Journal of Banking and Financial Economics

No 1(7)2017

University of Warsaw Faculty of Management

ISSN 2353-6845

Editorial Office: Faculty of Management, University of Warsaw, Szturmowa Str. 1/3, Postal Code 02-678 Warsaw, Email: jbfe@wz.uw.edu.pl

Publisher: Faculty of Management Publishing House, University of Warsaw, Szturmowa Str. 1/3, Postal Code 02-678 Warsaw Telephone: +48 22 55 34 164; Fax: +48 22 55 34 001; jbfe@wz.uw.edu.pl

Webpage of Journal of Banking and Financial Economics:

ttp://www.wz.uw.edu.pl/portale/journal-of-banking-and-financial-economics

Overview

The ***Journal of Banking and Financial Economics*** **(JBFE)** is an open access journal. The submission of manuscripts in free of fee payment. This journal follows a double-blind reviewing procedure.

Aims and Scope

JBFE publishes high quality empirical and theoretical papers spanning all the major research fields in banking and financial economics. The aim of the journal is to provide an outlet for the increasing flow of scholarly research concerning banking, financial institutions and the money and capital markets within which they function. The journal also focuses on interrelations of financial variables, such as prices, interest rates and shares and concentrates on influences of real economic variables on financial ones and vice versa. Macro-financial policy issues, including comparative financial systems, the globalization of financial services, and the impact of these phenomena on economic growth and financial stability, are also within the *JBFE*'s scope of interest. The Journal seeks to promote research that enriches the profession's understanding of the above mentioned as well as to promote the formulation of sound public policies.

Main subjects covered include, e.g.: [1] ***Valuation of assets***: Accounting and financial reporting; Asset pricing; Stochastic models for asset and instrument prices; [2] ***Financial markets and instruments:*** Alternative investments; Commodity and energy markets; Derivatives, stocks and bonds markets; Money markets and instruments; Currency markets; [3] ***Financial institutions, services and regulation***: Banking efficiency; Banking regulation; Bank solvency and capital structure; Credit rating and scoring; Regulation of financial markets and institutions; Systemic risk; [4] ***Corporate finance and governance****:* Behavioral finance; Empirical finance; Financial applications of decision theory or game theory; Financial applications of simulation or numerical methods; Financial forecasting; Financial risk management and analysis; Portfolio optimization and trading.

Special Issues

JBFE welcomes publication of Special Issues, whose aim is to bring together and integrate work on a specific theme; open up a previously under-researched area; or bridge the gap between formerly rather separate research communities, who have been focusing on similar or related topics. Thematic issues are strongly preferred to a group of loosely connected papers.

Proposals of Special Issues should be submitted to at jbfe@wz.uw.edu.pl. All proposals are being reviewed by the Editorial Team on the basis of certain criteria that include e.g.: the novelty, importance and topicality of the theme; whether the papers will form an integrated whole; and the overall 'added value' of a Special Issue.

CONTENTS

Koffie Nassar, Edder Martinez, Anabel Pineda
Determinants of Banks' Net Interest Margins in Honduras 5

Bernardin Akitoby , Ariel Binder, Takuji Komatsuzaki
Inflation and Public Debt Reversals in the G7 Countries 28

Chie Aoyagi, Giovanni Ganelli
Unstash the Cash! Corporate Governance Reform in Japan 51

Mario W. Cardullo, Manhong Mannie Liu
Global Thermoeconomics 70

David Cademartori-Rosso, Berta Silva-Palavecinos,
Ricardo Campos-Espinoza, Hanns de la Fuente-Mella
An Econometric Analysis for the Bid-Ask Spread in the Emerging Chilean Capital Market . . . 90

Determinants of Banks' Net Interest Margins in Honduras

Koffie Nassar[1]
International Monetary Fund, United States
knassar@imf.org

Edder Martinez
Comisión Nacional de Bancos y Seguros, Honduras
emartinez@cnbs.gob.hn

Anabel Pineda
Comisión Nacional de Bancos y Seguros, Honduras
apineda@cnbs.gob.hn

Received: 16 February 2016 / Revised: 01 August 2016 / Accepted: 05 August 2016 / Published online: 27 January 2017

ABSTRACT

This paper analyzes the determinants of banks' net interest margins in Honduras during the years 1998 to 2013 – a period characterized by increasing banks' net interest margins, foreign bank participation and consolidation. In line with findings in the previous literature, we find that operating costs are the most important drivers of banks' net interest margins. We also find that competition among banks has led to higher concentration and that funding by parent banks positively impacts foreign banks' net interest margins. Together, these results suggest that banks, particularly foreign banks, are under pressure to consolidate and reduce operating costs in order to offer competitive interest margins. We conclude that further structural reforms and consolidation may lower banks' net interest margins.

JEL Classification: E43; E44; D43

Keywords: Banks' interest margins; Commercial banks; Panel corrected standard errors (PCSE).

1. INTRODUCTION

Over the last two decades, Honduras has implemented banking sector reforms and liberalization. Key areas of the reform have included strengthening the legal and regulatory framework, granting greater independence to the supervisory agency, broadening the range of

[1] Corresponding author: International Monetary Fund, 700 19th Street, N.W., Washington, D.C. 20431, USA. Tel: +1 (202) 623-5420, e-mail: knassar@imf.org

Ministry of Science and Higher Education
Republic of Poland

The creation of the English-language version of these publications is financed in the framework of contract No. 768/P-DUN/2016 by the Ministry of Science and Higher Education committed to activities aimed at the promotion of education.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

corrective actions, revamping the financial safety net and, more recently, introducing a monetary policy interest rate. Progress has also been made in putting in place risk-based banking supervision. While these reforms have contributed to financial deepening, banks' net interest margins have increased in recent years. On the one hand, high interest margins can contribute to strengthening bank capitalization, through transfer of profits earned by banks to their capital base. On the other hand, high interest margins are usually interpreted as an indicator of inefficiency, which adversely affects domestic real savings and investment (Brock and Rojas-Suarez; 2000). Honduras may particularly be at risk because, like all developing countries, its financial system is less developed and bank loans are the main sources of funding.

This paper examines the determinants of banks' net interest margins. There are many reasons for this study. First, anemic growth following the 2008 global financial crisis and 2009 internal political crisis have revived debate about the efficiency of financial intermediation in Honduras. Second, policymakers care about banks' interest margins because they reflect the cost of financial intermediation. Third, it is commonly thought that international banks bring new capital and greater managerial expertise, and promote efficient and competitive banking practices. Therefore, policymakers expect that, through liberalization and integration, banks' interest margins will converge to international levels. Against this background, this paper analyzes the impact of foreign bank participation.

The empirical literature on the determinants of interest margins has primarily focused on the impact of bank specific factors and macroeconomic/policy variables. Bank specific characteristics that are found to be significant determinants of banks' interest margins include: operating costs, credit activity, capital adequacy, liquidity, loan quality, credit risk, interest risk, opportunity cost of bank reserves, bank size and ownership structure. Among macroeconomic variables, inflation and real GDP growth are found to be the most important determinants. However, while there is a broad consensus that higher inflation contributes to higher interest margins, the impact of real GDP growth remains ambiguous. On the one hand, there can be a negative effect of real GDP growth on banks' interest margins due to the fact that (i) borrowers' creditworthiness and net worth deteriorates during recessions and so loan rates increase (Bernanke and Gertler; 1989) and (ii) good economic performance lowers bank defaults (Tan; 2012). On the other hand, there can be a positive effect of real GDP growth on interest margins due to the fact that demand for loans increases during cyclical upswings. For Honduras, Pineda (2010) finds operational costs and inflation as the most important bank-specific and macroeconomic determinants, respectively.

In recent years, however, there has been an increased focus on the impact of foreign bank participation on banks' interest margins. These studies include: Claessens, Demirguc-Kunt, and Huizinga (2000), Barajas, Steiner, and Salazar (2000), Martinez and Mody (2004), Fungacova and Poghosyan (2009), Poghosyan (2010), Dumicic and Ridzak (2012) and Tan (2012). The contribution of this paper is threefold. First, it builds on the previous study by Pineda (2010) and covers more recent data. Second, it controls for bank ownership. Third, it uses Beck and Katz's (1995, 1996) OLS-based panel corrected standard errors (PCSE) approach, which is more appropriate, given the structure of the panel dataset, than the feasible generalized lease squares (FGLS) procedure used by Pineda (2010).[2]

In this paper, we estimate a modified version of the cost function model by Klein (1971) and Monti (1972). We find that operating costs are the most important driver of banks' net interest margins. In addition, we find that more efficient banks have lower costs, serve the best-quality borrowers and garner greater market share. We also find that high and increasing funding by parent banks positively impacts foreign banks' net interest margins. Together, these results suggest that banks, particularly subsidiaries of foreign banks, are under pressure to consolidate and reduce

[2] When comparing the performance of both estimators, the rule of thumb is that the OLS-PCSE estimator is preferable to its FGLS counterpart when (Jönsson 2005). For this study,

DOI: 10.7172/2353-6845.jbfe.2017.1.1

operating costs in order to offer competitive interest margins. We conclude that further structural reforms and consolidation may lower banks' net interest margins.

The rest of the paper is organized as follows. Sections II and III provide a review of the related literature and the institutional background of the banking sector, respectively. Section IV presents the methodology and data. Section V discusses the empirical results. Conclusions and policy implications are presented in Section VI.

2. LITERATURE REVIEW

The starting point for analyzing the determinants of banks' interest margins is the seminal model by Ho and Saunders (1981). In this pioneering study, banks are assumed to be mere intermediaries between lenders and borrowers and interest margins have two basic components: the degree of competition in the banking system and the interest rate risk to which banks are exposed. This model has been criticized for not taking into account the cost structure of banks. It has since been extended to incorporate money markets (McShare and Sharpe, 1985), different types of credits/deposits (Allen, 1988), credit and interest rate risks (Angbanzo, 1997), and banks' operating costs (Maudos and Fernandez de Guevara, 2004).

While the extended model remains the workhorse of the theoretical literature, cross-country empirical verification has proven difficult due to different institutional and regulatory environments. To circumvent these problems, some empirical studies apply a two-step procedure by first isolating the impacts of bank specific variables before proceeding to model the "pure spread" as a function of various exogenous factors not taken into consideration in the theoretical model (McShane and Sharpe, 1985; Allen, 1988; Angbazo, 1997; Saunders and Schumacher, 2000; and Brock and Rojas Suares, 2000). On the one hand, empirical results of the two-step approach generally corroborate the theoretical predictions of the extended model for industrialized countries. This has been the case in Europe (e.g., Saunders and Schumacher, 2000; Maudos and Fernandez de Guevara, 2004), the US (Angbanzo, 1997) and Australia (McShane and Sharpe, 1995; Williams, 2007).

On the other hand, empirical studies for developing countries have been more circumspect.[3] International comparison of determinants of interest margins (e.g., Demirguc-Kunt and Huizinga, 1998; Moore and Craigwell, 2000; Brock and Rojas-Suarez, 2000; Claessens, Demirguc-Kunt and Huizinga, 2001; and Gelos, 2006) go beyond the framework of the dealership model by considering a wide range of potential factors, including macroeconomic conditions, explicit and implicit bank taxation, deposit insurance regulations, financial structure, and legal and institutional indicators. More recently, Tennant and Folawewo (2009), using data for a group of 33 developing countries, find that the banking sector reserve requirement is a significant and positive determinant of interest margins. They also find that macroeconomic volatility, such as inflation, widens interest margins through its adverse impact on corporations' and households' balance sheets.

In recent years, studies have begun to explore the impact of the ownership structure of banks on interest margins.[4] For developing countries, Micco, Panizza and Yanez (2007), and Fungacova and Poghosyan (2009) show that the form of bank ownership has strong influence on bank performance; La Porta (2003), and Taboada (2011) observe that locally owned banks allocate a higher proportion of their loan portfolios to low quality industries; and Demirgue-Kunt and Huizinga (1999), Claessens, Demirguc and Huizinga (2001) and Martinez and Mody (2004) show that foreign-owned banks outperform locally owned banks. Overall, these findings suggest that foreign-owned banks play an important role in developing countries.

[3] Brock and Rojas-Suarez (2000) caution against applying this model directly to developing countries with less developed financial markets.

[4] See Fungacova and Poghosyan (2009) and Tan (2012) for a comprehensive review of the literature.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

On Latin America, in particular, Martinez and Mody (2004) analyze the impact of increasing foreign bank participation and high concentration levels on bank's interest rate spreads using bank level data for Argentina, Chile, Colombia, Mexico, and Peru. They find that foreign banks are able to charge lower spreads relative to domestic banks, that the overall level of foreign bank participation seemed to influence spreads through its effect on administrative costs, and that banks concentration was positively and directly related to both higher spreads and higher administrative costs. To the best of our knowledge, no study has examined the impact of foreign banks on the efficiency of the banking sector in Honduras.

3. BACKGROUND: INSTITUTIONAL STRUCTURE OF THE BANKING SECTOR

While commercial banking in Honduras started in 1889, the first foreign-owned bank (First National Citibank of New York) entered the market in 1965 through acquisition and merger (Tábora; 2007). Following financial sector reforms, including financial liberalization and international integration, in the 1990s, subsidiaries of international banks have entered the market through acquisition and mergers (none through *de novo* investment).[5] In the process, five banks either closed or merged, with the six largest banks accounting for 75 percent of total bank assets in 2013, compared with 10 banks in 1999. Partly as a result, despite the small size of the market in terms of population (about 7.8 million in 2011) and GDP (about US$18.8 billion in 2013), the banking system remains moderately deep with diversified ownership. As at end-2013, 7 locally owned banks and 10 subsidiaries of foreign banks comprise the market. The subsidiaries of foreign banks have about 43 percent and 45 percent of the market in terms of deposits and loans, respectively.

The banking sector is relatively large, with total assets equivalent to 94 percent of GDP, credit to the private sector amounting to 51 percent of GDP, and broad money (M3) standing at 50 percent of GDP. The financial system comprises commercial banks, savings and loans, and finance corporations. The banking sector is the dominant player in the financial system, accounting for over 90 percent of total assets. Banks mobilize most of their resources onshore through retail and wholesale deposits – about 12 percent in demand deposit and the reminder in time and savings deposits. Dollarization of deposits is at about 31 percent of total deposits and the role of off-shore operations in financial intermediation is growing.

Honduras has a defined benefit national insurance system with total assets amounting to about 15 percent of the total financial system. About 50 percent of social security funds are placed in bank deposits—mainly in locally owned banks. These funds represent the most substantial body of long-term funds for the banking system.

Structural reforms in the banking sector, such as initiatives to improve the regulatory and supervisory framework, are ongoing. Prior to 2004, legislation allowed banks to engage in related lending to and equity participation in private companies up to the equivalent of 120 percent and 50 percent of Tier I capital, respectively. By 2007, these ratios were brought down to the limit consistent with international best practices (20–30 percent and 25 percent of Tier I capital, respectively). Overtime, solvency characteristics (Capital Adequacy Ratios) of the subsidiaries of foreign banks have also converged with their local counterparts. However, there is lack of a well-functioning interbank market, informality is a major problem, and resolution of legal cases remains slow.

[5] Four subsidiaries of foreign banks entered the market during 2007–8.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

4. METHODOLOGY AND DATA

4.1. A Basic Cost-Structure Empirical Model

This paper estimates commercial banks' net interest margins using the cost-function model developed by Klein (1971) and Monti (1972).[6] The model is based on the assumption that there is a cost function for running a bank that depends on the aggregate value of the assets being managed by the bank as well as other factors of production, such as capital and labor; i.e. $Costs = C(A; K,L)$. Assuming that the bank maximizes profits, the income accounting identity is depicted as:

$$Profits = (r_A - r_D) - C(A; K,L) - Provisions - NoninterestExpenses \quad (1)$$

In equation (1) profits are positive in interest earned on loans r_A, and negative in interest paid on deposits r_D, in cost of production, provisions and in non-interest expenses. In this setting, the first-order conditions for profit maximization by a competitive bank (where $dD = dA$ at the margin) is obtained as:

$$(r_A - r_D) = \frac{\partial C(A;K,L)}{\partial A} \quad (2)$$

The first-order conditions state that a competitive bank will set the marginal cost of managing assets equal to the spread. All the other components of the accounting identity drop out because they involve inframarginal profits. If, instead, the banking system is assumed to be monopolistic, then profit maximization leads to the following condition:

$$(r_A - r_D) = \frac{\partial C(A;K,L)}{\partial A} + D\frac{\partial r_D}{\partial D} - A\frac{\partial r_A}{\partial A} = \frac{\partial C(A;K,L)}{\partial A} + \frac{1}{\eta_D} + \frac{1}{\eta_A} \quad (3)$$

where η_D and η_A are semi-elasticities of demand deposit and asset supply $\left[\eta_D = \frac{1}{D}\frac{dD}{dr_D}\right]$ and $\left[\eta_A = \frac{1}{A}\frac{dA}{dr_A}\right]$, respectively.

If, however, the banking system is characterized as oligopolistic, the spread will be a function of the number of banks in the system. Assuming a common linear cost function and Cournot behavior (see Freixas and Rochet; 2008), the spread can be expressed as:

$$(r_A - r_D) = \frac{\partial C(A;K,L)}{\partial A} + \frac{1}{N}\left(\frac{1}{\eta_A} + \frac{1}{\eta_D}\right) \quad (4)$$

where is the number of banks. Equation (4) suggests that changes in the concentration of the banking system will affect the spread by altering the size of oligopoly profits. In other words, equation (4) rules out contestable markets and predicts that a decline in the number of banks (i.e., an oligopolistic market structure) is associated with higher spreads and marginal operating costs.[7] A commonly used empirical proxy for concentration in the banking sector is the Herfindahl-Hirschman index (HHI). The index is obtained by squaring and summing individual bank market shares. Using HHI as a proxy for market concentration, equation (4) can be rewritten as:

$$(r_A - r_D) \approx OC + HHI \quad (5)$$

where $OC = \frac{\partial C(A;K,L)}{\partial A}$ is operating costs.

[6] See Freixas and Rochet (2008) for a full blown model.

[7] The theory of contestable markets holds that there exist markets served by a small number of firms, which are nevertheless characterized by competitive equilibria (and therefore desirable welfare outcomes), because of the existence of potential short-term entrants.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

4.2. Incorporating Risks

Three fundamental risks are considered in this paper: liquidity risk, credit risk and funding risk.

Liquidity Risk

Liquidity risk is the potential losses a bank faces from interest rate mismatches. In this model, banks are not able to match up deposits with loans, owing to the endemic maturity mismatch between banks' assets and liabilities. In line with other studies in the literature, this paper uses the ratio of liquid-assets-to-total assets as a proxy for liquidity risk (LR). The rationale is that if a bank has a higher liquidity ratio, it faces lower liquidity risk, but the opportunity cost of holding higher liquidity increases, leading the bank to charge higher interest rate spreads.

Credit Risk

Credit risk concerns the probability that a borrower will default on a loan. There are two ways in which a risky loan portfolio will raise the spread: (i) intensive use of the bank's productive resources to service risky loans; and (ii) higher probability of default leading to a risk premium on the loan rate. Empirical studies of bank spreads generally use either loan write offs, the delinquent loan portfolio, or provisions for non-performing loans (NPLs) as indicators of default risk. The problem with these measures, as noted in the literature, is that they are often backward-looking (reflecting realized defaults) rather than forward-looking proxies for default risk. In line with other studies in the literature, this paper uses the lagged ratio of loan loss provisions-to-total loans and advances as a proxy for credit risk (CR).

Funding Risk

Net interest margins also depend on the way lending is funded (Funding Risk, FR) and currency risk.[8] This paper uses credit-to-deposit ratio to assess the impact of banks' funding model on their net interest margins. A high and increasing loan-to-deposit ratio funded by capital inflows from abroad would lead to higher net interest margins, if the associated currency risk were adequately internalized. A sudden reversal of such inflows (a decline in the credit-to-deposit ratio) would also put pressure on banks' business models and lead to higher interest margins.

Liquidity risk (LR), credit risk (CR), and funding risk (FR) are incorporated into equation 5 to obtain a linear regression framework as follows:

$$(r_A - r_D) = LR + OC + CR + HHI + FR \tag{6}$$

4.3. Other Considerations

While there is no generally agreed model for analyzing the impact of macroeconomic shocks, the empirical literature has identified a number of macroeconomic variables deemed to be influential sources for variations in interest spreads. We include real GDP growth (RGDP) and CPI inflation (INFL) in the model to capture the macroeconomic environment. Thus, the equation that combines the microstructure variables with the macroeconomic determinants of interest margins is specified as:

$$(r_A - r_D) = LR + OC + CR + HHI + FR + RGDP + INFL \tag{7}$$

[8] This paper does not assess the impact of currency risk on net interest margins due to lack of readily available bank-by-bank data on the currency composition of loans and deposits.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

The model predictions can be summarized as follows: (i) the higher the operating costs, the higher the interest margins a bank has to charge; (ii) as market concentration rises, competition declines, and interest margins increase; (iii) higher liquidity risk, credit risk, and GDP and inflation are positively related to interest margins (Table 1).

4.4. Empirical Estimation

For the empirical estimation, equation 7 is rewritten to take the form:

$$NIM_{it} = \beta_1 LR_{it} + \beta_2 OC_{it} + \beta_3 CR_{it} + \beta_4 HHI_{it} + \beta_5 FR + \beta_6 RGDP_t + \beta_7 INFL_t + \varepsilon_{it}, \quad (8)$$

where subscripts i and t stand for bank and year, respectively; NIM_{it} is the net interest margin for bank i in period t; and ε_{it} is the error term.

In estimating equation 8, complications relating to the error term need to be addressed. First, the observations and traits that characterize the error term for each bank are bound to be interdependent across time (autocorrelation). Second, given that the banks operate in the same industry and country, there is the possibility that the error terms will tend to be correlated across banks (contemporaneous correlation). Third, the errors will tend to have differing variances across banks (heteroskedasticity). Moreover, the errors may show heteroskedasticity because the scale of the dependent variable differs between banks (Beck and Katz; 1995). We also consider the following:

- *Liquidity risk*. In the Monti-Klein model, liquidity risk depends on reserves (i.e., the difference between total deposits and loans). However, given that the link between liquidity risk and net interest margin relies on the distribution of random withdrawals, the relationship may not be readily tractable. As such, the parameters or moments of such distribution and the penalty interest rate for liquidity shortage could be considered as exogenous.
- *Operating cost*. It is assumed that the production technology employs labor and capital, whose prices are determined in other markets. As such, operating costs (prices and levels) could be considered as exogenous.
- *Credit risk*. It relates default risk to a risk premium, through assumptions of its probability distribution. In a simple case, it is shown that the interest margin is independent of the characteristics of the loan.[9] Thus, even when the debt-to-asset ratio of firms or households is endogenous in a General Equilibrium setting, for the purpose of this paper, it could be considered as exogenous.
- *Funding risk*. This variable may be considered endogenous, since it involves the quantity of loans and deposits. For this reason, in this paper, funding risk is not included in three of nine equations in order to examine its impact on the results.

Ideally, system GMM estimators of Arellano and Bover (1995) and Blundell and Bond (1998) would be more appropriate to address any potential inertia and endogeneity problems. However, given our sample size, the GMM system is not suitable as it is designed for large N and small T to provide consistent estimates.[10] For these reasons, the OLS-based PCSE procedure is used to estimate Equation 8 on the grounds that this technique allows to simultaneously correct for autocorrelation, cross-equation residual correlation, and cross-sectional heteroskedasticity in order to improve parameter efficiency and generate more accurate z-statistics.

[9] Freixas (2008) p. 268.

[10] Indeed, we considered system dynamic panel data estimation of various specifications of Equation 8 (assuming endogenous or predetermined risks), but both our tests for the null hypothesis of no serial correlation in the first-differenced errors at an order greater than 1 and valid overidentifying restrictions are rejected, implying model misspecification. Moreover, issues relating to managing the intractable number of instrument variables resulting from large T are beyond the purview of this paper.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

4.5. Data Overview

This section examines the statistical properties of the data and presents some stylized facts about banks' net interest margins (NIM). All the data series, except for real GDP growth and inflation, are commercial banks' quarterly data for the period 1998–2013. They are sourced from the *Comisión National de Bancos y Seguros'* (CNBS)'s database. The quarterly real GDP growth and inflation data are from the database of the Central Bank of Honduras. Table 1 presents a summary of the descriptive statistics of all the variables, along with their expected impact on the dependent variable (NIM). Figures 1–13 (attached) depict average variability of each variable over time.

Quarterly NIM[11] are used throughout this study. Table 1 shows that NIM for subsidiaries of foreign banks have averaged 260 basis points, compared with 190 basis points for locally owned banks. While Figure 1 depicts a discernible pattern of increasing banks' NIM since 2007, Figure 2 indicates that this was solely due to the subsidiaries of foreign banks. In fact, locally owned banks' NIM decreased steadily since 1998 (Figure 3). A possible explanation is that locally owned banks rely more on non-interest income.

Moreover, a striking observation is that the dispersion (standard deviation) of the NIM for the subsidiaries of foreign banks is much larger (0.032) than that for locally owned banks (0.006). One factor that could explain this observation is that variations in net interest margins between locally owned banks and their foreign counterparts might be driven by differences in the market segments in which they operate, which in turn are likely to be the result of informational advantages that the former might have over the latter.[12] In particular, it is possible that subsidiaries of foreign banks, even though they entered the market through mergers and acquisitions, have the least knowledge about the local market and so they are more likely to focus on segments that are more transparent (i.e., where it is easier to access information about borrowers).

There is also a clear difference between locally owned banks and subsidiaries of foreign banks regarding three other explanatory variables. First, subsidiaries of foreign banks tend to rely more on off-shore funding of credit than their domestic counterparts. Second, the Herfindahl-Hirschman Index shows that locally owned banks are highly concentrated (0.77), compared with a moderate level (0.50) for the subsidiaries of foreign banks. Third, perhaps partly because of the higher market concentration, the average operating costs for locally owned banks (2.0 percent) are almost half that for the subsidiaries of foreign banks (3.3 percent). Again, this is an indication of market segmentation, which means that it may be misleading to focus on aggregates to understand the behavior of banks' net interest margins in Honduras. In other words, careful consideration needs to be given to bank-specific performance and bank ownership.

The following section employs the OLS-based PCSE regression procedure to provide more comprehensive analysis of the determinants of NIM in Honduras. As seen in Table 2, the Im-Pesaran-Shin unit root texts show that the w-t-bar statistics are in most cases significant at all the usual testing levels. Therefore, the null hypothesis can be rejected, indicating that the series are stationary. In addition, removing the cross-sectional mean from the series to mitigate the effects of cross-sectional correlation obtains test statistics that are significant.

[11] Net interest margins are defined as the difference between a bank's interest earnings and expenses as a percentage of average interest earning assets. There are many reasons why most studies use this definition, including: (i) the data is readily available; and (ii) it forms part of a standard set of bank performance indicators which also include the return on equity (RoE), return on assets (RoA) and the cost to income ratio. The net interest margin is, however, generally seen as a better measure of banks' long-term revenue structure. Nonetheless, by definition, net interest margins do not take into consideration bank charges and income revenue associated with fees and commissions that effectively increase the costs paid by bank borrowers and reduces revenues received by depositors. An additional problem is that, by including all interest-earning assets, net interest margins may deviate significantly from the marginal spread that reflects the bank's marginal costs and revenues (Brock and Suarez; (2000). This is particularly true for Honduras, where banks hold non-interest bearing required reserves.

[12] Dell'Ariccia and Marquez (2003) suggest that differences in the information available to different banks will impact whom they would lend to and what spreads they are able to charge.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Table 1
Variable Description and Expected Impact on Banks' Net Interest Margins

Variable	Notation	Description	Mean	Standard deviation	No. Of Banks	Expected impact
All banks						
Net Interest Margins	NIM	Net interest income as a percentage of interest earning assets	2.2%	0.023	17	
Liquidity Risk	LR	Liquid assets-to-total assets	29.3%	0.137	17	Positive
Operating costs	OC	Operating cost-to-total earning assets	2.6%	0.025	17	Positive
Credit Risk	CR	Lagged ratio of loan loss provisions-to-total loans and advances	4.1%	0.029	17	Positive
Market concentration		Herfindahl-Hirshman Index				
Total Loans	HHI_L	Loans	0.7	0.009	17	Positive
Total Deposits	HHI_D	Deposits	0.7	0.010	17	
Funding Risk	FR	Credit-to-deposit ratio	96.2%	0.415	17	Positive/ negative
Real GDP growth	RGDP	Real GDP growth	3.8%	0.0297	17	Positive/ negative
Inflation	INF	End-of-year Inflation	1.9%	0.009	17	Positive
Subsidiaries of international banks						
Net Interest Margins	NIM	Net interest income as a percentage of interest earning assets	2.6%	0.032	11	
Liquidity Risk	LR	Liquid assets-to-total assets	31.3%	0.179	11	
Operating costs	OC	Operating cost-to-total earning assets	3.3%	0.035	11	
Credit Risk	CR	Lagged ratio of loan loss provisions-to-total loans and advances	4.1%	0.034	11	
Market concentration		Lagged Herfindahl-Hirshman Index				
Total Loans	HHI_L	Loans	0.5	0.008	11	
Total Deposits	HHI_D	Deposits	0.4	0.006	11	
Funding Risk	FR	Credit-to-deposit ratio	99.2%	0.551	11	
Locally owned banks						
Net Interest Margins	NIM	Net interest income as a percentage of interest earning assets	1.9%	0.006	10	
Liquidity Risk	LR	Liquid assets-to-total assets	27.6%	0.085	10	
Operating costs	OC	Operating cost-to-total earning assets	2.0%	0.007	10	
Credit Risk	CR	Lagged ratio of loan loss provisions-to-total loans and advances	4.2%	0.024	10	
Market concentration		Lagged Herfindahl-Hirshman Index				
Total Loans	HHI_L	Loans	0.8	0.011	10	
Total Deposits	HHI_D	Deposits	0.9	0.012	10	
Funding Risk	FR	Credit-to-deposit ratio	93.7%	0.250	10	

Source: Authors' calculations.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Table 2
Im-Pesaran-Shin Panel Data Unit Root Tests[1)]

	Im-Pesaran-Shin		Im-Pesaran-Shin (Demean)	
	W-t-bar	**P > t**	**W-t-bar**	**P > t**
All Banks				
Net Interest Margins	-3.51	0.00	-1.55	0.06
Liquidity Risk	-5.72	0.00	-6.13	0.00
Operating cost	-6.54	0.00	-2.48	0.01
Credit Risk	-2.85	0.00	-2.65	0.00
HHI Total Loans	0.98	0.84	-2.41	0.01
HHI Total Deposits	-0.35	0.36	-5.08	0.00
Funding Risk	-3.19	0.00	-2.81	0.00
Real GDP	-5.30	0.00		
Inflation	-10.70	0.00		

1) All variables are in levels. All regressions are augmented one lag and (excepting HHI variables) have no trend.

Source: Authors' calculations.

5. ESTIMATION RESULTS

We present the estimation results of Equation 8 in three steps. In the first step, we run the model on only the bank specific variables (Table 3, column 1). The second and third columns of Table 3 include dummies for subsidiaries of foreign banks and locally owned banks, respectively. In the second step, we run the model, including the macroeconomic variables, but excluding the funding-risk variable (Table 3, columns 4–6). In the third step, we run the full model (Table 3, columns 7–9). As can be seen in Table 3, the R-squares for the three steps are practically the same, which suggests that bank-specific variables explain almost all the variability in banks' net interest margins. We note that, by controlling for funding risk, the estimated coefficients for the dummy variables are not statistically significant, which means that ownership does not matter. We proceed by analyzing the estimation results in column 7.

As expected by the empirical model, the liquidity ratio is positively correlated with net interest margins. It is also statistically significant. This result is in tune with the literature, since banks tend to pass their liquidity risks to their clients via increased interest margins. Even though the estimated coefficient of the liquidity variable seems to be quantitatively small, it captures the positive impact of holding large amounts of excess liquidity (including low-yielding short-term assets, required reserves, and cash in vault) on net interest margins.[13] It also highlights the importance of a vibrant interbank market for operational efficiency and lower net interest margins.

13 Results not given in this paper show that required reserves are highly correlated with our liquidity ratio.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Table 3
OLS-PCSE Panel Estimation Results

	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6	Eq. 7	Eq. 8	Eq. 9
Liquidity risk	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(4.10)	(4.17)	(4.39)	(3.26)	(2.90)	(3.85)	(3.53)	(3.52)	(3.91)
Operating costs	0.46***	0.46***	0.45***	0.52***	0.50***	0.52***	0.46***	0.47***	0.46***
	(6.99)	(7.04)	(7.04)	(9.21)	(8.34)	(9.26)	(7.04)	(7.11)	(7.12)
Credit risk	0.09***	0.09***	0.09***	0.11***	0.11***	0.11***	0.08***	0.09***	0.09***
	(2.77)	(2.89)	(2.68)	(3.93)	(4.03)	(3.84)	(2.73)	(2.93)	(2.79)
Herfindahl-Hirschman index	-0.08***	-0.10***	-0.09***	-0.07***	-0.12***	-0.08***	-0.10***	-0.12***	-0.11***
	(-3.04)	(-3.13)	(-3.57)	(-2.95)	(-3.54)	(-3.20)	(-3.83)	(-3.55)	(-3.97)
Funding risk	0.004***	0.004***	0.004				0.004***	0.003***	0.004***
	(3.51)	(3.02)	(3.55)				(3.26)	(2.70)	(3.24)
Real GDP growth				-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
				(-1.14)	(-1.01)	(-1.03)	(-1.46)	(-1.44)	(-1.37)
Inflation				0.12***	0.11***	0.12***	0.07***	0.07***	0.07***
				(4.31)	(4.27)	(4.36)	(3.03)	(3.10)	(3.13)
Dummy (Subsidiaries of foreign banks)		0.001			0.004***			0.002	
		(1.14)			(3.60)			(1.55)	
Dummy (Locally owned banks)			0.000			-0.001			-0.001
			(0.06)			(-0.75)			(-0.90)
R-square	0.79	0.80	0.79	0.78	0.79	0.79	0.79	0.80	0.80
Wald test	3523.9	3760.3	5537.6	3942.6	4194.1	6139.3	5283.2	5364.1	7564.3
Prob > X^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	17	17	17	17	17	17	17	17	17

1) Coefficients in parentheses represent the respective z values.*,**,*** denotes significance at 10, 5, and 1 percent, respectively.

Source: Authors' calculations.

In line with Pineda (2010), we find that operating costs are positively and significantly correlated with net interest margins. In fact, the estimated coefficient is the largest among all the explanatory variables. Operating costs are, therefore, the most important determinant of banks' net interest margins. This finding is also in line with earlier studies on developed countries[14] and emerging economies.[15] Three factors explain this outcome. First, we associate this result with the costs of monitoring domestic borrowers. Operating costs reflect the activities in which different banks specialize. For example, banks that focus more on retail operations usually face larger operational costs than banks that are more oriented toward wholesale markets. This is because retail operations involve the establishment of a large number of branches, equipment and personnel to serve the retail customer. These larger costs usually translate into a higher spread (Brock and Suarez; 2000). Second, deficiencies in the legal system contribute to high cost of

[14] See for example Maudos and Fernandex de Guevara (2004); Valverde and Fernandez (2007); Williams (2007); and Maudos and Solis (2009).

[15] See for example Demirguc-Kunt and Huizinga (1998); Claessens, Demirguc-Kunt, and Heizinga (2001); Martinez and Mody (2004); Hesse (2007); Schwaiger and Liebeg (2008); Horvath (2009); and Fungacova and Poghosyan (2009)

DOI: 10.7172/2353-6845.jbfe.2017.1.1

credit. Outdated bankruptcy procedures increase the cost of asset recovery while lengthy civil procedures related to contract enforcement and adjudication of claims make credit operations riskier and costlier (IMF; 2001). Third, operating costs reflect less efficient management and inferior organizational structures. In this context, the legal infrastructure should be updated to speed up the resolution of financial claims. Banks should also be encouraged to upgrade their operational efficiency, including the development of mobile banking, in order to bring down overhead costs.

We also find that the ratio of loan loss provisions to total loans (our measure of credit risk), which is a measure of credit quality, is positively and significantly correlated with banks' net interest margins. This result suggests that structural reforms aimed at promoting prompt expedition of legal cases, making financial information on potential borrowers accessible to all banks, and good accounting standards will improve risk assessment, reduce non-performing loans, and the need for higher loan loss provisions.

