG) tax system by Kao and Lee (2013 and 2014b). Tables 4 shows the LG tax system for 2014. The 7 tax brackets in the existing two tax systems are reduced to 4 with 43% reduction. Its taxable income ranges are simplified into such as 0-100,000, 100,000-250,000, 250,000-450,000, and over 450,000. All Tax Schedules and Tax Tables/Tax Computations can be replaced by Table 4.

When individuals (Married Filing Jointly or Qualifying Widow(er)), have their taxable incomes from 0 to $100,000, a linear formula of $y = a + x/b$ is found to match tax rates from the Tax Rate Schedules and 12-page Tax Table. There is a check tool for tax rates within a narrow range of 10%-16.71%. Here 1/1,490,313 is a constant, which is the slope of $y = a + x/b$. Tax rates change linearly over taxable incomes from 0 to $100,000. The bottom tax rate is 0.1 or 10% (a).

Tax rate = 0.1 + TI/1,490,313 (tax rate range check: 0.1- 0.1671) ..... (1)

Example 1: When a Married filing jointly has a taxable income of $39,855.26, the tax rate formula is 0.1+TI/1,490,313 (for 2014) with the range check (10%-16.71%). Then 0.1+39,855.26/1,490,313=12.67% is the tax rate (tax is $5,056.84). When 2014 Tax Table (39,850-39,000) is used, the tax is $5,074 and tax rate is at 12.72%. Their tax rate difference is 0.05%, which is very minor. The item (39,850-39,000)/39,875 causes tax rate difference 0.13%.

Table 4 LG Tax System for Federal Individual Tax Return (2014)
(1) Married Filing Jointly or Widow(er), (2) Head of Household, (3) Single, and (4) Married Filing Separately

Filing Status	Taxable Income (TI) Over	Not over	Your TI	LG tax rate formula	Tax rate	Range check	Your Tax
1/1	0	100,000		0.1+ TI×F / 1,490,313		0.1-0.1671	
1/2	100,000	250,000		0.1228 + TI×F/2,255,639		0.1671-0.2336	
1/3	250,000	450,000		0.3346 - 25,256.3/TI×F		0.2336-0.2785	
1/4	450,000			0.396 - 52,875/TI×F		0.2785-0.396	
2/1	1			0.1 + TI×F / 1,062,699.3		0.1-0.1941	
		100,000					
2/2	100,000	250,000		0.1562 + TI×F/ 2,636,203.9		0.1941-0.251	
2/3	250,000	450,000		0.3383 - 21,881.3 / TI×F		0.251-0.2899	
2/4	450,000			0.396 - 47,745 / TI×F		0.2899-0.396	
3/1	0	75,000		0.1 + TI×F / 791,139.2		0.1-0.1948	
3/2	75,000	200,000		0.1621 + TI×F / 2,293,578		0.1948-0.2493	
3/3	200,000	400,000		0.3299 - 16,120 / TI×F		0.2493-0.2896	
3/4	400,000			0.396 - 42, 560 / TI×F		0.2896-0.396	
4/1	0	50,000		0.1 + TI×F / 745,156.5		0.1-0.1671	
4/2	50,000	125,000		0.1228 + TI×F/ 1,127,819.5		0.1671-0.2336	
4/3	125,000	225,000		0.3346 - 12,628 / TI×F		0.2336-0.2785	
4/4	225,000			0.396 - 26,437.5 / TI×F		0.2785-0.396	

When the simple LG tax rate formulas in the Table 4 are used to replace Tax Tables (12 pages), the filing status has been simplified and improved significantly. Their results are very compatible. Figure 1 shows tax rate differences between LG tax system and 2014 Tax Tables and Tax Computations. There are minor differences except low taxable incomes less than $1,000. From the existing Tax Table, tax rates at low taxable incomes from $5 to $1,000, tax rates are from 20% to 16%, and 11% respectively, which are not reasonable. The tax rates at low taxable incomes (< $1,000) should be close to 10%.

For different filing periods, employers may consider filing period factor (F) and government regulations and modify tax rate formulas. Table 5 shows different filing period factors. For tax simplification and reform, these constants (a, b, c and d) in the LG tax system (Tax rate= $a + TI/b$ or $c - d/TI$) may be modified and adjusted for more efficient way. In $y = a + x/b$, tax rates (y) against taxable incomes (x) change smoothly with constant slope 1/b, which is not related to taxable income and is more reasonable. The equation of $y = a + x/b$ is suggested to be used for all taxable income ranges except last taxable income range. In $y = c - d/x$, tax rate slope relates to taxable income and always changes at d/x^2, which are used in the existing U.S. federal systems. For last taxable income range, $y = c - d/x$ is suggested.

Table 5 LG Tax Rates for Federal and state Individuals on Different Filing Periods

D (daily)	W (weekly)	BW (bi-weekly)	SM (semi-month)	M (month)	Q (quater)	SY (semi-year)	Y (yearly)
365	52	26	24	12	4	2	1

When employers and employees (individuals) use the same LG tax system (Table 4) instead of the two tax systems (Tables 1, 2 and 3), both employers and individuals have the same standard and reference to be used for comparisons. Employers use the LG tax system (Table 4) to calculate withholding income taxes and transfer to governments. When employees provide accurate tax information such as filing status, exemption number, retirement, deduction and credit, withholding income taxes will be more accurate. Especially employees have simple tax situations with stable income, fixed retirement, standard deduction, and credit that are less than $100,000, accurate income taxes can be calculated by employers. These employees may have option to let the IRS and state governments to know they would not file tax returns because there is no difference between withholding income taxes and taxes in tax returns. Less tax return numbers can reduce work of governments to process during the tax season, which is helpful for governments to verify more tax returns and reduce potential tax evasions.

B. Tax refunds, timing and verification

Employers estimate income taxes according to different filing periods. Yearly withholding tax reports can be done and reported to the IRS and state governments by Jan 15 or 31. The tax report summary for each employee can have tax information of name, social security number, filing status, exemption number, retirement, deduction, credit, taxable income, tax rate, tax and address. Taxpayer's filing status, exemption number, retirement, deduction, credit, gross income, taxable income, tax rate and tax could be used for detail comparison and verification, which can be done automatically, when to the IRS and state governments receive tax returns. Filing status, exemption number, deduction, credit and taxable income, tax rate and tax are not covered in Form W-2. If there is unmatched item or large difference such as taxable income difference more than $2,000 or tax rate difference more than 10%, tax refunds can be hold for further inspection, which reduce or avoid potential tax frauds.

From timing issue, the tax report summary can go to the IRS and state governments electronically by Jan 15 or Feb 15 with modifications. Some individuals, who meet certain conditions, such as gross income less than $100,000, interest/capital gain less than $2,000 and tax difference less than $200, may have option to not file tax returns. Some employees may modify their tax information through their employers electronically by Feb 10. Then the IRS and state governments have all employees' tax information of filing status, exemption number, retirement, deduction, credit, gross income, taxable income, tax rate and tax by Feb 15. Before receiving tax returns by April 15, the IRS and state governments already have tax information ready and enough time to verify tax returns for all employees. If employees change tax information (except deduction, retirement, credit and income) between their employers' reports and tax returns, their tax refunds may be postponed reasonably because of the significant changes, which need extra verifications. The LG tax system could help the IRS (and State governments) to reduce or avoid potential tax evasions.

Related computer programs to calculate taxable income, tax rate, and tax amount automatically have been developed for the LG federal individual tax system in 2012, 2013, 2014 and 2015 and some states with complex individual tax situations such as CA and HI. A tax filing status from the four statuses is selected. When gross income, exemption, retirement, deduction, credit and withholding income tax are inputted, the computer programs recognize the tax filing status, pick up related LG tax rate formula and calculate taxable income, tax rate, tax refund or tax due automatically. A tax rate range check is provided to check its tax rate calculation, which must be within the narrow tax rate range check to reduce calculation mistakes.

C. Tax return option on filing exemption for reducing tax evasions

The total amount of resources needed to support the IRS activities for FY 2012 is about $13.6 billion, which is $1.5 billion more than the FY 2010 level of $12.1 billion. The IRS examined the collection cost was $4.7 billion in 2011(Greenberg, 2015). The simple linear and gradual (LG) tax system provides governments, employers, and individuals to calculate accurate taxes yearly, which may help many taxpayers with non-complex tax situations such as one income source, less than $100,000 income and unchangeable filing status and exemption number to match withholding income taxes with tax returns. So many taxpayers may have option to file no tax returns. If 30% tax returns are reduced, billions of dollars can be saved, which also can reduce potential tax evasions.

Example 2: A mother as Head of Household with two dependents (under 17) has one-income source at $75,000 yearly. She claims standard deductions. Her employer deducts related tax payments (including withholding income tax) for every two weeks and that year. Her Standard Deductions in 2014 are $9,100 for Head of household and $3,950 for each perso.al exemption. Other deductions are various, such as retirement, health deduction and credit. Her retirement is $300 bi-weekly. Each child has tax credit $1,000. Tax data may be calculated by a computer software product automatically.

Taxable income (TI) = Income (I) - Standard Deductions (SD) - Exemption (E) - Other Deductions (OD) .... (2)

3) Gross Income (two weeks): 75,000/26 = 2,884.62

Taxable income = 75,000 – 9,100 – 3,950 × 3 – 300 × 26 = $46,250

TI (2 weeks) = 2,884.62 – (9,100 + 3,950 × 3)/26 – 300 = 1,778.85

Tax rate = 0.1 + TI/1,062,699.3 (2/1) = 0.1 + 46,250/1,062,699.3 = 14.35%..... (3)

Income tax (two weeks) = Tax rate x 1,778.85 – 1000 x 2 / 26 = $178.38

4) There is an additional payment with $2,500 (bonus or salary raise) in December:

Final tax rate=0.1 + TI/1,052,631.6 (2/1) = 0.1+ (46,250 + 2,500)/1,062,699.3 = 14.59% ..... (4)

Total income tax = Final tax rate × 48,750 – 2000 = $5,111.35 ..... (5)

Last income tax payment = 5,111.35 – 178.38 × 25 = $651.85 ..... (6)

The IRS may have her tax records as Head of household with two children, one-income source $75,000 yearly, Standard Deduction $9,100, 3 exemptions, retirement $7,800, child credit $2,000, taxable income $48,750 and total withholding income taxes $5,111.35 at yearly tax rate of 14.59% from her employer's tax summary reported by Jan 15 or 31. She may have an option to not file tax return if she has her total interest and capital gain less than such as $2,000.

Example 3: When a man, who files as married couple with two children, works and lives in California and has a one-source annual based income of $95,000 from his company. His employer may use our tax software product to deduct related withholding taxes and credits on a bi-weekly and yearly basis. His federal standard deductions are $12,400 for Married Filing Jointly and $3,950 for each personal exemption. He has state standard deductions of $7,812 and exemption credit of $212 for Married Filing Jointly and dependent exemption credit of $326. He has one child credit for federal tax return. His retirement is at $146.15 biweekly and medical insurance is at $153.85 biweekly.

His employer calculates his initial federal income tax rate is at 13.96% and income tax (bi-weeks) is $278.30. His withholding taxes (bi-weeks), including withholding income tax, Social Security and Medicare from both employee and his employer, are $837.34 for the federal government. His initial California income tax rate is at 3.13% and income tax (bi-weeks) is $53.59 to his state. His biweekly payroll is $3,042.44. By the end of the year, if he receives a bonus of $4,500, which needs to be adjusted, his yearly overall federal income tax rate is at 14.26%, which is slightly increased from 13.96%. His total withholding taxes, which include total income withholding tax, social security and Medicare from both employee and his employer, are $23,279.14 to the federal government. His total federal income tax is $8,055.64. His yearly overall California income tax rate is at 3.24% %, which is slightly increased from 3.13%. His total state taxes are $1,590.73 to the State of California. His last biweekly payroll is $6,180.84 in the December. His yearly total federal taxable income is $63,500. His yearly total payroll is $82,241.88. These calculated numbers are shown by the tax software automatically.

The IRS may have his tax records of Married Filing Jointly with two dependents, one-income source $95,000 yearly, Standard Deduction $12,400, retirement $3799.90 and total federal withholding income taxes of $8,055.64 at 14.26% and state income taxes of $1,590.73 at 3.24%. The State of California may have his state tax records of $1,590.73 at 3.24% besides his tax filing status, exemption, deduction, retirement and taxable income. If the family has no other income except from their bank saving interest of $225.87, which may be not considered as a major taxable income or use the above federal and state deductions and tax credits, the family has income taxes the same as $8,055.64 and $1,590.73 respectively for the family to file the federal and state tax returns. The family may have an option to file no the federal and state tax returns if total interest and capital gain is less than such as $2,000.

If he reports the above bank saving interest of $225.87 to his employer or the IRS and adds it as his income, the family needs to pay total federal income tax of $8,097.51 with the difference of $41.87 and total state tax of $1,600.82 with the difference of $10.09, which is shown by the tax software product automatically. Total extra federal and state taxes are $51.96 (= $41.87+$10.09). It is not worth to file their federal and state tax returns by paying an extra $41.87 to the federal government and $10.09 to his state government, which involve more tax processing costs and time to the governments. This case has been discussed in 2015 AEF Conference (Kao and Lee, 2015). If bank interest and investment capital gain are less than $2,000 and federal tax difference less than $200 between income withholding tax and calculated tax in the federal tax return, it may be suggested to offer these taxpayers to have an option to file no federal tax returns, which reduce tax return numbers for saving tax processing time and costs, and eventually reducing potential tax invasions.

