

Representing the Financial System

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Office of Financial Research

***NITRD Big Data Working Group: 3rd Workshop on an Open Knowledge Network:
Enabling the Community to Build the Network***

Natcher Conference Center, National Institutes of Health

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Views expressed in this presentation are those of the speaker(s) and not necessarily of the Office of Financial Research.

Views and opinions expressed are those of the speaker(s) and do not necessarily represent official OFR positions or policy.

Markets are not waiting for lawyers

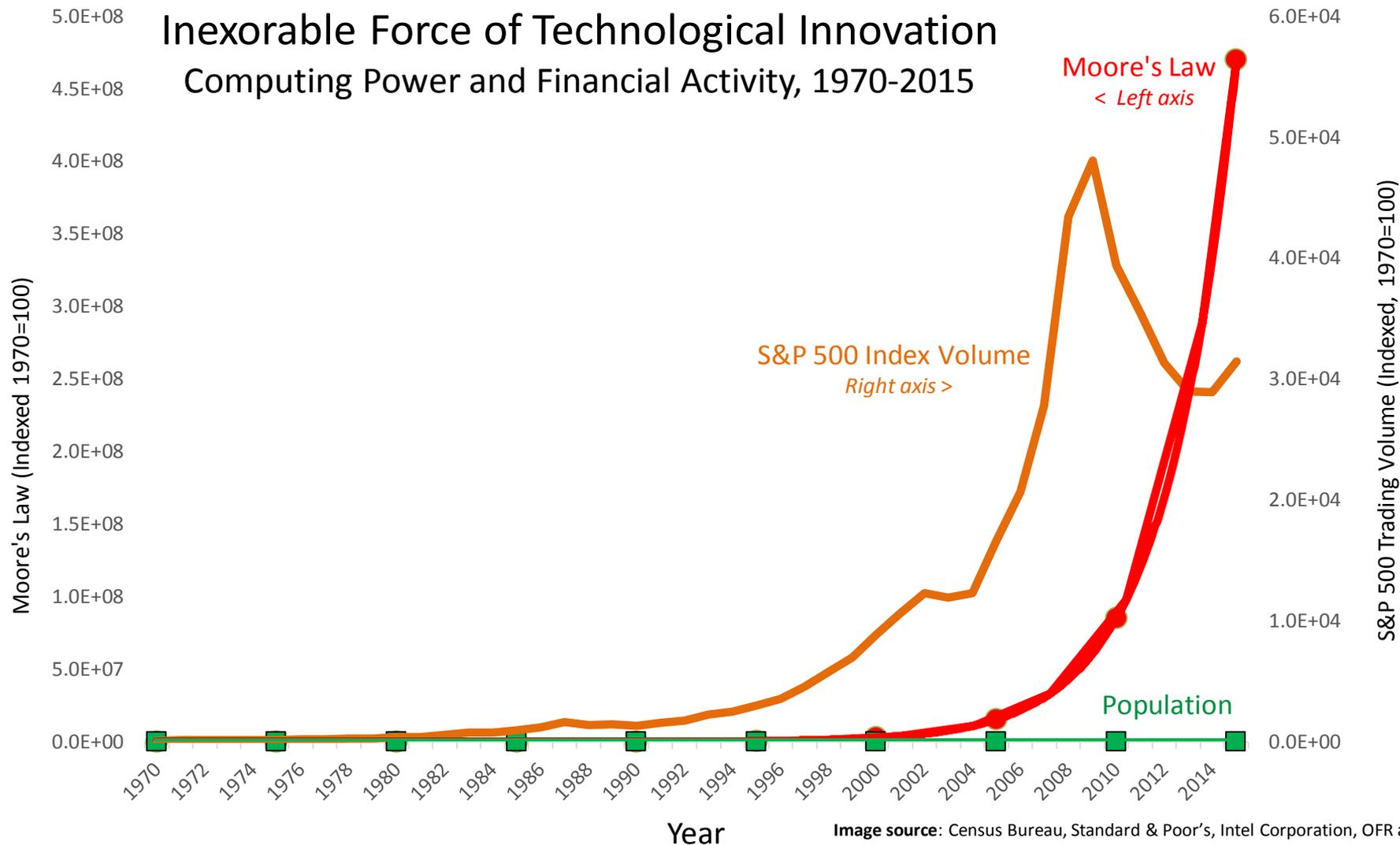


Image source: Census Bureau, Standard & Poor's, Intel Corporation, OFR analysis

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Firm-level financial statements

