



**Research, Analysis &  
Statistics**

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***2015 IRS-TPC Research Conference***

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***Improving Tax Administration  
Through Research-Driven Efficiencies***

***June 18, 2015***



**Research, Analysis &  
Statistics**

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## *2015 IRS-TPC Research Conference*

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# *Welcome*

**Eric Toder**

Institute Fellow: Urban Institute, and  
Co-Director: Urban-Brookings Tax Policy  
Center

**Alain Dubois**

Deputy Director: IRS Office of Research,  
Analysis, and Statistics

**John A. Koskinen**

Commissioner of Internal Revenue



## ***2015 IRS-TPC Research Conference***

# **Session 1: Innovative Methods for Improving Resource Allocation**

**Moderator:**

***Melissa Vigil***

*IRS, RAS, Office of Research*

**Estimating Marginal Revenue/Cost Curves  
for Correspondence Audits**

***Alan Plumley***

*IRS, RAS, Office of Research*

**Examining the TDA Collectability Curve**

***Jeff Wilson***

*IRS, Taxpayer Advocate Service*

**Analysis of Flow-Through Entities Using  
Social Network Analysis Techniques**

***Shannon Chen***

*University of Texas at Austin*

**Discussant:**

***Arnie Greenland***

*University of Maryland*



**Research, Analysis & Statistics**

**OFFICE OF RESEARCH**

# Estimating and Using Marginal Revenue/Cost Functions for Correspondence Audits

**Alan Plumley**

**18 June 2015**

**Team:**

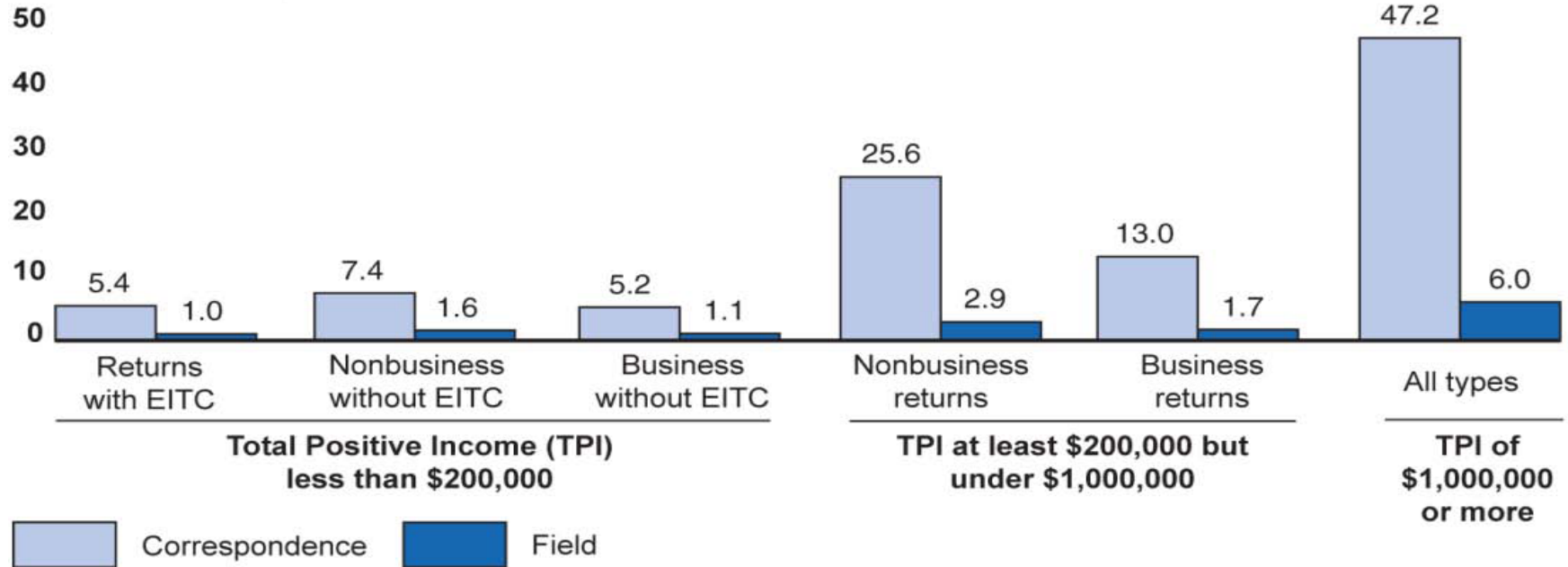
**Ron Hodge, Kyle Richison, and Getaneh Yismaw (RAS:R)  
Nicole Misek, Matt Olson, and Sanith Wijesinghe (MITRE)**

# Government Accountability Office:

“IRS Could Significantly Increase Revenues by Better Targeting Enforcement Resources”

Dollars of revenue per dollar of cost

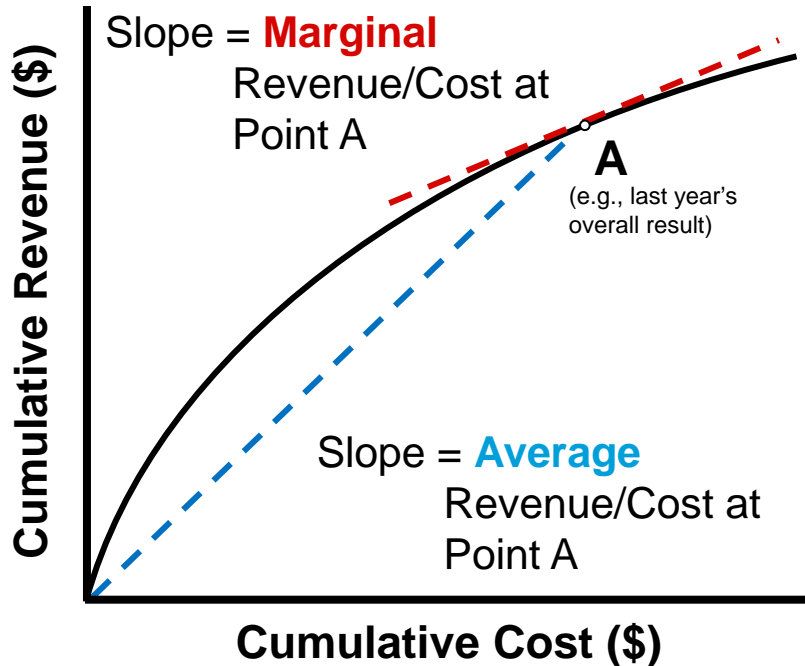
(December 2012)



Source: GAO analysis of IRS data.

# Government Accountability Office:

“A hypothetical shift of a small share of resources (about \$124 million) from exams of tax returns in less productive groups... to exams in the more productive groups could have increased direct revenue by \$1 billion... (as long as the average ratio of direct revenue to cost for each category of returns did not change).”



- The average R/C is constant only if we select cases **randomly**.
- If we're successful in giving priority to the most cost-effective cases, then the average should **decline** as we increase the budget.
- Making allocations based on average R/C **overstates** the impact of a change in budget.

# Is There Evidence of Marginality?

That is, are the methods used to prioritize potential audit inventory **better than random** selection?

- If we had to **reduce** the number audited, would we tend to avoid the least cost-effective ones?
- If we were able to **increase** the number audited, would the additional ones be less cost-effective than the ones already selected?

**Answer:** **YES**, there is evidence of marginality!

# Current Research Project

Focused on **correspondence** (rather than face-to-face) audits

- Many categories of correspondence audits (“**projects**”), defined by what tax return line item is being questioned
- Begin by trying to **improve resource allocation** across the projects assuming no change to operational selection system



