Article:

Utilising Item Response Theory in Computing Corporate Governance Indices

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A. INTRODUCTION

Scholars[1] have been at this for quite some time: how does one properly characterise the amalgamation of management, accounting, law, finance, economics, sociology, business ethics, and organisational behaviour? Although new in relative terms, corporate governance seems to provide an appropriate umbrella term, which combines all these interdisciplinary elements.[2]

With this in mind, and by no means exhaustive, corporate governance has been described in a few ways that merit restatement. Firstly, the Cadbury Report terms it as 'the system by which companies are directed and controlled'.[3] Daily sees it as the 'determination of the broad uses to which organisational resources will be deployed and the resolution of conflicts among the myriad participants in organisations'.[4] Likewise, Shliefer and Vishny view it as the way 'in which suppliers of finance to corporations assure themselves of getting a return on their investment'.[5] OECD, interestingly, style it as a 'set of relationships between a company's management, its board, its shareholders and other stakeholders…that provides the structure through which the objectives of the company are set, and the means of attaining those objectives and monitoring performance.'[6]

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[1] See generally A Smith, An Inquiry into the nature and causes of the Wealth of Nations (1776); and A Berle and G Means, The Modern Corporation and Private Equity (1932).

[2] DR Fischel, "The Corporate Governance Movement" (1982) 35 Vanderbilt Law Review 1259.

[3] Financial Aspects of Corporate Governance, the Committee on the Financial Aspects of Corporate Governance (1992) para 2.5.

[4] CM Daily, DR Dalton, and AA Cannella, "Introduction to Special Topics Forum – Corporate Governance: Decades of Dialogue and Data" (2003) 28 Academy of Management Review 371.

[5] A Shleifer and R W Vishny, "A Survey of Corporate Governance" (1997) 52 Journal of Finance 737.

[6] OECD, Principles of Corporate Governance (2004).

For this reason, it is fair to say (especially with the wide range of definitions attached to corporate governance) that the aims and the tools of corporate governance implementation also vary widely, and are especially dependent on the legal, cultural and structural implications of the corporate form in any given context.[7] And due to the broad effects of corporate governance, there have been numerous empirical and comparative studies[8] conducted, which, taken together, have sought to find correlative relationships between a range of factors: financial performance;[9] firm value;[10] access to finance;[11] executive remuneration;[12] accounting standards;[13] mergers and acquisitions;[14] behaviour compliance;[15] and shareholder activism.[16] This has been done through both a micro and macro-economic lens.

Notwithstanding, the earlier data were collected from a single country, or terribly similar groups of countries. To expound on this, until the mid-1990s little effort was made to publish quantitative research in comparative corporate governance. A seminal reason for this trend is centred on the fact that the comparative study of corporate governance was limited to four key

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[7] OECD, Principles of Corporate Governance (2004).

[8] See generally U Bhattacharya and H Daouk, "The World Price of Insider Trading" (2002) 57 Journal of Finance 75; S Claessens, S Djankov and LHP Lang, "The separation of ownership and control in East Asian Corporations" (2000) 58 Journal of Financial Economics 81; A Dyck and Z Luigi, "Private Benefits of Control: An International Comparison" (2004) 59 Journal of Finance 537; M Faccio and LHP Lang, "The Ultimate Ownership of Western European Corporations" (2002) 65 Journal of Financial Economics 365; M Pagano and P Volpin, "The Political Economy of Corporate Governance" (2005) 95 American Economic Review 1005; M Siems, "Shareholder Protection Around the World" (2008) 33 Delaware Journal of Corporate Law 111.

[9] T Aksoy and S Bozkus, "The Impact of Corporate Governance on accounting measures of financial performance, credit usage and trade and openness: an empirical study on Turkish SMEs" (2007), available at www.cass.city.ac.uk/data/assets/pdf/file/0006/37338/T-Aksoy.pdf.

[10] KV Lins, "Equity Ownership and Firm Value in Emerging Markets" (2003) 38 Journal of Finance and Quantitative Analysis 159; A Parthasarathy, K Menon and D Bhattacherjee, "Executive Compensation, Firm Performance and Corporate Governance: An Empirical Analysis" (2006), available at www.ssrn.com/abstract=881730; R Morck, "Management Ownership and Market Valuation: An Empirical Analysis" (1998) 20 Journal of Financial Economics 293.

[11] R La Porta, F Lopez-de-Silanes, A Shleifer and RW Vishny, "Law and Finance" (1998) 106 Journal of Political Economy 1113; R La Porta, F Lopez-de-Silanes, A Shleifer and RW Vishny, "Legal Determinants of External Finance" (1997) 52 Journal of Finance 1131.

[12] ID Gregory-Smith, "Empirical Studies in UK Corporate Governance and Executive Remuneration" (2008), available at www.etheses.nottingham.ac.uk/666/1/ianthesis.pdf.