Conclusion

The two major reasons to cause potential tax evasions are discussed in the paper. One is the IRS and many state governments make two tax systems for employers and individuals separately. Tax Schedules are used to estimate withholding income taxes. Tax Tables and Tax Computations are used for individuals to calculate their tax returns. The two tax systems are not connected with each other. Employers and individuals have different standards or references, and two tax systems may have no similar tax rates. Another reason relates to timing problem. Detail tax information, such as tax filing status, exemption, deductions, taxable income, overall tax rate and tax amounts, is not known by the IRS (and state governments) before receiving tax returns by April 15. When receiving tax returns from individuals, the IRS and state governments have no detail tax information as references to compare and verify these tax returns. The two major reasons would give a chance of fraud for a possible tax evasion.

The current two federal individual tax systems with Tax Schedules and Tax Tables/Tax Computations have been recognized and combined together. Then governments, employers, and individuals can use the same LG tax system as standard and common reference. Employers can report tax summary with detail tax information, such as tax filing status, exemption, deductions, taxable income, tax rate and tax, which is not covered in W-2 Form by March 15, to the IRS and state governments by Jan 15 or Feb 15 with modifications. Before receiving tax returns by Feb 15 - April 15, the IRS and state governments already have tax information and enough time to verify tax returns for all employees, which could help the IRS and state governments to reduce or avoid potential tax fraud.

The supporting computer programs to calculate taxable income, tax rate and tax automatically have been developed according to tax filing status, gross income, exemption, retirement, deduction, credit, and withholding income tax. The computer programs recognize the tax filing status, pick up related LG tax rate formula, and calculate taxable income, tax rate, tax refund or tax due automatically.

There are about 138 million tax returns per year. The average cost of estimated average taxpayer burden for individuals is about $210 by the IRS. If 20% of tax returns are exempted from filing out of total filings, the substantial amount of $5.8 billion can be saved. Significant time and costs could be reduced for the IRS and state governments. When tax return numbers are reduced, potential tax evasions could also be reduced.

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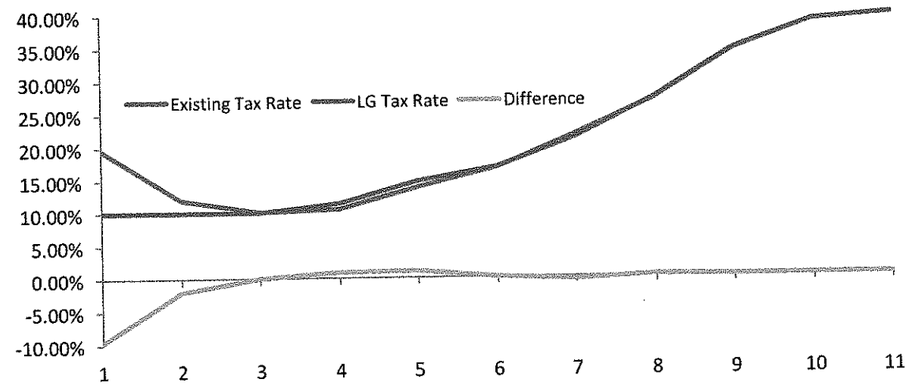
Figure 1 Existing Federal Individual Tax System and LG Tax System

Comparison of Tax Rates between 2014 and LG Tax Systems for Federal Married Filing Jointly Taxable Income: ($5 - $10,000,000)



(Taxable income: 1=$5.1, 2=$50.1, 3=$1,001, 4=$20,000, 5=$70,000, 6=$100,000, 7=$200,000, 8=$400,000, 9=$1,000,000, 10=$5,000,000, 11=$10,000,000.)

Can Non-Accredited Investors Find and Invest in the Next Unicorn?

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Abstract

On October 30, 2015 the SEC finalized the rules for securities crowdfunding under Title III of The Jumpstart Our Business Startups (JOBS) Act of 2012. Starting in the spring of 2016, all investors will have the ability to invest in startup companies through registered online intermediaries known as crowdfunding portals and broker-dealer offering platforms. We estimate the performance of 144 private firms listed in the *Wall Street Journal* to see whether non-accredited investors should have an interest in investing in private companies through the new platforms and discuss whether non-accredited investors can have similar success.

Introduction

Unicorns is a term used to describe private venture-capital backed startup firms valued at over $1 billion. Stanford (2015) reports that 2015 may well be remembered as the year of the unicorn. He identifies 47 companies reaching unicorn status in 2015 from the United States (US) and 28 from outside the US. Nearly $33 billion was invested in unicorns in 2015 and Stanford reports the median deal size of $158 million. Not all the money raised was from venture capital however as Stanford notes that Fidelity, Wellington Management and T. Rowe Price put money into 23 unicorns combined in 2015.

The results from unicorn investing are of relevance in light of the new rules regarding crowdfunding. One can look at the experience from the current unicorns and infer what may happen for investors who are early stage investors under the new rules. On October 30, 2015, the Securities and Exchange Commission (SEC) approved rules that allow all investors to invest and receive equity stakes in startup businesses via crowdfunding. For the first time, private company issuers are able to solicit investments in their securities using public advertising, and permit investment by both accredited and non-accredited investors. Prior to this change only accredited investors (investors whose net worth exceeds $1 million or who earn more than $200,000 a year) could participate in equity crowdfunding. The possibility of non-accredited investors participating in equity based crowdfunding began with the passage of the 2012 Jumpstart Our Business Startups Act (JOBS Act). This latest SEC rule change under the Title III portion of the JOBS Act opens the way for private startup companies to raise money from a wide range of investors in return for equity. Mary Jo White, the SEC chair since April 2013, stated in her speech to the 41st Annual Securities Regulation Institute in Coronado, CA that crowdfunding is "the start of what promises to be a period of transformative change in capital formation."

Taylor (2015) indicates Title III is overdue because the Joint Small Business Credit Survey Report for 2014 reports small businesses continue to struggle to obtain their desired capital through traditional methods. In addition, small loans that startups and small businesses desire are very difficult to obtain. Taylor believes equity based crowdfunding is superior to the traditional debt based funding startups traditionally get. Equity based crowdfunding does not require collateral to receive funds and it doesn't increase the firm's chances of bankruptcy. This may create a moral hazard problem leading business owners to take on too much risk but the added risk may also allow business owners the opportunity to discover new ways to innovate their products or business models. Taylor further argues that only time will tell if equity crowdfunding will work to fund small businesses.

By examining the performance of the 144 unicorns listed in *The Wall Street Journal* (*WSJ*), we show why non-accredited investors will be interested in investing in startup firms. We examine unicorn investors to determine who has been the most successful in picking unicorns and from those results we infer how non-accredited investors might fare as they invest in startups. Clearly, the new rules have only recently seen implantation so only time will tell whether investors can indeed find the next unicorns. In addition, we examine what might be the best strategies for non-accredited investors to use equity crowdfunding and how equity crowdfunding may be tweaked to create a better investing environment.

Title III of the JOBS Act – Non-accredited Equity Crowdfunding

The Jump-Start Our Business Start-Ups Act (JOBS) was enacted into law on April 5, 2012. The law was enacted to help facilitate capital raising for smaller companies by easing the regulatory burdens imposed by Federal securities law. The JOBS Act amended the Securities Act of 1933, providing an exemption, for the small businesses, from registration for the offer and sale of securities in connection with crowdfunding transactions similar to that provided to accredited investors (for more information on the crowdfunding exemption, see Walsh (2015)). It has taken the SEC over three years, but the final rules regarding Title III of the JOBS Act were finally adopted on October 30, 2015 allowing business enterprises to raise capital through crowdfunding initiatives. The new rules will become effective on May 16, 2016. The long delay in implementing Title III by the SEC has been concerns about letting non-accredited investors make investments in illiquid and risky equity and whether there is sufficient regulation regarding equity crowdfunding.

The new rules will allow companies to raise up to one million dollars over a twelve month period without having to comply with the Securities Act's registration requirements. The transaction has to be conducted through a broker or funding portal registered with the SEC. The amount a single investor can invest cannot exceed either $2000 or five percent of the annual income or net worth of the investor if either the annual income or the net worth of the investor is less than $100,000, and ten percent of the annual income or net worth of such investor if either the annual income or net worth of the investor is equal to or more than $100,000. The maximum amount of equity that can be sold to a single investor shall not exceed $100,000. There is no limit on the number of investors that may participate in a crowdfunding offering. There are certain companies that are not eligible to crowdfund under Title III of the JOBS Act. These would include non-US companies, public companies, investment companies and any company with any person that is subject to federal and state disqualifiers. Companies conducting a crowdfunding offering will be required to disclose certain information in an offering statement on Form C filed with the SEC and this statement is to be shared with prospective investors. Information about officers and directors as well as owners of 20 percent or more of the company would need to be disclosed. The issuer would need to provide a description of the company's business and the use of the proceeds from the offering. A description of the financial condition of the company would be also be needed. Further information required includes the price to the public of the securities being offered, the target offering amount, the deadline to reach the target offering amount, and whether the company will accept investments in excess of the target offering amount.

Companies that have filed a Form C to do a crowdfunding offering must file an ongoing annual report on Form C-AR with the SEC after the offering is completed. In the offering documents the company would be required to disclose information in the financial statements depending on the amount offered and sold during a 12 month period. For offerings amounts of $100,000 or less, the company must provide GAAP financial statements for the two most recently completed fiscal years of operations, and filed income tax returns for the most recently completed fiscal year. In both cases, the statements and tax returns need to be certified to be true and complete by the issuer's principal executive officer. If the target offering amount is more than $100,000, but less than $500,000, financial statements must be provided and reviewed by an independent public accountant. For issues of more than $500,000, reviewed financial statements must be provided by the issuer which was a departure from the SEC's original request for audited financial statements. Issuing companies would be required to amend the offering document to reflect material changes and provide updates on the company's progress toward reaching the target offering amount. Companies relying on the crowdfunding exemption to offer and sell securities would be required to file an annual report with the SEC and provide it to investors.

Kinds of Equity Offerings on Internet-based Platforms

Title III joins two other exemptions that were created by the JOBS Act regulating security crowdfunding. Title II lifted the ban on general solicitation for certain Regulation D offerings and Title IV, known as Regulation A+ because it expanded the existing Regulation A exemption. Under Regulation D, accredited investors have invested through equity based platforms since 2011. The JOBS Act simply accelerated the growth of equity crowdfunding.

Title II of the JOBS Act, which has been in effect since September 23, 2013, lifted the prohibition on publicly soliciting investments for private securities under Regulation D, Rule 506(c). Only accredited investors can participate in Rule 506(c) offerings but up to 15 non-accredited investors can participate in the traditional Rule 506(b), where general solicitation is still banned. The new feature of Rule 506(c) is the ability of issuers to advertise, allowing investors to more easily search for placements that suit their needs. Crowdnetic's, *Q3 2015 Report* identified 6,063 private offerings that have recorded capital commitments of approximately $870.0 million over the second year of Title II. This is compared to the 4,712 private offerings that had received capital commitments of $385.8 million through the end of the first year of Title II activity representing growth of 28.7% in the number of offerings and a growth of 125.5% in the amount of recorded capital commitments. These figures represent the performance of offerings under Rule 506(c). Rule 506(b) offerings are not included which would list crowdfunding platforms, and Crowdnetic indicates that it is likely that the numbers of 506(b) offerings and the amount of

capital raised are higher than that of 506(c) offerings. Crowdnetic states that business owners can now take their concept or product directly to the crowd to validate viability instead of relying solely on traditional angel investors and venture capitalists. Raneri (2015a) indicates Rule 506(c) has stricter requirement to verify investors' accredited status, which appears to hold back many issuers from taking advantage of the opportunity to reach more investors.

Final rules under Title IV of the JOBS Act were passed March 25, 2015 and went into effect June 19, 2015. Title IV allows an unlimited number of accredited and non-accredited investors to invest in Regulation A+ offerings. Freedman and Nutting (2015) say Title IV is ideal for growth and later stage companies that want to file so called mini-IPOs. Raneri (2015b) state the SEC created an intermediate capital formation step on the road to going public that could be very beneficial for companies and investors. However, Title IV is not viewed as being good for seed stage startups since compliance costs are projected to be high for the amount of capital being sought in smaller offerings. The Regulation A+ exemption was expanded from a $5 million raise limit to a $50 million limit but divided into Regulation A+ Tier 1 raising up to $20 million and Tier 2 up to $50 million. Before the JOBS Act, Regulation A issuers could sell unrestricted securities to non-accredited and accredited investors. The expanded Regulation A+ still lets non-accredited investors participate but limits their annual investment in offerings above $20 million to 10 percent of their income or net worth. All investors can invest an unlimited amount in Tier 1 offerings up to $20 million. In addition, Tier 2 preempts blue sky review so there is no need for approval by every state in which the offering is made. Tier 1 will still require blue sky review. Regulation A+ offerings are referred to as mini-IPOs as issuers are required to go through a scaled down registration process and file an offering circular with the SEC which is a prospectus like document. Again, Freedman and Nutting believe seed stage and startup companies will not use the Tier 1 part of Regulation A+ mainly because offerings still require blue sky review and compliance which is probably going to be too costly and time consuming. Raneri believes Regulation A+ will allow founders and early stage investors to get some liquidity from having their money tied up for years. He feels this is important because more and more companies are delaying IPOs because of the cost and regulatory burden.

Other options include equity crowdfunding through intrastate securities exemption. Under the Section 3(a)(11) of the Securities Act of 1933, issuers with headquarters in a particular state may sell securities to all investors who live in that state. Coverman (2015) shows that as of November 1, 2015, 29 states and the District of Columbia have such exemption in place. Some of these exemptions are variations of Title III of the JOBS Act, in terms of the dollar limits on capital raising, and investment limits for non-accredited investors.