# Method (for a given project and tax year)

**Step 1:** Identify for each closed audit:

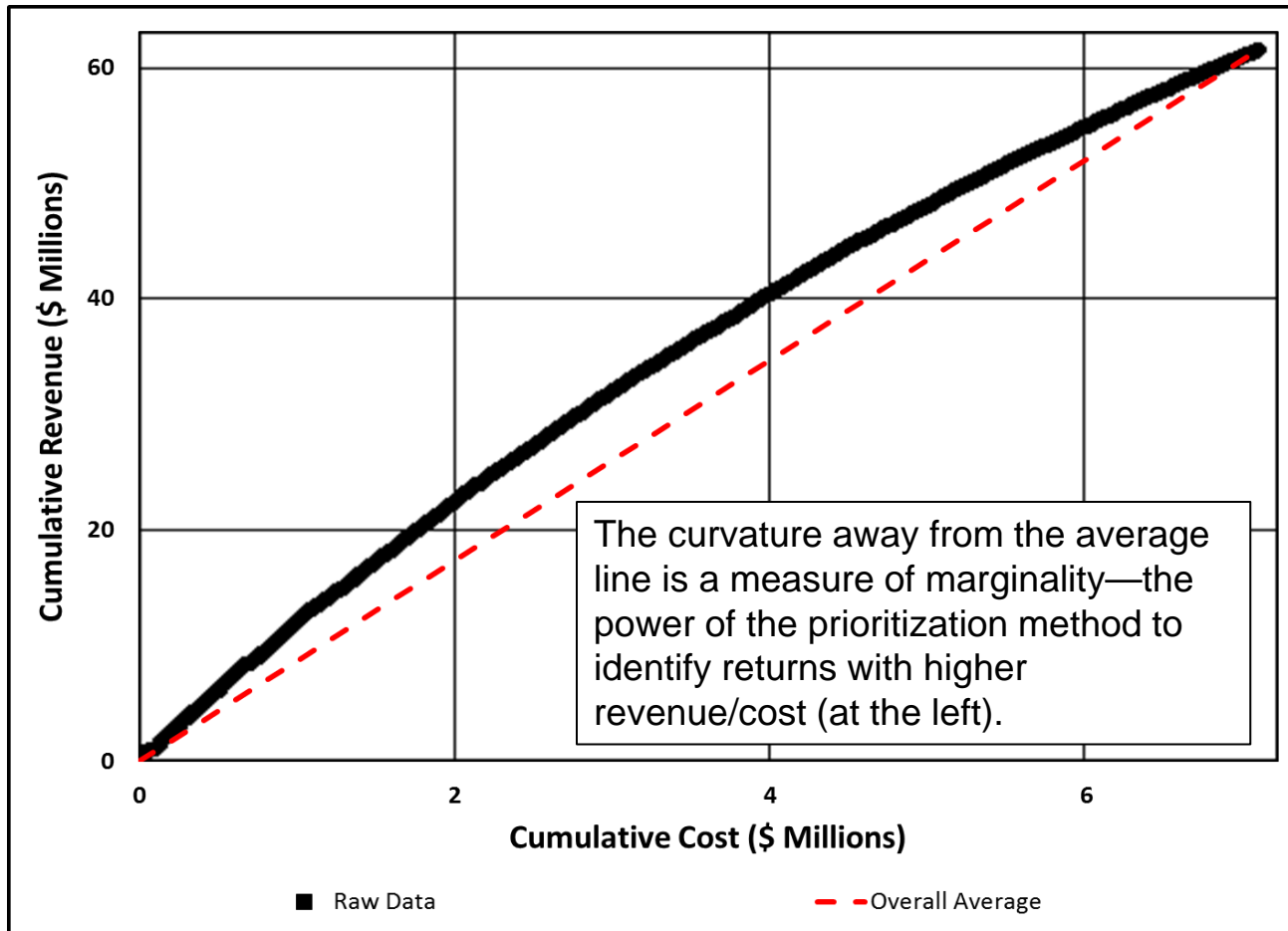
- The tax **revenue** collected from the audit;
- An estimate of the **cost** to identify, assess, and collect that revenue (from time applied, series, grade, etc.); and
- The value of the variable used operationally to assign **priority** to the audit.

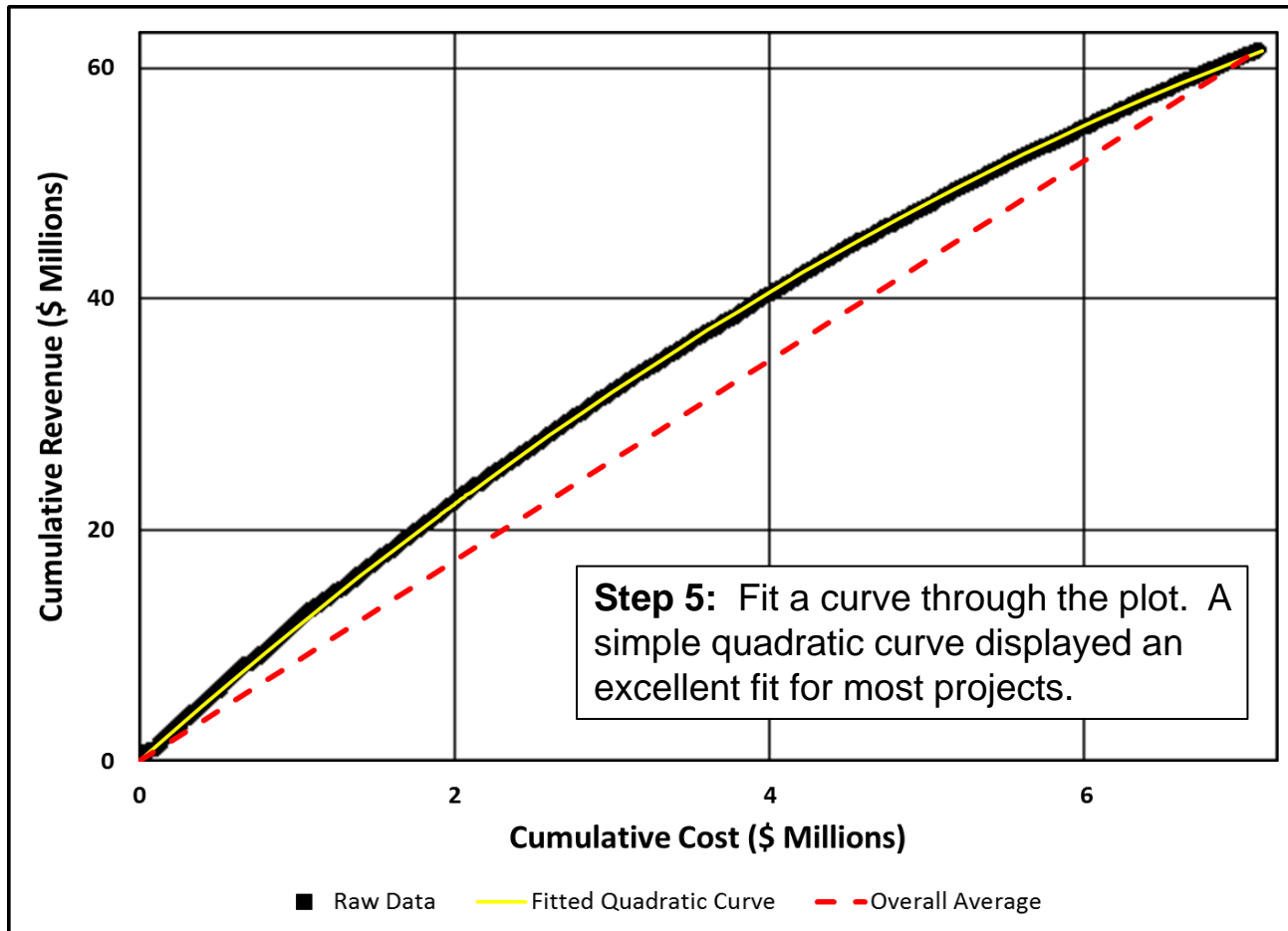
**Step 2:** **Sort** all closed audits in declining order of the prioritization variable.

*When a return was audited is generally not a proxy for priority.*

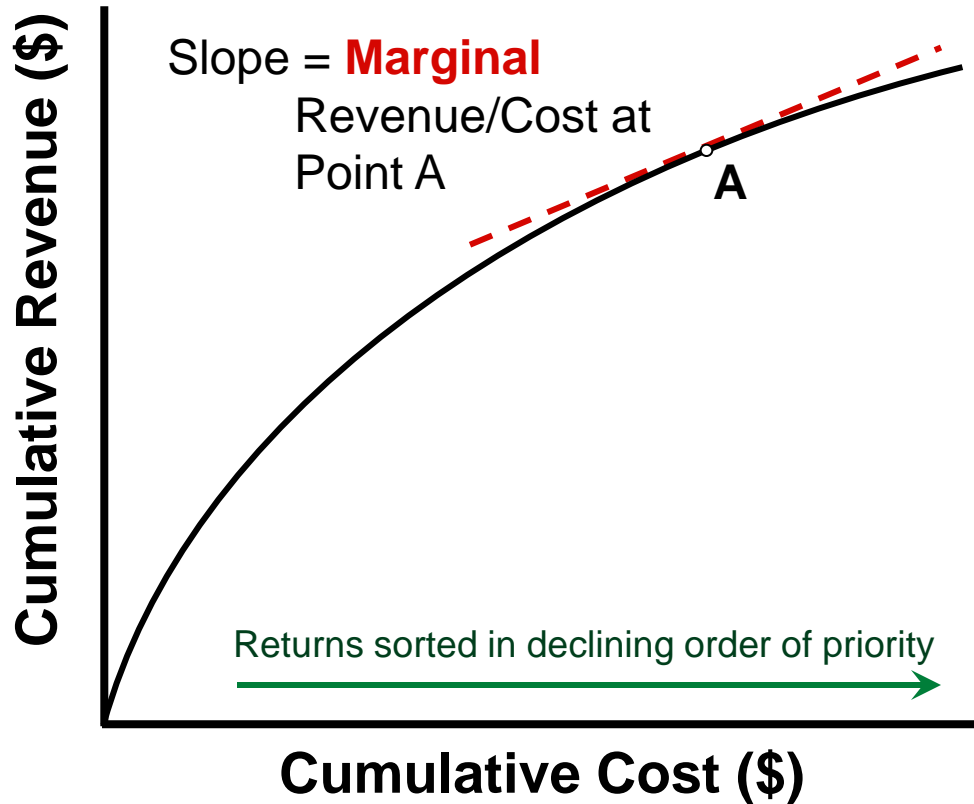
**Step 3:** Derive for each audit the **cumulative revenue** and **cumulative cost** of all returns audited having same or greater priority.