Table 4
OLS-PCSE Panel Estimation Results

	Eq1	Eq2	Eq3	Eq4	Eq5	Eq6	Eq7	Eq8	Eq9
Liquidity Risk	0.01***	0.009***	0.012***	0.009***	0.007**	0.013***	0.009***	0.008***	0.012***
	(3.48)	(3.25)	(3.99)	(2.86)	(2.18)	(3.5)	(3)	(2.76)	(3.54)
Operating cost	0.486***	0.49***	0.48***	0.539***	0.52***	0.529***	0.487***	0.495***	0.483***
	(7.1)	(7.16)	(7.11)	(8.99)	(8.18)	(8.99)	(7.14)	(7.26)	(7.21)
Credit Risk	0.083**	0.092**	0.088**	0.108***	0.109***	0.113***	0.08**	0.09**	0.087**
	(2.32)	(2.51)	(2.36)	(3.33)	(3.33)	(3.37)	(2.29)	(2.52)	(2.43)
HHI Total Loans	0.139**	0.139**	0.158**	0.198***	0.112*	0.215***	0.093	0.086	0.107*
	(2.41)	(2.26)	(2.57)	(3.89)	(1.88)	(3.9)	(1.63)	(1.38)	(1.76)
HHI Total Deposits	-0.207***	-0.206***	-0.229***	-0.276***	-0.186***	-0.298***	-0.18***	-0.176**	-0.192***
	(-3.15)	(-3.1)	(-3.37)	(-4.4)	(-2.84)	(-4.52)	(-2.74)	(-2.56)	(-2.8)
Funding Risk	0.004***	0.003**	0.004***				0.004***	0.003**	0.004***
	(3.05)	(2.41)	(3.11)				(2.84)	(2.16)	(2.82)
Real GDP				-0.011	-0.01	-0.009	-0.012	-0.012	-0.01
				(-1.14)	(-1.06)	(-0.96)	(-1.45)	(-1.38)	(-1.27)
Inflation				0.107***	0.101***	0.117***	0.064***	0.072***	0.075***
				(3.89)	(3.87)	(4.12)	(2.78)	(2.97)	(3.08)
Dummy (Subsidiaries of foreign bank)		0.002*			0.005***			0.002**	
		(1.9)			(3.46)			(2.1)	
Dummy (Subsidiaries of domestic bank)			-0.001			-0.001			-0.001*
			(-0.83)			(-1.31)			(-1.67)
R-square	0.77	0.78	0.77	0.77	0.78	0.77	0.78	0.78	0.78
Wald Test	2,959.66	2,624.22	4,160.39	3,647.99	3,055.63	4,675.85	4,331.55	3,632.17	5,384.79
Prob>χ2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1] Coefficients in parenthesis represent the respective z values. *,**,*** denotes significance at 10, 5 and 1 percent, respectively.

Source: Authors' calculations.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Contrary to the prior assumptions of the empirical model, the estimated coefficient for market concentration is negative and statistically significant for all banks (Table 3). As noted in Freixas (2008), even though empirical findings derived from the Monti-Klein model cannot explain features of deposit contracts, it can be expected that market power should allow banks "to quote lower deposit rates and higher rates on loans".[16] Furthermore, given that the oligopolistic version of the Monti-Kelin model relies on characteristics of credit and deposit markets, we deem it convenient to incorporate the HHI index for deposits in Equation 8 to stimulate a deeper discussion of the phenomenon of concentration and lower interest margins (Table 4). Results show that the HHI index for deposits is negative and significant, and that for loans turns positive and significant as expected, indicating that banks with market power can charge higher lending rates and offer lower deposit rates. Therefore, we conclude that the market is contestable. In other words, higher concentration is a consequence of tougher competition among banks (Boone and Weigand; 2000), especially to attract deposits. A possible rationale is that more efficient banks attract time and savings deposits, have lower costs, serve the best-quality borrowers and garner greater market share, thereby forcing less efficient banks to consolidate and reduce operating costs in order to offer competitive interest margins.

Funding risk is an important determinant of net interest margins, particularly for subsidiaries of foreign banks. We find that not controlling for funding risk makes the dummy variable for the subsidiaries of foreign banks positive and statistically significant (Table 3, column 5). In contrast, by controlling for funding risk (see column 8), we find that the estimated coefficient is positive and statistically significant, but that the estimated coefficient for the dummy variable becomes statistically insignificant. This means that high and increasing loan-to-deposit ratios, funded by parent banks, put pressure on the business models for subsidiaries of foreign banks and lead to higher interest margins. While the paper does not describe the channel behind this relationship, it could be related to transmission of shocks by parent banks to affiliates (Chava and Purnandam, 2011; Cetorelli and Goldberg, 2012a; and Cetorelli and Goldberg, 2012b). With relatively low percentage of the adult population having an account in the formal banking system in Honduras, improving access to financial services—financial inclusion—would help limit negative cross-border spillovers.

Turning to macroeconomic variables, we find that the results are mixed. As expected and in line with Pineda (2010), the estimated coefficient for inflation is positive and statistically significant, and the size is non-negligible. As stressed by Huybens and Smith (1999), inflation does exacerbate informational asymmetries and therefore leads to larger interest margins. However, similar to Pineda (2010), we find that economic growth (the business cycle) has no statistically significant impact on banks' interest margins. This finding suggests that banks are not adequately pricing intrinsic risks of projects and so are not allocating resources efficiently (Rajan and Zingales, 1998).

6. CONCLUSIONS AND POLICY IMPLICATIONS

This study provides empirical evidence on the determinants of banks' interest margins in Honduras. To this end, we specify an empirical model which constitutes an extension of the cost function model developed by Klein (1971) and Monti (1972).

As predicted by the empirical model, all the explanatory variables, except for bank concentration, real GDP growth and bank ownership, have the expected effect on banks' net interest margins. We find that operating costs are the most important determinant of banks' interest margins. In addition, we find that high provisions for nonperforming loans and liquidity ratio

[16] Freixas (2008) p. 81.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

get translated into high net interest margins. We also find that credit-to-deposit ratio positively impacts banks' net interest margins. However, contrary to the prior assumptions of the model, the banking concentration variable is negative and statistically significant, indicating that tougher competition has led to higher concentration and lower net interest margins. Beyond bank-specific variables, we find that inflation (uncertainty in the macroeconomic environment facing banks) appears to be an important determinant of high interest margins. However, real GDP growth has no statistically-significant impact on banks' net interest margins. Finally, we find that ownership does not matter if the transmission of funding risks from parent banks is limited.

These results suggest that banks, particularly subsidiaries of foreign banks, are under pressure to consolidate and reduce operating costs in order to offer competitive interest margins. To allow banks to upgrade their operational efficiency, the authorities could implement structural reforms aimed at supporting the information environment (such as promoting credit information-sharing systems and collateral registries) and promoting international accounting standards, independent and credible auditing of borrowers (private companies), prompt adjudication of legal cases, mobile banking, financial inclusion and a vibrant interbank market. At the same time, maintaining macroeconomic stability, such as low and stable inflation, will lower information asymmetries. Together, these measures will allow banks to adequately price intrinsic risk and improve the efficiency of resource allocation.

Acknowledgements

The authors would like to thank Lisandro Abrego, Pablo Druck, Bogdan Lissovolik, Carlos Medeiros, and staff of the Comisión Nacional de Bancos y Seguros for helpful comments. The authors remain responsible for all remaining errors and omissions.

References

Allen, L., 1988, "The determinants of Bank Interest Margins: A Note," *Journal of Financial and Quantitative Analysis*, 23(2), pp. 231–35.

Angbanzo, L., 1997, "Commercial Bank Net Interest Margins, Default Risk, Interest-Rate Risk, and Off-Balance Sheet Banking," *Journal of Banking and Finance*, 21, pp. 55–87.

Arellano, M., and O. Bover 1995, "Another Look at the Instrumental-Variable Estimation of Error-Components Models," *Journal of Econometrics*, Vol. 68 (1), pp. 29–51.

Barajas, A., R. Steiner and N. Salazar, 1999, "Interest Spreads in Banking in Colombia 1974–96," IMF Staff Papers, 46, pp. 196–224.

Beck, N., and N. Katz, 1995, "What to Do (and Not to Do) with Time-Series Cross-Section Data," American Political Science Review, Vol. 89, pp. 634–47.

Beck, N., and N. Katz, 1996, "Nuisance vs. Substance: Specifying and Estimating Time-Series-Cross-Section Models, Political Analysis, 6, pp. 1–36.

Bernanke, B.S., and M. Gertler, 1989, "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review*, 79, pp. 14–31.

Blackwell, J. L. III, 2005, "Estimation and Testing of Fixed-Effect Panel-Data Systems," *The Stata Journal*, 5, Number 2, pp. 202–7.

Blundell, R. W., and S. R. Bond, 1998, "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics,* Vol. 87, pp. 115–143.

Bonin, J., I. Hasan, and P. Wachtel, (2005), "Privatization matters: bank efficiency in transition Countries," *Journal of Banking & Finance*, 29 (1), pp. 31–53.

Boone, J., and J. Weigand, 2000, "Measuring Competition in the Dutch Manufacturing Sector: How are Cost Differentials Mapped into Profit Differentials," CPB Working Paper No. 131, Den Haag

Brock, P., and L. Rojas-Suarez, 2000, "Understanding the Behavior of Bank Spreads in Latin America," *Journal of Development Economics*, Vol. 63 (1), pp. 113–34.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Brock, P., and H. Franken, 2002, "Bank Interest Margins Meet Interest Rate Spreads: How Good is Balance Sheet Data for Analyzing the Cost of Financial Intermediation?" available at http://scid.stanford.edu/people/mckinnon_program/BrockV2/pdf.

Brock, P., and H. Franken, 2003, "Measuring the Determinants of Average and Marginal Bank Interest Rate Spreads in Chile, 1994-2001. Available at www.econ.washington.edu/user/plbrock/ChileSpreads091603.pdf.

Carbo-Valverde, S. and F. Rodriguez-Fernandez, 2007, "The Determinants of Bank Margins in European Banking," *Journal of Banking and Finance*, 31, pp. 2043–63.

Cetorelli, N., and L. Goldberg, 2012a, "Banking Globalization and Monetary Transmission," *Journal of Finance*, 67, pp. 1811–43.

Cetorelli, N., and L. Goldberg, 2012b, "Liquidity Management of U.S. Global Banks: Internal Capital Markets in the Great Recession," *Journal of International Economics*, 88(2), pp. 299–311.

Chava, S., and A. Purnanandam, 2011, "The Effect of Banking Crisis on Bank-Dependent Borrowers," *Journal of Financial Intermediation*, 19, pp. 1–25.

Chirwa, E. and M. Mlachila, 2004, "Financial reforms and interest rate spreads in the commercial banking system in Malawi, IMF Staff Papers, 51, pp. 96–122.

Claessens, S., A. Demirguc-Kunt, and H. Huizinga, 2001, "How Does Foreign Entry Affect Domestic Banking Markets," *Journal of Banking and Finance*, 25, pp. 891–911.

Dell'Ariccia, G., and R. Marquez, 2003, "Information and Bank Credit Allocation," Available at SSRN: http://ssrn.com/abstract=431300.

Demirguc-Kunt, A., and H. Huizinga, 1998, "Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence," Policy Research Working Paper, WPS1900, (Washington: World Bank).

Demirguc-Kunt, A., and L. Laeven, and R. Levine, 2003, "The Impact of Bank Regulations, Concentration, and Institutions on Bank Margins," mimeo, (Washington: The World Bank).

Dumicic, M., and T. Ridzak, 2012, "Determinants of Banks' Net Interest Margins in Central and Eastern Europe," *Financial Theory and Practice*, Croatian National Bank.

Financial System Stability Assessment (FSSA) for Honduras, 2009, SM/09/21, (Washington: International Monetary Fund).

Freixas, X., and J. Rochet, 2008, *Microeconomics of Banking*, 2nd Edition, Massachusetts Institute of Technology, The MIT Press.

Fungacova, Z., and T. Poghosyan, 2009, "Determinants of Bank Interest Margins in Russia: Does Bank Ownership Matter?" BOFIT Discussion Papers 22.

Gelos, R. G., 2006, "Banking Spreads in Latin America," IMF Working Paper No. WP/06/44.

Hesse, H., 2007, "Financial Intermediation in the Pre-Consolidation Banking Sector in Nigeria," World Bank Policy Research Working Paper 4267.

Hicks, A., 1994, "Introduction to Pooling," in T. Janoski and A. Hicks (edited by), *The Comparative Policy Economy of the Welfare State*, Cambridge University Press.

Ho, T., and A. Saunders, 1981, "The Determinants of Bank Interest Margins: Theory and Empirical Evidence," *Journal of Financial and Quantitative Analysis*, 16(4), pp. 581–600.

Holton, S., R. Kelly, R. Lydon, A. Monks, and N. O'Donnell, 2013, "The Impact of the Financial Crisis on Banks' Net Interest Margins," *Economic Letter Series*, Central Bank of Ireland.

Horvath, R., 2009, "The Determinants of the Interest Rate Margins of Czech Banks," *Czech Journal of Economics and Finance*, 59(2), pp. 128–36.

Huybens, E. and Smith, B. (1999). "Inflation, financial markets, and long-run real activity," *Journal of Monetary Economics*, 43, pp. 283–315.

IMF (2001), Hoduras—Selected Issues, SM/01/286, (Washington: International Monetary Fund).

Jönsson, K., 2005, "Cross-Sectional Dependency and Size Distribution in a Small-sample Homogeneous Panel-Data Unit Root Test," Oxford Bulletin of Economics and Statistics, Vol. 63, pp. 369–92.

Klein, M., 1971, "A Theory of the Banking Firm," *Journal of Money, Credit and Banking*, 3, pp. 205–18.

Martinez, M. S., and A. Mody, (2004), "How Foreign Participation and Market Concentration Impact Bank Spreads: Evidence from Latin America, *Journal of Money Credit and Banking*, 36 (3), pp. 511–37.

Maudos, J., and J. Fernandez de Guevara, 2004, "Factors Explaining the Interest Margin in the Banking Sectors of the European Union," *Journal of Banking and Finance*, 28, pp. 2259–81.

Maudos, J., and L. Solis, 2009, "The Determinants of Net Interest Income in the Mexican Banking System: An Integrated Model," EC Working Paper Series No. 2009–05.

McShane, R., and I. Sharpe, 1985, "A Time Series-Cross Section Analysis of the Determinants of Australian Trading Bank Loan-Deposit Interest Margins: 1962–1981," *Journal of Banking and Finance*, 9(1), pp. 115–36.

Micco, A., U. Panizza, and M. Yanez, 2007, Bank Ownership and Performance: Does Politics Matter?" *Journal of Banking and Finance*, 31, pp. 219–41.

Mody, A., 2009, "From Bear Stearns to Anglo Irish: How Eurozone Sovereign Spreads Related to Financial Sector Vulnerability," IMF Working Paper No. WP/09/108.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Monti, M., 1972, "Deposit, Credit, and Interest Rate Determination under Alternative Bank Objectives," In *Mathematical Methods in Investment and Finance*, ed. G.P. Szego and K. Shell. Amsterdam: North-Holland.

Moore, W., and R. Craigwell, 2000, "Market Power and Interest Rate Spreads in the Caribbean," Paper Presented at the XXXII Annual Monetary Studies Conference, Kingston, Jamaica.

Pineda, D., 2010, "Determinantes del Spread Bancario en Honduras," Banco Central de Honduras, UIE/DI-003/2010.

Podestà, F., 2000, "Recent Developments in Quantitative Comparative Methodology: The Case of Pooled Time Series Cross-Section Analysis, DSS Papers SOC 3-02.

Poghosyan, T., 2010, "Re-examining the impact of foreign bank participation on interest margins in emerging markets," *Emerging Markets Review*, Vol. 11, Issue4, pp. 390–403.

Rajan, G.R., and L. Zingales, 1998, "Which Capitalism? Lessons from the East Asian Crisis," *Journal of Applied Corporate Finance*, Vol. 11, No. 3, Fall 1998.

Saunders, A., and L. Schumacher, 2000, "The Determinants of bank interest margins: An International study," Journal of International Money and Finance, Vol. 19, Issue 6, pp. 813–32.

Schwaiger, M. and D. Liebeg, 2008, "Determinants of Bank Interest Margins in Central and Eastern Europe," *OeNB Financial Stability Report*, Austrian National Bank.

Sengupta, R., 2007, "Foreign entry and bank competition, *Journal of Financial Economics* 84, pp. 502–28.

Tábora, M., 2007, "Competencia y regulación en la Banca: caso de Honduras," CEPAL, Unidad de Comercio Internacional e Industria. *Serie Estudios y Perspectiva*, No. 91. Noviembre (Mexico).

Tan, T.B.P. (2012), "Determinants of Credit Growth and Interest Margins in the Philippines and Asia," IMF Working Paper 12/123 (Washington: International Monetary Fund).

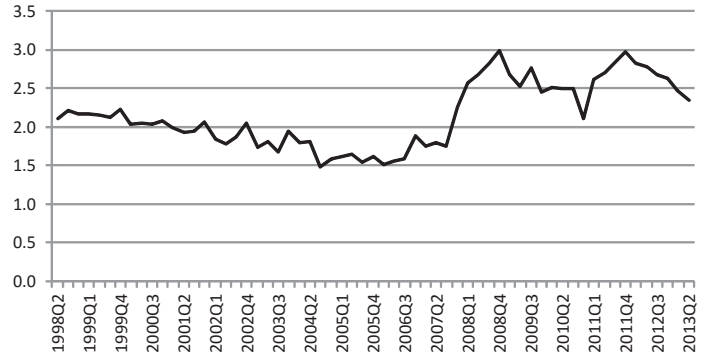
Tennant, D. and A. Folawewo, 2009, "Macroeconomic and Market Determinants of Banking Sector Interest Rate Spreads: Empirical Evidence from Low- and Middle-Income Countries," *Applied Financial Economics*, Vol. 19, Issue 6, pp. 489–507.

Williams, B., 2007, "Factors Determining Net Interest Margins in Australia: Domestic and Foreign Banks," Financial Markets, Institutions and Instruments, 16(3), pp. 145–65.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

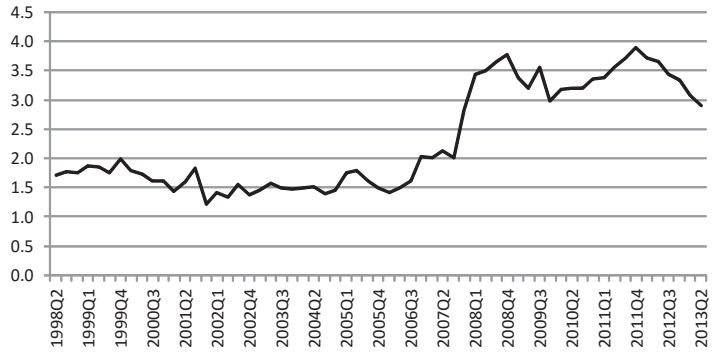
ANNEX: Attachments

Figure 1
Honduras: Banks' Net Interest Margins (In percent)



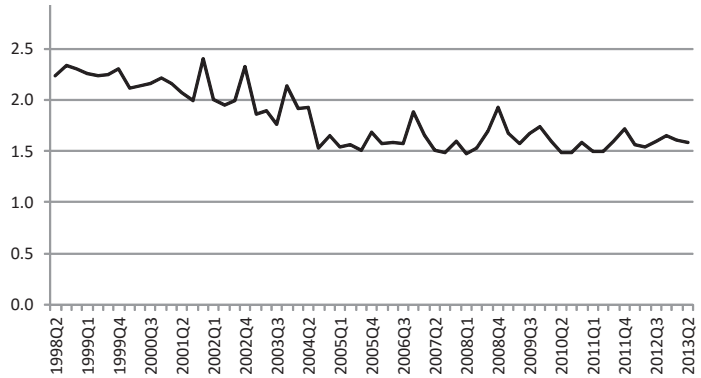
Source: CNBS.

Figure 2
Honduras: Subsidiaries of Foreign Banks' Net Interest Margins (In percent)



Source: CNBS.

Figure 3
Honduras: Locally Owned Banks' Net Interest Margins (In percent)



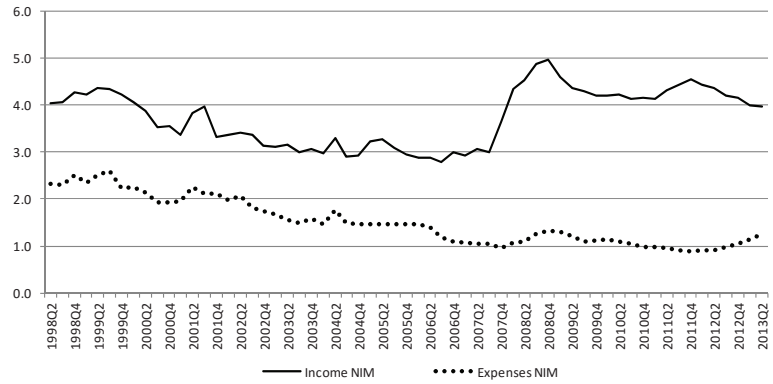
Source: CNBS.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Figure 4
Honduras: Banks' Interest Income and Interest Expenditure
(In percent of interest earning assets)

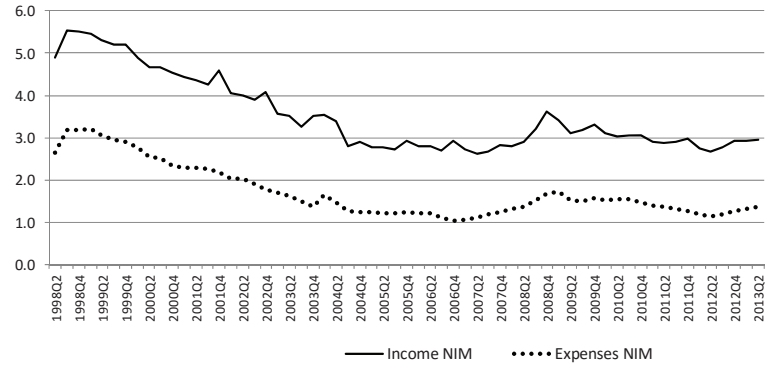
Source: CNBS.

Figure 5
Honduras: Subsidiaries of Foreign Banks' Interest Income and Interest Expenditure
(In percent of interest earning assets)



Source: CNBS.

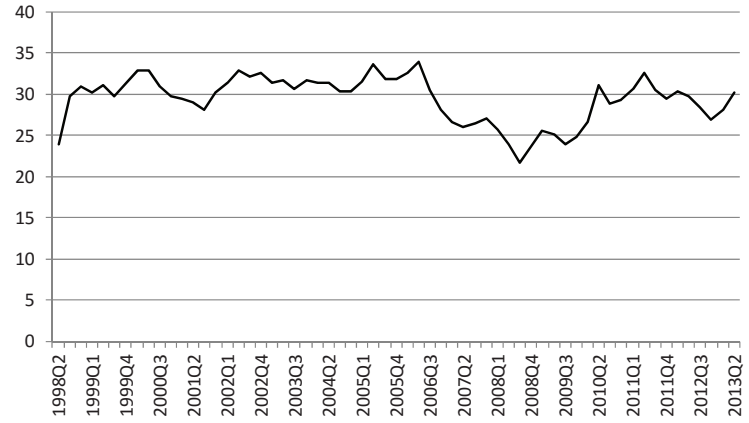
Figure 6
Honduras: Locally Owned Banks' Interest Income and Interest Expenditure
(In percent of interest earning assets)



Source: CNBS.

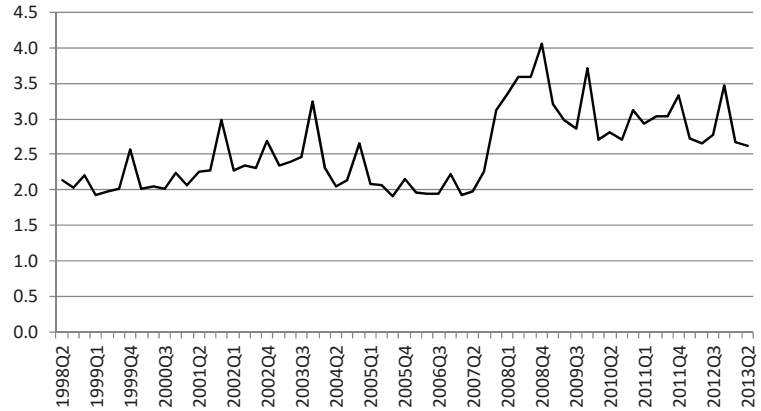
DOI: 10.7172/2353-6845.jbfe.2017.1.1

Figure 7
Honduras: Banks' Liquidity Ratio (In percent)



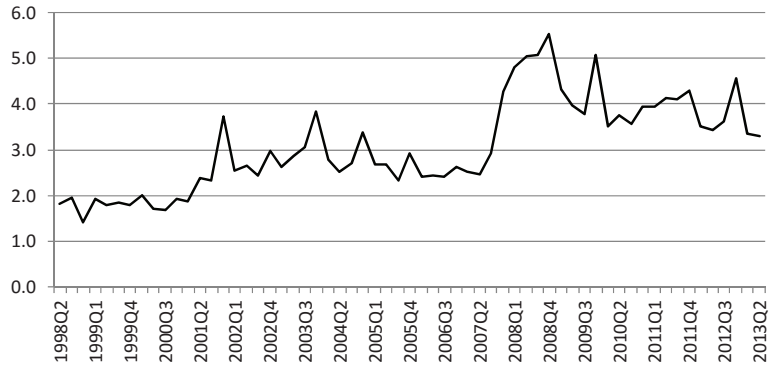
Source: CNBS.

Figure 8
Honduras: Banks' Operational Costs (In percent)



Source: CNBS.

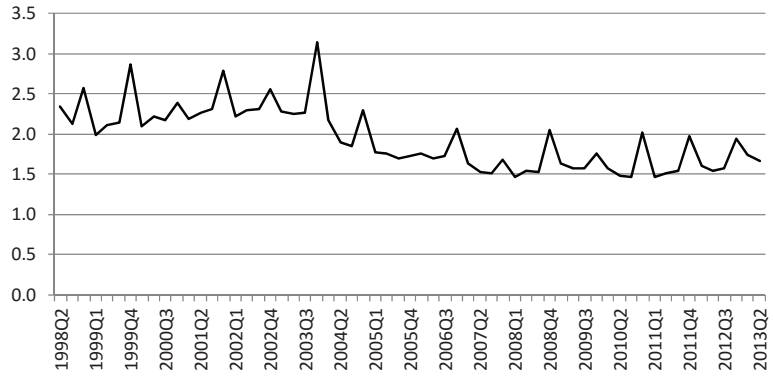
Figure 9
Honduras: Subsidiaries of Foreign Banks' Operational Costs (In percent)



Source: CNBS.

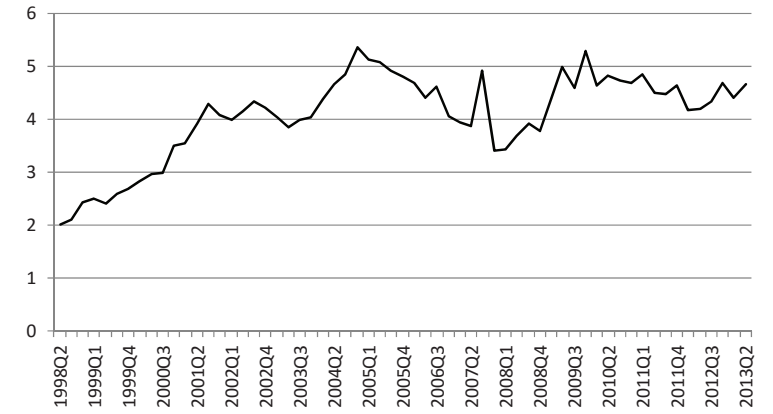
DOI: 10.7172/2353-6845.jbfe.2017.1.1

Figure 10
Honduras: Locally Owned Banks' Operational Costs (In percent)



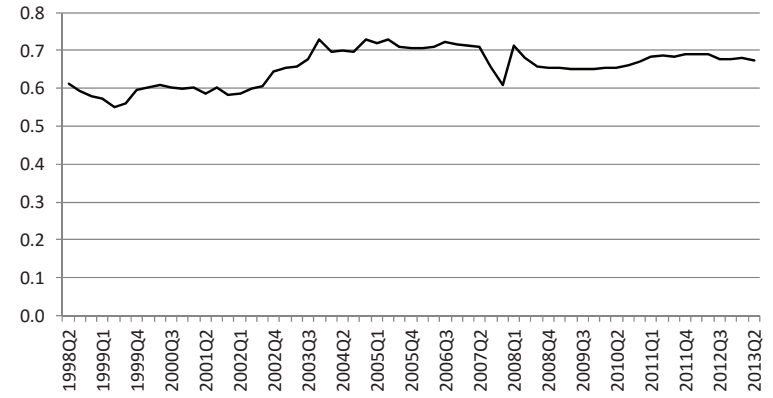
Source: CNBS.

Figure 11
Honduras: Banks' Credit Risks (In percent)



Source: CNBS.

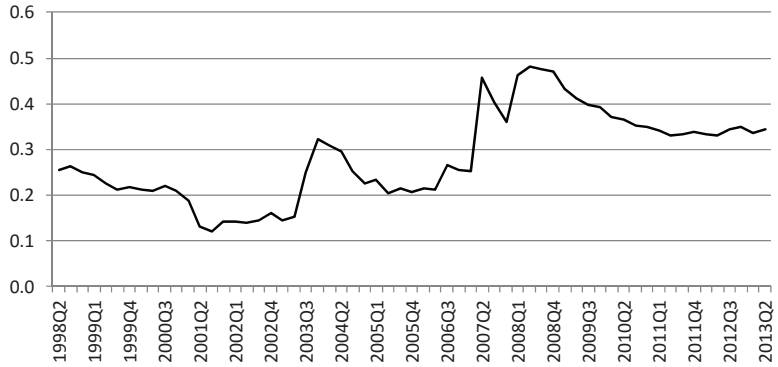
Figure 12
Honduras: Banks' Herfindahl-Hirschman Index (In percent)



Source: CNBS.

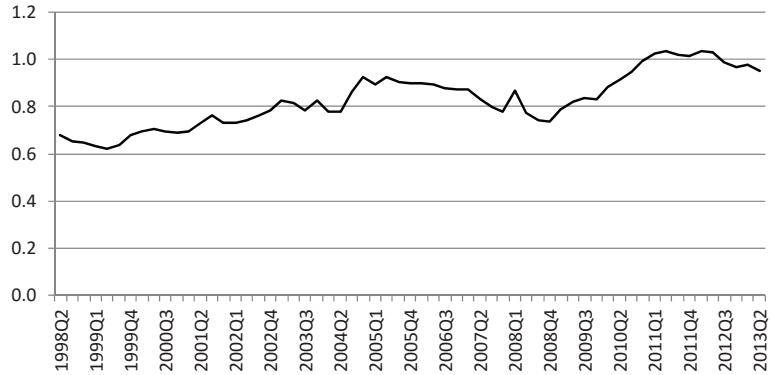
DOI: 10.7172/2353-6845.jbfe.2017.1.1

Figure 13
Honduras: Subsidiaries of Foreign Banks' Herfindahl-Hirschman Index (In percent)



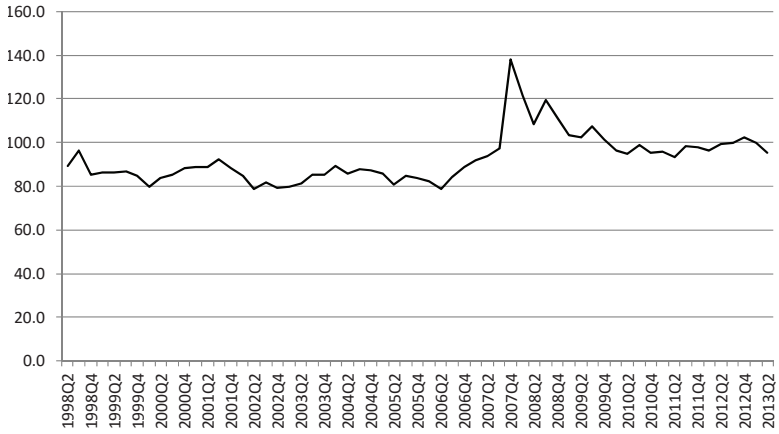
Source: CNBS.

Figure 14
Honduras: Locally Owned Banks' Herfindahl-Hirschman Index (In percent)



Source: CNBS.

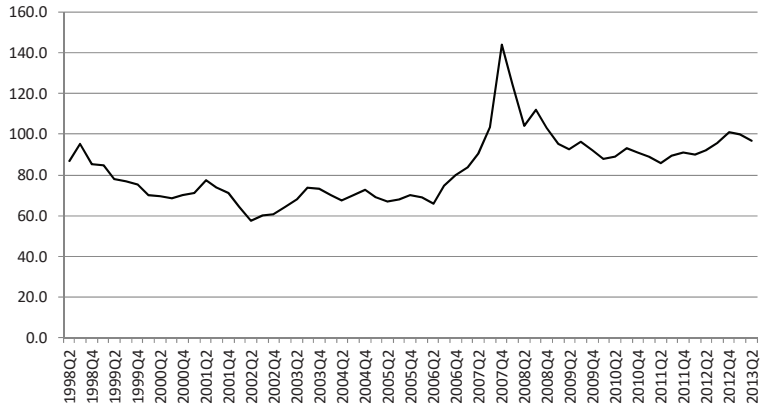
Figure 15
Honduras: Banks' Credit-to-Deposit Ratio (Quarterly; in percent)



Source: CNBS.

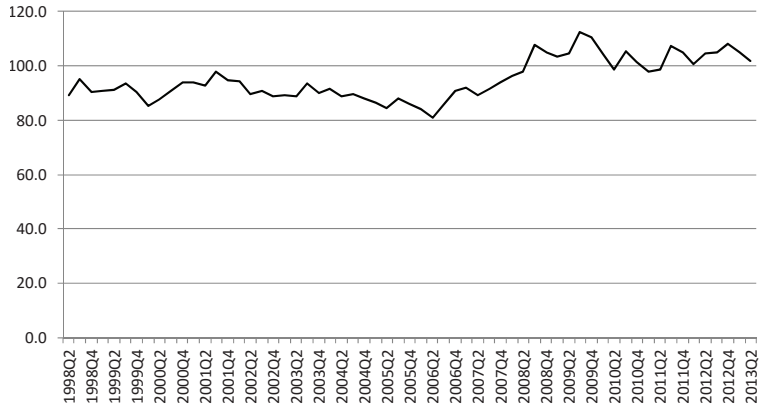
DOI: 10.7172/2353-6845.jbfe.2017.1.1

Figure 16
Honduras: Subsidiaries of Foreign Banks' Credit-to-Deposit Ratio (Quarterly; in percent)



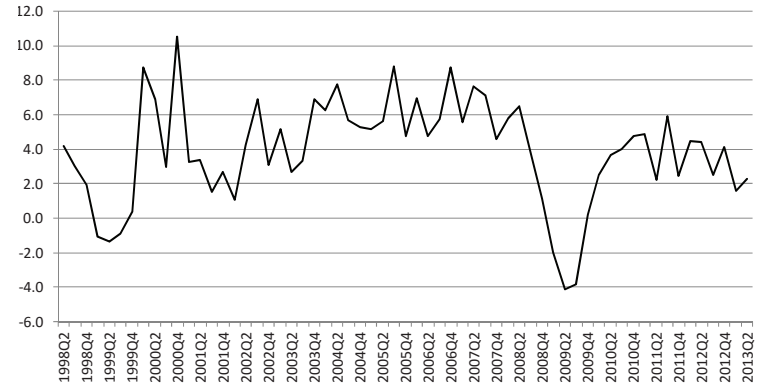
Source: CNBS.

Figure 17
Honduras: Locally Owned Banks' Credit-to-Deposit Ratio (Quarterly; in percent)



Source: CNBS.

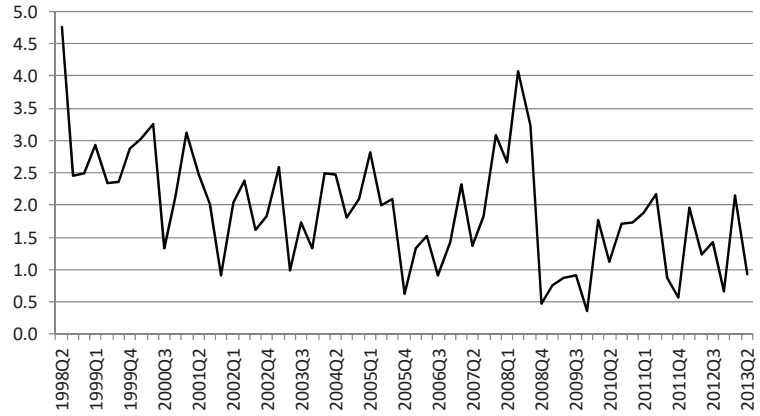
Figure 18
Honduras: Real GDP Growth (Quarterly; in percent)



Source: CNBS.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Figure 19
Honduras: Inflation (Quarterly; In percent)



Source: CNBS.

DOI: 10.7172/2353-6845.jbfe.2017.1.1

Inflation and Public Debt Reversals in the G7 Countries

Bernardin Akitoby
International Monetary Fund, United States of America
bakitoby@imf.org

Ariel Binder
University of Michigan, United States of America
ajbinder@umich.edu

Takuji Komatsuzaki[1]
International Monetary Fund, United States of America
tkomatsuzaki@imf.org

Received: 20 January 2016 / Revised: 28 July 2016 / Accepted: 09 January 2017 / Published online: 27 January 2017

ABSTRACT

This paper investigates the impact of low or high inflation on the public debt-to-GDP ratio in the G-7 countries. Our simulations suggest that if inflation were to fall to zero for five years, the average net debt-to-GDP ratio would increase by about 5 percentage points during that period. In contrast, raising inflation to 6 percent for the next five years would reduce the average net debt-to-GDP ratio by about 11 percentage points under the full Fisher effect and about 14 percentage points under the partial Fisher effect. Thus higher inflation could help reduce the public debt-to-GDP ratio somewhat in advanced economies. However, it could hardly solve the debt problem on its own and would raise significant challenges and risks. First of all, it may be difficult to create higher inflation, as evidenced by Japan's experience in the last few decades. In addition, an un-anchoring of inflation expectations could increase long-term real interest rates, distort resource allocation, reduce economic growth, and hurt the lower–income households.