Highly standardized

- FASB
- GAAP
- Basel capital rules

Backward looking

- Historical/fair value
- Monovalent

Market transaction information

Pre-trade transparency

- Quotes and spreads
- Limit orders

Post-trade transparency

- Transaction prices
- Volumes

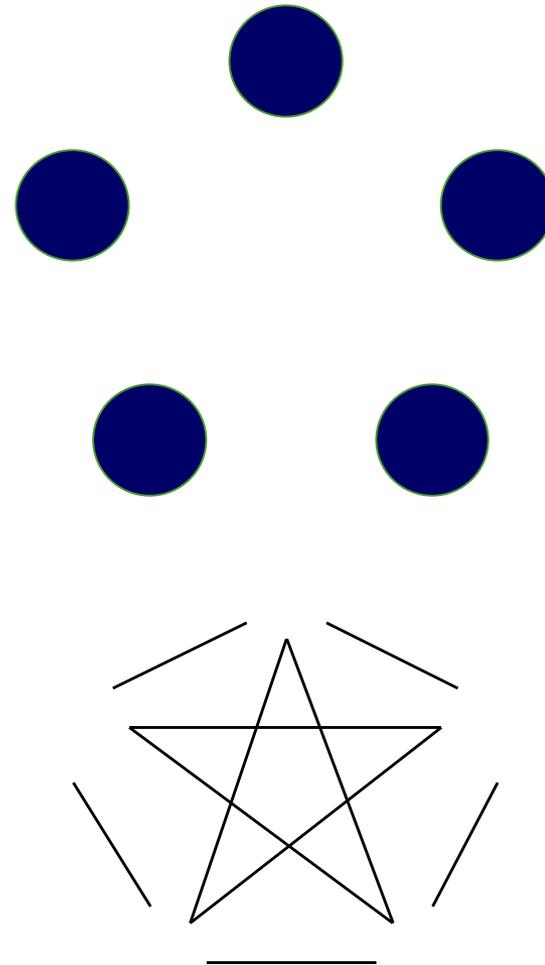


Image source : OFR analysis

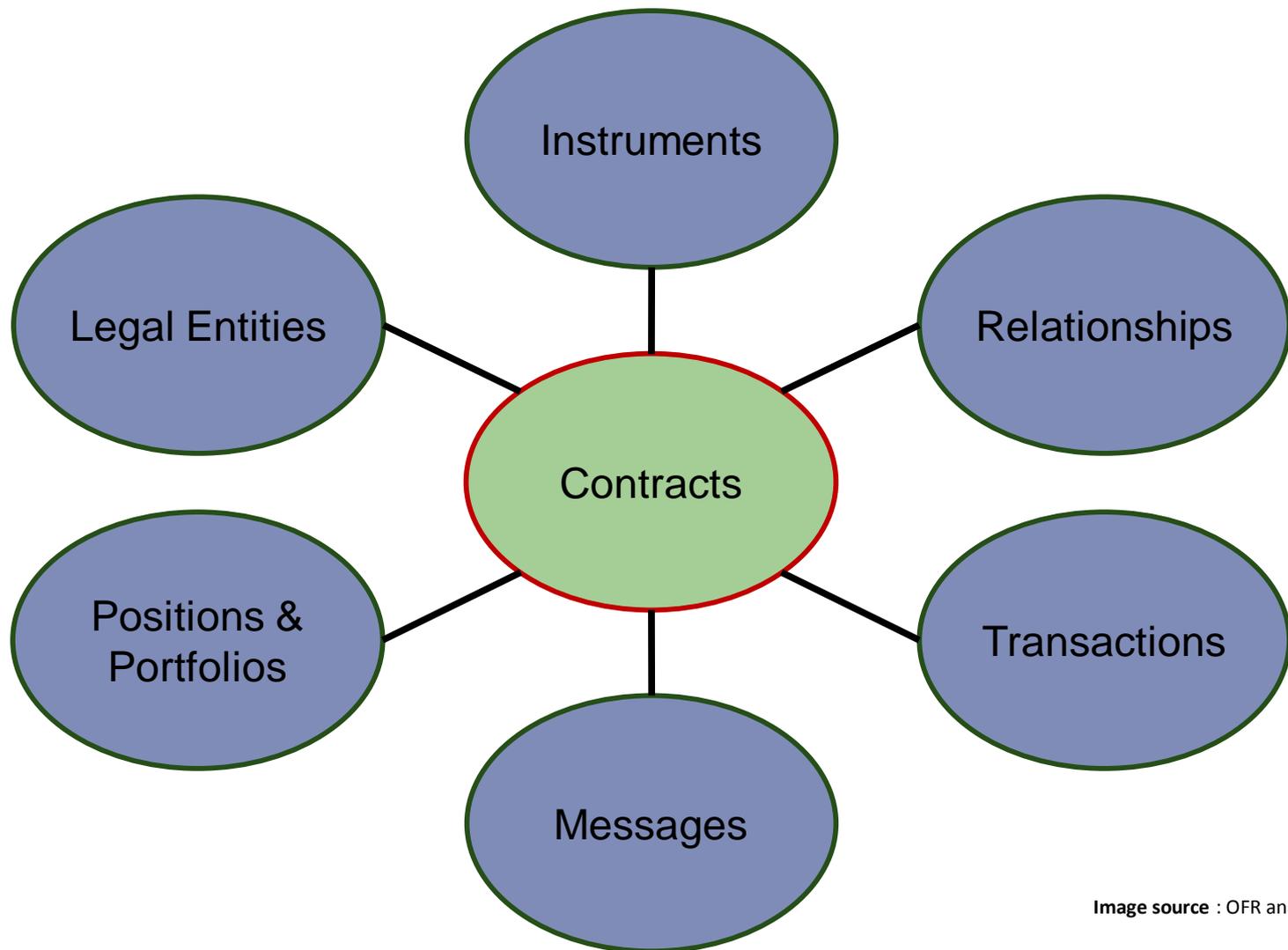
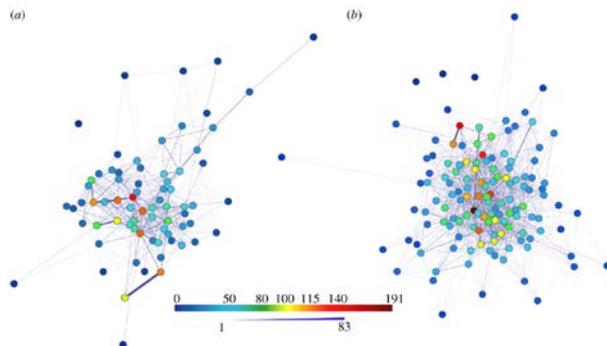


Image source : OFR analysis

Modeling organisms - cribbing from biology

- **Population characteristics**



Interaction networks in harvester ants

Image source : Pinter-Wollman, et al. (2011)