**Step 4:** **Plot** cumulative revenue vs. cumulative cost.





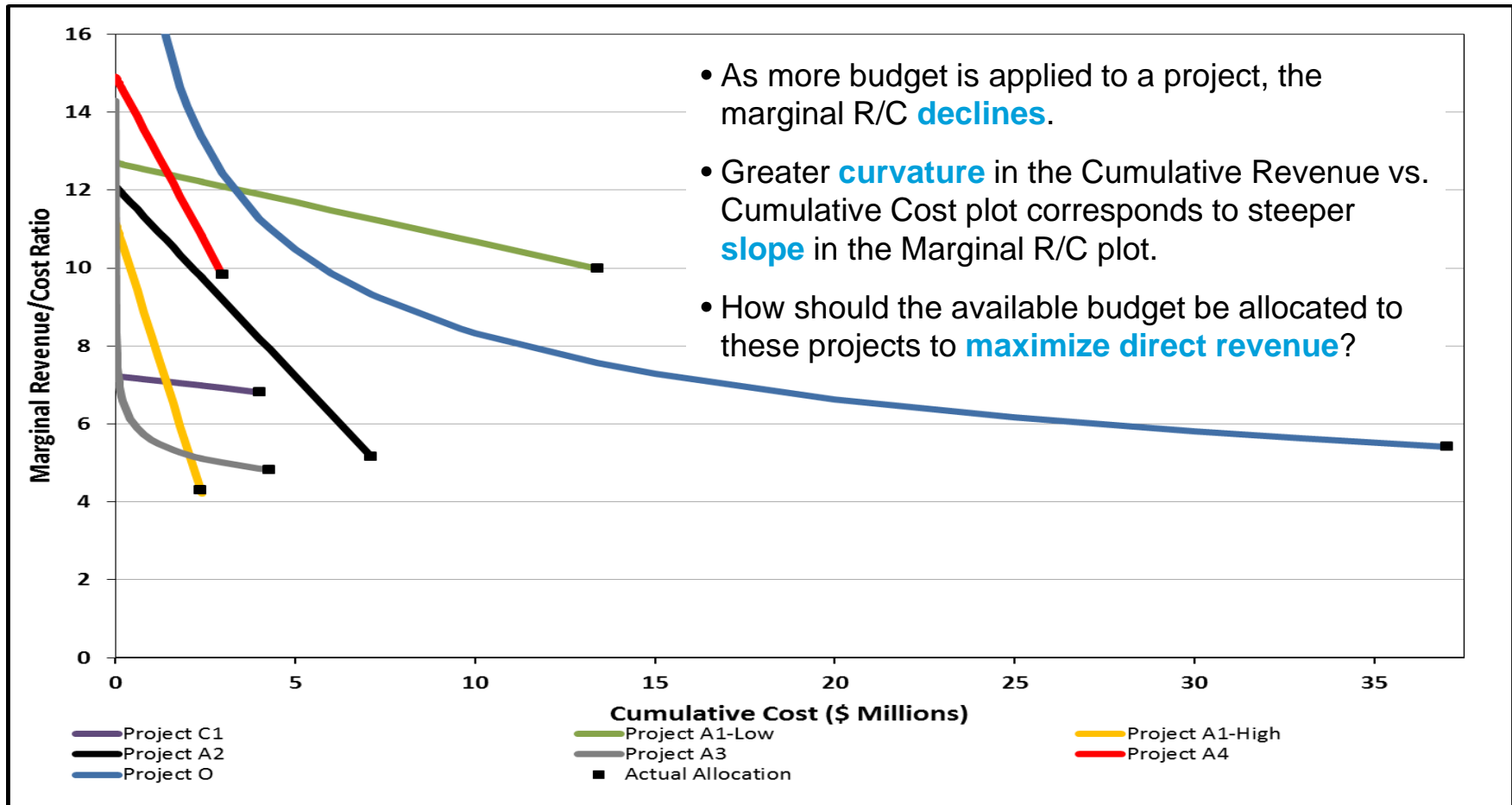
# Deriving Marginal Revenue/Cost Functions



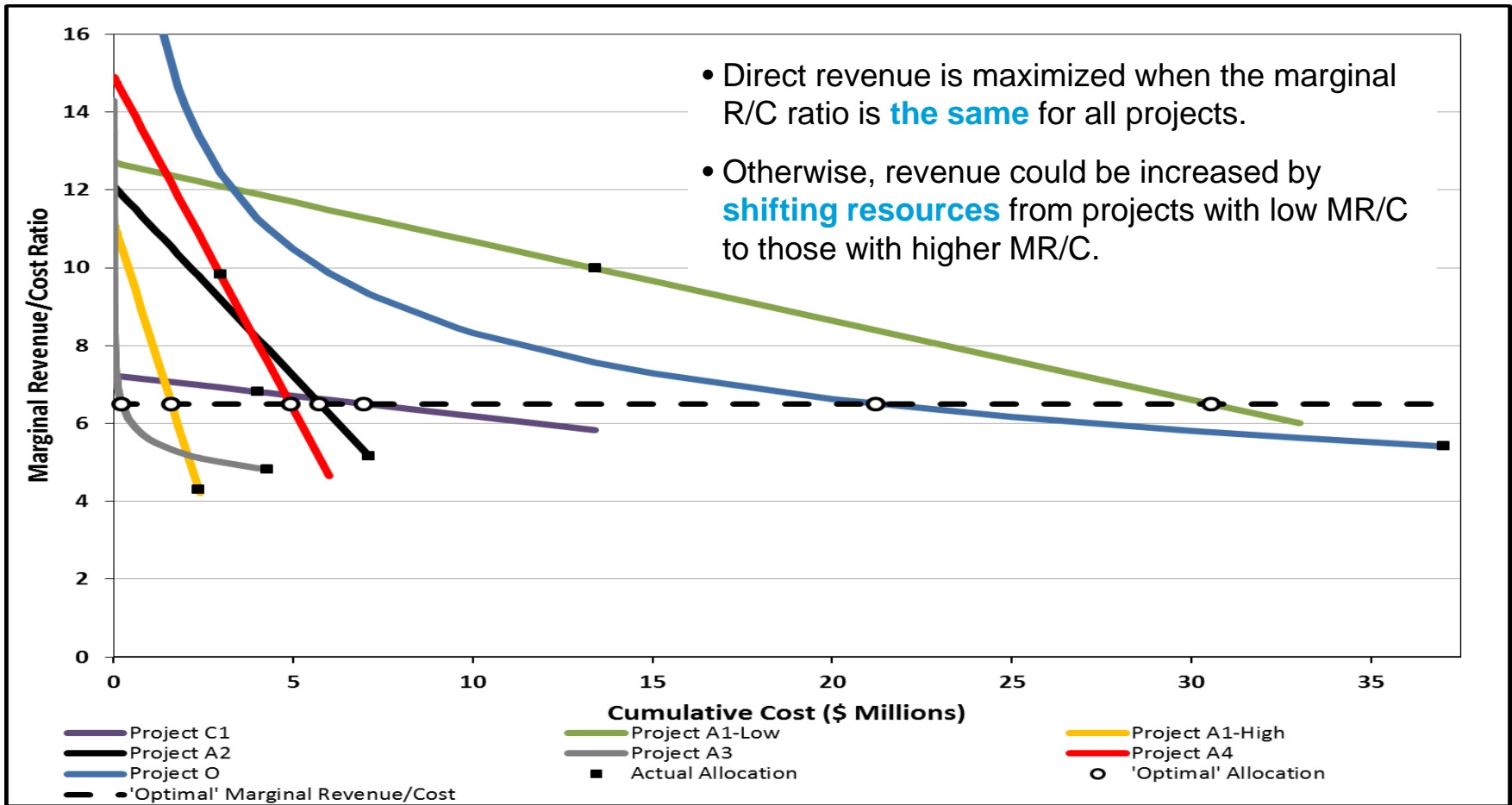
**Step 6:** Mathematically derive the **marginal** Revenue/Cost curve (the slope of the cumulative curve at each point)

- If the cumulative plot is a **quadratic** curve, then marginal R/C **declines linearly** as a function of cumulative cost.

# Marginal Revenue/Cost as a Function of Budget, Tax Year 2006



# Marginal Revenue/Cost as a Function of Budget, Tax Year 2006



## Actual vs. Optimal\* Revenue and Cost (\$ M)

Project	Actual Allocation					Optimal* Allocation					Change in Cost	Change in Revenue
	Total Revenue	Total Cost	Net Revenue	Average Rev/Cost	Marginal Rev/Cost	Total Revenue	Total Cost	Net Revenue	Average Rev/Cost	Marginal Rev/Cost		
C1	\$27.6	\$4.0	\$23.6	6.90	6.81	\$47.7	\$7.0	\$40.8	\$6.87	6.51	\$2.9	\$20.1
A1-Lo	\$151.9	\$13.4	\$138.5	11.33	9.98	\$293.3	\$30.5	\$262.7	\$9.60	6.51	\$17.1	\$141.4
A1-Hi	\$18.6	\$2.4	\$16.2	7.83	4.29	\$14.2	\$1.6	\$12.6	\$8.84	6.51	-\$0.8	-\$4.3
A2	\$61.7	\$7.1	\$54.6	8.67	5.16	\$53.3	\$5.7	\$47.6	\$9.30	6.51	-\$1.4	-\$8.4
A3	\$21.9	\$4.3	\$17.6	5.12	4.82	\$1.6	\$0.2	\$1.4	\$7.24	6.51	-\$4.1	-\$20.3
A4	\$36.3	\$3.0	\$33.4	12.22	9.83	\$52.7	\$4.9	\$47.8	\$10.71	6.51	\$1.9	\$16.3
O	\$287.1	\$37.0	\$250.0	7.75	5.41	\$205.7	\$21.2	\$184.5	\$9.70	6.51	-\$15.8	-\$81.4
<b>Total</b>	<b>\$605.1</b>	<b>\$71.2</b>	<b>\$533.9</b>	<b>8.50</b>		<b>\$668.6</b>	<b>\$71.2</b>	<b>\$597.4</b>	<b>\$9.39</b>	<b>6.51</b>	<b>\$0.0</b>	<b>\$63.5</b>

\* These are “optimal” allocations only in the sense that they maximize net direct revenue in the absence of any constraints. They are not truly optimal since they don’t account for indirect effects, other benefits or costs, constraints, or valuations of benefits and costs other than dollars.

