

## DEVELOPMENT FACETS: CHINA VERSUS US IN THE FIELD OF STANDARDIZATION OF INFORMATION COMMUNICATION

Liangyu Yu<sup>1</sup>, Maggie Foley<sup>2</sup>, Mohamad Sepehri<sup>3</sup>

<sup>1</sup>Shanghai Jiao Tong University, 800 Dongchuan Road, Shanghai, 200240, China

<sup>2,3</sup>Jacksonville University, 2800 University Blvd N, Jacksonville, FL 32211, USA

E-mails: <sup>1</sup>iso@sjtu.edu.cn; <sup>2</sup>mfoley<sup>3</sup>@ju.edu; <sup>3</sup>msepehr@ju.edu

Received 27 February 2013; accepted 20 June 2013

**Abstract.** We study the strategy for the development of standard means of communicating information between businesses and governments. At this time, almost all of the funding and activity to develop and enhance a tool for such communication, which is named eXtensible Business Reporting Language (XBRL) is being done by and in the United States. We use China, who competes with the U.S. in the XBRL market, as an example to investigate if sharing the developmental effort by one, or more, additional countries would produce a more optimum result. Based on game theory, we demonstrate that China should increase investment in XBRL. The best achievable performance is when China and the U.S. almost split equally the whole XBRL market, leaving only a small portion to the “Followers”. (Followers are users that utilize XBRL, but have little or no participation in its development.) The paper provides a brief overview of the history and the reality of XBRL. The authors attempt to estimate (1) the benefits for China in the development of XBRL (2) benefits under monopoly (3) benefits under oligopoly and (4) benefits under the extreme condition with two participants equally sharing the market.

**Keywords:** XBRL, China, United States, monopoly, oligopoly.

**Reference** to this paper should be made as follows: Yu, L.; Foley, M.; Sepehri, M. 2013. Development facets: China versus US in the field of standardization of information communication, *Journal of Security and Sustainability Issues* 3(1): 5–10. [http://dx.doi.org/10.9770/jssi.2013.3.1\(1\)](http://dx.doi.org/10.9770/jssi.2013.3.1(1))

**JEL Classifications:** O2, O38

### 1. Introduction

XBRL stands for eXtensible Business Reporting Language. As one of a family of “XML” languages, XBRL is a standard means of communicating information between businesses and governments. XBRL is mainly used for communicating business information electronically on the Internet. XBRL is used in many countries for business regulation, stock exchange and securities regulation, revenue reporting, tax-filing and national statistical reporting. Since its debut in 1999, XBRL not only provides major benefits in the preparation, analysis and communication of business information, but also offers cost

savings, greater efficiency and improved accuracy and reliability to all users. As an open source program, XBRL has been continuously developing since it was created (Jones and Willis 2003; Boritz and No 2005; Debreceeny *et al.* 2010). However, similar to other “free” computer software, the development of XBRL requires all costs to be borne by its developers, not the end users. This tends to dampen the enthusiasm of the developers of XBRL. The solution for this sort of dilemma regarding public goods is generally with governments taking an active role. Government support is especially important for XBRL, since XBRL has become a world-wide standard for electronic business reporting (Higgins and Harrell 2003; Willis

2003). For instance, in 2002, the Chinese government began to study the feasibility of implementing XBRL in China. By the end of 2003, its full application was approved. In 2004, China formally adopted XBRL for financial reporting purposes, mutual fund reporting, IPO approvals and nonofficial and internal financial reporting, including for smaller companies (Zhu and Wu 2011; Kernan 2008). A natural question arises. For the development of XBRL, what is the optimal level of input for a country to achieve the best results? To answer this question, we apply game theory and theoretically demonstrate that there indeed exists an optimal strategy. Of note, since China has already overtaken the European Union as the second largest economy in the world, we use China as the sampling country in this study.