JEL classification: E31; F34; H63

Keywords: Inflation; debt crisis; G7; public debt; sovereign debt.

1. INTRODUCTION

The global financial crisis has led to unprecedented public debt build-ups in peacetime, thereby raising serious concerns about debt sustainability in advanced economies (Figure 1). If history is any guide, the current environment of low growth and falling inflation will compound

[1] Corresponding author: International Monetary Fund. Tel: (202)-623-8486 Fax: (202)589-8486 E-mail: tkomatsuzaki@imf.org

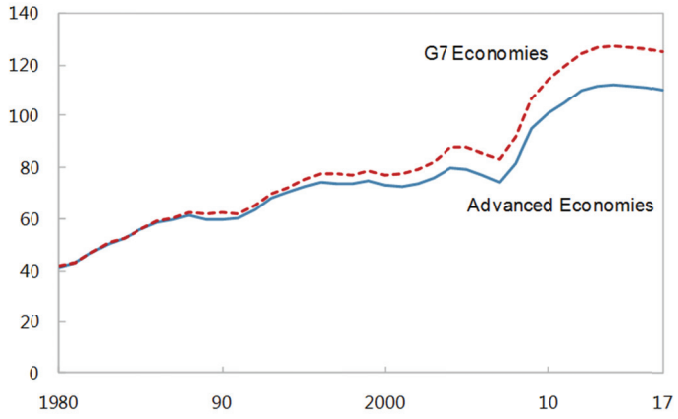
Ministry of Science and Higher Education
Republic of Poland

The creation of the English-language version of these publications is financed in the framework of contract No. 768/P-DUN/2016 by the Ministry of Science and Higher Education committed to activities aimed at the promotion of education.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

the scale of the problem. A situation of very low or even negative growth – as already experienced in the euro area – certainly makes the task of reversing high debt more difficult, as it makes debt – fixed in nominal terms – more expensive in real terms. Against this background, some prominent academics have wondered whether inflation could help deal with high debt in an era of low growth.[2]

Figure 1
Gross Public Debt in Advanced and G7 Economies, 1980–2017 (percent of GDP)



Source: Fiscal Monitor.

Higher inflation could help reduce public debt through three main channels. First, governments can capture real resources through base money creation (*seigniorage*). Second, inflation can erode the real value of the debt. The impact of this channel will depend on the maturity structure and currency denomination of the debt, as well as on the interest rate response to higher inflation, with inflation having the largest impact on long-term, fixed-rate, and local-currency-denominated debt. Short-term debt and maturing long-term debt will need to be refinanced at higher interest rates, the floating rate debt will adjust automatically to higher rates, and the local currency value of foreign-currency-denominated debt will rise due to the currency depreciation that will accompany higher inflation. Third, inflation can affect the primary balance, including if brackets are not indexed under a progressive income tax.

The paper simulates the effect of the first two channels for G-7 countries.[3] The findings show that seigniorage from higher inflation would play only a limited role in bringing down debt ratios, given the relatively low levels of base money in the G-7 countries. With regard to the impact of inflation on the real value of the debt, simulations suggest that if inflation were to fall to zero for five years, the average net debt-to-GDP ratio would increase by about 5 percentage points during that period. In contrast, raising inflation from *World Economic Outlook* (*WEO*) baseline projections to 6 percent for five years would erode the debt-to GDP ratio somewhat. Assuming that the G-7 countries have constant debt maturity structures, experience no impact of inflation on economic growth, and experience a one-for-one adjustment to inflation of nominal interest rates on newly-issued debt (full Fisher effect), the average net debt-to-GDP ratio would be reduced by about 11 percentage points during that period. Under partial Fisher effect, the net debt-to-GDP ratio reduction would be about 14 percentage points. Thus, higher inflation could have some effect on debt stocks. However, it could hardly solve the debt problem on its own and would raise significant challenges and risks.

[2] See Blanchard et al. (2010), Rogoff (2008), and Ball (2012). While these authors recommend a higher inflation, they do not claim that inflation alone can solve the public debt problem.

[3] A discussion of the third channel is beyond the scope of this paper.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

This paper is organized as follows: Section II provides a brief literature review, Section III discusses the impact of inflation on seigniorage revenue, Section IV simulates the role of inflation in eroding the real value of outstanding debt, Section V examines the robustness of the assumptions behind our simulations, and Section VI concludes.

2. BRIEF LITERATURE REVIEW

A recent strand of the literature on public debt reversals investigates the effect of inflation on public debt empirically. Reinhart and Sbrancia (2011) decompose the debt dynamics of selected advanced economies and emerging markets from 1945 to the present. They find that financial repression – where inflation is combined with the regulation of the financial sector – contributed to substantial debt reduction from 1945 through the 1970s in advanced economies. In contrast, using a debt dynamics equation and estimated rate of return to government bonds, Hall and Sargent (2010) find inflation's contribution to debt reduction in the U.S. from 1941 to 2009 to be modest. Similarly, applying a VAR framework to G7 countries (excluding France) over 1960–2005, Giannitsarou and Scott (2008) show that the contribution of inflation to debt movements is small. Most recently, Abbas et al. (2013) find that inflation has played a relatively minor role in a sample of 26 episodes of large debt reversals in advanced economies since the 1980s.

Another strand of the literature attempts to model the relationships between inflation, debt maturity, and public debt. Missale and Blanchard (1994) develop a model showing that when a government chooses the debt maturity it has an incentive to inflate away the debt, but faces reputational risks. In the authors' model, the longest debt maturity consistent with a credible pledge to low inflation is a decreasing function of the initial level of debt. In the model used by Aizenman and Marion (2011), the government chooses inflation while the initial debt maturity is taken as given. In calibrating their model to the U.S economy, they find that the government has an incentive to increase inflation optimally to 6 percent, resulting in a 20 percent decrease in the debt-to-GDP ratio over five years. Krause and Moyen (2011) build a standard New Keynesian DSGE model, featuring long-term debt and uncertainty regarding the targeted inflation. In this framework, raising inflation is difficult when confidence in monetary authorities remains intact. In contrast to the New Keynesian model, the literature on the Fiscal Theory of Price Level (FTPL) relaxes the assumption that the price level is determined exclusively by monetary policy while fiscal policy always adjusts to ensure debt sustainability – such as the studies by Leeper (1991), Davig and Leeper (2011), and Cochrane (2011). The FTPL model often generates high inflation depending on the coordination between fiscal and monetary policies. For instance, if fiscal policy does not ensure debt sustainability by generating sufficient primary surpluses, monetary policy should generate higher inflation to help reduce public debt – which means inflating the debt away.

Compared with the empirical literature, our paper focuses on the debt dynamics going forward. It simulates the impact of exogenous inflation shocks on public debt, thus quantifying the debt-reducing potential of higher inflation. Thus, it does not directly address the feasibility of generating inflation or the possibility of changes in monetary and fiscal policy regimes. However, we acknowledge the potential difficulty in generating high inflation, and we caution against fiscal dominance.[4]

[4] Fiscal dominance can be defined as a situation in which monetary policy is driven by the need to ensure fiscal sustainability when fiscal policy cannot adjust.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

3. SIMULATING SEIGNIORAGE FROM HIGHER INFLATION

3.1. Methodology

Seigniorage represents the real revenues a government acquires by using newly issued money to buy goods and non-money assets. Using the base money stock M_t and the price level P_t, it is defined as:

$$\frac{\dot{M}_t}{P_t} = \mu_t m_t = \dot{m}_t + \pi_t m_t$$

where $\mu_t = \frac{\dot{M}_t}{M_t}$, and $\dot{m}_t$ and $m_t \pi_t$ are growth in real money balances and inflation tax, respectively.

In principle, a government can increase seigniorage by raising inflation for a given level of real money balances. However, if high inflation leads to a reduction in holdings of real money balances ($\dot{m}_t > 0$), it shrinks the effective tax base and decreases seigniorage. On the other hand, if the central bank increases the real money balance in its attempt to increase inflation, it could increase seigniorage. We assume constant real money stock, which would hold at steady state, thereby focusing on the portion of seigniorage that deals with inflation tax ($\pi_t m_t$). We express seigniorage in terms of percentage of annual GDP and use base money as measure of money.

3.2. Results

Given the relatively low levels of base money in most advanced economies, seigniorage from higher inflation would play only a limited role in lowering debt ratios. Simulations suggest that one additional percentage point of inflation would raise seigniorage for the sample by about 0.12 percent of GDP annually. So, raising inflation from *World Economic Outlook* (WEO) baseline projections to 6 percent for five years (2013–17) would generate cumulative seigniorage revenue of about 2.5 percentage points of GDP on average (Table 1). Country-specific estimates vary from less than one percent (Canada) to about 5 percent (Japan).

Table 1
Seigniorage Gains from Inflation[1]

	2012–17 Inflation[2]	Annual Seigniorage gains, with one additional percent of inflation	Seigniorage Gains with 6 percent inflation for 5 years[3]
Canada	1.9	0.04	0.8
Euro area	1.6	0.12	2.7
Japan	0.3	0.24	5.3
United Kingdom	2.5	0.04	0.9
United States	1.7	0.17	3.8
Average[4]	**1.6**	**0.12**	**2.69**

1 Inflation figures are reported in percent; all other figures are in percent of GDP.
2 GDP deflator inflation, average over the period as projected in the WEO.
3 This implies an increase in inflation by 4.4 percentage points over projeted average inflation of 1.6 percent.
4 Simple average.

Sources: IMF, WEO, Bank of Japan, Bank of England, ECB, and Fund staff estimates.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

4. EROSION OF REAL VALUE OF DEBT

4.1. Methodology

4.1.1 The debt dynamics equation

The simulation of the "debt-erosion channel" is based on the standard debt dynamics equation. Total debt is broken down into three categories: domestic-currency-denominated, foreign-currency-denominated, and inflation-indexed debt. Debt maturity is split into short-term and medium- to long-term. Moreover, there is a distinction between medium- to long- term debts that are outstanding at the time of the inflation shock and those issued after the shock. In particular, the dynamic debt equation is specified as follows:

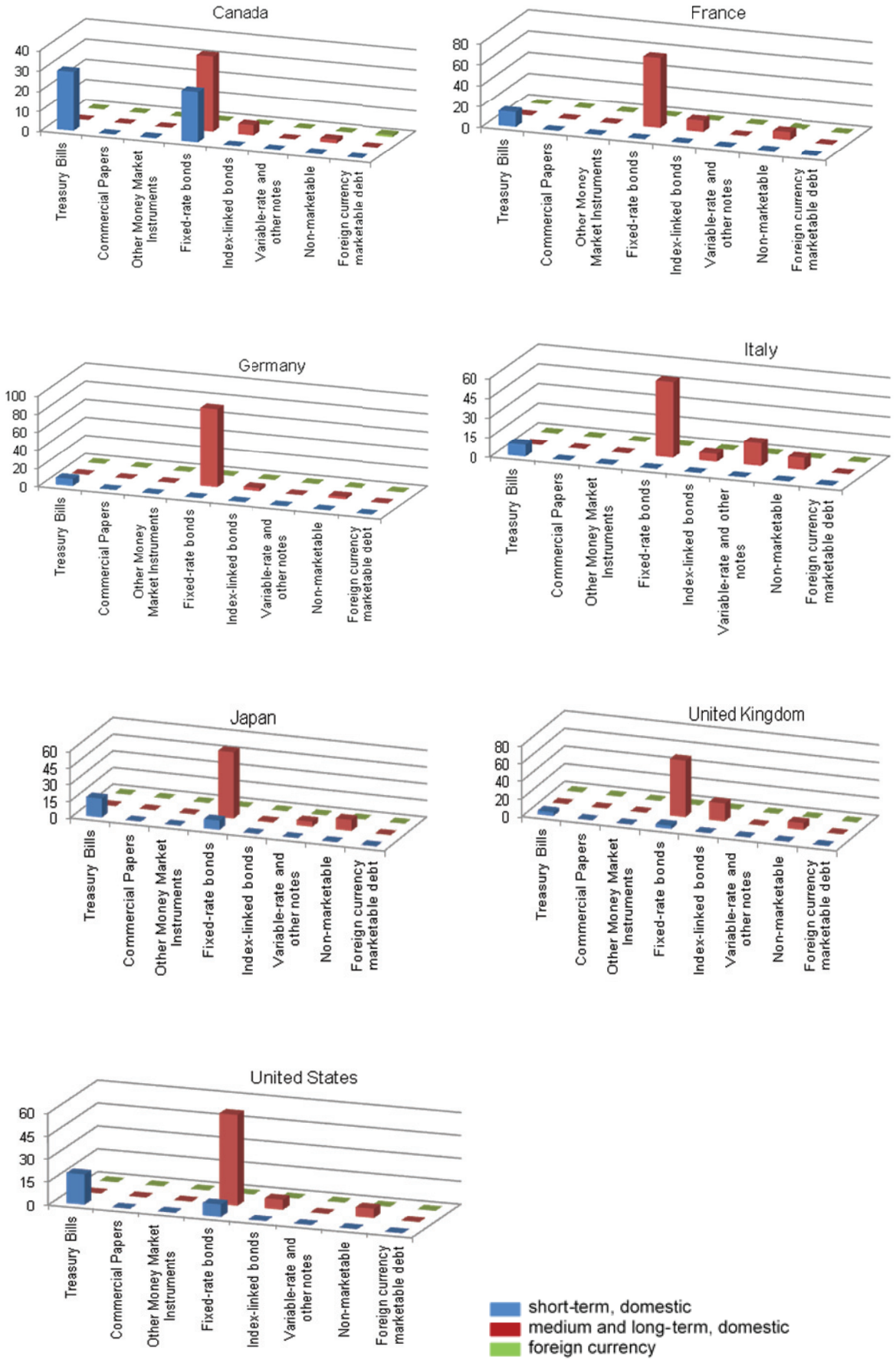
$$b_t = \left\{ \begin{array}{l} -pb_t + b_{t-1}^{ST}\left(\frac{1+r_t^{ST}}{1+g_t}\right) + b_{t-1}^{MT-LT,old}\left[\frac{1+i_t^{imp}}{(1+g_t)\left(1+\pi_t^{base}+\pi_t^{surprise}\right)}\right] \\ +b_{t-1}^{MT-LT,new}\left[\frac{1+i_t^{imp}+\pi_t^{surprise}}{(1+g_t)\left(1+\pi_t^{base}+\pi_t^{surprise}\right)}\right] + b_{t-1}^{indexed}\left(\frac{1+r_t^{MT-LT}}{1+g_t}\right) \end{array} \right\} \quad (4.1)$$

In (4.1), b_t, b_{t-1}^{ST}, $b_{t-1}^{MT-LT,old}$, $b_{t-1}^{MT-LT,new}$, $b_{t-1}^{indexed}$ are the debt- to- GDP ratio, short-term debt-to- GDP ratio, medium- and long-term outstanding debt- to- GDP ratios, post-inflation shock issuances of medium- and long-term debt to GDP ratio, and inflation-indexed or foreign currency debt-to-GDP ratio. The variables r_t^{ST}, i_t^{imp}, r_t^{MT-LT} represent real interest rates on short-term debt, implied nominal interest rates on medium- and long-term debt, and real interest rates on medium- and long-term debt. Respectively, π_t^{base} ,$\pi_t^{surprise}$, g_t, pb_t are baseline inflation, inflation shock ("surprise inflation"), real output growth, and primary balance- to- GDP ratio.

In the baseline scenario, inflation shock in time t ($\pi_t^{surprise}$) affects the debt-to-GDP ratio only via medium- and long-term debt that has already been issued prior to the inflation shock ($b_{t-1}^{MT-LT,old}$) because interest rates on the short-term and inflation-indexed debts are adjusted at the time of new issuance or via indexation. Moreover, foreign-currency-denominated debt cannot be inflated away. Thus, the medium- and long-term, non-indexed, domestic-currency-denominated debt should be the easiest to inflate away. The decomposition of gross debt by maturity, indexation, and currency composition shows that medium- and long-term, non-indexed, domestic-currency-denominated debt is the most common type of debt in G-7 countries (Figure 2). Thus, in principle, it is possible for inflation to reduce debt. However, in countries with substantial liquid assets, the inflation impact on net debt could be significantly different from that on gross debt. We therefore analyze the impact of inflation on both gross and net debt ratios.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Figure 2
Percentage Breakdown of Central Government Debt, 2010



Source: authors' calculations based on OECD central government debt data.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

4.1.2 Sources of data

Data on b_t, pb_t, r_t^{ST}, r_t^{MT-LT}, π_t^{base} come from projections in the October 2012 *WEO*. Decomposition of gross debt (b_t into b_{t-1}^{ST}, $b_{t-1}^{MT-LT,old}$, $b_{t-1}^{MT-LT,new}$, $b_{t-1}^{indexed}$), as well as data on the average maturity of domestic debt, are obtained from the latest OECD dataset on central government debt.[5] Since this database is only available up to 2010, we used the 2010 shares and average maturity data as constant parameters for the simulation period. For the simulation on net debt, data on the average maturity and currency breakdown of financial assets were not available in the OECD database. We then draw from the *WEO*, the IMF *Article IV Staff Reports*, and the IMF country desks' database. Where data are not available, we assume the same structure for gross debt and financial assets. Lastly, i_t^{imp} is endogenously obtained from (4.1).

4.1.3 Key assumptions

The baseline simulation assumes that the structure of government debt (shares of medium- and long-term debts; average maturity;[6] and the portion that is foreign-currency-denominated and inflation-indexed) remains constant over time. This implies that maturing debt is rolled over and that maturing medium- and long-term debts are replaced each year to keep the debt structure constant. Economic growth rates are unaffected by changes in inflation, and interest rates on a newly issued debt adjust one-for-one (full Fisher effect) to increases in inflation. The validity of some of these assumptions is discussed in Section V.

4.1.4 Inflation shocks simulated

The simulation exercise starts from the *WEO* baseline for the sample countries, with inflation averaging 1.6 percent over 2012–2017, and general government gross (net) debt averaging 117 (87) percent of GDP in 2017. It investigates the impact on gross and net debt ratios if inflation were to average 4, 6, or 8 percent annually over 2012–2017.

4.2. Baseline Results – Full Fisher Effect

4.2.1 Simulation of the impact of low inflation

To illustrate how low inflation could make it difficult to reverse public debt, we lower inflation to zero from the *WEO* baseline projections. This would increase the average gross debt-to-GDP ratio in 2017 by about 6 percentage points relative to *WEO* projections. Debt increase varies from 2 percentage points for Canada to 4-5 percentage points for France, Germany, the U.K., and the U.S. Italy's debt increase is 8 percentage points, and Japan's is 12.5 percentage points. As regards to the net debt, the average increase is about 5 percentage points by the end of the period for the sample (Table 2).

[5] We try to use the common data sources to the greatest extent possible in order to facilitate international comparison. This may have led to differences in data definitions used by IMF country teams.

[6] The average maturity in all countries (except the UK) is below or around seven years.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 2
Zero Inflation Simulation Results[1]

	2012				2012–17	2017			
	Gross		Net		Inflation, WEO[3]	WEO		Debt Reduction: 0% Scenario[4]	
	Total	MT-LT	Total	MT-LT		Gross	Net	Gross	Net
Canada	87.5	34.3	35.8	-12.4[5]	1.9	78.1	36.3	-1.9	0.4
France	90.0	67.4	83.7	63.5	1.8	86.5	80.2	-4.5	-4.2
Germany	83.0	73.6	58.4	58.9	1.6	73.7	56.2	-4.8	-4.1
Italy	126.3	108.7	103.1	93.7	1.4	120.6	98.7	-8.2	-7.1
Japan	236.6	175.2	135.4	98.6	0.3	250.3	158.7	-12.5	-9.3
United Kingdom	88.7	63.5	83.7	63.5	2.5	93.7	88.7	-4.5	-4.4
United States	107.2	70.2	83.8	52.5	1.7	114.0	89.4	-4.4	-3.4
Average	**117.0**	**84.7**	**83.4**	**59.8**	**1.6**	**116.7**	**86.9**	**-5.8**	**-4.6**

1 WEO inflation figures reported in percent; all other figures are percentages of GDP.
2 Medium and long-term debt in domestic currency, non-indexed.
3 GDP deflator inflation, average over the period as projected in the WEO.
4 This implies an decrease in inflation by 1.6 percentage points over projected average inflation of 1.6 percent.
5 Canada has more medium and long-term financial assets than medium and long term debt.

Sources: IMF, September WEO, OECD, and Fund staff estimates.

4.2.2 Simulation of the impact of high inflation

The debt-erosion channel could have a stronger impact than seigniorage does. As shown in Table 2, raising the average inflation rate to 6 percent annually – about 4.5 percentage points higher than that of the *WEO* baseline – would reduce the average gross debt-to-GDP ratio in 2017 by about 14.5 percentage points relative to the *WEO* projections. Debt reduction varies from 5 percentage points for Canada to 11–12 percentage points for France, Germany, the U.K., and the U.S., to 20 percentage points for Italy, and 30 percentage points for Japan.

Regarding the net debt, the average reduction is about 11 percentage points by the end of the period for most countries (aside from Japan and Italy, where the effect would be larger) (Table 3). The erosion effect would drop rapidly after five years because an increasingly large share of securities would have been issued at higher interest rates, including the replacement of the maturing debt that had been issued at lower rates. At this time, debt-to-GDP ratios could start increasing again, underscoring the temporary nature of the relief provided by inflation. Real interest rates on debt could rise, due to an inflation risk premium, and growth could be eroded from higher inflation or uncertainty over inflation.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 3
Baseline Simulation Results[1]

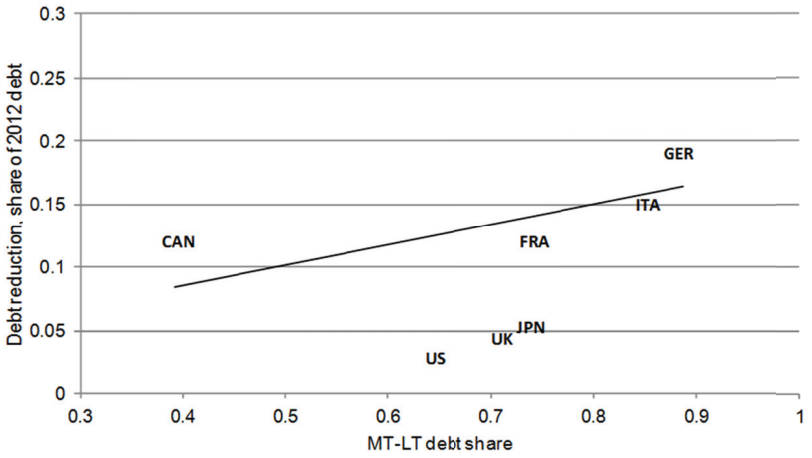
	2012				2012–17	2017			
	Gross		Net		Inflation, WEO[3]	WEO		Debt Reduction: 6% Scenario[4]	
	Total	MT-LT	Total	MT-LT		Gross	Net	Gross	Net
Canada	87.5	34.3	35.8	-12.4[5]	1.9	78.1	36.3	4.9	-0.8
France	90.0	67.4	83.7	63.5	1.8	86.5	80.2	11.2	10.5
Germany	83.0	73.6	58.4	58.9	1.6	73.7	56.2	11.8	9.9
Italy	126.3	108.7	103.1	93.7	1.4	120.6	98.7	19.9	17.4
Japan	236.6	175.2	135.4	98.6	0.3	250.3	158.7	30.8	22.9
United Kingdom	88.7	63.5	83.7	63.5	2.5	93.7	88.7	11.1	11.1
United States	107.2	70.2	83.8	52.5	1.7	114.0	89.4	11.0	8.4
Average	**117.0**	**84.7**	**83.4**	**59.8**	**1.6**	**116.7**	**86.9**	**14.4**	**11.3**

1 WEO inflation figures reported in percent; all other figures are percentages of GDP.
2 Medium and long-term debt in domestic currency, non-indexed.
3 GDP deflator inflation, average over the period as projected in the WEO.
4 This implies an increase in inflation by 4.4 percentage points over projected average inflation of 1.6 percent.
5 Canada has more medium and long-term financial assets than medium and long term debt.

Sources: IMF, September WEO, OECD, and Fund staff estimates.

The inflation impact on debt is positively correlated with the initial share of medium- and long-term, non-indexed, and domestic-currency debts. This is because inflation reduces debt primarily by eroding the real value of outstanding medium- and long-term debt. As shown in Figure 3, the debt reduction increases with the share of medium- and long-term debts. To illustrate the role of the maturity structure, we simulate the debt reduction under alternative shares of short-term debt (net of inflation-indexed debt) for the U.S. According to Figure 4, a 10 percent increase in the share of short-term debt would reduce the inflation impact on debt by about 1.5 percentage points.

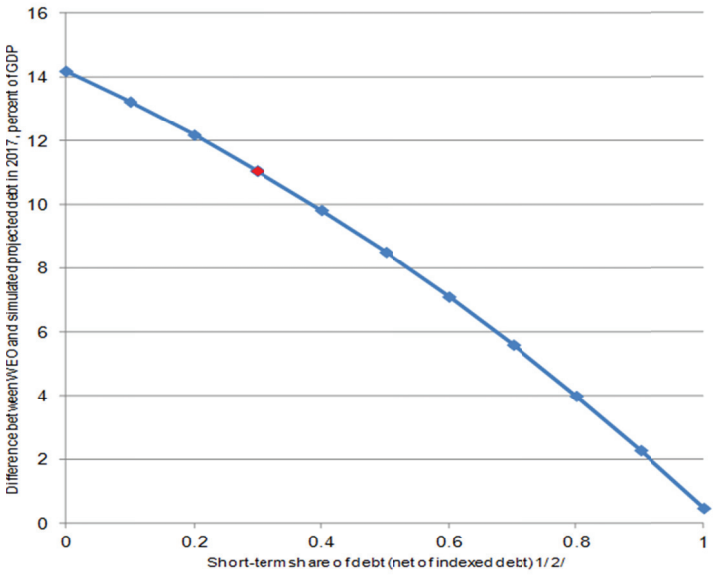
Figure 3
Debt Reduction as a Function of Medium- and Long-Term Debt Share
(6 Percent Inflation, baseline scenario, 2012–17)



Source: authors' calculations based on OECD central government debt data.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Figure 4
Debt Reduction Outcomes with Varying Short- Term Debt Shares, United States (6 percent inflation)
(6 Percent Inflation, baseline scenario, 2012–17)



1/ 6.6 percent of the United States debt in 2012 is inflation-indexed; the numbers on the axis refer to the share of the remaining 93.4 percent of debt that is short-term.
2/ Since the model does not allow for 0 medium and long term non-indexed debt, the rightmost point corresponds to a short-term share trivially lower than 93.4 percent.

Source: authors' calculations.

Suppose now we would like to target a high level of decrease in debt-to-GDP ratio, for example, by 30 percentage points. How much inflation would be needed to achieve this level of debt reduction? This sizable debt "liquidation" would require double-digit inflation. Simulations find that raising the inflation rate to about 11 percent between 2013 and 2017 or raising it to about 18 percent for two years, and then maintaining it at 6 percent for the remaining three years, would reduce the 2017 gross debt-to-GDP ratio for the sample by 30 percentage points (Table 4). For net debt, the required inflation is even more extreme; it would take 15 percent inflation over 2013–17, or 30 percent for the first two years, followed by 6 percent of the remaining three years. These results suggest that inflation could hardly solve the debt problem alone, as it would raise significant risks for the real sector through the un-anchoring of inflation expectations.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 4
30 Percent of GDP Debt Reduction Scenarios[1]

	2012				2012–17	2017					
	Gross		Net		Inflation, WEO	WEO		Gross Debt Reduction, Inflation Equal to:		Net Debt Reduction, Inflation Equal to:	
	Total	MT-LT	Total	MT-LT		Gross	Net	10.7%[4]	17.9% for 2013–14; 6% thereafter[5]	15.0%[6]	29.8% for 2013–14; 6% thereafter[7]
Canada	87.5	34.3	35.8	-12.4[8]	1.9	78.1	36.3	10.1	10.2	-2.7	-3.2
France	90.0	67.4	83.7	63.5	1.8	86.5	80.2	23.4	23.6	29.5	30.1
Germany	83.0	73.6	58.4	58.9	1.6	73.7	56.2	24.1	24.2	26.6	27.3
Italy	126.3	108.7	103.1	93.7	1.4	120.6	98.7	42.3	42.6	48.4	50.0
Japan	236.6	175.2	135.4	98.6	0.3	250.3	158.7	64.6	63.0	53.8	51.3
United Kingdom	88.7	63.5	83.7	63.5	2.5	93.7	88.7	23.1	22.7	31.1	30.6
United States	107.2	70.2	83.8	52.5	1.7	114.0	89.4	22.7	23.4	23.2	23.6
Average	**117.0**	**84.7**	**83.4**	**59.8**	**1.6**	**116.7**	**86.9**	**30.0**	**30.0**	**30.0**	**30.0**

1 WEO inflation figures reported in percent; all other figures are percentages of GDP.
2 Medium and long-term debt in domestic currency, non-indexed.
3 GDP deflator inflation, average over the period as projected in the WEO.
4 This implies an increase in inflation by 9.1 percentage points over projected average inflation of 1.6 percent.
5 This implies an increase in inflation by 16.3 percentage points followed by an increase by 4.4 percentage points over projected average inflation of 1.6 percent.
6 This implies an increase in inflation by 13.4 percentage points over projected average inflation of 1.6 percent.
7 This implies an increase in inflation by 28.2 percentage points followed by an increase by 4.4 percentage points over projected average inflation of 1.6 percent.
8 Canada has more medium and long-term assets than debt.

Sources: IMF, latest WEO, OECD, and Fund staff estimates.

4.3. Simulations of Partial Fisher effect

The partial Fisher effect would increase the inflation impact on debt reduction. The Fisher hypothesis postulates that *anticipated* inflation and nominal interest rates move together. However, most empirical studies have not confirmed a one-to-one relationship as postulated by Fisher (see Summers, 1983). Indeed, fully anticipated inflation has been found to have an effect of less than one unit on nominal interest rates, and thus reduces real interest rates (Poghosyan, 2012). Possible explanations for the deviation from the Fisher effect include the "wealth effect" (Mundell, 1963; Tobin, 1965), the "tax effect" (Darby, 1975; Feldstein, 1983), and the "inverted Fisher effect" (Carmichael and Stebbing, 1983). Unconventional monetary policies and financial repression could also result in incomplete Fisher effects.

To simulate a partial Fisher effect, we modify (4.1) slightly to account for the extent to which the inflation shock increases the nominal interest rate on government debt:

$$b_t = \left\{ \begin{array}{c} -pb_t + b_{t-1}^{ST}\left[\frac{\left(1+r_t^{ST}\right)\left(1+\pi_t^{base}+\alpha\pi_t^{surprise}\right)}{\left(1+g_t\right)\left(1+\pi_t^{base}+\pi_t^{surprise}\right)}\right] + b_{t-1}^{MT-LT,old}\left[\frac{1+i_t^{imp}}{\left(1+g_t\right)\left(1+\pi_t^{base}+\pi_t^{surprise}\right)}\right] \\ +b_{t-1}^{MT-LT,new}\left[\frac{1+i_t^{imp}+\alpha\pi_t^{surprise}}{\left(1+g_t\right)\left(1+\pi_t^{base}+\pi_t^{surprise}\right)}\right] + b_{t-1}^{indexed}\left(\frac{1+r_t^{MT-LT}}{1+g_t}\right) \end{array} \right\} \quad (4.2)$$

DOI: 10.7172/2353-6845.jbfe.2017.1.2

The only difference from (4.1) is the parameter (alpha) that captures the imperfect adjustment of nominal interest rates on newly issued debt (both short-term and medium- to long-term). In the baseline scenarios, this coefficient is set to 1 (full Fisher effect).

As reported in Table 5, the simulation results suggest that raising the average inflation rate to 6 percent annually with a partial increase in nominal rates, ($\alpha = 0.5$) would reduce the 2017 gross debt-to-GDP ratio for the sample by about 18 percentage points-3.5 percentage points more than it is in the baseline scenario. The net debt reduction is about 14 percentage points, or 2.8 percentage points more than it is in the baseline scenario. With no increase in nominal rates (alpha = 0), the average gross debt reduction is 21 percentage points, while the net reduction is about 17 percentage points (Table 6). Figure 5 shows that as alpha, the adjustment parameter, increases (i.e., as we get closer to the full Fisher Effect), the size of debt reduction decreases fairly linearly.

Table 5
Debt-Reducing Impacts of Inflation with Reduced Fisher Effect ($\alpha = 0.5$)[1]

	2012				2012–17	2017			
	Gross		Net		Inflation, WEO[3]	WEO		Debt Reduction: 6% Scenario[4]	
	Total	MT-LT	Total	MT-LT		Gross	Net	Gross	Net
Canada	87.5	34.3	35.8	-12.4[5]	1.9	78.1	36.3	9.4	3.1
France	90.0	67.4	83.7	63.5	1.8	86.5	80.2	13.3	12.5
Germany	83.0	73.6	58.4	58.9	1.6	73.7	56.2	13.1	10.5
Italy	126.3	108.7	103.1	93.7	1.4	120.6	98.7	22.1	18.9
Japan	236.6	175.2	135.4	98.6	0.3	250.3	158.7	38.4	29.5
United Kingdom	88.7	63.5	83.7	63.5	2.5	93.7	88.7	12.6	12.1
United States	107.2	70.2	83.8	52.5	1.7	114.0	89.4	15.3	11.9
Average	**117.0**	**84.7**	**83.4**	**59.8**	**1.6**	**116.7**	**86.9**	**17.8**	**14.1**

1 WEO inflation figures reported in percent; all other figures are percentages of GDP.
2 Medium and long-term debt in domestic currency, non-indexed.
3 GDP deflator inflation, average over the period as projected in the WEO.
4 This implies an increase in inflation by 4.4 percentage points over projected average inflation of 1.6 percent.
5 Canada has more medium and long-term financial assets than medium and long term debt.

Sources: IMF, September WEO, OECD, and Fund staff estimates.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

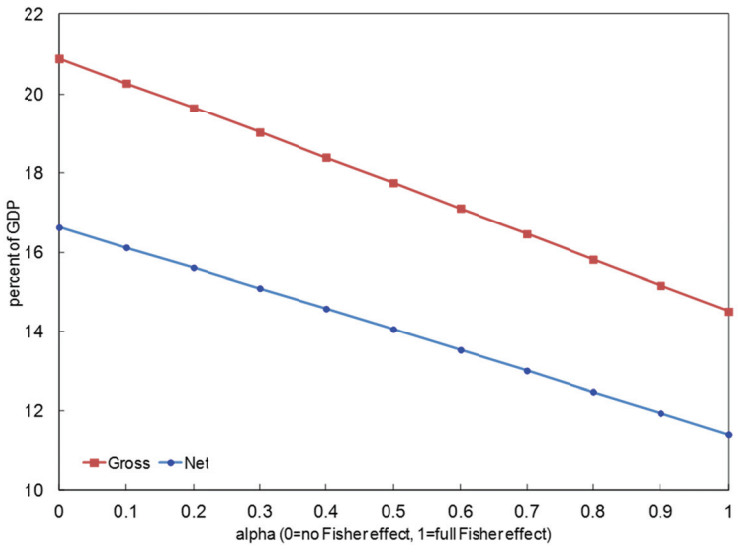
Table 6
Debt-Reducing Impacts of Inflation with Reduced Fisher Effect (α = 0)[1]

	2012				2012–17	2017			
	Gross		Net		Inflation, WEO[3]	WEO		Debt Reduction: 6% Scenario[4]	
	Total	MT-LT	Total	MT-LT		Gross	Net	Gross	Net
Canada	87.5	34.3	35.8	-12.4[5]	1.9	78.1	36.3	13.5	6.8
France	90.0	67.4	83.7	63.5	1.8	86.5	80.2	15.4	14.3
Germany	83.0	73.6	58.4	58.9	1.6	73.7	56.2	14.3	11.0
Italy	126.3	108.7	103.1	93.7	1.4	120.6	98.7	24.2	20.2
Japan	236.6	175.2	135.4	98.6	0.3	250.3	158.7	45.5	35.7
United Kingdom	88.7	63.5	83.7	63.5	2.5	93.7	88.7	14.2	13.2
United States	107.2	70.2	83.8	52.5	1.7	114.0	89.4	19.3	15.2
Average	**117.0**	**84.7**	**83.4**	**59.8**	**1.6**	**116.7**	**86.9**	**20.9**	**16.6**

1 WEO inflation figures reported in percent; all other figures are percentages of GDP.
2 Medium and long-term debt in domestic currency, non-indexed.
3 GDP deflator inflation, average over the period as projected in the WEO.
4 This implies an increase in inflation by 4.4 percentage points over projected average inflation of 1.6 percent.
5 Canada has more medium and long-term financial assets than medium and long term debt.