[13] K Shankaraiah and DN Rao, "Corporate Governance and accounting standards in Oman: An empirical study on practices" (2004), available at www.akamaiunuiversity.us/forms/ShankaraiahRao_051.pdf.

[14] S Rossi and P Volpin, "Cross-country determinants of mergers and acquisitions" (2003), available at www.ssrn.com/abstract=395020; A Bris and C Cabolis, "Adopting better corporate governance: evidence from cross-border mergers" (2008) 14 Journal of Corporate Finance 224.

[15] G Laan, "Behavioural Corporate Governance: Four Empirical Studies" (2009), available at www.dissertations.ub.rug.nl/FILES/faculties/feb/2009/g.van.der.laan/00titlecon.pdf.

[16] E Bengtsson, "Organisational approaches to corporate governance: an empirical study on shareholder activism" (2007) 3 International Journal of Business Governance and Ethics 238.

countries: the United States, United Kingdom, Germany and Japan.[17] And given the narrow approach to the study of these jurisdictions, the studies focused on the qualitative rather than quantitative method. There is another attribution factor for the low academic output in quantitative corporate governance research: the unavailability of an acceptable uniform standard to judge the law and policy adopted by different legal systems. This was remedied, partially, by the 1992 Cadbury Report[18], which acted as a catalyst for a wave of academic treatments associated with the investigation into the health of shareholder and investor rights[19] across nation-state boundaries. The standstill on quantitative comparative corporate governance research was finally broken by the publication of 'Law and Finance'[20] in 1998. Since then, there has been an oversaturation of academic research that focuses on quantifying comparative corporate governance traits, and studying its impact on various indicators.[21]

Consequently, this paper will discuss how to improve data aggregation for the purpose of creating a scientifically robust, unambiguous methodology in the pursuit of quantifying multi-country indices utilising item response theory (IRT). Moreover, the paper addresses how it is advantageous to operate IRT, rather than classical test theory (CTT), which is commonly used by a sizable group of researchers. More specifically, the paper highlights the differences between the uses of both methods on the same datasets, ultimately comparing the results.

B. DATA SET I[22]

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[17] See generally B Grossfeld and W Ebke, "Controlling the modern corporation: a comparative view of corporate power in the United States and Europe" (1978) 26 American Journal of Comparative Law 397; J Charkham, "The American Corporation and the Institutional Investor: Are There Lessons from Abroad" (1988) 3 Columbia Business Law Review 765.

[18] Financial Aspects of Corporate Governance (n 3).

[19] See generally L Bebchuk, "Efficient and inefficient sales of corporate control" (1994) Journal of Quarterly Economics 957; L Bebchuk and L Zingales, "Corporate Ownership Structures: Private v Social Optimality" (1995) National Bureau of Economic Research, available at www.nber.org/papers/w5584.pdf and D Gromb, "Is One-share-One-Vote Optimal?" (1993) Financial Markets Groups, LSE, available at www.insead.edu/faculty/research/personal/dgromb/research/documents/1s1v.PDF.

[20] La Porta et al., "Law and Finance" (n 11).

[21] R La Porta, F Lopez-de-Silanes and A Sheifler "Economic Consequences of Legal Origins" (2008) 46 Journal of Economic Literature 285.

[22] Original data set, available at www.faculty.tuck.dartmouth.edu/images/uploads/faculty/rafael-laporta/LegalDeterm-Share-Credits.xls. This was mirrored, with minor adjustments, available at https://drive.google.com/open?id=0Bwa6if0xMceTWhwX3c2bEMwT1E&authuser=0.

The 1998 paper worked on the hypothesis that countries with poorer investor protection have smaller, and, more importantly, thinner capital markets. The authors coded for forty-nine countries, using eleven factors to describe the corporate governance of each country. The variables were:

- One share-One vote[23]
- Anti-director rights index[24]
    - Proxy by mail[25]
    - Shares not blocked before meeting[26]
    - Cumulative voting or proportional representation[27]
    - Oppressed minorities mechanisms[28]
    - Pre-emptive right to buy new issues of stock[29]
    - Percentage of share capital to call for extra-ordinary general meeting[30]
- Creditor rights index containing four
    - Restrictions on filing a reorganisation petition[31]

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[23] Var: c1sh_1vo - Equals 1 if the company law or commercial code of the country requires that ordinary shares carry one vote per share, and 0 otherwise. Equivalently, this variable equals 1 when the law prohibits the existence of both multiple-voting and non-voting ordinary shares and does not allow firms to set a maximum number of votes per shareholder irrespective of the number of shares owned, and 0 otherwise.

[24] La Porta et al., "Law and Finance" (n 11) at 1134-38: describes ADRI in Table I as a cumulative of 5 variables based on the 1996 working paper; but in the calculation in Table II the ADRI consists of 5 variables, and theoretically the value can range between 0 and 6. The pre-emptive right to buy new shares is used in ADRI calculations in Table II, but not stated in Table I.