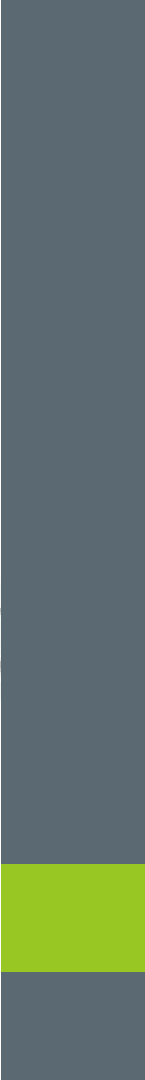
# Next Steps

- Work with Campus Exam and OCA to incorporate MR/MC functions in the **Exam Planning Scenario Tool** to support the FY16 Exam Plan.
- Identify constraints
  - How much can we expand projects with high MR/MC?
  - How easily can examiners work different projects?
- Make assumptions about indirect effects
  - Minimum coverage constraints, etc.
- Improve workload selection (screening, prioritization variables)



# IRS Collectability Curve

Taxpayer Advocate Service  
Research & Analysis  
June 2015



# Focus



- Taxpayer Delinquency Account (TDA) liabilities.
- Individual Master File
- Collection statute (generally 10 years)

# Background



- Over 50 percent of the IRS Individual Master File (IMF) TDA inventory has been in the function assigned the delinquency for at least 10 months.
- Over 70 percent of the IMF TDAs in IRS inventory at the end of 2014 are Tax Year 2010 and prior liabilities.
- Over 20 percent of the IMF TDAs have less than four years remaining on the collection statute, meaning that the delinquency has existed for over six years.

# Objectives

A faint, stylized illustration in the background shows a stack of three gold coins with a dollar sign on top, resting on a green banknote. The entire scene is rendered in a light, semi-transparent style.

- Determine dollars collected during each year after TDA assignment.
- Distinguish between TDA dollars collected from subsequent payments and offsets.
- Determine how dollars collected vary by categories of TDA balance due.

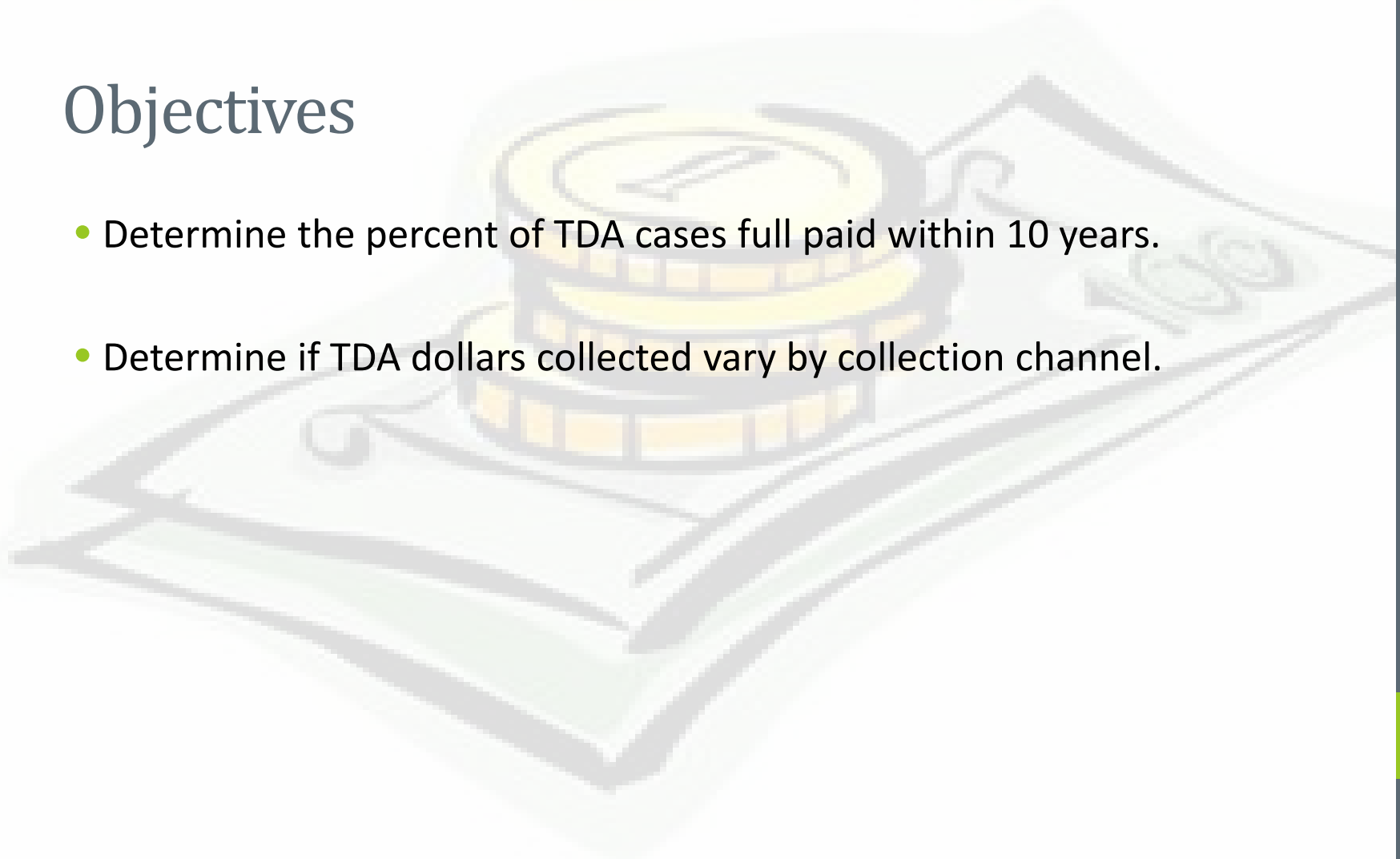
# Objectives

The background of the slide features a faint, stylized illustration of a stack of gold coins on top of a US dollar bill. The coins are depicted with a central emblem, and the bill shows some of its characteristic patterns and colors. The entire illustration is rendered in a light, semi-transparent style, serving as a decorative backdrop for the text.

- Determine how TDA dollars collected vary by type of assessment (self-reported and IRS imposed)
- Quantify the effect of assessed penalties and interest on the TDA balance due.
- Determine the percentage of TDA liabilities abated by the IRS and if abatements vary by sources of assessment.

# Objectives

- Determine the percent of TDA cases full paid within 10 years.
- Determine if TDA dollars collected vary by collection channel.



# Methodology

The background of the slide features a faint, stylized illustration of a stack of gold coins in the center, with a US dollar bill partially visible behind them. The illustration is rendered in a light, sketchy style. On the right side of the slide, there is a vertical bar with a grey top section and a lime green bottom section.

- Analyzed balance due (from IMF ARDI) at initial TDA assignment.
- Analyzed cases entering TDA status (by year entered) from calendar year 2003 through 2012.
- Used IMF data to distinguish between subsequent payments, offsets, penalties, interest, and adjustments (classified by transaction code).

# Methodology

A faint, stylized illustration in the background shows a stack of three gold coins on top of a folded green bill, possibly representing money or financial data.

- Used ARDI *major source of assessment* to determine type of IRS assessment (self-assessed or IRS imposed).
- Used *TRCAT* code to determine if case was assigned to ACS, collection queue, or Cff.



# Limitations

- Changes in module balances include assessed and accrued penalties and interest; however, the specific finding on penalties and interest only includes assessed amounts.
- Amounts abated because of accepted offers in compromise are included in the sections on abatements; however, in FY 2014, accepted offers in compromise only accounted for about one percent of the initial TDA balance.

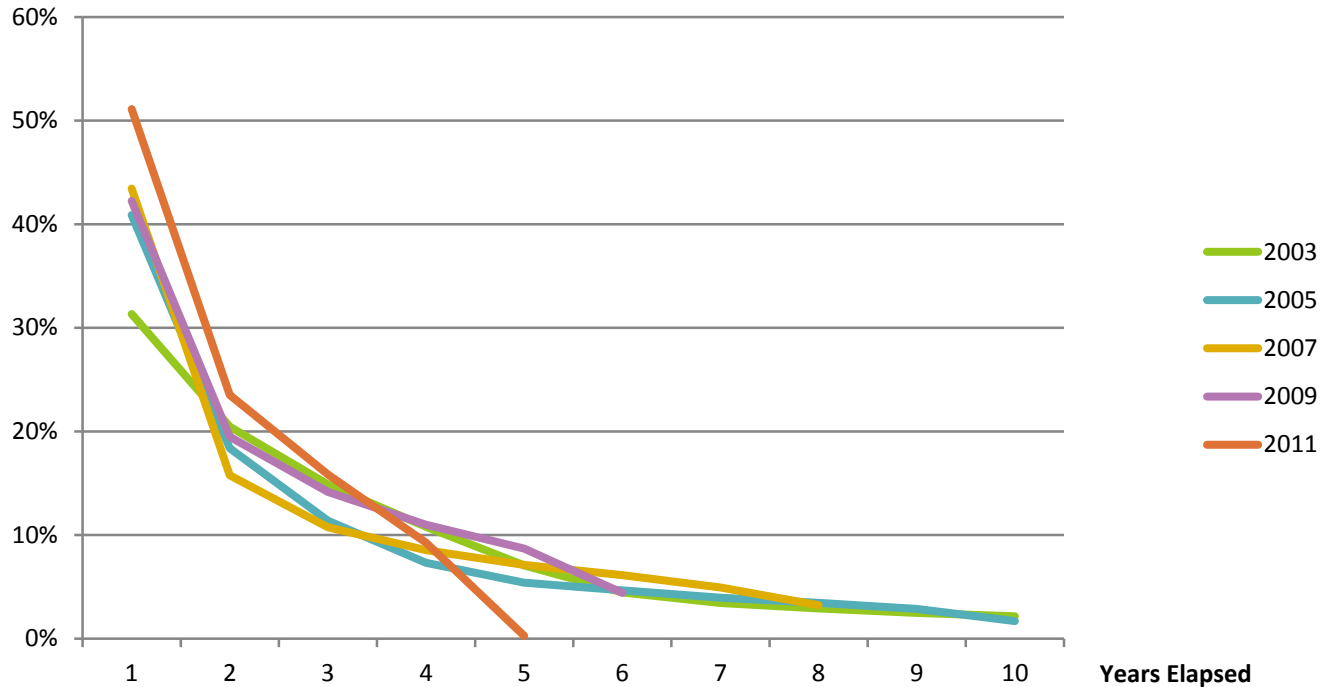
# Findings



- Dollars collected generally decreased by more than 50 percent from the first year to the second year.
- In the third year, collections decrease by about a third from the amount collected in the second year.