Freedman and Nutting (2015) report that as a result of the various ways private securities can be listed online, entrepreneurs and investors are confused about the differences between the exemptions and platforms where you find these offerings. Similar to Freedman and Nutting, Table 1 shows the differences, from an investor's point of view, between the four kinds of equity offerings that investors eventually will find on online offering platforms. There is lots of speculation about equity crowdfunding and how equity offering platforms will work. It would appear the natural progression of capital raising will be using Title III or intrastate securities exemption for early seed stage startups, moving to Regulation D for early growth stage companies that are expanding, and then Regulation A+ for pre-IPO later growth. Using Title III for the seed stage seems reasonable. Examining the dollar amount invested in seed rounds of private venture-backed firms over the past five years from *FactSet Mergerstat* shows the average invested to be $1.72 million and the median is $1.3 million out of 1,363 firms. As we will show later, investors will be interested in the equity crowdfunding because of the potential returns.

Table 1: Different Kinds of Equity Offerings on Internet-based Platforms

	Online Launch	Capital Raise Limit in 1 Year	Investor Status	Investment Limit	Intermediary Required
Title IV Reg. A+ Tier 1	June 19, 2015	$20 million	All Investors	No limit	No
Title IV Reg. A+ Tier 2	June 19, 2015	$50 million	All investors	Depends on income/worth	No
Title II Reg. D Rule 506(b)	Sept. 23, 2013	No limit	Accredited investors and 15 non-accredited investors	No limit	No
Title II Reg. D Rule 506(c)	Sept. 23, 2013	No limit	Accredited investors only	No limit	No
Intrastate Equity Crowdfunding	GA was first Dec. 8, 2011	Typically $1 to $2 million	All investors	Depends on income/worth	Varies with each state
Title III Equity Crowdfunding	May 16, 2016	$1 million	All investors	Depends on income/worth	Yes, online portals

Results

Table 2 provides information regarding the 144 private venture-backed companies listed in the *WSJ* (Austin, Canipe and Slobin 2015) as having valuations over $1 billion. Also in Table 2 is an estimated annualized return for each firm using data from *FactSet Mergerstat* and the valuation reported in the *WSJ*. To calculate the annualized return, the date and dollar amount of each investment round prior to the firm's public valuation is obtained from *FactSet Mergerstat.* Using data from Jensen, Marshall, and Jahera (2014), it was estimated that when private companies went public, venture capitalists/angel investors who had funded rounds of financing, owned around 60% of the public company at the time of the IPO. The valuation of these companies was smaller (average valuation at IPO was $650 million) but the median rounds of funding, 5, is the same as the private companies listed in Table 2. PitchBook.com reports the percentage stake in a company investors are willing to take for a round of funding has been dropping. In the fourth quarter report in 2014, *4Q 2014 U.S. Venture Industry Report*, the median stake investors required for seed funding was 23% of the firm. The median for Series A was 28%, Series B was 23%, Series C was 17% and for Series D and beyond is was 12%. Using these figures and knowing the median rounds of funding was five for our sample from Table 2, investors should have around 69% of the company value after the financing rounds. Therefore, the value of the company after investors have provided funding will be estimated to be 60% for this study. Winkler (2015) interviewing Bill Gurley, a venture capitalist for Benchmark and known as one of Silicon Valley's top technology deal makers, stated that when Benchmark talks to their limited partners about private companies, they discount the companies 40% as well.

The estimated annualized firm return prior to the public valuation date is then calculated by using the dates and amounts of the equity funding from *FactSet Mergerstat* with the valuation listed in the *WSJ* cut 40 percent. The calculation is done using the XIRR function of Microsoft Excel. An annualized return for the S&P 500 over the same time period for the private firms is calculated for comparison purposes. All of the firms, except Lazada Group, have a higher estimated annualized return than the S&P 500 return over the same time period. The average annualized return for the investors in the private companies is 5,355.43% (median is 119.19%) while for the S&P 500 it is only 10.49%. Eleven unicorns have annualized returns above 1000%. These are estimated returns and do not reflect the differences in returns between seed investors and the different series investors. Seed investors in the firm would have annualized returns that would be higher than that reported since they are the first to invest and hold a better stake in the company than series investors. The same would be true of first series investors such as series A, if the firm has several rounds of funding. Keep in mind these returns reflect private companies that have made it through the startup phase. Gage (2012) reports research done by Shikhar Ghosh who finds 3 out of 4 startups fail. This failure rate is much higher than that reported by The National Venture Capital Association who estimate that 25% to 30% of venture backed businesses fail. Needless to say, the returns for the sample are high.

Table 2 shows 21.17% of the unicorns were started by founders that had previous experience starting a firm. In addition, 83.33% of the founders have remained active in running their company. For those unicorns that report the total size of their board and management team on *FactSet Mergerstat*, the total size is around 12 with average tenure of 4.30 years. Table 2 shows there are around 5 members to the board and around 45% of the members are independent from management. Unicorns have on average 12.02 investors and 11.51 of the investors are classified as active. Table 2 points out that the average age of the unicorns is 8.44 years and the average amount of equity that has been invested is $450 million based on available information from *FactSet Mergerstat*.

Table 2: Summary Statistics of Unicorn Companies

Variable	Number	Mean	Median	Minimum	Maximum
Experienced founder	137	21.17%	0	0	1
Active founder	144	83.33%	1	0	1
Total size Board/Management	128	11.85	11	1	39
Number on Board	114	4.95	5	1	12
% Board Independent	113	45.13%	0	0	6
Age of firm	143	8.44	8	1	28
Average Tenure	125	4.30	4	0	13
Latest valuation (billions)	143	3.59	1.5	1	51
Number of investors	136	12.02	11	1	63
Number of active investors	136	11.51	10	0	56
Rounds of funding	142	4.86	5	1	12
60% return (%)	120	5355.43	119.19	8.59	472908.16
Excess return vs. S&P (%)	120	5344.94	107.65	-13.22	472926.44
Total Equity per FactSet (billions)	124	0.45	0.27	0.002	6.01
Total Equity per WSJ (billions)	144	0.52	0.28	0.02	7.40

Table 3 examines the investors in the unicorn companies reported in the *WSJ*. Sequoia Capital has invested in the most unicorns, investing in 27 of the 144. Unfortunately, the amount invested in each unicorn by investor is not known because *FactSet Mergerstat* lumps all investors in the same seed or series together with the total dollar amount of each round of funding. Interestingly, there were 414 different investors that invested in only one unicorn. Although not shown in Table 3, the investors that have invested in the most seed rounds coincide fairly well with the list of investors in Table 3. The top three investors in seed rounds were Sequoia Capital investing in 9 of the unicorn seed rounds, Accel Partners investing in 11 seed rounds, and SV Angel investing in 9 seed rounds. Given the dollar limits of how much money can be raised and invested each year by non-accredited investors, seed investing might be the initial way non-accredited investors participate in equity crowdfunding. If non-accredited investors are allowed to invest with accredited investors, it may make sense to invest with the investors that have done it before such as the top firms listed in Table 3.

Table 3: Frequency of Investors in Privately-held Billion Dollar Club Members

Rank	Investor	Frequency	Percentile	Cumulative # of investments	Cumulative percentile
1	Sequoia Capital	27	2.29	27	2.29
2	Accel Partners	19	1.61	46	3.90
3	Kleiner Perkins Caulfied & Byers	18	1.53	64	5.42
4	Tiger Global Management	18	1.53	82	6.95
5	Andreesen Horowitz	17	1.44	99	8.39
6	Google Ventures	15	1.27	114	9.66
7	Wellington Management	14	1.19	128	10.85
8	T Rowe Price	13	1.10	141	11.95
9	Temasek Holdings	13	1.10	154	13.05
10	Fidelity Investments	12	1.02	166	14.07
11	Goldman Sachs Ventures	12	1.02	178	15.08
12	Institutional Venture Partners	12	1.02	190	16.10
13	New Enterprise Associates	12	1.02	202	17.12
14	SV Angel	12	1.02	214	18.14
15	DST Group	11	0.93	225	19.07
16	Founders Fund	10	0.85	235	19.92
17	Greylock Partners	10	0.85	245	20.76
18	Khosla Ventures	10	0.85	255	21.61
19	Various (4)	9	3.05	291	24.66
23	Various (3)	8	2.03	315	26.69
26	Various (7)	7	4.16	364	30.85
33	Various (13)	6	6.61	442	37.46
46	Various (7)	5	2.96	477	40.42
53	Various (14)	4	4.75	533	45.17
67	Various (27)	3	6.86	614	52.03
94	Various (76)	2	11.89	766	64.92
170	Various (414)	1	35.08	1180	100.00

Table 4 lists where the unicorns are located and the general industry each unicorn is associated with. The vast majority of unicorns in the US are located in California and New York and the location of the most unicorns outside the US are in China. The industry the majority of unicorns are in or related to is the technology industry. The top three industry groups listed are packaged software, internet software/services and information technology.

Table 4: Billion Dollar Club by Industry and Location

Location	Number	Percentage of Total	Industry	Number	Percentage of Total
California	56	39.1	Packaged Software	39	27.3
New York	10	7.0	Internet Software/Services	30	21.0
Massachusetts	6	4.2	Information Technology	11	7.7
Utah	4	2.8	Catalog/Specialty Distribution	8	5.6
Illinois	3	2.1	Financial	7	4.9
Florida	2	1.4	Misc. Commercial Services	7	4.9
Connecticut	1	0.7	Biotechnology	5	3.5
Georgia	1	0.7	Commercial Printing/Forms	4	2.8
New Jersey	1	0.7	Medical Services	3	2.1
Texas	1	0.7	Specialty Stores	3	2.1
Washington	1	0.7	Advertising/Marketing	2	1.4
Washington DC	1	0.7	Aerospace & Defense	2	1.4
Total U.S.	87	60.8	Computer Processing	2	1.4
China	24	16.8	Data Processing Services	2	1.4
India	7	4.9	Movies/Entertainment	2	1.4
Germany	5	3.5	Specialty Telecommunications	2	1.4
United Kingdom	5	3.5	Wholesale Distributors	1	0.7
Singapore	3	2.1	Apparel/Footwear	1	0.7
South Korea	2	1.4	Broadcasting	1	0.7
Sweden	2	1.4	Computer Peripherals	1	0.7
Canada	1	0.7	Food Distributors	1	0.7
Czech Republic	1	0.7	Life/Health Insurance	1	0.7
France	1	0.7	Personnel Services	1	0.7
Hong Kong	1	0.7	Pharmaceuticals	1	0.7
Israel	1	0.7	Retail Trade	1	0.7
Luxembourg	1	0.7	Semiconductors	1	0.7
Netherlands	1	0.7	Technology Services	1	0.7
Taiwan	1	0.7	Telecommunications Equipment	1	0.7
Total International	56	39.2	Tools & Hardware	1	0.7
Total	143	100.0	Total	143	100.0

In Table 5, the unicorn excess returns (return for the unicorn less the return for the S&P 500 over the same time frame) are divided into quartiles with quartile 1 representing unicorn excess returns above 197.97%, quartile 2 and 3 having excess returns greater than 56.08% but less than 197.97%, and quartile 4 has unicorn excess returns that are less than 56.08%. Unicorn variables from Table 2 are than compared across quartiles to test for differences in the quartiles. First, the median excess return of quartile 1, is significantly larger than the other three quartiles. The unicorns with the largest excess returns have some characteristics that are significantly different than the other quartiles. The total size of the board/management is significantly smaller and the age of the firm is significantly less in quartile 1 than the other quartiles. Comparing quartile 1 to quartile 4, the average tenure of the board/management is significantly larger in quartile 4 and quartile 4 has significantly more rounds of funding than quartile 1. It would appear the longer the unicorn is around, the unicorn's excess return starts to fall. Stanford (2016) reports that given market volatility, oil prices, and fears of overly frothy private valuations, investors that would like to cash in on their private investments by taking a company public are having to wait given the conditions. He indicated a number of unicorns expected to make a public exit in 2015 waited. There appeared to be a rise in what some refer to as private IPOs. A private IPO is a late-stage funding round above $40 million. Stanford reports the number of private IPOs rose to a high of 135 in the third quarter of 2015 and there have been 44 deals of $40 million or more completed in the first month of 2016. The problem he states for unicorn investors is these late round fundings cut into the returns that were thought to be over a hundred times the return on investment.