[25] Var: mail_prx - Equals 1 if the company law or commercial code allows shareholders to mail their proxy vote, and 0 otherwise.

[26] Var: nshsbloc - Equals 1 if the company law or commercial code allows firms to require that shareholders deposit their shares prior to a general shareholders meeting, thus preventing them from selling those shares for a number of days, and 0 otherwise.

[27] Var: cumu_vot - Equals 1 if the company law or commercial code allows shareholders to cast all of their votes for one candidate standing for election to the board of directors, and 0 otherwise.

[28] Var: oppr_mi2 - Equals 1 if the company law or commercial code grants minority shareholders either a judicial venue to challenge the management decisions, or the right to step out of the company by requiring the company to purchase their shares when they object to certain fundamental changes, such as mergers, asset dispositions and changes in the articles of incorporation, and equals 0 otherwise.

[29] Var: prempt - coded as 1 when the pre-emptive right to buy new issues of stock which can only be waived by a shareholder vote, and 0 otherwise.

[30] Var: Esmvotes - It is the minimum percentage of ownership of share capital that entitles a shareholder to call for an extraordinary shareholder meeting. Coded 1 when the minimum percentage of shareholder vote is ten per cent or less.

[31] Var: ch11_res - Equals 1 if the reorganisation procedure imposes restrictions, such as creditors' consent or minimum dividend to file for reorganisation, and 0 otherwise.

- o Secured creditors gain possession of security once the reorganisation petition has been approved, with no automatic stay on secured assets[32]
- o Secured creditors first in distribution of proceeds from reorganisation[33]
- o Debtor management does not stay in control[34]

Thus the relevant corporate government data was in an **N x M** matrix of 49 x 11 data points.[35] A typical line of data is presented below:

Country	c1sh_1vo	oppr_mi2	esmvotes	mail_prx	cumu_vot	prempt	nshsbloc	secu_1st	ch11_res	mgt_nost	nauto_st
Chile	1	1	1	0	1	1	1	1	1	0	0
	Anti-director rights index = 5						Creditor rights index = 2				

(1) Classical Theory Test

For over a century, CTT has been the mainstay of social science measurement. CTT grew out of the work of Charles Spearman, in which he showed how to exact the correlation coefficient and obtain an index of reliability.[36] The basic postulate of CTT is usually expressed as $X = T + E$, which translates to (X) being the sum of true score/component (T) plus a random error (E). CTT theory led to factor analysis and related developments.[37] In its simplest form, researchers assume that (E) is inconsequential, and that all observed variables have equal weight on (X). La Porta, Lopez-de-Silanes, Shleifer and Vishny used this simple variation of CTT and calculated the anti-

[32] Var: nauto_st - Equals 1 if the reorganisation procedures impose an automatic stay on the assets of the firm upon filing the organisation petition. This restriction prevents secured creditors from gaining possession of their security, and 0 otherwise.

[33] Var: secu_1st Equals 1 if secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm. Equals 0 if non-secured creditors, such as the Government and workers, are given absolute priority.

[34] Var: mgt_nost - Equals 1 if the debtor keeps the administration of its property, pending the resolution of the reorganisation process, and 0 otherwise. Also, this variable equals 0 when an official appointed by the court or by creditors is responsible for the operation of the business during reorganisation.

[35] Edited dataset, available at https://drive.google.com/file/d/0BwXa6if0xMceMn16V1ROY3RJdzg/view.

[36] C Spearman, "The proof and measurement of association between two things" (1904) 15 The American Journal of Psychology 72.

[37] RE Traub, "Classical test theory in historical perspective" (1997) 8 Educational Measurement: Issue and Practices; K Bollen and R Lennox, "Conventional Wisdom on measurement: a structural equation perspective" (1991) 110 Psychological Bulletin 305.

director rights index and the creditor rights index, by merely adding all the variables represented under them. To illustrate, using the above data line as a point of reference, ADRI for Chile is five and the creditor rights index is two. Hence, an overall corporate governance index would comprise of equal representation from all eleven variables, and Chile's corporate government index would be eight as a result.[38]