Sources: IMF, September WEO, OECD, and Fund staff estimates.

Figure 5
How Varying Fisher Effects Impact Debt Reduction for G7 Average (6 percent inflation scenario)



Source: authors' calculations.

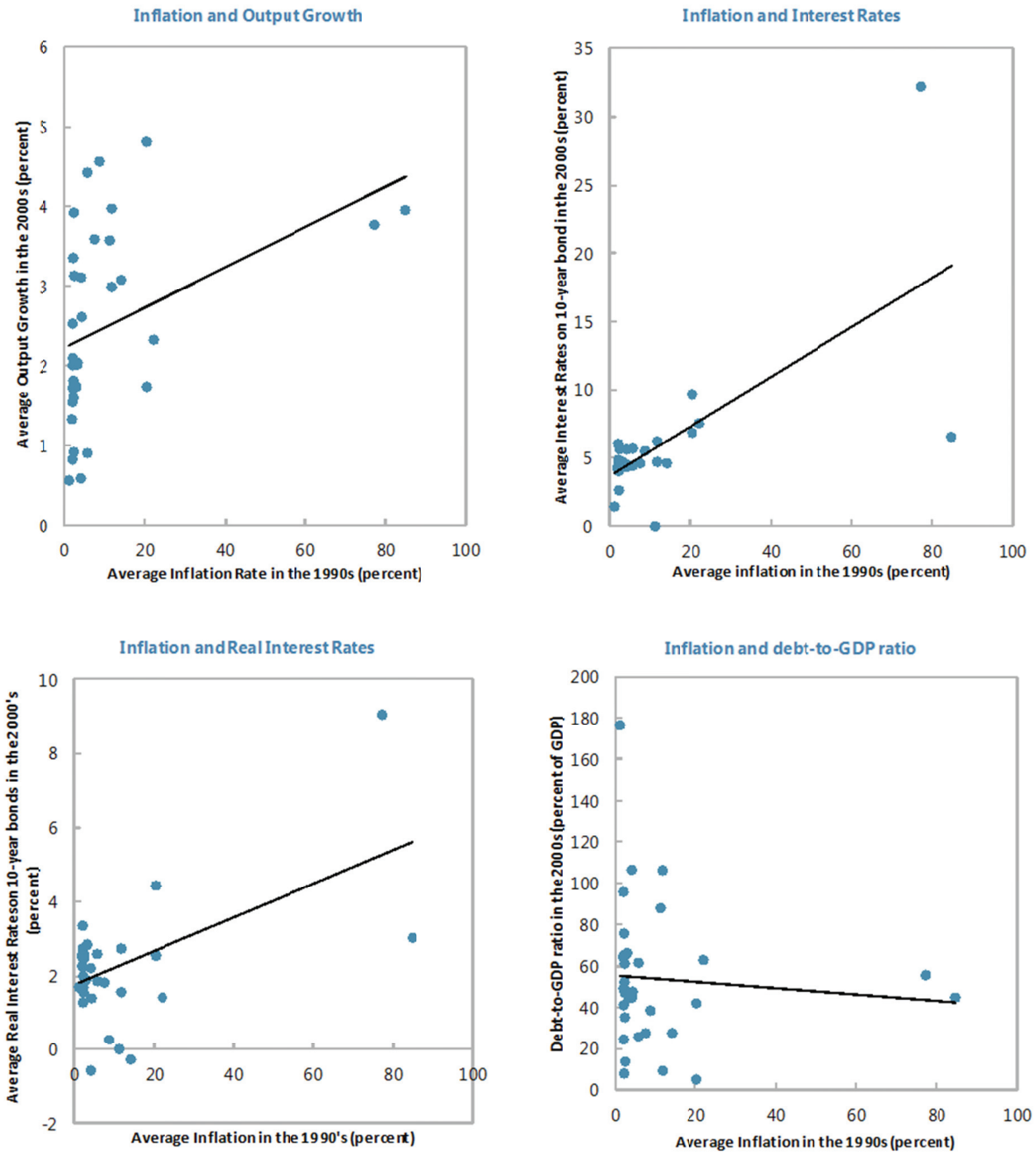
5. ROBUSTNESS OF ASSUMPTIONS

The results of our simulations are conditional on the assumption that inflation does not affect output growth, real interest rates on the newly-issued debt, or debt maturity. For example, if debt maturity shortens as markets responds to inflation shock, the effectiveness of inflation on debt reduction will be smaller. This section discusses whether these assumptions are valid for advanced economies.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

First, we analyze the pair-wise association between (i) inflation and output growth, (ii) inflation and interest rate (real and nominal), and (iii) inflation and level of debt. In each case, the average inflation in the 1990s is plotted against the average value of the variable of interest in the 2000s. We consider two sets of countries: all OECD countries (Figure 6), and OECD countries that were members prior to 1990, except Turkey and Greece (Figure 7). The second set includes only those countries that have had advanced economies throughout the past 20 years, a sample that is closer to the economics of the countries that we focus on in this paper. We refer to the former as the "full OECD countries case," and the latter the "selected OECD countries case."

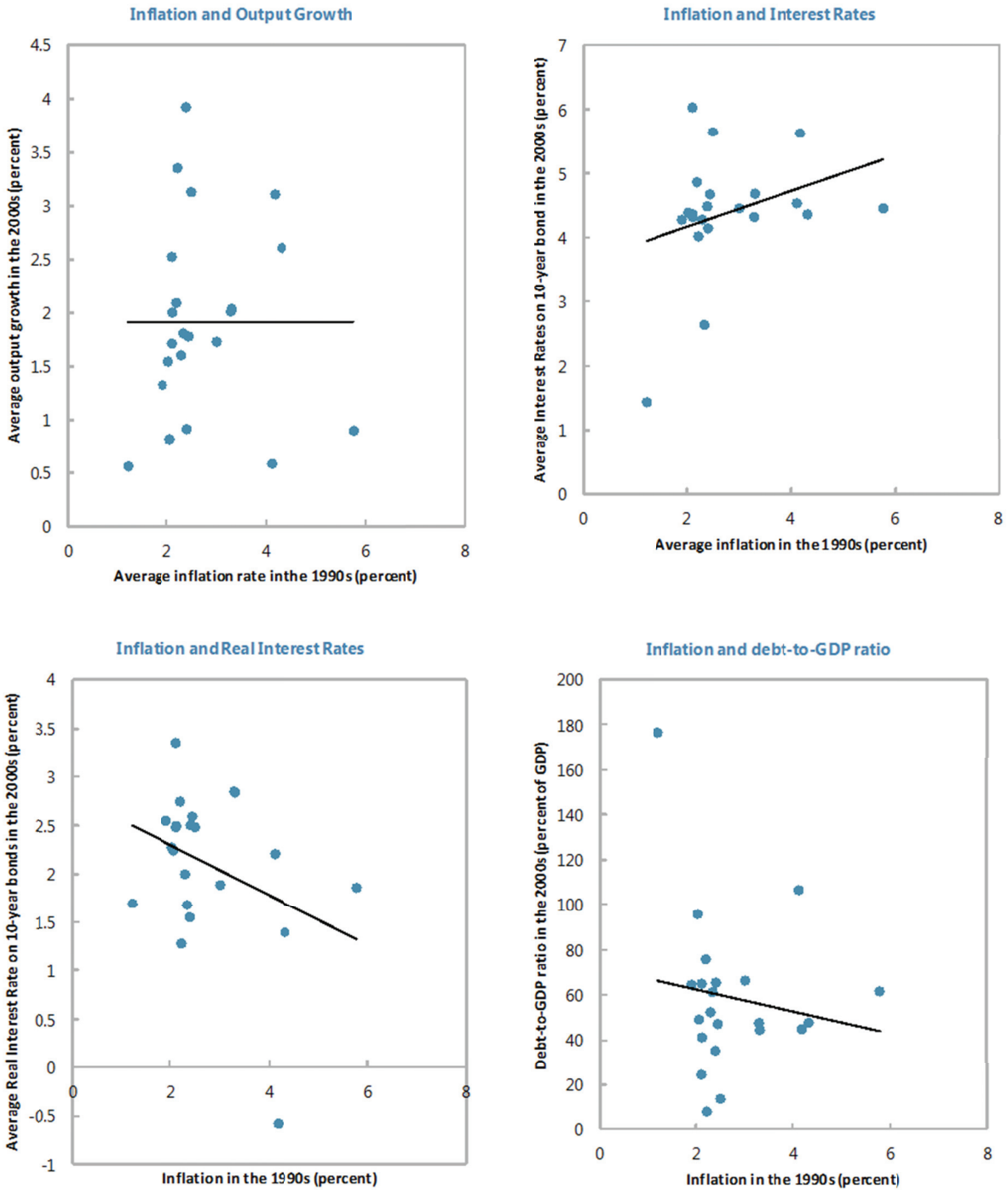
Figure 6
Inflation Scatterplots, All OECD Countries



Source: World Economic Outlook, OECD.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Figure 7
Inflation Scatterplots, Selected OECD Countries



Source: World Economic Outlook, OECD.

In the full OECD countries case, inflation is positively correlated with output growth, and real and nominal interest rates, and negatively correlated with the debt-to-GDP ratio. In the selected OECD countries case, inflation is not correlated with output growth, is positively correlated with nominal interest rates, and is negatively correlated with real interest rates as well as the debt-to-GDP ratio. These results show that our assumptions are broadly consistent with the stylized facts of the selected OECD countries, and fairly reasonable for the G-7 countries. In particular, inflation

DOI: 10.7172/2353-6845.jbfe.2017.1.2

is not associated with output growth rate in future years, while positive correlation with nominal interest rates and negative correlation with real interest rates suggest that the Fisher effect is at work, but appears to be less than perfect. However, a substantial and prolonged deviation from an inflation anchor could lead to a rise in the sovereign credit risk, thus causing a larger than one-for-one effect of inflation on nominal interest rates. This would therefore diminish inflation's debt reducing benefits.[7] In any case, results should be considered to be only suggestive, as the pair-wise correlation does not imply causation.

Regarding the effect of inflation on debt maturity, we shift our focus back to the G-7 countries, as the debt maturity data is incomplete for a number of OECD countries. A cursory look at the time series does not reveal any clear pattern between inflation and the share of short-term debt (Figure 8). Thus, following Aizenman and Marion (2011) who also test specifications in Missale and Blanchard (1994), we run a series of regressions that are specified as follows:

$$y_t = \beta_1 + \beta_2^* \, regressors_t + \epsilon_t$$

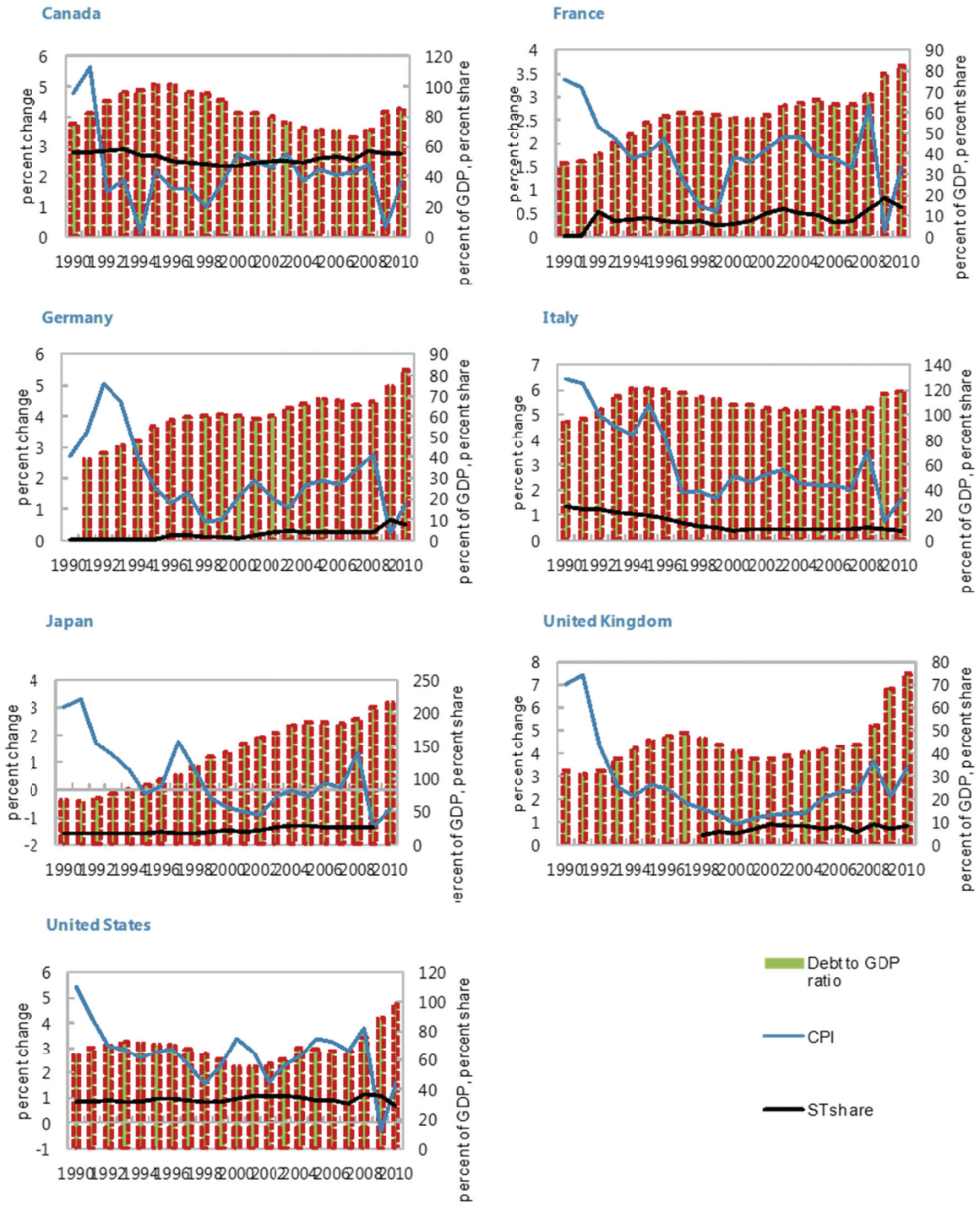
The regressors include log of debt-to-GDP ratio, CPI, lagged CPI, total government expenditure, and output growth, depending on the specification. Given the presence of unit roots in most of the variables, we test for cointegration and find that the no-cointegration hypothesis cannot be rejected at the 5 percent confidence level for overwhelming majority of regressions. Thus, we first-difference all variables to address concerns relating to potential nonstationarity and spurious regression. For the regressand, we use two alternative measures as described below.

First, using the average maturity as the regressand, we find that the effect of inflation (as measured by the CPI) on debt maturity is not statistically significant in any country (Table 7). Second, using the share of short-term debt as the regressand, we find that inflation positively affects the share of short-term debt in Italy while it is statistically insignificant in the other countries (Table 8). In summary, we do not find strong evidence that inflation leads to a maturity shortening. This result is similar to the findings of Aizenman and Marion (2011), which show no significant relationship between inflation and debt maturity for the U.S. It is also consistent with the results recorded by Missale and Blanchard (1994), which suggest no discernible effect of inflation on maturity.

[7] As a further robustness check, we examined results for an intermediate set of countries: full OECD countries minus two clear outliers in figure 6. Results also turned out to be intermediate, i.e. inflation is positively correlated with output growth as in full OECD countries case, while there is a positive correlation with nominal interest rates and negative correlation with real interest rates, as in the selected OECD countries case. We also performed additional exercises where we replaced CPI with core CPI in all sets of countries. Results were similar to the CPI case, except that real interest rates were not negatively correlated with inflation anymore, which implies a fuller Fisher effect. Results were omitted for space consideration, but are available from the authors upon request.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Figure 8
Average Maturity, Inflation, and Public Debt in G7 Countries



Source: World Economic Outlook, OECD.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 7
Robustness Regressions (Average Maturity)

Canada						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.237	-0.243	-0.512*	-0.170	-0.156	-0.494
	(-1.25)	(-1.16)	(-2.13)	(-0.58)	(-0.51)	(-1.85)
D.cpi		-0.000719	-0.0128	-0.000760	-0.00141	0.00362
		(-0.07)	(-1.04)	(-0.07)	(-0.13)	(0.42)
LD.cpi			-0.00763			
			(-0.67)			
D.ln_total_exp				-0.165	-0.243	0.506
				(-0.37)	(-0.45)	(1.02)
D.gdp_growth					-0.00190	0.00220
					(-0.27)	(0.38)
time						-0.00640**
						(-3.09)
_cons	0.0217	0.0217	0.0128	0.0204	0.0202	12.83**
	(1.83)	(1.77)	(1.05)	(1.57)	(1.50)	(3.09)
N	20	20	19	20	20	20
France						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.216	-0.230	-0.297	-0.156	-0.446	-0.345
	(-1.19)	(-1.15)	(-1.72)	(-0.49)	(-1.60)	(-1.03)
D.cpi		-0.00234	-0.0202	-0.00341	-0.00580	-0.00654
		(-0.20)	(-1.64)	(-0.27)	(-0.55)	(-0.60)
LD.cpi			-0.0318*			
			(-2.59)			
D.ln_total_exp				-0.244	1.250	0.944
				(-0.31)	(1.48)	(0.93)
D.gdp_growth					0.0178*	0.0165*
					(2.80)	(2.42)
time						0.00115
						(0.58)
_cons	0.0147	0.0151	0.0115	0.0132	0.0177	-2.288
	(1.21)	(1.19)	(1.05)	(0.91)	(1.48)	(-0.58)
N	18	18	18	18	18	18
Germany						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.122	-0.203	-0.246	-0.179	-0.348	-0.483
	(-0.36)	(-0.53)	(-0.58)	(-0.38)	(-0.74)	(-1.02)
D.cpi		-0.00938	-0.0104	-0.00966	-0.0155	-0.0164
		(-0.51)	(-0.53)	(-0.50)	(-0.81)	(-0.88)
LD.cpi			-0.00517			
			(-0.27)			
D.ln_total_exp				-0.0383	0.204	0.291
				(-0.09)	(0.47)	(0.68)
D.gdp_growth					0.00853	0.0104
					(1.43)	(1.73)
time						-0.00393
						(-1.31)
_cons	0.0208	0.0227	0.0236	0.0218	0.0276	7.887
	(1.01)	(1.06)	(1.06)	(0.91)	(1.17)	(1.31)
N	19	19	19	19	19	19

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 7
Robustness Regressions (Average Maturity) (Cont.)

Italy						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	0.719 (1.53)	0.689 (1.33)	0.591 (1.11)	1.332* (2.58)	1.358* (2.42)	1.176 (1.92)
D.cpi		-0.00320 (-0.16)	-0.0107 (-0.49)	-0.00884 (-0.51)	-0.00796 (-0.42)	-0.00727 (-0.38)
LD.cpi			-0.0169 (-0.81)			
D.ln_total_exp				-1.722* (-2.56)	-1.817 (-1.91)	-1.405 (-1.28)
D.gdp_growth					-0.00153 (-0.15)	0.00157 (0.14)
time						-0.00272 (-0.80)
_cons	0.0432* (2.27)	0.0428* (2.17)	0.0331 (1.52)	0.0305 (1.71)	0.0302 (1.63)	5.472 (0.80)
N	20	20	19	20	20	20
Japan						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.404 (-2.04)	-0.410 (-1.80)	-0.520* (-2.70)	-0.412 (-1.71)	-0.382 (-1.67)	-0.283 (-1.24)
D.cpi		-0.000531 (-0.06)	0.00376 (0.55)	-0.000362 (-0.04)	0.000772 (0.08)	0.000305 (0.03)
LD.cpi			0.0217* (2.85)			
D.ln_total_exp				0.00906 (0.04)	-0.130 (-0.54)	-0.177 (-0.77)
D.gdp_growth					-0.00703 (-1.65)	-0.00655 (-1.61)
time						0.00208 (1.55)
_cons	0.0287 (2.06)	0.0290 (1.94)	0.0421** (3.28)	0.0290 (1.88)	0.0254 (1.72)	-4.139 (-1.54)
N	19	19	18	19	19	19
United Kingdom						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.174* (-2.49)	-0.172* (-2.40)	-0.215* (-2.66)	-0.157 (-1.83)	-0.157 (-1.76)	-0.307* (-2.85)
D.cpi		0.00514 (0.54)	0.0124 (1.08)	0.00555 (0.56)	0.00699 (0.64)	-0.00240 (-0.23)
LD.cpi			0.0154 (1.11)			
D.ln_total_exp				-0.0614 (-0.35)	-0.113 (-0.52)	-0.376 (-1.62)
D.gdp_growth					-0.00172 (-0.42)	-0.00614 (-1.47)
time						0.00554 (2.02)
_cons	0.0307*** (4.64)	0.0304*** (4.46)	0.0314*** (4.61)	0.0303** (4.28)	0.0305** (4.13)	-11.05 (-2.02)
N	15	15	15	15	15	15

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 7
Robustness Regressions (Average Maturity) (Cont.)

	United States					
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.181 (-1.04)	-0.196 (-1.05)	-0.321 (-1.69)	-0.0317 (-0.13)	-0.173 (-0.64)	-0.213 (-0.86)
D.cpi		-0.00267 (-0.27)	-0.0136 (-1.22)	-0.00772 (-0.69)	-0.00993 (-0.89)	-0.0200 (-1.76)
LD.cpi			-0.0229 (-1.96)			
D.ln_total_exp				-0.653 (-1.05)	-0.196 (-0.27)	-0.858 (-1.15)
D.gdp_growth					0.00861 (1.13)	0.00689 (0.99)
time						0.00481 (2.01)
_cons	-0.00449 (-0.37)	-0.00468 (-0.38)	-0.0105 (-0.85)	-0.00489 (-0.39)	-0.00548 (-0.45)	-9.615 (-2.01)
N	20	20	19	20	20	20

t statistics in parentheses
= "* p < 0.05 ** p < 0.01 *** p < 0.001"

Table 8
Robustness Regressions (Short-term Share)

	Canada					
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	0.0959 (0.57)	0.185 (0.96)	0.188 (0.87)	0.167 (0.65)	0.167 (0.64)	0.0950 (0.31)
D.cpi		0.00781 (0.96)	0.00754 (0.88)	0.00775 (0.94)	0.00753 (0.63)	0.00781 (0.64)
LD.cpi			-0.00138 (-0.17)			
D.ln_total_exp				0.0375 (0.11)	0.0280 (0.05)	0.0948 (0.18)
D.gdp_growth					-0.000208 (-0.03)	-0.000183 (-0.02)
time						-0.000809 (-0.51)
_cons	0.00960 (0.89)	0.0112 (1.02)	0.0110 (0.94)	0.0115 (0.99)	0.0114 (0.87)	1.627 (0.51)
N	28	28	27	28	28	28

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Table 8
Robustness Regressions (Short-term Share) (Cont.)

Germany						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.0525 (-0.01)	-2.992 (-0.67)	-3.289 (-0.69)	3.372 (0.74)	1.628 (0.37)	1.873 (0.43)
D.cpi		-0.258 (-1.35)	-0.254 (-1.24)	-0.227 (-1.34)	-0.280 (-1.74)	-0.300 (-1.88)
LD.cpi			-0.00371 (-0.02)			
D.ln_total_exp				-11.65** (-2.81)	-14.82** (-3.56)	-14.81** (-3.60)
D.gdp_growth					-0.178* (-2.11)	-0.150 (-1.75)
time						0.0234 (1.26)
_cons	0.0527 (0.25)	0.0766 (0.37)	0.0727 (0.34)	-0.0978 (-0.51)	-0.0968 (-0.54)	-46.73 (-1.26)
N	28	28	27	28	28	28
Italy						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.0283 (-0.07)	0.680 (1.53)	0.773 (1.82)	-0.0917 (-0.20)	-0.179 (-0.37)	-0.100 (-0.19)
D.cpi		0.0383** (2.86)	0.0404** (3.09)	0.0352** (2.99)	0.0364** (3.04)	0.0357** (2.90)
LD.cpi			0.0183 (1.55)			
D.ln_total_exp				1.775** (2.95)	2.181* (2.71)	2.211* (2.68)
D.gdp_growth					0.00901 (0.77)	0.0111 (0.84)
time						0.000868 (0.37)
_cons	-0.0550* (-2.76)	-0.0467* (-2.61)	-0.0416* (-2.45)	-0.0395* (-2.50)	-0.0367* (-2.24)	-1.772 (-0.38)
N	28	28	27	28	28	28
Japan						
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	-0.0238 (-0.06)	0.00921 (0.02)	-0.310 (-0.67)	0.0662 (0.13)	0.0624 (0.12)	0.0329 (0.06)
D.cpi		0.00250 (0.12)	-0.0187 (-0.93)	0.000342 (0.02)	-0.00228 (-0.11)	-0.00472 (-0.21)
LD.cpi			-0.0251 (-1.38)			
D.ln_total_exp				-0.206 (-0.35)	0.0801 (0.13)	0.0263 (0.04)
D.gdp_growth					0.0139 (1.41)	0.0143 (1.41)
time						0.000772 (0.32)
_cons	0.0218 (0.86)	0.0208 (0.77)	0.0356 (1.41)	0.0191 (0.68)	0.0214 (0.78)	-1.518 (-0.32)
N	28	28	27	28	28	28

Table 8

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Robustness Regressions (Short-term Share) (Cont.)

	United States					
	(1)	(2)	(3)	(4)	(5)	(6)
D.ln_gross_debt	0.0198 (0.12)	0.0938 (0.47)	0.0888 (0.44)	-0.219 (-0.97)	-0.247 (-1.04)	-0.241 (-0.96)
D.cpi		0.00616 (0.76)	0.0101 (1.09)	0.0130 (1.62)	0.0139 (1.66)	0.0137 (1.51)
LD.cpi			0.000649 (0.08)			
D.ln_total_exp				1.177* (2.37)	1.356* (2.14)	1.331 (1.88)
D.gdp_growth					0.00265 (0.47)	0.00260 (0.45)
time						0.000121 (0.09)
_cons	-0.00528 (-0.47)	-0.00497 (-0.44)	-0.00538 (-0.46)	-0.00246 (-0.24)	-0.00213 (-0.20)	-0.244 (-0.09)
N	28	28	27	28	28	28

t statistics in parentheses
= "* p < 0.05 ** p < 0.01 *** p < 0.001"

6. CONCLUDING REMARKS AND POLICY IMPLICATIONS

This paper investigates the impact of inflation on the public debt-to-GDP ratio in the G-7 countries. Simulations suggest that if inflation were to fall to zero for five years, the average net debt-to-GDP ratio would increase by about 5 percentage points during that period. In contrast, raising inflation to 6 percent for the next 5 years would reduce the average net debt-to-GDP ratio by about 11 percentage points under the full Fisher effect, and about 14 percentage points under the partial Fisher effect. Thus, allowing inflation to drop to very low levels for an extended period would make the task of tackling high levels of public debt even more difficult. The occasional "surprise inflation" that leaves inflation expectations unaffected could help to a degree.

However, a deliberate policy of high inflation could hardly solve the debt problem alone, and would raise significant challenges and risks. As a practical matter, lifting inflation to a meaningful level might be difficult in the current economic environment, as evidenced by Japan's experience in the last few decades, and in any case, countries in a monetary union would not be able to use this tool on their own. More importantly, reliance on inflation to erode debt could lead to fiscal dominance with inflation rates drifting even higher as confidence in the future value of money is lost. As a result, inflation expectations could be un-anchored, undermining the framework's credibility to control inflation. The un-anchoring of inflation expectations might also have significant implications for the future structure of the government debt portfolio, making it more crisis-prone by raising liquidity, currency, and the interest rate risk.

The un-anchoring of inflation expectations could increase long-term real interest rates, distort resource allocation, reduce economic growth, and hurt the lower-income households. This would likely make it difficult for governments to finance their budgets, leading to even higher debt-to-GDP ratios. Introducing some form of financial repression could keep interest rates low, but such policies may be difficult to enforce in a complex financial environment, and could cause additional collateral damage to the economy. Altogether, the output costs of restoring inflation to more moderate levels in the future would be substantial – based on the experience of advanced economies in the 1980s (IMF 2012). Moreover, inflation would have a highly regressive impact on incomes: while higher inflation would be taxing on bondholders, it would also disproportionately affect lower-income households, which tend to have more limited access to indexed assets.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

References

Abbas, S.A., Akitoby, B., Andritzky, J., Berger, H., Komatsuzaki, T., and Tyson, J. (2013), "Dealing with High Debt in an Era of Low Growth," IMF Staff Discussion Note 13/7.

Aizenman, J. and N. Marion (2011), "Using Inflation to Erode the US Public Debt," *Journal of Macroeconomics*, 33(4): pp. 524–541.

Ball, L. (2012). *The case for Four Percent Inflation.* manuscript.

Blanchard, O., Dell'Ariccia, G., and Mauro, P. (2010), "Rethinking Macroeconomic Policy," Washington, DC: International Monetary Fund

Carmichael, J. and P. Stebbing (1983), "Fisher's Paradox and the Theory of Interest," *The American Economic Review*, 73(4): pp. 619–630.

Cochrane, J. (2011), "Understanding Policy in the Great Recession: Some Unpleasant Fiscal Arithmetic," *European Economic Review*, 55(1): pp. 2–30.

Darby, M. (1975), "The Financial and Tax Effects of Monetary Policy on Interest Rates," *Economic Inquiry*, 13(2): pp. 266–276.

Davig, T. and E. Leeper (2011), "Monetary-Fiscal Policy Interactions and Fiscal Stimulus," *European Economic Review*, 55(2): pp. 211–227.

Feldstein, M. (1983), "Inflation, Income Taxes, and the Rate of Interest: A Theoretical Analysis," in *Inflation, Tax Rules, and Capital Formation*, Chicago, IL: University of Chicago Press.

Giannitsarou, C. and A. Scott (2008), "Inflation Implications of Rising Government Debt," in *NBER International Seminar on Macroeconomics 2006*, National Bureau of Economic Research, Inc., NBER Chapters, pp. 393–442.

Hall, G. and T. Sargent (2010), "Interest Rate Risk and other Determinants of Post-WWII U.S. Government Debt/GDP Dynamics," NBER Working Paper No. 15702 (Cambridge, Massachusetts: National Bureau of Economic Research).

International Monetary Fund (2012). "World Economic Outlook: Coping with High Debt and Sluggish Growth," October 2012, (Washington: International Monetary Fund).

International Monetary Fund (2013), "World Economic Outlook: Hopes, Realities, and Risks," April 2013, (Washington: International Monetary Fund).

Krause, M. and S. Moyen (2011), "Public Debt and Changing Inflation Targets," Deutsche Bundesbank (Frankfurt, Germany: Deutsche Bundesbank).

Leeper, E. (1991), "Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policies," *Journal of Monetary Economics*, 27(1): pp. 129–147.

Missale, A. and O. Blanchard (1994), "The Debt Burden and Debt Maturity," *American Economic Review*, 84(1): pp. 309–319.

Mundell, R. (1963), "Inflation and Real Interest," *The Journal of Political Economy*, 71(3): pp. 280–283.

Poghosyan, T. (2012), "Long-Run and Short-Run Determinants of Sovereign Bond Yields in Advanced Economies," IMF Working Paper 12/271.

Reinhart, C., K. Rogoff and M. Savastano, "Debt Intolerance," NBER Working Paper No. 9908 (Cambridge, Massachusetts: National Bureau of Economic Research)

Reinhart, C. and M. Sbrancia (2011), "The Liquidation of Government Debt," NBER Working Paper No. 16893 (Cambridge, Massachusetts: National Bureau of Economic Research).

Rogoff, K. (2008, December 2), "Inflation is now the Lesser Evil," Project Syndicate: http://www.project-syndicate.org/commentary/inflation-is-now-the-lesser-evil

Summers, L. (1983), "The Nonadjustment of Nominal Interest Rates: A Study of the Fisher Effect," in: J. Tobin, ed., *Macroeconomic Prices and Quantities: Essays in Memory of Arthus Okun* (Washington, DC: Brookings Institution).

Tobin, J. (1965), "Money and Economic Growth," *Econometrica*, 33(4): pp. 671–684.

DOI: 10.7172/2353-6845.jbfe.2017.1.2

Unstash the Cash! Corporate Governance Reform in Japan

Chie Aoyagi[1]
International Monetary Fund, Regional Office for Asia and the Pacific, Japan
CAoyagi@imf.org

Giovanni Ganelli
International Monetary Fund, Regional Office for Asia and the Pacific, Japan
GGanelli@imf.org

Received: 18 February 2016 / Revised: 29 August 2016 / Accepted: 15 December 2016 / Published online: 30 January 2017

ABSTRACT

Japan's high corporate savings might be holding back growth, by preventing a more efficient use of resources. Small and medium enterprises (SMEs) have been the main contributors to high corporate cash balances, but more recently larger companies have also increased cash holdings. This paper focuses on the causes and consequences of the current corporate behavior and suggests options for reform. In particular, Japan's weak corporate governance – as measured by available indexes – might be contributing to high cash holdings. An empirical analysis on a panel of Japanese firms confirms that improving corporate governance would help unlock corporate savings. The main policy implication of the analysis carried out in this paper is that a more ambitious and comprehensive corporate governance reform should be a key component of Japan's growth strategy. Such a reform would help remove some of the bottlenecks of the legal and corporate governance framework which encourage high corporate cash holdings and prevent a more pro-growth use of resources.

JEL Classification Numbers: D22; G30; G34

Keywords: Japan; corporate cash holdings; corporate governance; growth strategy.

I. INTRODUCTION

The contribution of this paper is twofold. First, it contributes to the empirical literature on the determinants of corporate cash holdings. In particular, using a panel of Japanese corporations, the paper shows that improving corporate governance can significantly reduce corporate cash holdings. Second, the paper contributes to the policy debate on the strategy to revive growth

[1] Corresponding author: 21F, Fukoku Seimei Bldg., 2-2-2 Uchisaiwai-cho, Chiyoda-ku, Tokyo 100-0011, Japan, Tel:+81-3-3597-6700, Fax:+81-3-3597-6705.
The views expressed in this paper are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

Ministry of Science and Higher Education
Republic of Poland

The creation of the English-language version of these publications is financed in the framework of contract No. 768/P-DUN/2016 by the Ministry of Science and Higher Education committed to activities aimed at the promotion of education.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

and decisively exit from deflation in Japan, by drawing policy implications from the analysis and suggesting some reforms which could facilitate a more efficient use of corporate resources.

Japan's corporate sector stands out in terms of its high cash holdings compared to other advanced countries. While high firms' cash holdings play some positive roles, such as providing insurance against shocks, they also imply high macroeconomic costs if they prevent resources from being used in a more efficient way. This is likely to be relevant in Japan, where high cash holdings coexist with a negative contribution of private investment to growth in the last few years and with falling real wages in the face of positive labor productivity growth for most of the last two decades. In this context, Japan's high cash holdings are likely to be holding back both potential and short-term growth.

Given that holding large amounts of cash on their balance sheets – rather than investing or paying higher wages – might be rational for individual firms if they expect other firms to do the same, there seems to be space for policies to break this sub-optimal equilibrium and encourage more risk taking in the corporate sector. Accordingly, this paper focuses on the causes and economic consequences of the current corporate behavior and suggests options for reform.

Our main interest in this paper is to test the hypothesis that:

- There is a positive relationship between improved corporate governance and reduced cash holdings in Japan.

Various determinants of cash holdings have been highlighted in the previous literature. Keynes (1934) refers to the "transaction cost" and the "precautionary" motives for holding cash. The former means that, by holding cash, firms can save transaction costs to raise funds, while the latter refers to the fact that the firms can use cash to finance their activities if other sources of funding are not available. Other papers have focused on the trade-off between costs and benefits of holding cash. The costs considered in this literature include brokerage costs (Miller and Orr 1966) and inefficient investment resulting from insufficient liquidity (Jensen and Meckling 1976; Fazzari et al. 1988). Opler et al. (1999) find empirical support for the trade-off theory. Under this theory, firms tend to hold more cash when they are smaller, when they have more volatile cash flows, and invest more.

An alternative theory considered by Myers and Majluf (1984) and Opler et al. (1999) is the financing hierarchy theory, under which there is no optimal amount of cash and cash balances are simply the outcome of firms' profitability and financing needs. While some predictions of the two theories are similar, an important difference is that under the financing-hierarchy theory firms which invest more will have less cash.

In addition to the determinants highlighted in the previous literature on corporate cash holdings, discussed above, several Japan-specific factors – including entrenched deflation expectations; aversion to bankruptcies and lack of pre-packaged bankruptcy procedures; takeover regulations and ownership structure; role of banks in financing firms; and weak corporate governance – might be encouraging Japanese firms to hold excessive cash on their balance sheets. In particular, a cross-country comparison of corporate governance indexes shows that Japan scores lower than other G-7 countries regarding firm-level governance attributes, covering: board composition; audit quality; shareholder rights; and ownership structure and compensation.