Table 5: Independent variables by return quartile

Variable	Number	Mean	Median	Minimum	Maximum
Quartile 1 (Excess return greater than 197.97%)					
Experienced founder	28	28.57%	0	0	1
Active founder	30	83.33%	1	0	1
Total size Board/Management	25	8.64	9	2	25
Number on Board	20	4.15	4	1	8
% Board Independent	19	15.79%	0	0	2
Age of firm	30	5.8	5	2	12
Average Tenure	25	3.0	2	0	6
Latest valuation (billions)	30	4.84	1.8	1	51
Number of investors	30	12.13	8.5	2	63
Number of active investors	30	11.70	8.5	0	56
Rounds of funding	30	4.27	4	2	9
Excess return vs. S&P (%)	30	21127.29	529.51$^{\pm\pm\pm}$	198.27	472926.44
Total Equity per *FactSet* (billions)	30	0.55	0.27	0.002	6.01
Quartiles 2 and 3 (Excess return greater than 56.08 and less than 197.97%)					
Experienced founder	60	23.33%	0	0	1
Active founder	60	96.67%	1**	0	1
Total size Board/Management	58	13.09***	12***	2	39
Number on Board	53	5.13	5	1	12
% Board Independent	53	43.40%	0	0	4
Age of firm	60	8.70***	8***	3	21
Average Tenure	58	4.19	4	1	13
Latest valuation (billions)	60	4.06	1.7	1	46
Number of investors	60	12.70	12	1	35
Number of active investors	60	12.52	12	1	35
Rounds of funding	60	4.95	5	1	9
Excess return vs. S&P (%)	60	108.46	107.65	56.39	197.67
Total Equity per *FactSet* (billions)	60	0.45	0.27	0.03	2.60
Quartile 4 (Excess return less than 56.08%)					
Experienced founder	30	13.33%	0	0	1
Active founder	30	90.00%	1	0	1
Total size Board/Management	30	14.93***	15***	1	27
Number on Board	29	5.90**	6	1	11
% Board Independent	29	68.97%	0	0	6
Age of firm	30	12.37***	11.5***	5	28
Average Tenure	30	5.90***	6***	1	13
Latest valuation (billions)	30	1.81	1.2	1	12
Number of investors	30	13.97	13	2	31
Number of active investors	30	12.73	12	2	29
Rounds of funding	30	6.50***	6.5***	2	12
Excess return vs. S&P (%)	30	35.57	40.38	-13.22	55.77
Total Equity per *FactSet* (billions)	30	0.35	0.28	0.06	1.28

***,** Significantly larger than quartile 1 at the 1% level and 5% levels, respectively.
$^{\pm\pm\pm}$ Significantly larger than the other quartiles at the 1% level.

Conclusion

Equity crowdfunding gives ordinary investors the potential ability to invest in the early stages of high-growth firms. Investors have complained that this early investing has disappeared in public offerings due to costly regulatory mandates such as Sarbanes-Oxley and Dodd-Frank forcing companies to grow larger before going public. We have shown the reward for early stage investing is the potential for large returns but one of the problems of early stage investing is the potential for fraud because the non-accredited investors lack experience. Other issues associated with equity crowdfunding are the lack of liquidity and the risk. The SEC is limiting the amount of funding a non-accredited investor can do to reduce the exposure to risk but there is still the illiquidity issue.

Since non-accredited crowdfunding has not started yet in the US, it is too early to tell how popular equity crowdfunding will be with non-accredited investors and whether fraud will be an issue. Examining the UK experience, equity crowdfunding is growing and it appears it will change how small companies will capitalize themselves. Since non-accredited investors don't have experience investing in private companies, US equity crowdfunding platforms should follow the lead of UK platforms and allow non-accredited investors to co-invest with accredited investors. Given that one of the goals of the JOBS Act is to create job growth, the US may want to consider giving a tax break to investors that invest in startups similar to the UK. Another example would be the Shanghai market where Jie, Areddy, and Areddy (2016) report that to spur investment firms to take more risk on early stage tech startups, the Shanghai market is offering subsidies of up to 30 to 60% of financial losses incurred by investors.

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Designing Effective Examples of Optimal Capital Structure Estimation for the Intermediate Corporate Finance Course

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Abstract

Capital structure policy is a mandatory topic in courses in corporate finance. The level of detail presented depends on the level of the course in question. While the topic is typically presented in overview in introductory courses, intermediate and advanced courses frequently include estimation of an optimal capital structure. Numerical examples of optimal capital structure in popular textbooks are frequently based on discounted cash flow valuation and weighted average cost of capital estimates which vary based on the degree of financial leverage. This paper points out some potential pitfalls of such examples and provides suggestions for maximizing their benefit to students.

Optimal Capital Structure Theory

Optimal capital structure theory is essentially an application of discounted cash flow analysis. In this framework, the value of any asset can be estimated as the sum of the present values of the expected future cash flows associated with the asset. Because there is an inverse relationship between present values and discount rates, the possibility exists for increasing value by reducing discount rates.

For an entire firm, the relevant cash flows are the firm's Free Cash Flows (FCFs). An appropriate discount rate for the firm's free cash flows is the firm's Weighted Average Cost of Capital (WACC) which considers in weighted proportion the required rates of return of all investors who provide capital to the firm.

The funding mix which a firm chooses determines its WACC. As the funding mix changes, the WACC changes, leading to the possibility of finding a minimum WACC – and, therefore and optimal firm value. Because the risk of financial distress increases with the level of financial leverage, the required rates of return on the individual component costs of capital increase as financial leverage increases. Thus, although inclusion of relatively cheaper debt in the funding mix at first reduces the firm's WACC, eventually the higher required rates of return overwhelm the advantage of cheaper debt funding as the firm reaches higher levels of financial leverage. This explanation is commonly referred to as the "tradeoff" theory of capital structure.

Although other factors such as agency relationships and degree of information asymmetry also play a role, the tradeoff relationship is generally accepted as the fundamental reason that capital structure policy is an important managerial consideration. The examples discussed in this paper are the types often used to demonstrate the tradeoff relationship.

Numerical Examples

While mathematical functions and their graphical representations are often used to explain the effect of financial leverage on firm value, students often gain greater insight from working through a detailed mathematical estimation. Typically, percentage costs of debt are simply given in these types of examples. These costs of debt may or may not be explicitly linked to realistic debt yields as might be associated with a level of default risk as reflected in debt ratings. In such examples, the costs of equity at different levels of financial leverage are most often estimated using the adjustment of stock's beta using the Hamada model. This general approach is used by practitioners in actual valuations, so structuring classroom examples in this way provides students with a skill directly transferrable to the workplace.

Overall, these types of examples of the estimation of an optimal capital structure can be quite beneficial to the students. However, the precise structure used in the example must be carefully developed to not only demonstrate the key relationships, but also to increase the likelihood that a student will be able to work his or her way through the calculations in the example. Certain examples from popular textbooks inadvertently introduce potential pitfalls to the student which seem to consistently result in student frustration.

While many textbooks use some type of mathematical example when demonstrating the estimation of optimal capital structure, few provide as comprehensive an example as that presented in the Brigham group of intermediate and MBA level textbooks. Readers who teach corporate finance and have used one of the Brigham products are no doubt familiar with the now long lived Strasburg Electronics Company example which has appeared largely unchanged in multiple versions and editions of the Brigham textbooks.

In this example, the hypothetical company is considering potential changes to its capital structure. An investment banking team is said to have provided the necessary inputs. The example then describes the process of estimating the firm's WACC and value at various possible levels of financial leverage. For ease of calculation, the firm is assumed to have zero growth, so the necessary discounting can be accomplished using the simple present value of a perpetuity formula. In addition, the zero growth rate assumption makes the calculation of free cash flow particularly straightforward. In a zero growth situation, there is no required additional investment in operating working capital. And, since depreciation charges would approximate actual required investment in fixed assets, free cash flow would be equal to Net Operating Profit After Taxes (NOPAT). NOPAT is calculated as EBIT(1-t).

In the Strasburg example, Net Income is $50 million and free cash flow is $30 million. The required rates on debt are said to have been provided by the firm's investment bankers. The rates on debt increase as financial leverage increases. The after-tax effective cost of debt is simply the pre-tax cost times the adjustment factor (1-T), where T is the marginal corporate tax rate. The firm's required rate of return on equity capital is calculated using the CAPM. Beta is adjusted for each potential level of financial leverage using the Hamada Model. Finally, the number of share outstanding is calculated using the relationship between the value of the firm's operations at each level of financial leverage and the presumed amount of additional debt funding necessary to create that level of leverage. The Brigham group's example is presented in Table 1 below. In the table, "Shares Repurchased" is presented to aid in the subsequent discussion although this variable does not appear in the original Brigham example. Note that all values are state in terms of millions except for EPS and share value.

Table 1: Brigham Textbook Group Example

W_d	0	0.1	0.2*	0.3	0.4**	0.5	0.6
W_s	1	0.9	0.8	0.7	0.6	0.5	0.4
Pre-tax r_d	7.70%	7.80%	8.00%	8.50%	9.90%	12.00%	16.00%
After-tax r_d	4.62%	4.68%	4.80%	5.10%	5.94%	7.20%	9.60%
β	**1.0870**	1.1594	1.2500	1.3665	1.5217	1.7391	2.0652
r_m	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%
r_{rf}	6.30%	6.30%	6.30%	6.30%	6.30%	6.30%	6.30%
r_s	12.82%	13.26%	13.80%	14.50%	15.43%	16.73%	18.69%
WACC	12.82%	12.40%	12.00%	11.68%	11.63%	11.97%	13.24%
Value of Operations	233.98	241.96	250.00	256.87	257.86	250.68	226.65
Value of Debt	0.00	24.20	50.00	77.06	103.14	125.34	135.99
Value of Equity	233.98	217.76	200.00	179.81	154.72	125.34	90.66
# Shares	12.72	11.34	**10.00**	8.69	7.44	6.25	5.13
Shares Repurchased***		1.37	1.34	1.31	1.25	1.20	1.11
$ Value per Share	18.40	19.20	20.00	20.69	20.79	20.07	17.66
Net Income	30.00	28.87	27.60	26.07	23.87	20.98	16.95
$ EPS	2.36	2.54	2.76	3.00	3.21	3.36	3.30

*starting capital structure, **optimal capital structure, ***not presented in original example

The required calculations are described in detail in the textbook and in concise summary in the notes to the primary table showing the main results. For the most part, the calculations are relatively easy to follow. The one exception is the calculations necessary to determine the number of shares outstanding after the repurchase necessary to move the firm to the new level of financial leverage. The formula provided is as follows.

$$n_{Post} = n_{Prior}\, x\, (V_{OpNew} - D_{New})/(V_{OpNew} - D_{Old}) \qquad (1)$$

In the example, this formula is applied using an assumed starting level of financial leverage described by a total debt ratio of .20. The zero financial leverage number of shares is thus determined by the characteristics of the firm at the .20 total debt ratio level of leverage. The number of shares outstanding at each of the potential capital structures is calculated from the 10 million share starting point.

The required rate of return on equity is based on the CAPM. The adjustment for differing levels of leverage is accomplished through the use of the Hamada Model. This model describes the relationship between the firm's unleveraged and leveraged betas as follows.

$$\beta_L = \beta_U\,[1 + (1 - T)(w_d/w_s)] \qquad (2)$$

In Table 1, the zero leverage value of beta is presented in bold. Also, the number of shares at the .20 total debt ratio level of financial leverage is presented in bold. If a student begins with the zero leverage value of beta and applies the provided Hamada formula, he or she will be able to find the same leveraged betas presented in the table. However, if the student attempts to calculate the number of shares outstanding starting at the zero financial leverage level, the numbers in the table will not appear to be correct. This is because the nature of the relationship causes the number of shares outstanding calculated from the anchored point of 10 million will not be the same as the number of shares if one begins at the 12.72 million shares indicated at the zero level of leverage.

In the author's experience, the motivated student who does attempt to prove the values in the table will begin at the zero level of financial leverage. He or she will be able to calculate the progressively larger betas that result as financial leverage increases. But, the student will not be able to replicate the number of shares outstanding. Nearly every semester, a student has approached the author to disclose the "error" in the table. Of course, the table is technically correct, but if a large percentage of the motivated students are unable to replicate the data in the table using the formulas given, there must be something about the table's layout which does not fit the typical student's approach. Clearly a student with "Sequential Learner" tendencies will start with the zero level of leverage and attempt to work up.

Table 2 presents the variation in the example which would result if one begins at the zero financial leverage and works his or her way up through the table as the level of financial leverage increases. In each case, the formulas are applied to a given case and the subsequent case in stepwise fashion. Thus, each estimate is based on the immediately preceding estimate – not on the zero values. The values will be the same up to the number of shares. Thereafter, all resulting values will be different from the base case of the Brigham example. In Table 2 the values which are different are presented in italics.

Table 2: Variation One – Stepwise From Zero (Changes in Italics)

W_d	0*	0.1	0.2	0.3	0.4**	0.5	0.6
W_s	1	0.9	0.8	0.7	0.6	0.5	0.4
Pre-taxr_d	7.70%	7.80%	8.00%	8.50%	9.90%	12.00%	16.00%
After-tax r_d	4.62%	4.68%	4.80%	5.10%	5.94%	7.20%	9.60%
β	**1.0870**	1.1594	1.2500	1.3665	1.5217	1.7391	2.0652
r_m	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%
r_{rf}	6.30%	6.30%	6.30%	6.30%	6.30%	6.30%	6.30%
r_s	12.82%	13.26%	13.80%	14.50%	15.43%	16.73%	18.69%
WACC	12.82%	12.40%	12.00%	11.68%	11.63%	11.97%	13.24%
Value of Operations	233.98	241.96	250.00	256.87	257.86	250.68	226.65
Value of Debt	0.00	24.20	50.00	77.06	103.14	125.34	135.99
Value of Equity	233.98	217.76	200.00	179.81	154.72	125.34	90.66
# Shares	**12.72**	*11.45*	*10.14*	*8.81*	*7.54*	*6.41*	*5.73*
Shares Repurchased***		*1.27*	*1.31*	*1.33*	*1.27*	*1.13*	*0.67*
$ Value per Share	18.40	*19.03*	*19.73*	*20.41*	*20.52*	*19.57*	*15.81*
Net Income	30.00	28.87	27.60	26.07	23.87	20.98	16.95
$ EPS	2.36	*2.52*	*2.72*	*2.96*	*3.17*	*3.27*	*2.96*

*starting capital structure, **optimal capital structure, ***not presented in original example

Another likely student approach would be to start at the zero level of financial leverage and work through the increasing levels of financial referring at each step back to the zero level data. This is similar to what is done in the original Brigham example, albeit with an anchor point at the .20 total debt ratio level of financial leverage. Again, the resulting values will be the same up through the number of shares outstanding. Thereafter, all of the values will be different from the base case of the Brigham example. The values resulting from this sequence of calculations is presented in Table 3. Note that in both

Table 2 and Table 3, the variation in the number of share calculations does not change the degree of financial leverage which yields the highest firm value.