- **Genotyping**

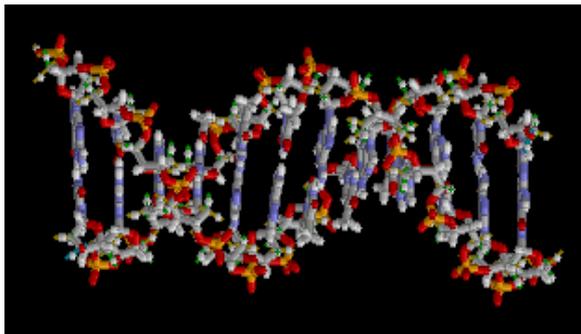


Image source : Wikipedia

- **Phenotyping**



Image source : Wikipedia

Wells Fargo's acquisition of Wachovia

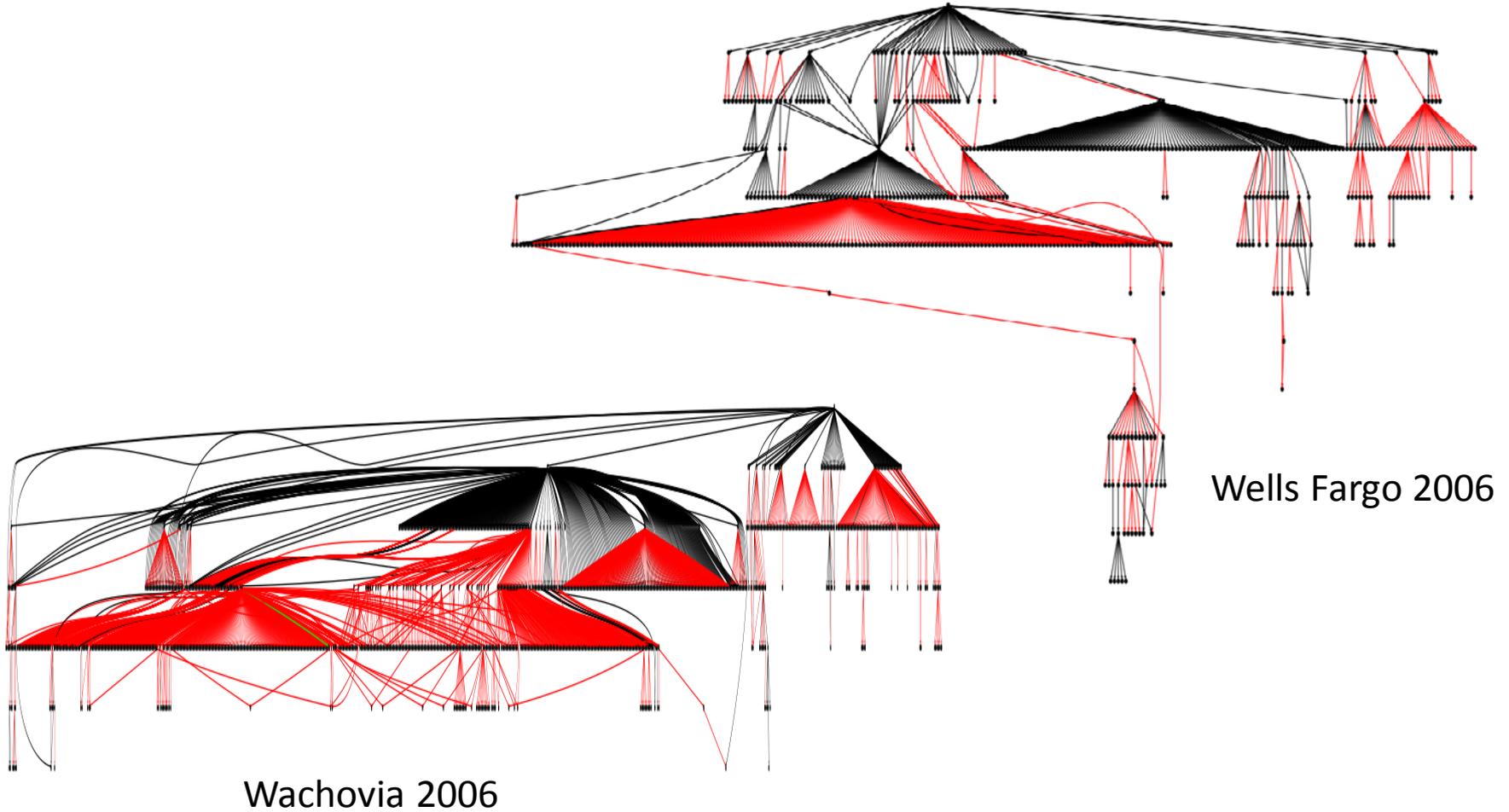
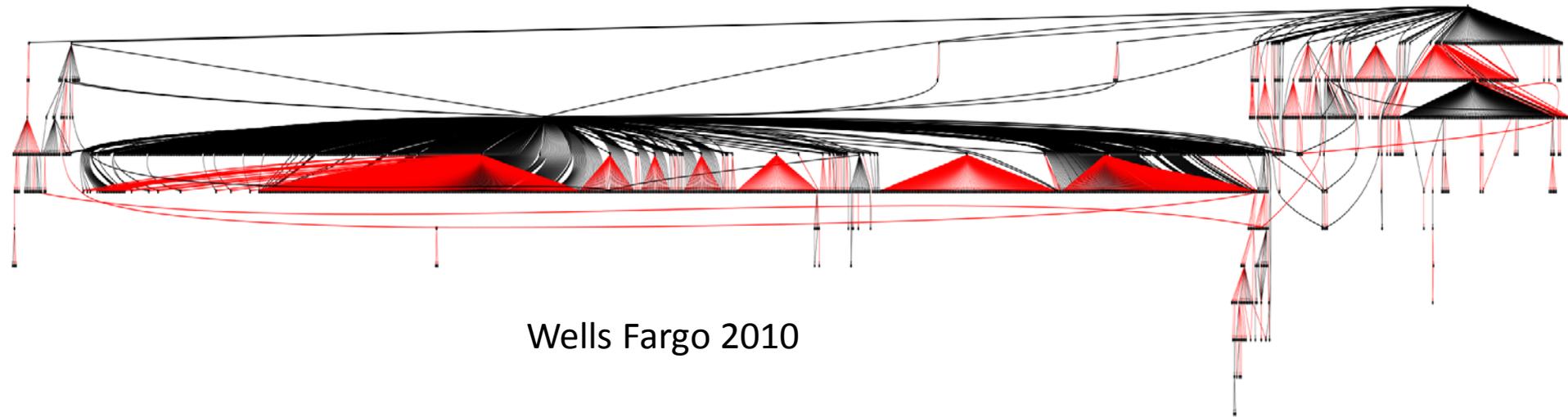