## 2. The History and the Reality of XBRL

In August, 1999, twelve companies and organizations, including the Registered Accountants Association of the United States, PWC, KPMG, Deloitte, Ernst & Young, Arthur Andersen, Edgar on Line and Microsoft, jointly set up an XBRL executive committee. Soon, the XBRL executive committee expanded overseas. This XBRL international organization is a non-profit organization dedicated to developing XBRL worldwide. It has branches, such as (1) the XBRL executive committee (2) a standardization committee and (3) nine other groups. Moreover, the XBRL international organization is operated under the XBRL international executive committee. So far, there are 24 regional branches, among which seven branches are temporary (Klement 2007; Strand *et al.* 2001). Further, over 550 members worldwide joined the XBRL international organization. Members include global information networks, government audit organizations, accounting firms, software companies, banks, broker firms, insurance companies and tax agencies, etc. (Kernan 2008). As more and more companies get familiar with XBRL, it is foreseeable that XBRL will soon take over the market to help synchronize the global economy. However, the development of XBRL is not balanced around the world. The main reason is that XBRL allows users to extend its taxonomies as needed, thereby, without a centralized authority, necessary interoperability is almost impossible (Kernan 2008). The lack of adoption of XBRL in many countries reflects the fact that it is too costly to extend XBRL (Cohen 2009;

Coffin 2001). In sum, XBRL was originated in the United States based on general accounting rules of the United States. The XBRL executive committee set up the first XBRL standard, the XBRL V1.0 specification and XBRL taxonomy. Even though the U.S. has always been the major contributor for the development of XBRL, China, along with other countries, is catching up quickly.

## 3. Estimation of Net Benefits for Followers in a Monopoly Environment

Assume China is a Following country, not a major player in the development of XBRL. What is the optimal level of input for China? In this session, we thoroughly evaluate the costs and benefits for Followers and then derive a model based on game theory to answer the above question. To start, we assume that each member determines its own desirable inputs for maximized gains. Next, we further assume that, during the first stage, the only costs for each member come from the expenses in information collection. Of note, the reality is much more complicated than this. Assume that  $A$  is the total market value of XBRL, which is estimated to be at least ten billion dollars. Assume that the cost of input from the United States is  $C_1$ . Thus,  $1 - \alpha - \frac{\beta}{C_1}$  represents the U.S.

market share, where  $\alpha$  is the market share unrelated to the U.S.,  $0 < \alpha < 1$ .  $-\frac{\beta}{C_1}$  shows that market share increases with the amount of input from the U.S. Of note,  $0 < \beta < A$ .

The total gain from XBRL for the U.S. is as follows.

$$U_1 = (1 - \alpha - \frac{\beta}{C_1})A - C_1.$$

$$\text{Let } \frac{dU_1}{dC_1} = 0. \text{ Thus, } C_1^* = \sqrt{A\beta}.$$

$$U_1^* = (1 - \alpha - \frac{\beta}{C_1^*})A - C_1^* = (1 - \alpha)A - 2\sqrt{A\beta}$$

If inputs from all other Following countries, including China, are  $C_1, C_2, \dots, C_n$ , respectively, then the value of the remaining market is

$$\text{the following, } B = A - (1 - \alpha - \frac{\beta}{C_1^*})A = \alpha A + \sqrt{A\beta}$$

Where  $B$  represents the value of the remaining market. Dividing  $B$  by the amount of raw investment of each Follower, the corresponding benefit for each member country is  $\mu_1$ ,

$$u_i = (\alpha A + \sqrt{A\beta}) \frac{c_i}{\sum c_i} - c_i$$

Let  $\frac{du_i}{dc_i} = 0$ . Thus, the following must hold.

$$\sum c_i - c_i = (\sum c_i)^2 / B$$

Adding up all of the above n equations, we get

$$(n-1)\sum c_i = n(\sum c_i)^2 / B, \text{ or } \sum c_i = B(n-1) / n$$

Since  $\sum c_i - c_i = (\sum c_i)^2 / B$ , we thereby get

$c_i^* = B(n-1) / n^2 = (\alpha A + \sqrt{A\beta})(n-1) / n^2$ . Next, we substitute the cost function into the benefit function and get the following equation.

$$u_i^* = B / n - B(n-1) / n^2 = B / n^2 = (\alpha A + \sqrt{A\beta}) / n^2$$

Comparing the benefit functions for the United States with that of following countries, we demonstrate that the U.S. can easily be the only dominant force in XBRL as long as each following country persistently invests far less than the U.S. At present, the XBRL international organization has less than thirty member countries, but the future membership is expected to be over one-hundred (Kernan 2008).