Table 3: Variation Two – Anchored from Zero (Changes in Italics)

W_d	0*	0.1	0.2	0.3	0.4**	0.5	0.6
W_s	1	0.9	0.8	0.7	0.6	0.5	0.4
Pre-taxr_d	7.70%	7.80%	8.00%	8.50%	9.90%	12.00%	16.00%
After-tax r_d	4.62%	4.68%	4.80%	5.10%	5.94%	7.20%	9.60%
β	**1.0870**	1.1594	1.2500	1.3665	1.5217	1.7391	2.0652
r_m	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%
r_{rf}	6.30%	6.30%	6.30%	6.30%	6.30%	6.30%	6.30%
r_s	12.82%	13.26%	13.80%	14.50%	15.43%	16.73%	18.69%
WACC	12.82%	12.40%	12.00%	11.68%	11.63%	11.97%	13.24%
Value of Operations	233.98	241.96	250.00	256.87	257.86	250.68	226.65
Value of Debt	0.00	24.20	50.00	77.06	103.14	125.34	135.99
Value of Equity	233.98	217.76	200.00	179.81	154.72	125.34	90.66
# Shares	**12.72**	*11.45*	*10.17*	*8.90*	*7.63*	*6.36*	*5.09*
Shares Repurchased***		*1.27*	*1.27*	*1.27*	*1.27*	*1.27*	*1.27*
$ Value per Share	18.40	*19.03*	*19.66*	*20.20*	*20.28*	*19.71*	*17.82*
Net Income	30.00	28.87	27.60	26.07	23.87	20.98	16.95
$ EPS	2.36	*2.52*	*2.71*	*2.93*	*3.13*	*3.30*	*3.33*

*starting capital structure, **optimal capital structure, ***not presented in original example

Clearly, the objective of the numerical example is to provide the student with reinforcement. In this case a relatively minor design flaw in the example can lead to an unnecessary potential confusion for students. Instructors using textbooks from the Brigham group should be aware of this issue and guide students in advance. And, the authors in the Brigham group should consider modifying the example to avoid this pitfall.

Variations on the basic numerical example approach presented above can easily be developed to accentuate other issues in optimal capital structure policy formation. One of these is the mention in several textbooks of the relatively "flat" nature of the functions in the midranges of financial leverage. This is typically presented using a graph which shows the value of the firm and the firm's WACC being functions which have a near zero slope in the 20-50% total debt ratio range. (See, for example, Brigham and Ehrhardt, p. 613).

It is straightforward to develop variations in the general example which demonstrate this effect. Examples can also be constructed to yield "smooth" curves of the sort generally depicted in the purely graphical textbook representations. Of course, usual "kinky" function examples can also be developed.

In the author's experience it is useful to provide students with multiple examples which result in somewhat different functional forms. This serves to both reinforce the theoretical relationships and make students accustomed to the variations which may be encountered in real world estimations.

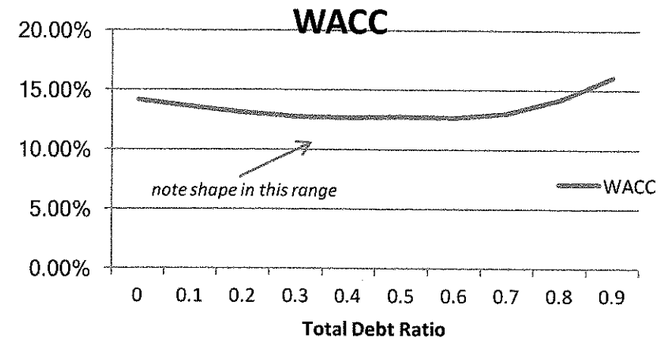
Table 4 presents an example developed by the author to replicate the "flat" curves described for both the WACC and value function in real world settings by many sources. In this example, the author adds hypothetical bond ratings as an aid to student comprehension. Figure 1 presents the WACC and firm value functions resulting from this numerical example. Note that it is generally assumed that the firm in such examples will not have any nonoperating assets, so the value of operations is the same as the value of the firm. In this example, the complication of the number of shares is omitted so the emphasis is on the relationship between firm value and the degree of financial leverage. Note that there is a local maximum at a total debt ratio of .40, so the inattentive student may not identify the actual maximum. However, as intended, there is little difference in value in the midrange value for this example.

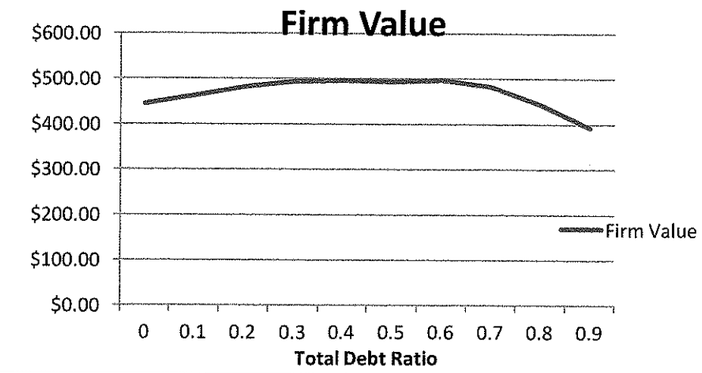
Table 4: Author's Example Showing "Flat" Value Function

W_d	0*	0.1	0.2	0.3	0.4	0.5	0.6**	0.7	0.8	0.9
W_s	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
Pre-tax r_d	3.05%	3.11%	3.38%	4.52%	6.13%	7.57%	8.15%	9.62%	12.25%	15.68%
After-tax r_d	1.86%	1.90%	2.06%	2.76%	3.74%	4.62%	4.97%	5.87%	7.47%	9.56%
Hypothetical Bond Rating***	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	C*
β	**1.3200**	1.4095	1.5213	1.6651	1.8568	2.1252	2.5278	3.1988	4.5408	8.5668
r_m	11.50%	11.50%	11.50%	11.50%	11.50%	11.50%	11.50%	11.50%	11.50%	11.50%
r_{rf}	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%
r_s	14.17%	14.92%	15.85%	17.05%	18.65%	20.90%	24.26%	29.86%	41.07%	74.68%
WACC	14.17%	13.62%	13.09%	12.76%	12.69%	12.76%	12.69%	13.07%	14.19%	16.08%
Value of Operations	444.54	462.66	481.11	493.55	496.52	493.86	496.62	482.18	443.94	391.87

*starting capital structure, **optimal capital structure, ***added to aid student understanding

Figure 1: WACC and Firm Value for "Flat" Example





A second numerical example is presented in Table 5. In this example the values are selected so as to yield the theoretically implied curved functional forms without reversals. The resulting functions are depicted in Figure 2. In this case, the value of the firm increases up to the maximum value and then decreases. There are no reversals and the functions match the expectations of one who had only be presented with the typical representative graphs.

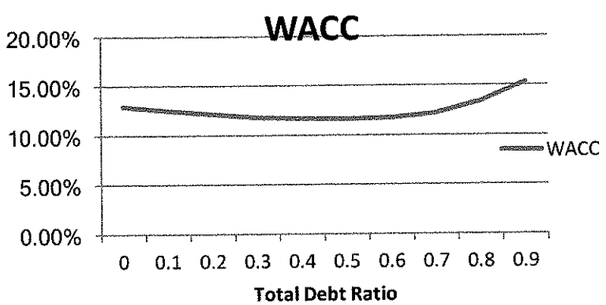
A third numerical example is present in Table 6. The graphs resulting from this example are presented in Figure 3. In this case, the values in the example are selected to render an unexpected share for the functions. Here again the student would need to pay careful attention in order to identify the actual maximum value capital structure.

Table 5: Author's Example Showing "Smooth" Value Function

W_d	0*	0.1	0.2	0.3	0.4	0.5**	0.6	0.7	0.8	0.9
W_s	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
Pre-tax r_d	4.05%	4.65%	4.95%	5.25%	6.25%	7.09%	8.15%	9.62%	12.25%	15.68%
After-tax r_d	2.47%	2.84%	3.02%	3.20%	3.81%	4.32%	4.97%	5.87%	7.47%	9.56%
Hypothetical Bond Rating***	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	C*
β	1.1000	1.1746	1.2678	1.3876	1.5473	1.7710	2.1065	2.6657	3.7840	7.1390
r_m	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%
r_{rf}	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%
r_s	12.90%	13.56%	14.40%	15.47%	16.90%	18.90%	21.90%	26.91%	36.92%	66.94%
WACC	12.90%	12.49%	12.12%	11.79%	11.66%	11.61%	11.74%	12.18%	13.36%	15.30%
Value of Operations	581.62	600.50	618.76	636.19	642.99	645.85	638.61	615.76	561.32	490.11

*starting capital structure, **optimal capital structure, ***added to aid student understanding

Figure 2: WACC and Firm Value for "Smooth" Example



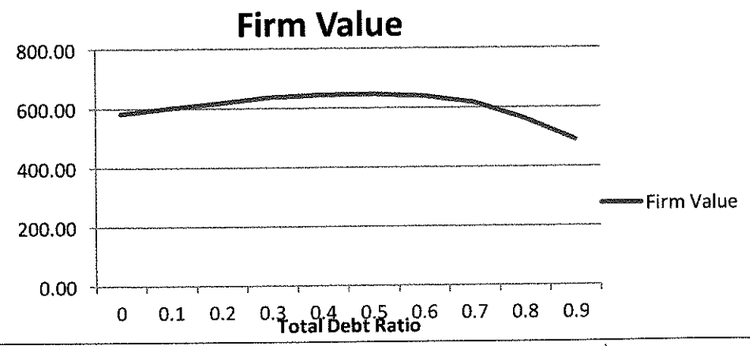
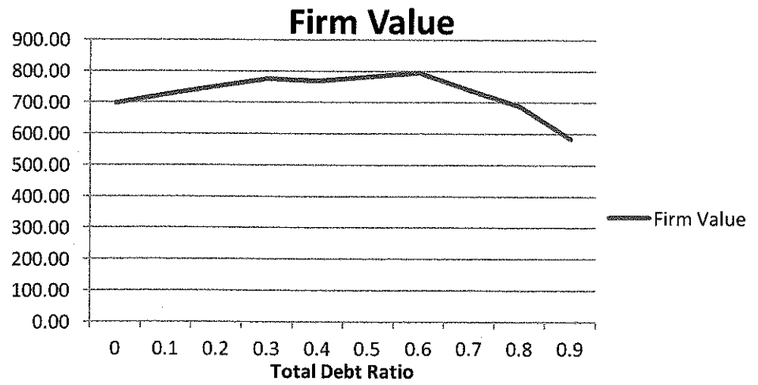


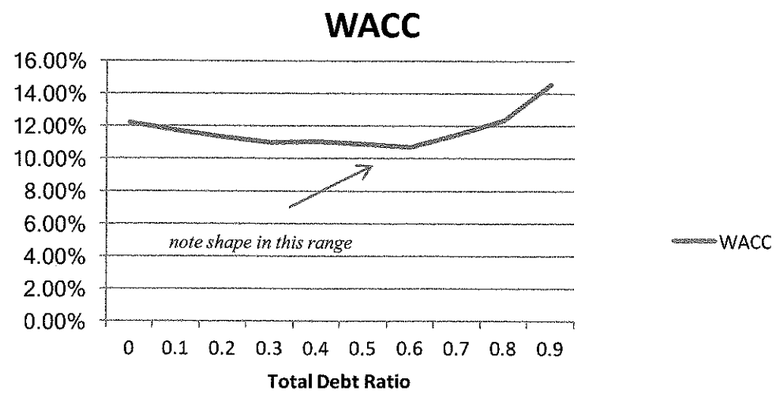
Table 6: Author's Example Showing "Kinky" Value Function

W_d	0*	0.1	0.2	0.3	0.4	0.5	0.6**	0.7	0.8	0.9
W_s	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
Pre-tax r_d	3.75%	3.81%	4.08%	4.52%	6.56%	6.93%	7.15%	9.62%	11.62%	15.68%
After-tax r_d	2.25%	2.29%	2.45%	2.71%	3.94%	4.16%	4.29%	5.77%	6.97%	9.41%
Hypothetical Bond Rating***	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	C*
β	1.1500	1.2267	1.3225	1.4457	1.6100	1.8400	2.1850	2.7600	3.9100	7.3600
r_m	11.00%	11.00%	11.00%	11.00%	11.00%	11.00%	11.00%	11.00%	11.00%	11.00%
r_{rf}	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%
r_s	12.18%	12.78%	13.53%	14.50%	15.79%	17.59%	20.30%	24.82%	33.84%	60.93%
WACC	12.18%	11.73%	11.31%	10.96%	11.05%	10.88%	10.69%	11.49%	12.35%	14.56%
Value of Operations	698.01	724.64	751.22	775.35	769.40	781.54	794.77	740.08	688.47	583.80

*starting capital structure, **optimal capital structure, ***added to aid student understanding

Figure 3: WACC and Firm Value for "Kinky" Example





Summary and Conclusions

This paper has discussed the use of numerical examples of the estimation of optimal capital structure in reinforcing student learning. Potential difficulties in using one such example appearing in a popular group of finance textbooks were discussed. Then variations on the type of numerical were presented which can be used to sensitize students to variations in outcomes which are likely to be encountered in actual real world capital structure estimations. With a modest amount of effort the basic numerical examples can be expanded to provide a richer experience for the students.