(2) Item Response Theory

IRT houses several mathematical models that describe, in terms of probability, the association between observed variables and the inborn latent trait being measured. Louis Thurstone developed the conceptual basis for IRT in the 1920s.[39] His findings focused on the connection between the success in test items and the distribution of successive age or grade groups.[40] So, under IRT it is assumed that all observed factor values are expressions of the underlying latent trait of the object being tested. Resultantly, from a frequentist — or classical — perspective, IRT is a probabilistic factor analysis, which uses Bayesian analysis to estimate factor loading. In the context of the LLSV data assessment, again using the previous example, an IRT researcher would assume that the latent trait for Chile is θ_{Chile}. Due to this, observed items, like c1sh_1vo, oppr_mi2, esmvotes, mail_prx, cumu_vot, and prempt, assume the response pattern of $Y_{Chile} = \{1,1,1,0,1,1\}$. A two-parameter IRT model for one observed variable mathematically manifests as expressed below:

$$P\left(c1sh\_1vo = 1 | \theta, \alpha c1sh\_1vo, \beta_{c1sh\_1vo}\right) = \frac{1}{1 + e^{-\alpha_{c1sh\_1vo}(\theta - \beta_{c1sh\_1vo})}} \quad [41]$$

Where probability of the value of c1sh_1vo is to be 1, and dependent on three parameters, which is the latent trait being measured, α_{c1sh_1vo} is the discrimination parameters of variables c1sh_1vo and β_{c1sh_1vo}; these also act as the difficulty parameter of c1sh_1vo. Put differently, if the underlying corporate governance trait of Chile is θ_{Chile}, then the probability of c1sh_1vo having a value of 1 or 0 depends on the unknown discrimination parameter, α_{c1sh_1vo}, and the unknown

[38] La Porta et al., "Law and Finance" (n 11) did not calculate an overarching corporate governance index; they used ADRI, creditor rights index and one share-one vote, to act as separate proxies for investor protection.

[39] LL Thurstone, "A Method of Scaling Psychological and Educational Tests" (1925) 16 Journal of Educational Psychology 433.

[40] D Thissen and L Steinberg, "Item Response Theory", in RE Millsap and AM Olivares (eds), The Sage Handbook of Quantitative Methods in Psychology (2013).

[41] BB Reeve and P Fayers, "Applying item response theory modelling for evaluating questionnaire items and scale properties", in P Fayers and R Hays (eds), Assessing Quality of Life in Clinical Trials: Methods of Practice, 2nd edn (2005).

difficulty parameter, β_{c1sh_1vo}, of the observed variable. This can also be written as: the probability of whether Chile will have regulations that state that one share should equate to one vote. Weighing this against the findings in 'Law and Finance'[42], the data set includes forty-nine countries apart from Chile. In a similar vein, the equation to predict whether Argentina would have a regulation for c1sh_1vo would be:

$$P\big(c1sh\_1vo, Argentina = 1|\theta_{Argentina}, \alpha_{c1sh\_1vo}, \beta_{c1sh\_1vo}\big) = \frac{1}{1 + e^{-\alpha_{c1sh\_1vo}(\theta - \beta_{c1sh\_1vo})}}$$

For x countries, the following must be taken into account:

- Y_i denotes the observed response pattern of corporate governance indicators
- j describes the individual corporate governance items
- α_j represents the discrimination for j
- β_j signifies the difficulty for j

And trait θ_i can be estimated as:

$$\ell(Y_i|\theta_i, \alpha_i, \beta_i) = \prod_{i=1}^{i} P(Y_{ij} = 1|\theta_i, \alpha_i, \beta_i) \,[43]$$

The problem with executing IRT was simple: algebraically, it is impossible to solve an equation with one known value, pitted against three unknown values. Ultimately, this means that either: 1) difficulty and discrimination parameters should be known; or 2) their distribution pattern should be estimated;[44] or 3) it should involve iterative simulations under Markov Chain Monte Carlo (MCMC) algorithms to converge to an approximate integration over the distribution.[45] A

[42] R La Porta et al., "Law and Finance" (n 11).
[43] F Baker and S Kim, Item Response Theory, 2nd edn (2004).
[44] See generally FM Lord, "Maximum Likelihood and Bayesian Parameter Estimation in Response Theory" (1986) 23 Journal of Educational Measurement 157.
[45] See generally W Gilks, S Richardson and DJ Speigelhalter, Markov Chain Monte Carlo in practice (1997).

Bayesian estimation of IRT[46] was also developed to complement the MCMC simulation; but this process was computer-intensive. Its full potential was only realised in the late 1990s, when processing power became more conventional.[47]

The advantages of using IRT over CTT, where the model fully fits the data[48] set, are manifold. To begin with, there is item parameter invariance, which means that 'while all CTT concepts are specific to a given sample, the parameters of an IRT model hold for an entire population'.[49] This translates to item difficulty parameters being independent of subject ability, and subject abilities being independent of the items being observed. Secondly, CTT researchers are forced to do an arbitrary factor analysis on parameter value to realise the final index; but this never fully explains why certain factors are more important than others. It also fails to proffer an explanation as to why when using MCMC in IRT, in explaining the underlying trait, and assuming that each parameter has equal importance and discriminatory power, it is possible to simulate the probable values of parameters, and then extract the values that best fit the response pattern.