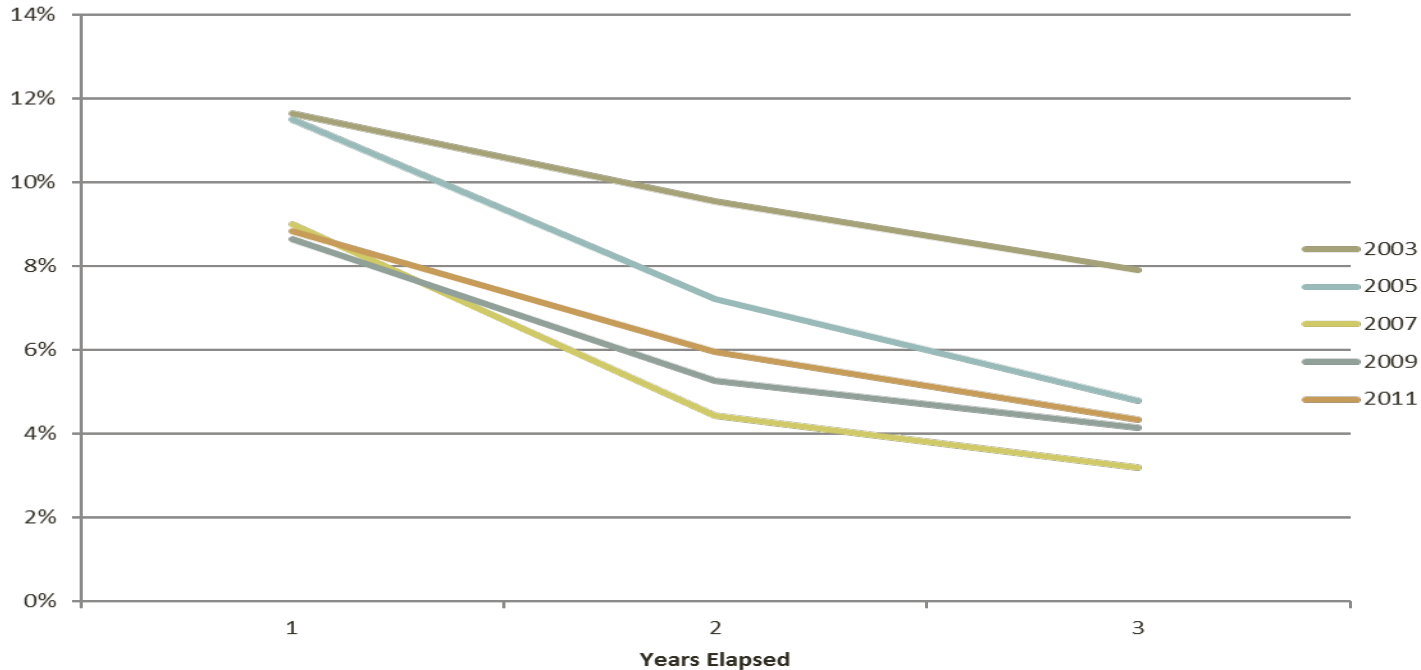
# Findings – Percent of Payments Collected per Year

## Percent Collected by Years Elapsed



# Findings - Dollars collected also decline as a percent of the available balance.

## Decline in Dollars Collected as % of Module Balance



# Findings – Dollars Collected by Subsequent Payment Have Decreased

- In the earlier years, dollars collected by subsequent payment are nearly triple dollars collected through offset however, in more recent years, this margin has decreased to only double.
- Overall, dollars collected on TDAs by subsequent payment appear to be decreasing from 2003 to 2012.

# Findings – Percent of Dollars Collected vary by TDA Balance

- Nearly Three-quarters of TDAs have balances of \$5,000 or less.
- However, over 80 percent of the balance owed is contained in TDAs with balances above \$5,000.
- The IRS Collects a Higher Percentage of dollars when the TDA Balance is Smaller.

# Findings – Percent of Dollars Collected vary by TDA Balance

- The IRS offsets the highest percent of dollars to TDAs under \$5,000.
- As time progresses, the percent of TDAs with initial balances of \$5,000 or less are decreasing, while the percent of the total initial TDA balance above \$5,000 is increasing.

# Findings – Source of Assessment

- On a percentage basis ...
  - The IRS Collects twice as much from TDAs resulting from self-assessments than from audit assessments.
  - In recent years, the IRS also collects about twice as much from TDAs resulting from self-assessments than AUR assessments (the difference was not quite as large in earlier years).



# Findings – Source of Assessment

- The IRS generally collects the least on SFR assessments.
- The IRS collects the highest percentage from offsets on TDAs from AUR assessments.
- The IRS generally offsets a slightly higher percentage on TDAs from audit assessments than self-reported assessments.

# Findings – Source of Assessment

## Subsequent Payments

Year	Self-Reported Assessments	Substitute for Return	Audit Assessments	AUR Assessments	Trust Fund Recovery Penalties
2003	56%	14%	23%	33%	16%
2005	60%	13%	28%	31%	17%
2007	51%	10%	24%	25%	12%
2009	45%	9%	21%	24%	9%
2011	40%	7%	15%	21%	8%

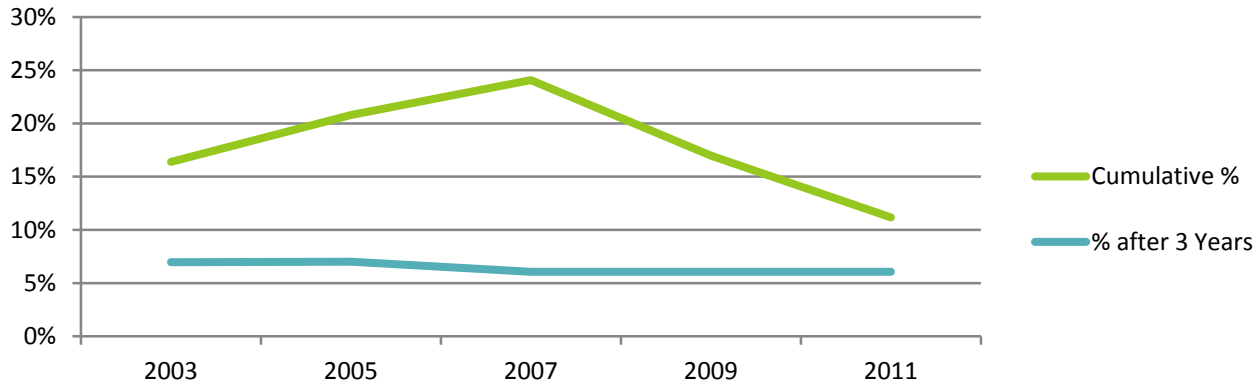
## Offsets

Year	Self-Reported Assessments	Substitute for Return	Audit Assessments	AUR Assessments	Trust Fund Recovery Penalties
2003	18%	4%	12%	34%	6%
2005	20%	5%	20%	32%	6%
2007	20%	5%	25%	36%	6%
2009	15%	4%	20%	28%	6%
2011	10%	2%	12%	25%	4%

# Findings – Assessed Penalties and Interest

- Over equivalent three year periods, assessed penalties and interest have remained relatively constant; however, when sufficient time has elapsed, penalties and interest are increasing.

**Percent of Liability (actually due) Attributable to Penalties and Interest**



# Findings - Abatements

- Generally, the IRS abates from a quarter to a third of TDA assessments.

Year	Initial TDA Balance	\$ Abated	% Abated
2003	\$15,326,191,192	\$2,985,977,270	19%
2005	\$25,996,084,845	\$8,066,761,341	31%
2007	\$40,678,451,308	\$13,086,103,480	32%
2009	\$41,987,700,518	\$10,716,623,485	26%
2011	\$42,926,217,917	\$11,990,870,525	28%

# Findings - Abatements

A faint, stylized illustration in the background shows a stack of gold coins resting on an open green book. The coins are rendered in a simple, blocky style with a yellow-gold color. The book is open, with its pages visible, and is colored in a light green. The entire illustration is semi-transparent and serves as a decorative background for the slide.

- SFR assessments have the highest abatement rate (nearly 50 percent in some years).
- Abatements attributable to AUR assessments are growing, while self-reported assessments are the least likely to be abated.

# Findings – Abatements by Source of Assessment

Year	Self-Reported Assessments	Substitute for Return	Audit Assessments	AUR Assessments	Trust Fund Recovery Penalties
2003	6%	49%	15%	15%	39%
2005	6%	47%	12%	29%	40%
2007	12%	43%	14%	28%	35%
2009	9%	36%	13%	27%	28%
2011	16%	40%	19%	18%	29%

# Findings – Full Payments and Collection Channel

- The full payment rate has been decreasing for TDAs issued in more recent years, while a higher percentage of the initial TDA liability remains due.
- ACS collects a higher percent of TDA dollars by both subsequent payment and offset than Cff (may be a reflection of inventory composition).
- Often, over a third of TDA dollars assigned to Cff are abated.