#### 4. Estimation of Net Benefits in an Oligopoly Environment

China's economy has been growing at roughly 10% annually in the past two decades. At present, China has already overtaken the European Union as the second largest economy in the world. However, the role of China in the XBRL organization is almost neglected as compared with that of the U.S. Imagine that China has become the only competitor of the U.S. in the XBRL market. In such an oligopoly environment, how big is the market and how much input is required?

Assume that the inputs of the U.S. and China in XBRL are  $C_1$  and  $C_2$ , respectively. Thus, the total

market share of the U.S. and China is  $1 - \alpha' - \frac{\beta'}{C_1 + C_2}$ , where  $\alpha'$  represents the percentage of markets that

have been locked up by the U.S. Of note,  $0 < \alpha' < \alpha < 1$ , since  $\alpha$  includes  $\alpha'$  plus the portion of China's market share.  $-\frac{\beta'}{C_1 + C_2}$  indicates that market share increases with an escalation in outlay. However, increases

of market share would be lower under the case of oligopoly than that under monopoly, implying that the following must hold.

$$0 < \beta < \beta' < \alpha A$$

Assume that the U.S. and China allocate markets by input alone. Thereby, the total benefits for the U.S. and

China,  $U_1$  and  $U_2$ , are as follows.  $U_1 = (1 - \alpha' - \frac{\beta'}{C_1 + C_2}) \frac{C_1}{C_1 + C_2} A - C_1$

$$U_2 = (1 - \alpha' - \frac{\beta'}{C_1 + C_2}) \frac{C_2}{C_1 + C_2} A - C_2$$

To obtain maximized values of  $U_1$  and  $U_2$ , we assume that the inputs of China and the U.S. are equal,  $C_1 = C_2$ . It is a reasonable assumption since at equilibrium, the following must hold.

$$\frac{C_2}{C_1 + C_2} = \frac{1}{2}$$

$$\text{Thus, } U_1 = (1 - \alpha' - \frac{\beta'}{C_1 + C_2}) \frac{1}{2} A - C_1$$

$$U_2 = (1 - \alpha' - \frac{\beta'}{C_1 + C_2}) \frac{1}{2} A - C_2$$

$$\text{Let } \frac{dU_1}{dC_1} = \frac{dU_2}{dC_2} = 0. \text{ The equilibrium solutions are as follows. } C_1^* = C_2^* = \frac{\sqrt{2}}{2} \sqrt{A\beta'}$$

$$U_1 = U_2 = (1 - \alpha' - \frac{\beta'}{C_1^* + C_2^*}) \frac{1}{2} A - C_1^* = \frac{1}{2} (1 - \alpha') A - \frac{3\sqrt{2}}{4} \sqrt{A\beta'}$$

The findings tend to suggest that under oligopoly, the U.S. and China are better off not to invest the same amount as that under monopoly. The marginal benefits drop faster than the decreases in outlay. However, China's total increase in benefits from a Following country to a major competitor under oligopoly surpasses the increase in costs.

Meanwhile, assume all other countries have outlays of  $c_1, c_2, \dots, c_n$ , respectively. They completely share the rest of the market with a value of B, where  $B = A - (1 - \alpha' - \frac{\beta'}{C_1 + C_2})A = \alpha'A + \frac{\sqrt{2}}{2} \sqrt{A\beta'}$ .