Previous studies have shown that good corporate governance is a significant factor in reducing cash holdings. La Porta et al. (2000), for example, find that good shareholder protection in the U.S. imply that shareholders can force managers to return excess funds to them. Similarly, Dittmar et al. (2003) show that corporate cash holdings in countries in which shareholder rights are not well protected are twice as much as those in countries with good shareholder protection. This literature suggests that improving corporate governance could go a long way toward unlocking Japan's corporate savings.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

The hypothesis of a relationship between improved corporate governance and reduced cash holdings in Japan is confirmed by the empirical analysis carried out on this paper on a panel of about 3,400 Japanese firms. The results suggest that improving corporate governance in Japan – proxied in the regression by an index summarizing company disclosure of governance data – could significantly reduce corporate cash holdings. In addition, corporate governance reform could have significant second round effects. By encouraging higher investment and nominal wages, such reforms would help Japan exit from deflation, which in turn would make holding cash on firms' balance sheets more costly, thus encouraging further corporate spending in a self-reinforcing virtuous circle.

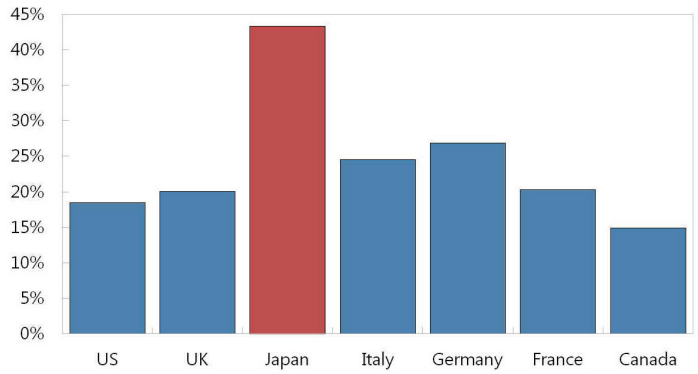
The policy implications of the research presented in this paper are clear: comprehensive corporate governance reform should be an important component of the government's growth strategy. In this regard, recent steps taken by the authorities go in the right direction, including the introduction of the Stewardship Code for institutional investors and encouraging the use of independent outside directors on a "comply or explain" basis. However, in light of the encouraging empirical results presented here, reforms could be more ambitious. In this context, the paper proposes and discusses some possible additional measures, including expanding the use of independent outside directors beyond current plans.

The structure of the paper is as follows. Section II presents some stylized facts regarding Japan's high corporate cash holdings in an international perspective. Section III discusses the determinants of cash holdings, with special attention to Japan-specific factors. Section IV looks in detail at Japan's corporate governance indicators from an international perspective. Section V states our hypothesis. Section VI presents some empirical evidence based on a panel of Japanese firms, which confirms that improving corporate governance could reduce corporate cash holdings in Japan. Section VII discusses progress made in corporate governance reform in Japan so far and provides some policy recommendations. Section VIII concludes.

II. CORPORATE JAPAN'S HIGH CASH HOLDINGS

Cash holdings by Japanese companies are very high compared to other G-7 countries. As it can be seen in the text chart, the average ratio of cash and cash-equivalent holdings to market capitalization of Japanese listed companies during 2004–2012 was above 40 percent in Japan, compared to values in the 15–27 percent range in other G-7 countries.

Listed companies' cash and cash equivalents holdings (% of market capitalization; Average between 2004 and 2012)

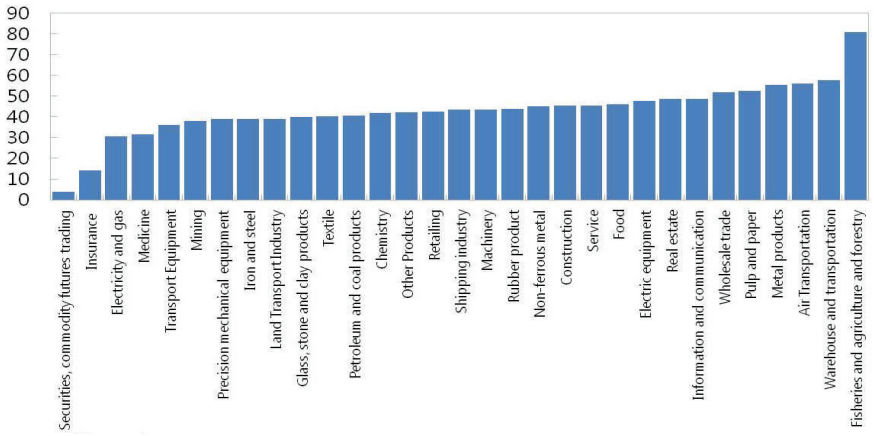


Sources: Bloomberg.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

Japan's high cash holdings are not driven by a particular industrial sector but rather broad-based. In theory, some sectors might face greater need to hold cash than others. However, in Japan, currently most sectors' cash balances as percentage of their market capitalizations are higher than the G-7 average (excluding Japan and Italy) of 24 percent in 2012 and of 19 percent between 2000 and 2012, suggesting that Japan's high cash balance phenomenon is not particularly driven by industry-specific factors (see text chart).

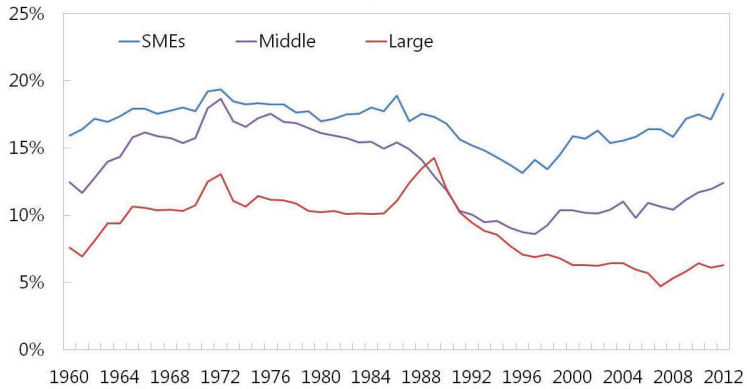
Firms' cash holdings by sector 2013 (%; Cash and cash equivalent/Market Capitalization)



Sources: Bloomberg.

Small and medium enterprises (SMEs) have been the main contributors to high corporate cash balances, but more recently larger companies have also increased cash holdings. A Ministry of Finance survey shows that SMEs have held over 15 percent of total assets as cash and deposits for most years since 1960, and more recently the share has been increasing to around 20 percent. SMEs' high cash holdings were coincident with high debt. Despite the trend of deleveraging across firms after the bubble burst in 1990s, SMEs rely more on borrowing from financial institutions than larger firms, while continuing to hoard cash. Furthermore, the post 2008 crisis trend suggests that larger companies, which had reduced cash holdings from their peak in the late 1980s, have also re-started accumulating cash (text chart).

Cash and Deposit Holdings by Firm Size (% of total assets; Non-financial companies)



Sources: Ministry of Finance of Japan.

The data discussed above suggest that Japan's corporate cash holdings might be excessive and not justified by economic fundamentals. This is consistent with the results of Ivanova and Raei (2014) who find that Japanese firms have exhibited an excessive increase in cash holdings in

DOI: 10.7172/2353-6845.jbfe.2017.1.3

recent years compared to what a standard model of corporate demand for cash would imply. Such excessive corporate savings are likely to be detrimental for the economy. Japan's corporations' preferences for holding a large amount of cash might be preventing them from increasing wages and investment, thus holding back both aggregate demand and potential growth. This view is consistent with the results of Shinada (2012), who uses Japanese firm-level data for 1980–2010 to analyze the impact of cash holdings on business performance. His results suggests that firms' conservative cash management regardless of large investment opportunities increases "side-line" cash, and firms cannot fully utilize investment opportunities to maximize their return on assets. Given the macro-relevance of excessive corporate cash holdings, this paper looks at their determinants and provides some policy recommendations to reduce them.

III. DETERMINANTS OF CASH HOLDINGS

The literature has highlighted various determinants of firms' cash holdings, but there is no overwhelming support for a unified theory. In the early literature, transaction costs were considered as the main determinants of cash levels, and firms with higher marginal costs of cash shortfalls were expected to have higher cash holdings (Miller and Orr 1966; Meltzer 1993; Mulligan 1997). Opler et al. (1999) find empirical support for the trade-off theory, which suggests that firms consider not only the costs but also the benefits of holding cash to derive optimal cash levels. Under this theory, firms tend to hold more cash when they are smaller, when they have more volatile cash flows, and invest more. In addition, the trade-off theory incorporates the effect of agency problems between shareholders and managers, as they tend to view the costs and benefits of cash holdings differently. An alternative theory considered by Opler et al. (1999), for which they also find some support in their analysis, is the financing-hierarchy theory, under which there is no optimal amount of cash and cash balances are simply the outcome of firm profitability and financing needs. While some predictions of the two theories are similar, an important difference is that under the financing-hierarchy theory firms which invest more will have less cash.

Some recent studies on corporate cash holdings highlight the importance of legal protection of investors. Kusnadi and Wei (2011) argue that firms in countries with strong legal protection of minority investors are more likely to decrease their cash holdings compared to firms in countries with weak legal protection. Yung and Nafar (2014) find that the tendency to hold excessive cash motivated by high creditor rights is mitigated in countries with strong investor protection.

Previous cross-country studies have shown that good corporate governance tends to reduce corporate cash holdings. Corporate cash holdings have both costs and benefits, but these differ from the managers' and shareholders' points of view, thus creating an agency problem. Holding cash provides insurance against macroeconomic shocks, which is a benefit from the point of view of both the managers and the shareholders. However, in the absence of strong corporate governance, managers might have a preference for much higher levels of cash holdings compared to those which would maximize shareholders' value. A cross-country analysis carried out by Dittmar et al. (2003) conclude that corporate governance is an important determinant of cash holdings, since their results show that corporate cash holdings in countries in which shareholder rights are not well protected are twice as much as those in countries with good shareholder protection.

In the context of Japan, the economic environment as well as some characteristics of the legal and corporate-governance framework might contribute to large corporate savings, both by increasing managers' preferences for cash holdings and by exacerbating the agency problem. These are discussed in more detail below.

Starting with the economic environment, entrenched deflationary expectations are likely to be an important determinant of large cash holdings in Japan. A deflationary environment lowers

DOI: 10.7172/2353-6845.jbfe.2017.1.3

the opportunity cost of holding cash for both managers and shareholders. As stressed by Bank of Japan (BoJ) Governor Kuroda in a recent speech, deflation encourages holding cash over alternative more productive uses of resources.[2] Even though recent developments suggest that Japan has made progress towards reviving growth and exiting deflation, if firms do not believe that the recovery is long-lasting and that there are profitable investment opportunities, they can be reluctant to reduce their cash holdings.

Moving to factors related to the legal framework, bankruptcy procedures might increase managers' preference for precautionary cash holdings in Japan. Japanese firms might tend to accumulate larger cash balances as a form of insurance against having to file for bankruptcy. Kinoshita (2013) makes the point that, due to the lack of pre-packaged bankruptcy reorganization procedures, the threats faced by managers when filing for bankruptcy in Japan are higher than those faced in the other advanced countries, such as the US and Germany. For example, in Japan management faces a higher threat of loss of initiative in the enterprise and of being prosecuted under civil and criminal law in case of bankruptcy.

As shown in Table 1, which compares Japan to the US and Germany, only a small number of bankruptcy applications are made in Japan for reorganization (as few as 420 in 2012). Even after taking into account differences in the size of the Japanese and US economies, this is in stark contrast with the much higher number of applications made under Chapter 11 in the US. In comparing Japan with Germany, the fact that the German procedure of Insolvenzordnung does not distinguish between reorganization and liquidation needs to be taken into account. Even assuming that half of the Insolvenzordnung procedures will end up in liquidation and half in reorganization, Japan again stands out as having a very low number of reorganization procedures. The fact that reorganization procedures are not widespread in Japan implies that managers might want to hoard cash as a way to avoid having to file for bankruptcy.

Kinoshita (2013) also makes the point that the filing of a bankruptcy substantially increases the threat of dismissal for employees in Japan compared to the US. Japanese employees are therefore likely to be more adverse to bankruptcies compared to US employees, which can also contribute to higher precautionary cash holdings of firms.

Table 1.
Bankruptcy Procedures in Selected Countries

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States (Chapter 11)	9,762	10,882	6,250	5,701	4,688	6,274	10,348	13,583	11,093	9,616
Germany (Insolvenzordnung)	23,061	23,898	23,247	23,291	20,491	21,359	24,301	23,482	23,586	n.a.
Japan (Reorganization)	856	551	592	536	601	906	716	529	519	420

Source: Kinoshita (2014).

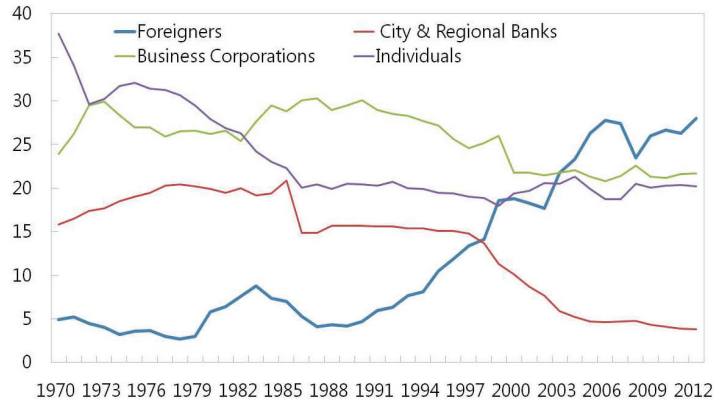
In Japan, takeover regulations and share ownership structure might also not provide enough pressure on managers to act in the shareholders' interests. For example, Kinoshita (2013) argues that there is a significant imbalance in the discretionary powers of the bidder and of the directors of the target enterprise in the Japanese legal system, a situation which might provide disincentives for takeovers. As a consequence, takeovers in Japan are relatively rare, thus reducing pressure on companies to use resources in a productive way.

[2] "*In a state of deflation, the holding of cash or deposits will become a relatively better investment. In fact, cash and deposits held by Japanese firms have reached 230 trillion yen, close to 50 percent of nominal GDP. Persistent deflation has created an environment in which the status quo is better than making investment in new initiatives, and has brought a sense of stagnation to Japan.*", in "Overcoming Deflation: The Bank of Japan's Challenge" available at http://www.boj.or.jp/en/announcements/press/koen_2013/ko131010a.htm/

DOI: 10.7172/2353-6845.jbfe.2017.1.3

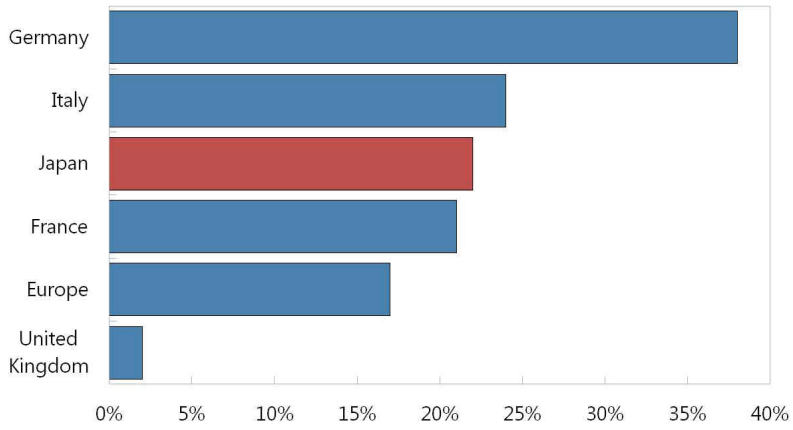
Kinoshita (2013) also argues that cross-shareholding might be another contributing factor to high cash holdings, because corporations who hold stocks of other corporations might have a greater interest in so-called 'individual benefits' – such as securing credit, developing a deeper business relationship with the issuer, and pursuing the self-defense of the management bodies of both enterprises – than in the maximization of stock values. As it can be seen in the text chart, cross-shareholding in Japan is still widespread and above the European average. Against this background, many corporations in Japan, in exercising their shareholder rights, may not place adequate pressure on managers of firms whose stock they own to pursue higher monetary returns.

Share Holding Ratio by Investor Category (%; on a value basis)



Sources: Tokyo Stock Exchange.

Share Holding Ratio by Non-financial Companies 2012

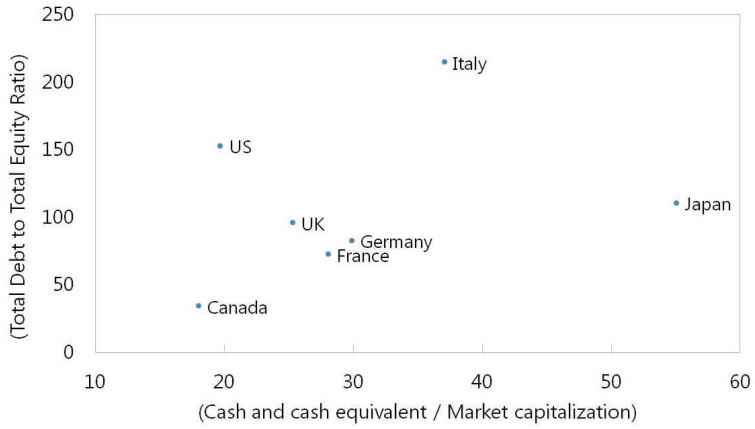


Sources: The Financial Services User Group.

The role of banks in financing firms' activities can also affect corporate cash holdings in Japan. Pinkowitz and Williamson (2001) have argued that Japanese corporate cash balances are affected by the monopolistic power of banks. Their analysis suggests that banks have an interest in extracting rents from the corporate sector by pushing companies to hoard cash rather than using it to pay down their debt. Pinkowitz and Williamson (2001) argued that this effect is important in Japan but became less strong over time as banks' monopolistic power decreased starting from the late 1980s, due to regulatory changes and financial sector shocks. However, as shown in the text chart, Japan's debt-to-equity ratio, which can be interpreted as a broad measure of bank's power, is still higher than in most G-7 countries.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

Dept to Equity and Cash Holding Ratio 2012 (%; Listed Non-financial Firms)



Sources: Bloomberg.

Weaker corporate governance in Japan compared to other advanced countries can also make solving the agency problem more difficult. As discussed in more detail in the next section, some internationally comparable indicators suggest that corporate governance might be weaker in Japan compared to other advanced countries. As a consequence, managers in Japan might have more leeway to pursue individual benefits rather than maximize shareholders value, thus choosing to hold more cash. Nakajima (2013) argues that weak market monitoring mechanisms and weak corporate governance make it difficult to solve the agency problem in Japan, which results in high cash holdings.

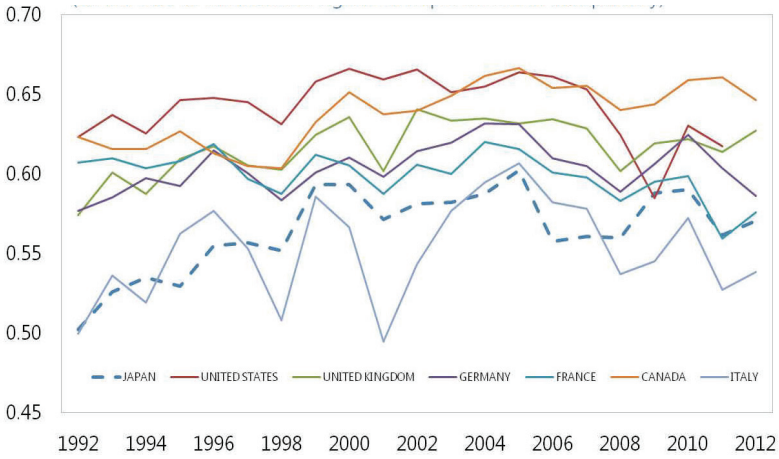
The above discussion suggests that corporate governance and legal framework reforms can be important in Japan to encourage companies to reduce cash holdings. The next section looks more in detail at Japan's corporate governance indicators from an international perspective.

IV. CORPORATE GOVERNANCE IN JAPAN: AN INTERNATIONAL COMPARISON

An international comparison based on the Corporate Governance Quality (CGQ) index developed by De Nicolò, Laven and Ueda (2006) suggests that Japan scores low compared to other G-7 countries. The CGQ index is constructed at the country level using accounting and market data of samples of listed non-financial firms. The index is a simple average of three proxy measures of outcomes of corporate governance in the dimensions of accounting disclosure and transparency. As such, it gives an account of the de facto, as opposed to de jure, corporate governance environment in a given country. As shown in the text chart, the CGQ dynamics suggests that although Japan's corporate governance quality has improved since the early1990s, it is still the second lowest in the G7 after Italy.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

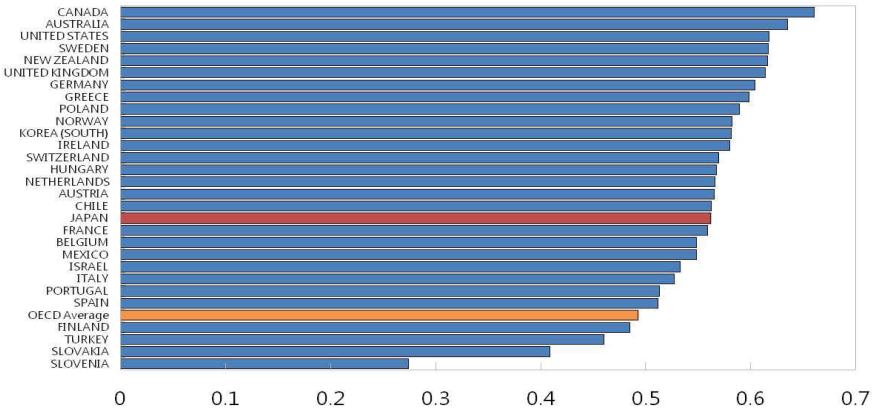
Corporate Governance Quality Index (An increase of this indicator signals an improvement in transparency)



Sources: IMF, Corporate Vulnerability Utility.

A disaggregated analysis of the various components of the CGQ index suggests that Japan is doing relatively well in terms of accounting standards but less so along other important transparency dimensions. As shown in the text charts, Japan's level in the CGQ is higher than the OECD average (although still lower than most G-7 countries). Looking at the sub-components of the CGQ index, Japan is above the OECD average for the sub-indexes on "accounting standards" – a simple measure of the amount of accounting information disclosed by firms – and for the one on "stock-price synchronicity" – which aims to capture the extent to which a poor governance environment leads to investors' inability to distinguish good performers from bad performers, and of poor governance associated with inefficient connected lending. However, Japan scores quite low and considerably below the OECD average for the CGQ sub-index on "earnings smoothing" which tracks the extent to which published accounts might conceal the true performance of firms.

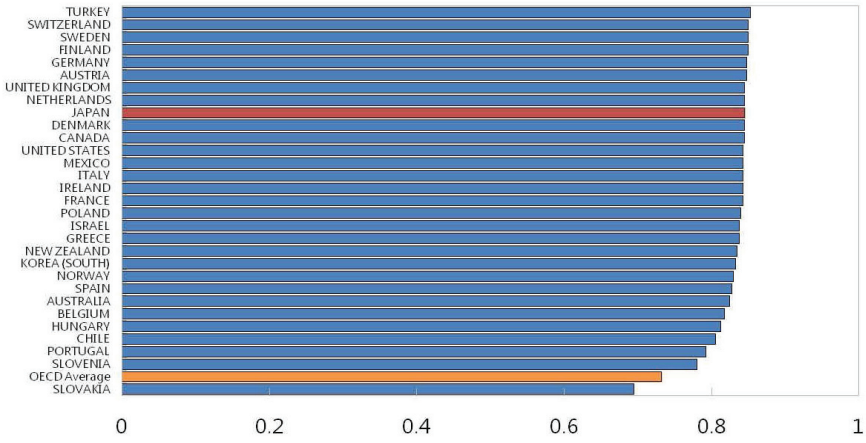
Corporate Governance Quality Index 2011 (An increase of this indicator signals an improvement in transparency)



Sources: IMF, Corporate Vulnerability Utility.

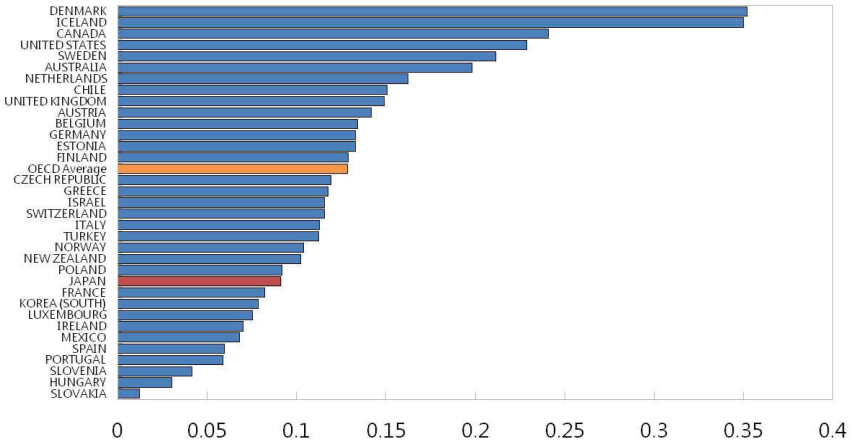
DOI: 10.7172/2353-6845.jbfe.2017.1.3

Subindex: Accounting Standards Indicator 2011 (An increase of this indicator signals an improvement in transparency)



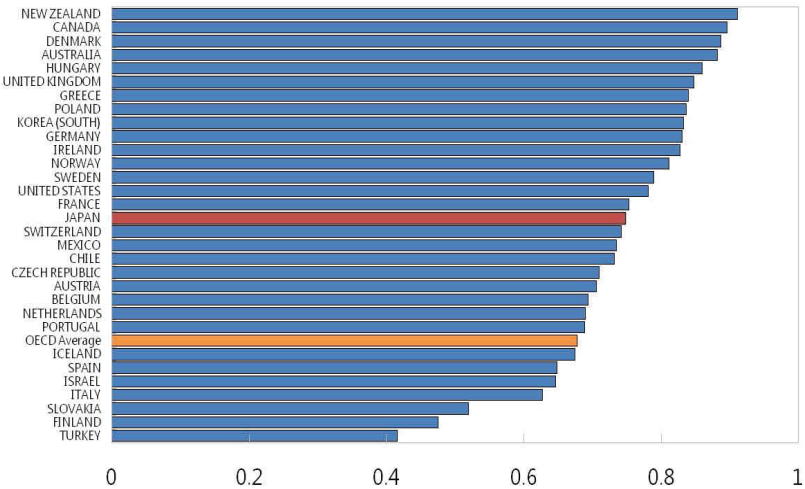
Sources: IMF, Corporate Vulnerability Utility.

Subindex: Earnings Smoothing Indicator 2011 (An increase of this indicator signals an improvement in transparency)



Sources: IMF, Corporate Vulnerability Utility.

Subindex: Stock Price Synchronicity Indicator 2011 (An increase of this indicator signals an improvement in transparency)

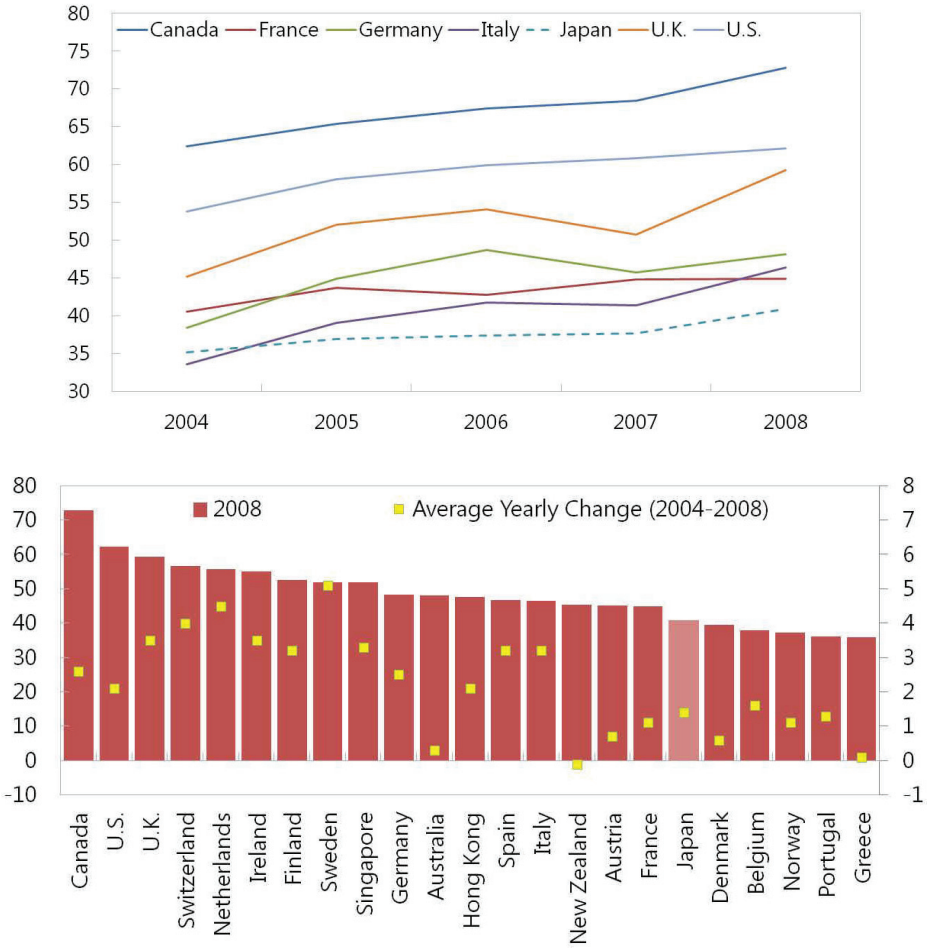


Sources: IMF, Corporate Vulnerability Utility.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

A different indicator which summarizes several de jure corporate governance firm-level attributes suggests that Japan does not fare well in an international comparison. The Firm Level Governance (FLG) index developed by Aggarwal et al.(2010) summarizes 41 firm-level governance attributes which cover four broad sub-categories: i) Board, including independence of directors and how the Board conducts its work; ii) Audit, focusing on independence and the role of auditors; iii) Anti-Take-Over Provisions, which includes some aspects of shareholder rights; and iv) Compensation and Ownership, which deals with setting and monitoring of executive and directors' compensation and stock ownership. When corporate governance is measured using the FLG, it can be seen that Japan scored consistently lower than any other G-7 country over the years. Even compared to a wider sample of advanced countries, Japan's corporate governance performance is low both in terms of level and progress made in recent years (text charts).

Firm-Level Governance Index (An increase of this index signals an improvement in corporate governance)



Sources: Aggarwal et al. (2010).

The discussion in Section III and the evidence presented in this section suggest that there is scope to improve corporate governance in Japan, and that corporate governance reforms can encourage a more productive use of resources by firms. As suggested by Kinoshita (2013), corporate governance regulations and practices are likely to contribute to excessive corporate cash holdings in Japan. Furthermore, an international comparison based on the CGQ and FLG indexes suggests that there is scope to improve Japan's corporate governance standards and bring it closer to that of other advanced countries. The next Section focuses more in detail on what could be the impact of improving corporate governance in Japan by presenting some regression results for a panel of Japanese companies.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

V. HYPOTHESIS DEVELOPMENT

Given the literature and the empirical evidence discussed above, we developed the hypothesis that improving corporate governance in Japan would, by increasing shareholder power and putting more pressure on firms' managers to use resources efficiently, reduce excessive corporate cash holdings.

The rest of the paper is devoted to empirically testing this hypothesis (i.e. testing a relationship between improved corporate governance and reduced corporate cash holdings) in Japan.

VI. CORPORATE GOVERNANCE AND CASH HOLDINGS IN JAPAN: EMPIRICAL ANALYSIS

In this section the impact of corporate governance on corporate cash holdings is assessed by estimating a model for a panel of Japanese firms which include a firm-specific governance index. The data set includes 3,412 non-financial firms for the 14 years between 2000 and 2013 (or less, depending on data availability). The sample consists of all listed companies in Japan, excluding the ones for which data are not completely available over the coverage period. The dependent variable is the stock of cash and cash equivalents as a percentage of market capitalization, which is regressed on variables which we expect to impact corporate cash holdings. The effect of corporate governance in the regression is captured by the "Proprietary Bloomberg Score" an index which ranges from 0.1 for companies that disclose a minimum amount of governance data to 100 for those that disclose every data point collected by Bloomberg. Each data point is weighted in terms of importance, with board of directors data carrying a greater weight than other disclosures. The score is also tailored to different industry sectors. In this way, each company is only evaluated relative to its industry sector. The choice of this variable as a proxy for corporate governance was mostly driven by data availability at the firm level (see the Appendix for more details on variables' definitions and data sources).

Regressors also include controls for other factors which we expect to affect cash holdings. According to the trade-off theory (Opler et al. 1999; Dittmar et al. 2003) firms hold more cash when they are smaller, have higher investment opportunities, and have higher cash flow concerns, because these are characteristics which either increase the cost of cash shortfalls or increase the cost of raising funds. As proxies for firms' size and investment, the regression includes the number of employees and the value of common stock – which are expected to have negative signs – and capital expenditures, which is expected to have a positive sign.[3] As a proxy for cash flow concerns, the regression includes the cash conversion cycle, defined as Inventory Turnover Days + Account Receivable Turnover Days – Accounts Payable Turnover Days. This variable is expected to have a positive sign, since the trade-off theory postulates that firms which take longer to convert their resources into cash want to keep a higher stock of cash. The regression also includes the free cash flow per share which is expected to have a positive sign, in accordance with predictions of the financing-hierarchy theory that firms with high cash flows will hold more cash. In order to capture the effect of bank power on cash holdings stressed by Pinkowitz and Williamson (2001), the debt-to-equity ratio is also included. This variable is interpreted as a broad measure of banks' monopolistic power in lending and it is expected to have a positive sign. Lags of the dependent variable are also included to control for autocorrelation and habit formation in cash holding.

[3] These three variables enter the regression in logarithmic form.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

The results suggest that better corporate governance reduces cash holdings. Table 2 summarizes the panel regression for various estimation techniques. Regardless of the specific estimation method used, the indicator of corporate governance always has a negative sign, suggesting that improving corporate governance would reduce corporate cash holdings in Japan. The coefficient is also significant at the 10 percent level for fixed effects estimation with default standard errors and at the 1 percent level using random effects and Arellano Bond estimations. If fixed effects with robust standard errors are used, the coefficient is still negative but the level of significance is reduced to 15 percent. A Hausman test rejected the null hypothesis that a random effect model would be statistically different from a fixed effects one, suggesting that a fixed effect model is preferred.

Table 2.
Determinants of Cash Holdings in a Panel of Japanese Firms: Regression Results[1)]

	Fixed Effects	Fixed Effects (Robust SE)	Random Effects	Arellano Bond (Robust SE)
Dependent Variable: Cash Holdings in Percent of Market Capitalization				
Governance Index	-0.089 [-1.82]*	-0.089 [-1.44][2)]	-0.380 [-8.59]***	-0.565 [-4.73]***
Log of Common Stock	-0.380 [-0.69]	-0.380 [-0.78]	0.280 [1.35]	0.092 [0.16]
Log of Number of Employees	8.179 [4.45]***	8.179 [2.81]***	2.002 [5.17]***	10.513 [2.13]**
Cash Conversion Cycle	-0.009 [-0.72]	-0.009 [-0.37]	-0.003 [-0.82]	-0.013 [-0.67]
Log of Capital Expenditure	-1.838 [-3.42]***	-1.838 [-2.30]**	-2.187 [-7.78]***	-0.268 [-0.31]
Debt-to-Equity Ratio	0.010 [3.70]***	0.010 [1.61]	0.005 [2.61]***	0.010 [1.83]
Free Cash Flow per Share	0.007 [2.77]***	0.007 [2.20]**	0.002 [1.18]	0.015 [3.90]***
Lagged Dependent Variable (t–1)	0.095 [7.26]***	0.095 [1.93]**	0.786 [98.32]***	0.166 [3.68]***
R-squared (overall)	0.060	0.060	0.647	…

* denotes significance at 10% level, ** significance at 5% level, and *** significance at 1% level.
1) T-statistics are reported in parenthesis.
2) Level of significance is 15 percent.

Source: IMF Staff Calculations.

Several other factors also have an impact on cash holdings. In accordance with the prediction of the trade-off theory, firms' size as captured by the log of common stock has a negative coefficient when fixed effects are used. However, the coefficient turns positive for other estimation techniques and is in general not significant. The number of employees has a positive and highly significant coefficient, which is in contrast with the prediction of the trade-off theory, but could be explained in the Japanese context by the "aversion to bankruptcy" channel highlighted by Kinoshita (2013), and discussed in Section III, i.e. firms which are more labor-intensive might accumulate more cash as a way to avoid bankruptcies and protect employment. The cash conversion cycle has a negative sign in contrast with the predictions of the trade-off theory but it is not significant. The cash flow per share has the expected positive sign according to the financing-hierarchy theory and

DOI: 10.7172/2353-6845.jbfe.2017.1.3

is statistically significant. This result is also consistent with the finding by Horioka and Terada-Hagiwara (2013) on a panel of firms from 11 Asian countries. The debt-to-equity ratio has a positive and mostly significant coefficient, confirming the result by Pinkowitz and Williamson (2001) that higher banks' monopolistic power tends to push companies to hoard cash in Japan. The impact of capital expenditure is negative and mostly significant, which is contrary to the trade-off theory, but can be explained in terms of the financing-hierarchy theory.