# Conclusions

The background of the slide features a faint, stylized illustration of a stack of gold coins on top of a US dollar bill. The coins are depicted with a circular pattern and a central emblem, while the bill shows the characteristic wavy lines and a portrait. The entire illustration is rendered in a light, semi-transparent style, serving as a decorative backdrop for the text.

- Dollars collected in aggregate and as a percent of the balance due decrease significantly during the first three years after the IRS assigns a liability to TDA status.
- When continuing to look at the collection of liabilities after the third year of the initial TDA assignment, collections continue to dwindle and the reduction in the module balance declines almost completely.
- Overall, dollars collected through the offsets of other overpayments are much less than dollars collected through subsequent payments.



# Conclusions

- Delinquent modules with balances due not in excess of \$5,000 comprise the vast majority of TDAs. However, over 80 percent of the total amount due resides with TDAs with balances greater than \$5,000.
- The IRS collects both a higher percentage of subsequent payments and offsets in the lowest balance due categories.
- The percent of the TDA balance collected is significantly greater for self-reported liabilities than when the IRS makes additional assessments.
- Penalty and interest significantly increase the balance owed by taxpayers, particularly when the underlying balance remains unresolved for several years.

# Conclusions

- The IRS abates between a quarter and a third of TDA liabilities. The IRS abates about 40 to 50 percent of its substitute for return (SFR) assessments.
- The IRS completely resolves most of its TDA modules within the 10 year collection statute, with a resolution rate of about 80 percent for TDAs assigned in 2003 and 2005. Unfortunately, the percent of TDAs resolved appears to be declining for TDAs initiated in later years. Additionally, the balance owed on these delinquencies has only been reduced by less than 50 percent.
- ACS realizes the largest percent of TDA balances collected by subsequent payment and offset. While the percent of dollars abated is high in all TDA collection channels, the abatement rates are significantly higher in the queue and Cff than in ACS.

# ANALYSIS OF FLOW-THROUGH ENTITIES USING SOCIAL NETWORK ANALYSIS TECHNIQUES

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**Advisory Roles:** Robert Hanneman ( UC Riverside), Lillian Mills (UT Austin)

# Research Question(s)

- **Application:** Can Social Network Analysis (SNA) be a useful technique for IRS “big data” analysis of flow-through entities?
- **Compliance Risk:** Do the ways “enterprises” embed flow-throughs in their corporate structure facilitate noncompliance?
  - Do SNA characteristics of greater network complexity explain tax noncompliance?
    - (How) Do loss flow-through entities create more compliance risk?

# Prior Evidence

- Prior work examines the association between **firm characteristics** and **corporate noncompliance**.
  - Mills (1998) finds a positive association between book-tax difference and proposed IRS audit adjustments.
  - Hanlon, Mills, & Slemrod (2005) examine firm size, industry, multinationality, public vs. private firms, choice of executive compensation, and corporate governance.
- Some academic work on **complexity** and **tax avoidance** or tax risk generally.
  - Wagener and Watrin (2013) find that organizational complexity (number of subsidiaries, ownership chain length, cross-country links, and ownership percentage) is associated with greater income shifting incentives.
  - Balakrishnan et al. (2012) argue that tax avoidance increases financial complexity as evidenced by decreased corporate transparency.

# Prior Evidence (cont.)

- Some academic work on choice of **overall business structure**.
  - e.g., Guenther (1992), Ayers et al. (1996), Gordon & MacKie-Mason (1994), MacKie-Mason & Gordon (1997)
- Some recent academic work on use of **special purpose entities**, which include LLCs, LLPs, trusts, and other flow-through entities.
  - Feng et al. (2009) & Demere et al. (2015)
- However, there is a lack of empirical evidence on the effect of **flow-through entities** on **tax noncompliance** specifically.

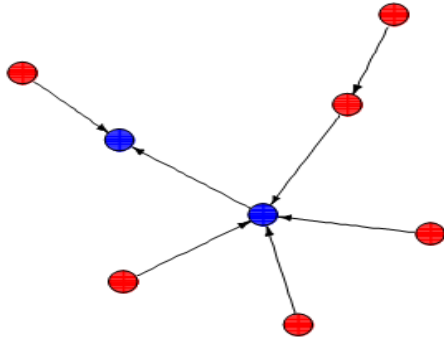
# Data Sample

	<b>Sample Based on Proposed Deficiency Database</b>	<b>Random Sample</b>
<b>Year</b>	<b>2009</b>	<b>2009</b>
<b>Number of Enterprises</b>	5,913	5,000
<b>Entities</b>	107,638	31,884
<b>k-1 links</b>	411,644	28,210
<b>Parent-Sub links</b>	75,832	1,225
<b>Primary-Secondary links</b>	55	2,590

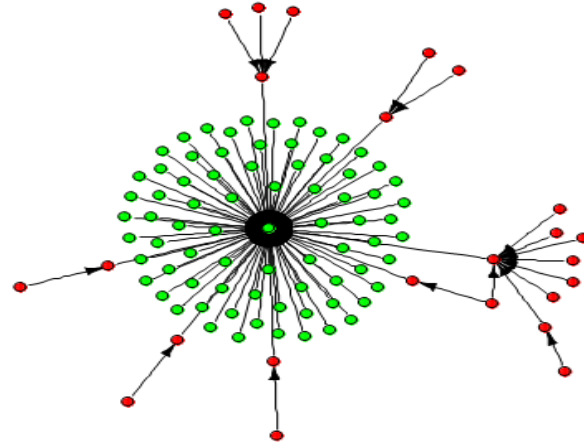
- The following pictures describe SNA variables.

# Sample Enterprise Plots

Enterprise X



Enterprise Y



- Parent or Subsidiary Node
- Flow through Node
- Primary or Secondary Node



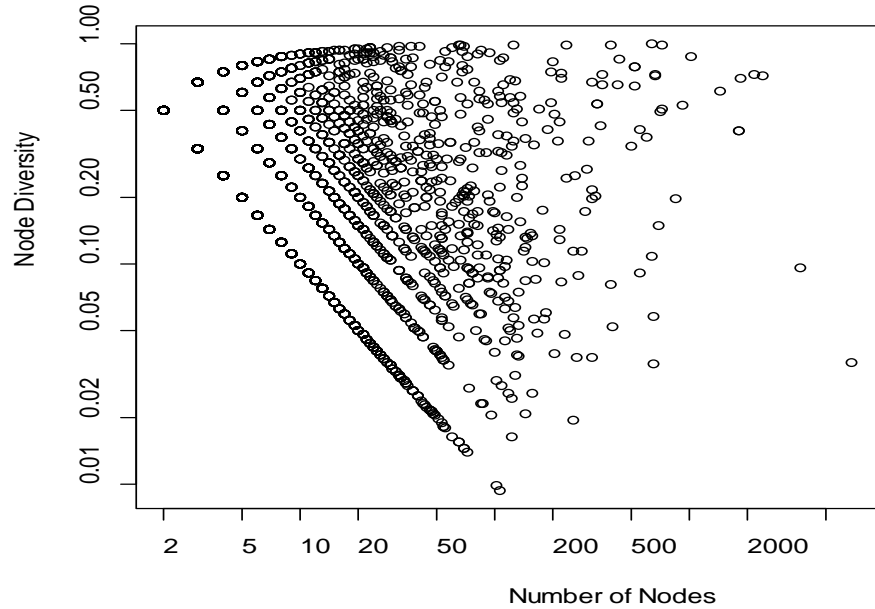
# Preliminary Evidence on Our Research Questions

- Effort last summer yielded learning how to use YK1 data and applying SNA approach to measure various nodal and linkage characteristics of about 6,000 enterprises in the 1120 LB&I taxpayer population for 2009.
- Some measures of network complexity are associated with higher *detected* noncompliance (proposed deficiencies).
  - Controlling for raw predictors of audit selection like size, profitability, DAS.

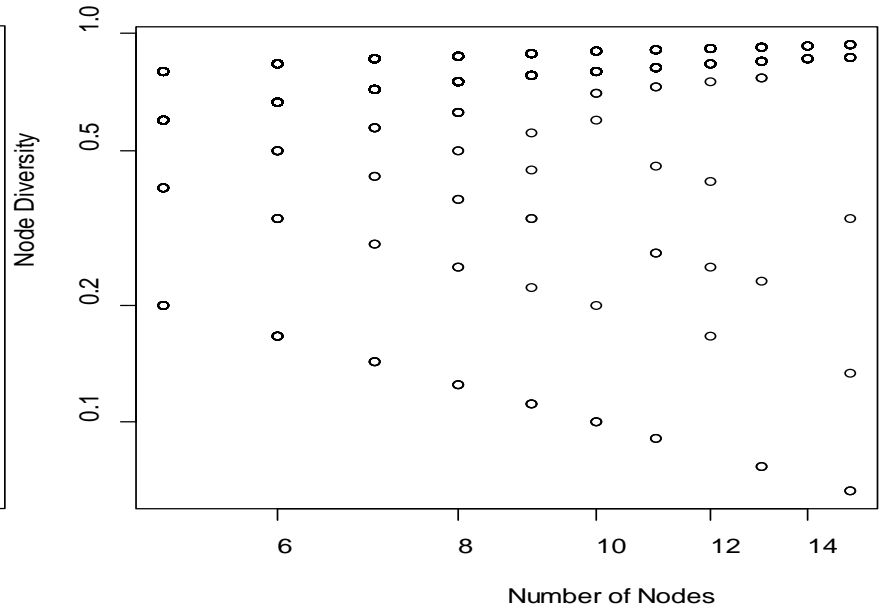
# SNA Measures

Network Measure	Definition
<b>Density</b>	$\frac{\text{Total Number of Links}}{\frac{1}{2}n(n-1)}$
<b>Diversity</b>	$\sum_i p_i^2$
<b>Degree Centrality</b>	$\frac{\text{Number of Links per Node}}{n-1}$
<b>External Degree Centrality</b>	$\frac{\text{Total Number of External Links Associated with Other Enterprises}}{\text{Total Number of Links}}$
<b>Closeness Centrality</b>	$\left[ \frac{\sum_{j=1}^n \text{Distance}(i,j)}{n-1} \right]^{-1}$