Further assume that the rest of the market with a value of B is fairly shared according to each member's outlay. Thus, the gain for each country is the following.

$$u_i = (\alpha'A + \frac{\sqrt{2}}{2} \sqrt{A\beta'}) \frac{c_i}{\sum c_i} - c_i.$$

$$\text{Let } \frac{du_i}{dc_i} = 0. \text{ We get } \sum c_i - c_i = (\sum c_i)^2 / B. \text{ Adding up all } n \text{ equations for } i = 1, 2, \dots, n-1, \text{ we get}$$

$$(n-2) \sum c_i = (n-1) (\sum c_i)^2 / B, \text{ or } \sum c_i = B(n-2) / (n-1). \text{ Since } \sum c_i - c_i = (\sum c_i)^2 / B, \text{ we thereby come up with the following equilibrium condition.}$$

$$c_i^* = B(n-2) / (n-1)^2 = (\alpha'A + \frac{\sqrt{2}}{2} \sqrt{A\beta'}) (n-2) / (n-1)^2$$

$$u_i^* = B / (n-1) - B(n-2) / (n-1)^2 = B / (n-1)^2 = (\alpha'A + \frac{\sqrt{2}}{2} \sqrt{A\beta'}) / (n-1)^2$$

## 5. Estimation of Net Benefits for China as One of the Two Players

The U.S. as a leader of XBRL controls the market for XBRL. China instead is still a Following member. However, it is possible for China to split the whole market of XBRL with the U.S. only. Under this extreme case, what can China gain? Assume that China and the U.S. equally divide up the total costs of C. Hence, each

country's market share would be  $1 - \alpha' - \frac{\beta}{C}$ , where  $\alpha'$  stands for the rest of the market unrelated to the U.S. and China. Since  $\alpha$  includes China, we get  $0 < \alpha' < \alpha < 1 - \frac{\beta}{C}$  implies that market share increases with outlay and that  $0 < \beta < C < A$ .

The benefits for the U.S. and China are the following.

$$U_1 = U_2 = \frac{1}{2} \{ (1 - \alpha' - \frac{\beta}{C}) A - C \}$$

$$\text{Let } \frac{dU_1}{dC_1} = \frac{dU_2}{dC_2} = 0, \text{ then } C^* = \sqrt{A\beta},$$

$$\begin{aligned}
 U_1 = U_2 &= \frac{1}{2} \left\{ (1 - \alpha' - \frac{\beta}{C}) A - C \right\} \\
 &= \frac{1}{2} \left\{ (1 - \alpha') A - \sqrt{A\beta} - \sqrt{A\beta} \right\} \\
 &= \frac{1}{2} (1 - \alpha') A - \sqrt{A\beta}
 \end{aligned}$$

For the remainder of the n-1 members as Followers for the remainder of the market with value of B, their outlays are  $c_1, c_2, \dots, c_{n-1}$  and  $B = A - (1 - \alpha' - \frac{\beta}{C^*}) A = \alpha' A + \sqrt{A\beta}$ .

Let  $\frac{du_i}{dc_i} = 0$ , thus,  $\sum c_i - c_i = (\sum c_i)^2 / B$ . Adding up all n equations for  $i=1, 2, \dots, n-1$ , we get

$(n-2) \sum c_i = (n-1) (\sum c_i)^2 / B$  and  $\sum c_i = B(n-2) / (n-1)$ . Since  $\sum c_i - c_i = (\sum c_i)^2 / B$ , equilibrium conditions are as follows.

$$c_i^* = B(n-2) / (n-1)^2 = (\alpha' A + \sqrt{A\beta})(n-2) / (n-1)^2$$

$$u_i^* = B / (n-1) - B(n-2) / (n-1)^2 = B / (n-1)^2 = (\alpha' A + \sqrt{A\beta}) / (n-1)^2$$

In sum, by comparing the costs and benefits in equilibrium under monopoly, oligopoly, and the extreme case with two competitors, we demonstrate that the market values of the two dominant forces under oligopoly are higher than that under monopoly, even though the total costs are the same. The best outcome for two competitors is from the extreme case where the market is almost split by the two countries. Under that scenario, the input is relatively lower but the gains are the highest. Whatever the situation is, the Following members are worse off.