Image source : FFIEC (2015), OFIR analysis

Wells Fargo & Co. acquires Wachovia Corp. in 2008

- Wachovia was the fourth largest bank holding company at the time
- Wachovia faced a troubled mortgage portfolio and depositor withdrawals



Wells Fargo 2010

Flood, Kenett, Lumsdaine, and Simon (2017), "The Complexity of Bank Holding Companies"

Image source : FFIEC (2015), OFR analysis

Case Study: Wells Fargo 1986-2016

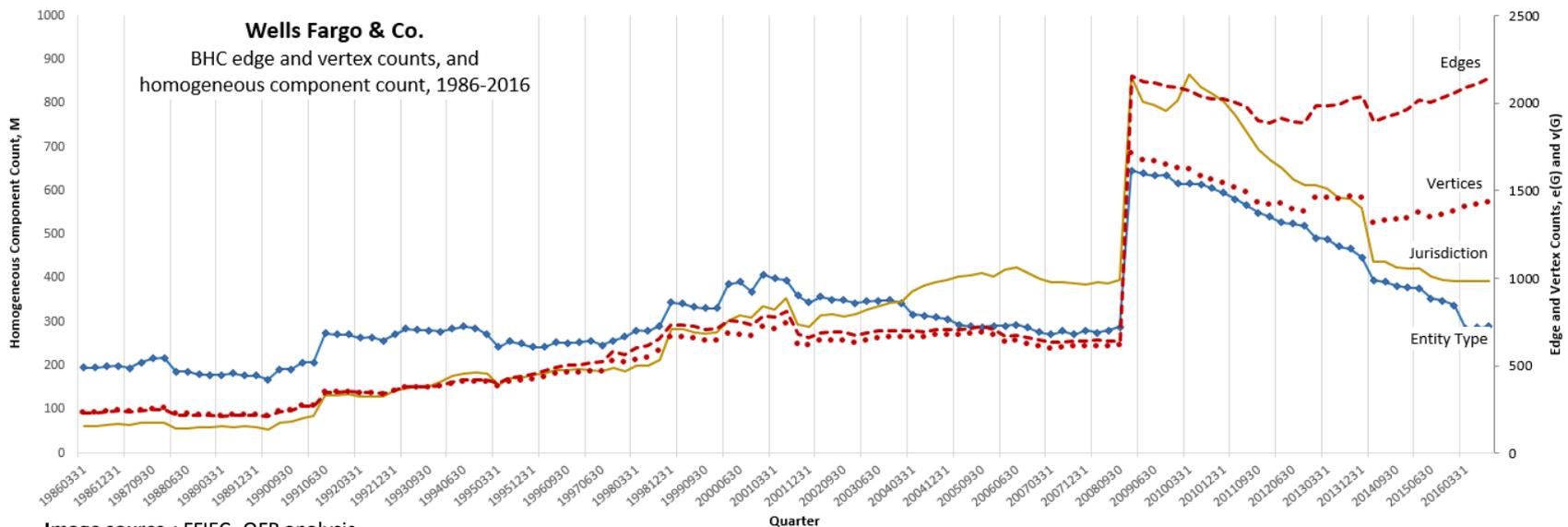
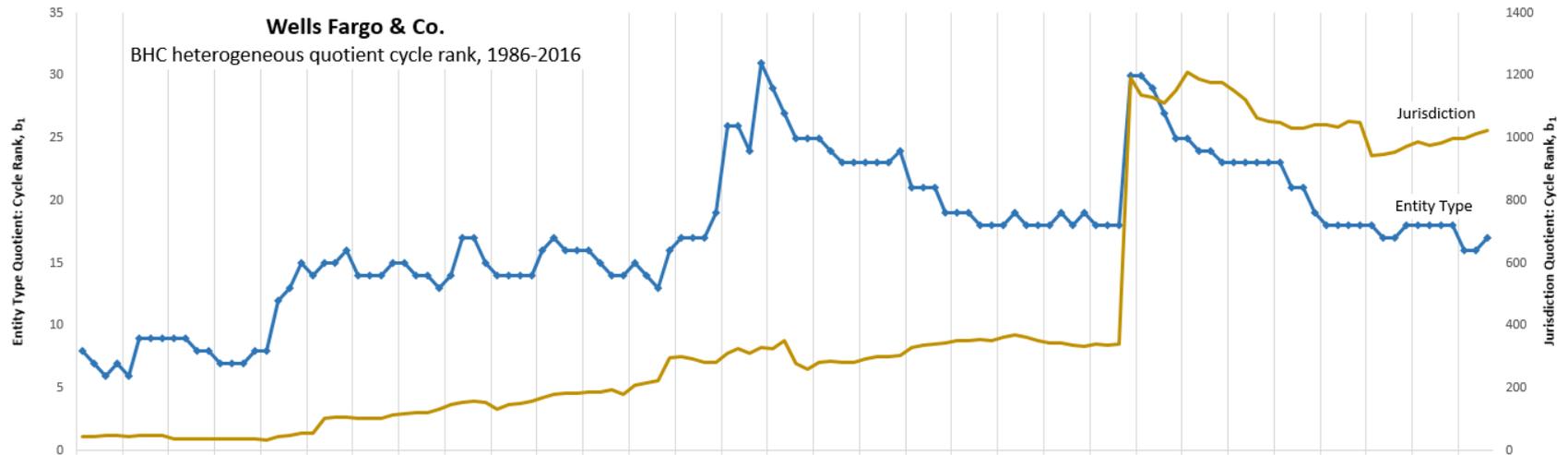