# Node Diversity

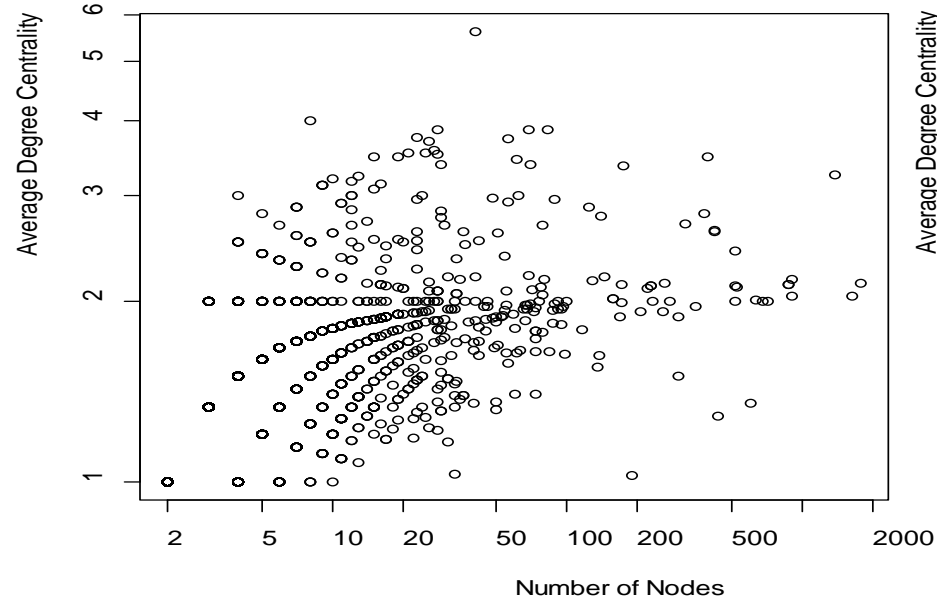


PDD Sample

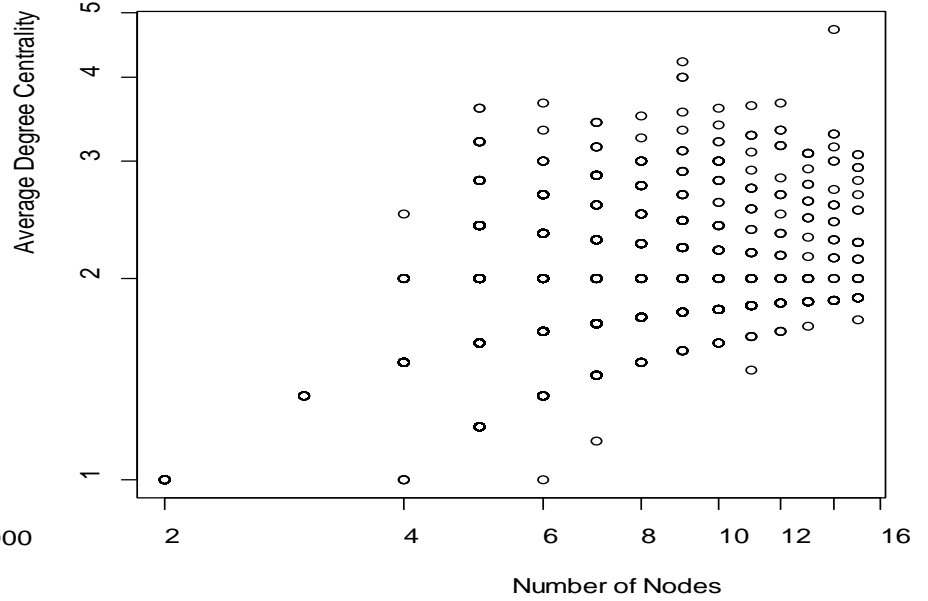


Random Sample

# Degree Centrality

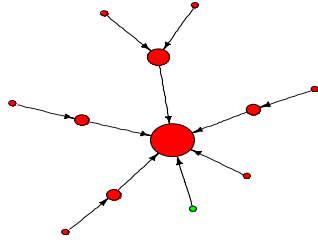


PDD Sample

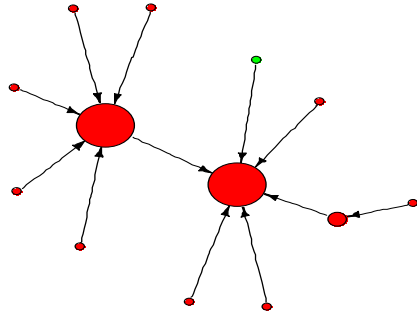


Random Sample

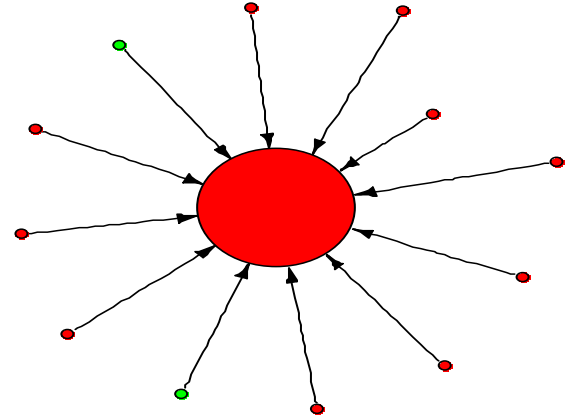
# Centralization & Node Level Degree Centrality