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Years-of-Service Caps on Defined Benefit Pensions: Structuring the Decision

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Abstract

Among the set of organizations offering a defined benefit pension plan, one difference in philosophy involves whether to "cap" the number of years of service for which credit is awarded in the calculation of benefits. While intangible factors clearly will influence these decisions, there also are some tradeoffs that are at least partially quantifiable. This paper provides a means for comparing some of the more obvious financial tradeoffs involved in this decision.

Introduction

Motivation

Defined-benefit plans, while clearly on the wane as a proportion of employer-sponsored retirement plans, continue to exist in one form or another in many organizations. Typically, such plans involve setting the amount of the annual pension payment using a formula along the following lines:

Years of Service * (Designated Percentage) * Average Annual Salary,

with the average annual salary based on some measure of the average of the most recent years. For instance, the average annual salary might be the highest three years of the last ten, or whatever consecutive five-year period within the past ten years had the highest average salary for that employee, etc.

One issue that employers offering such plans face is whether to "cap" the number of years for which service credit is awarded. For instance, the authors of this paper work for an employer that caps service credit after 25 years. The annual pension benefit can continue to go up after the 25 years have ended, due to annual raises, overloads, or other factors that might increase the "average salary" calculation; but, the years of service number used in the formula is capped. Other employers do not cap years-of-service credit.

As employers that offer defined-benefits plans monitor their financial status, one issue that they face is whether to institute years-of-service caps where they do not exist, remove years-of-service caps where they do exist, or make no changes. As detailed below, even if one focuses entirely on quantifiable (or some might say semi-quantifiable) implications for the employer, there are a number of tradeoffs that must be considered in determining which approach is most likely to minimize costs. Further, based on our results to date it does not appear that there is a universally correct answer as to whether the existence of a years-of-service cap increases or decreases total costs to the employer.

Thus, this paper does not presume to offer any advice to any given employer as to whether years-of-service caps are effective or ineffective as a cost-control mechanism, much less whether the net cost advantage or disadvantage outweighs the net benefit or harm of intangible benefits and costs. Rather, what this paper offers is a mechanism by which a given employer can input its own assumptions regarding certain key parameters to determine the likely net financial benefit or cost of a years-of-service cap. We make multiple simplifying assumptions, and also simplify the calculations in a number of other ways; obviously, a given employer might see fit to modify the calculations if the employer believes that doing so will improve the decision process.

Having chosen to simplify the calculations as far as seems prudent, we then test the sensitivity of the bottom-line result to changes in several key parameters. It quickly becomes clear that the three dominant factors are the relative propensity of employees to retire earlier with a years-of-service cap than without one, the relative increase in the cost of filling a given position if the incumbent employee does leave earlier than he or she otherwise would, and the discount rate that is applied to future cash flows in calculating the present values of various costs. The lower the marginal propensity of employees to retire earlier in response to a years-of-service cap, the lower the proportionate salary markup to replace those employees who do retire earlier, and the lower the discount rate applied to future cash flows, the more likely our model is to produce a result in which a years-of-service cap produces a net savings for the employer.

Limitations

It should be stressed that our model is, first of all, designed entirely from the employer's perspective. An employer that is considering adding or removing a pension cap might, of course, choose to factor into its decision the impact on existing or even prospective employees; however, those factors are beyond the scope of our model.

Second, even to the extent that the employer is making its decisions based entirely on the perceived impact on the health of the organization, an employer might very well wish to look at various intangible factors. For instance, does imposing a years-of-service cap create a net benefit by encouraging the departure of employees who are no longer contributing substantially to the organization, and are merely collecting a salary? Or, does a years-of-service cap harm the organization by "chasing off" employees who provide valuable institutional memory?

Indeed, the issue might well be even more complicated than that. There might be an employee who might leave after "year 30" in the absence of a years-of-service cap, who now either leaves after "year 25" (because there is now relatively little pension benefit to staying longer) or stays through "year 40" (because the elimination of the increment in years-of-service credit makes retirement after "year 30" less affordable than it otherwise would have been).

The possibilities here are seemingly endless, and any given employer might choose to consider any or all of them. However, we would argue that even in those situations, the model provided in this paper can contribute to the employer's decision. The employer might, for instance, conclude that imposing a years-of-service cap imposes, on net, a slight disadvantage from the standpoint of the intangibles, but might also surmise that this same cap creates net savings from a financial standpoint. For such an employer, our model provides one means of quantifying those presumed financial savings. If the net financial savings turn out to be greater (less) than the employer had initially believed, then the employer might well conclude that those savings are more (less) than sufficient to outweigh the less-quantifiable costs of the cap.

Model

We create a relatively simple Excel model in which we attempt to estimate savings and costs to an employer of including versus omitting a years-of-service cap. Over and above the limitations described above, which would seem to be inherent (or very nearly so), we employ various assumptions in order to simplify the computations and narrow the scope of parameters that are considered. Any one or combination of these assumptions could be modified, if the precision-vs.-complexity tradeoff seems to warrant such a change.

Simplifying Assumptions and Parameters Held Constant

The first simplifying assumption that we should mention is that the model, as currently constructed, does not measure benefits and costs on a "global" basis, but rather by comparing the cost to the employer of a given employee whose current years of service is exactly equal to the number of years at which the employer has, or is contemplating, a service cap. Specifically, we set the potential service cap at 25 years, and perform our calculations of the employer's costs relative to an employee who currently has exactly 25 years of service, and/or relative to that employee's potential replacement. Clearly, the model could be expanded to include employees currently sitting at 24 years of service credit, 23 years of service credit, and right on down the line. There could be value in making that adjustment; for instance, an employee who already has 22 years of service credit might be more inclined to accept another opportunity if he/she is rapidly closing in on a service credit cap, than if he/she has the potential to continue accruing service credit with the current employer indefinitely.

The second simplifying assumption that we make is that among employees currently holding 25 years of service credit, cumulative retention each year falls by a steady proportion of cumulative retention through the prior year. Further, in order to keep the possibilities from stretching out to an unrealistically large number of years, with cumulative retention rates increasingly approaching but not reaching zero, we impose an assumption that among those employees who have been with the organization 25 years, none intend to remain beyond "year 35" under any circumstances. Thus, under both the assumption of a service cap and the assumption of no service cap, cumulative retention rates decline gradually (and smoothly) from year 25 to year 35, and then drop to zero. Clearly, the assumption that cumulative retention among employees currently at 25 years of service would be roughly 13.4% through year 34, roughly 10.7% through year 35, and then fall all the way to zero after year 35 is an oversimplification. This could be modified by, for instance, holding the attrition factor constant as a proportion of the original set of people who have been with the organization for 25 years, rather than holding it constant as a proportion of the cumulative retention rate to date. This would allow the cumulative retention rate to fall naturally to zero as of some particular point in time.

We further assume a present life expectancy of 20 years on the part of employees holding 25 years of service credit, and to avoid having the calculations become completely unwieldy we calculate expected pension payoffs based strictly on the expected value of remaining longevity. We could, of course, calculate expected pension payments under both the "no cap" and "with cap" scenarios by taking a weighted average of various life spans, with the weights determined by the probability of death at a given point in time. However, the increased complexity of the calculations seemed to us to outweigh any advantage of increased precision in terms of the relative expected NPV's of pension payments under the "no cap" and "with cap" scenarios.

Our model is based on an employee whose current salary is $100,000. All other parameters (including percentage salary differentials, etc.) being held constant, this would seem to affect only the magnitude of the net benefit or cost of imposing a cap, and not the sign. We assume that the annual pension upon retirement is calculated as the following product:

Years of Service * 2% * Average Annual Salary Over Past 5 Years,

subject of course to the stipulation that the employer may or may not choose to cap the number of years of service credit awarded for purpose of the calculation.

Parameters Considered

Our base case calculations include the following assumptions. It is assumed that raises for the incumbent employee have been 3% per year over the last 5 years, and will remain at 3% for the foreseeable future. It is further assumed that the cost of an "external" hire will likewise increase at 3% per year for the foreseeable future, with the new hire's salary likewise increasing at 3% per year after the hire takes place.

In the absence of a years-of-service cap, attrition among employees who currently have 25 years of service is projected at 20% per year of those still remaining at any given point in time, subject as noted above to the assumption that among those employees none will remain beyond the 35-year mark. It is assumed that for those employees having 25 years' service credit to date, cumulative retention at any given point in time is reduced by one-half if service credit for purposes of pension calculations is capped at 25 years. (Said another way, only half as many employees will remain beyond the 25th year with a service cap as will remain if there is no service cap. After that, under both the "cap" and "no cap" scenarios, given that an employee has remained through Year X, there is an 80% chance that he or she will remain through Year X+1.)

The current "mark to market" is initially assumed to be 25%. Thus, if the 25-year incumbent is currently receiving a salary of $100,000 per year, it is assumed that the current salary for a replacement hire is $125,000 per year. Finally, for purposes of calculating the net present values of the cost of salaries and pensions, the discount rate is initially set at 4%.

Results

Base Case Calculations

Due to space considerations, the tables referenced below are omitted from the proceedings version of the paper. However, the results calculated in the various tables are described below.

Tables 1 through 3 display the results when we use the base case assumptions outlined above. Table 1 performs a calculation of the net present value of the expected marginal cost resulting from employees retiring sooner than they otherwise would as a result of the imposition of the years-of-service cap. Calculations are performed as follows. First, for "year 26" after the incumbent was hired, we compare the incumbent's projected salary (if he or she stays) with the projected salary of the incumbent's replacement (if the incumbent leaves). This provides us with the marginal cost to the employer, for that year, of replacing the incumbent with a new employee.

Next, we compare the projected probability that the incumbent is still with the organization in Year 26 in the absence of a year of service cap to the projected probability that he or she is still with the organization if a 25-year cap has been placed on the pension benefit calculation. The marginal reduction in the probability of retaining the incumbent for Year 26 if there is a years-of-service cap is multiplied by the salary differential in the event that the incumbent does leave; this gives the statistical expectation of the additional salary cost for the employer for that year. This is then discounted one year to determine the present value of the expected differential.

The process is repeated for Years 27 through 45. (As noted earlier, since we assume that the employee will leave after no more than 35 years in any event, the differential for Years 36 through 45 is calculated to be zero. However, the workbook is set up to allow for non-zero results in these years if the retention probability projections are altered.) The results of these present value calculations are summed. Under our base case assumptions, the expected salary differential represents, in net present value terms, an additional cost to the employer of $43,037.

Table 2 performs a calculation of the net present value of the expected pension savings resulting from the imposition of the cap. For each year, we first calculate the expected lifetime pension payments under a scenario in which there are no years-of-service caps. Based on the cumulative retirement/retention probabilities calculated in Table 1, we first calculate the probabilities of retirement at the end of each year beginning with the current year, year 25. For instance, since Table 1 initially assumes an 80% retention rate each year in the absence of a years-of-service cap, the probability of retirement at the end of Year 25 is 20%. Since the probability of retention beyond Year 26 is 64% (.80 * .80 = .64), the probability of retirement at the end of Year 26 is calculated to be 16% (80% retention after Year 25 minus 64% retention after Year 26). Similar to the above discussion regarding Table 1, given the fact that we have set up the model to assume retirement no later than the end of Year 35, probabilities for retirement at the end of each year starting in Year 36 are assumed to be zero. But, also similar to Table 1, the workbook is set up in such a way as to allow these probabilities to change to non-zero numbers if we alter the assumption that there is no probability of retention beyond Year 35.

For each potential retirement date, we then calculate the annual pension payment if retirement does in fact occur at that date. For instance, if retirement occurs at the end of Year 25, the five-year average salary upon which the pension is based turns out to be $94,342. This number is then multiplied by 50% (25 years at 2% per year) to produce an annual pension payment of $47,171. Under this scenario, deferring retirement by one year increases the size of the annual pension payment for two reasons: the one-year increment in the years-of-service credit itself, and any increase in average salary that occurs. For instance, if retirement occurs at the end of Year 26, under our assumptions the five-year average increases from $94,342 to $97,172. In addition, however, the percentage-of-pay factor increases from 50% to 52% (26 years at 2% per year). The resulting annual pension payment is $50,530.

For each potential retirement date, we calculate the net present value, as of today, of lifetime pension payments. (This is done by first finding the net present value of future pension payments as of the retirement date itself, and then discounting that number by the appropriate number of years to set the result at its present value as of today.) We then take a weighted average of those numbers by multiplying the net present value of lifetime pension payments if retirement occurs at a particular date by the probability that retirement does in fact occur at that date, and then adding the results across the various possible retirement dates.

Next, we perform analogous calculations under the assumption that a years-of-service cap is used. Here, under the assumption that the employee has been receiving raises and continues to do so, there is still an increase in the annual pension payment if the employee remains with the organization longer. However, this increase results solely from the increase in the average salary. For instance, if the employee retires at the end of the 26th year, the updated five-year average of $97,172 is now multiplied only by 50% rather than by 52%. Thus, the annual pension in this case increases from $47,171 to $48,586, rather than increasing from $47,171 to $50,530.