## Conclusions

Since the debut of XBRL in 1999, the U.S. has been the dominant force to improve and promote XBRL in the world. However, as a “free” public good, it is difficult to get governments involved as main sponsors, unless their potential benefits can surpass the outlays.

In this study, we use China, as an example, to compete with the U.S. for the XBRL market. Based on game theory, we demonstrate that China should invest more in XBRL. The best achievable performance is when China and the U.S. almost split the whole XBRL market, leaving only a small portion to the Following members.

Models derived in this study can be applied in other standardization fields as well. Future study can apply game theory to study dynamic development of the XBRL market.

## References

- Boritz, J. E.; No, W. G. 2005. Security in XML-based Financial Reporting Services on the Internet, *Journal of Accounting and Public Policy* 24(1):11–35.
- Cohen, E. E. 2009. XBRL’s Global Ledger Framework: Exploring the standardized missing link to ERP integration, *International Journal of Disclosure and Governance* 6(3):188–206.
- Coffin, Z. 2001. The top ten effects of XBRL: the future of internet reporting. Available on the Internet: < <http://circa.europa.eu/irc/dsis/accstat/info/data/en/TopTenEffectsofXBRL-2001-zcoffin1.pdf>>.
- Debreceeny, R.; Farewell, S.; Piechocki, M.; Felden, C.; Graning, A. 2010. Does it add up? Early evidence on the data quality of XBRL filings to the SEC, *Journal of Accounting and Public Policy* 29 (3):296–306.
- Higgins, L.N.; Harrell, H.W. 2003. XBRL: Don’t Lag Behind the Digital Information Revolution, *The Journal of Corporate Accounting & Finance* 7(8): 13–21.
- Jones, A.; Willis, M. 2003. The challenge of XBRL, *Balance Sheet* 11(3):29–37. doi: 10.1108/09657960310491172
- Kernan, K. 2008. XBRL around the World, A look beyond US shores to put the SEC’s interactive data initiative in a global context, *Journal of Accountancy*. Available on the Internet: < <http://www.journalofaccountancy.com/Issues/2008/Oct/XBRL-AroundTheWorld.htm>>.
- Klement, T. 2007. Standardized Company Reporting with XBRL, in Debreceeny, R.; Felden, C.; Piechocki, M. (Eds.). *New Dimensions of Business Reporting and XBR*. Deutscher Universitäts-Verlag, 249–271.
- Strand, C.; McGuire, B.; Waterson, L.; Hoffman, Ch. 2001. The XBRL potential, *Strategic Finance* 82(12): 58–63.
- Zhu, H.; Wu, H. 2011. Quality of data standards: framework

and illustration the using XBRL taxonomy and instances, *Electron Markets* (21):129–139.

Willis, M. 2003. Corporate Reporting Enters the Information Age, *Regulation* 26(3): 56–60.

**Liangyu YU** is professor at Shanghai Jiao Tong University, China. His research interests embrace international economics and finance.

**Maggie FOLEY** is Assistant Professor of Finance at Davis College of Business, Jacksonville University. She obtained her PhD at Texas Tech University. Her research interests include business finance, corporate governance, and institutional investors.

**Mohamad SEPEHRI** (Dr. Mo) is the Division Chair and professor of Management and International Business at Davis College of Business, Jacksonville University. He has a unique combination of academic and business experience, with extensive background in strategic management/leadership and broad experience in international and global business operations. Dr. Sepehri has extensive scholarly researches that have been presented at national as well as international forums. He has written numerous research papers that were published in professional and refereed journals. Dr. Sepehri has also been recognized by other professional and scholarly bodies. He has been acknowledged in the *Journal of Operations Management (JOM)* as an “outstanding contributor” on several occasions.