Image source : FFIEC, OFR analysis

FEII project – ambiguous (RSSD, LEI) pairs



| ID | Root | Modifier | Street | City | State | Expert 1 | Expert 3 |
|------------------------------|---|-------------------------|---|----------------|-------|----------|----------|
| RSSD ID: 606046 | bancorpsouth bank | | 201 south spring street | tupelo | ms | ✗ | ✓ |
| LEI: Q7C315HKI8VX0SSKBS64 | bancorpsouth bank | | 1 mississippi plaza | tupelo | ms | | |
| RSSD ID: 3338357 | ojai community bank, | | 402 west ojai avenue, suite 102 | ojai | ca | ✗ | ✓ |
| LEI: 5493006EYJ8EDSZFXG70 | ocb bancorp | | 402 west ojai avenue suite 102 | ojai | ca | | |
| RSSD ID: 3192960 | zions trust, | national association | | salt lake city | ut | ? | ∅ |
| LEI: 8WH0EE09O9V05QJZ3V89 | zions first | national bank | 1 south main street | salt lake city | ut | | |
| RSSD ID: 688079 | wells fargo bank northwest | national association | 2389 washington boulevard | ogden | ut | ? | ✗ |
| LEI: 549300RFXISSEVCFN040 | wells fargo bank northwest, (737 msn 34596 trust) | national association | 260 north charles lindbergh drive mac: u1240-026 | salt lake city | ut | | |

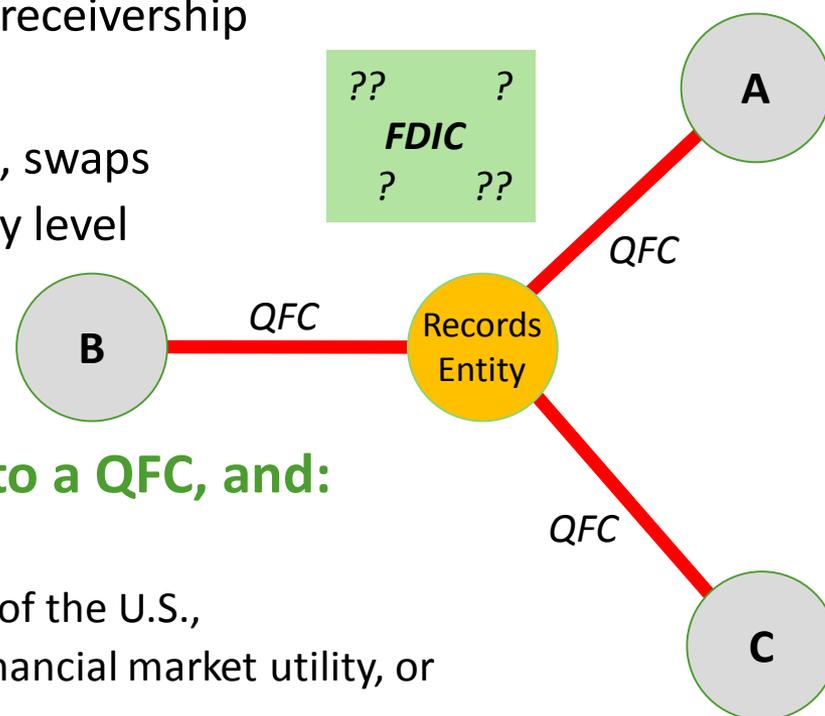
Scoring: ✗=No match ✓=Match ?=Ambiguous ∅=ID missing

Proposed Rule – Qualified Financial Contracts (QFC)

- Maintain detailed data on qualified financial contracts
 - Deliverable to primary regulator within 24 hours of a request
- QFCs have special treatment under FDIC receivership

Defining a QFC:

- Securities, commodities, forwards, repos, swaps
- 102 attributes at contract or counterparty level
 - Position-level terms and conditions
 - Master agreement
 - Collateral details



Defining a Records Entity – If a party to a QFC, and:

- Party to an open QFC, and:
 - Could threaten the financial stability of the U.S.,
 - Designated systemically important financial market utility, or
 - Total assets exceeding \$50 billion; or
 - Affiliated with a firm that matches the above