After performing these analogous calculations for the "with cap" scenario, we calculate the difference in the projected net present values of lifetime pension payments. Our initial savings projection is $13,213. On the one hand, the increased probability that the employee accelerates retirement implies a greater number of years of pension payments, and also implies that these pension payments begin sooner since it is the start date, rather than the end date, that changes. But, that same increased probability of accelerated retirement implies a smaller pension amount. (Recall that even with the years-of-service cap, the pension amount increases as long as the pre-retirement average salary increases.) Further, as noted above, even for those employees who do not accelerate their retirement, the cap on years of service credit reduces the rate at which the pension amount increases as years of service increase. This pair of factors outweighs the combination of the greater number of years of pension payments and the acceleration of the start date of that series of payments. Thus, the net impact on the present value of future pension costs is that the employer saves money by imposing a years-of-service cap.

Table 3 provides a simple comparison of these marginal savings on the pension side to the previously discussed marginal costs of increased salary expenses. Under our base case assumptions, the net present value of the cost of the expected salary differential ($43,037) easily outweighs the net present value of the benefit of the expected pension differential ($13,213), resulting in a net cost with a present value of $29,824.

Sensitivity of Results to Parameter Assumptions

Obviously, as with any model a change in input assumptions could lead to radically different findings. For instance, if the imposition of a years-of-service cap had no impact on retention, the financial impact on the employer would be strongly positive. For one thing, there would be no salary cost from having to replace, at a higher salary, employees who leave early due to the years-of-service cap. In addition, the savings on the pension side would be enhanced, because there would be no acceleration of the pension payout's start date, nor any increase in the number of years over which the pension is received. The only impact would be the reduction in future pension payments made to those employees who chose to stay beyond the point

in time at which years of service credit was no longer awarded. Thus, we experiment to attempt to ascertain the sensitivity of the final result to the various input assumptions. Table 4 displays the results of these calculations.

First, we examine the impact of a change in the assumption regarding past raises. If the average raise over the past five years has been only 2% rather than 3%, there is a reduction in the net benefit on the pension side that results from the imposition of a years-of-service cap. Given that the current salary is held constant at $100,000, lower past raises imply that the raises were on a larger base number. Thus, the average salary over the past five years is higher under the revised assumption. As a result, the employees who retire early as a result of the cap generate a higher pension payment under this revised assumption than under the original assumptions. So, while there is still a net benefit to the employer on the pension side, the size of that benefit is reduced. The marginal increase in costs on the salary side is not affected by this alteration in the underlying assumptions. So, for any given current salary level, the net impact on the employer turns out to be worse if recent salary levels have been quite close to the current salary level, than if current salary is substantially higher than the salary of previous years that are still within the five-year window.

Next, we experiment with how the impact of the salary cap changes if future raises are decreased from 3% per year to 2% per year. Here, the amount of the net savings on the pension side is reduced even further than in the previous example. The reason for this is the reduced savings in the future pension payments to those employees who do stay beyond the 25-year point. Suppose, for instance, that a given employee stays 30 years rather than 25. The cap saves the employer money because the employee's final average salary is multiplied by only 50% (25 * 2%) rather than 60% (30 * 2%). But, if the average salary to which this percentage is being applied is smaller, then the savings generated by the reduction from 60% to 50% is likewise smaller. A change in this variable does also provide a bit of relief on the salary cost side. If an employee with a salary of $100,000 is replaced by an employee with a salary of $125,000, the ultimate cost of that initial $25,000 differential is lower if subsequent raises average 2% per year than if they average 3% per year. However, while the cost on the salary side is reduced slightly, the benefit on the pension side is reduced by much more. So, the net impact of the cap is worse if future raises are smaller than if they are larger.

Not surprisingly, if the future salary level of "replacement" employees grows more rapidly than does the future salary level of incumbent employees, the net impact of a salary cap is worsened significantly. If this is the only variable that is altered, the savings on the pension side will be unchanged from the base case scenario. However, for any given increase in the proportion of existing employees who retire earlier than otherwise planned and must be replaced, any increase in the cost of such replacements will of necessity increase the expected marginal cost of increased salaries.

Changes in the discount rate produce an interesting result. If the discount rate increases from 4% to 6%, the absolute size of the net present value of the marginal salary costs is reduced, albeit only slightly. But, given the other assumptions of the model, this same increase in the discount rate not only reduces the marginal benefit on the pension side, but actually turns that marginal benefit negative. Recall from the earlier discussion that the net savings on the pension side occurred because the advantage (smaller annual pension payouts) outweighed the disadvantage (pension payments over a greater number of years due to retirements occurring earlier than they otherwise would). With a steeper discount rate, the acceleration in the timing of the pension payments to those employees who retire earlier in response to the cap increases in importance relative to the savings in the size of the pension payments to those employees who continue to work past the "cap date," to the point that eventually there is an increase in the net present value of pension costs.

The opposite occurs if the discount rate is reduced. For instance, we tested the impact if the discount rate were reduced from 4% to 3%. Here, the net disadvantage on the salary side is worsened slightly, but the net advantage on the pension side is enhanced significantly. The net impact of the years-of-service cap is therefore much better when the discount rate is reduced. Using the goal-seek function in Excel, we found that the break-even level for the discount rate is 0.77%. In other words, holding all other original assumptions constant, 0.77% is the discount rate at which the net benefit on the pension side exactly offsets the net cost on the salary side. Of course, one might argue that a discount rate of 0.77% is unrealistically low. However, if one or more of the other original assumptions were altered, the base case scenario might be much closer to break-even; in that case, the discount rate would not have to be lowered nearly as much to bring about a break-even scenario. The overriding point is that a lower discount rate leads to a more positive net result from the years-of-service cap, whereas a higher discount rate leads to a more negative net result.

Next, we experimented with changing the assumption about the percentage of employees who would remain with the organization in the absence of a years-of-service cap. Reducing the annual retention proportion from 80% to 70% produced a significant decline in the absolute size of the net cost of the pension cap. There was a small decrease in the size of the benefit on the pension side, but there was a much larger decrease in the size of the cost on the salary side. This is because of the reduction in the number of employees who must be replaced at a higher salary. If 80% of the employees with 25 years of service would otherwise remain, but half of them leave because of the years-of-service cap, a total of 40% of that group must be replaced at year 25. If only 70% would have remained, and half of those employees leave due to the years-of-service cap, a total of only 35% of that group must be replaced. So, the absolute size of the marginal cost on the salary side is reduced significantly.

However, when we used the goal-seek function to find a break-even level for this parameter, we were surprised to find that the answer was zero! Upon further reflection, however, this result makes sense. If 100% of the employees with 25 years of service credit were going to retire anyway, then the imposition of the service cap would not make any difference at all, either on the salary side or on the pension side. And, if there is some net benefit or some net cost to the imposition of the service cap, the direction of that impact should not be affected by whether there are a large number of people who are considering staying beyond the 25th year or a small number. The only thing that should be impacted by the answer to that question is the absolute size of the net benefit or of the net cost.

However, if there is a significant decline in the level of marginal attrition, that can easily affect the bottom-line result. Our base case assumption was that 50% of the employees who would have stayed past any given number of years of service will instead leave, if a years-of-service cap is imposed. If that number declines to 40%, there is, first of all, an increase in the pension-side savings. In other words, if more employees remain with the organization despite the fact that they are no longer receiving an increment to their years-of-service credit, the organization continues to get the benefit of the cap itself, without the offsetting cost of having to start making pension payments sooner due to people leaving immediately after the 25th year. Second, there is a reduction in the absolute size of the cost on the salary side, since a reduction in the marginal attrition implies a reduction in the number of new employees who must be hired at a higher salary. The combined result of this is that the net cost to the organization declines in absolute value terms from a net present value of nearly $30,000 to a net present value of just under $11,000.

The goal-seek function in Excel allows us to find the break-even point. All other assumptions held constant, if the marginal attrition created by the years-of-service cap declines from 50% to 34.16%, the years-of-service cap creates neither a net benefit nor a net cost.

A decline in the size of the salary increase that must be paid to replace those employees who do leave has no impact on the pension side, but of course it does have an impact on the salary side. However, the break-even number turns out to be quite low here: only 7.68%. Thus, if all of our other base case assumptions were to be correct, the imposition of a years-of-service cap would create a net cost for the organization unless it could hire new employees at a salary quite close to what it was paying the existing employees who retired.

Obviously, there are any number of combinations of changes that we could make to the input variables. Table 4 shows only one example – marginal attrition as a result of the years-of-service cap is only 40% rather than 50%, and the salary differential for replacing departing employees is 15% rather than 25%. Here, the savings on the pension side improves by roughly $10,000 relative to the base case, and the marginal cost on the salary side declines by over $22,000. The bottom-line impact therefore improves from a net cost of about $30,000 to a net savings of about $3,000.

Conclusions

Our model provides a means for enabling an organization to partially quantify the impact of imposing a years-of-service cap on a defined benefit plan. The model is by no means intended to be prescriptive, as it is designed to allow the organization to input its own assumptions regarding various parameters, and even to modify the set of parameters whose impact it chooses to test.

Under our base-case assumptions, the single most important driver appears to be the assumption about the degree to which retirement increases (i.e., retention declines) when a years-of-service cap is imposed. If no one retires any sooner as a result of the cap, then the only impact of the cap on the organization is a reduction in the size of pension payments to those employees who remain beyond the number of years at which service credit is capped. If large numbers of people retire sooner as a result of the cap, the organization must replace them; and, under our assumptions, it must do so at a higher salary. Further, the organization will also find itself paying these employees' pensions for a greater number of years, and starting sooner. So, the greater the marginal impact of the cap on retention levels, the less positive (or more negative) the net financial impact on the organization will be when a years-of-service cap is imposed.

The bottom-line results are also somewhat sensitive to the assumption regarding the exact size of the salary mark-up that results when employees who leave earlier than they otherwise would have left must be replaced at the market rate. Here, the impact is solely on the salary side of the equation.

Finally, the discount rate proves to be somewhat more important than we had anticipated. With a sufficiently high discount rate, under the other assumptions of our model the imposition of a years-of-service cap can actually result in a net cost even on the pension side, and produces a worsening of the overall impact of the cap. When the discount rate declines, the net impact of the cap improves. It is true that all other factors held constant, the discount rate would have to fall to an improbably low level to turn the overall impact positive. But, if one or more of the other factors is altered sufficiently, it is entirely possible that even a modest reduction in the discount rate could change the overall result from a net cost to a net benefit.

Modelling Levels of Relationship Banking In Business Banking[ii]: An Initiation

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Abstract

In the banking literature, relationship banking (RB) with SMEs has been approached as a one-size-fits-all. However, Boulanouar (2013) has clearly identified three distinct levels of RB depending on variables such as size of the business, amount of borrowings, and level of business complexity. A call then was made to model these RB levels. This paper presents a model as a system of postulates and inferences in mathematical terms. The model is a systematic description of the three RB levels with micro, small and medium sized enterprises. The purpose is to capture the structure and dynamics of the three RB levels from the supply/bank side.

Introduction

In dealing with SMEs, usually described as informationaly opaque businesses, banks and other financial institutions developed a number of what Berger and Udell have termed lending technologies (please see

Table 1, below). A lending technology is described "as a unique combination of primary information source, screening and underwriting policies/procedures, loan contract structure, and monitoring strategies/mechanisms" (Berger & Udell, 2006, p. 2946).

Table 1: Lending technologies

Technology	Type	Borrower	Information
Asset-based lending	Transaction	Opaque	Hard
Equipment lending	Transaction	Opaque & Transparent	Hard
Factoring	Transaction	Opaque	Hard
Financial statement lending	Transaction	Transparent	Hard
Leasing	Transaction	Opaque & Transparent	Hard
Real estate-based lending	Transaction	Opaque & Transparent	Hard
Relationship lending	Relationship	Opaque	Soft
SME credit scoring	Transaction	Opaque	Hard
Trade credit	Transaction	Opaque & Transparent	Soft & hard

Source: Taketa and Udell (2007)

With regard to relationship banking (RB), it has been the subject of study for many years and by scholars from different academic departments including finance (Boot, 2000; Petersen & Rajan, 1994), Economics (Baas & Schrooten, 2006; Bornheim & Thomas, 1998), management (Maque, 2007).), and Marketing ((Deakins & Hussain, 1994; Degryse & Cayseele, 2000).

In finance, different aspects of RB have been studied. Although studies investigating these aspects from both sides of the relationship (banks and businesses) at the same time seem to be very rare (Boulanouar, 2013; Maque, 2007). RB aspects studied include length of the relationship measured by number of years, its depth measured by the scope or the number of banking services. Another aspect include the benefits of RB to both businesses and banks. Although, benefits to banks is relatively a recent area of investigation (Boulanouar, 2013; Bharath, Dahiya, Saunders, & Srinivasan, 2007; and Ergungor, 2005).

Yet in all of these studies, RB at the business banking level is approached (or at least assumed to be) as though it was one (size fits all) homogenous type where no differences between micro, small and medium enterprises exist. An example of this is the often quoted definitions of RB in studies about RB, such as that of Boot (2000). However, Boulanouar (2013) showed how RB levels exist differentiating between three levels.

The first section provides a background into those 3 levels of RB. After that, the main building blocks of the model will be introduced followed by the model. Section 3 will conclude the paper.

Background

Since Boulanouar (2013) seems to be the first and only work[iii] to explicitly talk about levels of relationship at the SME level, in this section, we are going to borrow heavily from him to lay the ground for the proposed modelling of RB levels. Using interviews with a number of relationship managers and some upper bank level managers such as area manager of the 5[iv] big banks in New Zealand that together control 83% of the registered banks' total assets in New Zealand (Reserve Bank of NZ, 2012), Boulanouar (2013) argued for an existence of clear demarcation between the 3 levels of RB and called it taxonomy of SMEs-banks relationships. The three levels are many-to-many relationship model, small business model, and Medium sized business relationship model.