The estimated impact of improving corporate governance on cash holdings in Japan is sizeable. In line with findings from other cross-country governance indicators mentioned above, the corporate governance proxy used in the regressions also indicates that Japanese firms' governance score on average was lower than that of other advanced countries, except Germany, for most years between 2000 and 2013 (or less depending on data availability). Table 3 shows estimates of how much improving corporate governance – as measured by the index we use in the regression – could contribute to reducing cash holdings on the basis of our results. Specifically, the table shows by how much cash holdings could be reduced for a representative Japanese firm if the index were to improve from the Japanese firms' panel average of 41.5 to the maximum in Japanese firms' panel of 62.5; and the theoretical maximum value that the index could take of 100. The results vary depending on which regression coefficients are used amongst the ones presented in Table 2, which correspond to various estimation methods. Overall, Table 3 suggests that the effect of improving corporate governance on cash holdings could be sizeable, since the estimated reductions in the cash-to-market capitalization ratio range from about 2 to about 33 percentage points.

Table 3.
Estimated Reduction in Cash Holdings Due to Improvement in Corporate Governance
(cash to market capitalization, percentage points)

	Fixed Effects	Random Effects	Arellano-Bond	Average of Estimation Methods
Average to Maximum in Panel (index from 41.5 to 62.5)	1.9	8.0	6.9	5.6
Average to Theoretical Maximum (index from 41.5 to 100)	5.2	22.2	33.1	20.2

Source: IMF staff calculations.

In interpreting these results some caveats need to be kept in mind. First of all, the results only refer to first round effects of improving corporate governance on cash holdings. If firms use the reduction in cash to finance increases in wages and investment, this will stimulate the economy and help Japan exit from deflation. A higher inflation environment, in turn, will make hoarding cash less attractive, giving further incentives to firms to reduce cash holding beyond the amount captured in the regressions. It is also important to keep in mind that the index used in the regression refers solely to disclosure of data related to corporate governance. As such, it is not necessarily a perfect proxy of corporate governance, because the fact that data are disclosed does not guarantee in itself that corporate governance practices are improved. It should therefore not be concluded that the only policy recommendation flowing from this analysis is to just improve disclosure. Rather, this empirical analysis can be seen as supporting the more general point that corporate governance and legal-framework reforms can contribute to reducing corporate cash holdings. With this in mind, the next section will discuss the progress made so far in improving corporate governance in Japan, and discuss some options for further reform.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

VII. OPTIONS FOR CORPORATE GOVERNANCE REFORM IN JAPAN

The discussion and empirical analysis presented in the previous section suggest that corporate governance reform should be part of Japan's growth strategy. Such reforms would help remove some of the bottlenecks of the legal and corporate governance framework which encourage high corporate cash holdings and prevent a more pro-growth use of resources. Corporate governance reforms would also enhance the transmission of the BoJ's Quantitative and Qualitative Easing (QQE) framework, by reducing cash holdings, contributing to investment and wage growth and therefore stimulating actual and expected inflation.

The government has made a step forward for needed corporate governance reform. In June 2014, the Companies Act was amended to encourage the appointment of outside directors. The amended Companies Act requires listed companies who do not appoint outside directors to provide an explanation at their annual shareholders' meeting. Underpinning the "comply or explain" rule is the principle that outside directors should be appointed at listed companies unless there are good reasons for not doing so.

Japan also introduced in February 2014 a Stewardship Code aimed at increasing fiduciary responsibilities of institutional investors. Such a code will encourage investors to push managers to maximize shareholders' value rather than pursuing individual benefits. The JPX-Nikkei 400 Index which was launched in January 2014 is also expected to improve corporate governance. The JPX-Nikkei 400 Index is Japan's first broad stock index that includes only profitable companies with good corporate governance. The index is expected to have a positive impact on corporate behavior by exerting pressure to improve profitability and corporate governance.[4]

Indeed, recent developments suggest that the introduction of the Stewardship Code and the JPX-Nikkei 400 Index might result in Japanese institutional investors taking a more active role in improving firms' corporate governance. Japan's nearly 130-trillion yen ($1.3 trillion) public pension fund (GPIF) accepted the Stewardship Code, a move expected to improve equity returns through more engagement with companies whose stock it owns. Adoption of the code by GPIF is expected to encourage other institutional investors to follow suit, and in fact as of February 2015, 184 institutional investors, including most of the largest Japanese asset managers, had subscribed to the code. JPX-Nikkei 400 is becoming increasingly popular benchmark amongst individual and institutional investors, and the assets under management of funds linked to the index reached more than 2 trillion yen as of end-January 2015.

In addition, the Tokyo Stock Exchange (TSE) adopted a corporate governance code on June 1, 2015. The corporate code aims at complementing the Stewardship Code. The code contains requirements for companies to i) appoint at least two outside directors on a "comply or explain" basis; and ii) to explain their rationale for cross-shareholding and anti-takeover measures.

Despite these positive developments, since the empirical analysis presented in this paper suggests that the gains from improving corporate governance could be large, reforms aimed at discouraging excessive corporate savings could be more ambitious. In particular, the following additional measures could be considered:

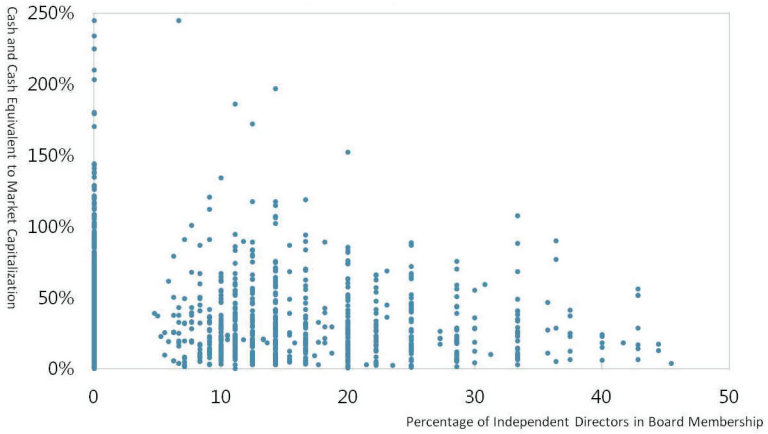
- Expanding the use of outside directors and reinforcing their independence. The percentage of listed companies which have appointed outside directors increased from 47 percent in 2013 to 61 percent in 2014: however the percentage of outside directors out of total directors remain low at 8 percent, reflecting the fact that most companies only have one or two outside directors. This ratio is extremely low compared to other advanced countries. For example, the proportion of independent outside directors is about 70 percent in the United States, 50 percent or higher in the United Kingdom, and greater than 30 percent in South Korea (Miyajima 2012). Most other advanced countries require a substantial number of outside directors either in a mandatory way

[4] Central to the calculation of the JPX-Nikkei 400 is a three-year-record of return on equity employed (ROE), along with various qualitative measures of corporate governance, such as independent directors and reports in English.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

(more than half of the board in the US, more than one quarter of the board in Korea) or under a "comply or explain" approach (e.g. more than half of the board in the UK, an "appropriate number" in Germany, and half of the board in France). Considering the experience of other countries, there seems therefore to be scope for expanding the use of outside directors even more, either by adopting a US-style mandatory approach, or by increasing the number of independent outside directors required under the "comply or explain" approach, as done for example in the UK and France. While having multiple independent directors in the board may not be sufficient, by itself, to reduce cash holdings, it seems an important determinant, suggesting that it should be a necessary and important component of comprehensive corporate governance reform. As shown in the text chart, although the level of cash holdings varies among companies with zero or a very low share of independent directors, it is rare for companies with high shares of independent directors to have extremely high cash holdings. At the same time, very high cash holdings tend to be associated with relatively low shares of independent directors. All 67 cases of Japanese non-financial listed companies with greater than 100 percent cash-to-market capitalization ratio in 2013 occurred in companies whose share of independent directors in total board membership is less than 30 percent.

Cash Holdings and Independent Directors (Non financial Listed Companies in Japan; 2013)



Sources: Bloomberg.

- Measures to enhance board diversity. Diversification of the board members can balance decision making by bringing different points of view. According to a study of Fortune 500 companies (Catalyst 2007), companies with more female board directors outperform those with the least, for several financial measures such as Return on Equity, Return on Sales and Return on Invested Capital. In Japan, there is scope to improve the representation of women and foreigners in boards. For example, while women account for 20.7% of board members in the U.K and 16.9% in the U.S., the figure in Japan is only a 1.1%.5 Having more women in boards would also create role models for working women and generate synergies with reforms aimed at increasing female labor participation, which are important for growth (see Steinberg and Nakane 2012). Having more foreigners in corporate boards could also help Japanese corporations in expanding abroad and exploring new markets, which would help counteract the effects of Japan's declining and aging population.
- Implementation of tax and regulatory reforms which would reduce incentives for shareholders to pursue "individual" rather than monetary benefits. In this context, limits or measures which create incentives to end excessive cross-shareholdings could be considered. For example, tax reforms were successful in Germany in the early 2000s in reducing cross-shareholding, although

5 See http://www.catalyst.org/knowledge/women-boards.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

it increased again from 2007. Also, cross shareholdings in OECD countries are frequently limited by law (OECD 2007). Similar tax and legal reforms could be considered in Japan.

- Measures aimed at reducing the threat faced by firm managers in case of filing for bankruptcy, for example by introducing pre-packaged reorganization plans such as those available in the US under Chapter 11. Such measures would reduce the incentives for corporations to hold cash as insurance against filing for bankruptcy. Also it is important that the government follows up on its plans to propose legislation which would limit business owners' individual liability in case of bankruptcy, since such a measure would reduce the threat associated with filing for bankruptcy. Plans to encourage creditor-led debt workout to make it easier for companies to have debt forgiven, a move aimed at encouraging quicker corporate rehabilitation, would also help if implemented.
- Removing bottlenecks which prevent takeovers, such as reducing the asymmetry between the duties of the bidder and those of the target enterprise in takeover regulations and introducing a more favorable tax treatment for the owners of stocks of companies which are acquired. These measures would encourage takeovers, therefore putting pressures on managers to prioritize profitability over cash holdings as cash-rich companies are likely to be considered takeover targets.

VIII. CONCLUSIONS

This paper argues that Japan's excessive corporate savings might be holding back growth, by preventing a more efficient use of resources. The literature has identified various determinants of cash holdings, including good corporate governance, which usually contributes to reducing excessive corporate savings by putting pressure on managers to act in shareholders' interests. This paper argues that this channel is likely to be particularly important in Japan, given its low scores, compared to other G-7 countries, in terms of corporate governance indexes.

The hypothesis of a relationship between improving corporate governance and unlocking corporate savings in Japan is confirmed by the empirical analysis carried out in the paper. Panel regressions on a panel of about 3,400 Japanese firms suggest that improving corporate governance in Japan – proxied by an index summarizing company disclosure of governance data – could significantly reduce corporate cash holdings.

On the basis of this empirical analysis, it can be concluded that comprehensive corporate governance reform should be a key component of Japan's growth strategy. The steps recently taken by the authorities in this area – such as the introduction of the Stewardship Code for institutional investors and plans to encourage the use of outside directors on a "comply or explain" basis – go in the right direction. However, reforms could be more ambitious. In this regard, possible additional measures could include expanding the use of outside directors beyond current plans. With such additional measures, we expect that firms' resources will be used in a more efficient way, such as additional investment and increase in wages, and that this will lead to improvements in both potential and short term growth for the whole economy. We also hope that the reported finding in this study can be useful for policy-makers to consider corporate governance reforms aimed at unlocking corporate savings.

Acknowledgements

We are grateful to Nobuyuki Kinoshita for very useful discussion. We also thank an anonymous referee, Dennis Botman, Stephan Danninger, Jerry Schiff, and participants in the IMF seminar held in Tokyo on "Towards a more dynamic business sector" for their comments.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

References

Aggarwal, Reena, Isil Erel, Miguel Ferreira and Pedro Matos, 2010, "Does Governance Travel Around the World? Evidence from Institutional Investors," Fisher College of Business Working Paper No. 2009-008 (Ohio: the Ohio State University).

Catalyst, 2007, "The Bottom Line: Corporate performance and women's representation on boards".

De Nicolò, Gianni, Luc Laeven, and Kenichi Ueda, 2006, "Corporate Governance Quality: Trends and Real Effects," IMF Working Paper06/293 (Washington: International Monetary Fund).

Dittmar, Amy, Jan Mahrt-Smith, and Henri Servaes, 2003, "International Corporate Governance and Corporate Cash Holdings", Journal of Financial and Quantitative Analysis Vol. 38, No. 1, March 2003.

Fazzari, Steven M., Hubbard, R. Glenn, and Bruce C. Petersen, 1988, "Financing Constraints and Corporate Investment", Brookings Papers on Economic Activity Vol. 19, pp. 141–195.

Horioka, Charles Yuji, and Akiko Terada-Hagiwara, 2013, "Corporate Cash Holdings in Asia", NBER Working Paper 19688.

Ivanova, Anna, and Faezeh Raei, 2014, "Corporate Cash Holdings: Are German Companies Different?". Forthcoming, IMF Working Paper.

Jensen, Michael C. and William H. Meckling, 1976, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure", Journal of Financial Economics 3, pp. 305–360.

Keynes, John Maynard, 1934, "The General Theory of Unemployment". In: Interest and Money. Harcourt Brace, London.

Kinoshita, Nobuyuki, 2013, "Legal Background to the Low Profitability of Japanese Enterprises," Center on Japanese Economy and Business Working Papers No. 316 (New York: Columbia University).

Kinoshita, Nobuyuki, 2014, "Comparison of Enterprise Law in Japan, Germany and the United States", slides presentation.

Kusnadi, Y., Wei, K.C.J., 2011, "The determinants of corporate cash management policies: Evidence from around the world", Journal of Corporate Finance, 17 (3), pp. 725–740.

La Porta, Rafael, Lopez-de-Silanes, Florencio, Shleifer, Andrei, and Robert. W. Vishny, "Agency Problems and Dividend Policies Around the World," Journal of Finance Vol. 55, pp. 1–33.

Meltzer, A. H., 1993, "The Demand for Money: A Cross-Section Study of Business Firms," Quarterly Journal of Economics, 77 (1993), Vol. 77, pp. 405–422.

Miller. M.H. and D. Orr, 1966, "A Model of the Demand for Money by Firms," Quarterly Journal of Economics Vol. 80, pp. 414–435.

Miyajima, Hideaki , 2012, "Pros and Cons of Mandating the Appointment of Outside Directors: Based on new empirical testing" available online at http://www.rieti.go.jp/en/papers/contribution/miyajima/03.html

Mulligan, C. B., 1997, "Scale Economies, the Value of Time, and the Demand for Money: Longitudinal Evidence from Firms" Journal of Political Economy Vol. 105, pp. 1061–1079.

Myers, Stewart. C., and Nicolas Majluf, 1984, "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have," Journal of Financial Economics Vol. 13, pp. 187–221.

Nakajima, Kan, 2013, "Ko-pore-to gabanansu to kigyou no genkin hoyu" (Corporate Governance and Companies' Cash Holdings), Securities Analysts Journal 2013.6 (Tokyo: The Securities Analysts Association of Japan). Nakano, Makoto and Takasu,Yusuke, 2013, "Nihon kigyo no genkin hoyu kettei youin bunseki- shoyu kouzou to torishimariyakukai tokusei no shiten kara" (Determinants of Japanese Companies' Cash Holdings – From the point of view of the board of directors and ownership structure characteristics). HERMES-IR No.161 (Tokyo: Hitotsubashi University).

OECD, 2007, "Lack of Proportionality Between Ownership and Control: Overview and Issues for Discussion". Issued by the OECD Steering Group on Corporate Governance.

Opler, Tim, Pinkowitz, Lee, Stulz, Rene, and Rohan Williamson, 1999, "The Determinants and Implications of Corporate Cash Holdings," Journal of Financial Economics, Vol. 52, pp. 3–46.

Lee Pinkowitz and Rohan Williamson, 2001, "Bank Power and Cash Holdings: Evidence from Japan", Review of Financial Studies, Vol. 14, Issue 4, pp. 1059–1082.

Shinada, Naoki, 2012, "Firms' Cash Holdings and Performance: Evidence from Japanese Corporate Finance," RIETI Discussion Paper Series 12-E-031.

Steinberg, Chad, and Masato Nakane, 2012, "Can Women Save Japan?" IMF Working Paper 12/248 (Washington: International Monetary Fund).

Yung, K., Nafar, N.A., 2014, "Creditor rights and corporate cash holdings: International evidence", International Review of Economics and Finance, 33, pp. 111–127.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

APPENDIX

A. Benchmark Model

An econometric model of determinants of corporate cash holdings was estimated for a panel of 3,412 non-financial Japanese firms for the 14 years between 2000 and 2013 (or less, depending on availability). Regressions were conducted using both fixed and random effects, as well as Arellano-Bond estimation with one lag.

The dependent variable is cash and cash equivalent in percent of market capitalization, available from Bloomberg.

Explanatory variables and data sources are as follows:

- The proxy for corporate governance is the "Proprietary Bloomberg Score", an index which ranges from 0.1 for companies that disclose a minimum amount of governance data to 100 for those that disclose every data point collected by Bloomberg. Each data point is weighted in terms of importance, with board-of-directors data carrying greater weight than other disclosures. The score is also tailored to different industry sectors. In this way, each company is only evaluated in terms of the data that is relevant to its industry sector.
- Common stock (which enters the regression in logarithmic form), value of common stock as reported by the company, from Bloomberg.
- Number of employees of the firm (which enters the regression in logarithmic form), from Bloomberg.
- Cash conversion cycle defined as Inventory Turnover Days + Account Receivable Turnover Days – Accounts Payable Turnover Days, from Bloomberg.
- Capital expenditure (which enters the regression in logarithmic form), from Bloomberg.
- Debt-to-equity ratio, defined as the sum of short term and long term borrowings divided by total shareholder's equity, multiplied by 100 from Bloomberg.
- Free cash flow per share, calculated as free cash flow (cash from operations – capital expenditures) divided by the average basic number of shares for the period, from Bloomberg.

DOI: 10.7172/2353-6845.jbfe.2017.1.3

Global Thermoeconomics

Mario W. Cardullo
The Belfield Group, Inc., Alexandria, Virginia, USA
mario_cardullo@yahoo.com

Manhong Mannie Liu
Renmin University, Beijing, The People's Republic of China
maniemm@gmail.com

Received: 9 August 2016 / Revised: 30 October 2016 / Accepted: 14 February 2016 / Published online: 17 March 2017

ABSTRACT

This paper illustrates that basic global economic concepts can be directly related to the First and Second Laws of Thermodynamics. We believe that all economic returns are from nothing except from current and past human expenditure of human energy; this is the result of the First Law of Thermodynamics. It is shown that everything is a product of energy in the form of labor and that the basic principle of Labor Theory of Value is still valid and this principle is validated not relying on economics and finance models, rather on thermodynamic principles. This is illustrated by the development of the Labor Value Equation based on the application of the First and Second Law of Thermodynamics and how it can impact employment, asset valuation, supply/demand, productivity, global conflict, global reserve currency and global stability.

JEL Classification: C; G; J; P; F; A

Keywords: Thermodynamics, Labor Theory of Value, Labor Value Equation, Global Reserve Currency, Financial Stability, Employment, Asset Valuation, Productivity

1. INTRODUCTION

"What has gone wrong with the world?". This is the opening line of the seminal work by Nobel Laureate Frederick Soddy in 1933 on thermodynamic economic theory. Today we still are trying to answer this question even though over 80 years have passed. While science and technology have given a higher standard of living to many people, yet many others are still in poverty, "insecure, being now never free from the specter of unemployment and consequent submersion into destitution and degradation." The objective of this paper is to present a system study of global finance based on the Laws of Thermodynamics to investigate the nature of capital instability.

The use of thermodynamic concepts has been primarily applied to environmental, energy, and general economics. Bryant has used the gas laws, the distribution of income, the Laws of Thermodynamic applied to economics processes. However, the basic Laws of Thermodynamics have lacked a global approach by many prior academic contributions.

Ministry of Science and Higher Education
Republic of Poland

The creation of the English-language version of these publications is financed in the framework of contract No. 768/P-DUN/2016 by the Ministry of Science and Higher Education committed to activities aimed at the promotion of education.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

It appears that the financial markets are measured in ways that only indicate the symptoms. It is like a group of individuals who are blind, feeling an elephant to describe what they are feeling. While the measures are symptomatic they are only partial indicators of the underlying processes and usually are lagging, or leading, or shifting. In all instances, we believe it is energy that produced by labor and the productivity based on human energy consumption that drives the system.

In this paper, we argue that everything is a product of energy in the form of labor and that the basic principle of Labor Theory of Value is still valid. We validate this principle not relying on economics and finance models, rather on thermodynamic principles. We believe it is the energy created by labor that is the core element of the system, and is the fundamental variable to explain the nature of capital market and of the entire financial systems.

While economics has a social science basis, thermodynamics is based on physical science, yet both are different views of the same universe. This multiplicity results in a more total system understanding of the basis of interactions of human agents in developing value. Together, these approaches result in 'global thermoeconomics'.

The nature of capital is multilevel; it can consist of property, resources, human labor and various other assets. But it is the ability to trade one asset for another asset. In this regard, capital like money can be used to acquire another asset like someone's labor or a physical asset. In a way, it is barter because liquid capital is only a way of exchange. From a market perspective, an asset has value only because someone wants it. If that asset was placed in a forest or desert or a high mountain and no one was there to claim it, then it would have no value. So, for an asset of any type to have value someone must want it otherwise it would be valueless.

However, while its value depends on someone desiring it, the asset has a more fundamental value in the thermodynamic sense. That thermodynamic value is the amount of human labor expended to produce it. That must be the total labor cycle from basic resource acquisition to the final asset. This includes the labor to build any device and the material in that cycle allocated to that device. Thus, nothing on this planet is produced de novo, that is, without human labor.

Therefore, the Laws of Thermodynamics hold and economic processes are not an exception. Thermodynamics consist of two fundamental laws:

- the First Law of Thermodynamics is the law of conservation of energy or energy balance. The first law of thermodynamics shows the equivalence between heat and work but not the direction of transformation.
- the Second Law of Thermodynamics places limitations on the direction of transformation and that processes evolve in one direction only.

Exploring these laws in the framework of capital markets is the basis of this paper.

2. LITERATURE REVIEW

The seminal work by Nobel Laureate Frederick Soddy in 1933 on thermodynamic economic theory can be considered the foundation of this theory. Other initial formulations of these concepts and relationships to economics and resources followed. This initial development has been expanded upon from both resource economics and valuation. The evolution of Georgescu-Roegen's thought about valuation and the environmental and social policy recommendations arose out of his concepts of bio-economic theory. These various studies have not been without controversy. Bryant has used the gas laws, the distribution of income, the Laws of Thermodynamic applied to economics processes. A measure based on human expenditure has been proposed by Cardullo and Liu, which expands existing studies.

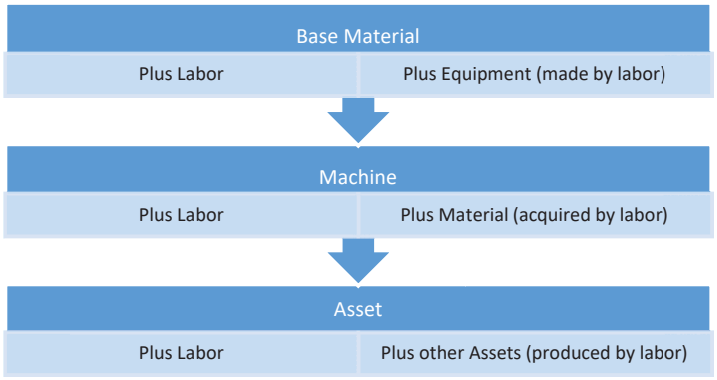
DOI: 10.7172/2353-6845.jbfe.2017.1.4

3. VALUE OF ASSETS

3.1. Thermodynamic Theory of Assets

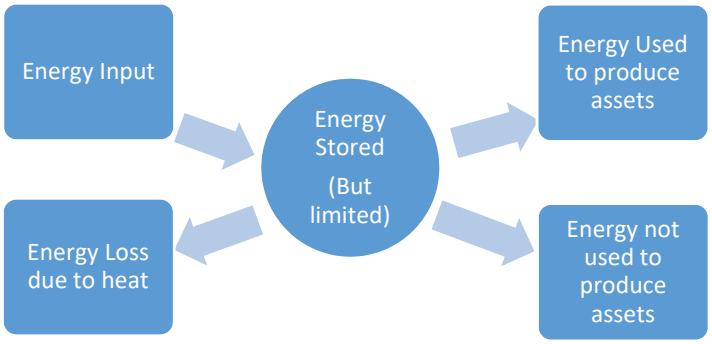
Let us consider a hard asset. An asset must be mined, transported, manufactured, and used. In this case, human labor is the only way of completing this asset. That human labor requires use of human energy. All assets are derived from human labor, i.e. nothing arises except through the application of human labor through the expenditure of labor (Figure 1). As an example, a hammer consists of a wood handle plus a steel head. The wood is processed trees which are cut down by machines operated by human labor, and the machines are made through labor, on and on.

Figure 1
Assets derived from human labor



Labor results from the expenditure of approximately 9 x 10^6 joules per day per person[1]. Therefore, all assets are related to human energy. However, Energy Used is a function of Energy Input [$E_U = f(E_1)$]. Under the First Law of Thermodynamics energy cannot be destroyed only converted. The First Law of Thermodynamics states that the total energy of an isolated system is constant; energy can be transformed from one form to another, but cannot be created or destroyed, this is known as the conservation of energy. The energy allocation is basically composed of several distributions as shown in Figure 2.

Figure 2
Human energy distribution



[1] Based on 2,000–2,500 kilocalories per day per person.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

During a year on this planet hard [A_H], soft [A_S] and liquid assets [A_L] are produced Therefore the sum of all assets [A_T] is a function of World Gross Product:

$$A_T = A_H + A_S + A_L = f(WGP) \quad \text{Eq. (1.)}$$

No hard assets [A_H] are produced without labor. Now the question could be how intellectual pursuits are countered. These soft assets [A_S] however are also based on human energy to produce those soft assets. On a first approximation basis, all 7.0 billion humans use 6.3 x 10^{16} joules per day or 2.3 x 10^{19} joules per year. Therefore, this total planet expenditure of human energy must be directly related to all assets produced [A_T] in a year and thus related to WGP. In 2011, the WGP totaled approximately USD84.97 trillion (10^{12})[2] in terms of purchasing power parity (PPP)[3], and around USD71.83 trillion in nominal terms. The per capita PPP WGP was approximately USD11,071 in 2011. WGP is composed of a base [WGP_B] plus productivity [WGP_P]. [WGP_B] is related to all the human energy [E_{H_n}] for that year [n]. WGP_P is related to prior assets produced through human energy less losses given by:

$$\left[\sum_{n=0}^{n=k} E_{H_n} - \sum_{n=0}^{n=(k-1)} \alpha E_{H_n}\right] \quad \text{Eq. (2.)}$$

Where $\sum_{n=0}^{n=(k-1)} \alpha E_{H_n}$ represents the entropy[4] loss in the total asset formation system and $E_{H_{2012}}$ = 2.3 x 10^{19}. However, based on a base going back to the point in time when there was little or no productivity, the first century of the Common Era[5], then $WGP_{P_0} \cong 0$ and WGP_{B_0} = USD102.5 x 10^9 or USD513 per capita in PPP terms and 2011 USD. If we assume that population then was 200 million, this would equate to 6.9 x 10^{17} joules per year, and then value of joule would be USD1.49 x 10^{-7}. The value of a joule in 2011 was still \$1.49 x 10^{-7} in 2011 USD, this basic global average value will likely continue. This value can serve as the basis of a new global reserve currency. However, in terms of individual economies, the value of the joule will vary as the Gross Domestic Product (GDP) varies.

3.2. Labor Theory of Value

In economics, labor is a measure of the work done by human beings and is conventionally contrasted with such other factors of production as land and capital. Capital can be considered as 'Solid Labor' or 'realized Labor' or 'indirect labor'. Modern economics considers the interrelations among the labor (direct labor), the goods, the money, and the foreign trade. It looks at how these interactions influence macro variables such as employment levels, inflation rates, aggregate income and Gross Domestic Product (GDP). The social science of economics seldom considers that how human labor contributes to the total system. Some economists have postulated that understanding the labor market is fundamental to understanding modern economy. Labor economics tries to determine how labor is exchanged for wages. It does not explain how that labor results in an asset and what is the basis for that exchange.

"The labor theory of value presents one of the most puzzling and intriguing phenomena in the history of thought" (Foley, 1997). Many researchers believe that John Locke (1632–1704) was one of the pioneers of Labor Theory of Value or LTV. Even though Locke assumed that all natural resources had been provided by God, he believed that when people took natural things and

[2] Values are in 2011 USD.

[3] Purchasing-power-parity (PPP) adjustment attempts to make currency among different countries comparable based on the amount required to purchase the same volume of goods in each country. These values are expressed in a theoretical currency that corresponds to real (inflation-adjusted) 2011 U.S. dollars.

[4] Entropy measures a system's unavailable energy.

[5] See Table 1.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

reshaped them into products, they mixed their labor with the raw naturally provided materials, and thus had the right to own the products. For instance, picking an apple off a tree, that labor entered into the object, and so the object became property of that person, which is the base of value, therefore, Locke indicated in his work the concept of LTV.

Others argued, however, that while Locke did indicate LTV, "the relative value or price of a thing was dependent upon its usefulness and scarcity and not the amount of labor it contained". These researchers, therefore, argued that Locke would have agreed completely with Archbishop Whately's famous dictum: "it is not that pearls fetch a high price because men have dived for them; but on the contrary, men dive for them because they fetch a high price".

Adam Smith (1723–1790) and David Ricardo (1772–1823) were among the classic economists who advocated LTV. Smith lectured that labor – rather than the nation's quantity of gold or silver – is the cause of increase in national wealth. According to Smith, human activity rather than natural endowment of resources or treasure is the spring of prosperity and wealth. Smith distinguished the concepts of 'value in use' and 'value in exchange'; the former is the usefulness of this commodity, or its utility, while the latter is the ratio of this commodity exchanges for another. Smith further concluded that labor is the 'real measure' of any product's value.

Smith explained: the real price of everything, what everything costs to the man who wants to acquire it, is the toil and trouble of acquiring it. What everything is really worth to the man who has acquired it, and who wants to dispose of it or exchange it for something else, is the toil and trouble which it can save to himself, and which it can impose upon other people. Even a person drinking water from a good stream at his doorstep must "spend" labor to gain this value, at least if this action is relevant to economics. He suggested that the amount of labor used in the production of a good was a measure of its value. "If among a nation of hunters, for example, it usually costs twice the labor to kill a beaver which it does to kill a deer, one beaver should naturally exchange for or be worth two deer."

Evidently, LTV is a major pillar of traditional Marxian economics, created by Karl Marx (1818–1883) and Friedrich Engels (1820–1895) in Marx's masterpiece, "Capital". The theory claims that value of a commodity can be objectively measured by "socially necessary labor-time," required to produce that commodity. We believe that the concept of "socially necessary labor time" should be adjusted according different environment and different historic period.

Marx believed that value has its duality: value and use value, and similarly labor: concrete labor and abstract labor, the former is the base for commodity's use value and the latter for value itself. If the commodity is to be traded, it has an exchange value. However, LTV is considered by many not the creation of Marxism, rather, Marx and his friend and co-author Engels' contribution is the theory of surplus value. They believed that surplus value is the excess of the value the proletarian has produced above what it takes to keep the proletarian working, and surplus value is the source of profit for the capitalists.

In the post Marxism period, debates on LTV have never been stopped, especially in China. Right after the economic reform took place in 1979, numerous papers were published among outstanding and eminent Chinese economists.

In 1981, for instance, Prof. Yu Guangyuan claimed that all labor involved in production, including labor in education, science, art, services can create value. Prof. Sun Ye Fang, however, believed that it is only physical labor that produces value.

In the 1990s, Gu Shu Tang emphasized nonphysical labor also created value and considered that labor productivity is also an element in measuring labor time (Gu 1993). Su Xing, on the other hand, indicated only active labor is the sole source of value. At the same time, Qian Bo Hai argued that both active labor and materialized labor created value (Qian 1994).

The debate carried on into the new century. In 2000, Mr. Gao Shang Quan raised a proposition that scientists, technician and managers should be all considered as labors and therefore create value. This claim induced a serious debate in "Economic Daily" in November of that year.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

As economic reform continues in the new century in China, the discussion on LTV continues, yet more and more towards modifying and redefining Marxist theory.

Wu Jie believed that labor can be identified as "superior labor" and "inferior labor", and therefore, intellectual labor and innovative labor create more value (Wu 2002).

Liu Shi Bai believed that modern technology innovation is a product of technological innovative labor. It has four characteristics: high creative labor; high intellectually accumulative labor; high specialized labor and high socially syndicated labor.

Wei Xinghua distinguished labor into four different categories: physical production labor; spiritual production labor; commercial services labor and social public labor. Generally speaking, the first three types of labor create value, not the last category.

To further explore Labor Theory of Value in modern society, Liu Guan Jun identified three different value fountains and thereafter three value flows, namely: "the primary value chain"; "the secondary value chain"; and "the tertiary value chain". The primary value chain defines production labor at the working location in the absence of science and technology; the secondary value chain defines production labor partially at the location; and the tertiary value chain defines labor not at the location, such as scientists and technician who contributed basic scientific foundation to the modern production labor.

Among western scholars and researchers, the debate on LTV has never stopped, for instance, how value can be transformed into the price of production. The so called "New Interpretation" of Marx's LTV by French scholar Gérard Duménil and US professor Duncan K. Foley, for instance, argued that the value of labor-power should be measured as the ratio of the money wage to the monetary expression of labor, not as the labor embodied in the commodities workers consume (Foley, 1997). LTV can be used to determine the totality of economic value production, which is consisted of functionally relevant parts (Foley 2000).

While some argued that Marx clearly suggested that the exchange value or market price of a commodity is determined by the labor producing it (Guerrero,2007) and that the magnitude of value is itself an expression of the socially necessary labor-time embodied in the commodity-form (Lucarelli, 2007), Marx tries to break free from classical political economy through applying the Hegelian method of "systematic dialectics" (Brown, 2004) and empirical correlations between relative prices and relative values is log linear (Shaikh 1984). However, Marx had been in a struggle to reconcile the concept of value represented by the amount of labor embodied in it, and the exchange value reflected supply and demand and the principal fallacy in the labor theory of value is that it ignores Hume's notion of causality (Fulda, 2007). In contrast to Marxian theory of value, the Sraffan economists suggested that aggregating capital can be used as dated inputs of labor (Sraffa, 1970).

Scholars' favor of the basic principles set by Marx and his co-author, Engels. argued that the labor theory of value can be demonstrated empirically, and all the elements of the cost of production can be reduced to labor, and to labor alone and that prices are the monetary expressions of labor values, and a pure economic theory can be developed properly in terms of labor values only, regardless of price (Hagendorf, 2009).

3.3. Thermodynamics Approach

The basic approach is that everything requires labor and labor requires energy. The only energy that enters our planet comes from the sun. Even coal and oil are products of past sunlight. Radioactive material was deposited when the planet was formed and like the planet itself is here. Meteors and galactic dust enter our planet but do not contribute much to the energy input.

The earth receives a net of about 20 to 30 metric tons of energy per day or 8,000 to 12,000 metric tons per year based on Einstein's equation [$E = MC^2$]. Human beings now use only about 0.25 metric tons per year or approximately 0.00208% to 0.00312% of the net solar energy input.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

All human endeavors are a result of the total energy used by the world population due to the First Law of Thermodynamics. Therefore, all assets produced are directly related to this mere 0.25 metric tons of solar energy plus the productivity resulting from prior energy inputs. Even the energy used by humans must be extracted and that extraction and associated equipment are a result of human energy expended.

On average, each person on earth uses approximately 10,000 kilojoules of energy per day to meet their needs. This unit requirement is approximately of the same magnitude as required in the Neolithic era. Now that implies that approximately 6×10^{13} kilojoules per day or 2.2×10^{16} kilojoules per year can be related to all asset formation in combination with past human endeavor resulting in productivity or leverage through the application of existing past assets. Nothing results except from current and past human expenditure of human energy; this is the result of the First Law of Thermodynamics.

In one way or another all humans contribute some energy to the formation of assets either by forming those assets or using them to develop other assets. This is independent of whether the worker is in a factory, farm, or office, or is unemployed. All humans must acquire sources of energy to survive and to accomplish their individual endeavors whatever they may be. The only source of this energy is the sunlight past and current and radioactive material formed when the earth formed. Thus, all assets and capital are directly related to these expenditures of human energy.

Based on this premise we can develop a model explaining how this is related to World Gross Product and Capital and what its relationship to Liquid Capital or soft assets and in turn what may be the cause of the instability of the global financial system.

3.3.1. General Equations

The recent worldwide financial crisis illustrated that a real systematic understanding of the relationships between financial systems may not be fully understood in terms of a total system. If we consider the world as a system, the only things that enter earth are sunlight, radiation and extraterrestrial bodies; thus, the financial system only results from labor, use of resources and productivity. While this is a simplistic system in fact its complexity and interactions can become extremely unstable. Financial crises have been the "sine qua non" of the 1970 to 2010 period with over 124 worldwide

Starting with the premise that we are dealing with a system, on a global level we need to understand the general interaction between the measures of the world's economic factors. Initially these factors can be given by the World Gross Product [WGP] and the World Capital [WC] and how they are related.