Image source : OFR analysis

| State | Label | Natural Language Consequences and Correlates (A) | Sec |
|----------------------|-----------------------------------|---|----------|
| start ^q | Start | Contract is fully specified; key information (payment dates, notice addresses and procedures, choice of law and dispute process) delivered | 7, 9, 11 |
| q0 ^v | Active contract | Contract is fully signed/executed | |
| q1 ^v | Principal Requested | Borrower's has requested and awaits \$1,000 | 1 |
| P1 ^v | Pmt 1 accruing | | |
| P1d ^v | Pmt. 1 due | | |
| P2 ^v | Pmt 2 accruing | | |
| P2d ^v | Pmt. 2 due | | |
| DI | Default (lender) | Lender has failed to deliver principal | 5 |
| Acc1 | Payments 1 and 2 Accelerating | Accelerated payment due is \$1075 | 6 |
| Acc2 | Payments 2 Accelerating | Accelerated payment due is \$525 | 6 |
| Db0_1 | Default (borr.) payment missed | Borrower has failed to make first payment in a timely fashion, and should be notified | 5 |
| Dbcv_1 | Default (borr.) Covenant | Borrower violates covenant(s), and should be notified | 5 |
| Dbrw_1 | Default (borr.) Reps/Warr. | Borrower breaches reps. and/or warranties; should be notified | 5 |
| Dbbkr_1 | Default (borr.) Bankruptcy | Borrower files for bankruptcy or insolvency; should be notified | 5 |
| Nb0_1 ^a | Borr. notified of payment default | Borrower has 2 days to pay, or all payments accelerate | 5 |
| Nbnpd_1 ^a | Borr. notified of general default | Borrower has 2 days to pay, or all payments accelerate | 5 |
| Db0_2 | Default (borr.) payment missed | Borrower has failed to make first payment in a timely fashion, and should be notified | 5 |
| Dbcv_2 | Default (borr.) Covenant | Borrower violates covenant(s), and should be notified | 5 |
| Dbrw_2 | Default (borr.) Reps/Warr. | Borrower breaches reps. and/or warranties; should be notified | 5 |
| Dbbkr_2 | Default (borr.) Bankruptcy | Borrower files for bankruptcy or insolvency; should be notified | 5 |
| Nb0_2 ^a | Borr. notified of payment default | Borrower has 2 days to pay, or all payments accelerate | 5 |
| Nbnpd_2 ^a | Borr. notified of general default | Borrower has 2 days to pay, or all payments accelerate | 5 |
| xT [*] | TERM | Contract is fulfilled in accordance with its terms | |
| xL [*] | LIT | A legal action is brought to enforce, interpret or otherwise deal with the agreement in the state courts of the State of New York located in New York County and that the results of this action will replace the computation of the contract | 9 |
| xC [*] | CANC | Contract is canceled due to the passing of time beyond the statute of limitations or canceled because of modification or termination by mutual agreement of the parties | 8 |
| Crisis1 | Crisis1—accel. payments not made | Payments accelerated, but borrower has not responded | 6 |
| Crisis2 | Crisis2—accel. payments not made | Payments accelerated, but borrower has not responded | 6 |

^q States on the "happy" path of the contract lifecycle
^v Default states
^{*} Terminal states

| ID | Label | Natural Language Event Specification | Section |
|----|---------------------------------|---|---------|
| A | Contract signed | Contract is signed to bind all parties | |
| B | 1 Day passes since last event | June 1, 2014 passes | 1 |
| C | Money requested | Borrower gives request for loan of \$1,000 | 1 |
| D | Lawsuit | A legal action is brought to enforce, interpret or otherwise deal with the agreement in the state courts of the State of New York located in New York County. | |
| E | Statute of limitations | June 1, 2020 passes—the Statute of Limitations on debt obligations in New York is six years | |
| F | Principal advanced | Lender advances \$1,000 no later than June 2, 2014 | 1 |
| G | June 1, 2015 passes | Payment 1 due on June 1, 2015 | 2(a) |
| H | Reps/Warr. | The Borrower's assets exceed its liabilities as determined under an application of the FASB rules of accounting | 3, 5(b) |
| I | Covenant | The Borrower fails to make a timely payment of an amount of state or federal tax | 4, 5(c) |
| J | Bankruptcy | The Borrower files for bankruptcy or insolvency under any applicable federal or state law | |
| K | Notice given | Notice given to Borrower of a failure to make timely payment of an amount due to Lender under this agreement | 5 |
| L | Notice given of general default | Notice given to Borrower of an event of default other than a failure to make timely payment of an amount due | 5 |
| M | Payment default cured | A payment-related event of default is cured | 5 |
| N | General default cured | A non-payment related event of default is cured | 5 |
| O | 2 Days pass since last event | Two days elapse since last event/notice | 5 |
| P | June 1, 2016 passes | Payment 2 is due on June 1, 2016 | 2(b) |
| Q | Payment made \$550 | | |
| R | Payment made \$525 | | |
| S | Payment made \$1075 | | |
| T | Cancel or modify | Contract in this form is canceled because of modification or termination by mutual agreement of the parties | 8 |

| Initial State | Event | Resulting State |
|--------------------|-------|-----------------|
| start ^q | A | q0 |
| q0 | B | xT |
| q0 ^v | C | q1 |
| q1 | B | DI |
| DI | D | xL |
| DI | E | xC |
| q1 ^v | F | P1 |
| P1 ^v | G | P1d |
| P1d | B | Db0_1 |
| P1 | H | Dbrw_1 |
| P1 | I | Dbcv_1 |
| P1 | J | Dbbkr_1 |
| Db0_1 | K | Nb0_1 |
| Dbcv_1 | L | Nbnpd_1 |
| Dbbkr_1 | L | Nbnpd_1 |
| Dbrw_1 | L | Nbnpd_1 |
| Nb0_1 | Q | P2 |
| Nbnpd_1 | N | P2 |
| Nb0_1 | O | Acc1 |
| Nbnpd_1 | O | Acc1 |
| Acc1 | B | Crisis1 |
| Acc1 | S | xT |
| Crisis1 | E | xC |
| Crisis1 | D | xL |
| Crisis1 | S | xT |
| P1d ^v | Q | P2 |