According to this taxonomy, businesses are allocated to a bank relationship manager who manages the relationship from the bank side. As businesses and their banking requirements grow, they are transferred to the next level up in the relationship management ladder to be managed by another/different manager. Furthermore, just as the skills required to manage businesses vary from one level to the next, resources available to the bank managers such as cars to visit clients, discretion levels, and levels of support were found to differ too. The next part of this section elaborates on details about RB at each level.

Levels of Relationship Banking

Micro-Business (Many-To-Many) Relationship Model

Micro (lower end of) businesses are managed online by phone via a call centre and/or a local bank branch. At this level, information about these micro businesses is kept online in files in a central computer. With a team of bank managers, when the small business owner/operator calls the call centre, for example, for a banking product and/or service, any business manager who happens to be free and is online will deal with him or her. It is as if a number of online business managers collectively manage a set of online businesses, hence the label many-to-many relationship management model. None of the online business managers at this level seem to have any discretion beyond a small amount of lending like that granted under a business credit card or a small overdraft. Another key criterion at this level of RB is the number of businesses per business manager which tends to be very high. Other aspects include resources available to the bank manager which are minimal.

Small Business Relationship Model

As businesses grow, their levels of business activity, complexity and sophistication grow as well. The volume, the kind of banking products and services, and the level of bank involvement and management need to match this growth. The banks' response to these changes is then to provide a one-to-one business relationship-banking model.

Each and every small business is allocated to a designated/specific small business manager. Each of these business managers is physically located in one of the bank branches around the country, and is responsible for managing his/her customers' RB with the bank. These business managers are the main point of contact between the bank and the small business client. While the number of businesses per business manager seems to vary greatly from bank to bank, on average it is much less than that of the online business manager. This seems to be a natural outcome of the nature of RB at this level, as more time and expertise are required of the business manager to cater properly to these types of businesses, which includes visiting their work premises.

With regard to the issue of discretions given to the different bank managers, and in comparison to the online-business managers, the business managers enjoy higher levels of discretion, including dollar-lending discretion. The business managers also have access to more resources and bank support. The support model used at this level is that of one-to-many where a credit analyst, for example, is shared among a number of business managers

Medium sized business relationship model:

At the upper end of business banking, there are the managers of medium sized businesses, henceforth called relationship managers. On average, these relationship managers are in charge of a portfolio of businesses numbering less than half that

of a business manager. Furthermore, relationship managers have discretion levels with upper limits much higher than those enjoyed by the business managers.

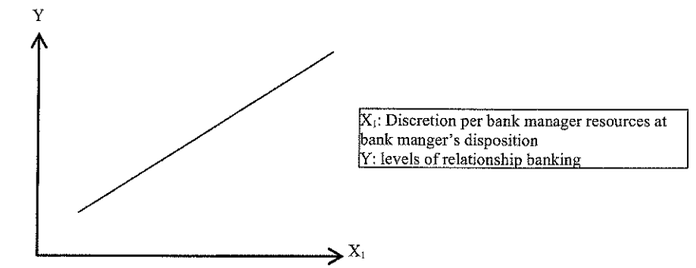
The relationship managers are expected to be more proactive in their approach with their customers in terms of keeping in touch with them via phone and emails, visiting their work premises, and initiating deals. Whereas the business managers are more reactive to their customers when it comes to contacting them and/or when needed, following the "set and forget" guide. The relationship managers are also expected to know/learn about their customers more intimately than the business managers and to deal with them face to face. This clearly shows that managers at this level spend much more time on individual customer than the previous level.

Furthermore, relationship managers have an assistant manager (could be called an account manager) who is in charge of the day-to-day management of the relationship-managed-business account and who (attends to) look after things such as their term deposits and maintenance queries, because once, for example, a loan is contracted the clients want banking to be easy. The relationship manager is called in only when big things are happening, such as new loans, in which case the relationship/business manager gets involved until the deal gets approved, gets it all through to the solicitor for documentation, and then the account manager picks it up and does the rest. This frees the relationship/business manager to attend to bigger and more profitable tasks from the bank's point of view.

Graphical Representation of the 3 Levels of Relationship Banking

The relationships that exist between the 3 levels of RB and the different criteria can be depicted as follow:

Figure 1: Levels of relationship banking and levels



In Figure 1 (above), the Y axis represents the level of RB in terms of discretion level given to the relationship manager, resources at his/her disposition to use such as a phone, car etc. It is an increasing function of the type of RB going from Micro (where the relationship manager has minimal discretion and resources, if any) to small RB then to the medium relationship where the relationship manager is granted the highest discretion in SME banking.

Figure 2: Relationship between size of business, level

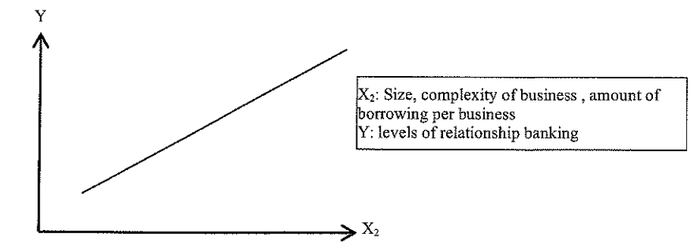
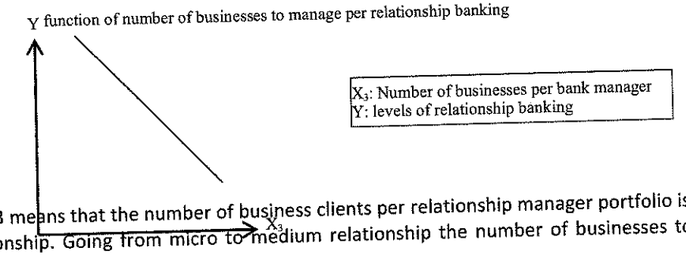


Figure 2 says there is a positive relationship between size of the business, level of complexity, the amount of borrowing and the type of RB that the business will have. As size of the business increases going from micro to small to medium – this coupled with the complexity of the business and more borrowing, RB model used will go up from micro-business model to small business model, and then finally to medium business model.

Figure 3: Levels of relationship banking as a decreasing



Finally, Figure 3 means that the number of business clients per relationship manager portfolio is a decreasing function of the type of relationship. Going from micro to medium relationship the number of businesses to be managed decreases substantially.

The next section will first summarize the main determinants of the explanatory variables (such as business size and amount of borrowings per business) in their relationship with the dependent variable which is the RB level. Then, in mathematical terms, modelling of the above three RB levels will be done.

The Model

Determinants of the model

In mathematical notations format, Table 2 (below) boils down the main variables that will be used in the model. Explanations of each variable follows the table then the model.

Table 2: Main determinants of the model

	Dependent variables		
Relationship banking levels i: (L_i)	S_i C_i B_i	K_i R_i D_i	N_i

Note: $i = 1, 2, 3$ indicates the relationship banking level with micro-business, small business, and medium business, respectively.

- S_i: size of the business managed at the RB level *i*. Size can be measured via one of the standard proxies such as sales, assets, number of employees. As size of a business increases we suppose the business to be moved up through the levels of relationship from L_1 to L_2, and then L_3.
- C_i: complexity refers to complexity of the activity of the managed business at level *i* of RB, its environment, or banking products and services the business requires. An example of this is a business with foreign suppliers and foreign customers. This business would require bank services such as Foreign Exchange due to changes in exchange rates, commodity prices, payment in foreign currencies. As *i* increase, the business requirements become more complex.
- B_i refers to the amount of borrowing by the business being managed at the RB level L_i. As *i* increases, the amount of borrowing per business increases[v]. More borrowing means more involvement by the bank or its relationship manager particularly with medium sized businesses.
- K_i denotes skills that the bank manager should have to manage a RB with businesses at level *i*. For the bank manager to acquire these skills there is investment either by the bank manager and/or the bank in things like obtaining a degree, training, and experience.
- R_i resources available to the bank manager to do his/her work such a computer, a car and (in)direct access to an assistant manager's help. As mentioned above, the level of resources available to the bank manager, such as a car to visit the work premises of his/her relationship-managed client varies between levels. At the small level of RB, the bank manager would be expected to have resources such as a computer, a phone, and direct access to services of a shared

assistant manager (with other bank managers at same RB level) but not a car. At the next level up of the relationship, the manager would have a car and a direct access to a full-time assistant manager.

- D_i represents level of discretion given to the bank manager at level i. as we move up the levels, more discretion is given to the bank manager.
- N_i represents the number of businesses managed by an individual RB manager i.e. number of businesses in each bank manager portfolio to manage. Moving up the levels of RB, L_1 through to L_3, the number of businesses per bank manager decreases substantially. This means we have $N_1 > N_2 > N_3$.

The Model Details

The RB service production Y is related to the level of RB level L_i $with\ i = 1, 2, 3$. The production function Y_{L_i} depends on the variables $S_i, C_i, B_i, N_i, K_i, R_i, and\ D_i$ detailed above and is related to L_i such that each level would have its own behaviour and its own function F_{L_i}. Thus we can write:

$$Y_{L_i} = F_{Li}(S_i, C_i, B_i, N_i, K_i, R_i, D_i, Z_i) + \varepsilon_i \qquad (1)$$

$$with \begin{cases} i = 1, 2, 3 \\ \varepsilon_i\ is\ a\ stochastic\ term, and \\ Z_i \text{ represents exogenous variables such as monetary policy, economy growth.} \end{cases}$$

It is worth noting that as micro businesses tend to be noncomplex, we assume complexity to be absent for $i = 1$, in other words C_1 takes zero value.

Working out the Per-capita variables of the model:

In light of the details about the determinants of the model discussed above, we can show that per capita borrowing at L_1 would be smaller than per capita borrowing at L_2 which is in turn smaller than per capita borrowing in L_3.

At the relationship level L_i, we have B_i the amount of total borrowing and the number of businesses served N_i. The per capita borrowing at level L_i is $b_i = \frac{B_i}{N_i}$

$$\text{As} \begin{cases} B_1 < B_2 < B_3 \\ and \\ 0 < N_3 < N_2 < N_1 \end{cases} \quad then\ b_i < b_{i+1}$$

Following the same steps with all other variables in Table 2 (above), we get Table 11(below)[vi].

Table 3: Per capita variables and per capita relationship banking service production

Per capita variable at level L_i	Relationship of the per capita variable between all levels	Per-capita RB service production' & 'Per-capita determinant variable
$s_i = \frac{S_i}{N_i}$	$s_1 < s_2 < s_3$	$\frac{y_{L_i}}{s_{L_i}}$
$c_i = \frac{C_i}{N_i}$	$c_1 < c_2$	$\frac{y_{L_i}}{c_{L_i}}$
$b_i = \frac{B_i}{N_i}$	$b_1 < b_2 < b_3$	$\frac{y_{L_i}}{b_{L_i}}$
$n_i = \frac{N_i}{N_i} = 1$	-	-
$k_i = \frac{K_i}{N_i}$	$k_1 < k_2 < k_3$	$\frac{y_{L_i}}{k_{L_i}}$
$r_i = \frac{R_i}{N_i}$	$r_1 < r_2 < r_3$	$\frac{y_{L_i}}{r_{L_i}}$
$d_i = \frac{D_i}{N_i}$	$d_1 < d_2 < d_3$	$\frac{y_{L_i}}{d_{L_i}}$
$z_{L_i} = \frac{Z_{L_i}}{N_i}$	$z_{L_1} < z_{L_2} < z_{L_3}$	
$y_{L_i} = \frac{Y_{L_i}}{N_i}$	$y_{L_1} < y_{L_2} < y_{L_3}$	

Of particular interest is the last row which is the per capita RB service production. The last cell, in column 2, shows that per capita RB service production at L_1 *is smaller than that of* L_2 *which is in turn smaller than that of* L_3. This points to our first important result which systematically shows the existence of three RB levels.

Using the per capita variables, function (1) can be rewritten as:

$$y_{L_i} = f_{L_i}(s_i, c_i, b_i, 1, k_i, r_i, d_i, z_i) + u_i \quad with\ i = 1, 2, 3 \qquad (2)$$

Where u_i is an error term.

Furthermore, dividing 'per-capita RB service production' at L_i by 'per-capita borrowing' at levelL_i, would result in how much 'per-capita borrowing' would produce 'per-capita RB service': $\frac{y_{L_i}}{b_{L_i}}$

Following the same process with all other variables vis-à-vis y_{L_i} we get the last column in Table 11 (above). It points to our second important result which systematically shows how each of the three RB levels is dependent on the determinant variables. Further it shows how it is possible to compare between $y_{L_1}, y_{L_2}, and\ y_{L_3}$ based on the contribution of per-capita of each of the determinant variables in turn to the per-capita RB service production.

Conclusion

This paper has developed a model to conceptualize and understand the three different levels of relationship between micro, small and medium firms and bank.

The model shows the existence of three distinct RB levels and how these levels are dependent on the specific determinant variables.

Future research could empirically test and validate the proposed model. The propped model can also be used to work out the optimal allocation of the bank limited resources among the 3 levels of RB to achieve maximum creation of value for its stakeholders.

Endnotes

[ii] Business banking defined as banking to micro, small and medium sized businesses
[iii] To the best our my knowledge.
[iv] After amalgamation
[v] Share of medium business loans in total SME loans is bigger than share of small business loan, which is in turn bigger than share of micro business loans (OECD, 2015)
[vi] The first two columns only.

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