Centralization = 0.05

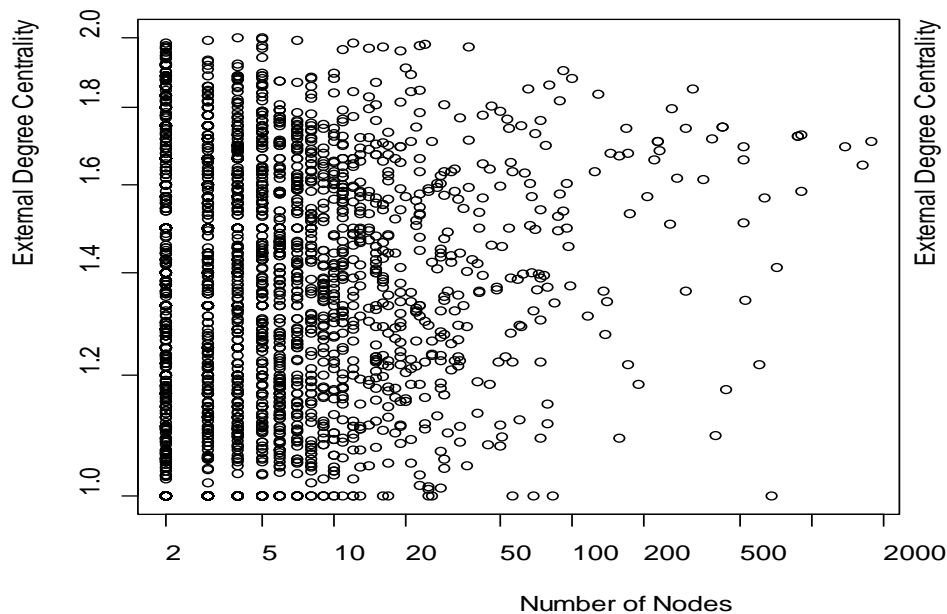


Centralization = 0.1875

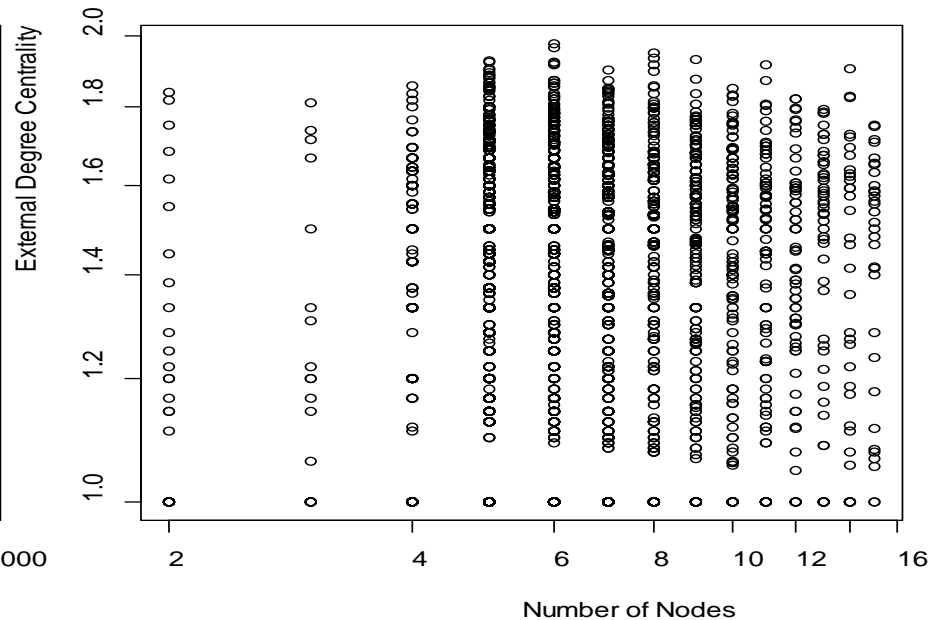


Centralization = 0.45

# External Degree Centrality

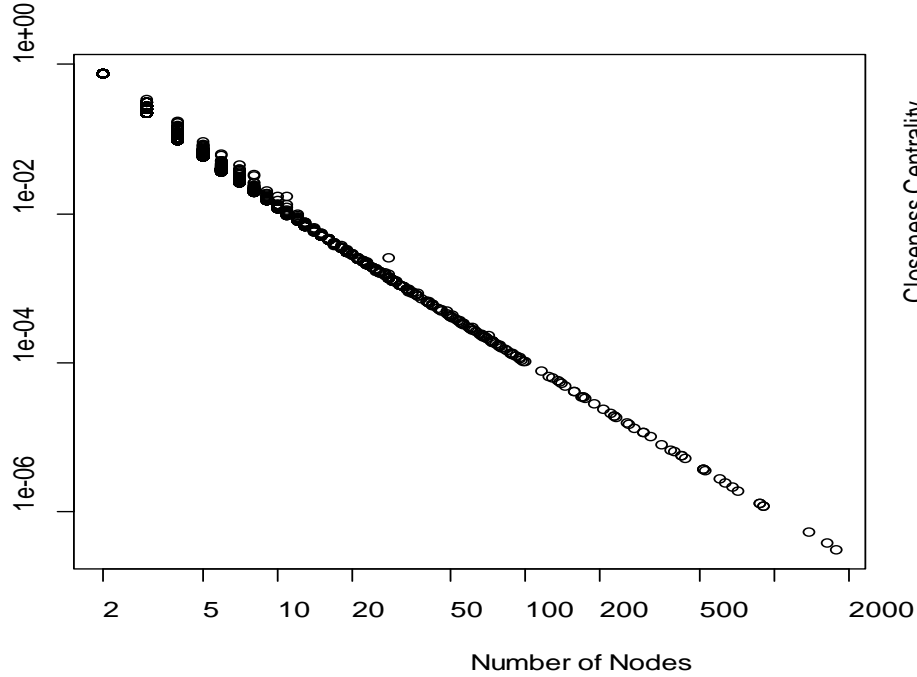


PDD Sample

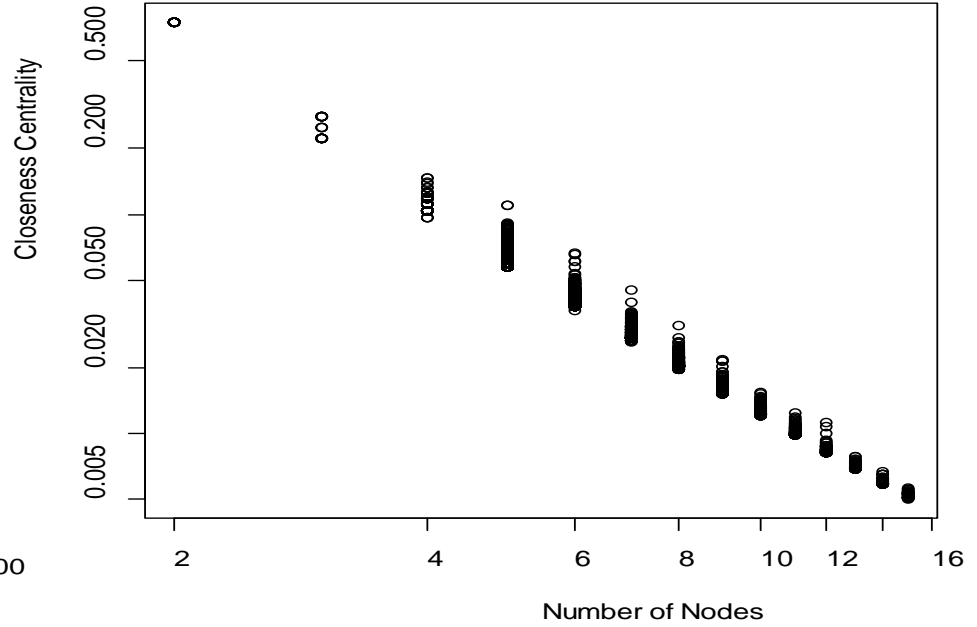


Random Sample

# Closeness Centrality

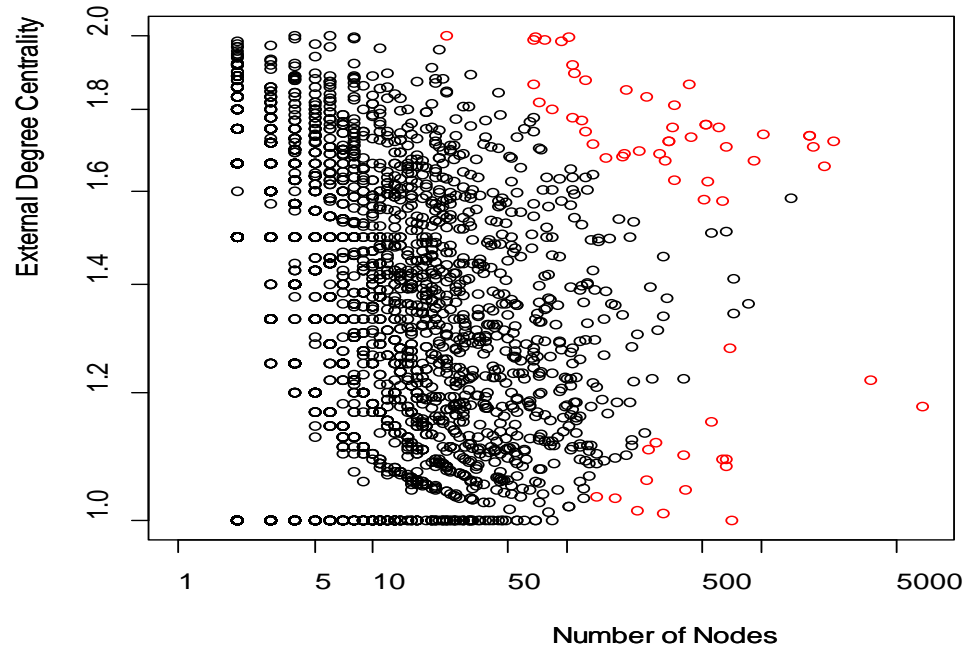


PDD Sample



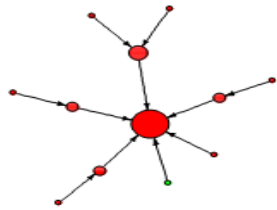
Random Sample

# Outlier Analysis

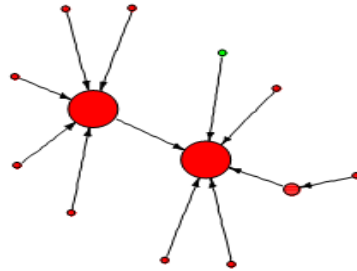




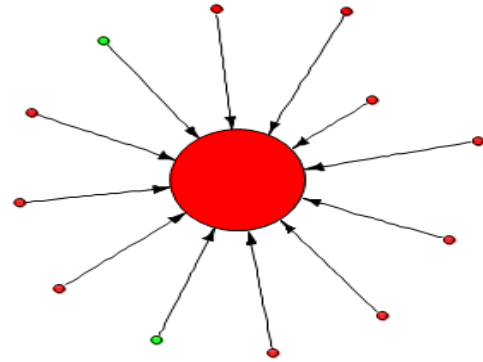
# Identifying Economically Important Nodes



Centralization = 0.05



Centralization = 0.1875



Centralization = 0.45

# Relationship Between Deficiency and SNA Measures (Preliminary Analysis)

- Regression:

$$\text{Deficiency} = a_0 + a_1 \text{ Assets} + a_2 \text{ DAS} + a_3 \text{ NetIncome} + \\ a_4 \text{ ClosenessCentrality} + a_5 \text{ Nodes} + a_6 \text{ Degree} + \\ a_7 \text{ NodeDiversity} + a_8 \text{ DegreeCentrality}$$

- As expected, Deficiencies are higher for larger and more profitable firms.
- Relevant to our question, Deficiencies are significantly higher when the nodes are further away ( $a_4 < 0$ ) or when the node type is more concentrated ( $a_7 < < 0$ ).

# Project Status

- Initial contract for Ashish Agarwal and Shannon Chen ended September 2014, simple results shown today.
- Waiting to re-establish IPA and Disclosure.
- Great opportunities for future work when access restored.

# Future Work

- Refine measures
- Generate measures for multiple years
- Conduct validation of measures
- Explore other enterprise definitions
- Contribute to tax administration of complex organizations
- Academic Paper on Noncompliance (Agarwal, Chen & Mills)



## ***2015 IRS-TPC Research Conference***

# **Session 1: Innovative Methods for Improving Resource Allocation**

**Moderator:**

***Melissa Vigil***

*IRS, RAS, Office of Research*

**Estimating Marginal Revenue/Cost Curves  
for Correspondence Audits**

***Alan Plumley***

*IRS, RAS, Office of Research*

**Examining the TDA Collectability Curve**

***Jeff Wilson***

*IRS, Taxpayer Advocate Service*

**Analysis of Flow-Through Entities Using  
Social Network Analysis Techniques**

***Shannon Chen***

*University of Texas at Austin*

**Discussant:**

***Arnie Greenland***

*University of Maryland*