C. LLSV DATA: COMPARISON OF THE CORPORATE GOVERNANCE INDEX

In the 'Law and Finance' dataset, there were forty-nine countries and eleven data indicators per country. Therefore there was a 49 x 11 data matrix. In this section, the corporate governance traits of forty-nine countries is estimated using a fully Bayesian algorithm.[50] 10,000 iterations each are run, across three chains of the algorithm. R is within parameter, and the trace plot indicates the chains have properly converged. The results are then traced in the caterpillar plot. The countries are staked in two columns, with ascending corporate governance traits. The line represents the ninety-five per cent credible interval for each estimated value of corporate governance. The filled-up dot represents the mean, or true value, of the corporate governance trait for any given country.

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[46] H Swaminathan, "Parameter estimation in item response model", in R Hambleton (ed), Application of Item Response Theory (1983).
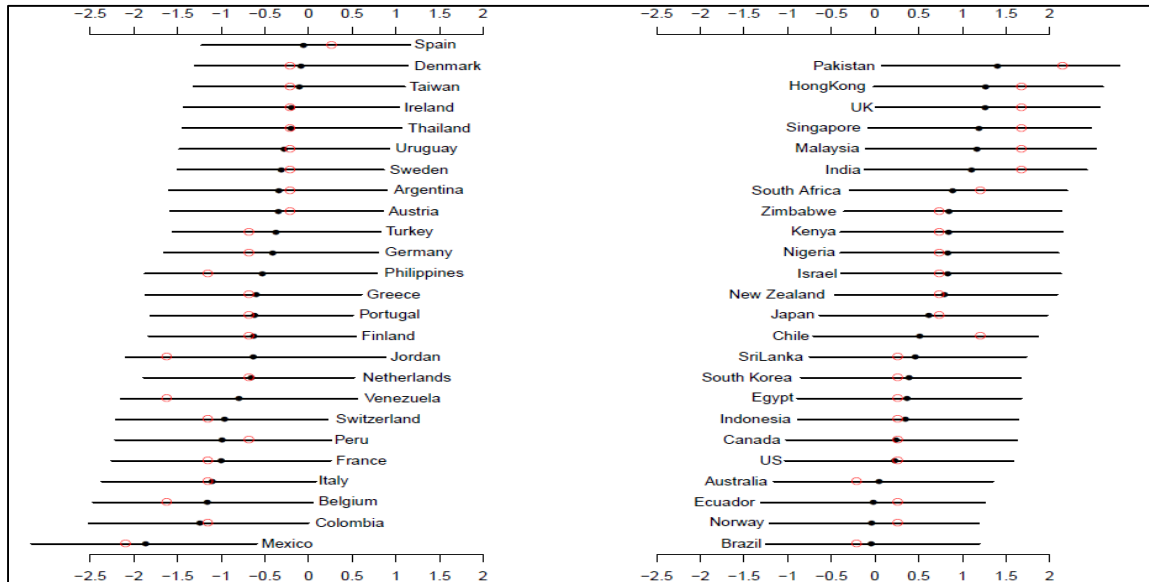
[47] S Kim, "An evaluation of a Markov chain Monte Carlo method for the Rasch model" (2001) Applied Psychological Measurement 163; R Patz and BW Junker, "A straightforward approach to Markov chain Monte Carlo methods for item response theory models" (1999) Journal of Educational Behavioural Statistics 146; D Clayton, "Generalized linear mixed models", in WR Gilks, S Richardson and DJ Speigelhalter (eds), Markov Chain Monte Carlo methods in practice (1999).

[48] R Hambleton, H Swaminathan and HJ Rogers, Fundamentals in Response Theory (1991).