| Initial State | Event | Resulting State |
|------------------|-------|-----------------|
| P2 ^v | P | P2d |
| P2d | B | Db0_2 |
| P2 | H | Dbrw_2 |
| P2 | I | Dbcv_2 |
| P2 ^v | J | Dbbkr_2 |
| P2d ^v | R | xT |
| Db0_2 | K | Nb0_2 |
| Dbcv_2 | L | Nbnpd_2 |
| Dbbkr_2 | L | Nbnpd_2 |
| Dbrw_2 | L | Nbnpd_2 |
| Nb0_2 | R | xT |
| Nbnpd_2 | N | P2 |
| Nb0_2 | O | Acc2 |
| Nbnpd_2 | O | Acc2 |
| Acc2 | B | Crisis2 |
| Acc2 | R | xT |
| Crisis2 | E | xC |
| Crisis2 | D | xL |
| Crisis2 | R | xT |

^q Transitions along the "happy" path of the contract lifecycle
As noted above, only the transitions that result in a change of states are noted here; all un-noted transitions result in the state being unchanged.

State Space (27)

Q

Event Alphabet (20)

Σ

Transitions (45)

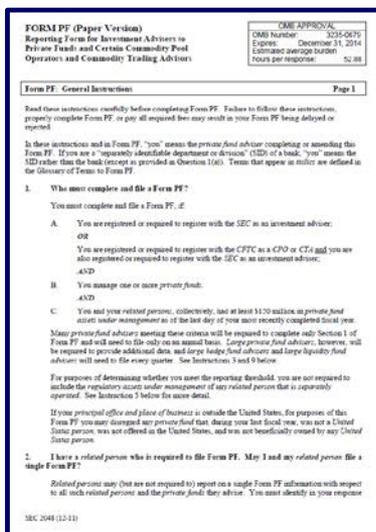
δ

Image source: OFR analysis

Form PF embeds significant structure

- 11 pages of instructions
- 10 pages of definitions

Form PF



FORM PF (Paper Version)
Reporting Form for Investment Advisers to
Private Funds and Certain Commodity Pool
Operators and Commodity Trading Advisors

OMB APPROVAL:
OMB Number: 3215-0070
Expires: December 31, 2014
Estimated average burden
hours per response: 52.08

Form PF - General Instructions Page 1

Read these instructions carefully before completing Form PF. Failure to follow these instructions, properly complete Form PF, or pay all required fees may result in your Form PF being delayed or rejected.

In these instructions and in Form PF, "you" means the private fund adviser completing or amending this Form PF. If you are a "separately identifiable department or division" (SID) of a bank, "you" means the SID rather than the bank (except as provided in Question 1(a)). Terms that appear in *italics* are defined in the Glossary of Terms to Form PF.

1. Who must complete and file a Form PF?

You must complete and file a Form PF if:

A. You are registered or required to register with the SEC as an investment adviser; OR

You are registered or required to register with the CFTC as a CPO or CTA and you are also registered or required to register with the SEC as an investment adviser; AND

B. You manage one or more private funds; AND

C. You and your related persons, collectively, had at least \$1.75 million in private fund assets under management as of the last day of your most recently completed fiscal year.

Many private fund advisers meeting these criteria will be required to complete only Section 1 of Form PF and will need to file only on an annual basis. Large private fund advisers, however, will be required to provide additional data, and large hedge fund advisers and large liquidity fund advisers will need to file every quarter. See Instructions 3 and 9 below.

For purposes of determining whether you meet the reporting threshold, you are not required to include the reporter's account under management of any related person that is separately operated. See Instruction 5 below for more detail.

If your principal office and place of business is outside the United States, the purpose of this Form PF is to assist investors in private funds that design your fund. You, as not a United States person, was not offered in the United States, and was not beneficially owned by any United States person.

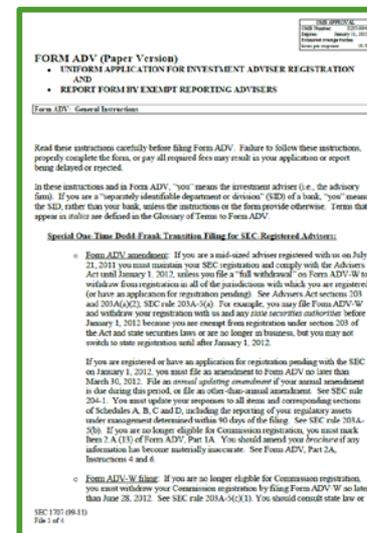
2. I have a related person who is required to file Form PF. May I and my related person file a single Form PF?

Related persons may (but are not required to) report on a single Form PF information with respect to all such related persons and the private funds they advise. You must identify in your response

SEC 2048 (12-11)

Refers to

Form ADV



FORM ADV (Paper Version)
UNIFORM APPLICATION FOR INVESTMENT ADVISER REGISTRATION
AND
REPORT FORM BY EXEMPT REPORTING ADVISERS

Form ADV - General Instructions

Read these instructions carefully before filing Form ADV. Failure to follow these instructions, properly complete the form, or pay all required fees may result in your application or report being delayed or rejected.

In these instructions and in Form ADV, "you" means the investment adviser (i.e., the advisory firm). If you are a "separately identifiable department or division" (SID) of a bank, "you" means the SID, rather than your bank, unless the instructions or the form provide otherwise. Terms that appear in *italics* are defined in the Glossary of Terms to Form ADV.