These factors when analyzed in a systematic and quantitative manner may allow the understanding of the system and variables which when perturbed can cause a cascaded instability.

The world gross product [WGP] or world gross income [WGI], is a basic measure of a world's economic performance, and is the market value of all final goods and services made in the world in a year. WGP can be defined in three ways, all of which are identical. First, it is equal to the total expenditures for all final goods and services produced in the world in a year. Second, it is equal to the sum of the value added at every stage of production (the intermediate stages) by all the industries in the world, plus taxes less subsidies on products, in the period. Third, it is equal to the sum of the income generated by production in the world in the period – that is, compensation of employees, and gross operating surplus (or profits).

The most common approach to measuring and quantifying WGP is the expenditure method:

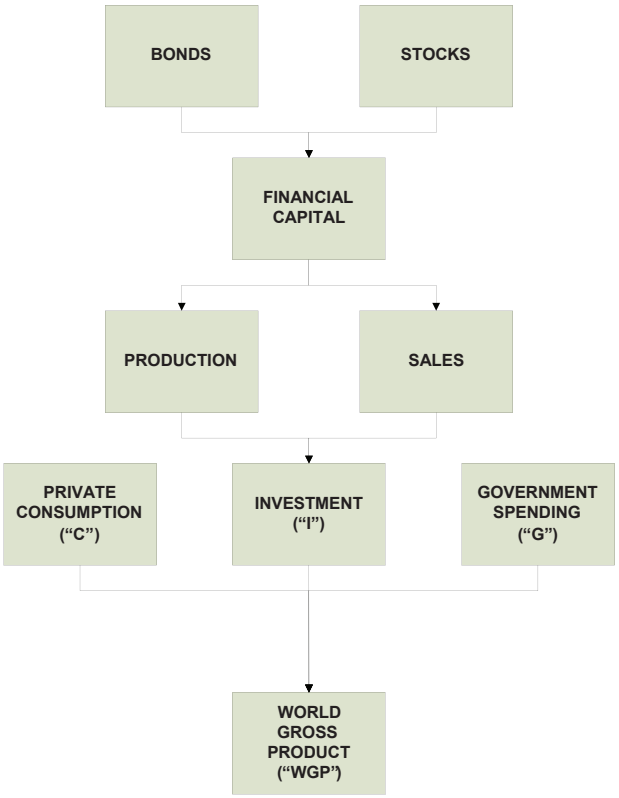
WGP = private consumption (C) + gross investment (I) + government spending (G), or,

$$WGP = C + I + G \qquad \text{Eq. (3)}$$

DOI: 10.7172/2353-6845.jbfe.2017.1.4

"Gross" means that depreciation of capital stock is not subtracted out of WGP. If net investment (which is gross investment minus depreciation) is substituted for gross investment in the equation above, then the formula for net domestic product is obtained. Consumption and investment in this equation are expenditure on final goods and services.

Figure. 3
World gross product



World Gross Product can be related to world population and productivity. Since caloric use per individual has been relatively constant for over thousands of years then based on estimates of WGP during periods of low productivity such as the first century of the Common Era, the basic WGP per population was approximately USD513 per person in PPP 2011 dollars. Table 1 shows estimates of WGP, population and the results over a 2,100-year period.

Therefore:

$$WGP_B = K_p * P_{T_t} + P_{r_t} \quad \text{Eq. (4)}$$

Where, K_p = average value in terms of USD per person [USD500] or in terms of joules per person per year (3.3×10^9) if joules are used, then WGP would be in terms of joules.
P_{T_t} = world population at time (t)
P_{r_t} = productivity value in terms of 't' or $\alpha_t * P_{T_t}$ where α_t is the measure of productivity per person at time 't'

The population can be estimated by:

$$P_{T_t} = 4.43 * \operatorname{arccot}\frac{(2007 - T_t)}{42} \quad \text{Eq. (5)}$$

Where, T_t = year of population estimate.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Therefore:

$$WGP_t = P_{T_t} * (K_p + \alpha_t) \quad \text{Eq. (6)}$$

Let us assume that 'α_t' can be described by logistic equation in the form:

$$\alpha_t = \frac{\beta e^t}{\beta + (e^t - 1)} \quad \text{Eq. (7)}$$

Where 'β' represents the maximum range of the productivity. However, this productivity must relate to prior human energy expenditures less loss of assets from a First Law of Thermodynamics viewpoint. Therefore, the total amount of world "human thermodynamic assets" consists of human energy plus all prior expenditures less losses. When pseudo-assets and hard assets approach this value, instability in global finances may result.

There are many different definitions of capital. According to Adan Smith, he defines capital as "That part of Man's stock which he expects to afford him revenue is called his capital." Capital is something owned which provides ongoing services. In the national accounts, or to firms, capital is made up of durable investment goods, normally summed in units of money. Broadly: land plus physical structures plus equipment. But it is also a measure of the accumulated financial strength of an individual, firm, or nation, or the world created by sacrificing present consumption in favor of investment to generate future returns above investment costs. It can be defined also as assets available for use in the production of further assets or as wealth in the form of money or property owned by a person or business and human resources of economic value.

We will use the definition that total capital [C_{T_t}] at time 't' is the value of all the equipment, land and liquid assets.

Now capital [C_{T_t}] consists of current and past capital [$C_{T_{(t-1)}}$] plus input from past World Gross Product [$WGP_{(t-1)}$].

Applying a preliminary analysis, we can show that:

$$C_{T_t} = \left\{ \frac{K_p * [1 + R] * [1 * S_f]}{\left[1 - \frac{C_{S_t}}{C_{T_t}}\right]} \right\} * \sum_{i=0}^{i=t} \left(P_{T_i} + P_{T_{t-1}}\right) \quad \text{Eq. (8)}$$

Where,
R = is a logistic function over a period '0' to 't' (assumption)
S_f = is an unknown function now, possibly another logistic function (assumption)
C_{S_t} = is the amount of liquid or soft capital at time 't'

This equation seems to indicate that as liquid or soft capital (C_{S_t}) grows where it represents most the total capital (C_{T_t}) the equation will 'balloon', i.e. a bubble and likely lead to instability! We believe this is what happened during the 'Great Recession of 2008'.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Table 1
Estimated relationship between WGP and population

Year	WGP (Million USD)	Population (Million Persons)	WGP/Pop (USD per Person)	Productivity Ratio (Year to Year 1)	Base WGP (Million USD)	WGP Due to Productivity (Million USD)
1	102,536	200	513	1.00	102,536	0
1000	116,790	310	377	0.73	158,931	-42,141
1500	247,116					
1600	329,417					
1700	371,369					
1750		791			405,530	
1800		978			501,401	
1820	694,442					
1850		1,262			647,002	
1870	1,101,369					
1900		1,650			845,922	
1913	2,704,782					
1950	5,336,101	2,519	2,118	4.13	1,291,441	4,044,660
1955		2,756			1,412,946	
1960		2,982			1,528,812	
1970		3,692			1,892,815	
1973	16,059,180					
1975		4,068			2,085,582	
1980		4,435			2,273,736	
1985		4,831			2,476,757	
1990		5,263			2,698,235	
1995		5,674			2,908,946	
1998	33,725,635					
2000		6,070			3,111,968	
2005		6,454			3,308,837	
2007	55,000,000		8,100	15.80	3,481,160	51,518,840
2008	61,070,000		9,600	18.73	3,261,392	57,808,608
2009		6,796			3,483,944	
2050		8,909				
2150 (Estimated)		9,746				

Source: Based on data contained in.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

4. PRELINARY RESULTS

4.1. What drives world financial instability

As we have seen world financial instability may be driven because the growth of liquid capital overwhelms real capital, i.e. capital formed due to labor not just paper. We should divide total capital [C_{T_t}] at time 't' into also real or hard capital, i.e. assets based on labor [C_{H_t}] at time 't' and representational or soft assets such as mortgages, bonds, stocks, derivatives, etc. [C_{S_t}] at time 't'. The assets based on labor [C_{H_t}] can be divided between the base assets [C_{Hb_t}] when they were originally placed into service and their growth based on either supply-demand or other pricing mechanisms (C_{Hp_t}):

$$C_{Hp_t} = \gamma_t * C_{Hb_t} \quad \text{Eq. (9)}$$

Where
γ_t = growth factor for assets at time 't'
So, if Eq. 8 is reviewed in reference to these factors, then:

$$C_{T_t} = C_{S_t}\left[\left(\frac{C_{Hb_t}}{C_{S_t}}\right) * (1 + \gamma_t) + 1\right] \quad \text{Eq. (10)}$$

Therefore, when representational or soft assets such as mortgages, bonds, stocks, derivatives and other non-labor based assets become so large that base assets become much debased then as:

$$C_{S_t} \rightarrow C_{T_t} \quad \text{Eq. (11)}$$

Then an asset 'bubble' occurs and instability becomes very likely. Basically, this result from the First Law of Thermodynamics, which you cannot obtain, more than enters the system. Financial crisis in any era is an illustration of this factor, as is the collapse of financial markets.

4.1.1. Basis for global financial systems model

We believe while we have initially shown a relationship in the global markets, these factors also hold in all financial systems from global down to individuals. This factorial relationship is illustrated by various situations. We have demonstrated the initial global case now let us consider some other areas.

The Asian financial crisis that held much of Asia in its grip began in July 1997. This crisis started because Thailand floated its currency due to severe financial overextension. This overextension was due to a large foreign debt that caused a bankruptcy of the country. Foreign debt to GDP ratios increased from 100% to 167% in 1993–1996 in four major countries of the ASEAN region. This is a regional example of our preliminary thesis.

The major recession in many countries including Latin America in the 1950–1990 time periods provide other examples. In these cases, countries borrowed heavenly from various international organizations. This caused hyper-inflation and eventually bankruptcy as many of these nations defaulted on their debts.

Industries also experience over expansion with a rise of equity values far exceeding their real asset values, leading to a collapse of equities and the collapse of many companies due to the growth of pseudo-capital, i.e. capital without a labor base. This was the case of the technology equity "bubble" in 2000. Corporations similarly fail by incurring debts, which exceed available assets. Similarly, individuals fail for the same reasons. The failure of the American and British housing due to mortgages that exceed the real value of the assets is also illustrative of this failure.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

In many instances when the First Law of Thermodynamics has been ignored, the overall cascade also destroys much more than the failure of just the industry, company or individuals involved, causing further hardships in human terms.

As the availability of soft capital or assets increases then per the First Law of Thermodynamics, the system balance can only be maintained by decreasing the value of and/or amount of labor. Therefore, promoting more soft capital or assets that are not directed into producing hard assets through capital injections, debt issues and derivatives and other instruments decreases the portion of hard assets and thus soft capital or assets becomes a higher proportion of the total capital. The real impact of this is that labor loses its value through inflation/deflation and other economic mechanisms and/or the proportion of labor used to make assets decreases. Therefore, generating more soft capital or assets that do not result in hard assets has negative impacts on labor either through reduced value or lower utilization or both. Thus, central bank's 'quantitative easing' rarely results in an equivalent increase in hard assets but an increase in soft assets, which can lead to eventual financial instability.

This paper shows the importance of the First Law of Thermodynamics in determining the stability of financial markets from global down to individuals. The analysis in this paper shows that the basic principle of Labor Theory of Value explicated by Marx in his "Capital"' is still valid and we validate this principle not relying on economics and finance models but rather on the Laws of Thermodynamics. This is illustrated by the following set of equations.

Let us define the energy used by human by:

where;

E_{T_d} = total energy used by a person per day

E_{P_d} = personal energy per day

E_{H_d} = energy used to produce assets = σE_{P_d} where σ is the proportion of the population devoted to labor

E_{S_d} = energy stored in body per day

E_{L_d} = energy lost due to heat and mass per day

But,

$E_{L_d} = \alpha E_{T_d}$ where α is the proportion of the total energy (E_{T_d}) lost which in magnitude does not vary significantly

$E_{S_d} = \beta E_{T_d}$ where β is the amount of total energy (E_{T_d}) stored but there is a limit

Then;

$$E_{T_d} = \frac{E_{H_d}}{\sigma} + \alpha E_{T_d} + \beta E_{T_d} \qquad \text{Eq. (13)}$$

Therefore;

$$E_{H_d} = \sigma E_{T_d}(1 - \alpha - \beta) = \sigma \tau E_{T_d} \qquad \text{Eq. (14)}$$

Where,

$$\tau = (1 - \alpha - \beta) \qquad \text{Eq. (15)}$$

Now the total capital or assets during time (k) is given by:

$$C_{T_t} = C_{H_t} + C_{L_t} \qquad \text{Eq. (16)}$$

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Where,
C_{T_t} = total capital (assets)during time 't'
C_{H_t} = hard capital (hard assets) during time 't'
C_{L_t} = liquid or capital (soft assets)during time 't'

But;

$$C_{H_t} = \mu_t P_{T_t} E_{H_t} = \sigma_t \mu_t \tau_t P_{T_t} E_{T_t} \cong GWP_t \quad \text{Eq. (17)}$$

Where,
μ_t = value of energy at time 't', however, as we have shown this global average value has remained relative constant over 2,000 years at UD$1.49 x 10^{-7} per joule, and

$$\mu_t = \frac{\sum \mu_{t_k} P_{t_k}}{P_t} \cong \text{Constant}$$

μ_{t_k} = is labor value for the individual economy 'k'
P_{T_t} = total population at time 't'
P_{t_k} = population of each individual economy 'k'

But; the total capital (C_{T_t}) at time 't' can also be written as the net capital additions (C_{N_t}) plus the net capital from prior years less any losses and changes in valuation, i.e. $\left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} C_{N_i}$

Where,

$\left(\frac{V_t}{V_{(t-1)}}\right)$ = average value of prior assets at time 't' in reference to time (t − 1), but;

$$\sum_{i=0}^{i=(t-1)} C_{N_i} = \sum_{i=0}^{i=(t-1)} C_{H_i} - \sum_{i=0}^{i=(t-1)} C_{H_{Loss\,i}} + \sum_{i=0}^{i=(t-1)} C_{L_i} - \sum_{i=0}^{i=(t-1)} C_{L_{Loss\,i}} \quad \text{Eq. (18)}$$

$$C_{N_t} = C_{H_t} - C_{H_{Loss\,t}} + C_{L_t} - C_{L_{Loss\,t}} \quad \text{Eq. (19)}$$

But;

$$C_{L_t} = C_{L_t} - C_{L_{Loss\,t}} + \sum_{i=0}^{i=(t-1)} C_{L_i} - \sum_{i=0}^{i=(t-1)} C_{L_{Loss\,i}} \quad \text{Eq. (20)}$$

$$\sum_{i=0}^{i=(t-1)} C_{H_{Loss\,i}} = \sum_{i=0}^{i=(t-1)} \epsilon_i C_{H_i} \quad \text{Eq. (21)}$$

Where ϵ_i = percentage of hard assets lost at time 'i', then;

$$\left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} C_{H_i} - \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} C_{H_{Loss\,i}} =$$

$$= \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} C_{H_i}(1-\epsilon_i) = \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \mu_i \gamma_i P_{T_i}(1-\epsilon_i) P_{T_i} \quad \text{Eq. (22)}$$

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Therefore,

$$\nabla_t = \left(C_{T_t} - C_{L_t}\right) = \sigma_t \mu_t \tau_t P_{T_t} E_{T_t} + \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1 - \epsilon_i) P_{T_i} \qquad \text{Eq. (23)}$$

Therefore, this equation shows that the difference between total capital $[C_{T_t}]$ and liquid capital $[C_{L_t}]$ is strictly a function of human energy. This equation basically shows the impact of the First and Second Laws of Thermodynamics on capital. As the availability of liquid capital increases then the right side of the equation must decrease. The only way this can occur is by decreasing the amount of labor $[\sigma_t]$ and the value of prior hard assets $\left(\frac{V_t}{V_{(t-1)}}\right)$, such as housing. Therefore, promoting more liquid capital through capital injections, debt issues and derivatives and other instruments decreases "∇_t" since liquid capital $[C_{L_t}]$ becomes a higher proportion of the total capital (C_{T_t}). The real impact of this is that labor is reduced and thus increasing unemployment and existing hard asset value. Also as Eq. 8 shows this also results in a 'bubble'. Thus, injection of capital beyond a certain level could result in human value destruction in current and past assets. This is exactly what occurred during the "Great Recession of 2008", when unemployment increased and housing and or existing hard assets declined in value.

4.2. Impacts

The implications of Eq. (23) are many. These implications include:

- Employment
- Value of existing hard assets such as property
- Supply/Demand
- Productivity
- Global reserve currency
- Gross World Product and how it can change

4.2.1. Employment

The basic variable in Eq. (23) that cover employment is σ_t, which represents the percentage of the population P_{T_t} capable of producing hard assets. However,

$$\sigma_t = (1 - \omega_t) \qquad \text{Eq. (24)}$$

Where, ω_t = percentage of the population which is not producing assets.

As soft assets increase without a commensurate increase in total assets, then one aspect of Eq. (23) is an increase in proportion of the population not engaged in production of assets ω_t. This value is increased by both unemployment (both seekers and dropouts), retired, and underage.

4.2.2. Asset valuation

Prior hard assets, such as property, have a valuation when acquired. However, the current value of those assets can be higher or lower based on how they are impacted by Eq. (23). This is determined how the current valuation $[V_t]$ changes about prior valuation $[V_{(t-1)}]$. Therefore, as $\nabla_t < \nabla_{(t-1)}$, then, $V_t < V_{(t-1)}$.

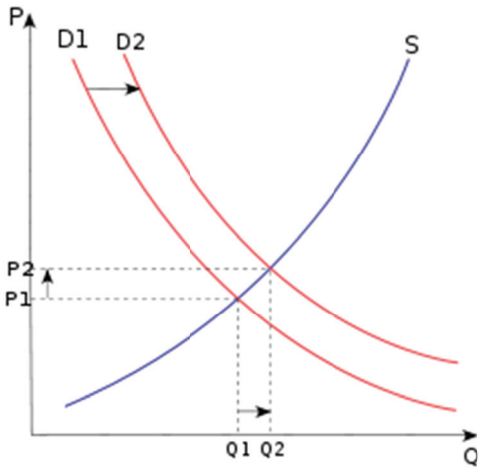
This results in decreased prior hard asset values. This is precisely what occurred in the "Great Recession of 2008", when housing and other hard assets decreased substantially in value.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

4.2.3. Supply/Demand

Figure 4 shows the classical supply-demand curves. However, Eq. (23) will impact this classical economic concept.

Figure 4
Classical supply-demand



The price P of a product is determined by a balance between production at each price [supply S] and the desires of those with purchasing power at each price [demand D]. The diagram shows a positive shift in demand from D1 to D2, resulting in an increase in price [P] and quantity sold [Q] of the product.

Let us consider that all hard assets [A_t] are given by:

$$A_t = Q_t P_t = C_{H_t} \qquad \text{Eq. (25)}$$

But,

$$C_{H_t} = \nabla_t = \left(C_{T_t} - C_{S_t}\right) = \sigma_t \mu_t \tau_t P_{T_t} E_{T_t} + \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1 - \epsilon_i) E_{T_i} \qquad \text{Eq. (26)}$$

Therefore;

$$P_t = \frac{\sigma_t \mu_t \tau_t P_{T_t} E_{T_t} + \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1 - \epsilon_i) E_{T_i}}{Q_t} \qquad \text{Eq. (27)}$$

Or,

$$P_t = \frac{\left(\sigma_t \mu_t \tau_t P_{T_t} E_{T_t}\right)}{Q_t} + \frac{\left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1 - \epsilon_i) E_{T_i}}{Q_t} \qquad \text{Eq. (28)}$$

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Where,

$\frac{\left(\sigma_t \mu_t \tau_t P_{T_t} E_{T_t}\right)}{Q_t}$ = must be ratio of value of hard asset units based on human energy to supply demand units at time 't'

$\frac{\left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1-\epsilon_i) E_{T_i}}{Q_t}$ = must be ratio value of the sum of net hard asset units based on human energy available in time (t – 1) to supply demand units at time 't'

Therefore, as $\nabla_t = (C_{T_t} - C_{S_t}) \rightarrow 0$ as then both the demand and the supply will need to decrease and so will the clearing price if the rules of economics are to be utilized. Here we see how the First Law of Thermodynamics impacts classical economics.

4.2.4 Productivity

Productivity is a measure of output from a production process, per unit of input. For example, labor productivity is typically measured as a ratio of output per labor-hour, an input. Productivity may be conceived of as a metric of the technical or engineering efficiency of production.

Production is a process of combining various material inputs and immaterial inputs to make an output. Technology is the means of combining the inputs of production to produce output. A production function, which describes the relation between input and output, depicts technology. The production function can be used as a measure of relative performance when comparing technologies.

Total productivity = Output quality and quantity / Input quality and quantity = ρ_t

The changes in productivity between any two periods is given by:

$$\Delta\rho = \rho_t - \rho_{(t-1)} \qquad \text{Eq. (29)}$$

But,

$$\rho_t = \frac{Q_{o_t}}{Q_{I_t}} \qquad \text{Eq. (30)}$$

Where Q_{o_t} = output quality and quantity and Q_{I_t} = input quality and quantity at time 't'

$$Q_{o_t} = \frac{C_{H_t}}{V_{o_t}} = \frac{\sigma_{o_t} \mu_t \tau_t P_{T_t} E_{T_t}}{V_{o_t}} \qquad \text{Eq. (31)}$$

Where V_{o_t} = unit value of the output in period 't'

$$Q_{I_t} = \frac{\sigma_{I_t} \mu_t \tau_t P_{T_t} E_{T_t}}{V_{I_t}} \qquad \text{Eq. (32)}$$

Where V_{I_t} = unit value of the input = unit value of the labor plus the unit value of the material in terms of labor in period 't'

But, for the global economy, $\mu_t \tau_t P_{T_t} E_{T_t} \cong$ constant $= \aleph_t$

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Then,

$$\rho_t \cong \frac{\sigma_{o_t}}{\sigma_{I_t}} \qquad \text{Eq. (32)}$$

Therefore,

$$\Delta\rho_t \cong \frac{\sigma_{o_t}}{\sigma_{I_t}} - \frac{\sigma_{o_{(t-1)}}}{\sigma_{I_{(t-1)}}} = \frac{\sigma_{I_{(t-1)}}\sigma_{o_t} - \sigma_{I_t}\sigma_{o_{(t-1)}}}{\sigma_{I_{(t-1)}}\sigma_{I_t}} \qquad \text{Eq. (33)}$$

Therefore, the changes in productivity are due to the changes in input and output labor, or as Eq. (24) indicate the changes in unemployment (ω).

There are other implications that can be drawn from Eq. (23). This Labor Value Equation (LVE) can be used to address how conflict impacts economic issues and how it is possible to develop a new global reserve currency which can assist in maintaining global financial stability.

4.2.5. Global conflict

LVE, i.e. Eq. (23), has certain values that are impacted by conflict. These factors include:

σ = Labor percentage and unemployment
P_T = Population
V = Value of prior assets
ϵ = Entropy factor related to destruction of existing hard assets

These factors plus the need to issue more debt or soft assets are directly related to conflict. In fact, these taken together can eventually lead to global financial collapse.

4.2.6. Global reserve currency

A new measure based on human expenditure has been proposed. The nature of capital is multilevel; it can consist of property, resources, human labor and various other assets. But it is the ability to trade one asset for another asset. In this regard, capital like money can be used to acquire another asset like someone's labor or a physical asset. In a way, it is barter because liquid capital is only a way of exchange in fact since any asset, from a market perspective, only has value because someone wants it. If that asset was placed in a forest or desert or a high mountain and no one was there to claim it, then it would have no value. So, for an asset of any type to have value, someone must want it otherwise it would be valueless.

However, while its value depends on someone desiring it, the asset has a more fundamental 'value' in the thermodynamic sense. That thermodynamic value is the amount of human labor expended to produce it. That must be the total 'labor' cycle from basic resource acquisition to the final asset. This includes the labor to build any device and the material in that cycle allocated to that device, and intellectual labor that contributed any technological innovation. Thus, nothing on this planet is produced "de novo", that is without human labor. Starting with the premise that we are dealing with a system, on a global level we need to understand the general interaction between the measures of the world's economic factors. The First Law of Thermodynamics has been shown determining the stability of financial markets from global down to individuals.

Realizing that the maximum value of real assets is based on past and present labor, the First Law of Thermodynamics says that we cannot obtain assets that exceed a maximum number of "joules" during any period. Therefore, the world capital will grow through growth in population plus net additions due to World Gross Product (WGP), less losses. To determine this, additional research will be required including quantifying this premise. This preliminary analysis shows that based on the First Law of Thermodynamics, the world financial system is in fact a "Zero

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Sum Game". There are only gainers and losers in this "game" and it is imperative that we have a methodology to have a level playing field in global finance.

The premise is that:

- Reserve currency total value cannot exceed the value of the global hard assets
- Hard assets value based on the First Law of Thermodynamics
- Therefore, the value of global reserve currency should be in joules

Let, R_T = Total global reserve currency in joules, therefore, a modified version of the Eq. 23 can be written as:

$$R_T = \sigma_t \mu_t \tau_t P_{T_t} E_{T_t} + \left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1 - \epsilon_i) E_{T_i} \quad \text{Eq. (34)}$$

Let,

$$K = 1 + \frac{\left(\frac{V_t}{V_{(t-1)}}\right) * \sum_{i=0}^{i=(t-1)} \sigma_i \mu_i \tau_i P_{T_i} (1 - \epsilon_i) E_{T_i}}{\sigma_t \mu_t \tau_t P_{T_t} E_{T_t}} \quad \text{Eq. (35)}$$

but, $E_{T_i} \sim E_{T_t}$ and $\tau_t \sim \tau_i$ and $\mu_t \sim \mu_i$

Therefore,

$$K = 1 + \frac{\sum_{i=0}^{i=(t-1)} \sigma_i P_{T_i} (1 - \epsilon_i)}{\sigma_t P_{T_t}} \quad \text{Eq. (36)}$$

But hard assets have only a useful life of 'n' years, for a reasonable number of years the ratio $\frac{\sigma_i}{\sigma_t}$ is relatively constant, if not very close to unity

Therefore,

$$K = 1 + \frac{\sum_{i=0}^{i=(t-1)} P_{T_i} (1 - \epsilon_i)}{P_{T_t}} \sim e^{rn} \quad \text{Eq. (37)}$$

Where r = population growth rate and 'n' is the average useful life of hard assets
Therefore,

$$R_T \sim \sigma_t \mu_t \tau_t P_{T_t} E_{T_t} e^{rn} \quad \text{Eq. (38)}$$

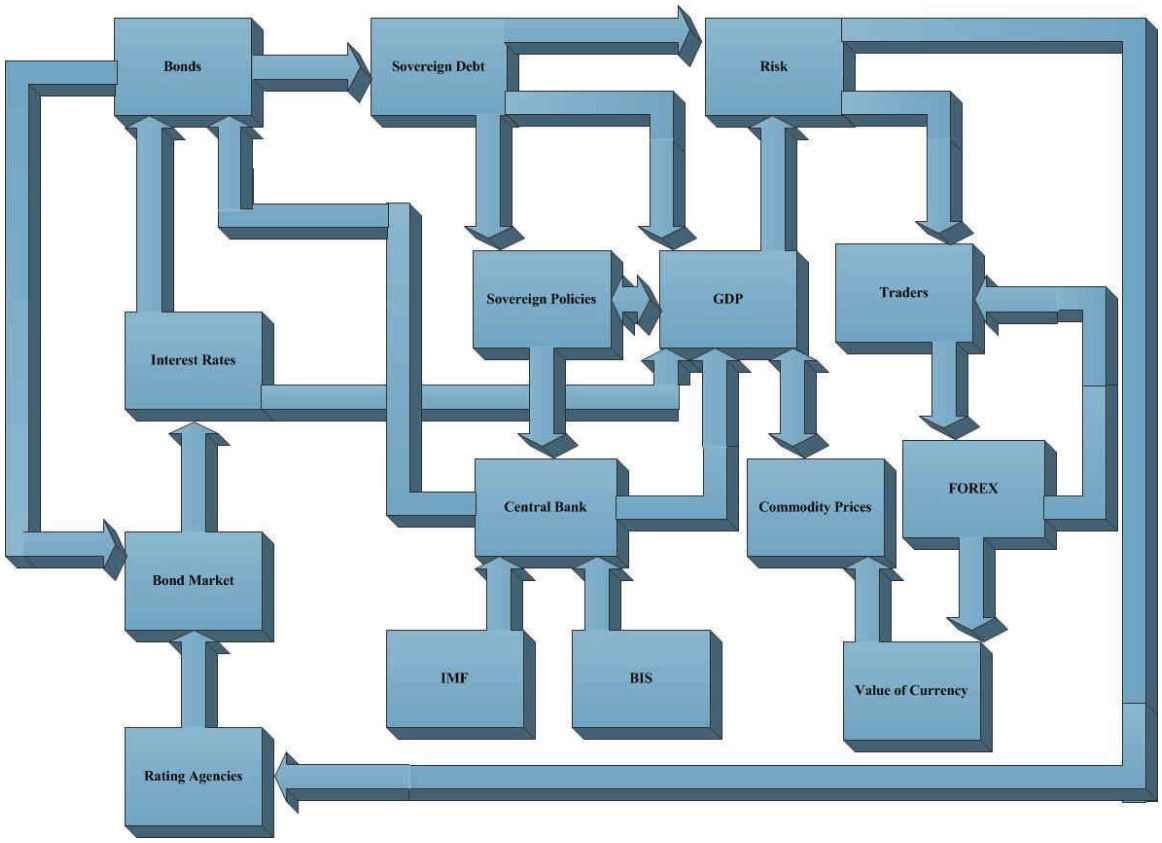
This offers a means for determining the world reserve currency at any time 't' and determining a baseline for future estimates of reserve currency.

4.2.7. Global Stability

Eq. (8) indicates that as liquid or soft capital $[C_{S_t}]$ approaches where it represents most of the total capital $[C_{T_t}]$ the equation will "balloon", i.e. form a bubble and likely lead to instability. We believe this is what happened during the "Great Recession of 2008". These inflations tend to occur because we are dealing with a complex system like that shown in Figure 5.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

Figure 5
Simplified Financial Interactions



Source: Cardullo, 2013.

4. CONCLUSIONS

The recent worldwide financial crisis illustrated that a real systematic understanding of the relationships between financial systems may not be fully understood in terms of a total system. This paper illustrates that basic global economic concepts can be directly related to the First and Second of Thermodynamics. Nothing results except from current and past expenditure of human energy; this is the result of the First Law of Thermodynamics. In economics, labor is a measure of the work done by human beings and is conventionally contrasted with such other factors of production as land, and we consider capital is a form of realized labor. In this paper, we argue that everything is a product of energy in the form of labor and that the basic principle of Labor Theory of Value is still valid and we validate this principle not relying on economics and finance models, rather on thermodynamic principles. We believe it is the energy created by labor that is the core element of the system, and is the fundamental variable to explain the nature of capital market and of financial systems. This is illustrated by the development of the LVE and how it can impact employment, asset valuation, supply/demand, productivity, global conflict, global reserve currency and global stability.

DOI: 10.7172/2353-6845.jbfe.2017.1.4

References

Bryant, J. (2011). *Thermoeconomics: A Thermodynamics Approach to Economics* (Second ed.). Harpenden, Herts, UK: VOCAT International Ltd.

Buchholz, T. (1999). *New ideas from Dead Economists: An introduction to modern economic thought*: Penguin Books.

Cahus, P.Z., M. (2001). *Labor Economics* (W. McCraig, Trans.). Bruxelles: De Bolch & Larcles/MIT.

Cardullo, M., & Liu, M. (2012). *Initial Approach to System Study of Global Finance*. Paper presented at the ICFTE 2012, Singapore. H.C., L. J. (1949). Ch. IV *Econometrics, Statistics and Thermodynamics*. The Hague, Holland: The Netherlands Postal and Telecommunications Services. (2000, Nov. 14). *Economic Daily*.

Cardullo, M. W. (2013). *Development of Information and Knowledge Architectures and an Associated Framework and Methodolog for System Management of a Global Reserve Currency.* (PhD Dissertation), George Mason University, Fairfax, VA.

Devine. T.J.; Kiefer, N.M. (1991). *Emperical Labor Economics: The Search Approach*. New York, N.Y.: Oxford University Press, Inc.

Georgescu-Roegen, N. (1971). *The Entropy Law and the Economic Process*. Cambridge, MA.: Harvard University Press.

Georgescu-Roegen, N. (1976). *The economics of production. Energy and Economic Myths: Institutional and Analytic Economic Essays*. New York: T. Pergamon Press.

Georgescu-Roegen, N. (1993). *Thermodynamics and We the humans*. Paper presented at the Entropy and Bioeconomics: Proceedings of the First International Conference of the E.A.B.S, Milan, Italy.

Gordon, R.B., Koopmans, J.J., Nordhaus, W.B., Skinner, B.J. (1987). *Towards a New Iron Age*. Cambridge, MA: Harvard University Press.

Gu, S.T. (1989). *Principles on Socialist Economics*. Shanghai, China: Shanghai People's Press.

Guo, S.Q. (2000). Further Recognition of Labor and Labor Theory of Value. *Macro China* (9).

Institute, E.P. (2012). *Gross World Product, 1950–2011*.

Kapitsa, S.P. (1996). The phenomenological theory of world population growth. *Physics-Uspekh*, *39*(1), 57–71.

Ksenzhek, O. (2007). *Money: Virtual Energy Economy through the Prism of Thermodynamics*. Boca Raton, FL: Universal Publishers.

List of regions by past GDP (PPP). (2009). Retrieved from http://en.wikipedia.org/wiki/List_of_regions_by_past_GDP_(PPP)

Liu, G.J. (2008). The "value – meshwork"mode about the production and movement of value in modern science-technology enterprise – a review from the modern value theory of science-technology labor. *Studies in Science of Science* (2).

Liu, S.B. (2001). On Technological Innovative Labor. *Economists.*

Locke, J. (1689). *Two Treatises of Government: In the Former, The False Principles and Foundation of Sir Robert Filmer, And His Followers, are Detected and Overthrown. The Latter is an Essay concerning The True Original, Extent, and End of Civil-Government*.

Mandel, E. (1962). Traité D'économie Marxiste. *Marxist Economic Theory*.

Marx, K. (1867). *Das Kapital. Kritik der politischen Okonomie*. Hamburg, Germany: Band I.

Meisner, O. (1968). *Karl Marx – Friedrich Engels*.

Roll, E. (1953). *A History of Economic Thoughts*. Prentice Hall.

Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*.

Soddy, F. (1933). *Wealth, virtual wealth and debt; the solution of the economic paradox*. London,: G. Allen & Unwin.

Solow, R.M. (1997). Reply: Georgescu-Roegen versus Solow/Stiglit. *Ecological Economics*, *22*(3), 267–268.

Stiglitz, J.E. (2010). *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York: W.W. Norton & Company.

Su, X. (1992). Labor Theory of Value Monism. *Social Science in China* (6).

Sun, Y.F. (1981). Production Labor has to be Physical Production Labor. *Economic Perspectives* (8).

Vaughn, K.I. (1978). John Locke And The Labor Theory Of Value. *Journal of Liberrarian Studies*, *2*(4).

Werke. (1968). *Das Kapital* (4th ed.). Berlin/DDR: Dietz Verlag.

Yu, G.Y. (1981). Production Labor and Non Production Labor in a Socialist Society. *Economic Issues in China*, *1*.

Wei, X.H. (2008). Labor Theory of Value: Inheritance, Explore and Development. *Economic Review (China)* (9).

DOI: 10.7172/2353-6845.jbfe.2017.1.4

An Econometric Analysis for the Bid-Ask Spread in the Emerging Chilean Capital Market

David Cademartori-Rosso
Facultad de Ciencias Económicas y Administrativas
Pontificia Universidad Católica de Valparaíso, Chile
dcademar@gmail.com
Phone: (56) 32-2273512

Berta Silva-Palavecinos
Facultad de Ciencias Económicas y Administrativas
Pontificia Universidad Católica de Valparaíso, Chile
bsilva@pucv.cl
Phone: (56) 32-2273329

Ricardo Campos-Espinoza
Facultad de Ciencias Económicas y Administrativas
Pontificia Universidad Católica de Valparaíso, Chile
ricardo.campos.e@pucv.cl
Phone: (56) 32-2273337

Hanns de la Fuente-Mella
Facultad de Ciencias Económicas y Administrativas
Pontificia Universidad Católica de Valparaíso, Chile
hanns.delafuente@pucv.cl
Phone: (56) 32-2273328

Received: 03 August 2016 / Revised: 13 March 2017 / Accepted: 03 April 2017 / Published online: 15 May 2017

ABSTRACT

The purpose of this paper is to show that different methods for calculating the spread (Bid-Ask) and the methods for annualizing intra-day data affect the results of econometric models. To achieve our goal, we analyze different econometric models in the context of:

i) the International Financial Reporting Standards (IFRS) adoption,
ii) the reduction of information asymmetry due to new corporate governance standards, and
iii) the ownership concentration that characterize the Chilean Capital Market. We test the quality of the information delivered to the market using two information disclosure indices (DIS and Botosan).