[49] AD Mead, "Test Construction using CTT and IRT with Un-representative samples", available at http://mypages.iit.edu/mead/Mead_and_Meade-v10.pdf.
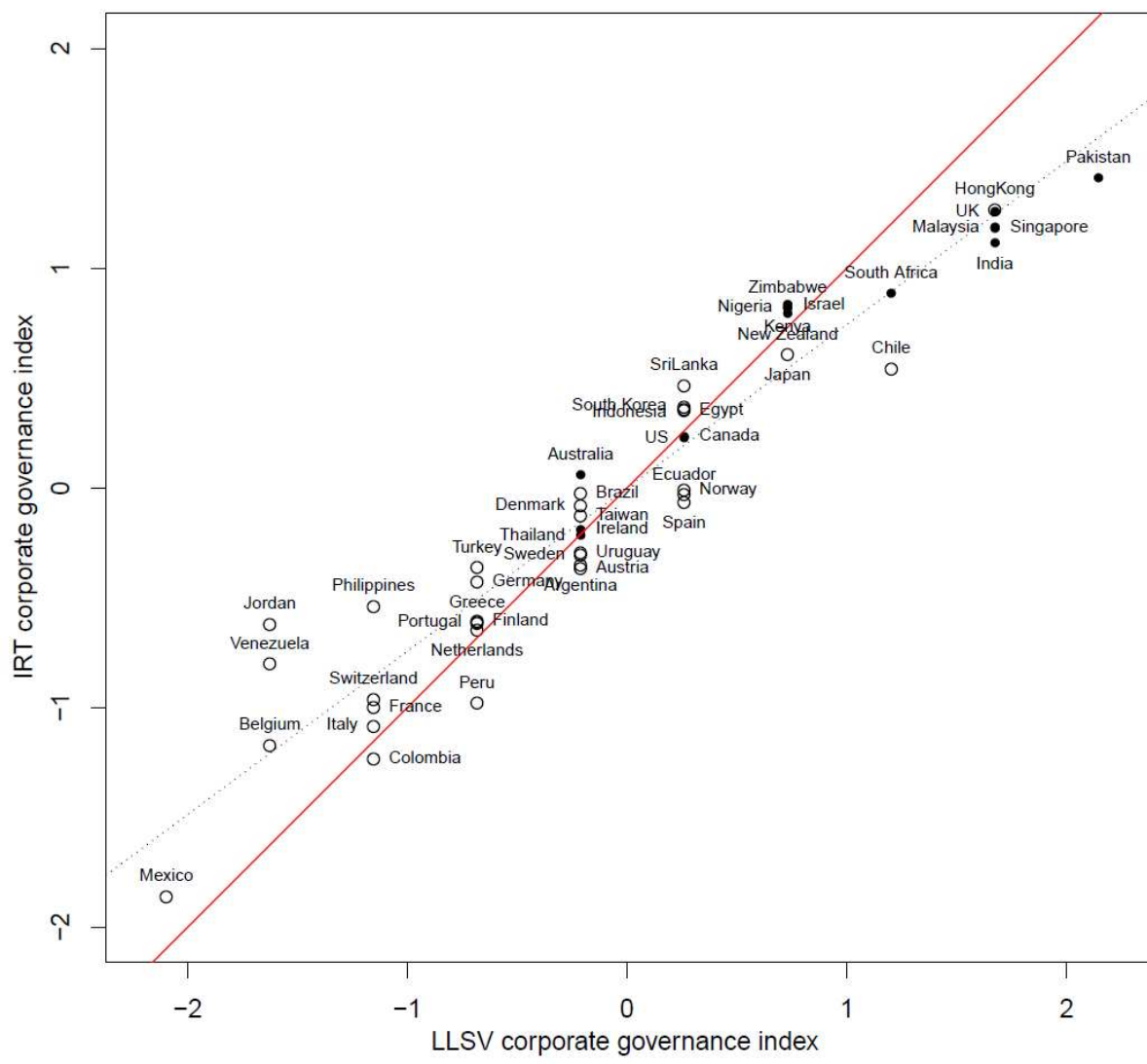
[50] The statistical programme R was used to write the codes, in conjunction with JAGS, which is a programme used to analyse the Bayesian hierarchical models within the context of the MCMC simulation.

The empty circle represents the estimation of corporate governance traits using CTT. All data have been standardised[51] for comparison.

The standardised score is also traced on the scatter plot, with the IRT-based scores on the Y-axis and the CTT-based scores on the X-axis. The dotted line is the regression line, whilst the solid line is the (0, 1) index line.
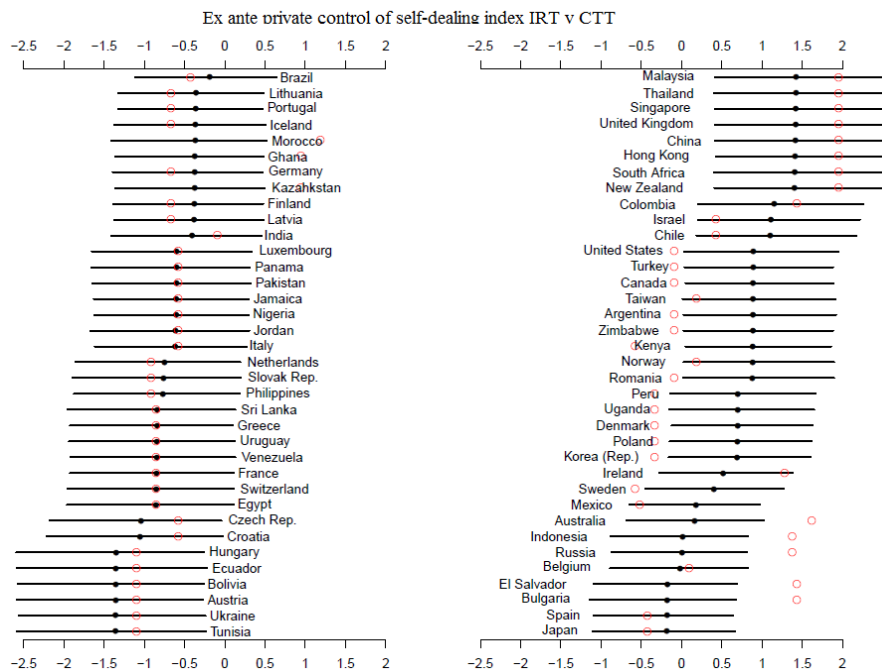
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[51] The classical test scores were calculated by adding up the values from eleven corporate governance variables, and then the mean and standard deviations were calculated. The standard scores were calculated by using the following formula: (country score- mean score)/standard deviation.