Special One-Time Dodd-Frank Transition Filing for SEC Registered Advisers:

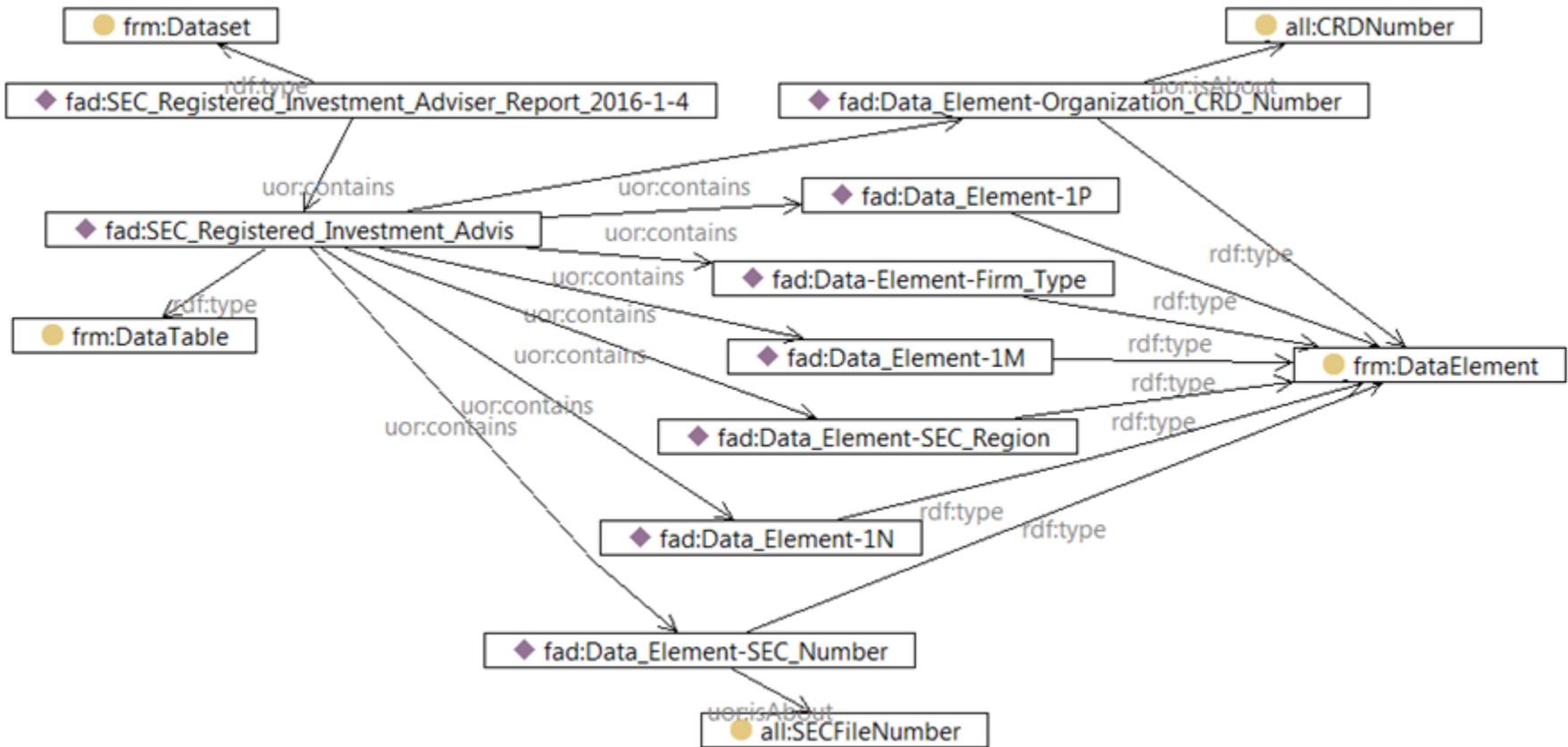
- **Form ADV amendment:** If you are a mid-sized adviser registered with us on July 21, 2011 you must maintain your SEC registration and comply with the advisers Act until January 1, 2012, unless you file a "full withdrawal" on Form ADV-W to withdraw from registration in all of the jurisdictions with which you are registered (or have an application for registration pending). See Advisers Act sections 203 and 203A(a)(2), SEC rule 203A-5(a). For example, you may file Form ADV-W and withdraw your registration with us and any state securities authority before January 1, 2012, because you are exempt from registration under section 203 of the Act and state securities laws or are no longer in business, but you may not wish to state registration until after January 1, 2012.
- **If you are registered or have an application for registration pending with the SEC on January 1, 2012, you must file an amendment to Form ADV no later than March 30, 2012. File an annual updating amendment if your annual amendment is due during this period, or file an other-than-annual amendment. See SEC rule 204-1. You must update your responses to all items and corresponding sections of Schedules A, B, C and D, including the reporting of your regulatory assets under management determined within 90 days of the filing. See SEC rule 204-1, 5(b). If you are no longer eligible for Commission registration, you must mark Item 2 A (13) of Form ADV, Part 1A. You should amend your brochure if any information has become materially inaccurate. See Form ADV, Part 2A, Instructions 4 and 6.**
- **Form ADV-W filing:** If you are no longer eligible for Commission registration, you must withdraw your Commission registration by filing Form ADV-W no later than June 28, 2012. See SEC rule 203A-5(c)(1). You should consult state law or

SEC 1702 (08-11)
File 1 of 1

Structure in Form ADV

- 25 pages of instructions
- 8 pages of definitions

Image source: Form PF and Form ADV (SEC, 2011)



Fan and Flood (2016), "An Ontology of Form PF," DSMM'16 Proceedings, ACM SIGMOD

Image source: OFR analysis

OFFICE OF FINANCIAL RESEARCH

Thanks!