We find that the definition of spread and the methods for annualizing intraday data it is a key decision and may affect the statistical significance of the variables of a specific model.

JEL Classification:

Keywords: Spread (Bid-Ask), Econometric Modeling, IFRS, Information Asymmetry, Information Disclosure.

Ministry of Science and Higher Education
Republic of Poland

The creation of the English-language version of these publications is financed in the framework of contract No. 768/P-DUN/2016 by the Ministry of Science and Higher Education committed to activities aimed at the promotion of education.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

I. INTRODUCTION

The paper's purpose is to show the effect of choosing different spread definitions for modeling the relationship between information asymmetry and information disclosed by corporations that quote in the Chilean Capital Markets. Different methods for annualizing intraday data are, moreover, tested. The spread (Bid-Ask) calculated on intra-day shares from the Santiago Stock Exchange for 2007–2012 will be used as a proxy for information asymmetry. The quality of information provided to the capital markets is measured by two information disclosure indices (DIS and Botosan), in the context of IFRS adoption by Chilean accounting standards.

The paper contributes to the literature by offering an analysis that the definition of spread is not neutral and may affect the robustness of the different models we analyze. We test this in a small market with highly concentrated ownership. The average ownership share of the majority shareholder of the 40 stock son the Selective Stock Price Index (IPSA, in Spanish) is 41%, whereas in a random sample of 100 companies from the S&P 500, this share amounts to only 9% (Rubin, 2007; Coloma, 2010; Rapaport and Sheng, 2010). The market is primarily regulated by the Public Corporate Act and Stock Market Act, which are being modified to adjust to a globalized market and to protect minority shareholders. In the same context, the Superintendence Supervision of Securities and Insurance (SVS, in Spanish) plays an important role in issuing regulations that require sound practices in legal and corporate governance. In this paper, we analyze the effects on the Chilean market of adopting IFRS. Additionally, we consider it is necessary to identify whether a given company analyzed was listed on the IPSA in a given year because this factor will affect the instrument's liquidity.

The reminder of this paper is organize as follows, section II contains the literature review, section III describes the materials and methods, section IV analyzes the results and section V shows the conclusions and research implications.

II. LITERATURE REVIEW

Market efficiency is a central element of economic theory, and its importance is derived from the fact that the more efficient the markets are, the better resource allocation becomes. Many authors conclude that with lower levels of information asymmetry come lower costs of private equity, which in turn affects company growth and profitability (Gompers, Ishi and Metrick, 2003; Khurana, Pereira and Martin, 2006; Fu, Kraft and Zhang, 2012; Ghoul, Guedhami, Ni, Pittman and Saadi, 2013). Munteanu (2011) concludes in an extensive literature review that companies that seriously and voluntarily adopt IFRS observe a decrease in the cost of capital, while also finding that when the adoption is mandatory the quality of information is lower, albeit not significantly so. Armstrong, Barth, Jagolinger and Riedl (2010) analyze the impact of 16 events associated with the adoption of IFRS in Europe and conclude that adoption decreases the cost of capital, particularly in companies in which the quality of information was low and information asymmetry high prior to the adoption.

In the literature, there is also evidence of an existing relation between corporate governance and information asymmetry. For example, Cormier, Ledoux, Magnan and Aerts (2010) relate the quality of corporate governance, among other variables, with the number of independent directors and leverage (relative debt). Healy and Palepu (2001) develop a substantial literature review on the relation between disclosure decisions by management and their effects in the capital market. They conclude that demand for additional information disclosure is a response to agency problems between management and external investors. Kanagaretnam, Lobo and Whalen (2007) demonstrate that better corporate governance results in less information asymmetry. In their model, they relate the spread with variables such as independent directors and other features of the board, using company size as one control variable.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

In addition, the quality of corporate governance has been measured by various indices. However, there is no general consensus on the matter. Verrecchia (2001) constructed a taxonomy of the indices and distinguished three types: indices based on associativity, discretionality and efficiency. The indices based on associativity measure the effect of disclosing one event on the behavior of investors and stake holders with reference to prices and transaction volumes (Lintner; 1969; Karpoff, 1987). The second index type measures the degree of discretion exercised by managers in information disclosure to positively influence company value (Trueman, 1986; Gigler and Hemmer, 1999). For disclosure indices based on efficiency, the efficacy of management establishing an information disclosure policy is measured in the absence of a priori knowledge (Marshall, 1974; Kunkel, 1982). There are many options for calculating the indices. One option is measurement at the request of the company being assessed, for example, when Standard and Poor's (2006) conducts an assessment at the request of a client. Another way to calculate the index of corporate governance quality is based on available public information. This approach is in line with the proposal of Haat, Mahenthiran, Rahman and Hamid (2006), who investigated a 17-item information disclosure index (DIS) that integrated aspects of information quality disclosed. Another proposal is an index constructed by Botosan (1997), which consists of 138 items in 18 groups and includes a wide spectrum of corporate information features disclosed', e.g., strategic information from the company, cash flow projections and segment information.

One way to measure information asymmetry is using the spread (Copeland and Galai, 1983), under the assumption that when market participants possess similar information, the spread should be lower. Traders expand the Bid-Ask to cover losses that result from possible information asymmetry (Glosten and Harris, 1998).

Additionally, the spread is considered to be a transaction cost for agents who wish to conduct a rapid exchange of shares for money. This difference is the compensation for the traders for operating without significant delay (Chan and Chung, 2012). The pace of exchange can be increased with narrower price movements by offering a smaller Bid-Ask. In competitive conditions, the Bid-Ask will measure the cost of conducting non-delayed operations (Demsetz, 1968). Thus, dealers offer immediate exchange, matching purchase and sale orders and maintaining inventories for orders that cannot be matched (Benston and Hagerman, 1974).Various studies have used the dealer spread to assess an increase in information asymmetry prior to an anticipated disclosure of an event, such as the publication of results or dividends by a company (Venkatesh and Chiang, 1986).The ways to calculate the spread and its modeling (Bollen, Smith and Whaley, 2004; Amihud and Mendelson, 1989) are not insignificant. The financial literature has used various measures of the spread. The spread can be calculated absolutely or relatively, in its original or modified scale, with or without the effect of past prices of the same shares or based only on put or call orders versus those which include the transfer price (see Table 1). Furthermore, the spread can be measured over different time periods (e.g., intra-day, daily, monthly, quarterly). To cite only a few examples of time measurement, Kanagaretnam et al. (2007) studied whether good corporate governance practices reduce information asymmetry near the time of publishing quarterly results and described the spread variable as the difference between the average percentage margin for each of the four days of the period during which results were announced and the average for a non-event period. Chen, Chung, Lee and Liao (2007) calculated the spread using the McInish and Wood (1992) formula, where by the stock quotation is considered in seconds and the number of seconds of daily negotiation is also observed.

Another approach is to estimate the spread instead of calculating the true spread, Roll (1984), Corwin and Schultz (2012); Corwin and Schultz shows that the estimate of the cross-sectional-correlation coefficient, high-low spread estimator and the true spread is about 0.9. Harris (1990) suggest that the Roll Bid-Ask spread model assumes that the underlying stock value follows a random walk that buy and sell orders are equally probable and serially independent, and that underlying value is independent of the order flow.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

Table 1.
Main measures on the spread observed in the financial literature

Absolute ($)	Relative (%)
$(PV - PC)$	$\frac{(PV - PC)}{\frac{(PV + PC)}{2}}$, $\ln(PV) - \ln(PC)$
Original scale	**Modified scale**
$(PV - PC)$, $\frac{(PV - PC)}{\frac{(PV + PC)}{2}}$	$\ln(PV - PC)$, $\frac{(\ln PV - \ln PC)}{\frac{(\ln PV + \ln PC)}{2}}$
Relative at the present moment	**Relative at a moment in the past**
$(PV_t - PC_t)$, $\frac{(PV_t - PC_t)}{\frac{(PV_t + PC_t)}{2}}$	$\frac{1}{2}\left[\left(\frac{(PV_t - PC_t)}{(PV_t + PC_t)/2} + \frac{(PV_{t-1} - PC_{t-1})}{(PV_{t-1} + PC_{t-1})/2}\right)\right]$
Base only in peaks	**Based on transaction price**
$(PV - PC)$, $\frac{(PV - PC)}{\frac{(PV + PC)}{2}}$	$2\left\lvert PT - \frac{(PV - PC)}{2}\right\rvert$, $2\left\lvert\frac{\left(PT - \frac{PV - PC}{2}\right)}{\frac{PV - PC}{2}}\right\rvert \times 100$

In Table 1, *PC* is the purchase price of the request made, *PV* is the selling price of the request made, *PT* is the price of the transactions actually performed.

Regarding institutional investor participation in company owner ship, it is worth noting that the Organization for Economic Co-operation and Development (OECD) (2011, p. 3) views the role of institutional investors in Latin America as more critical than in others parts of the world in "supporting the development of the markets in order for them to function properly and be sustained by good corporate governance practices". This importance results from the high ownership concentration that prevails in Latin American markets and the existence of risk for minority shareholders. Dennis and Weston (2001) found that the relation between institutional equity and the spread is negative and significant as opposed to Sarin, Shastri and Shastri (1996), who found a significant (positive) relation. In general, Dennis and Weston's results indicate diminished liquidity with concentrated ownership.

Our study considered the participation of institutional investors in the ownership of sample companies, which provides them the right to an independent director[1]. Additionally, to visualize the concentration of ownership in the Chilean market, which significantly affects liquidity, Rubin (2007) identified the ownership controlled by the five largest shareholders.

Florou and Pope (2012) analyze the effects of IFRS adoption and conclude that the better quality of financial statements has influenced the behavior of institutional investors. Soderstrom and Sun (2007) demonstrate that the impact of IFRS adoption depends on the economic and legal environment. The same processes do not occur in countries in which the legal system is based on the French civil code or on Common l] Law. Greenstein and Sami (1994) analyze the effects of the Securities and Exchange Commission's (SEC) regulations on the obligation to report by

[1] The "Enersis Case" persuasively argues for the importance of independent directors. In this case, the independent director and the Chilean pension fund representatives requested a ruling from the SVS on the relative increase in capital proposed by the majority shareholders of Enersis S.A. and forced the company to disclose information on its investment plan (Economía y Negocios, 2012).

DOI: 10.7172/2353-6845.jbfe.2017.1.5

segments on the spread and demonstrate that these regulations decreased the spread. Assidi and Omri (2012) demonstrate that among the companies on the Paris stock exchange that comprise the CAC 40 index, the companies that adopted the IFRS significantly improved the quality of information and mitigated information asymmetries, both measured by the Kothari, Leone and Wasley (2005) model.

Bakhshi, Bazrafshan, Rezaei and Fereidouni (2011) analyzed the effects of corporate governance on the spread, specifically in reference to equity held by company management and independent directors. These authors concluded that the spread increases when management has a larger stake and decreases when the majority of shares are owned by other investors; particularly, institutional investors and independent directors.

When a company is traded on the home country stock exchange and on the North American stock capital market, it is necessary to control the model data for a variable that differentiates the American Depositary Receipts (ADR) because such companies are subject to different regulations regarding the disclosure of public information. The issuance of ADR simplies the adoption of regulations additional to those that apply in the country in which the shares are originally traded (i.e., the US SEC regulations on trading on the New York Stock Exchange (NYSE)). These additional regulations require additional shareholder protection compared with the regulations in place in emerging countries (Chung, 2006). This additional protection results in less information asymmetry, and, therefore, the spread becomes narrower.

Lin, Sanger and Booth (1995) examine the relation between the transaction volume and the spread and conclude that volume is positively related to the average spread. In addition, they observe that the transaction volume is different at different times of day, with a higher volume during the first hours of trading, when pending transactions from the previous day are being concluded.

As noted in the literature review, the hypotheses presented in this investigation are as follows:
Hypothesis 1. The definition of spread used affects the robustness of the model.
Hypothesis 2. The method used to annualize intra-day data affects the robustness of the model.

III. MATERIALS AND METHODS

Exploratory empirical analysis is conducted on a sample of 12 companies traded on the Santiago de Chile Stock Exchange, whose trading names are: Aguas-A, Andina-B, Antarchile, Colbún, Conchatoro, Copec, CTC-A, Endesa, IAM, Masisa, Ripley and SK. The majority of the selected companies maintained a presence on the IPSA for the entire 2007–2012 period. The sample companies represent 27% of the total market capitalization of the companies traded on the IPSA (the 40 most important companies) as of December 2012. On average, these companies conduct 33,850 annual stock market transactions (in 2012), which is more than the average transaction count of all of the publicly-traded companies in Chile (15,283).

The data related to stock market operations were obtained directly from the Santiago Stock Exchange, and the data on the companies and the quality of their publicly available information were obtained from financial statements acquired from the SVS. All of the data are annual and synthesize the transactions of the companies during the financial year.

According to the purpose of this study and the literature review, we use a set of factors that determine information asymmetry to assess the ability of the proposed model to generalize based on the sample. Therefore, the general model includes the spread as an endogenous variable, which corresponds to a series of share purchase and sale prices of the sample companies. The spread has been measured in four ways;

(i) the annual average of the differences between both prices (Spread_A_B),
(ii) the annual average of the natural logarithm of the differences between both prices (Ln_Average_Spread),

DOI: 10.7172/2353-6845.jbfe.2017.1.5

(iii) the average spread weighted by the stock quantity traded (Weighted_Spread), and
(iv) the annual average of the differences between both prices divided by its average value (Average_Spread). Gjerde, Mahenthiran and Cademartori (2013) annualized the spread using the ratio of the absolute value of daily return, divided by daily cash volume, then weighted and summed over the number of days in the year in which a trade occurs.

The magnitude of the four variables of spread are different (Table 2). Weighted_Spread and Simple_Spread have significantly larger magnitudes comparing to the others two variables. Similarly the differences in the four statistical moments are also great.

Table 2.
Descriptive analysis of variables of spread

	Weighted_Spread	Simple_Spread	Average_Spread	Ln_Average_Spread
N	2 002 746	2 002 746	2 002 746	2 002 746
Mean	3 004 468 254	1 296 432 846	0.006675241	0.00669037
Standard deviation	7 929 492 038	5 661 541 091	0.013682464	0.01676721
Skewness	3 513 965 943	4 120 631 873	2 603 666 214	145 355 836
Kurtosis	4 726 756 606	2 594 936 244	2 037 467 199	529 968 225
Minimun	0	0	0	0
Maximun	17 820 399.77	4 770	19 957 716	6 851 185

Source: Authors' calculations.

A cross-sectional model, using the ordinary least squares method, for this empirical application was used in which the companies and periods were combined for each of the model's cross sections. And we also used different ways to measure the endogenous variable, presenting the results for each of the four models obtained in the Table 4.

The general model in its functional form is specified by the following equation:

$$Spread_i = \beta_0 + \beta_1 * Sale\_Quant_i + \beta_2 * Pur\_Quant_i + \beta_3 * IFRS_i + \beta_4 * Mean\_Dis_i + \\ + \beta_5 * Kurtosis\_DIS_i + \beta_6 * Leverage_i + \beta_7 * Ln\_Assets_i + \beta_8 * ADR\_Issue_i + \beta_9 * IPSA_i + \\ + \beta_{10} * Own\_5\_Shareholders_i + \beta_{11} * Own\_\ InstInv\_PF_i + \beta_{12} * Botosan_i + \mu_i$$

where:

- $Spread_i$: the difference between of the share purchase and sale price for the sample companies,
- $Sale\_Quant_i$: the quantity offered for the sale of sample company shares,
- Pur_Quant_i the quantity offered for the purchase of sample company shares,
- $IFRS_i$: the dichotomist variable that sums the value of 1 if company "i" adopts IFRS and 0 in the contrary case,
- $Mean\_DIS_i$: the sample company information disclosure index (calculated by mean value),
- $KurtosisDIS_i$: the sample company information disclosure index (calculated by the kurtosis),
- $Leverage_i$: the leveraging of the sample companies' debt,
- Ln_Assets_i: the natural logarithm of the sample companies' assets,
- ADR_Issue_i: the dichotomist value that assumes the value of 1 if company "i" issues ADR and 0 in the contrary case,
- $IPSA_i$: the dichotomist value that assumes the value of 1 if company "i" is traded on the SSPI and 0 in the contrary case,

DOI: 10.7172/2353-6845.jbfe.2017.1.5

- Own_5_Shareholders$_i$: the ownership percentage of the five main shareholders of the sample companies,
- Own_ Inst_ Inv_PF$_i$: the participation of institutional investors in the ownership of the sample companies, particularly in the case of pension funds (PF),
- Botosan$_i$: the sample company information disclosure index, we use the value obtained by calculating the 138 items and,
- μ_i: random error.

Table 3 shows the primary data from the exploratory analysis of the continuous exogenous variables presented in the empirical analysis. The Table shows that the values of the variables are fairly heterogeneous. Certain variables (Sale_Quant and Pur_Quant) have values that are substantially higher than in the case of other variables (i.e., Kurtosis_DIS and Leverage). Additionally, the level of ownership concentration of sample company shareholders is notable. The average percentage share of the five main shareholders is 70%, and the company with the highest ownership concentration (the telecom CTC-A) boasts 98.5%. The percentages of ownership participation of the institutional investors, pension funds (Own_ Inst_ Inv_PF) amount to an average of 6.5%, with a ceiling of 26% (the case of Aguas Andina S.A., whose shares are denoted Aguas-A).

Table 3.
Descriptive analysis of continuous model exogenous variables

	Mean	Maximum	Minimum	Stand. Dev.	Asymmetry	Kurtosis
Sale_Quant	26683.21	150401.2	1 142 669	33196.39	1 791 883	5 522 053
Pur_Quant	25468.10	162203.1	1 193 516	33179.99	1 999 314	6 670 038
Mean_DIS	0.602124	0.741176	0.482353	0.068438	0.085244	2 473 136
Kurtosis_DIS	-0.971111	0.190170	-1 833 589	0.475957	0.764296	3 087 189
Leverage	0.912788	1 566 445	0.509735	0.252914	0.557354	2 782 955
Botosan	3 724 306	5 550 000	2 500 000	6 957 615	0.372145	2 200 716
Ln_ Assets	2 091 857	2 310 814	1 467 406	1 721 432	-2 366 565	9 771 537
Own_5_Shareholders	6 961 917	9 850 000	7 690 000	1 821 537	-0.730911	3 758 112
Own_ Inst_ Inv_PF	6 502 986	2 647 000	0.000000	6 758 253	1 115 546	3 610 577

Source: Authors' calculations.

IV. RESULTS

The results of the four models with endogenous variable measured by: Spread_A_B, Ln_Average_Spread, Weighted_Spread, and Average_Spread, are shown in Table 4 and Table 5. Table 5 presents results of the accuracy of the adjustment for these models, observing the fit indices (coefficient of determination and adjusted coefficient of determination) we can see that, despite that the Weighted_Spread model has the best adjustment index, the Ln_Average_Spread model has the highest number of significant coefficients. This model also shows a good quality of adjustment measure by the criterion of Akaike, Schwarz and Hannan-Quinn. Thus the best model to represent the variability of the asymmetry of information through the spread is that in which the endogenous variable is measured through the difference of the logarithm of the share purchase and sale price for the sample companies.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

For this model, the results presented in Table 4 enable us to observe the individual significance levels and the joint levels for model variables at 95%[2], with the exception of the variables Ln_Assets and Botosan, which are 90% significant. The variability of the endogenous variable is explained in 56% of the sample by the variability of the exogenous variables. Additionally, the model presents adequate information criteria (Akaike, Schwarz, Hannan-Quinn[3]). The hypotheses associated with the model residuals do not present residual autocorrelation[4]or heteroscedasticity problems[5].

Table 4.
Estimation results of different endogenous variables

Endogenous variable Spread_A_B model

Variable	Sale_Quant	IFRS	Kurtosis_DIS	Ln_Assets	IPSA	Own_ Inst_ Inv_PF	Botosan	C
Coefficient	-0.000559	1 316 211	-9 996 496	-2 509 044	-2 527 352	-1 594 019	-1 598 691	1 760 416
Stand. Dev.	0.000161	1 129 104	1 131 181	3 370 909	1 530 891	0.812351	0.777754	7 176 484
t-statistic	-3 468 546	0.116571	-0.883722	-0.744323	-1 650 902	-1 962 229	-2 055 524	2 453 034
P-value	0.0009	0.9076	0.3802	0.4594	0.1037	0.0541	0.0439	0.0169

Endogenous variable Ln_Average_Spread model

Variable	Sale_Quant	IFRS	Kurtosis_DIS	Ln_Assets	IPSA	Own_ Inst_ Inv_PF	Botosan	C
Coefficient	-6.44E-08	-0.008294	-0.003138	-0.001144	-0.020018	-0.000680	-0.000285	0.073754
Stand. Dev.	3.15E-08	0.002207	0.002211	0.000659	0.002993	0.000159	0.000152	0.014030
t-statistic	-2 044 404	-3 757 396	-1 418 986	-1 736 439	-6 688 553	-4 283 220	-1 874 882	5 256 831
P-value	0.0450	0.0004	0.1608	0.0873	0.0000	0.0001	0.0654	0.0000

Endogenous variableWeighted_Spread model

Variable	Sale_Quant	IFRS	Kurtosis_DIS	Ln_Assets	IPSA	Own_ Inst_ Inv_PF	Botosan	C
Coefficient	-5.73E-08	-0.007219	-0.003130	-0.001007	-0.018775	-0.000570	-0.000169	0.062779
Stand. Dev.	2.68E-08	0.001876	0.001879	0.000560	0.002544	0.000135	0.000129	0.011923
t-statistic	-2 139 891	-3 848 106	-1 665 459	-1 797 226	-7 381 336	-4 223 234	-1 309 305	5 265 158
P-value	0.0362	0.0003	0.1007	0.0770	0.0000	0.0001	0.1951	0.0000

Endogenous variable Average_Spread model

Variable	Sale_Quant	IFRS	Kurtosis_DIS	Ln_Assets	IPSA	Own_ Inst_ Inv_PF	Botosan	C
Coefficient	-4.27E-07	-0.009906	-0.030265	-0.001574	-0.114091	-0.002722	0.000448	0.148765
Stand. Dev.	2.01E-07	0.014086	0.014112	0.004205	0.019099	0.001013	0.000970	0.089531
t-statistic	-2 124 252	-0.703205	-2 144 594	-0.374363	-5 973 718	-2 686 135	0.461850	1 661 606
P-value	0.0375	0.4845	0.0358	0.7094	0.0000	0.0092	0.6458	0.1015

Source: Authors' calculations.

[2] P-value= < 0.0450.

[3] Akaike: –6.665764; Schwarz: –6.412801; Hannan-Quinn: –6.565058.

[4] Autocorrelation test: Durbin-Watson Test = 2.094, dl = 1.175, du = 1.799, α = 0.05.

[5] Heteroscedasticity Test: White Test = F-statistic: 0.821750; P-value = 0.7155.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

Table 5.
Summary estimation results of different endogenous variables

Endogenous variable	Number of Significant Coefficient (90%)	Determination Coefficient	Adjusted Coefficient of Determination	Akaike Criterion	Schwarz Criterion	Hannan-Quinn Criterion
Spread_A_B	4	0.29	0.22	10 414	10 667	10 519
Ln_Average_Spread	7	0.56	0.51	-6 666	-6 413	-6 565
Weighted_Spread	6	0.58	0.53	-6 991	-6 738	-6 890
Average_Spread	4	0.44	0.38	-2 959	-2 706	-2 858

Source: Authors' calculations.

Table 4 shows that the sign of the sale quantity of sample company shares (Sale_Quant) is coherent with economic theory (Demsetz, 1968). Thus, for each unit by which the sale quantity is increased, the spread value of the sample companies decreases by 6.44E-06%.

Regarding the measurement of the quality of corporate governance in each of the sample companies, measured by Kurtosis_DIS and Botosan, and its effect on information asymmetry, the signs were as expected. That is, at a higher level of sample company corporate governance, information asymmetry is lower, all other variables remaining equal. These results are in concordance with Cormier, Ledoux, Magnan and Aerts, W. (2010), they conclude that good corporate governance practice, such as board size and audit committee and voluntary governance disclosure, reduce asymmetry of information. The same reasoning is shown in Bakhshi, Bazrafshan, Rezaei and Fereidouni (2011).

As for the qualitative variable that measures IFRS adoption (IFRS) for each of the sample companies, when companies adopt international accounting standards, they have less information asymmetry than they would have in the contrary case because more information disclosure (primarily expressing assets, liabilities and equity in economic and not historical values) generates less information asymmetry for investors, which results in a lower spread (ceteris paribus the others factors).This result agrees with Assidi and Omri (2012), because they find that adoption of IFRS mitigate the asymmetry of information. Regarding the listing of sample companies on the IPSA, when a company belongs to this index, information asymmetry measured by the spread decreases by 2% compared with companies that were not listed on the IPSA during the study period.

Regarding control variables, for the natural logarithm variable of assets (Ln_Assets) as a measure of company size, larger companies have more resources to develop stronger corporate governance structures. Therefore, they disclose more information, which decreases information asymmetry and lowers the spread (all other variables remaing equal).

The negative effect of the control variable PF institutional investor ownership (Own_ Inst_ Inv_PF) on the spread can be explained by the fact that a greater participation of institutional investors in the ownership of companies leads them to fulfill a fiduciary role and to safeguard the quality of corporate governance and the adequate use of contributed resources, which in turn increases trust among investors. Therefore, the difference between the purchase and sale value of a share (spread) is smaller.

There is a strong correlation between two variables, shares sale quantity (Sale_Quant) and shares purchase quantity (Pur_Quant), in the sample companies. Therefore, the variable shares sale quantity captures information provided by the variable shares purchase quantity[6]. A similar conclusion was reached by Copeland and Galai (1983): they conclude that the Bid-Ask spread increases with greater price volatility in the asset being traded, with a higher asset price level,

[6] Correlation Coefficient = 0.992140, P-value = 0.0000.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

and with lower volume. Other non-significant variables included in the study are the following: whether the company issues ADRs, the level of leveraging of a sample company's debt (Leverage) and the ownership percentage of the five main shareholders of sample companies. As for the latter, a high concentration of ownership in the hands of the five main shareholders may not be significant. Although they share among themselves important information that they would not be willing to publish without appropriate regulations, the legislation and regulations of the SVS forces the companies to issue an information handling manual, which is of interest to the market[7]. This phenomenon can largely explain the small significance of the other variables.

V. CONCLUSIONS AND RESEARCH IMPLICATIONS

This study has used different models to measure the relation between: variables related to the quality of corporate governance, control variables, with the spread. To validate the above relations different measures of spread were used, for which different econometric models have been used. We find that the different ways for measuring the spread is not indifferent, affecting the goodness of fit of the proposed models.

Regarding the paper's hypotheses, the definition of spread used affects the robustness of the model, so, when we used the natural logarithm of the differences between ask and bid prices as a measure of the spread, it has the best indicators of goodness of fit of all models tested, which supports hypothesis 1. And, the method used to annualize intra-day data affects the robustness of the model, so, in our case when we annualize our intra-day data, as the annual average of the natural logarithm of the differences between ask and bid prices, we obtain the best fit of our model, which supports hypothesis 2.

When the sample is extended to all of the companies that were listed on the IPSA at any time during the study period, the general model variables will still be incorporated and may possess increased relevance for future research as information disclosure regulations and other issues of corporate governance are strengthened. This will give us the opportunity to try other kinds of models, perhaps using multivariate time series methodology or panel data models (de la Fuente et al., 2015; Coughenour et al., 2016).

Thus, the Chilean market shows similar characteristics of other emerging markets, where there is high ownership concentration, lower liquidity, and lack of transparency.

The finding suggests that regulators should produce new regulations to improve the quality of corporate governance and the information disclosed to the market in order to reduce information asymmetry and make the Chilean market more efficient and this also holds for other emerging markets.

References

Amihud, Y. and Mendelson, H. (1989). The Effects of Beta, Bid-Ask Spread, Residual Risk, and Size on Stock Returns. *The Journal of Finance*, *44*(2), 479–486.

Armstrong, C.S., Barth, M.E., Jagolinger, A.D. and Riedl, E.J. (2010). Market Reaction to the Adoption of IFRS in Europe. *The Accounting Review*, *85*(1), 31–61.

Assidi, S. and Omri, M.A. (2012). IFRS and Information Quality: Cases of CAC 40 Companies. Global. *Journal of Management and Business Research*, *12*(19), 72–83.

Bakhshi, M., Bazrafshan, E., Rezaei, M. and Fereidouni, H.G. (2011). The Impact of Corporate Governance on the Bid-Ask Spread: Evidence from an Emerging Market. International Conference on Sociality and Economics DevelopmentIPEDR vol. 10 (2011) © (2011) IACSIT Press, Singapore. Recuperado de http://www.ipedr.com/vol10/97-S10064.pdf

[7] The information handling manual is required by General Norm No. 211 (SSI, 2008) and the Mercado de Valores Law No. 18.045.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

Benston, G. and Hagerman, R. (1974). Determinants of Bid-Ask spreads in the over-the-counter market. *Journal of Financial Economics*, 1, 353–364.

Bollen, N.P.B., Smith T. and Whaley, R. (2004). Modeling the bid/ask spread: measuring the inventory-holding premium. *Journal of Financial Economics*, *72*(1), 97–141.

Botosan, C.A. (1997). Disclosure Level and The Cost of Equity Capital. *The Accounting Review,72*(3), 323–349.

Chan, K. and Chung, P. (2012). Asymmetric Price Distribution and Bid-Ask Quotes in the Stock Options Market. Asia-Pacific. *Journal of Financial Studies*, *41*, 87–102.

Chen, W.P., Chung, H., Lee, C. and Liao, W.L. (2007). Corporate Governance and Equity Liquidity: analysis of S&P transparency and disclosure rankings. *Corporate Governance: An International Review*, *15*(4), 644–660.

Chung, H. (2006). Investor protection and the liquidity of cross-listed securities: Evidence from the ADR market. *Journal of Banking and Finance*, *30*, 1485–1505.

Coloma, F. (2010). Desafíos de la Regulación de Gobiernos Corporativos en Chile. Superintendente de Valores y Seguros. [Challenges of Corporate governance regulations in Chile.] Superintendente de Valores and Seguros. Corporate governance presentation.

Copeland, T.E. and Galai, D. (1983). Information Effects on the Bid-Ask Spread. *The Journal of Finance*, *38*(5), 1457–1469.

Cormier, D., Ledoux, M.J., Magnan, M. and Aerts, W. (2010). Corporate governance and information asymmetry between managers and investors. *Corporate Governance*, *10*(5), 574–589.

Corwin, S.A. and P. Schultz (2012). A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices. *The Journal of Finance* LXVII, (2): 719–759.

Coughenour, C., Paz, A., De la Fuente, H. and Singh, A. (2016). Multinomial logistic regression to estimate and predict perceptions of bicycle and transportation infrastructure in a sprawling metropolitan area. *Journal of Public Health*, 38(4), e401-e408, doi: 10.1093/pubmed/fdv179.

De la Fuente, H., Paz, A., Conover, R. and Khan, A. (2015). Forecasting of financial series for the Nevada department of transportation using deterministic and stochastic methodologies. *Procedia Manufacturing*, 3, 3317–3324.

Demsetz, H. (1968). The Cost of Transacting. *The Quarterly Journal of Economics*, *82*(1), 33–53.

Dennis, P. and Weston, J. (2001). Who's Informed? An Analysis of Stock Ownership and Informed Trading (June 4, 2001). AFA 2002 Atlanta Meetings. Available at SSRN: http://ssrn.com/abstract=267350 or http://dx.doi.org/10.2139/ssrn.267350

Economía and Negocios (2012). Director independiente de Enersis solicita a la SVS que precise tiempos para pronunciarse. [Independent director of Enersis requests the SVS to specify ruling times] (October 24), available athttp://www.economiaynegocios.cl/noticias/noticias.asp?id=101888

Florou, A. and Pope, P. (2012). Mandatory IFRS Adoption and Institutional Investment Decisions. *The Accounting Review*, *87*(6), 1993–2025.

Fu, R., Kraft, A. and Zhang, H. (2012). Financial reporting frequency, information asymmetry, and the cost of equity. *Journal of Accounting and Economics*, *54*(2), 132–149.

Gigler, F. and Hemmer, T. (1999). On the frequency, quality, and informational role of mandatory financial reports. *Journal of Accounting Research*, *36*, 117–147.

Ghoul, S.E., Guedhami, O., Ni, AND., Pittman, J. and Saadi, S. (2013). Does Information Asymmetry Matter to Equity Pricing? Evidence from Firms' Geographic Location. *Contemporary Accounting Research*, *30*(1), 140–181.

Gjerde, T., Mahenthiran, S. and Cademartori, D. (2013). Effect of ownership, governance, and transparency on liquidity – Chilean evidence. *Journal of Contemporary Accounting and Economics*, *9*(2), 183–202.

Glosten, L.R. and Harrris, L.E. (1988). Estimating the Components of the BID/ASK Spread. *Journal of Financial Economics*, *21*(1), 123–142.

Gompers, P., Ishi, J. and Metrick, A. (2003). Corporate Governance and Equity Prices. *The Quarterly Journal of Economics*, *118*(1), 107–155.

Greenstein, M.M. and Sami, H. (1994). The Impact of the SEC's Segment Disclosure Requirement on Bid- Ask Spreads. *The Accounting Review*, *69*(1), 179–199.

Haat, H.M., Mahenthiran, S., Rahman A.R. and Hamid A.N. (2006). Agency Costsas a Factor in the Suspension of Companies from the Kuala Lumpur Stock Exchange, *Journal of Contemporary Accounting and Economics*, *2*(1), 99–121.

Harris, L. (1990). "Statistical Properties of the Roll Serial Covariance Bid/Ask Spread Estimator." *The Journal of Finance* LXV (No. 2): 570–590.

Healy, P.M. and Palepu, K.G. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of Accounting and Economics*, *31*(1–3), 405–440.

Kanagaretnam, K., Lobo, G. and Whalen, D. (2007). Does good corporate governance reduce information asymmetry around quarterly earnings announcements? *Journal of Accounting and Public Policy*, *26*(4), 497–522.

Karpoff, J.M. (1987). The relation between price changes and trading volume: a survey. *Journal of Financial and Quantitative Analysis 22* (1), 109–126.

DOI: 10.7172/2353-6845.jbfe.2017.1.5

Khurana, I.K., Pereira, R. and Martin, X. (2006). Firms Growth and Disclosure: An Empirical Analysis. *Journal of Financial and Quantitative Analysis*, *41*(2), 357–380.

Kothari, S.P., Leone A. and Wasley, C. (2005). Performance Matched Discretionary Accrual Measures. *Journal of Accounting and Economics*, *39*, 163–197.

Kunkel, G. (1982). Sufficient conditions for public information to have social value in a productionand exchange economy. *Journal of Finance 37*, 1005–1013.

Lin, J.C., Sanger, G.C. and Booth, G.G. (1995). Trade Size and Components of the Bid-Ask Spread. *The Review of Financial Studies*, *8*e *Journal of Financial and Quantitative Analysis 4 (4)*, 347–400.

Marshall, J.M. (1974). Private incentives and public information. *The American Economic Review64*, 373–390.

McInish, T. and Wood, R. (1992). An Analysis of Intraday Patterns in Bid/Ask Spreads for NYSE Stocks. *The Journal of Finance*, *47*(2), 753–764.

Munteanu, L. (2011). Cost of Equity, Financial Information Disclosure, and IFRS adoption: A Literature Review. *Internal Auditing and Risk Management*, *4*(24), 67–80.

Organization for Economic Cooperation and Development (OECD). (2011). Strengthening Latin American Corporate governance. The role of institutional investors, 1–80.

Rapaport, M. and Sheng, H.H. (2010). Ownership structure and firm value in Brazil. *Revista Latinoamericana de Administración*, *45*, 76–95.

Roll, R. (1984). A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market, *The Journal of Finance* XXXIX, (4): 1127–1139.

Rubin, A. (2007). Ownership Level, Ownership Concentration and Liquidity. *Journal of Financial Markets*, *10*(3), 219–248.

Sarin, A., Shastri, K. and Shastri, K. (1996). Ownership structure and stock market liquidity. Available at SSRN: http://ssrn.com/abstract=2652

Soderstrom, N.S. and Sun, K.J. (2007). IFRS Adoption and Accounting Quality: A Review. *European Accounting Review*, *16*(4), 675–702.

Standard and Poor's. (2006). Standard and Poor's Corporate Governance Scores, Criteria, Methodology and Definitions.

Superintendencia de Valores and Seguros (SVS) (2008). Norma de Carácter General 211. Establece normas para la publicidad de políticas y procedimientos relativos al manejo y divulgación de información para el mercado [General Regulation211. Establishing regulations for publishing policies and procedures for handling and disclosing market information.] Issued 15 January 2008.

Trueman, B. (1986). Why do managers voluntarily release earnings forecasts? *Journal of Accounting and Economics 8*(1), 53–71.

Venkatesh, P.C. and Chiang, R. (1986). Information Asymmetry and the Dealer's Bid-Ask Spread: A Case Study of Earnings and Dividend Announcements. *The Journal of Finance*, *41*(5), 1089–1102.

Verrecchia, R. (2001). Essays on disclosure. *Journal of Accounting and Economics*, *32*(1–3), 97–180.

DOI: 10.7172/2353-6845.jbfe.2017.1.5