Common law jurisdictions have been represented with a filled-up dot, and other jurisdictions are represented as hollow dots.

Both the caterpillar plot and the scatter plot use the same corporate governance data set produced by LLSV, and compare the IRT estimates against the CTT values of the corporate governance index used by LLSV. From the plots it is clear that later criticisms of LLSV are true

concerning the prepositions put forward about common law jurisdictions.[52] Most of the represented countries towards the top right corner of the diagram are over-estimated under CTT, and all of them are common law jurisdictions. At the same time, LLSV seems to have under-approximated corporate governance for most civil law countries. This shows that, even when data are inconsistent and biased, it is possible to get an accurate picture by using IRT instead of CTT.

D. THE LAW AND ECONOMICS OF SELF-DEALING

Djankov, La Porta, Silanes and Shleifer[53] devised a novel index on the 'legal protection of minority shareholders against exploitation by corporate insiders', which they called the anti-self-dealing index. They coded for twenty-seven variables, which ranged from public and private enforcement of controls, to expropriation by management, across seventy-two countries. They also re-coded the LLSV ADRI from 1998, but improved this with more consistent coding. Nonetheless, in compiling the index, they still relied on factor analysis and CTT. The plots below explain how the index on ex ante private control would vary if IRT had been used in the first instance.

Ex ante private control of self-dealing index IRT v CTT

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[52] H Spamann, "On the insignificance and/or endogeneity of La Porta et al.'s Anti-Director Rights Index under Consistent Coding" (2006), available at http://ssrn.com/abstract=894301 and H Spamann, "The Anti-Director Rights Index" (2010) 23 Review of Financial Studies 467.
[53] S Djankov, R La Porta, FL Silanes and A Shleifer, "The Law and Economics of Self-Dealing" (2005), available at http://www.nber.org/papers/w11883.pdf.

The caterpillar plot manifests an interesting result: there is wide dispersion of mean indices; but the country trend, approximately, remains the same. One methodological reason for the minor dispersion can be attributed to the breakup of factorial items into binomial variables, which was reflected in the 2005 findings.

E. SPAMANN (2006)

To correct the inherent flaws in the data collection that stemmed from LLSV (like the inconsistent coding and common law bias), Spamann focused on ADRI and coded for forty-six of the forty-nine countries from the original experiment.[54] Spamann used the original component variables of ADRI:

- Whether proxy vote by mail is permitted
- Whether shares can be blocked before a general meeting
- Whether cumulative voting is allowed
- Whether the oppressed minority shareholders are allowed an appropriate relief mechanism
- Whether shareholders have pre-emptive rights to new issues
- The percentage of share capital required to call an extraordinary general meeting
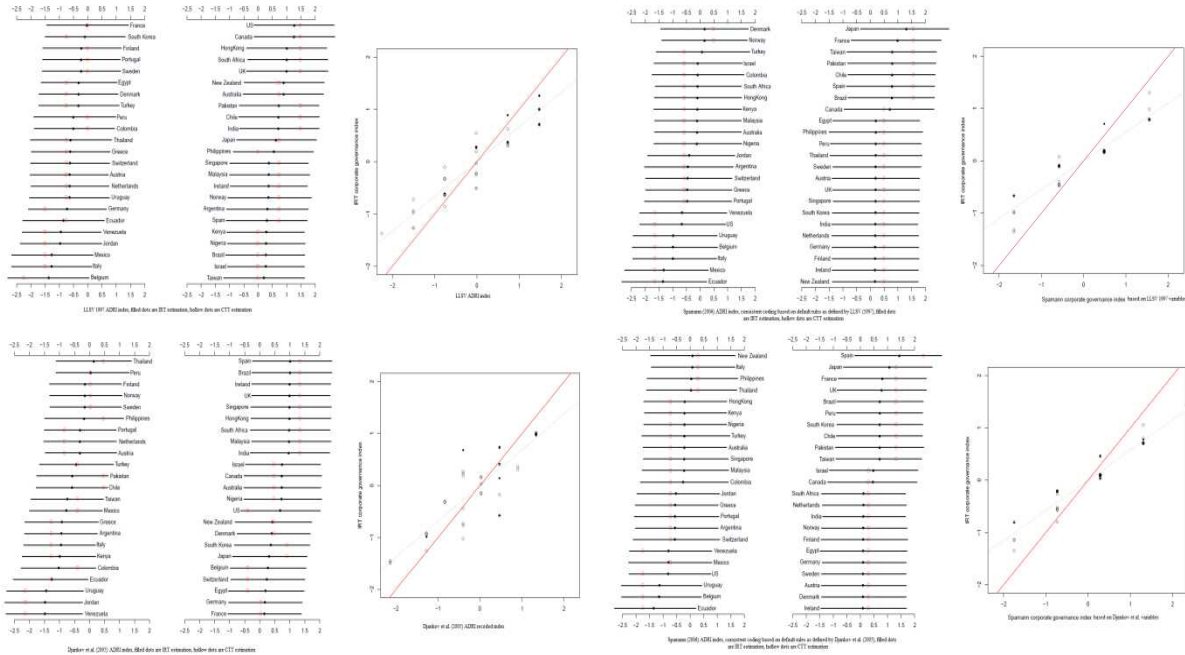
He also added two more variables to investigate:

- Whether one share affords one vote
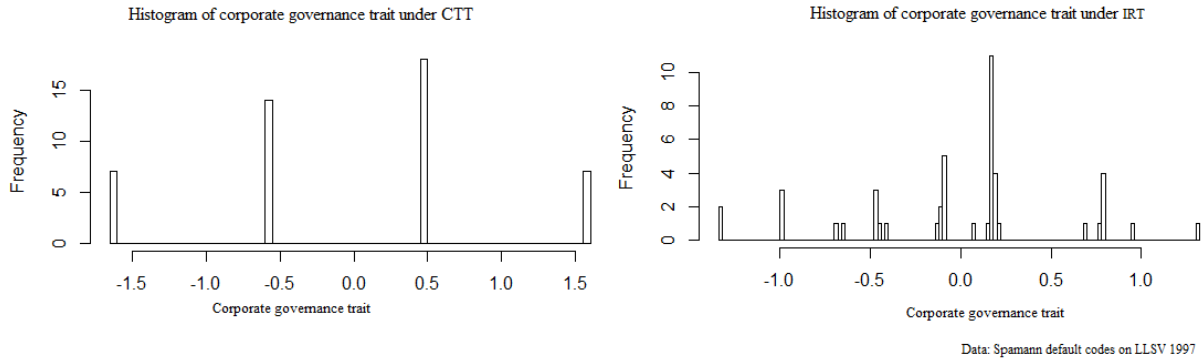- Whether country laws stipulate for mandatory dividends

Spamann concluded that the LLSV data contained errors, and therefore empirical studies based on that data were susceptible to erroneous results. Aside from this, Spamann also employed CTT to calculate his index. Here, the Spamann data are put through IRT, and are similarly scrutinised for dispersal problems like those found in LLSV. Critically, only ADRI values are addressed, and run through comparative IRT and CTT simulations. This is done for the six data

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[54] Djankov, La Porta, Silanes and Shleifer (n 53).

items coded by Spamann in a cumulative index, followed by the Spamann coding of the work done by Djankov, La Porta, Silanes and Shleifer, plus the original data.

The graphs show a correlation of .93 between the IRT and CTT estimations of ADRI in the LLSV data. There is a correlation of .88 for the re-coded ADRI vis-à-vis the Djankov, La Porta, Silanes and Shleifer data. And there is a correlation of .96 for the Spamann data, which is based on the definition used in the 2005 paper. This shows that consistent data shorten the gap between IRT and CTT estimation. But this correlation does not explain the whole story. If one looks at the plotting of the density graphs of traits derived under IRT and CTT, the picture is far clearer.

Histogram of corporate governance trait under CTT

Histogram of corporate governance trait under IRT

Data: Spamann default codes on LLSV 1997

Instead of bunching the countries into neat categories, as done with CTT, IRT breaks down the categories, and provides a wider range of groupings. Thus, IRT creates more intuitive and realistic indices that provide accurate representations of the transition between corporate governance traits across different countries.

F. CONCLUSION

In closing, from the comparison, it is clear that corporate governance indexes utilising IRT enjoy advantage over those using CTT. Instead of having a rigid quantitative category, IRT affords a gradual range, which increases the inherent explanatory power of an index. This allows for the adjustment of rater reliability. Furthermore, IRT calculations do not execute arbitrary factor analysis, but instead use probabilistic modelling to estimate the parameter value for increased scientific robustness and indexing accuracy. This is not to say that IRT does not suffer from drawbacks. The learning curve is steep, and it is ever important to consistently monitor whether the models have converged before drawing conclusions. And it must be borne in mind that larger sample sizes have more explanatory power in providing credible intervals. It follows that, on balance, it is beneficial to utilise IRT to compute indices on corporate governance.